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PREFACE

On-Farm Research Division (OFRD) of Bangladesh Agricultural Research Institute (BARI) is going to publish its Annual Research Report for the experiments conducted during 2008-09 in the Farming System Research and Development (FSRD) and Multilocation Testing (MLT) sites across the country. The mandate of OFRD is to conduct research for the improvement of existing farming system and testing and validation of on-station technologies under a wide range of agro-climatic situation for the fine tuning of the technologies. Development of location specific technology based on the local problems and needs is another mandate of OFRD. In this regard, major thrust was given on the improvement of existing cropping systems through introduction of improved varieties, crop management as well as soil fertility management practices.

Emphasis was also given on the improvement of existing cropping system practiced by the farmers' with introduction of new crops and varieties for coastal, rainfed and hill areas. Similarly, Soil fertility management is another important issue which to be addressed comprehensively for sustainable crop production through cropping pattern based balanced fertilization for major AEZs. Emphasis was given on IPNS approach, bio-slurry management and location specific soil test-based fertilizer recommendation to maintain and improve soil fertility. Research reports on climate change, socio-economic studies, integrated farming system, family nutrition and homestead gardening were also included in this report.

On-farm trials on wheat, maize, tuber crops, pulses, oilseeds and horticultural crops conducted at different MLT and FSRD sites throughout the country in collaboration with development partners. Results of these activities also incorporated in this report. Different training activities and field days for farmers, DAE personnel, SSA/SA as well as for the scientists of OFRD was organized during 2008-09 through ICM, ATT and Bio-slurry project funded by BARC.

I hope this report will be very useful to the researchers, GO, NGOs and extension personnel working in this field.

I expressed my sincere thanks and gratitude to DANIDA, IDCOL, FAO and BARC for providing financial assistance to conduct different research, training and Research-Extension linkage activities. I sincerely admire and appreciate my colleagues and SSA/SA who look after the experiments at different locations during the study period. Special thanks to the cooperator farmers for their valuable cooperation. Last of all, I acknowledged those who worked very hard to accomplish this voluminous work.

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Content

Title	Page no.

Preface

Integrated Crop Management (ICM)

Title	Page no.

ON-FARM SOIL FERTILITY MANAGEMENT (SFM)

IMPROVEMENT OF CROPPING SYSTEMS (ICS)

A. Plain Land

B. High Barind Tract

Performance of Intercropping Hybrid Maize with Bushbean in the High Barind Area

Abstract

The experiment was conducted in the farmer's field of Bijoynagar, Godagari, Rajshahi during the rabi season of 2008-09. There were four treatment combinations e.g. T_1: Sole maize, T_2: Sole bushbean, T_3: Maize normal row with 2 rows of bushbean in between maize rows and T_4: Maize paired-row with 4 rows of bushbean in maize paired-row. The highest yield of maize (7.18 t ha^{-1}) and bushbean (8.01 t ha^{-1}) were obtained from T_1 (sole maize) and T_2 (bushbean) respectively; but higher maize equivalent yield (MEY) observed in T_4 (12.79 t ha^{-1}) followed by T_2 (12.02 t ha^{-1}) and T_3 (10.49 t ha^{-1}) and the lower yield from T_1 (7.18 t ha^{-1}). Higher LER was recorded from treatment T_4 (1.32) followed by T_3 (1.15) and lower LER from sole crop of maize and bushbean. Higher net return (Tk.92050 ha^{-1}) and BCR (4.27) were obtained from T_2 and lower net return (Tk.29240 ha^{-1}) and BCR (1.70) were obtained from T_1.

Introduction

Intercropping has several advantages over sole culture of crops, such as enhancement of efficient use of environmental factors (e.g., light, nutrient and soil moisture) and labors, reduces the adverse effect of various biotic and abiotic stress, provides diversity of food, generates more income, offers insurance against crop failure, higher return and total productivity per unit area (Akanda and Quayyum, 1982). Intercropping is considered as a very efficient technique in maximizing the crop production per unit area, if plant competition minimized by selection of suitable crops and adoption of proper plant population, spatial arrangement and nutrient and moisture management (Willey, 1979). In Barind area, maize and bushbean becomes popular day by day due to its higher yield potentiality and their high economic return. On the other hand, intercropping of maize with bushbean was found remunerative in different locations of Bangladesh. Hybrid maize requires high amount of chemical fertilizers for exploiting its maximum yield potentiality. On the contrary, bushbean is a leguminous crop needs lower quantity of nutrients for its cultivation. Maize - bushbean is a competent intercropping system because of their different photosynthetic pathway, growth duration, root system and requirement of growth resources. Growing of bushbean in association with hybrid maize may reduce nutrient requirement for the system as bushbean can fix atmospheric N_2 and subsequently release it to the soil. Moreover, after harvesting of green pods, incorporation of brown biomass of bushbean may improve soil health in the long run. Thus, intercropping of hybrid maize with bushbean may increase vegetables consumption and develop soil fertility through symbiotic nitrogen fixation. The present experiment was undertaken (i) to find out the best compatible intercrop combination of maize with bushbean in terms of economic return and to verify the technology at farmer's level at High Barind Tract for higher productivity.

Materials and Methods

The field trial was conducted at the farmers' field of Bijoynagar ICM club members, Godagari, Rajshahi during the rabi season of 2008-09. Farmers were selected with the help of local DAE personnel. The experiment was laid out in a randomized complete block design with six dispersed replications. The unit plot size was 8 m x 5 m. There were four treatment combinations viz. T_1 : Sole maize (75cm × 25cm), T_2 : Sole bushbean (30cm × 10cm), T_3: Maize normal row (75cm × 25cm) with 2 rows of bushbean (30cm × 10cm) in between maize rows and T_4: Maize paired-row (37.5cm/150cm/37.5cm) with 4 rows of bushbean (30cm x 10cm) in maize paired-row. The variety of maize and bushbean were BARI hybrid maize-5 and BARI Jharshim-1, respectively. Seeds were sown on 5-15 December 2008. The plot was fertilized @ 250-52-90-50-1 kg N-P-K-S-B ha^{-1} in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. One third urea and all fertilizer were applied as basal dose during final land preparation. Among the rest $^{2}/_{3}$rd urea; $^{1}/_{3}$rd was applied at 8-10 leaves stage and another $^{1}/_{3}$rd was given during tasseling stage. Bushbean was harvested by 3 times as on 8, 17, 28 February and maize on 20-25 April 2009. Data on seed yield and yield components of bushbean and maize were recorded from randomly selected 10 plants and the data were analyzed statistically and the mean differences were calculated by Duncan's Multiple Range Test (Gomez and Gomez, 1984). Maize equivalent yield, Land equivalent ratio (LER) and BCR were calculated to ascertain the efficiency of intercropping. Economic analysis was done on the basis of existing market prices of input and output (Reddy and Reddi, 1992). Benefit Cost Ratio (BCR) was calculated as below mentioned:

$$\text{BCR} = \frac{\text{Gross return (Tk. ha}^{-1}\text{)}}{\text{Total cultivation cost (Tk. ha}^{-1}\text{)}}$$

LER method was used after Shaner *et al.* (1982) as mentioned bellow:

$$\text{LER} = \frac{\text{Yield of intercrop (Maize)}}{\text{Yield of sole crop (Maize)}} + \frac{\text{Yield of intercrop (Bushbean)}}{\text{Yield of sole crop (Bushbean)}}$$

Maize equivalent yield was calculated by converting the yield of bushbean into the yield of maize on the basis of prevailing market prices using the formulae (Anjaneyulu *et al.* 1982) as mentioned below:

$$\text{Maize equivalent yield (MEY)} = \frac{\text{Yield of bushbean} \times \text{Price of bushbean}}{\text{Price of maize}}$$

Result and Discussion

Yield of Maize: Significant variation was observed among the treatments (Table 1). Significantly the highest grain yield was obtained form T_1 (7.18 t ha^{-1}) where maize was grown solely. The significant increase in seed yield from sole Maize was due to significantly better performance of different yield attributes than intercrop treatments. Among the intercrops, higher yield (4.94 t ha^{-1}) was obtained from T_3 (Maize normal row with 2 rows of bushbean in between maize rows) and lower (4.49 t ha^{-1}) from T_4 (Maize paired-row with 4 rows of bushbean in maize paired-row).

Yield of bushbean: The yield and yield attributes of bushbean significantly differed due to intercropping of maize with bushbean (Table 2). Significantly the highest pod yield (8.01 t ha^{-1}) was obtained from T_2 (sole bushbean) due to better performance of different yield contributing characters than intercrop situations. Among the intercrop treatments, significantly the highest pod yield (5.53 t ha^{-1}) was obtained from T_4 because of producing significantly the highest number fresh pods per plant (24.75) and the highest amount of fresh pod per plant and on the hand, the lowest pod yield was recorded in T_3 (3.78 t ha^{-1}). Among the intercrop treatments, T_4 performed better probably due to exposing more space for the better growth and development of bushbean in paired-row system rather than single row system.

Maize equivalent yield (MEY): The maize equivalent yield was higher in treatment T_4 (12.79 t ha^{-1}) but very close to T_2 (12.02 t ha^{-1}) due to high market price of bushbean in the Barind area (Table 3). Moderate MEY (10.49 t ha^{-1}) was obtained from T_3 in which, 2 rows of bushbean was intercropped in between 2 rows of maize. The lowest MEY (7.18) was recorded in T_1 where sole maize was involved.

Land equivalent ration (LER): The LER is the total area required by sole crop to produce as much yield as can be obtained from an intercropping system. All the intercropping treatments showed higher LER than sole crop of maize and bushbean (Table 3). Higher LER was recorded from treatment T_4 (1.32) followed by T_3 (1.15). The LER value of 1.32 indicates that by intercropping maize (var. BARI hybrid maize-5) with bushbean (var. BARI jarshim-1) the productivity of maize could be increased up to 32%.

Cost Benefit analysis: An analysis on cost-benefit of intercropping maize with bushbean has been given in Table 3. The higher gross return (Tk. 127850 ha^{-1}) was obtained from treatment T_4 (Maize paired-row with 4 rows of bushbean) which was closely followed by treatment T_2 (Tk. 120200 ha^{-1}) due to better performance of bushbean in the study. Other treatments failed to earn higher gross return than T_4 (Maize paired-row with 4 rows of bushbean) and T_2 (sole bushbean). The cultivation cost is higher in sole maize and maize based intercrops due to use of high and costly inputs in maize cultivation. So higher net return (Tk. 92050 ha^{-1}) was obtained from T_2 (sole bushbean) which is followed by T_4 (Tk. 89600 ha^{-1}) when 4 rows of bushbean was used in maize paired-row and the lowest net return (Tk. 29240 ha^{-1}) was recorded in T_1 (sole maize). All other treatments failed to show higher benefit cost ratio (BCR) than sole bushbean and higher BCR was found in T_2 (4.2) followed by T_4 (3.34) and T_3 (2.66) and lowest was from T_1 (1.70).

Farmers' reaction

Farmer showed their interest for growing bushbean with maize because they can get additional income earlier from sole bushbean. They opined that fresh pod of bushbean has good access as vegetable to local market as well as nearby urban market with high price.

Conclusion

Bushbean grown in between maize paired-rows exerted higher yield and economic returns over sole cropping of maize. Intercropping of maize with bushbean was found promising in the locality because of extra income within a short period of time.

Table 1. Yield and yield attributes of maize as influenced by intercropping with bushbean at Bijoynagar, Godagari, Rajshahi, 2008-09.

Treatments	Plant height (cm)	Cob length (cm.)	Seeds cob^{-1} (No.)	Seed wt. cob^{-1} (g)	100 seed wt. (g)	Seed yield (t ha^{-1})
T_1	208.62a	18.73a	511.00a	154.00a	30.70a	7.18a
T_3	198.25c	16.78b	444.50b	141.67ab	28.97b	4.94b
T_4	203.88b	17.62b	432.83b	138.00b	29.08b	4.49b
CV (%)	10.11	3.42	7.40	7.33	8.28	9.04

Table 2.Yield and yield attributes of bushbean as influenced by intercropping with maize at Bijoynagar, Godagari, Rajshahi, 2008-09.

Treatment	Plant height (cm)	Plant population m^{-2} (No.)	No. of fresh pod $plant^{-1}$	Wt. of fresh pod $plant^{-1}$ (g)	Pod yield (t ha^{-1})
T_2	30.40a	24.00a	29.62a	203.33a	8.01a
T_3	28.13b	20.00b	22.20c	142.00c	3.78c
T_4	28.35ab	22.00b	24.75b	160.00b	5.53b
CV (%)	3.98	4.70	5.17	5.42	9.10

Table 3. Maize equivalent yield (MEY), LER and economic performance of maize intercropped with bushbean at Bijoynagar, Godagari, Rajshahi, 2008-09

Treatment	Yield (t ha^{-1})		MEY (t ha^{-1})	LER	GR (Tk. ha^{-1})	TCC (Tk. ha^{-1})	NR (Tk. ha^{-1})	BCR
	Maize	Bushbean						
T_1	7.18a	-	7.18	1.00	71000	41760	29240	1.70
T_2	-	8.01a	12.02	1.00	120200	28150	92050	4.27
T_3	4.94b	3.78c	10.49	1.15	104900	39375	65525	2.66
T_4	4.49b	5.53b	12.79	1.32	127850	38250	89600	3.34
CV (%)	9.04	9.10	-	-	-	-	-	-

* GR=Gross return, TCC=Total cultivation cost & NR=Net return

** **Price:** Maize Tk. 10 kg^{-1} and Bushbean Tk.15 kg^{-1}

Urea Tk.12 kg^{-1} , TSP Tk.45 kg^{-1}, MP Tk.40 kg^{-1} , Gypsum Tk.7 kg^{-1}, Boron Tk.100 kg^{-1}

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Effect of Irrigation on Mustard at High Barind Area

Abstract

A field experiment was conducted in the farmer's field of Bijoynagar ICM Club Godagari, Rajshahi during r*abi* 2008-09 to find out the suitable time and frequency of irrigation at Barind condition. There were three treatments combinations e.g. I_0: No irrigation, I_1: One irrigation at flowering stage and I_2: Two irrigation at flowering and siliqua formation stage. Maximum seed yield (1.39 t ha^{-1}) was produced by I_2 followed by I_1 (1.19 t ha^{-1}) and the lowest seed yield (0.85 t ha^{-1}) was recorded from I_0. Significantly the highest stover yield was obtained from I_2 (1.70 t ha^{-1}) followed by I_1 (1.50) and the lowest was from I_0 (1.27 t ha^{-1}). From economic point of view, higher net return was obtained from I_2 (Tk. 36250 ha^{-1}) followed by I_1 (Tk. 30150 ha^{-1}) and lower amount gross return was found from I_0 (Tk. 23000 ha^{-1}). Considering benefit cost ratio (BCR), higher BCR was recoded in I_2 (2.56) followed by I_1 (2.35) and lower BCR from I_0 (2.07).

Introduction

In Bangladesh mustard (*Brassica spp*.) is the principal and popular edible oil crops, annually produced 3.34 million metric ton of oil seeds against a total oil seed production of 5.48 million metric tons that ultimately providing around 61% of the total oilseed production (Krishi Dairy, 2007). In the country, the national average seed yield of mustard is 778 kg ha^{-1} (BBS, 2002) that is nears to half of its potential yield. Andrews (1972) reported that mustard is an irrigated crop and so irrigation is one of the most important factors that contribute to higher yield in mustard. Several researchers found that seed yield is greatly increased by the presence of adequate soil moisture (Banerjee *et al*., 1967; Clarke and Simpson, 1978; Jain and Jain, 1979; Joarder *et al*., 1979; Mandal *et al*; 1986, Reddy and Sinha, 1987; Reddy *et al*., 1988). It was observed that 32.21% yield reduction was obtained in mustard due to no irrigation (BARI, 2000). In the High Barind Tract, most of the farmers cultivate the mustard as rainfed crop since the seed yield is very low. Thus irrigation is necessary to increase the productivity of mustard grown under Mustard-Boro-T.Aman rice cropping pattern. The present experiment was, therefore, undertaken to find out the suitable time and frequency of irrigation under Barind situation.

Materials and Methods

The field trial was conducted at the farmer's field of Bijoynagar ICM club members, Godagari, Rajshahi during *rabi* 2008-09. Farmers were selected with the help of local DAE personnel. The experiment was laid out in a randomized complete block design with six dispersed replications. There were three treatments combination namely, I_0: No irrigation, I_1: One irrigation at flowering stage, I_2: Two irrigations at flowering and siliqua formation stage. The unit plot size was 6m x 4m. The crop variety was BARI sharisa-9 and seeds were sown continuously in 30 cm row to row distance. Seeds were sown on 18-24 September 2008. The seed rate was 8 kg ha^{-1}. The lands were fertilized with 115-36-50-32-10 N-P-K-S-B kg ha^{-1} in the form of urea triple super phosphate, muriate of potash, gypsum and boric acid, respectively. All fertilizers were applied as basal during final land preparation. To control *Aphids, Melataf* 57 EC @ 2 ml/L water was applied for two times like- 1st spraying was done before flowering and 2nd spraying was applied during pod setting stage. Weeding was done at 15 DAS and 25 DAS. The crop was harvested during 8-20 January 2009. Data on seed yield and yield components of mustard were recorded and analyzed statistically. The economic analysis was done for gross return, net return and benefit cost ratio (BCR) for different treatments following the method suggested by Perrin *et al*. (1979). The gross return and benefit cost ratio (BCR) were estimated by using the following formula:

Gross return (Tk. ha^{-1}) = Yield (t ha^{-1}) × Average market price (Tk. kg^{-1}) × 1000

$$BCR = \frac{\text{Gross return}}{\text{Total cultivation cost}}$$

Results and discussion

Yield and yield parameter

Yield and yield attributes of mustard significantly influenced by the different irrigation regimes (Table 1). Significantly the tallest plant (110.83 cm.) obtained when crop was irrigated two times (I_2) followed by I_1 (105.33 cm) and the smallest plant (83.67) was produced when crop was not irrigated (I_0). Maximum plant population m^{-2} (77.00) obtained in I_2 that is statistically identical to I_1 (65.5) and the significantly lowest number of plant populations m^{-2} (59.50) observed in I_0. Same trend was found in case of siliqua plant^{-1} and maximum number of siliqua plant^{-1} (82.67) obtained in I_2 that is statistically identical to I_1 (66.47) and the significantly lowest number of siliqua plant^{-1} (47.77) observed in I_0. Significantly the highest number of seeds siliqua^{-1} (18.90) were recorded from I_2 followed by I_1 (15.60) and the lowest number of seeds pod^{-1} (11.70) were obtained from I_0. Significant observation was found in 1000 seed weight and comparatively higher seed weight was found from I_2 (3.15 g) followed by I_1 (2.78 g). Maximum seed yield (1.39 t ha^{-1}) was produced by I_2 probably due to higher seed weight (3.15 g), the highest number seeds pod^{-1} (18.90), the highest number of siliqua plant^{-1} (82.67) and the highest number plants m^{-2} (77). On the other, significantly the lower seed weight (2.02 g), the lowest number seeds pod^{-1} (11.70), the lowest number of siliqua plant^{-1} (47.77) and the lowest number plants m^{-2} (59.50) were observed in I_0 and all these contributed to the lowest seed yield (0.85 t ha^{-1}) in I_0. Significantly the highest stover yield (1.7 t ha^{-1}) were recorded from I_2 followed by I_1 (1.5 t ha^{-1}) and the lowest stover yield (1.27) were obtained from I_0.

Cost and return analysis

From economic analysis, higher gross return was obtained from I_2 (Tk. 59500 ha^{-1}) followed by I_1 (Tk. 52500 ha^{-1}) and lower amount gross return was found from I_0 (Tk. 44450 ha^{-1}). Same trend was obtained in net return, higher net return was obtained from I_2 (Tk. 36250 ha^{-1}) followed by I_1 (Tk. 30150 ha^{-1}) and lower amount net return was found from I_0 (Tk. 23000 ha^{-1}). Considering benefit cost ratio (BCR), higher BCR was recoded in I_2 (2.56) followed by I_1 (2.35) and lower BCR from I_0 (2.07).

Farmers' reaction

Farmers opined that irrigation is more effective for higher yield of mustard. Most of the cooperators obtained similar results and they are, therefore, interest to extent the area of mustard cultivation by using irrigation in the next year.

Table 1. Yield and yield attributes of mustard as affected by irrigation at Bijoynagar ICM club, Godagai, Rajshahi during 2008-09.

Treatment	Plant height (cm)	No. of plant m^{-2}	No. of siliqua $plant^{-1}$	No. of seeds $siliqua^{-1}$	1000-seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
I_0	83.67	59.50	47.77	11.70	2.02	0.85	1.27
I_1	105.33	65.50	66.47	15.60	2.78	1.19	1.50
I_2	110.83	77.00	82.67	18.90	3.15	1.39	1.70
LSD (0.05)	8.36	11.18	18.39	2.70	0.44	0.22	0.16
CV (%)	4.57	9.07	15.31	9.58	7.60	10.69	8.29

I_0: No irrigation, I_1: One irrigation at flowering stage, I_2: Two irrigation at flowering and siliqua formation stage

Table 2. Cost and return analysis as affected by irrigation on mustard at Bijoynagar ICM club, Godagai, Rajshahi during 2008-09

Treatment	Gross Return (Tk. ha^{-1})	Total cultivation cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
I_0	44450	21450	23000	2.07
I_1	52500	22350	30150	2.35
I_2	59500	23250	36250	2.56

Price (Tk. kg^{-1}): Mustard= 40, Urea=12 , TSP= 45, MP= 40, Gypsum= 7, Boron= 100

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Effect of Shoot and Fruit Pruning on the Yield and Economic Return of Early Planting Tomato in High Barind Tract

Abstract

An experiment was carried out at Bijoynagar, Godagari, Rajshahi during rabi 2008-2009 to study the effect of pruning on yield and economic return of tomato in High Barind Tract (HBT). Four pruning treatments were used in the trial such as, T_1: Lateral shoot pruning below first flower bearing branch, T_2: Kept 8 cluster per plant with 5 fruits per cluster, T_3: T_1+T_2 and T_4: Control (Farmers practice or no pruning). The number of clusters plant^{-1} (10.87) and fruits plant^{-1} (39.73) was highest in the shoot pruning (T_1) treatment. Unit fruit weight was produced highest in the Shoot + fruit pruning (T_3) treatment. Shoot pruning (T_1) gave highest fruit yield (71.81 t ha^{-1}) which was found statistically identical with shoot + fruit pruning (70.31 t ha^{-1}) as well as fruit pruning (68.48 t ha^{-1}) treatments. In respect of economic analysis, the maximum gross return (Tk. 574480 ha^{-1}), net return (Tk. 569980 ha^{-1}) and marginal benefit cost ratio (MBCR) (19.82) were obtained from shoot pruning.

Introduction

Tomato is a popular vegetable in Bangladesh especially in the urban areas. The total tomato production in the country is about 1.03 lac metric ton (BBS, 2004). A vast area of land of High Barind Tract (HBT) is being used for cultivating early hybrid tomato to get high price in the early market. After planting tomato seedlings, farmers of this area generally do not practice pruning of shoot and fruit, as a result the plant ultimately becomes bushy and produces small sized fruit. While pruning increases the expenditure in tomato cultivation, on the other hand it also enhances yields and exposes the plant to sunlight for more efficient photosynthetic activities (Rajewar and Patil, 1978). Pruning forces the better fruit set, early fruit maturity, increases fruit size and fruit uniformity. Removal of side shoots at the lower part of the plant and staking avoids fruit contact with the soil and fruit rot. It improves air circulation in the canopy and that may reduce development of foliar diseases. Removal of excessive shoots increases the number of marketable fruit. The fruit yield and marketable fruit per plant may be improved by pruning of excessive shoots, cluster and fruits of tomato. Under these circumstances, the present investigation has been undertaken to study the effect of pruning on yield and economic return of tomato in HBT.

Materials and Methods

The field trial was carried out at Bijoynagar, Godagari, Rajshahi during rabi 2008-09 in the Bijoynagar ICM club (club no.12714) member's field of High Barind Tract. The experiment was laid out in Randomized Complete Block Design with six dispersed replications. The unit plot size was 4 m x 3 m. Four pruning treatments were given the trial such as, T_1: Lateral shoot pruning below first flower bearing branch, T_2: Kept 8 cluster per plant with 5 fruits per cluster, T_3: T_1+T_2 and T_4: Control (Farmers practice or no pruning). A hybrid Tomato variety Sabal was used in the experiment. The seed was sowing in seed bed on 25 August 2008. The 27 days old seedlings were transplanted in the main plots on 22-24 September 2008 with spacing 60 cm row to row distance and 40 cm plant to plant distance. The experimental plot was fertilized with 250-90-125-30-1 kg ha^{-1} N-P-K-S-B, respectively in the form of urea, TSP, MP, gypsum and boric acid, respectively and 10 ton ha^{-1} cowdung (FRG, 2005). The TSP, boric acid and cowdung were applied during final land preparation as basal. The next MP and urea fertilizers were used in two installment of side-dressing after 25 and 40 days after planting, respectively. The AVRDC recommendation of placing side-dressing fertilizer 5 cm under the soil was used at both times to reduce volatilization loss. Irrigation was applied three times during the crop-growing period. Insecticide (Admire @ 0.5 ml/L water) and fungicide (Dithane M-45 @ 2g L^{-1} water) were sprayed four times for controlling insect and diseases of tomato plant. Weeding and other intercultural operations were done as per need for better growth and development of the crop plant. For staking, Bamboo sticks of 2.5 m long was used to make a vertical triangular formation support, with some sticks running horizontally across at mid-height for more support of trellised vines(Cradle type). Synthetic nylon twines were used to tie the tomato vines upon the bamboo sticks.

Pruning was done by hand by nipping off the unwanted auxiliary buds, branches, cluster and fruits depending on the treatment. Before and after every treatment was pruned, hands were washed with soap to reduce the transmission of pathogen. The green mature tomato was harvested. The tomato was harvested ranging from 04 December 2008 to 10 January 2009. The data on yield components of tomato were collected from five randomly selected plants of each plot. Yield was recorded plot wise and then converted into ton per hectare. Recorded data were analyzed statistically and means were separated by Duncan's Multiple Range Test (Gomez and Gomez, 1984). The economic analysis was done for gross return, net return and marginal benefit cost ratio (MBCR) for different treatments following the method suggested by CIMMYT, 1988. The gross return and MBCR were estimated by using the following formula: Gross return (Tk.ha^{-1}) = Yield (t ha^{-1}) × Average market price (Tk. kg^{-1}) × 1000.

$$\text{MBCR} = \frac{\text{Marginal Value of Product (MVP)}}{\text{Marginal Value of Cost (MVC)}}$$

Results and Discussion

Yield and Yield components

Yield and yield component of tomato responded significantly to different pruning (Table 1). It was observed that number of clusters plant^{-1} (10.87) and number of fruits plant^{-1} (39.93) were highest in shoot pruning treatment (T_1) which was followed by control, fruit pruning and shoot + fruit pruning treatments. Lateral branch below first flower bearing branch is more succulent. It can uptake more nutrient. So, nutrients can not translocate to the reproductive part of tomato plant. For fruit pruning and shoot + fruit pruning treatments, the number of cluster and fruit were limited. In case of shoot pruning treatment, translocation of nutrients may be done properly resulted to higher clusters and fruits per plant. Unit fruit weight was found highest in shoot + fruit pruning treatment (53.02 g) which was statistically similar to that of fruit pruning treatment (51.63 g) and lowest in control (no pruning) (47.47 g). In shoot + fruit pruning treatment, the number of fruit and lateral branch (sinks of nutrients) were minimum compared to other treatments resulted to higher fruit size. The highest fruit yield (71.81 t ha^{-1}) was found in shoot pruning treatment that was similar to shoot + fruit pruning (70.31 t ha^{-1}) as well as fruit pruning (68.48 t ha^{-1}) treatment and lowest in control (no pruning). The number of clusters and fruits were higher in shoot pruning compared to other treatments. These may be the main reason of highest fruit yield.

Cost and economic return analysis

Gross return, total variable cost, net return and marginal benefit cost ratio (MBCR) of different pruning treatments were calculated (Table 2). Cost and return analysis of the experiment exhibited that the maximum gross return (Tk. 574480 ha^{-1}), net return (Tk. 569980 ha^{-1}) and MBCR (19.82) were obtained from shoot pruning treatment having lowest variable cost (Tk. 4500 ha^{-1}). The highest variable cost (Tk. 9000 ha^{-1}) and lowest MBCR (8.57) were found when the crop was pruned both shoots and fruits. This variation was attributed due to the variation of fruit yield and pruning cost of tomato. Considering net return and marginal benefit cost ratio, it was found that only shoot pruning was economically profitable and viable for the production of tomato in High Barind Tract (HBT).

Farmers' reaction

Farmers are very much happy to get higher yield by shoot pruning. They opined that shoot pruning is effective for higher fruit yield of tomato. They show interest to take this technology.

Conclusion

Therefore, from the aforesaid discussion it may be concluded that shoot pruning gave the highest yield as well as economic benefit for tomato production in High Barind Tract. This is the first year result. The experiment should be continued in the next year for further conformation.

Table 1. Plant characters of tomato influenced by pruning in HBT, 2008-09

Treatment	Plant height (cm)	No. of clusters plant^{-1}	No. of fruits plant^{-1}	Unit fruit weight (g)	Fruit yield (t ha^{-1})
T_1 : Shoot pruning	95.43	10.87	39.93	48.32	71.81
T_2 : Fruit pruning	95.30	8.00	33.47	51.63	68.48
T_3 : Shoot and Fruit pruning	97.20	8.00	32.70	53.02	70.31
T_4 : Control (No pruning)	94.30	9.38	39.73	47.47	60.66
LSD (0.05)	NS	1.46	3.88	2.22	7.98
CV (%)	5.48	13.12	8.64	3.60	9.56

Table 2. Economic return of Tomato as influenced by pruning in HBT, 2008-09

Treatment	Gross return (Tk. ha^{-1})	Variable cost* (Tk.ha^{-1})	Net return (Tk.ha^{-1})	MBCR (Over control)
T_1 : Shoot pruning	574480	4500	569980	19.82
T_2 : Fruit pruning	547840	4500	543340	13.90
T_3 : Shoot and fruit pruning	572480	9000	553480	8.58
T_4 : Control (No pruning)	485280	0	485280	-

*labour cost for pruning only

Market prices (Tk. kg^{-1}): Tomato= 8, Labour wage for pruning = Tk.150 day^{-1}

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Performance of Intercropping of Tomato with Different Short Duration Leafy Vegetables

Abstract

An experiment was conducted at Bijoynagar, Godagari, Rajshahi during rabi 2008-2009 to know the feasibility of intercropping of tomato with leafy vegetables in High Barind Tract (HBT). Three intercropping combinations were T_1: Sole tomato (60 cm × 40 cm), T_2: Tomato (60 cm × 40 cm) + 3 rows red amaranth 20 cm apart between tomato rows and T_3: Tomato (60 cm × 40 cm) + 3 rows spinach 20 cm apart between tomato rows. The intercrop red amaranth and spinach affected the growth of tomato adversely due to competition for air, sunlight; space etc resulted to poor growth and low yield of tomato. Intercropping of tomato with leafy vegetables performed lower tomato equivalent yield than sole tomato yield.

Introduction

Intercropping is an age-old practice of the traditional system of agriculture in the developing world. The practice aims at increasing yield against total crop failure under aberrant weather conditions or increase total productivity per unit land area and to equitably and judiciously utilize land resources and farming inputs. Proper management of the intercropping system can play a determining role in making a success of the system. Intercropping, now-a-day, is gaining popularity due to its total production per unit area and higher cash return than sole cropping. To exploit yield potentiality, maximum utilization of land and natural resources (e.g. space, light, water and soil nutrient) is possible in intercropping system. Tomato is a popular vegetable in Bangladesh especially in the urban areas. The total tomato production in the country is about 1.03 lac metric ton (BBS, 2004). Presently, the farmers of high Barind Tract extensively cultivate various local and exotic hybrid tomato varieties at early *rabi* season after the harvest of T.Aus rice (cv. *Parija*). Early tomato cultivation is increasing day by day in this area. Hybrid tomato requires high amount of chemical fertilizer for exploiting its maximum yield potentiality. On the contrary, different short duration leafy vegetables e.g., red amaranth and spinach need lower quantity of nutrients for its cultivation. Tomato seedlings are planted in the month of September. Till 40 days after planting, tomato field have free space due to small canopy of tomato plant. Within this time, different short duration leafy vegetables can easily grow in the same field. In these circumstances, the present study is undertaken to know the feasibility of intercropping of tomato with leafy vegetables in High Barind Tract.

Materials and Methods

The field experiment was conducted at Bijoynagar, Godagari, Rajshahi during rabi 2008-2009 in the Bijoynagar ICM club (club no.12714) member's field of High Barind Tract. The experiment was laid out in Randomized Complete Block Design having six dispersed replications. The unit plot size was 4 m x 3 m. Three intercrop combination were given the trial such as, T_1: Sole tomato (60 cm × 40 cm), T_2 : Tomato (60 cm × 40 cm) + 3 rows red amaranth 20 cm apart between tomato rows and T_3 : Tomato (60 cm × 40 cm) + 3 rows spinach 20 cm apart between tomato rows. The tomato cv. Sabal (hybrid variety), red amaranth cv. BARI Lalshak^{-1} and spinach cv. Kopipalong were used as planting materials. The tomato seed was sown in seed bed on 27 August 2008. The 25 days old seedlings were transplanted in the main plots on 22-24 September 2008 with spacing 60 cm row to row distance and 40 cm plant to plant distance. Three lines of red amaranth and three lines of spinach were sown in tomato inter rows on the same day of tomato planting as per treatments. 20% extra tomato seedlings were allowed in case of any losses. The experimental plot was fertilized with 250-90^{-1}25-30^{-1} kgha^{-1} N-P-K-S-B, respectively in the form of urea, TSP, MP, gypsum and boric acid, respectively and 10 ton cowdungha^{-1} (FRG, 2005). The full dose of TSP, boric acid and cowdung and one third of MP and urea were applied during final land preparation as basal. The next MP and urea fertilizers were used in two installment of side-dressing after 25 and 40 days after planting, respectively. No additional fertilizer was applied for intercrops. The AVRDC recommendation of placing side-dressing fertilizer 5 cm under the soil was used at both times to reduce volatilization loss. Irrigation was applied three times during the crop-growing period. Insecticide (Admire @ 0.5 ml/L water) and fungicide (Dithane M-45 @ 2g/L water) were sprayed four times for controlling insect and diseases of tomato plant. Weeding and other intercultural operations were done as per need for better growth and development of the crop plant. Red amaranth and Spinach were harvested ranging from 20-27 October 2008 and 02^{-1}2 November 2008, respectively. The green mature tomato was harvested. The tomato was harvested ranging from 01 December 2008 to 12 January 2009. The data on yield components of tomato were collected from five randomly selected plants of each plot. Yield of the three crops were recorded plot wise and then converted into ton per hectare. Recorded data were analyzed statistically and means were separated by Duncan's Multiple Range Test (Gomez and Gomez, 1984). The intercrops yield was converted to equivalent yield of tomato.

Results and Discussion

Almost all the crop characters of tomato were significantly influenced by intercropping. The highest number of fruits plant^{-1} (41.56) and unit fruit weight (48.24g) were obtained from the sole tomato treatment followed by tomato + red amaranth intercrop combination and lowest value were observed from tomato + spinach treatment combination. This can be explained by the fact that leafy vegetables are N loving crop. The growth and development of tomato plant was adversely affected by the both the red amaranth and spinach at the early stage. The highest fruit yield of tomato (56.93 t ha^{-1}) was recorded from sole cropping. Number of fruits plant^{-1} and unit fruit weight of tomato were higher in sole cropping resulted to higher fruit yield. The lowest fruit yield (49.12 t ha^{-1}) was found in tomato + spinach treatment combination. The highest tomato equivalent yield (56.93 t ha^{-1}) was also found in sole cropping.

Farmers' reaction

Farmer got higher fruit yield in sole tomato cropping. So they did not like intercropping system.

Conclusion

It should be suggested that the tomato hybrid variety Sabal will be profitable in sole cropping system without intercropping system in HBT.

Table 1. Yield and yield contributing characters of tomato and leafy vegetables under intercropping in HBT, 2008-09

Treatment	Clusters plant^{-1} (no.)	Fruits plant^{-1} (no.)	Unit fruit weight (g)	Tomato yield (t ha^{-1})	Vegetables yield (t ha^{-1})	Tomato equivalent yield (t ha^{-1})
T_1 : Sole tomato	10.86	41.56	48.24	56.93	-	56.93
T_2 : Tomato + Red amaranth	10.44	33.92	47.56	52.67	4.11	55.75
T_3 : Tomato + Spinach	9.26	30.56	45.30	49.12	5.34	54.46
LSD (0.05)	NS	5.73	1.93	3.80	-	-
CV (%)	20.28	11.11	2.81	4.93	-	-

Response of Boron Fertilizer on Seed Production of Onion

Abstract

A field experiment was conducted in High Ganges River Flood Plain soil (AEZ-11) at MLT site Shibpur, Puthia, Rajshahi during rabi 2008-09 to know the effect of Boron on quality seed production of onion. There were three treatments, T_1: 0 kg B ha^{-1}, T_2: 1 kg B ha^{-1} and T_3: 1.5 kg B ha^{-1}. Other fertilizer was applied as blanket dose ($N_{100}P_{50}K_{120}S_{40}Zn_4$ and cowdung (5 t ha^{-1}). The highest seed yield (637.5 kg ha^{-1}) was produced by T_3 (1.5 kg B ha^{-1}) followed by the yield (589.2 kg ha^{-1}) of T_2 (1 kg B ha^{-1}). The applied boron contribute 23-33% increased yield over boron control (T_1). The 1.5 kg B ha^{-1} was economically profitable (Tk. 193368 ha^{-1}) and gave higher net return and BCR.

Introduction

Among the spices crop, onion (*Allium cepa* L) ranks first both in area and production but its average yield is very low (4.21 t ha^{-1}) compared to the average yield (17.0 t ha^{-1}) of the onion growing countries (FAO, 1999). One of the reasons of lower yield is the non-availability of quality seeds in the country. Seeds produced in the country can hardly meet 50% of the total requirement and there quality is not up to the mark (Nahar *et al*. 2003). There Bangladesh has to import onion seed every year in exchange of hard earned foreign currency. However, production of quality seeds of onion is possible of the appropriate production technology becomes available. Seed crop of onion raised by the farmers are found often seedless or with degenerated, Poor quality seeds having low yield. Among the plant nutrients, boron plays vilal role in cell division and seed formation. Boron involves in flowering and fruiting process. However, research work regarding the role of Boron on quality seed production of onion is scanty in Bangladesh. The present study was therefore, undertaken to evaluate the effect of boron on the seed yield of onion in farmers' field.

Materials and Methods

The experiment was conducted in MLT site Shibpur, Rajshahi during 2008-09 in High Ganges River Flood Plain soil (AEZ-11). The experiment was laid out in RCB design with 6 replications. The unit plot size was 80 m^2 with 30 cm x 15 cm spacing. The initial soil sample of the soil was collected and analyzed to know the nutrient status and results have been presented in Table 1. The soil was slightly alkaline (pH 8.2) having low organic matter content (1.1%) and the Boron content were also low (0.16 µg). The overall soil fertility status was low. The treatment includes three levels of Boron, T_1: 0 kg ha^{-1}, T_2: 1 kg ha^{-1} and T_3: 1.5 kg ha^{-1} in addition, a blanket dose of $N_{100}P_{50}K_{120}S_{40}Zn_4$ and cowdung (CD) 5 t ha^{-1} was used. The onion bulbs (CV BARI piaz^{-1}) were planted on last week of (24-27 November 08) November. The entire amount of CD, P,S, Zn and B (as per treatment) including ¼th of N and $^1/_3$rd of K was applied at the time of final land preparation. Again, ½ N and $^2/_3$rd K were applied in two equal splits at 30 and 60 days after planting (DAP). The rest ¼th N was top dressed at 90 DAP. The fungicides mixture (Rovral @ 2% and Ridomil @ 0.2%) was sprayed 4 times to control purple blotch. Irrigation and weeding were also done as and when required. The crop was harvested two times at it maturity during mid April (10-12 April 09 and 20-21 April 09).

Table 1. Fertility status of initial soil of the experimental field at Shibpur MLT site, Puthia, Rajshahi.

Item	pH	OM (%)	Total N (%)	K	P	S	B	Zn
				meq/100g soil	Micro gram/g soil			
Result	8.2	1.1	0.08	0.07	10.1	10.62	0.16	0.71
Critical limit	-	-	0.12	0.12	10.0	10.0	0.20	0.6
Interpretation	Slightly alkaline	Low	Very low	Very Low	Low	Low	Low	Low

Results and Discussion

The seed yield of onion increased significantly due to boron fertilizer (Table 2). The highest seed yield (637.5 kg ha^{-1}) was obtained from T_3 (1.5 kg B ha^{-1}) followed by the yield (589.2 kg ha^{-1}) of T_2 (1 kg B ha^{-1}). The lowest yield (479.7 kg ha^{-1}) was produced by T_1 (0 kg B ha^{-1}). The applied boron contributed 23-33% increased yield over boron control. Hossain (2000) also obtained significant seed yield of onion due to boron. The yield components like 1000-seed weight (g), no of seed stalk hill^{-1} and height of the seed stalk also showed similar trend of response. The seed stalk height varied from 70.87-75.10 cm where the longest seed stalk was obtained from T_3 (75.1 cm) and the shortest from boron control. Similarly, the number of seed stalk hill^{-1} varied from 3-4.28 where the highest number of seed stalk was found in T_3 (1.5 kg B ha^{-1}) which was also similar to T_2. The weight of 1000-seeds was also found greater in T_3 (3.22 g) followed by T_2 (3 g). The lowest 1000-seed weight was produced by T_1 (2.73 g) where boron level was zero. Cost and return analysis (Table 3) showed that 1.5 kg B ha^{-1} was economically profitable (net return Tk. 193368 ha^{-1} and BCR 2.54) to the farmers.

Farmers' reaction

Farmers are very much impressed to have satisfactory seed size and seed yield due to boron application.

Conclusion

The seed crop of onion was found responsive to boron fertilizer in the study. Application of 1.5 kg B ha^{-1} was found suitable and economic for cultivation of onion seed crop. The experiment should be continued for next year for concrete conclusion.

Table 2. Yield and yield components of onion seed crop as influenced by Boron level at MLT site, Shibpur, Rajshahi, 2008-09.

Boron level (kg ha^{-1})	Seed stalk height (cm)	Seed stalk hill^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1})	% increased yield over control (T_1)
T_1 (0)	70.87	3.00	2.73	479.7	-
T_2 (1)	75.10	3.83	3.00	589.2	22.83
T_3 (1.5)	74.20	4.28	3.22	637.5	32.89
LSD (0.05)	3.17	0.81	0.2	44.13	-
CV (%)	3.6	17.4	5.3	6.03	-

Table 3 : Cost and return analysis of onion seed production as influenced by Boron level at MLT site Shibpur, Rajshahi, 2008-09.

Boron level (kg ha^{-1})	Gross income (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1 (0)	239850	124302	115548	1.93
T_2 (1)	294600	125022	169578	2.37
T_3 (1.5)	318750	125382	193368	2.54

Price : Urea @ 12 Tk/kg, TSP @ 80 Tk/Kg, MP @ 70 Tk/Kg, Gypsum @ 6 Tk/Kg, Boric Acid @ 120 Tk/Kg, Zinc Sulphate @ 100 Tk/Kg, CD @ 1 Tk/Kg, Labour wage @ 150 Tk/day, seed bulb @ 45 Tk/kg, Rovral @ 1400 Tk/kg, Ridomil 1200 Tk/kg, Ploughing 1500 Tk. ha^{-1}, Water @ 800 Tk. ha^{-1} and Onion seed @ 500 Tk/kg.

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Effect of Management Techniques for Controlling of Root and Clove Rot of Garlic

Abstract

The experiment was carried out during the rabi season of 2008-09 at MLT site, Atghoria, Pabna to reduce root and clove rot disease and to increase economic return. The experiment was laid out in randomized complete block (RCB) design with five treatments and six dispersed replications. Minimum root rot disease was observed in the plot where seed was treated with trichoderma liquid and maximum in control plot. The highest bulb yield was attained in trichoderma compost used plot which was statistically identical with trichoderma liquid and poultry manures used plot and lowest in control plot. Maximum economic return in terms of net return was obtained from trichoderma compost and benefit cost ratio was recorded from trichoderma liquid plot where as control treatment showed poor performance in all cases.

Introduction

Cultivation of garlic under zero tillage condition in Pabna region is gaining popularity and areas coverage being increased in the recent years. But at harvesting stage and as well in storage condition garlic root and clove rot symptom appear which causes economic loss and make the infested cloves unsuitable for use and long term storage. Through discussion with the local farmers, this problem is being regarded as a researchable issue. Trichoderma is a beneficial fungus and some research findings indicate its efficacy for controlling different harmful fungus, which causes diseases. Similarly, provax and poultry manure have some effect for controlling fungal disease. Considering these views, the experiment was undertaken to reduce root and clove rot disease of garlic and to increase economic return.

Materials and Methods

The experiment was carried out during the rabi season of 2008-09 at MLT site, Atghoria, Pabna. Before starting the experiment, discussion was made with farmers of Atgharia and scientist of RARS, BARI, Ishurdi and BSRI. Ishurdi. The soil of the experimental area was clay loam with very low organic matter content (0.57%) and neutral (pH-6.8) in nature. Nitrogen (0.18%) was low and P (13.0 µg g^{-1} soil), K (0.22 meq/100g) and B (0.40 µg g^{-1}) was medium. S (48.0 µg g^{-1}) and Zn (6.0µg g^{-1}) content of the soil was very high. The experiment was laid out in randomized complete block (RCB) design with six dispersed replications. The unit plot size was 6m X 5m. Five different treatments viz. T_1 = Trichodema compost (3 t ha^{-1}), T_2 = Trichoderma liquid (100 ml per kg seed), T_3 = Provax (2.5 g per kg seed), T_4= Poultry manure (3 t ha^{-1}) and T_5 = Control were tested for the crop. The bulb of garlic (var. local) was sown on November 3, 2008. Three times irrigation were applied at 2nd week of December, January and February. Standard crop management practices were used for maintain the productivity of the crop. The crop was harvested on March 20, 2009. All necessary data were collected and analyzed statistically**.**

Results and Discussion

The yield attributes were differed significantly among the treatment (Table 1). The highest no. of plant established in trichoderma liquid treated plot which was statistically identical with other treatment except control. It seems that seed or soil treating has a positive effect on plant establishment. The identically highest plant height was found in trichoderma liquid used plot and trichoderma compost used plot followed by poultry manure used plot. Control plot produce minimum height in plant. It is clear that trichoderma also influenced plant growth. The highest bulb diameter was measured in trichodertma compost treated plot which was also identical with trichoderma liquid and poultry manure treated plot. The lowest bulb diameter was found in control treatment. These results revealed that organic matter added by trichoderma compost and poultry manure had a succeeding effect on soil nutrition which influenced to maximize bulb diameter. On the other hand trichoderma also had a positive effect on bulb growth as well as increasing soil nutrition. Foot rot disease could not remove fully by applying different treatment. However, minimum disease infestation was found in the plot where garlic clove were treated with liquid trichoderma before sowing followed by trichoderma compost and poultry manure treatment. The highest rotted percentage was calculated in control treatment. The highest bulb yield was obtained from trichoderma compost and trichoderma liquid treatment followed by poultry manure treatment. The lowest yield was obtained from control treatment. This result might be the cumulative effect of yield attributes performance as well as the effect of organic matter and antifungal effect.

Maximum economic return in terms of net return was obtained from trichoderma compost plot and it is mainly due to higher yield and maximum BCR was obtained from trichoderma liquid plot which is mainly due to relatively low cost but higher yield (Table 2).

Farmers' reaction

Farmers also opined that trichoderma is very good option for seed treatment but it should be available.

Conclusion

The result revealed that among the tested options, trichoderma both in compost or liquid form are promising though 100% disease could not remove. It also increase soil health by adding organic matter and decreasing soil or seed pathogen. So, it should take an initiative by the authority to be available of trichoderma at farmers reach with low cost.

Table 1. Yield and yield contributing characters of garlic as influenced by different management techniques at MLT site, Atghoria, Pabna during the rabi season of 2008-09.

Treatments	Plant population m^2 (no.)	Plant height (cm)	Bulb diameter (cm)	Rotted bulb (%)	Bulb yield (t ha^{-1})
T_1= Tricodarma compost	58.62	71.86	3.14	0.68	7.18
T_2 = Tricodarma liquid	69.40	72.68	3.04	0.33	7.06
T_3 = Provax	58.74	70.18	2.80	3.04	6.67
T_4 = Poultry manure	58.72	71.44	3.02	1.02	6.90
T_5 = Control	57.54	60.66	2.68	5.43	6.40
LSD (0.05)	1.67	1.74	0.22	-	0.29
CV (%)	5.18	4.94	5.74	-	5.28

Table 2. Cost and return analysis of garlic as influenced by different management techniques at MLTsite, Atghoria, Pabna.during the rabi season of 2008-09

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1= Tricodarma compost	179500	71020	108480	2.53
T_2 = Tricodarma liquid	176500	68518	107982	2.58
T_3 = Provax	166750	69013	97737	2.42
T_4 = Poultry manure	172500	71012	101488	2.43
T_5 = Control	160000	68019	91981	2.35

Effect of Boron and Magnesium on Cauliflower Seed Production

Abstract

An experiment was carried out in medium highland and irrigated condition in the farmers' field at the MLT site, Sadar, Tangail under AEZ 8 during the rabi season of 2008-09. Four levels of B viz., 0.0, 1.0, 1.5 and 2.0 kg ha^{-1} and four levels of Mg viz. 0.0, 5, 10 and 15 kg ha^{-1} were employed in the experiment in factorial RCB design with six dispersed replications. The highest seed yield (663.97 kg ha^{-1}) was found when the soil was fertilized with 1.5 kg ha^{-1} B along with 10 kg ha^{-1} Mg.

Introduction

Cauliflower is a popular winter vegetable crop in Bangladesh. Most of the farmers of Tangail cultivate for both as vegetable and seed purpose. After harvest of most of the plants as vegetable only 5-10% plants kept for seed purpose. But the farmers don't get the desirable seed yield. Farmers use only NPK fertilizer. They use no micro-nutrients. As a result, production and seed quality decreases. Available information reveals that there is deficiency of B and Mg in some areas of Tangail. Boron and Mg deficiency symptom was observed in cauliflower and its seed production in previous years. Micro nutrient is essential for quality seed production and it plays vital role on seed vigor and seed viability. Hence, the experiment was taken to observe the effect of boron and Mg on seed production of cauliflower.

Materials and Methods

The experiment was carried out in medium high land irrigated condition in the farmers' field at the MLT site, Sadar, Tangail under AEZ 8 during rabi 2008-2009. The trial was laid out in factorial RCB design with six dispersed replications (farmers). Farmers are the numbers of ICM club/FFS who were selected with the help of local DAE personnel. Boron and Mg were the two different treatments. Four levels of boron viz., 0.0, 1.0, 1.5 and 2.0 kg ha^{-1} and four levels of Mg viz. 0.0, 5, 10 and 15 kg ha^{-1} were considered as the two factor treatments. The unit plot size was 3m x 3m and the plants were spaced at 75 cm x 60 cm. The crop was fertilized with 330-240-120-110 kg ha^{-1} urea-TSP-MP-gypsum. One third of urea, half of MP and all amount of other fertilizers were applied as basal during final land preparation. Remaining urea and MP were divided into three equal splits and were applied at 10, 30 and 50 days after transplanting (DAT) as top dress. Seedlings were transplanted during 13-18 November 2008. Four irrigations were done at 30, 50, 75 and 100 days after transplanting. Two weedings and earthing up operations were done at 25 and 40 DAT and plant protection measures were done when necessary. The seed crop was harvested during 11-15 March 2009. Necessary data were collected and analyzed statistically using Crop State analytical package.

Results and Discussions

Siliqua was not influenced by Mg levels (Table 1). In interaction, Table 2 reveals that the highest numbers of siliqua per plant (698) was obtained from 1.5 kg B along with 10 kg Mg per hectare. The lowest number of siliqua per plant (40) was found from 5 kg ha^{-1} Mg with no boron (442). The number of seeds per siliqua was significantly influenced by the B and Mg levels treated. The highest number of seeds per siliqua (17) was obtained from 1.5 kg boron per hectare treated plants, which was at par with 1.0 kg per hectare boron (17). Seeds per siliqua were not influenced by Mg levels. In interaction (Table 2) boron 1 to 1.5 kg ha^{-1} along with Mg 5 to 10 kg ha^{-1} gave the highest number seeds per siliqua (18). Seed yield was significantly influenced by boron levels. The highest seed yield (576 kg ha^{-1}) was obtained from plants received 1.5 kg ha^{-1} boron and no boron treated plants gave the lowest yield of 295 kg ha^{-1} (Table 2). Seed yield was not influenced by Mg levels. In interaction, Table 3 indicates that the highest seed yield was found from 1.5 kg boron along with 10 kg ha^{-1} Mg treated plot (664 kg ha^{-1}) and it was at par with 1.5 kg boron with 5 kg ha^{-1} Mg treated plots. The plants with no boron and 5 kg Mg gave the lowest seed yield 265 kg ha^{-1}.

Farmers' reaction

Earlier the farmers of the locality did not use boron and Mg in cauliflower seed production. They showed keen interest to use boron and Mg in cauliflower seed production next year.

Conclusion

Use of boron and Mg in cauliflower seed production is new in Tangail area. Use of 1.5 kg boron and 10 kg Mg ha^{-1} gave the highest seed yield. It was the first year trial, for concrete conclusion, the trial may be repeated next year.

Table 1. Effects of boron and magnesium on seed yield and yield contributing characters of cauliflower at MLT site Sadar, Tangail, during Rabi 2008-09.

Levels (kg ha^{-1})	No. of siliqua $plant^{-1}$	Siliqua length (cm)	No. of seeds $siliqua^{-1}$	1000- seed weight (g)	Seed yield $plant^{-1}$ (g)	Seed yield (kg ha^{-1})
B levels						
0	445	5.6	15	2.36	14.8	295
1	544	5.6	17	2.51	21.8	433
1.5	665	5.7	17	2.70	28.9	576
2.0	473	5.8	15	2.59	17.5	348
LSD (0.05)	41.02	0.35	0.78	0.78	2.83	52.37
CV (%)	7.2	5.7	4.6	2.9	12.8	11.9
Mg levels						
0	508	5.56	16	2.51	19.53	388
5	532	5.76	16	2.54	20.99	417
10	547	5.63	16	2.58	22.19	441
15	540	5.73	16	2.54	20.35	405
LSD (0.05)	41.02	0.35	0.78	0.78	2.83	52.37
CV (%)	7.2	5.7	4.6	2.9	12.8	11.9

Table 2. Interaction of boron and Mg levels on seed yield and yield contributing characters of cauliflower at MLT site Sadar, Tangail, during Rabi 2008-09.

Fertilizer dose	Plant height cm	Siliqua $plant^{-1}$	Length of siliqua (cm)	Seeds $siliqua^{-1}$	1000 seed weight	Seed yield $plant^{-1}$ (g)	Seed yield kg ha^{-1}
B_0M_0	43.6	462	5.6	16	2.39	16.26	323
B_0M_5	41.8	430	5.5	14	2.35	12.87	256
B_0M_{10}	43.8	454	5.8	15	2.34	14.68	292
B_0M_{15}	37.4	433	5.5	16	2.36	15.54	309
B_1M_0	39.0	519	5.3	17	2.46	20.03	398
B_1M_5	43.8	561	6.0	18	2.53	24.22	481
B_1M_{10}	44.3	553	5.5	18	2.52	23.14	460
B_1M_{15}	45.3	543	5.7	15	2.53	19.69	391
$B_{1.5}M_0$	44.1	608	5.4	16	2.68	24.69	491
$B_{1.5}M_5$	42.4	660	5.7	18	2.71	29.97	596
$B_{1.5}M_{10}$	43.8	698	5.8	18	2.80	33.40	664
$B_{1.5}M_{15}$	43.8	696	6.0	16	2.63	27.88	554
B_2M_0	45.4	442	6.0	16	2.52	17.16	341
B_2M_5	42.8	480	5.8	15	2.57	16.92	335
B_2M_{10}	47.0	484	5.5	15	2.65	17.56	349
B_2M_{15}	46.6	487	5.7	15	2.64	18.33	364
LSD (0.05)	5.47	82.04	0.69	1.56	0.16	5.66	104
CV (%)	6.0	7.2	5.7	4.6	2.9	12.8	11.9

Effect of Boron on Groundnut Seed Production

Abstract

An experiment was carried out in medium highland and irrigated condition in the farmers' field at the MLT site, Ghatail, Tangail under AEZ 28 during kharif–II, 2008. BARI Chinabadham-7 and local one were considered in main plot treatments. Four boron levels viz., 0.0, 1.0, 1.5 and 2.0 kg ha^{-1} were considered as sub-plot treatments. The highest pod yield of 2.49 t ha^{-1} was obtained from the variety BARI Chinabadam 7 having 2.0 kg ha^{-1} boron.

Introduction

Groundnut is the third important oilseed crop after mustard and sesame on the basis of annual production and acreages. It contains 45% high quality oil, 25% highly digestible protein, 20% carbohydrate and a remarkable amount of vitamin B and E. The crop is capable to enrich the soil fertility. The average yield of existing local cultivars is about 1100 kg ha^{-1}, which is lower compared to world's average yield (2200 kg ha^{-1}). However, the potential yield of groundnut is 2500-3000 kg ha^{-1} (Hussaim *et al*. 2006), which is much higher than the national average yield. The farmers get lower yield due to use of local cultivar, improper agronomic and fertilizer managements specially micronutrients. BARI has developed several modern varieties of groundnut, which are supposed to be higher yielder and less disease susceptible. Farmers grow groundnut in off season (late autumn) mainly for seed purpose at the hilly area of Ghatail, Tangail. But they don't get higher yield and quality seed as they use no micronutrients. In last years, deficiency of boron was observed in groundnut seed production under farmer's field situation at Ghatail. No remarkable research work has yet been done on groundnut seed production especially during autumn, Hence, the experiment was undertaken to adapt the BARI developed varieties and to determine the optimum dose of B for higher seed yield of groundnut.

Materials and Methods

The experiment was carried out in medium highland and irrigated condition in the farmers' field at the MLT site, Ghatail, Tangail under AEZ 28 during kharif–II, 2008. The trial was laid out in split-plot design with four dispersed replications (farmers). Farmers are the members of ICM club/FFS who were selected with the help of local DAE personnel. BARI Chinabadham-7 and local one were considered in main plot treatments. Four boron levels viz., 0.0, 1.0, 1.5 and 2.0 kg ha^{-1} were considered as sub-plot treatments. The unit plot size was 5m x4m with 30 cm x15 cm plant spacing. The crop was fertilized with 25-160-85-300 kg ha^{-1} urea-TSP-MP-gypsum. Two third of urea and all amount of fertilizers were applied as basal during final land preparation. Remaining urea was applied at 30 days after sowing as top dress. Seeds were sown on 27-30 August 2008 considering 100 kg ha^{-1} seed rate. Two irrigations were done at 30 days interval during the cropping period. Two weeding and earthing up operations were done at 20 and 35 days after sowing and plant protection measures were done when necessary. The crop was harvested during 6-23 December 2008 irrespective of variety and B levels.

Results and discussions

Higher plant height, number of pods per plant, pod weight per plant, 1000-pod weight and pod yield was found in BARI Chinabadam-7 (Table 1). Among the four boron levels, plant height, higher number of pods, the highest pod weight and the highest pod yield was obtained with the application of 2.0 kg B ha^{-1} (Table 2). Interaction of BARI Chinabadam-7 and boron level of 2 kg ha^{-1} showed the higher yield contributing characters which resulted the higher yield (Table 3).

Farmers' reaction

Earlier the farmers of the locality never cultivated the modern cultivar and did not use boron in groundnut cultivation. They showed keen interest regarding the variety BARI chinabadam 7 and also opined that they would definitely use boron in groundnut cultivation next year.

Conclusion

BARI developed chinabadam varieties are new in the area. The modern variety produced almost double yield over local one. The plants obtained 2.0 kg ha^{-1} Boron provided about 58% higher yield over plants received no boron. It was the first year trial, it may be repeated next year for concrete decision

Table 1. Effects of variety on yield and yield contributing characters of groundnut at MLT site Ghatail, 2008.

Variety	Plant height (cm)	Pods $plant^{-1}$ (no.)	Pod wt $plant^{-1}$ (g)	1000 pod wt (g)	Pod yield (t ha^{-1})
BARI chinabadam-7	35.3	26	13.8	569.6	2.13
Local	28.50	20	6.6	319.6	0.96

Table 2. Effects of boron levels on yield and yield contributing characters of groundnut at MLT site Ghatail, 2008.

Variety	Plant height (cm)	Pods $plant^{-1}$ (no.)	Pod wt $plant^{-1}$ (g)	1000 pod wt (g)	Pod yield (t ha^{-1})
0	30.7	20	7.3	360.2	1.11
1.0	30.3	23	9.0	446.6	1.54
1.5	32.7	24	11.2	473.6	1.65
2.0	34.0	26	13.4	498.2	1.89
LSD (0.05)	0.43	2.85	1.13	7.31	0.19
CV (%)	1.3	12.0	10.7	2.6	11.8

Table 3. Interaction of variety and boron levels on yield and yield contributing characters of groundnut at MLT site Ghatail, 2008.

Treatment combination	Plant height (cm)	Pods $plant^{-1}$ (no.)	Pod wt $plant^{-1}$ (g)	1000 pod wt (g)	Pod yield (t ha^{-1})
$V_1 T_1$	35.1	24	10.3	451.7	1.58
$V_1 T_2$	32.4	26	13.3	588.2	2.22
$V_1 T_3$	36.1	25	14.7	608.4	2.22
$V_1 T_4$	37.8	27	17.0	630.2	2.49
$V_2 T_1$	26.4	16	4.3	268.6	0.63
$V_2 T_2$	28.2	19	4.8	305.1	0.86
$V_2 T_3$	29.3	22	7.7	338.8	1.08
$V_2 T_4$	30.2	24	9.7	366.1	1.28
LSD (0.05)	0.61	4.03	1.60	10.34	0.27
CV (%)	1.3	12.0	10.7	2.6	11.8

V_1= BARI chinabadam-7 and V_2= Local

T_1= 0 kg B ha^{-1}, T_2= 1.0 kg B ha^{-1}, T_3= 1.5 kg B ha^{-1} and T_4= 2.0 B ha^{-1}.

Integrated Nutrient Management for Tomato Production in Sunamganj

Abstract

A field experiment was conducted at MLT site Sunamganj during 2008-09, to evaluate different nutrient management packages for tomato. Four different nutrient management options viz.T_1: Soil test based dose for HYG as per fertilizer recommendation guide 2005, T_2: IPNS with 3 t ha^{-1} poultry manure for HYG, T_3: IPNS with 5 t ha^{-1} CD for HYG and T_4: Farmers practice was tested. The yield and yield components of tomato were significantly influenced by the different nutrient management packages. The IPNS treatment with 5 t ha^{-1} cowdung (T_3) produced the maximum fruit yield of tomato (92) t ha^{-1} which was followed by IPNS treatment with 3 t ha^{-1} poultry manure (T_2) treatment. But the highest BCR (8.44) was obtained T_2 treatment followed by T_3 treatment (7.84).

Introduction

The basic concept of Integrated Plant Nutrition System (IPNS) is the management of all available plant nutrient sources from organic and inorganic to provide optimum and sustainable crop production condition within the prevailing farming system. Therefore, in IPNS an appropriate combination of mineral fertilizers and organic manures is used according to the local ecological conditions, land use systems and the individual farmer's social and economical conditions.

A crop production system with high yield targets can not be sustainable unless nutrient inputs are supplied to soil against nutrient removable crops (Bhuiyan et al 1991). Integrated nutrient management for prevailing cropping system appears to be one of the effective ways to meet the economical nutrition requirement of crop (Kulkarni et al. 1993). Inorganic fertilizers today hold the key to the success of the crop production systems of Bangladesh agriculture being responsible for about 50 percent of the total production usually they are not applied in balanced proportion by our farmers (BARC 1977). It is important to develop IPNS based fertilizer dose for specific agro-ecological zones. Tomato (*Lycopersicon esculentum*) is an important and popular vegetable of Bangladesh. It is very nutritious and so much tasty also it grows well in Sunamganj district, but yield performance at that local area is not satisfactory due to imbalanced fertilization. Integrated nutrient management with organic and inorganic fertilizers will be very useful to improve and maintain for sustainable higher yield. Keeping this view in mind the experiment was designed to increase crop productivity and to improve soil fertility and sustain it.

Materials and Methods

The experiment was initiated at MLT site, Sunamganj during 2008-09. Organic matter of the soil is low (1.95% only). The initial soil status is presented in Appendix-1. The soil of the experimental field was chemically analyzed and levels of the fertilizers were selected on the basis of target yields as per Fertilizer Recommendation Guide 2005. The treatments combinations were i) T_1 - STB fertilizer dose (Kg ha^{-1}) for HYG following FRG ($N_{116}P_{33}K_{54}S_6B_{0.5}$) ii) T_2 - IPNS with 3 t ha^{-1} poultry manure for HYG ($N_{81.5}P_{1.5}K_{33}S_6B_{0.5}$ + 3 t ha^{-1} Poultry manure) iii) T_3 - IPNS with 5 t ha^{-1} CD for HYG ($N_{94}P_{25.5}K_{29}S_6B_{0.5}$ + 5 t ha^{-1} CD), iv) T_4 – FP ($N_{120}P_{42}K_{50}$ + 3 t ha^{-1} CD). The design was RCBD with 6 replications. Plot size was 8m x 5m. Twenty five day old seedling of hybrid tomato (var. Epok) was transplanted on 21.11.2008. The data on different plant characters and yield components were collected from 10 plants selected at random in each plot.

Results and Discussion

The yield and yield components of tomato were significantly influenced by the different nutrient management packages (Table 1). Tallest plant height (92.02 cm) was recorded from STB dose which was not statistically different from FP (91.50 cm). The lowest plant height was recorded from IPNS treatments. The highest branch plant^{-1} was obtained from IPNS with 5 t ha^{-1} CD (5.93) and the lowest branch plant^{-1} was found from FP (4.79). The highest fruit plant^{-1} was observed from IPNS with 5 t ha^{-1} CD (47.23) which was followed by IPNS with 3 t ha^{-1} poultry manure (45.02). IPNS with 5 t ha^{-1} CD gave highest yield 92 t ha^{-1} which was followed by IPNS with 3 t ha^{-1} poultry manure (86 t ha^{-1}).

The highest BCR was found from IPNS with 3 ton poultry manure (8.44) which was followed by IPNS with 5 t ha^{-1} CD (7.84). The lowest BCR was found from farmer's practice (6.16) (Table 2).

Conclusion

From the one years study, it showed that the fertilizer treatment with IPNS basis performed better in compared to other treatments. The experiment should be repeated for another year to confirm the findings.

Table 1. Effect of different nutrient management fertilizers on the yield and yield attributes of Tomato at MLT Site, Sunamganj (2008-09)

Treatment	Plant height	Branch plant^{-1}	Cluster plant^{-1}	Fruit plant^{-1}	No. of Fruit kg^{-1}	Yield (t ha^{-1})
T_1	92.02	4.67	10.30	37.68	11.92	70
T_2	86.01	5.15	11.24	45.02	11.61	86
T_3	87.77	5.93	12.40	47.23	11.35	92
T_4	91.50	4.77	10.70	41.06	12.10	75
LSD	3.41	0.03	0.59	0.62	0.26	3.85

T_1: $N_{116}P_{33}K_{54}S_6B_{0.5}$, T_2 : $N_{81.5}P_{1.5}K_{33}S_6B_{0.5}$ + 3 t ha^{-1} Poultry manure, T_3 : $N_{94}P_{25.5}K_{29}S_6B_{0.5}$ + 5 t ha^{-1} T_4: (FP : $N_{120}P_{42}K_{50}$ + 3 t ha^{-1} CD)

Table 2. Effect of different nutrient management fertilizers on the yield and Economics of Tomato at MLT Site, Sunamganj (2008-09)

Treatment	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1: $N_{116}P_{33}K_{54}S_6B_{0.5}$	700000	111348	588652	6.28
T_2 : $N_{81.5}P_{1.5}K_{33}S_6B_{0.5}$ + 3 t ha^{-1} Poultry manure	860000	101851	758149	8.44
T_3 : $N_{94}P_{25.5}K_{29}S_6B_{0.5}$ + 5 t ha^{-1} CD	920000	117344	802656	7.84
T_4 : FP ($N_{120}P_{42}K_{50}$ + 3 t ha^{-1} CD)	750000	121762	628238	6.16

Price : Tomato 10 Tk/kg, Urea 6 Tk/kg, TSP 80 Tk/kg, MOP 70 Tk/kg, Gypsum 4 Tk/kg, Cowdung 2.50 Tk/kg, Poultry manuer 3 Tk/kg

Appendix-I. Initial soil status of the experimental site

Location	AEZ	Land type	Soil texture	pH	OM	K	Total N	P	S	B	Zn
					(%)	meq/100 g soil	(%)	µg/g soil			
Sunamganj	20	MHL	Loam	5.9	1.95	0.14	0.1	7.67	25.28	0.41	2.04
Interpretation				acidic	low	low	low	low	Opt.	Med.	Hig.

Effect of Different Sowing Date on the Performance of Chickpea in Sylhet Region

Abstract

An experiment was conducted at MLT site Sunamganj during 2008-09 to find out the suitable sowing time of chickpea. The trial was carried out in a randomized complete block design with 6 replications. Four sowing times viz- 10 Nov, 20 Nov, 30 Nov, 10 Dec. were used. Different sowing dates showed significant influence on yield and yield attributes. The highest yield was obtained from 30 Nov which was followed by 20 Nov. The lowest yield was found from 10 Dec.

Introduction

Recently chickpea is performing well in the fallow area of Sylhet region. These soils are characterized by a low P^H. Sylhet is a drought prone area and chickpea is a deep-rooted crop, which can be grown in this area. In that situation more productive and profitable chickpea variety should be selected which is feasible for that area. Therefore, the trial was undertaken to investigate the appropriate sowing time at Sunamganj region. Pulses as a group can utilize limited soil moisture and nutrients more efficiently than cereals and mainly for these reasons these crops can be grown in this area after satisfying the demand of cereals.

In the Sylhet region, a vast area of land remains fallow for a long time (December-May) after the harvest of T.Aman rice due to moisture stress. Chickpea is a drought tolerant and deep-rooted crop, which can play a major role in acquisition of both water and nutrient from below the soil surface. In order to increase pulse production, chickpea may be introduced in the existing fallow period. Therefore, the present experiment was undertaken to find out the yield and suitability of chickpea variety after harvest of T.Aman rice in the Sylhet region.

Materials and Methods

The experiment was carried out at MLT site, Sunamganj during rabi season of 2008-09 to find out the suitable sowing time of chickpea after harvest T.Aman rice. Four sowing times Viz.- 10 Nov, 20 Nov, 30 Nov, 10 Dec. were used. Treatments were arranged in the RCB design with 6 replications. The plot size was 5m x 8m. Fertilizer were applied at the rate of 20 - 18 - 17- kg ha^{-1} of NPK, respectably and spacing was 40 x 10cm. The chickpea variety was BARI chickpea-3.

Results and Discussions

Different sowing times showed significant influence on yield and yield attributes. Maximum plant height (51.40 cm) was obtained from 30 Nov which was statistically followed by 20 Nov. There was significant reduction in heights of plants in subsequent planting. The maximum no of pod $plant^{-1}$ (27.88) was observed in 30 Nov sowing and minimum was observed in 10 Dec sowing. Sowing date did not influence number of seeds per pod but 1000 seed weight was significant. The grain yield was highest in 30 Nov sowing (1.77 t ha^{-1}). It might be due to higher pod $plant^{-1}$ and 1000 seed weight which was followed by 20 Nov sowing. The yield was lowest in 10 Dec sowing.

Regarding economics, the higher returns were also obtained from 30 Nov. sowing date for the crop studied in the area and the highest BCR (4.83) was obtained from the same sowing date followed by 20 Nov. which was 4.20. But the lowest BCR (2.80) was found from 10 Dec. sowing.

Table 1. Effects of sowing date on yield and yield attributes of chickpea at Sunamganj during 2008-09

Treatment	Plant height (cm)	Pod plant^{-1}	Seeds pod^{-1}	1000 seed wt (g)	Yield (t ha^{-1})
10 Nov	45.12	23.16	1.35	178	1.227
20 Nov	50.57	24.78	1.370	180.8	1.43
30 Nov	51.40	27.88	1.41	184.7	1.77
10 Dec	42.70	21.66	1.32	174.0	0.953
$LSD_{0.05}$	1.03	1.11	NS	1.09	0.36

Table 2. Effects of sowing date on yield and economics of chickpea at Sunamganj during 2008-09

Treatment	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
10 Nov	73620	20125	53495	3.65
20 Nov	85800	20205	65595	4.20
30 Nov	102000	21105	80895	4.83
10 Dec	57180	20405	36775	2.80

Effect of Different Sowing Date on the Performance of Bushbean

Abstract

An experiment was conducted at MLT site, Sunamganj during the period of November, 2008 to March, 2009 to find out the optimum sowing time of bushbean. Both the green pod and seed yield was obtained from 20 November planting which was at per with 30 November planting.

Introduction

Bushbean is the second pulse crop in the world but it is grown in Bangladesh in a limited scale particularly at greater Sylhet, Chittagong Hill Tracts and Cox's bazar district. Its area and production is increasing due to its high nutritive value and export opportunity BARI released high yield potential bushbean variety BARI bushbean-1. This variety has already been tested as a potential variety for many region of the country. But sowing time is an important factor which may ensure its potential yield as the rainfall pattern of Sylhet area is quite different from rest of the country. So it is required to find out the optimum sowing time for bushbean in this area.

Materials and Methods

The experiment was conducted during November, 2008 to March, 2009 at MLT site, Sunamganj which is situated in the North-Eastern part of Bangladesh. Four sowing dates 10 November, 20 November, 30 November and 10 December were used in this study. The unit plot size was 4 x 5m^2. The land was manured and fertilized with cowdung N, P, and K @ 2000, 50, 33, 50 kg ha^{-1}, respectively. The entire amount of CD, TSP and half of urea and MP were applied at the time of final land preparation and rest was applied at 30 days after planting. In this study BARI bushbean^{-1} was used. Data were recorded from 10 randomly selected plants for individual plant performance and five sqm of plot was used for green pod yield and seed yield separately.

Results and Discussions

Both the planting of 20 November and 30 November gave higher number of pods plant^{-1} than earlier or late planting. The lowest number and weight of pod were obtained from 10 December planting. The average number of pods plant^{-1} (17.6) and pod weight (78.2 g plant^{-1}) as well as green pod (14.75 t ha^{-1}) and yield (2.64 t ha^{-1}) were higher in 20 November planting that was statistically similar with 30 November planting. Mozumder *et al.* (2003) in a study at ARS, Raikhali also observed that 15

November planting gave more pods plant^{-1}, pod weight plant^{-1} and seed yield. Number of survived plant was higher in 10 December planting (19.2 plant m^{-2}) which was at par with 20 and 30 November plantings than 10 November planting (15.4 plant m^{-2}). This was might be higher temperature and excess soil moisture. Mozumder *et al.* (2003) revealed that foot and root rot disease was highest in the earlier planting due to comparatively high temperature of early crop. Lower temperature prohibited the growth of fungus (*Pythium, Rhizoctonia, Fusarium*) which cause the foot and root of disease complex of French bean in the early stage.

From the above discussion it may be revealed that 20-30 November planting gave higher green pod and seed yield in this study area.

Table 1. Effect of different date on yield and yield components of Bushbean at Sunamganj during 2008-09

Sowing date	No. of plant m^{-2}	No. of pods plant^{-1}	Weight of pods plant^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Wt of green pod (t ha^{-1})	Seed yield (t ha^{-1})
10 Nov	15.4	15.2	75.1	4.8	21.64	11.56	1.84
20 Nov	18.7	17.6	79.2	4.9	22.28	14.75	2.64
30 Nov	18.2	17.1	77.6	4.9	22.15	14.11	2.44
10 Dec	19.2	13.2	63.6	4.7	20.92	12.08	1.62
$LSD_{0.05}$	0.47	0.11	0.14	-	0.68	0.47	0.15

Development of Cropping Pattern for Fallow Land Utilization in Patuakhali Region

Introduction

Coastal area of Bangladesh is probably the most vulnerable area in context of agriculture. In this area total agricultural production as well as crops/varieties are limited due to various causes, like varying degree of soil and water salinity, drought, heavy clay soils , excess or less rainfall in the early or late crop season, unavailability of irrigation water in the dry season, cultivation of long duration of T.Aman, Cyclone, tidal inundation, high humidity, shorter winter period etc. are most common. T.Aman rice is the major crop in this region next to T.Aus rice. Rabi crops are neglected here due to above mentioned environment hazards. In Patuakhali district out of 2, 42,000 ha of cultivable land 89,980 ha (41%) remains fallow during dry season. In the rabi season farmers grow few crops like, mungbean, chilli, sweet potato, potato, sweet gourd, khesari, cowpea, water melon etc. Due to food crisis situation the national thrust is given to utilize the coastal fallow land in crop production.

Materials and Methods

The experiment was conducted at FSRD site, Razakhali, Patuakhali during rabi season of 2008-2009. Four cropping pattern were used. The experiment was laid out in RCB design with six dispersed replications having unit plot size 25m x 20m. Recommended spacing were followed for each crop. Application method of fertilizer was followed as recommended. Weeding and other intercultural operation were done as and when necessary. Yield and yield attributes were recorded and analyzed statistically.

01.	Existing cropping pattern	:	Mungbean-	T.Aus-	T.Aman
	Variety	:	Local	Local	Local
	Improved cropping pattern	:	Mungbean-	T.Aus	T.Aman
	Variety	:	BARI Mung-6	BRRI dhan-27	Local
02.	Existing cropping pattern	:	Chilli/Sweet potato-	T.Aman seed bed-	T.Aman
	Variety	:	Local	Local	Local
	Improved cropping pattern	:	Chilli/Potato/Sweet potato-	T.Aman seed bed-	T.Aman
	Variety	:	Local/Diamont/Cardinal/BARI sweet potato-7	BRRI dhan-27	Local
03.	Existing cropping pattern	:	Fallow-	Faloow-	T.Aman
	Variety	:			Local
	(a) Improved cropping pattern	:	Mungbean-	T.Aus	T.Aman
	Variety	:	BARI Mung-6	BRRI dhan-27	Local
	(b) Improved cropping pattern	:	Relay Khesari/Cowpea-	T.Aus	T.Aman
	Variety	:	Local	BRRI dhan-27	Local

Results and Discussion

1. Mungbean- T.Aus- T.Aman cropping pattern

For this cropping pattern instead of local variety modern variety were used; BARI mung-6 for mungbean and BRRI dhan 27 for T.Aus rice. Performance of mungbean was satisfactory compared to local variety. Thrips infestation was high in this year and protective measures were taken. Yield obtained was $845^{-1}130$ kg ha^{-1} (average 978 kg ha^{-1}). Yield of mungbean was 60-73% higher than farmers local variety. For T.Aus BRRI dhan 27 was transplanted on 14-20 May 2009.

2. Chilli- T.Aman cropping pattern

For this cropping pattern BARI lanka-1 was used instead of local cultivars. BARI lanka-1 is a new and attractive variety in this region. Farmers like it for its plant architecture. Leaves cover the fruit and birds do not see the ripen fruits. Moreover, fruits size and shape are more or less uniform. Harvesting of ripen fruits started on 05.05.2009. In this year farmers are interested to sell green chilli due to its high price. Unfortunately crop was damaged by Aila innunded the crop fully on 25 May, 2009 at harvesting stage.

3 (a). Mungbean- T.Aus- T.Aman cropping pattern

About 16% cultivable land of Patuakhali district covers fallow- fallow- T.Aman cropping pattern. To address this fallow land mungbean- T.Aus – T.Aman cropping pattern was selected. For this cropping pattern instead of local variety modern variety were used; BARI mung-6 for mungbean and BRRI dhan 27 for T.Aus rice. Performance of mungbean was satisfactory compared to local variety. Thrips infestation was high in this year and protective measures were taken. Yield obtained was $872^{-1}145$ kg ha^{-1} (average 910 kg ha^{-1}). Yield of mungbean was 60-73% higher than farmers local variety. For T.Aus BRRI dhan- 27 was transplanted on 14-20 May 2009.

3(b). Relay Khesari- T.Aus- T.Aman cropping pattern

About 16% cultivable land of Patuakhali district covers fallow- fallow- T.Aman cropping pattern. To address this fallow land relay khesari- T.Aus – T.Aman cropping pattern was selected. Local variety of Khesari was sown before 25-30 days of T.Aman harvesting on 5-10 Dec 2008. 7 days after sowing tidal flash innunded the field and Khesari was damaged. For T.Aus BRRI dhan 27 was transplanted on 14-20 May 2009.

Late Sowing Potential of Tomato Varieties in Patuakhali Region

Abstract

The experiment was conducted at FSRD site, Razakhali, Patuakhali and MLT site, Amtali, Barguna during rabi season of 2008-2009 to evaluate the Late sowing potential of BARI tomato-14 in Patuakhali region. It was observed that fruit yield was highest in 20.12.08 transplanting (62.9 t ha^{-1}) followed by 01.01.09 transplanting (52.4 t ha^{-1}) and lowest yield (32.6 t ha^{-1}) was obtained from 20 January planting. From the economic study it was revealed that the highest BCR was obtained from first transplanting and it decreases gradually with increasing planting time. Considering BCR planting up to 20 January tomato cultivation was observed profitable. However, it is the result of 1st year experiment; the trial should be continuing the next year for more confirmation.

Introduction

Tomato is an important winter vegetables in Bangladesh. Its vitamin C contents are 31 mg per 100g of tomato. (Matin *et. al.* 1996). Tomato is a photo neutral but thermo sensitive crop and is grown during the winter months of Bangladesh. (Bhuyan and Haque, 1983). Ideal planting time of tomato in rabi season that is cool season of Bangladesh has been recommended from mid September to mid October. Location specific research may be more useful for making any recommendation for a particular region. In rice based cropping system in Patuakhali region sowing time of tomato ranges from 2nd week of November to 1st week of January, though delay in sowing reduced yield.

$AEZ^{-1}3$ characterized by tidal flooding of field, high rainfall during monsoon and short winter. After T.Aman harvest land mainly remains fallow in this region. Delay harvest of transplanted aman rice and wetness of soil are the main reasons for remaining the land fallow. Land become free and soil comes to working condition at the end of November to 1st week of January which is not optimum time for growing many rabi crops including vegetables. Therefore the study has been taken to identify the suitable planting time of tomato for late planting potential for the Patuakhali region of Bangladesh.

Materials and Methods

The experiment was conducted at MLT site, Amtali, Barguna and FSRD site, Razakhali, Patuakhali during rabi season of 2008-2009. Four sowing time: S_1: 20 December, S_2: 01 January, S_3: 10 January and S_4: 20 January were tested. In this regard fertilizer application was following FRG 2005. The experiment was laid out in RCB design with six dispersed replications having unit plot size 5m × 8m. In each location 3 replications were set up. Spacing was 60cm x 40cm and var. BARI Tomato-14 was used in the experiment. Application method of fertilizer was followed as recommended. Irrigation and other intercultural operation were done as and when necessary. Yield and yield attributes were recorded and analyzed statistically.

Results and Discussion

At Amtali transplanting was done at 20.12.2008 and 01.01.2009. Harvesting was done three times. Fruits $plant^{-1}$, fruit weight $plant^{-1}$ and individual fruit weight were observed higher in early planting and decreased gradually over time transplanting. Fruit yield was observed highest in 20.12.08 transplanting (62.9 t ha^{-1}) followed by 01.01.09 transplanting (52.4 t ha^{-1}) due to low temperature. Lowest yield (32.6 t ha^{-1}) was obtained from 20 January planting due to high temperature during flowering and thus setting of less number of fruits. It might be due to drying up of stigma specially its receptive part and/or pollen.

At Razakhali, crop was damaged by hailstorm on 27.03.2009. However, it was 1st year experiment, it should be continued for the next year for more confirmation. This trial may be continued including more varieties.

Farmers' reaction

1. Farmers are highly satisfied to get this yield as well as economic benefit
2. Farmers preferred BARI tomato- 14 fruit size and flesh

Table 1. Effect of sowing time potentiality on tomato yield and yield attributes during rabi, 2008-09 at MLT site Amtali, Barguna.

Treatments	Fruits plant^{-1} (No.)	Fruits weight plant^{-1} (kg)	Individual fruit weight (g)	Fruit yield (t ha^{-1})	Yield reduction (%)
S_1: 20 December	19	1.52	87.86	62.9a	-
S_2: 01 January	19	1.28	68.58	52.4b	16.69
S_3: 10 January	16	1.13	64.90	45.9c	27.02
S_4: 20 January	15	0.95	58.80	32.6d	48.17
CV (%)	-	-		10.65	-

The values with same letter within a column do not differ significantly at 5% level of significance as per DMRT.

Table 2. Cost and return analysis of tomato as affected by sowing time potentiality during rabi, 2008-09 at MLT site Amtali, Barguna.

Treatments	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})
S_1: 20 December	377400	111445	265955
S_2: 01 January	340600	110945	229655
S_3: 10 January	321300	110445	210855
S_4: 20 January	260800	109945	150855

Tomato @ 6-8 Tk/kg in local market.

Effect of Urea Super Granule (USG) as a Source of Nitrogen on the Performance of Pointed Gourd

Introduction

Pointed gourd (*Trichosanthes dioica*) is one of the popular vegetable crops of Bangladesh grown during summer season. The total production and area coverage of the crop is 41160 MT and 17255 acre respectively in Bangladesh (BBS, 2006). The farmers use no recommended dose of fertilizer in this crop specialty the nitrogenous fertilizer. They apply N by 4-5 times as top dress, which covers 30-50% higher than that of the recommended dose. Urea super granule (USG), an effective nitrogenous fertilizer is now available in the market. The efficiency of USG in different vegetables like brinjal, cabbage, cauliflower etc. has been proven better in different regions. But the efficiency of USG in pointed gourd is not yet tested. Considering the above facts, it is imperative to evaluate the efficiency of USG in pointed gourd cultivation. Hence, the experiment was undertaken to find out the optimum and economic dose of USG and compare prilled urea for pointed gourd cultivation.

Materials and Methods

The experiment was conducted under irrigated condition at the MLT site, Madhupur, Tangail, Rangpur and Joypurhat during kharif-I, 2009. The land of the experimental site is medium high in nature and it It was laid out in RCB design with 6 replications (farmers). Farmers are the members of ICM club/FFS who were selected with the help of local DAE personnel. The four treatments were considered as T_1 : Recommended dose of N as prilled urea (STB) T_2 : Recommended dose of N as

USG (STB) T_3 : 10% less than recommended dose of N as USG and T_4 : 20% less than recommended dose of N as USG .

Results : The experiment is on going. Table 1 shows the partial results in Tangail.

Table 1. Effect of USG on the performance of pointed gourd at the MLT site, Modhupur, Tangail during Kharif', 2009.

Treatment	Yield (kg decimal^{-1})	Yield (t ha^{-1})
T_1= Recommended dose of N as prilled urea	10.25	2.28
T_2= Recommended dose of N as USG	12.75	2.84
T_2= 10% less than recommended dose of N as USG	15.00	3.33
T_2= 20% less than recommended dose of N as USG	12.50	2.78
LSD (0.05)	2.89	0.64
CV (%)	14.9	14.8

Development of Fertilizer Recommendation for Potato-Maize-T.Aman Rice Cropping Pattern

Abstract

The experiment was conducted at the MLT site, Ulipur, Rangpur and MLT site, Paba, Rajshahi during 2007-08 to 2008-09 to verify different nutrient management approaches for Potato-Maize-T.Aman cropping pattern. Four different nutrient management approaches viz., STB fertilizer dose for moderate yield goal, STB fertilizer dose for high yield goal, IPNS (5 t ha^{-1} cow dung) based fertilizer dose for high yield goal and farmers practice were evaluated for this purpose. Among the different fertilizer management practices, significantly the highest tuber yield, the highest grain yield of maize and higher grain yield of T.Aman were found from IPNS treatment in Rangpur. But in Rajshahi, the tuber yield was found from the farmers' practice, higher but similar yield was found from the STB fertilizer dose and IPNS treatment. Higher gross return and net return were found from IPNS treatment in the both locations.

Introduction

Potato is the most popular vegetable crops in Bangladesh. In the last year it was grown in 4 lack hectares of land with a total production of 66.4 lacks m. tons (BBS, 2007-08). Similarly, maize is also the most important cereal crops grown in the country. The cultivated area of this crop is increasing day by day. Potato-Maize-T.Aman is a popular cropping pattern in this region and the cropping pattern is also increasing day by day. Higher yield potential through sequential cropping may demands balanced and integrated nutrient management system. Sequential cropping in one hand ensures better utilization of nutrient but on the other hand demands skilled and efficient nutrient management system. Both potato and maize in the Potato-Maize-T.Aman cropping pattern is nutrient exhaustive crop. Further, nutrient requirement of these two crops is higher compared to many other field crops. Under such circumstances, better and efficient nutrient management system is a pre-requisite for this cropping pattern. Crop production in Bangladesh will then be sustainable if we apply balance nutrient elements and organic matter against crop removal and nutrient loss phenomena. Potato-Maize-T.Aman rice cropping patterns acreage increases sharply day by day in medium and high land condition. Farmers normally use fertilizer on single crop basis without considering the whole cropping pattern. But some of the nutrients have considerable residual effect on the succeeding crop. There is no any recommended dose for this pattern in BARC developed national fertilizer recommendation guide' 2005. The requirements of fertilizers for potato and maize are comparatively higher than other field crops. So it is need to find out the optimum and economic dose of fertilizers for this promising cropping pattern.

Materials and Method

The experiment was conducted at MLT site, Ulipur, Rangpur and MLT site, Paba, Rajshahi during 2007-08 to 2008-09. Before conducting the experiment soil sample were collected at depth of 0^{-1}5 cm for laboratory analysis. The four fertilizer management packages were tested and the combination of fertilizer (Table 1) was calculated on the basis of soil test values (Appendix Table 1). The experiment was conducted in Randomized completely block design with six dispersed replications. The unit plot size was 80 m^2 for each treatment. The variety of potato was Diamant in 2007-08 and Granula in 2008-09 in Rangpur and Diamant was in Rajshahi. Potato was sown in last week of November to first week of December. The entire amount of P, S, Zn, B and cowdung and half of nitrogen and potassium were applied at final land preparation and mix well with soil. Remaining N and K were applied at the side of the row and covered with soil at 25-30 DAP at the time of earthing up followed by irrigation. Three irrigation was done at 35, 50 DAP, and 70 DAP. Ridomil gold (2g/L) and Shobicron (1 ml/L) mixture were sprayed at 10 days interval from last December to last January. The potato was harvested on 1st week of March. The next crop was Maize and the variety BARI Hybrid 5 was in Rangpur and CV. NK-40 was in Rajshahi. The crop was sown in 75 cm x 20 cm spacing during 30 March in Rangpur and 12-15 March in Rajshahi. One third N and all P, K, S, Zn B and cowdung were applied as basal during final land preparation. Remaining N was applied as side dress at 8-10 leaf stage (20-25 DAS) and taselling stage (45-50 DAS) followed by irrigation. The crop was harvested on 10^{-1}5 July in Rangpur and 3-5 July 08 in Rajshahi. The last crop of this pattern was T.Aman and variety BRRI dhan 33 was in rangpur and BRRI dhan 11 was in Rahshahi. All P, K, S and Zn were applied in soil and incorporated with soil before transplanting. Thirty five days old T.Aman seedlings were transplanted on Mid July. The crop was harvested on last week of October to Mid November. All data of the pattern were compiled and analyzed statistically.

Table 1. Nutrient dose of treatment applied in the Potato-Maize-T.Aman cropping pattern.

Treat	Fertilizer dose N-P-K-S-Mg-Zn-B (kg ha^{-1})					
	Rangpur			Rajshahi		
	Potato	Maize	T.Aman	Potato	Maize	T.Aman
T_1	101^{-1}4-32-2^{-1}2^{-1}-0.4	145^{-1}3-26-8-3-3-2	70-7-8-20-0-0.5	130-23^{-1}48^{-1}7-2^{-1}	180-34^{-1}14-35-2-2	86-62^{-1}3-0.5
T_2	143^{-1}8-45-3^{-1}5^{-1}.3-0.5	205^{-1}8-37^{-1}2-0-4-2	101-7^{-1}1-3-0^{-1}	185-29-208-22-2^{-1}.5	267-51^{-1}70-52-2-2	123-82^{-1}7^{-1}-0
T_3	128^{-1}5-33-3^{-1}5^{-1}.3-0.5 + 5 t ha^{-1} CD	205^{-1}8-37^{-1}2-0-4-2	101-7^{-1}1-3-0^{-1}	162-21^{-1}83-22-2-^{1}.5+5 t ha^{-1} CD	267-51^{-1}70-52-2-2	123-82^{-1}7^{-1}-0
T_4	112^{-1}4-27-2-0-2	140^{-1}6-34^{-1}1-0^{-1}- 0.5	94-4-3	265-98-235-35-5^{-1}+ 6t ha^{-1} CD	52^{-1}0-25-0-0-0	80-40^{-1}1^{-1}-0

T_1= STB fertilizer dose for MYG, T_2= STB fertilizer dose for HYG, T_3= IPNS fertilizer dose for HYG, T_4= Farmers practice

Results and Discussion

Potato

Rangpur: Significant variation on the number of stem per hill was observed due to different fertilizer management in both the years. In 2007-08, the highest number of stem per hill (3.03) was obtained from T_3=IPNS based fertilizer system which was identical to T_2 (STB fertilizer dose for high yield goal) and T_1 (STB fertilizer dose for medium yield goal). In 2008-09 the highest number of stem per hill (3.05/hill) was counted from IPNS fertilizer system which was identical to STB fertilizer dose for high yield goal. The number of tubers per hill was also highest with IPNS based fertilizer system in both the years. The weight of tubers per hill was also highest with IPNS fertilizer system in both the years. The highest tuber yield (26.79 t ha^{-1} in 2007-08 and 26.92 t ha^{-1} in 2008-09) was obtained from IPNS fertilizer system which differed significantly from other fertilizer management. The lowest tuber yield was recorded from farmers practice. The increase in tuber yield in IPNS fertilizer system was 33% and 21% higher over farmers practice in 2007-08 and 2008-09, respectively. The increase in yield with IPNS system might be due to its integrated approach where addition of organic manure may played a significant role in producing higher tuber yield. Due to foggy weather, incidence of late blight disease was higher but it was properly controlled by spraying fungicides. Incidence of cut warm or any other insect was not observed.

Rajshahi: The stem plant^{-1} was also highest in T_4 (4.53) and T_3 (4.22). The number of tuber plant^{-1} was found highest in T_4= Farmers practice (6.37) and T_1= STB for moderate yield goal (4.9) produced the lowest number of tuber plant^{-1}. The highest tuber yield was found in T_4= Farmer practice (28.27 t ha^{-1}). The treatment T_3 (25.89 t ha^{-1}) and T_2 (24.45 t ha^{-1}) were statistically identical in yield which were less than T_4. The treatment T_1= STB for moderate yield goal (20.93 t ha^{-1}) produced the lowest yield.

Maize

Rangpur: Except length of cob, weight of grain per cob and grain yield all other yield contributing characters did not vary significantly due to different fertilizer management practice (Table-4). The highest length of cob (17.70cm) was obtained from IPNS fertilizer system (T_3) which was identical to T_1. Different fertilizer treatments had a significant effect on the weight of grain per cob. The maximum weight of grain (125.8 g) was recorded from IPNS fertilizer system (T_3) which was identical to T_2 (STB fertilizer dose for high yield goal). The highest grain yield (6.93 t ha^{-1}) was recorded from IPNS based fertilizer management (T_3). The lowest yield (5.64 t ha^{-1}) was recorded from farmers practice. No disease or insect infestation was observed except few cut worms and it was controlled properly by hand picking.

Rajshahi: plant height and 100-grain weight failed to produce significant difference among the treatments (Table 5). The seed/row was found higher in T_3 = IPNS for HYG (39.1) which was similar to T_2 = STB for HYG (34.91). The treatment T_4 = Farmer practice (24.67) produced the lowest seed/row as they use very low fertilizer in Maize. The treatment package T_3 = IPNS for HYG (9 t ha^{-1}) produced the highest grain yield which was statistically identical to T_2 = STB for HYG (8.5 t ha^{-1}). The Treatment T_4 = Farmers practice (5.37 t ha^{-1}) produced the lowest yield due to low fertilizer in maize that produced half filled cobs.

T.Aman

Rangpur: Except number of effective tillers per hill, straw and grain yield all other yield contributing characters did not vary due to different fertilizer management practice (Table-6). The highest grain yield (4.21 t ha^{-1}) was obtained from IPNS based fertilizer dose (T_3) which was identical to T_2 (4.05 t ha^{-1}) . Similarly the highest straw yield (4.82 t ha^{-1}) was obtained from IPNS based fertilizer dose (T_3). The lowest yield was obtained from farmers practice.

Rajshahi: the plant height was found higher in T_3 (102.18 cm) which was similar to T_2 (100.88 cm) (Table 7). The panicle m^{-2} (374.17) and grain panicle^{-1} (112.03) were found higher in T_2 which were statistically similar to T_3. The highest and identical grain yield was produced in T_2 (4.84 t ha^{-1}) and T_3 (4.79 t ha^{-1}). Similar trend was found in straw yield. The highest and identical straw yield was produced by T_3 = IPNSA basis HYG (6.97 t ha^{-1}) and T_2 = STB for HYG (6.61 t ha^{-1}).

Cost and return analysis

Rangpur:. The gross return, net return and benefit cost ratio of the whole cropping pattern was highest with T_3 (IPNS fertilizer dose for HYG) (Table 8). The lower gross return (Tk.302985 ha^{-1}), net return (Tk.135603 ha^{-1}) and benefit cost ratio (1.81) was obtained from T_4 (Farmers practice). It was evident that IPNS based fertilizer management in the cropping pattern found better compared to other fertilizer management.

Rajshahi: It was found that T_3 = IPNS for HYG produced the highest income of farmers (200283 Tk. ha^{-1} yr^{-1} net return and BCR 1.77) (Table 8).

Farmers' reaction

Because of its higher production and from soil health management point of view farmers prefer IPNS based fertilizer management approach but want of cow dung is a problem to them. They are suggested to prepare and apply more compost to the field.

Conclusion

It was found that IPNS basis treatment produced better than other packages. However, the experiment is still on going, so concrete conclusion will be made after completion of three years cycle.

Table 2. Effects of different fertilizer doses on the yield and yield contributing characters of potato at MLT site, Ulipur OFRD, ARS, Rangpur

Treatments	Plant height (cm)	No. stems hill^{-1}	No. tubers hill^{-1}	Wt. of tubers hill^{-1} (g)	Yield (t ha^{-1})
			2007-08		
T_1	43.03b	2.66ab	5.53bc	307.8c	24.54b
T_2	44.80ab	3.01a	5.73b	335.0b	24.25b
T_3	46.78a	3.03a	6.03a	358.3a	26.79a
T_4	42.53b	2.43b	5.28c	280.0d	20.04c
CV (%)	5.23	12.75	4.11	5.72	4.27
			2008-09		
T_1	42.62b	2.70b	8.20b	346.8c	24.13c
T_2	45.45b	2.95ab	8.65ab	366.3b	25.48b
T_3	50.05a	3.05a	8.88a	386.6a	26.92a
T_4	43.02b	2.43c	7.60c	312.0d	22.13d
CV (%)	6.45	7.87	4.76	3.75	4.43

T_1=STB fertilizer dose for medium yield goal, T_2=STB fertilizer dose for high yield goal, T_3=IPNS (5 t ha^{-1} cow dung) fertilizer dose for high yield goal, T_4=Farmers practice (FP)

Table 3. Effect of fertilizer package on yield and yield component of potato under Potato-Maize-T.Aman cropping pattern at MLT site, Paba, Rajshahi during 2007-2008.

Treatment	Plant height (cm)	Stem plant^{-1}	Tubers plant^{-1}	Yield plant^{-1} (g)	Yield (t ha^{-1})
T_1	42.78	3.37	4.90	216.5	20.93
T_2	43.67	4.00	5.60	267.5	24.45
T_3	46.70	4.22	5.83	276.3	25.89
T_4	51.57	4.53	6.37	316.0	28.27
CV (%)	6.66	12.98	7.58	8.11	7.33
LSD (0.05)	3.78	0.644	0.529	26.86	2.267

Table 4. Effects of different fertilizer doses on the yield and yield contributing characters of maize under Potato-Maize-T.Aman cropping pattern at MLT site, Ulipur OFRD, ARS, Rangpur during kharif 2008

Treatments	Plant height (cm)	Length of cob (cm)	No. of grains cob^{-1}	Wt of grain cob^{-1} (g)	100-grain weight (g)	Yield ($t\ ha^{-1}$)
T_1	177.0a	17.37ab	421.1a	118.0bc	20.58a	6.35b
T_2	177.2a	16.53c	439.7a	123.8ab	20.42a	6.51b
T_3	176.8a	17.70a	462.0a	125.8a	21.42a	6.93a
T_4	172.2a	16.73bc	433.6a	111.6c	19.83a	5.64c
CV (%)	2.35	3.46	5.34	4.51	6.98	4.25

Table 5. Effect of fertilizer package on yield and yield component of Maize under Potato-Maize-T.Aman cropping pattern at MLT site, Paba, Rajshahi during 2007-2008.

Treatment	Plant height (cm)	Seed row^{-1}	100-grain weight (g)	Grain yield ($t\ ha^{-1}$)
T_1	173.03	34.78 b	31.93	6.98 b
T_2	176.25	34.91 ab	32.05	8.50 a
T_3	172.38	39.01 a	32.10	9.00 a
T_4	165.87	24.67 c	30.27	5.37 c
LSD (0.05)	NS	4.22	NS	0.638
CV (%)	6.07	10.29	4.0	6.95

Table 6. Effects of different fertilizer doses on the yield and yield contributing characters of T.Aman at MLT site, Ulipur OFRD, ARS, Rangpur during kharif 2008

Treatments	Plant height (cm)	No. of effective tillers $hill^{-1}$	Length of panicle (cm)	No. of grains $panicle^{-1}$	1000-grain weight (g)	Straw yield ($t\ ha^{-1}$)	Yield ($t\ ha^{-1}$)
T_1	97.27 a	7.03b	23.83a	145.6a	22.80a	4.59ab	3.85b
T_2	97.72a	7.95a	23.90a	156.1a	23.13a	4.71a	4.05a
T_3	102.60a	7.98a	24.20a	153.3a	24.90a	4.82a	4.21a
T_4	95.78a	6.95b	23.47a	142.0a	22.55a	4.34b	3.47c
CV (%)	5.10	7.48	7.30	7.37	8.81	5.10	3.75

Table 7 : Effect of fertilizer package on yield and yield component of T.Aman under Potato-Maize-T.Aman cropping pattern at MLT site, Paba, Rajshahi during 2007-2008.

Treatment	Plant height (cm)	Panicle m^{-2}	Grain $panicle^{-1}$	1000-grain wt. (g)	Grain yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)
T_1	99.37 b	316.67 b	91.17 b	22.92	3.77 b	5.52 b
T_2	100.88 ab	374.17 a	112.03 a	23.17	4.84 a	6.61 a
T_3	102.18 a	358.33 ab	105.75 a	23.27	4.79 a	6.97 a
T_4	98.92 b	268.67 c	85.17 b	22.73	3.4 b	5.41 b
CV (%)	1.91	11.18	10.24	2.15	8.58	9.39

Table 8. Cost and return analysis of the whole Potato-Maize-T.Aman rice cropping pattern as influenced by different fertilizer treatments at Ulipur, Kurigram and Paba, Rajshahi during 2007-08.

Treat.	Kurigram				Rajshahi			
	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	358537	176204	182333	2.03	368960	239000	129960	1.54
T_2	360827	180901	179926	1.99	439785	260311	179474	1.68
T_3	390915	182426	208489	2.14	461645	261362	200283	1.77
T_4	302985	167382	135603	1.81	436445	248364	188081	1.75

Price (Tk. kg^{-1}):

Kurigram:

November 2007: Potato= 9.00, Urea= 5.90, TSP=15.60, MP=22.88, Gypsum=6, Zinc sulphate=120, Borax=160, Magnesium sulphate=25, Labour=112/day, Cowdung=1,

Maize grain= 11, maize straw= 1, Urea= 5.90, TSP=29.04/kg, MP=24.82, Gypsum=6, Zinc sulphate=120, Borax=160, Magnesium sulphate=25, Labour=112/day, Cowdung=1

T.Aman: Grain= 14, Urea=11.80, TSP=74.36, MP=55, Gypsum=7, Zinc sulphate=140, Borax=180, Labour=112/day, Rice straw =1.25

Rajshahi:

Urea= 12, TSP= 40, MoP= 35, gypsum= 3, Zn= 120, Boron= 350, Cowdung= 0.5, Didemil= 200, Shobicron=350 Tk/400 ml, Ploughing 1500 Tk. ha^{-1}, water @ 1500 Tk. ha^{-1}, Labour wage @ 150 Tk. ha^{-1}, Potato seed= 30, Maize seed= 280, T.Aman seed= 35, Potato= 12, Maize=10, T.Aman= 12 and Straw =0.5.

Appendix Table 1: Fertility status of initial soil sample of the experimental site at MLT site Paba, Rajshahi during 2007-2008.

Sample	pH	OM (%)	Total N (%)	K	P	S	Zn	B
				meq/100g	ug/g			
Average			0.082	0.036	8.64	6.06	0.852	0.15
Critical level			0.12	0.12	10.0	10.0	0.6	0.2
Interpretation			VL	VL	L	VL	L	VL

Evaluation of Different Fertilizer Management for Maize-Mungbean-T.Aman Cropping Pattern

Abstract

The experiment was conducted at the MLT site, Gobindagonj, Rangpur during 2007-08 to 2008-2009 and at FSRD site, Lahirirhat Rangpur during 2008-09 to increase the yield of maize and T.Aman rice in the cropping pattern through sustaining soil fertility and to increase farmer's income in Maize-Mungbean-T.Aman rice cropping pattern. Four fertilizer treatments viz., T_1: soil test based (STB) inorganic fertilizer for high yield goal (HYG), T_2: Brown manuring with mungbean + inorganic fertilizer for high yield goal, T_3: Recommended fertilizer following fertilizer recommended Guide - 2005 (FRG,2005) and T_4: Farmers practice were evaluated in 2007-08 and three fertilizer treatments. viz., T_1: soil test based (STB) inorganic fertilizer for high yield goal (HYG), T_2: Brown manuring with mungbean + inorganic fertilizer for high yield goal and T_3: Farmers practices were evaluated in 2008-09. Fertilizer doses for different concerned treatments were estimated based on initial soil test data. In the first cycle (2007-08), highest grain yield of maize (9.40 t ha^{-1}) was obtained from T_1 which was identical to T_2 and T_3. In case of mungbean, the highest seed yield (1.37 t ha^{-1}) was obtained from T_1 which was also identical to T_2 and T_3. Similarly, in T.Aman rice, the grain yield obtained from T_1, T_2 and T_3 was identical, No impact of brown manuring was observed in grain yield of T.Aman rice. Cost and return analysis showed that the highest gross return and net return were obtained from T_2 followed by T_1 and T_3. In second cycle identical grain yield of maize was obtained from T_1 and T_2 at both locations.

Introduction

Soil fertility is a dynamic property which varies with crop, cropping intensity input use and erosion. The fertility of the soil has a declined trend throughout the country. This is because of low organic matter content of the soil, intensive cropping system, improper cropping sequence, imbalance use and faulty management of fertilizer. Crop production in Bangladesh will than be sustainable if we apply balance nutrient elements and organic matter against crop removal and nutrient loss phenomena. Farmers of Bangladesh usually use fertilizer on mono crop basis without considering the resident effect of the applied nutrients in preceding crop to the succeeding one. The development of appropriate nutrient management system for different cropping pattern felt an urgent need for soil fertility research. Maize is an important cereal crop grown in Bangladesh. Last few years wheat yield is drastically reduced due to environmental condition and is being replaced by maize due to its higher yield potential. But maize is an exhaustive as well as high nutrient- demanding crop. Imbalance chemical fertilizer management and no addition of organic matter is becoming a threat for soil health and sustainable yield. From the previous study, it was revealed that maize yield declined substantially over 3 to 4 consecutive years. Leguminous crop is important for soil fertility concern because of its nitrogen fixation ability and subsequent adding to the soil. In maize based cropping pattern Mungbean can be relayed in the later reproductive stage of maize with low ground coverage making by top working of maize canopy. After the first picking of pod of Mungbean, incorporation of brown biomass may lead to improve soil fertility and supply of available nutrients to the growing plants. Organic matter through adding Mungbean biomass may exert subsequent effect on succeeding T.Aman rice. In addition to that soil test based (STB) fertilizer management is deemed great significance for improvement of soil health and sustainable yield. Therefore, the study was undertaken to increase yield of maize and T .aman rice in the cropping pattern through sustaining soil fertility and to increase farmer's income.

Materials and Method

The experiment was conducted at the MLT site, Gobindagonj during 2007-08 to 2008-09 and at FSRD site Lahirirhat Rangpur during 2008-09. The study was initiated with the first crop maize of the Maize-Mungbean –T.Aman rice cropping pattern in irrigated medium highland condition. The experiment was laid out in a RCB design with six dispersed replications (ICM club members). The unit plot size was 6m x 7m. Four fertilizer treatments viz., T_1= soil test based (STB) inorganic fertilizer for high yield goal (HYG), T_2= Brown manuring with mungbean + inorganic fertilizer for HYG, T_3= Recommended fertilizer following fertilizer recommendation guide 2005 (FRG,2005) and T_4= Farmers practice were evaluated in 2007-2008 at MLT site, Gobindagonj and three fertilizer treatments viz., T_1 =soil test based (STB) inorganic fertilizer for high yield goal HYG, T_2= Brown manuring with mungbean + inorganic fertilizer for HYG and T_3 = Farmers practice were evaluated in 2008-09 at Lahirirhat Rangpur . The details of the treatments are shown in Table 1.

Table 1. Details of different treatments of the tested cropping pattern (2007-08).

Treatments	N-P-K-S-Mg-Zn-B (kg ha^{-1})		
	Maize	Mungbean	T.Aman
T_1: Soil test based inorganic fertilizer (HYG)	209-44-37-22-3-3-2	15-10-10	97-7-11-4-0-1-0-0
T_2: Brown manuring with mungbean+Inorganic fertilizer	209-44-37-22-3-3-2		97-7-11-4-0-1-0-0
T_3: Rec. fertilizer (FRG'2005)	196-36-75-30-3-3-1		45-4-14-8-0-1-0-0
T_4: Farmers practice	160-24-35-8-0-0-0		100-0-0-0-0-0

The cultivar NK-40 was used for test crop in maize for the both years. The seeds were sown on 20-22 November in 2007 and 20-24 November in 2008, maintaining 75cm x 25cm plant spacing. Fertilizers were applied as per treatment concerned. One third of urea and entire amount of other fertilizers were applied during final land preparation. The rest N was applied in two equal installments as top dress at 25-30 DAS and at 40-45 DAS in the both years. One weeding was done at 20 and 25 DAS in 2007 and 2008, respectively. Irrigation was applied at 15, 35, 70 and 85 DAS in 2007 and at 20, 35,70 and 80 DAS in 2008. At the later stage of maturity of maize, mungbean seed was sown on 25 March in 2008 and 28 March in 2009 in between two maize lines. The maize was harvested on 10 April, 2008 and 13 April in 2009. Mungbean pod was harvested on 25-30 May in 2008 and 20-28 May in 2009. After picking of pod the brown biomass of mungbean was incorporated in to the soil in treatment T_2 in both the years. In case of other treatment Mungbean crop was uprooted. Thirty days old seedlings of T.Aman rice (var. BRRI dhan 33) was transplanted on 6-8 August, 2008 maintaining 20cm x 15cm spacing. The crop was fertilized as per treatment concerned, The entire amount of P.K.S and Zn were applied during final land preparation. Nitrogen was applied in three equal installments at 15, 30 and 45 DAT. One weeding was done on 25 DAT. Other intercultural operations were done as and when necessary. The crop was harvested on 1-5 November, 2008. Data on yield and yield contributing characters of all the crops were taken and analyzed following MSTATC software package.

Result and Discussion

MLT site, Gobindoganj

The yield and yield contributing characters of maize are presented in Table 2. The tallest plant (216.9 cm) was obtained drown T_1 (Soil test based inorganic fertilizer for HYG) which was identical to T_2 (Brown manuring + inorganic fertilizer) and T_3 (recommended fertilizer following FRG,05) in 2007-08. While the tallest plant (179 cm) was recorded from T_2 in 2008-09 which was identical to T_1. Similar trend of results was obtained in case of length of cob in both the years. The diameter of the cob obtained from T_1 and T_2 were identical in both the years but differed significantly from other treatment. The highest number of grains per cob was recorded from T_1 (434.6) which was identical to T_2 (434.5) and T_3 (433.9) in 2007-08 while the highest number of grains per cob was recorded grown T_2 (434.6) which was identical to T_1 (433.2) in 2008-09 but differed significantly from T_3 (Farmers practice). The 100 grains weight obtained from T_1,T_2,T_3 was identical but differed significantly from farmer practice in 2007-08. In 2008-09, T_1 and T_2 also gave identical 100 grain weight. The highest grain yield (9.40 t ha^{-1}) was obtained from T_1 which was identical to T_2 (9.35 t ha^{-1}) and T_3 (9.18 t ha^{-1}) in 2007-08 but differed significantly from farmers practice. In 2008-09, the highest grain yield (9.16 t ha^{-1}) was obtained from T_2 which was identical to T_1 (9.07 t ha^{-1}) but differed significantly from farmers practice (6.25 t ha^{-1}). In case of mungbean, the plant height, number of pods per plant, number of grains per pod and 100 grains weight obtained from T_1, T_2 and T_3 were identical but differed significantly from farmers practice (Table 3). The highest brown biomass yield (2.98 t ha^{-1}) was obtained from T_1 which was identical to T_2 (2.87 t ha^{-1}) and T_3 (2.97 t ha^{-1}). The biomass obtained from T_2 was incorporated to the soil and it was uprooted in other treatments. In case of T.Aman, the plant height, number of effective tillers per hill, panicle length, number filled grains per panicle, 1000 grain weight and straw yield obtained from T_1,T_2 and T_3 were identical but differed significantly from farmers practice (Table 4).The highest grain yield (5.92 t ha^{-1}) of T.Aman rice was obtained from T_2 which was identical to T_1 (5.65 t ha^{-1}) and T_3 (5.60 t ha^{-1}) but differed significantly from T_4 (farmers practice). The result revealed that significant impact of mungbean brown manuring was not observed in grain yield of succeeding T.Aman rice. Cost and return analysis showed that the highest gross returns (Tk 262335 ha^{-1}) and net return (Tk. 147028 ha^{-1}) was obtained from T_2 followed by T_1 and T_3 (Table 5).

FSRD site Lahirirhat, Rangpur

The yield and yield contributing characters of maize are presented in Table 6. The tallest plant (179.1 cm) was obtained from T_1 which was identical to T_2 (178.9cm) but differed significantly from T_3 (Farmer practice). The length of cob, diameter of cob, number of grains per cob and 100 grains weight were highest in T_1 which was identical to T_2, but differed significantly from farmers practice. The highest grain yield of maize (7.27 t ha^{-1}) was obtained from T_2 which was identical to T_1 (7.19 t ha^{-1}) but differed significantly from T_3 (farmers practice).

Farmers' reaction

Farmers were very much impressed by getting higher yield and economic return from Maize-Mungbean-T.Aman rice cropping pattern. Previously they practice Maize-fallow-T.Aman rice cropping pattern while after intervention, mungbean crop was included in this cropping pattern. Now they are happy to have an additional mungbean crop.

Conclusion

Previously farmers were practicing Maize-fallow-T.Aman rice cropping pattern .After intervention, mungbean crop was included in this cropping pattern. The result indicated that higher grain yield of all crops were obtained from T_2 treatments and it was identical to T_1. The highest net return was also obtained from T_2. Though the yield was not differed significantly with T_1 and T_3 but in the long run soil fertility and soil health in T_2 will be improved.

Table 2. Effect of different nutrient management package on the yield of maize in Maize-Mungbean-T.Aman rice cropping pattern at MLT site, Gobindoganj during 2007-08 and 2008-09.

Treatments	Plant height (cm)	Length of cob (cm)	Diameter of cob (cm)	No. of grain cob^{-1}	100 seed wt (g)	Grain yield (t ha^{-1})
			2007-08			
T_1	216.9a	18.75a	13.59a	434.6a	40.50a	9.40a
T_2	216.6a	18.51a	13.71a	434.5a	40.49a	9.35a
T_3	213.9a	16.69a	12.56b	433.9a	40.30a	9.18a
T_4(FP)	199.3b	15.79b	10.32c	378.08b	38.21b	6.34b
CV (%)	4.9	5.41	7.88	4.69	2.97	3.80
			2008-09			
T_1	209.9a	17.90a	14.82a	433.2a	44.47a	9.07a
T_2	202.9a	18.68a	15.63a	434.6a	44.33a	9.16a
T_3 (FP)	176.3b	14.40b	11.80b	377b	34.17b	6.25b
CV (%)	5.54	5.41	6.64	8.24	4.25	5.95

T_1: Soil test based inorganic fertilizer (HYG), T_2 : Brown manuring with mungbean + Inorganic fertilizer, T_3 : Rec. fertilizer (FRG'2005), T_4= Farmers practice

Table 3. Effect of different nutrient management package on the yield of munbean in Maize-Mungbean-T.Aman rice cropping pattern at MLT site, Gobindoganj during 2007-08 and 2008-09.

Treatments	Plant height (cm)	No. of pods plant^{-1}	No. of grains pod^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Brown biomass yield (t ha^{-1})
			2007-08			
T_1	25.85a	12.62a	6.62a	35.99a	1.37a	2.98a
T_2	25.81a	11.93a	6.52a	35.57a	1.29a	2.875a
T_3	24.90a	11.93a	5.98a	35.77a	1.35a	2.972a
T_4	20.00b	6.93b	4.12b	34.25b	0.831b	1.977b
CV (%)	7.17	10.47	9.65	3.30	8.77	7.95
			2008-09			
T_1	52.91a	11.34a	8.7a	42.22a	1.10a	2.21a
T_2	54.12a	11.62a	8.9a	42.86a	1.14a	2..30a
T_3	43.45b	6.23a	7.4b	0.845b	1.35a	1.47b
CV (%)	5.32	6.35	6.23	3.12	5.23	5.12

Table 4. Effect of different nutrient management package on the yield of T.Aman in Maize-Mungbean-T.Aman rice cropping pattern at MLT site, Gobindoganj during 2007-08.

Treatments	Plant height (cm)	No. of effective tiller hill^{-1}	Panicle length (cm)	No.of filled grain panicle^{-1}	1000-grain wt(g)	Yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	90.50a	8.72a	22.25a	107.0a	22.62a	5.06a	5.65a
T_2	91.83a	9.28a	23.05a	110.7a	22.80a	5.20a	5.92a
T_3	90.33a	8.98a	21.52a	100.0a	22.20a	4.67a	5.60a
T_4	89.50b	7.42b	19.60b	87.76b	20.32b	3.91b	4.01b
CV (%)	4.25	10.86	5.83	9.67	5.81	8.78	9.20

Table 5. Cost and return analysis of the whole cropping pattern (Maize-Mungbean-T.Aman rice) as influenced by different fertilizer treatments at MLT site, Gobindoganj during 2007-08.

Treatments	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Net return (Tk. ha^{-1})
T_1	261455	115307	146148
T_2	262335	115307	147028
T_3	240430	95242	145188
T_4	176190	78349	97841

Price (Tk./kg): Urea=11.80 , TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160, Maize =9 ,Mungbean =70 and Taman=13

Table 6. Effect of different nutrient management package on the yield of maize in Maize-Mungbean-T.Aman rice cropping pattern at FSRD site, Lahirirhat, Rangpur during 2008-09.

Treatments	Plant height (cm)	Length of cob (cm)	Diameter of cob (cm)	No. of grain cob^{-1}	100 seed wt (g)	Grain yield (t ha^{-1})
T_1	178.9	18.02a	14.53a	337.26a	42.27a	7.19a
T_2	179.1a	18.07a	14.23a	330.91a	42.38a	7.27a
T_3 (FP)	165.5b	17.87b	12.12b	300.10b	33.92b	5.64b
CV (%)	8.44	4.25	7.12	6.45	5.62	6.89

Table 7. Effect of different nutrient management package on the yield of munbean in Maize-Mungbean-T.Aman rice cropping pattern at FSRD site, Lahirirhat, rangpur during 2008-09.

Treatments	Plant height (cm)	No. of pods plant^{-1}	No. of grains pod^{-1}	1000-grain wt (g)	Grain yield (t ha^{-1})	Brown biomass yield (t ha^{-1})
T_1	50.21a	10.21a	8.14a	40.22a	0.987a	2.31a
T_2	50.11a	10.11a	8.14a	40.23a	0.988a	2.35a
T_3	44.21b	7.12a	7.6b	36.20b	0.512a	1.64b
CV (%)	6.23	5.32	5.23	3.12	6.23	5.11

Appendix Table 1. Initial status of soils of the experimental plots under Gobindoganj MLT sites of, OFRD, Rangpur during 2006-07

pH	OM (%)	Total N (%)	P	S	Zn	B	Mg (m.eq/100 g soil)
			(Micro gram/g soil)				
6.03	1.25	0.06	30.66	33.30	0.82	0.52	3.11
Slightly acidic	L	VL	VH	H	L	opt	VH

Integrated Nutrient Management for Potato-Mungbean-T.Aman Rice Cropping Pattern

Abstract

The experiment was initiated at the farmers' field of the MLT site, Domar, Nilphamari, MLT site, Joypurhat and MLT site, Shibpur, Rajshahi during rabi 2007-08 and 2008-09 (on going) to develop agro-economically suitable fertilizer dose for Potato-Mungbean-T.Aman cropping pattern. Potato variety, Dheera for Rangpur, Diamant for Joypurhat and Rajshahi was tested along with four different fertilizer management approaches viz. Soil test based (STB) fertilizer dose for moderate yield goal, STB fertilizer for high yield goal (HYG) and Integrated Plant Nutrition System (IPNS) approach for HYG and farmers dose. It was evident that IPNS based fertilizer management approach in the cropping patterns found better compared to other fertilizer management.

Introduction

A crop production system with high yield targets cannot be sustainable unless nutrient inputs are supplied to soil against nutrient removable crops (Bhuiyan et. al. 1991). Sequential cropping ensures maximization of efficient use of moisture and nutrients for soil (Kanwar 1986). Integrated nutrient management for prevailing cropping systems appears to be one of the effective ways to meet the economical nutrition requirement of crop (Kulkarni et. al. 1993). Farmers usually use fertilizer on single crop basis without considering the cropping pattern followed round the year. But it is known that some nutrients have considerable residual effect on the succeeding crops, which may extend up to two/three crops. Similarly, inclusion of legume in the cropping system substantially contributes in nutrient supply. Legumes like mungbean can be fitted in potato based cropping systems owing to its short duration and grow well in summer conditions. However, it is important to find out the economically viable fertilizer dose for that cropping pattern. The present study is proposed to evaluate the impact of mungbean and pattern based fertilizer recommendation on the productivity of Potato-Mungbean-T.Aman rice cropping pattern.

Materials and Methods

The experiment was conducted at the farmers' field of the MLT site, Domar, Nilphamari, MLT site, Joypurhat and MLT site, Shibpur, Rajshahi during rabi 2007-08 and 2008-09 (on going).The trial was laid out in RCB design with six dispersed replications (farmers). It was conducted in ICM/IPM club/Farmers Field School (FFS) members' land, selected with the help of local DAE personnel. The unit plot size was 40 m^2. Three treatments viz. Soil test based fertilizer dose for moderate yield goal

(T_1), STB fertilizer dose for high yield goal (T_2) Integrated Plant Nutrition System approach for HYG (T_3) were calculated on the soil test values (Appendix Table 1) and farmers practices (T_4) were calculated on an average of 25 farmers (Table 1). The crop potato variety Dheera at Rangpur was sown on 1-3 December 2007 and Diamant for Joypurhat and Rajshahi were sown on 30 November to 5 December 2008. The entire amount of P-K-S-Zn-B- Cow dung and ½ of N were applied during final land preparation. The rest of nitrogen was applied at 35 DAP following earthing up. The second earthing up was done at 50 DAP. The crop was irrigated thrice at 35, 50 and 70 DAP. To control late blight, melodiduo @ 2.0 g/litre of water was sprayed at the early stage of crop growth and Secure @ 2.0 g/litre of water was sprayed at the later stage of crop growth. The crop was harvested from 25 February to 2 March 2008. Seeds of mungbean (var. BARI mung 6) were sown 10 March, 2008 in Rangpur, 6-8 March, 2008 in Joypurhat and $15^{-1}8$ March, 2008 in Rajshahi. After picking of pod the brown biomass of mungbean was incorporated into the soil in both the years. Thirty days of T.Aman seedling (var. BR 11) were transplanted on $7^{-1}0$ July, 2008 in Rangpur, 25-28 July, 2008 in Joypurhat and 20-22 July, 2008 in Rajshahi. The entire amount of P,K,S,Zn was applied during final land preparation. The N was applied in three equal splits at 15, 25 and 45 DAT. One weeding was done at 25 DAT. Plant protection measures were taken as and when necessary. The crop was harvested on 3-8 November, 2008 in Rangpur, $6^{-1}0$ November, 2008 in Joypurhat and 17-22 Npvember, 2008 in Rajshahi. Yield attributes were collected from 10 randomly selected plants. All data were analyzed statistically. Market price of the crop at harvest was recorded to calculate economics.

Table 1. Details of different treatments of the tested cropping pattern

Treat	Fertilizer dose N-P-K-S-Zn-B-CD (kg ha^{-1})					
	Rangpur			Joypurhat		
	Potato	Mungbean	T.Aman	Potato	Mungbean	T.Aman
T_1	96-10-60-10-3-0-0	15-10-10	98-7-13-4-0-1-0-0	110-18-106-12-1.5-1-0	17-20-33-15	72-9-43-9
T_2	135-10-85-13-4-0-0	15-10-10	98-7-13-4-0-1-0-0	155-22-148-15-2-1-0	20-22-40-18	103-11-60-12
T_3	112.5-3-60-13-4-0-5000	15-10-10	50-4-15-8-0-1-0-0	132-15-123-8-2-1-5000	20-22-40-18	103-11-60-12
T_4	124-7.5-69-12-0-0-4000	15-10-10	100-0-0-0-0-0	140-15-100-15-0-0-4000	22-18-30-15	90-15-30-15

Contd.

Treat	Fertilizer dose N-P-K-S-Zn-B-CD (kg ha^{-1})		
	Rajshahi		
	Potato	Mungbean	T.Aman
T_1	132-23-142-13-2-0.5	20	87-11-56-9-1
T_2	186-29-200-16-3-1	20	124-13-77-13-1
T_3	163-21-175-16-3-1	20	124-13-77-13-1
T_4	245-75-245-35-5-1		90-7-45-10-1

Results and Discussion

Potato

Rangpur : All the characters under study varied significantly due to different fertilizer management in both the years (Table 2). The highest tuber yield (33.94 t ha^{-1}) was recorded from IPNS treatment and the lowest from STB fertilizer treatment for MYG in 2007-08. The increase in yield with IPNS system might be due to its integrated approach where addition of organic manure may play a significant role in producing higher tuber yield.

Joypurhat : The highest plant height (58.60 cm) was obtained from the treatment T_2 which was statistically similar with that of T_3 (Table 3). The numbers of branch plant^{-1} was highest in T_3 and it was statistically similar with T_2. The highest number of tubers plant^{-1} was also observed in T_3 and the lowest was noted in T_1. Tuber weight plant^{-1} was maximum in T_3 and it was statistically similar with

T_2 treatment. The highest tuber yield (25.01 t ha^{-1}) was obtained from the treatment T_3 (IPNS) which was statistically identical with T_2 (HYG). The lowest tuber yield (15.89 t ha^{-1}) was obtained from the treatment T_1 (MYG).

Rajshahi : The significantly highest plant height in potato was produced by T_4 (54.4 cm) and rest treatment were identical in plant height (Table 4).. Stem $plant^{-1}$ failed to produced significant different among the treatments and the number of tuber $plant^{-1}$ was also insignificant. The highest yield $plant^{-1}$ was produced by T_4 (300.3 g) and T_3 (273.5 g) which were statistically identical. The lowest per plant yield (208.33 g) was produced by T_1. The highest yield was produced by T_4 (29.11 t ha^{-1}). The treatments T_3 (26.06 t ha^{-1}) and T_2 (24.96 t ha^{-1}) were identical and second highest producer. The treatment T_1 (21.76 t ha^{-1}) produced the lowest yield.

Mungbean

Rangpur : The highest grain yield (1.22 t ha^{-1}) was recorded in T_3 (IPNS treatment) which was identical to T_2 and T_1 treatment (Table 5). The lowest yield was obtained from farmer practice. Similarly, the highest biomass (2.55 t ha^{-1}) yield was recorded in T_3 (IPNS treatment) and it was identical to T_2 and T_1. The lowest biomass was obtained from farmers practice.

Joypurhat : The yield and yield contributing characters was significantly different among the treatments (Table 6). The highest seed yield (1384 kg ha^{-1}) was obtained from the treatment T_3 (IPNS) which was statistically different with all other treatments. The lowest seed yield (976 kg ha^{-1}) was recorded in T_1 (MYG).

Rajshahi : All the treatments failed to produce significant difference in plant height, plant population m^{-2}, seed pod^{-1} and TGW. The treatments T_1 (11.96), T_2 (12.10) and T_3 (13.03) produced height and identical pod $plant^{-1}$ but T_4 produced the lowest pod $plant^{-1}$ (8.87). The treatment T_3 (1282.5 kg ha^{-1}) produced highest grain yield followed by T_2 (1132.8 kg ha^{-1}) and T_1 (912.3 kg ha^{-1}). The treatment T_4 (769.17 kg ha^{-1}) produced the lowest yield.

T.Aman

Rangpur : Except no. of effective tillers per hill, 1000- grain weight and yield t ha^{-1} all other yield contributing characters did not vary due to different fertilizer management (Table-5). The highest grain yield (4.22 t ha^{-1}) was obtained from IPNS based fertilizer management practice. The lowest yield was obtained from farmers practice.

Joypurhat : the highest grain yield (5.68 t ha^{-1}) was also recorded in T_3 (IPNS) which was significantly different with all other treatments. The lowest yield (4.17 t ha^{-1}) was obtained from T_1 (MYG) treatment. Similarly, the highest straw yield (5.82 t ha^{-1}) was observed in T_3 (IPNS) treatment and the lowest (4.31 t ha^{-1}) was in T_1 (MYG) treatment. Other yield contributing characters were also significantly influenced by the treatments (Table 3).

Rajshahi : The plant highest of T.Aman was identical in T_1, T_2 and T_3 but the lowest in T_4 (95.42 cm). The panicle m^{-2} was found the highest and identical in T_3 (379.5) and T_2 (365.0) but T_1 (323.8) and T_4 (304.7) produced the lowest panicales m^{-2}. The grain $panicle^{-1}$ was produced higher in T_3 (112.86) which were similar to T_2 (105.42). The lowest grain $panicle^{-1}$ was produced by T_4 (86.26). The highest grain yield was produced by T_2 (4.78 t ha^{-1}) which was identical to T_3 (4.72 t ha^{-1}). The treatment T_1 (3.8 t ha^{-1}) and T_4 (3.45 t ha^{-1}) produced identical yield. The straw yield was also followed the similar trend to grain yield in respect of treatments (fertilizer management package).

Cost and return analysis

Rangpur : The gross return (Tk.445320 ha^{-1}), net return (Tk.269489 ha^{-1}) and benefit cost ratio (2.53) of the whole cropping pattern was highest with T_3 (IPNS fertilizer dose for HYG). The lower gross return (Tk.358570 ha^{-1}), net return (Tk.192076 ha^{-1}) and benefit cost ratio (2.15) was obtained from T_4 (Farmers practice).

Joypurhat :). The highest net return (Tk 2,43,360 ha^{-1}) and benefit cost ratio (2.78) was obtained from T_3 (IPNS) treatment and the lowest return (Tk 31,842 ha^{-1}) and benefit cost ratio (2.05) was observed in T_1 (MYG) treatment.

Rajshahi : Annual (cropping pattern basis) cost and return analysis indicated that package T_3 (IPNS basis fertilizer) was found suitable than other packages in respect of yield and income (Tk. 202722 ha^{-1} yr^{-1} gross margin and 1.92 BCR). The treatment T_4 (FP) occupied second position in respect of net return (Tk. 186533 ha^{-1} yr^{-1}) but BCR (1.84) was higher in T_2 (STB for HYG).

Farmer's reaction

Because of its higher tuber yield, grain yield, economic return and soil health management point of view, farmers prefer IPNS based fertilizer management approach. The farmers are very happy with higher yield from IPNS based fertilizer dose compared their own practice.

Conclusion

The result revealed that the tuber and grain yield of the concerned crop of the Potato-Mung bean-T.Aman rice cropping pattern was highest with T_3 (IPNS fertilizer dose for HYG). Similarly, the economic performance of this treatment was also highest compared to other fertilizer treatments ,hence from one year trial it may be concluded that IPNS fertilizer dose for HYG (T_3) may be the best fertilizer management practice for the whole cropping pattern.

Table 2. Effect of different fertilizer dose on the yield attributes of potato under Potato-Mungbean – T.Aman cropping pattern at the MLT site, Domar, Nilphamari (Rangpur), during 2007-08

Treatment	Plant height (cm)	No. of tuber plant^{-1}	Straw yield (t ha^{-1})	Tuber yield (t ha^{-1})
T_1	73.18bc	12.0c	14.67c	29.76d
T_2	77.62ab	13.0b	16.44a	32.42b
T_3	78.78a	13.88a	16.98a	33.94a
T_4	71.95c	12.05c	15.71b	30.36c
CV(%)	5.6	4.8	3.2	5.8

Table 3. Effect of different treatments on yield and yield attributes of Potato at the MLT site, Joypurhat under Potato-Mungbean-T.Aman rice cropping pattern during 2007-08

Treatments	Plant height (cm)	No. of branch plant^{-1}	No. of tuber plant^{-1}	Weight of tuber plant^{-1} (g)	Tuber yield (t ha^{-1})
$T_1 = N_{110}\ P_{18}\ K_{106}\ S_{12}\ Zn_{1.5}\ B_1$	56.30 c	5.02 b	7.67 c	332.0 c	15.89 c
$T_2 = N_{155}\ P_{22}\ K_{148}\ S_{15}\ Zn_{1.5}\ B_1$	58.60 a	5.47 a	8.53 a	392.3 a	24.84 a
$T_3 = N_{132}\ P_{15}\ K_{123}\ S_8\ Zn_{1.5}\ B_1$+5000CD	57.95 ab	5.62 a	8.80 a	394.3 a	25.01 a
$T_4 = N_{140}\ P_{15}\ K_{100}\ S_{15}$+4000CD	57.03b c	5.18 b	8.20 b	371.3 b	19.85 b
CV (%)	1.87	4.48	3.64	3.85	1.54

Table 4. Effect of fertilizer package on yield and yield component of potato under Potato-Mungbean-T.Aman cropping pattern at MLT site, Shibpur, Rajshahi, 2007-2008.

Treatment	Plant height (cm)	Stem plant^{-1} (no.)	Number of Tuber plant^{-1}	Yield plant^{-1} (g)	Yield (t ha^{-1})
T_1	45.28	3.37	5.41	208.33	21.76
T_2	45.00	4.00	5.97	242.50	24.96
T_3	48.48	3.80	6.08	273.50	26.06
T_4	54.40	4.50	6.20	300.33	29.11
LSD (0.05)	3.829	NS	NS	29.75	2.63
CV (%)	6.44	18.48	11.49	9.44	8.31

Table 5. Effect of different nutrient management package on the yield of mungbean in Potato-Mungbean-T.Aman rice cropping pattern at Domar MLT site OFRD, Rangpur, 2007-08.

Treatments	Plant height (cm)	No. of pods plant^{-1}	No.of grains pod^{-1}	1000 grain wt (g)	Grain yield (t ha^{-1})	Brown biomass yield (t ha^{-1})
T_1	25.53a	11.62a	6.12a	33.15a	1.05a	2.22a
T_2	24.60a	10.86a	5.32a	33.52a	1.15a	2.14a
T_3	25.61a	11.73a	6.55a	33.95	1.22a	2.55a
T_4	20.50b	7.33b	4.60b	32.25b	0.871b	1.88b
CV (%)	6.53	8.46	5.88	7.14	5.08	6.46

Table 6. Effect of different treatments on yield and yield attributes of mungbean at the MLT site, Joypurhat under Potato-Mungbean-T.Aman rice cropping pattern, 2007-08.

Treatments	Plant height (cm)	No. of plant m^{-2}	No. of pods plant^{-1}	No. of seeds pod^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})
$T_1 = N_{17}\ P_{20}\ K_{33}\ S_{15}$	44.63 c	27.18	18.67 c	10.18 c	43.15 d	976 d
$T_2 = N_{20}\ P_{22}\ K_{40}\ S_{18}$	46.20 ab	27.07	19.85 ab	10.50 b	46.25 b	1281 b
T_3 = Same as T_2	46.78 a	27.60	20.48 a	10.85 a	47.08 a	1384 a
$T_4 = N_{22}\ P_{18}\ K_{30}\ S_{15}$	45.10 bc	27.42	19.32 bc	10.35 bc	44.02 c	1067 c
CV (%)	2.25	1.90	3.29	2.62	1.46	4.87

Table 7. Effect of fertilizer package on yield and yield component of Mungbean under Potato-Mungbean-T.Aman cropping pattern at MLT site, Shibpur, Rajshahi, 2007-2008.

Treatment	Plant height (cm)	Plant population (m^2)	Pod plant^{-1}	Seed pod^{-1}	1000 seed weight (g)	Grain yield (kg ha^{-1})
T_1	39.12	36.67	11.96 a	9.06	48.07	912.3 c
T_2	34.67	37.67	12.10 a	8.93	49.42	1132.8 b
T_3	36.77	38.33	13.03 a	9.80	49.33	1282.5 a
T_4	39.53	36.83	8.87 b	9.53	50.17	769.17 d
LSD (0.05)	NS	NS	2.07	NS	NS	65.46
CV (%)	14.35	9.57	14.66	8.47	5.57	5.19

Table 8. Effect of different fertilizer dose on yield attributes of T.Aman rice at the Domar, MLT site, Nilphamari during 2007-08

Treatment	Plant height (cm)	Effective tiller plant^{-1}	Non effective tiller plant^{-1}	1000 grain weight (g)	Yield t ha^{-1}	Straw yield (t ha^{-1})
T_1	107.2	9.11bc	1.58	25.87b	3.65b	4.65
T_2	104.7	9.73ab	1.46	26.15ab	4.19a	4.92
T_3	100.3	9.91a	1.53	26.37a	4.22a	4.99
T_4	103.6	8.80c	1.76	26.13ab	3.53b	4.11
CV (%)	5.55	6.01	10.93	1.19	4.58	-

Table 9. Effect of different treatments on yield and yield contributing characters of T.Aman rice at the MLT site, Joypurhat under Potato-Mungbean-T.Aman rice cropping pattern, 2007-08.

Treatments	Plant height (cm)	No. of tillers hill^{-1}	Panicle length (cm)	Grains panicle^{-1} (cm)	1000 grain weight (g)	Yield (t ha^{-1})	
						Grain	Straw
$T_1 = N_{72}\ P_9\ K_{43}\ S_9$	120.2 a	8.92 c	24.11 b	94.32 c	22.13 c	4.17 d	4.31 c
$T_2 = N_{103}\ P_{11}\ K_{60}\ S_{12}$	121.5 a	9.58 ab	25.73 ab	112.2 a	22.43 ab	5.50 b	5.60 a
T_3 = Same as T_2	122.1 a	9.88 a	26.70 a	112.6 a	22.50 a	5.68 a	5.82 a
$T_4 = N_{90}\ P_{15}\ K_{30}\ S_{15}$	121.0 a	9.27 bc	24.99 ab	100.6 b	22.24 bc	4.37 c	4.47 b
CV (%)	1.57	4.09	6.93	3.81	0.87	3.41	9.13

Table 10. Effect of fertilizer package on yield and yield component of T.Aman under Potato-Mungbean-T.Aman cropping pattern at MLT site, Shibpur, Rajshahi, 2007-2008.

Treatment	Plant height (cm)	Panicle m^{-2}	Grain $panicle^{-1}$	TGW (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	100.2 a	323.8 b	91.17 bc	23.08	3.80 b	5.63 b
T_2	102.05 a	365.0 a	105.42 ab	23.75	4.78 a	6.64 a
T_3	102.02 a	379.5 a	112.86 a	23.43	4.72 a	7.13 a
T_4	95.42 b	304.7 b	86.26 c	23.27	3.45 b	5.53 b
CV (%)	2.91	7.08	12.2	2.69	10.09	10.23

Table 11. Cost and return analysis of the whole cropping pattern (Potato- Mungbean- T aman rice) as influenced by different fertilizer treatments at Domar MLT sites OFRD, Rangpur, 2007-08

Treatments	Grain yield (t ha^{-1})			Stover yield (t ha^{-1})	Gross Return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross Margin (Tk. ha^{-1})	BCR
	Potato	Mungbean	Taman	Taman				
T_1	29.76	1.05	3.65	4.65	367850	166494	201356	2.21
T_2	32.42	1.15	4.19	4.92	404320	174813	229507	2.31
T_3	33.94	1.22	4.22	4.99	445320	175831	269489	2.53
T_4	30.36	0.871	3.53	4.11	358570	166494	192076	2.15

Price (Tk./kg): Urea=11.80 , TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160, Maize =9 ,Mungbean =70 and Taman=13

Table 12. Cost and return analysis of different treatments in Potato-Mungbean-T.Aman rice cropping pattern at the MLT site, Joypurhat, 2007-08.

Treatment	Yield of crops				Gross return (Tk. ha^{-1})	Cost of production (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
	Potato (t ha^{-1})	Mungbean (kg ha^{-1})	T.Aman					
			Grain (t ha^{-1})	Straw (t ha^{-1})				
T_1(MYG)	15.89	976	4.17	4.31	256850	125008	131842	2.05
T_2 (HYG)	24.84	1281	5.50	5.60	369280	136983	232297	2.70
T_3 (IPNS)	25.01	1384	5.68	5.82	379960	136600	243360	2.78
T_4 (FP)	19.85	1067	4.37	4.47	297310	130182	167128	2.28

Market price of Potato Tk 8/kg, Mungbean Tk 60/kg, T.Aman Tk 15/kg and Rice straw Tk 2/kg

Table 13. Cost and return analysis of different fertilizer management package at MLT site, Shibpur, Rajshahi, 2007-08.

Treatment	Yield (t ha^{-1})				Gross income (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
	Potato	Mungbean	T.Aman					
			Grain	Straw				
T_1	21.76	912.3	3.80	5.63	346027	209876	136151	1.65
T_2	24.96	1132.8	4.78	6.64	405512	220230	185282	1.84
T_3	26.06	1282.5	4.72	7.13	424225	221503	202722	1.92
T_4	29.11	769.1	3.45	5.53	424249	237716	186533	1.78

Appendix Table 1. Soil analysis values at different locations

Location	Analyzed Results							
	pH	OM (%)	Total N (%)	P	K	S	Zn	B
				PPM	m.eq/100g soil	microgram/g soil		
Rangpur	6.63	2.09	0.09(VL)	60.43 (VH)	0.19(M)	10.44(L)	0.44(VL)	0.15(VL)
Joypurhat	4.93	0.599 (OC)	0.0599(VL)	13.41(L)	0.073(VL)	7.146(VL)	1.655(O)	-
Rajshahi	8.06	1.194	0.12(L)	10.0 (L)	0.12(VL)	10.0(L)	0.6(L)	0.2(L)

L= Low, VL= Very low, O = Optimum, OC= Organic carbon

Integrated Nutrient Management for Mustard-Mungbean-T.Aman Rice Cropping Pattern

Abstract

The experiment was carried out during rabi 2007-2008, kharif-I 2008 and kharif-II 2008 at MLT site, Atghoria, Pabna under AEZ-11 to find out a cropping pattern based fertilizer recommendation and to determine the economic dose of fertilizer. The highest seed yield of mustard and T.Aman were obtained from integrated plant nutrient system and lowest from farmers practice treatment. Higher seed yield of mungbean was obtained form farmers practice treatment. The significant cumulative effect of important yield attributes supported to achieve the maximum yield. Higher gross return, net return and BCR were obtained from IPNS treatment where FP treatment showed lower performance.

Introduction

A crop production system with high yield targets cannot be sustainable unless nutrient inputs are supplied to soil against nutrient removable crops (Bhuiyan *et al.*1991). Sequential cropping ensures maximization of efficient use of moisture and nutrients for a soil (Kanwar 1986). Integrated nutrient management for prevailing cropping system appears to be one of the effective ways to meet the economical nutrition requirement of crop (Kulkarni *et al.* 1993). Farmers usually use fertilizers on single crop basis without considering the cropping pattern followed round the year. But it is known that some nutrients have considerable residual effect on the succeeding crops which may extend up to two/three crops. Similarly, inclusion of legume in the cropping system substantially contributes in nutrient supply. Legumes like mungbean can be fitted in mustard based cropping systems owing to its short duration and grow well in summer conditions. However, it is important to find out the economically viable fertilizer dose for that cropping pattern. The present study is proposed to evaluate the impact of mungbean and pattern based fertilizer recommendation on the productivity of Mustard-Mungbean-T.Aman rice cropping pattern

Objectives

i) To verify different nutrient management approaches

ii) To find out a cropping pattern based fertilizer recommendation

iii) To determine the economic dose of fertilizer

Materials and Methods

The experiment was carried out during 2007-2008, kharif-I 2008 and kharif-II 2008 at MLT site, Atghoria, Pabna under AEZ^{-1}1. Before experimentation, the cooperator farmers were selected from the supplied list of the members of ICM club, FFS and demonstration farmers of the respective Upa-zilla Agriculture Office with help of Sub-Assistant Agriculture Officer. The site team organized a participatory discussion meeting with the selected cooperators farmers and assessed their needs. Based on the resources and needs of the farmers required experiment was designed and conducted at the respective farmers field**.** The experiment was laid out in randomized complete block (RCB) design with six dispersed replications. The unit plot size was 8m × 5m. Four different nutrient management treatments e.g. T_1: Soil test based (STB) nutrient management for medium yield goal, T_2: Soil test based (STB) nutrient management for high yield goal, T_3: Integrated plant nutrient system (IPNS) and T_4: Farmers practice (FP) were tested for the pattern (Table 1).

Table 1. Treatments for different nutrient management

Treatment	Mustard (kg ha^{-1})							Mungbean	T.Aman (kg ha^{-1})					
	N	P	K	S	Zn	B	CD		N	P	K	S	Zn	B
T_1	87	24	39	26	2	0.44	-		38.79	4	4.5	3.7	0	0
T_2	124	32	54	33	3	0.60	-		57.4	5.34	7.49	5.56	0	0
T_3	109	27	39	33	3	0.60	5 t ha^{-1}		57.4	5.34	7.49	5.56	0	0
T_4	86.6	22.6	17.5	13.8	1.7	0.80	-		45.50	10	12	0	0	0

The seed/seedling were sown/transplanted on Nov. 8-9, 2007, Feb. 29, 2008 and July 24, 2008 for mustard (BARI Sharisha13), Mungbean (BARI Mung-6) and T.Aman (BRRI dhan-39) respectively. One irrigation was applied at first week of December just after thinning of mustard. Standard crop management practices were followed for maintain the productivity of the pattern. The crops were harvested on Feb. 13^{-1}5, May 15 and Oct. 27, 2008 of mustard, Mungbean and T.Aman, respectively. Necessary data were collected and analyzed statistically.

Results and Discussion

Mustard

The yield and yield contributing characters were significantly different among the treatments (Table 2). Identically higher plant populations were found in IPNS and MYG treatments where identically higher plant heights were measured in MYG and HYG treatments. Though the plant height measured lowest in IPNS treatment but its plant was healthier and contains higher number of siliqua plant^{-1} which was also identical with HYG and FP treatments. Number of seeds siliqua^{-1} and 1000-seed weight were also found higher in IPNS treatment where as FP treatment gave the lowest value. The highest seed and stover yield were also obtained from IPNS treatment where the FP treatment produced the lowest yield. This result is the cumulative effects of yield attributing characters.

Mungbean

Yield and yield attributes differed significantly among the treatments though there were not applied any fertilizer for mungbeen cultivation (Table-3). This difference might be due to succeeding effect of applied previous crops fertilizer. However, the highest plant height and seed pod^{-1} ware observed in IPNS treatment which was also identical with HYG treatment where as lowest was observed in FP treatment. Plant population and pods plant^{-1} were identical among the treatments though pods plant^{-1} in farmers practice treatment was relatively higher. The highest 1000 grain weight was obtained from MYG treatment which was also identical with IPNS treatment and the lowest was in farmers practice treatment. The highest seed yield was obtained from farmers practice treatment and it is mainly due to higher no. of plant population and pods plant^{-1}. One the other hand, IPNS treatment gave relatively poor yield and it might be due to bushy plant with less pods bearing. The succeeding effect of cowdung might be resulted the bushy plant in IPNS treatment which lead to highest stover yield in IPNS treatment.

T.Aman.

Yield and yield attributes of T.Aman were also differed significantly due to different treatments applied (Table-4). In all cases (viz. plant height, panicle length, grains no. panicl^{-1}, 1000 grain weight, grain and straw yield) IPNS treatment showed better performance than any other treatments. The better performance of yield attributes mainly leads the highest seed yield in IPNS treatment. It might be due to the succeeding effect of cowdung and incorporated higher amount of brown stover of mungbean during previous crops. The lowest performance of yield attributes resulted the lowest grain yield in farmers practice treatment.

Cost and return analysis

From the cost and return analysis, it was found that the highest BCR was calculated from IPNS treatment which is mainly due to highest gross return from highest yield (Table 5). Net return was also higher in this treatment and production cost is relatively lower than HYG treatment and it is mainly due to higher price of chemical fertilizer in the respective year. The lowest BCR was calculated from FP treatment due to lower return.

Farmers' reaction

Farmers opined that yield was higher in both HYG and IPNS treatments but IPNS is better. They wanted to know the soil status of their land after treatment applied.

Conclusion

The combined application of organic and inorganic fertilizer for the crop production might have a positive effect on soil and crop productivity. This is the first cycle result of the pattern, so, after completion of the 2nd year experiment it may be concluded.

Table 2. Yield and yield contributing characters of mustard as affected by different fertilizer packages in Mustard-Mungbean-T.Aman cropping pattern at MLT site, Atghoria, Pabna during the rabi season of 2007-08.

Treatments	Plant population m^{-2} (no.)	Plant height (cm)	Siliqua $plant^{-1}$ (no.)	Seeds $siliqua^{-1}$ (no.)	1000 seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1=MYG	61.17ab	134.30a	122.40b	22.50b	3.57a	2350b	1615a
T_2=HYG	59.67b	130.50ab	124.60ab	22.75b	3.52ab	2422b	1586a
T_3=IPNS	62.83a	124.70c	127.90a	23.95a	3.63a	2783a	1639a
T_4=FP	56.83c	128.50bc	123.70ab	20.53c	3.33b	2111c	1511b
CV (%)	9.81	6.87	7.79	7.70	5.35	7.37	2.79

Table 3. Yield and yield contributing characters of Mungbean as affected by different fertilizer packages in Mustard-Mungbean-T.Aman cropping pattern at MLT site, Atghoria, Pabna during the kharif season of 2008.

Treatments	Plant height (cm)	Plant population m^{-2} (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000 seed weight (gm)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1=MYG	41.63b	31.02a	13.95a	10.62b	42.67a	1062d	1065d
T_2=HYG	43.40ab	31.37a	13.88a	10.72ab	40.83ab	1068b	1070c
T_3=IPNS	44.85a	31.40a	13.95a	11.55a	41.67a	1065c	1093a
T_4=FP	41.20b	31.60a	14.08a	10.60b	39.33b	1077a	1085b
CV (%)	4.33	4.58	5.57	6.25	3.63	6.08	5.51

Table 4. Yield and yield contributing characters of T.Aman as affected by different fertilizer packages in Mustard-Mungbean-T.Aman cropping pattern at MLT site, Atghoria, Pabna during the kharif season of 2008.

Treatments	Plant height (cm)	Panicle length (cm)	Grains $panicle^{-1}$ (no.)	1000 grain weight (gm)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1=MYG	91.50b	22.47ab	86.37bc	18.10ab	4.27c	6.21a
T_2=HYG	98.93bc	21.73bc	87.77b	17.53b	4.34b	6.31a
T_3=IPNS	95.10a	22.97a	94.70a	18.70a	4.40a	6.36a
T_4=FP	88.20c	21.13c	82.67b	14.97c	4.04d	6.18a
CV (%)	5.21	6.53	6.98	3.87	5.67	6.50

Table 5. Cost and return analysis of Mustard-Mungbean-T.Aman cropping pattern as affected by different fertilizer packages in Mustard-Mungbean-T.Aman cropping pattern at MLT site, Atghoria, Pabna during the kharif season of 2008.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1=MYG	235904	92067	143837	2.56
T_2=HYG	235855	95635	140220	2.47
T_3=IPNS	254104	95524	158580	2.67
T_4=FP	215828	91061	124767	2.37

Appendix Table 1. Yield and yield contributing characters of mustard as affected by different fertilizer packages in Mustard-Mungbean-T.Aman cropping pattern at MLT site, Atghoria, Pabna during the rabi season of 2008-09.

Treatments	Plant population m^{-2} (no.)	Plant height (cm)	Siliqua plant (no.)	Seeds siliqua^{-1} (no.)	1000 seed weight (gm)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1=MYG	67.43ab	78.70b	41.70ab	14.45b	3.25a	1230b	1510a
T_2=HYG	67.68a	77.75bc	40.15bc	16.23a	3.20a	1214b	1529a
T_3=IPNS	66.43b	81.70a	43.13a	14.77b	3.38a	1283a	1547a
T_4=FP	66.60b	75.75c	38.15c	14.25b	3.15a	1113c	1381b
CV (%)	6.96	6.33	4.32	4.02	3.09	4.98	7.70

Integrated Nutrient Management for Watermelon in the Costal Area

Abstract

The experiment was conducted at the farmers' field in Atkapalia, Noakhali and MLT site, Kuakata, Patuakhali during 2008-09 to find out the proper nutrient management packages for watermelon in char areas. Three treatments like STB for HYG, IPNS and farmers were considered in the experiment. Higher but similar yield was found from IPNS and STB for inorganic fertilizer in Noakhali. In Patuakhlai the crop was damaged due to heavy hailstorm.

Introduction

Imbalance use of fertilizer is a serious problem for the country. Previous survey reveals that farmers of many areas of Bangladesh applied nitrogenous fertilizer higher than recommended dose in some crops. On the other hand, the use of other fertilizer is less than recommended dose. Watermelon is a promising crop in the coastal region of Bangladesh. Farmers are producing watermelon in the same land years after years. But they are ignorant about the recommended fertilizer for watermelon. Therefore, it is very important to introduce them with Integrated Plant Nutrient System (IPNS) for watermelon to maintain their soil fertility and productivity.

Materials and Methods

The experiment was conducted at Atkapalia, Noakhali, MLT site, Kuakata, Patuakhali during rabi season of 2008-2009. Three fertilizer doses: T_1: Soil test based inorganic dose for high yield ($N_{96}P_{41}K_{51}S_{10}Zn_{1.2}B_{1.2}$ kg/ha in Noakhali), T_2 : IPNS approach ($N_{61}P_{29}K_{11}S_{8.7}Zn_{1..2}B_{1.2}$ kg/ha +8t/ha CD in Noakhali) and T_3 : Farmers' practice ($N_{80}P_{41}K_{50}S_{60}$kg/ha +4 t/ha CD in Noakhali) were tested. The experiment was laid out in RCB design with six dispersed replications having unit plot size 5m x 8m. Spacing was 3 m x 2 m and var. Glory was used in Noakhali and Cornflower in Patuakhali. Sowing was done on 18 January 2009 in Noakhali and 20-24 January 09 in Patuakhali. The crop was harvested at maturity on 22 April 2009 in Noakhali. Two seedlings were allowed for each pit.

Application method of fertilizer was followed as recommended. Irrigation and other intercultural operation were done as and when necessary.

Results and Discussion

Noakhali: Higher yield was STB for HYG but it was at par with IPNS. Higher economic return was found in STB for HYG. However, the farmers used both organic and inorganic fertilizer but yield was comparatively low. This is due to use of imbalance fertilizer.

Table 1. Yield components of watermelon as influenced by nutrient management in Noakhali during 2009

Treatments	No. of fruits plant^{-1}	Fruit weight (kg)	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Variable cost of fertilizers (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
STB for HYG	3.18	2.55	26.65	159000	15746	56717	86537
IPNS for HYG	3.04	3.13	27.16	162000	25568	63214	73218
FP	2.95	2.92	22.86	137000	24283	62356	50361
CV %	14.03	30.52	19.97				

Price (Tk kg^{-1}): Urea= 12, TSP= 40, MoP= 35, Gypsum= 10, Zinc oxide= 75,Boric acid= 120, Cowdung= 2, Watermelon = 6

Patuakhali : At fruiting stage a heavy hailstorm was occurred at Kuakata on 31 March 2009 and 50% crop was damaged.

Performance of Intercropping Hybrid Maize with Different Vegetables

Abstract

An experiment was conducted at the farmers' field of Tangail, Comilla, Mymensingh, Rangpur and Sherpur during 2007-08 and 2008-09 to identify the suitable and profitable vegetable crops for intercropping with maize. Four treatment combinations viz., T_1: Maize (Sole), T_2: Maize+ red amaranth, T_3: Maize + Garden pea and T_4: Maize + Spinach/bushbean were considered. Higher maize equivalent yield and net return were obtained from Maize + gardenpea/spinach intercropping in all the locations.

Introduction

Cropping intensity as well as crop production can be increased by multiple cropping practices. Intercropping is one of the way of multiple cropping has long been recognized as a very common practice. It is suggested that intercropping can provide substantial yield advances compared to sole crop (Singh *et al.,* 1992). Maize (*Zea maize*) is the third largest cereal crop in Bangladesh. It is also important source of carbohydrate. In Bangladesh, Maize occupies a total 50050 ha of land producing 241460 metric tons grain (BBS 2003-04). Maize is grown in Tangail which occupies 423 ha of land producing 1255 metric tons grain (BBS, 2003-04). Maize cultivation is going popular day by day.

Intercropping vegetables with maize is a profitable proven technology of BARI. Maize is grown in well drained medium high land, which is also suitable for growing other cash crops. Most of the farmers of Ghatail, Tangail grow different vegetables viz. sweet gourd, as gourd, red amaranth, garden pea, spinach, stem amaranth etc. as intercrop with maize having inadequate knowledge of agronomic practices as well as benefit of the crop. Intercrop should be selected such a way that there is no or little adverse affect on the main crop. The proper crop combinations of existing practices have not been standardized. Hence, it is necessary to find out the potential of intercropping maize with suitable vegetables to increase production as well as profitability of the farmers.

Materials and Methods

The experiment was carried out at MLT Tangail, Comilla, Mymensingh, Rangpur and FSRD site, Sherpur during 2007-08 and 2008-09 to identify the suitable and profitable vegetable crops for intercropping with maize. The trial was laid out in RCB design with six dispersed replications (farmers). It was conducted in IPM/ICM club/Farmers Field School (FFS) members' land, selected with the help of local DAE personnel. The four intercrops were considered as T_1: Maize (Sole), T_2: Maize + red amaranth, T_3: Maize + garden pea and T_4: Maize + spinach or Maize + bushbean. The variety BARI hybrid maize-5, BARI Lalshak^{-1}, BARI Motorshuti-3, Kopipalong and BARI Jharshim^{-1} were used as planting materials. Two lines garden pea and two lines of bushbean were provided in maize inter rows, spinach and red amaranth were sown in broadcast. Crop management practices done under different locations are mentioned in Table 1. Weeding, mulching, irrigation and crop protection measures were taken as and when necessary. No additional fertilizer was applied for intercrops. Intercrop yield was recorded plot wise. Ten plants for maize and 3 m^2 areas for vegetable were collected randomly in each replication for collecting data. Collected data were analyzed statistically using CropState/Mstat-C analytical package.

Table 1. Crop management practices done in different locations

Location	Tangail	Comilla	Mymensingh	Rangpur	Sherpur
Variety	BHM-5	BHM-5	BHM-5	BHM-5	BHM-5
Unit plot size & spacing	10m x 8m 75cm x 25cm	6m x 5m 75cm x 20cm	6m x 5m 75cm x 20cm	10m x 8m 75cm x 20cm	6 m × 4.5 m
Sowing time	7 Nov. 2007 and 18-20 Nov.2008	10 Nov. to 2 Dec. 07 and Nov. 29, 2008	1-8 Dec.	13 Dec. 07 and 24-28 November, 2008	November 26-27, 2008
Fertilizer dose	As per FRG 2005	As per FRG 2005	As per FRG 2005	As per FRG 2005	As per FRG 2005

Results and Discussion

TANGAIL

2007-08: The grain yield of maize was significantly influenced by intercropping (Table 2). The highest grain yield (9.20 t ha^{-1}) was obtained from the sole plots followed by Maize + garden pea (8.63t ha^{-1}) and maize + Spinach (8.59 t ha^{-1}). The lowest grain yield (8.17 t ha^{-1}) was recorded from Maize + red amaranth intercropping. The highest maize equivalent yield (12.16 t ha^{-1}) was recorded from maize + Spinach treatment combination (Table 3) followed by maize + garden pea (11.99 t ha^{-1}). The lowest maize equivalent yield (10.99 t ha^{-1}) was obtained from maize with red amaranth inter cropping.

2008-09: The highest grain yield (8.81 t ha^{-1}) was obtained from Maize + garden pea followed by maize + spinach (8.79 t ha^{-1}). The lowest grain yield (6.93 t ha^{-1}) was recorded from maize + red amaranth intercropping. The highest maize equivalent yield (14.23 t ha^{-1}) was recorded from maize + spinach treatment combination (Table 2) followed by maize + garden pea (13.76 t ha^{-1}). The lowest maize equivalent yield (11.48 t ha^{-1}) was obtained from maize with red amaranth inter cropping.

The highest gross return was recorded from maize + spinach intercrop combination which was very close to maize + garden pea intercrop combination Maize as Sole crop gave lowest gross return.

COMILLA

2007-08: Yield and yield attributes of hybrid maize are presented in Table 4. Significant difference was found in different yield attributes, i.e. cobs per m^2, 100 grains weight and maize yield. Significantly highest maize yield was recorded when maize intercropped with Jharshim^{-1} that was at par with sole maize and maize with BARI Motorshuti-3. The lowest yield was observed in maize with red amaranth. Partial analysis budget indicates that the highest gross return, net return as well as MBCR were recorded in Maize + bushbean intercropping system (Table 6). Considering average of the location highest vegetable yield was recorded in Maize+Red amaranth and the lowest in Maize+Motorshuti intercropping system.

2008-09: Significant differences were found in different yield and yield attributes, i.e. cobs number, cob weight, maize yield and also in maize equivalent yield; but there were no significant differences in plant pop^n m^{-2}, plant height, ear height, seed weight cob^{-1} and hundred seed weight, it may be due to use of same variety in every system (Table 5). It was observed that intercropping maize with bushbean showed better performance in respect of cobs per plant, cob weight cob^{-1}, which ultimately contribute to the highest maize yield as well as maize equivalent yield which was followed by maize with red amaranth. Due to more nitrogen availability in the crop root zone through nitrogen fixation by bushbean root, adding of nutrient and its bushy growth controls the weed growth and restore soil moisture effectively contribute higher yield. Due to extra N fertilizer use for red amaranth crop it gives better yield; so the extra N fertilizer might be used by the maize crop. There was no significant difference between the maize yield in the treatments of Maize + Red amaranth and Maize + BARI Matarshuti 1 inter cropping system. Lowest maize yield was obtained from sole maize as no addition of nitrogen to the crop root zone, and quick evaporation of soil water and also N fertilizer from the field. Significantly highest maize equivalent yield was found from Maize + Bushbean intercropping system due to higher maize grain yield as well as bushbean yield. Price of matarshuti in the market was highest but due to comparatively lower maize grain and matarshuti yield its maize equivalent yield was at per with maize + red amaranth intercropping system.

NETROKONA (MYMENSINGH)

2007-08: Yield and yield contributing characters of intercropped maize were not statistically significant (Table 7). However, agronomic performance of sole maize was a little bit better than that of other treatments. Number of grains cob^{-1} ranged from 405-408, 1000-grain weight ranged from 325-330 g in different treatments. The highest grain yield (8.95 t ha^{-1}) was recorded from sole maize. The grain yield of maize in intercropped combination varied from 8.77-8.80 t ha^{-1}. Stover yield ranged from 13.03^{-1}4.15 t ha^{-1}. The yield data indicate that due to intercropping there was not significant yield loss of maize. Rather higher maize equivalent yield and economic returns were obtained from the intercropping combinations (Table 8). The highest maize equivalent yield (12.77 t ha^{-1}) was obtained from the maize + motorshuti followed by maize + bushbean with yield of 11.55 t ha^{-1}. The lowest maize equivalent yield (8.95 t ha^{-1}) was obtained from sole maize. Like equivalent yield, the highest gross return (Tk. 191550 ha^{-1}) and net return (Tk.149414 ha^{-1}) were also obtained from the intercrop combination of maize + motorshuti. The lowest gross return (Tk. 134250 ha^{-1}) and net return (Tk. 98114 ha^{-1}) were obtained from sole maize.

2008-09: Plant height ranged from 174.1^{-1}76.5 cm, number of cobs plant^{-1} ranged from 1.1-1.3, number of grains cob^{-1} ranged from 404-413, 1000-grain weight ranged from 306-310 g in different treatments. The highest grain yield (7.68 t ha^{-1}) was recorded from sole maize. The grain yield of maize in intercropped combination varied from 7.30-7.43 t ha^{-1}. Stover yield in different treatments ranged from 10.76^{-1}1.27 t ha^{-1}. The yield data indicated that due to intercropping, there was not significant yield loss of maize. Rather higher maize equivalent yield and economic returns were obtained from the intercropping combinations (Table 2). The highest maize equivalent yield (14.96 t ha^{-1}) was obtained from the maize + motorshuti followed by maize + bushbean with yield of 12.64 t ha^{-1}. The lowest maize equivalent yield (7.68 t ha^{-1}) was obtained from sole maize. Like equivalent yield, the highest gross return (Tk 224400 ha^{-1}), net return (Tk.166830 ha^{-1}) and benefit cost ratio (3.90) were also obtained from the intercrop combination of maize + motorshuti. The lowest gross return (Tk. 115200 ha^{-1}), net return (Tk. 64128 ha^{-1}) and benefit cost ratio (2.26) were obtained from sole maize.

RANGPUR

2007-08: The results showed that the highest maize yield 8.35 t ha^{-1} was found from sole maize and the highest vegetable yield 5.36 t ha^{-1} was recorded from bushbean (Table 9). Grain yield of maize did not influenced significantly due to different intercropping combination. The highest maize equivalent yield was obtained from treatment maize+ bushbean and the lowest maize equivalent yield 8.35 t ha^{-1}

was obtained from sole maize. The highest gross return (Tk. 113300 ha^{-1}) was found in treatment maize+ bushbean. The lowest gross return Tk.83500 ha^{-1} was found in treatment sole maize (Table 10).

2008-09: The highest vegetable yield (7.67t ha^{-1}) was recorded from maize + bushbean combination and it was significantly higher than maize + red amaranth but identical to maize + garden pea (table1). The highest maize equivalent yield (16.47 t ha^{-1}) was obtained from maize+ bushbean intercrop combination (Table 2) followed by maize + garden pea (12.31 t ha^{-1}).The grain yield of sole maize was 8.35 t ha^{-1} (Table 1).The yield of sole maize and the yield of maize in intercrops did not vary significantly. This suggests that grain yield of maize did not hamper due to intercropping. The highest net return (Tk.78840 ha^{-1}) and BCR (2.17) were recorded from maize + bushbean. The lowest net return (Tk.21200 ha+) and BCR (1.34) were recorded from sole maize. The result revealed that intercrop of maize with vegetables was a profitable practice particularly in case of maize + bushbean and maize + garden pea.

Sherpur (Jamalpur) : Plant height, ear height and leaf number of hybrid maize did not differed with intercropping of red amaranth, motorshuti and bushbean. Grain cob^{-1} differed significantly among the treatments. The highest grain cob^{-1} was obtained when maize was intercropped with bushbean. Other three treatments were produced identical maize grain cob^{-1}. 1000-grain weight was also differed significantly due to treatment variation. Maize intercropped with bushbean produced the bolder maize grain while other treatments produced identical grain weight. From the table 2, it was clearly notified that maize production was profitable when it was produced with leguminous intercrop. Maize equivalent yield was the highest from intercropping systems with bushbean. The highest gross return, (Tk. 126500 ha^{-1}), net return (Tk. 65945 ha^{-1}) and BCR (2.09) were recorded from maize + bushbean intercropping systems. Second highest gross return and net return was recorded from maize intercropped with red amaranth.

Farmers' reaction

- Maize production intercropped with short duration vegetable is a profitable practice.
- Extra income can be earned.
- During field visit the DAE people also opined in favour of the new intercrop practice

Conclusion

Considering the agro-economic performance and soil health maize + garden pea or maize + bushbean intercrop combination were found suitable almost all the locations.

Table 2. Yield and yield contributing characters of maize and vegetables yield under intercropping situation at the MLT site Ghatail, Tangail during 2007-08 and 2008-09

Treatments combination	Maize plant height (cm)	Cobs plant^{-1}	Cob length (cm)	Cob breadth (cm)	Grain cob^{-1} (no.)	1000 grain wt (g)	Grain wt. cob^{-1} (g)	Maize yield (t ha^{-1})	Vegetable yield (t ha^{-1})	Maize equivalent yield (t ha^{-1})
2007-08										
Sole maize	223.33	1.75	20.46	15.75	531	41.74	218.90	9.20	0.00	9.20
Maize+red amaranth	223.00	1.68	18.70	15.06	498	39.15	211.37	8.17	5.89	10.99
Maize+garden pea	221.00	1.73	19.28	15.36	510	41.75	212.12	8.63	1.81	11.53
Maize + spinach	222.67	1.72	20.32	15.59	506	41.44	216.03	8.59	5.59	12.16
LSD (0.05)	9.83	0.80	1.37	0.84	29.33	18.80	9.11	0.69	0.59	
CV (%)	2.2	2.3	3.5	2.8	2.9	2.3	2.7	4.0	9.0	
2008-09										
Sole maize	203	1.28	18.4	15.5	407	318.1	318.1	8.67	0.00	8.67
Maize+red amaranth	205	1.24	18.6	15.5	403	299.6	299.6	6.93	9.52	11.48
Maize+garden pea	201	1.30	19.1	15.4	397	336.0	336.0	8.81	3.09	13.76
Maize + Spinach	200	1.28	18.2	15.7	409	338.6	338.6	8.79	8.53	14.23
LSD (0.05)	7.45	0.82	1.36	0.59	46.65	11.88	11.88	0.90	0.53	
CV (%)	2.5	4.7	5.3	2.7	8.4	2.6	2.6	7.8	7.3	

Table 3. Cost and benefit analysis of maize intercropped with vegetables at the MLT site Ghatail, Tangail during 2007-08 and 2008-09

Treatments combination	Gross return (Tk. ha^{-1})		Total variable cost (Tk. ha^{-1})		Net return (Tk. ha^{-1})	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Sole maize	117445	108375	45937	45937	71508	62438
Maize + Red amaranth	139790	143500	55267	55267	84523	88233
Maize + Garden pea	146383	172000	57049	57049	89334	114951
Maize + Spinach	154458	177875	60481	60481	93977	117394

Price (Tk./kg): Maize = 12.50, Red amaranth = 6.00, Garden pea = 20.00, Spinach = 8.00, Stover = 0.25

Table 4. Yield and yield attributes of hybrid maize and average yield of vegetables yield in Daudkandi during 2007-08

Treatment	Cobs m^{-2}	Cobs plant^{-1}	Cob length (cm)	Grains cob^{-1}	100 Grains wt. (gm)	Maize yield (t ha^{-1})	Veg. yield (t ha^{-1})	Maize equivalent yield (t ha^{-1})
Sole Maize	5.02	1.30	17.43	426	28.37	6.37	-	6.37
Maize+red amaranth	4.44	1.21	16.41	409	28.40	6.21	9.83	13.20
Maize+ garden pea	4.17	1.13	16.97	410	26.90	6.50	1.39	9.59
Maize+ bushbean	5.84	1.37	17.25	401	30.30	6.94	7.86	30.36
LSD (0.05)	0.97	NS	NS	NS	2.29	0.59	-	
CV (%)	12.05	-	9.28	10.02	5.27	5.68	-	

Table 5. Yield and yield contributing characters of hybrid maize intercropped with vegetables in Daudkandi, Comilla during rabi 2008-09.

Treatments	Cob plant^{-1}	Cob weight (gm)	Seed wt. cob^{-1} (gm)	100 seed weight (gm)	Maize yield (t ha^{-1})	Veg. yield (t ha^{-1})	Maize equi. yield (t ha^{-1})
Sole maize	1.23 c	191.9 b	141.8	29.95	8.82 c	-	8.820c
Maize + red amaranth	1.53 b	202.4 a	151.4	29.95	11.67 ab	2.35	14.47 b
Maize + garden pea	1.47 b	196.0 ab	146.9	29.57	10.86 b	1.15	13.73 b
Maize + bushbean	1.77 a	196.9 ab	141.4	30.48	12.57 a	4.54	22.01 a
LSD (0.05)	0.17	9.49	NS	NS	1.292	-	2.90
CV (%)	9.48	3.92	5.73	4.22	9.57	-	15.99

Note: Maize grain, red amaranth, matarshuti, and bushbean rate were 12, 15, 30, and 25 Tk/Kg respectively.

Table 6. Cost and return of in intercropping system in Daudkandi during rabi 2008-09

Treatment	Total cost (Tk.)	Gross return (Tk. ha^{-1})	Net Return (Tk. ha^{-1})
Sole maize	65825.5	105840	40014.5
Maize + red amaranth	70518.5	175290	104771.5
Maize + garden pea	69654	164820	95166
Maize + bushbean	69530.5	264340	194809.5

Table 7. Yield and yield contributing characters of maize under different intercropping situation at Netrakona during rabi 2007-08 and 2008-09

Crop combination	Plant height (cm)	No. of cobs plant^{-1}	No. of grains cob^{-1}	Weight of grains cob^{-1} (g)	1000-grain weight (g)	Grain yield (t ha^{-1})	Maize equivalent yield (t ha^{-1})
2007-08							
Sole maize	178.9	1.2	408	127	330	8.95	8.95
Maize+ red amaranth	176.7	1.1	406	125	328	8.79	11.32
Maize+ bushbean	176.4	1.4	405	125	326	8.80	11.55
Maize+ garden pea	176.3	1.3	405	125	325	8.77	12.77
LSD (0.05)	NS	NS	NS	NS	NS	NS	
CV (%)	1.86	8.95	2.89	4.93	5.13	13.32	
2008-09							
Sole maize	176.5	1.2	413	128	310	7.68	7.68
Maize + red amaranth	174.5	1.1	411	126	307	7.43	10.67
Maize+ bushbean	174.1	1.3	404	124	306	7.32	12.64
Maize+ garden pea	175.0	1.1	404	124	307	7.30	14.96
LSD (0.05)	NS	NS	NS	NS	NS	NS	
CV (%)	1.57	3.81	2.11	2.80	1.62	3.75	

Table 8. Economic performance of Maize and vegetables in intercropping system at MLT site, Netrakona, 2007-08 and 2008-09

Treatments combination	Gross return (Tk. ha^{-1})		Total variable cost (Tk. ha^{-1})		Net return (Tk. ha^{-1})	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Sole maize	134250	115200	36136	51072	98114	64128
Maize+ red amaranth	169800	160050	38386	53480	131414	106570
Maize+ bushbean	173250	189600	42136	57570	131114	132030
Maize+ garden pea	191550	224400	42136	57570	149414	166830

*TVC includes cost of seed, fertilizer, insecticide, irrigation, man and animal labour cost.
Price (Tk kg^{-1})
2007-08: Maize seed= 50, Maize non-seed = 15, Maize stover= 0.50, Red amaranth= 8, Bushbean= 20, Garden pea= 25
2008-09: Maize seed: 50, Maize non-seed= 15, Maize stover: 0.50, Red amaranth: 10.00, Bushbean: 20, Motorshuti: 30

Table 9. Yield of Maize and vegetables in intercropping system, Gobindaganj, Gaibandha, 2007-08 and 2008-09

Treatment	Yield (t ha^{-1})					
	Maize		Intercrop (vegetable)		Maize equivalent	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
T_1: Sole maize	8.35 a	9.30a	0	-	8.35	9.30
T_2: Maize +red amaranth	8.13 ab	8.75a	3.31	4.67b	8.92	11.52
T_3: Maize + garden pea	8.07 ab	9.20a	3.39	4.95b	10.13	12.31
T_4:Maize + bushbean	7.89 ab	9.00a	5.36	7.67a	11.33	16.47

Table 10. Economic performance of Maize and vegetables in intercropping system, Gobindaganj, Gaibandha, 2007-08 and 2008-09

Treatments combination	Gross return (Tk. ha^{-1})		Total variable cost (Tk. ha^{-1})		Net return (Tk. ha^{-1})	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
T_1: Sole maize	83500	83700	45584	62500	37916	21200
T_2: Maize +red amaranth	89200	94680	46582	62700	42614	31980
T_3: Maize + garden pea	101300	106740	47084	65500	54216	41240
T_4:Maize + bushbean	113300	146340	47088	67500	66212	78840

In put price (Tk./kg): Urea=11.80 , TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150,
Boric acid = 160, Maize= 200, Red amaranth= 100, Motorshuti =50 and Bushbean =100
Out put price (Tk./kg): Maize =9, Red amaranth= 5, Motorshuti =10 and Bushbean =10 .

Table 11. Different characters of hybrid maize as influenced by intercrop at FSRD site, sherpur during 2008-09

Treatment	Plant height	Ear height	Leaf no.	Cob plant^{-1}	Grain cob^{-1}	1000-grain wt.
T_1	187.68	82.12	11.16	1.13	481.87 b	290.00 b
T_2	187.60	83.44	11.08	1.11	489.07 b	290.00 b
T_3	183.92	82.80	10.92	1.10	488.73 b	290.00 b
T_4	182.88	83.56	11.00	1.11	501.93 a	293.00 a
CV (%)	2.00	3.49	2.25	2.36	1.70	0.47
F	NS	NS	NS	NS	*	**

Table 12. Cost and return of intercropping components at FSRD site, sherpur during 2008-09

Treatment		Grain yield (t ha^{-1})	Maize equivalent yield (t ha^{-1})	GR (Tk. ha^{-1})	TC (Tk. ha^{-1})	GM (Tk. ha^{-1})	BCR
T_1	Maize sole	8.33	8.33	83,300.00	57,035.00	26,265.00	1.46
T_2	Maize Red amaranth	8.27 12.44	12.00	120,000.00	61,710.00	58,290	1.94
T_3	Maize Garden pea	8.27 1.66	11.74	117,400.00	60,345.00	57,055.00	1.94
T_4	Maize Bushbean	8.53 2.66	12.65	126,500.0	60,555.00	65,945.00	2.09

Price of Maize = Tk.10.00/kg, Red amaranth= Tk. 3.00/kg, Motorshoti= Tk. 21.00/kg, Bushbean= Tk. 15.50/kg, Maize stover= Tk. 1.00/kg

Intercropping of Pointed Gourd with Leafy Vegetable and Spices

Abstract

An intercropping experiment was conducted at MLT site, Manikganj to evaluate the performance of intercropping of leafy vegetables and spices in pointed gourd during 2008-09. Three treatment combinations and one sole pointed ground were considered. Higher pointed gourd equivalent yield and gross margin were obtained from 100% pointed gourd + 50% coriander intercropping at Manikganj.

Introduction

Cropping intensity as well as crop production can be increased by multiple cropping practices. Intercropping is one of the way of multiple cropping has long been recognized as a very common practice. It is suggested that intercropping can provide substantial yield advances compared to sole crop (Singh *et al.,* 1992). Pointed gourd (*Trichosanthes dioica*) is one of the popular cucurbitaceous vegetables cultivated in Bangladesh. In Bangladesh, it is cultivated during summer season in about 4651 hectare of land with total production of 25,295 tons (BBS 1999). During rainy season, the scarcity of vegetables is a serious problem in this country. During that lean period, pointed gourd is one of the important vegetable. Because, it is a relatively long duration vegetable and can be harvested from March to October covering the whole summer and rainy season. The optimum planting time of pointed gourd is last week of October to second week of November. The growth of pointed gourd stunted during winter at that time it could not cover the whole plot. Short duration leafy vegetable and spices can be cultivated in the uncovered area with out hampering the yield of pointed gourd.. So this experiment is under taken to observe the performance of pointed gourd intercropped with leafy vegetables and spices.

Material and Methods

The experiment was carried out at MLT site Manikganj during 2008-09 to identify the suitable and profitable vegetables or spices crop for intercropping with pointed gourd. The trial was laidout in RCB design with six dispersed replications (farmers). It was conducted in IPM/ICM club farmers field school (FFS) member's land selected with the help of local DAE personnel. The three intercrops were considered as T_1 = Sole pointed gourd (100%) T_2 = 100% pointed gourd + 50% red amaranths T_3 = 100% pointed + 50% spinach and T_4 = 100% pointed gourd and 50% coriander, were used in planting materials. The intercrops were sown in broadcast on raised pointed gourd bed. Weeding, irrigation and crop protection measure were taken as and when necessary. No additional fertilizer was applied for intercrops. The crops were sown on 11 November 2008. The unit plot size was 1.25m $\times$4m and plant spacing was 1 m $\times$1.25 m. Manure and fertilizer were applied at the rate of 10 ton cowdung, 150 kg TSP, 100 kg MoP and 120 kg gypsum per hectare. The quantity of cowdung, TSP, and gypsum were applied as basal dose during pit preparation. Urea and MOP were applied as topdressing in three equal installments 20 days, 60 days and 90 days after emergence. The pointed gourd plants were trailed over one meter high bamboo pandal. Pointed gourd were harvested from May 13-June 24, 2009 and continued up to July, 2009. Intercrop yield was recorded plot wise. Collected data were analyzed statistically.

Results and Discussion

Table 1 showed that yield and yield contributing characters of intercropped pointed gourd were not statistically significant. No. of fruits/plant ranged from 26.2-30.4, fruits weight ranged from 78.9-85.2 g in different treatments. The highest pointed gourd yield (13.6 t ha^{-1}) was recorded from T_1 (100% pointed gourd). The yield data indicate that due to intercropping there was not significant yield loss of pointed gourd. Rather higher pointed gourd equivalent yield and economic returns were obtained from the intercropping combinations. The highest pointed gourd equivalent yield (17.9 t ha^{-1}) was recorded from T_3 and T_4 treatments followed by pointed gourd + red amaranth with yield of 15.82 tha^{-1} . The lowest pointed gourd equivalent yield (13.8 t ha^{-1}) was obtained from sole pointed gourd. Like equivalent yield the highest gross return (Tk. 215200 t ha^{-1}) and gross margin (Tk. 49080 t ha^{-1}) and BCR (1.6) were also obtained from the intercrop combination of pointed gourd + coriander. The lowest gross return (Tk.165600 ha^{-1}) and gross margin (Tk.30980 ha^{-1}) were obtained from sole pointed gourd.

Farmers' reaction

Farmer's are interested to cultivate pointed gourd with vegetables and spices but they want the vines of pointed gourd make available.

Conclusion

Considering the agro economic performance and from 1st year results pointed gourd, vegetables and spices intercrop combination were found suitable for Manikganj.

Tabel 1. Yield contributing characters of pointed gourd with leaf vegetables and spices under intercropping situation at the MLT sites of Manikganj during 2008-09.

Treatment	No. of fruits $plant^{-1}$	wt. of fruits $plant^{-1}$ (kg)	Fruits length (cm)	Fruit breath (cm)	Fruit wt. (g)
T_1= 100% pointed gourd	27.4	2.31	8.41	3.2	78.9
T_2 = 100% pointed gourd + 50% red amaranth	30.4	2.35	7.58	3.2	79.7
T_3 =100% pointed gourd + 50% spinach	26.2	2.24	7.35	3.18	85.2
T_4 =100% pointed gourd + 50% Coriander	27.4	2.69	6.55	3.21	81.9

Table 2. Yield and equivalent yield of pointed gourd and intercropped at MLT site Manikganj during the rabi season of 2008-09.

Treatment	Pointed gourd yield (t ha^{-1})	Intercrop yield (t ha^{-1})	Pointed equivalent yield (t ha^{-1})
T_1= 100% pointed gourd	13.8	-	13.8
T_2 = 100% pointed gourd + 50% red amaranth	13.6	4.44	15.82
T_3 =100% pointed gourd + 50% spinach	13.4	6.70	17.9
T_4 =100% pointed gourd + 50% Coriander	13.5	1.33	17.9

Table 3. Economic performance of pointed gourd and leafy vegetables and spices in intercropping system

Treatment	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1= 100% pointed gourd	165600	134620	30980	1.23
T_2 = 100% pointed gourd + 50% red amaranth	189840	136520	53320	1.39
T_3 =100% pointed gourd + 50% spinach	214400	136620	77780	1.60
T_4 =100% pointed gourd + 50% Coriander	215200	136120	79080	1.60

Year Round Vegetable Production and Quick Growing Fruit Trees in Homestead

Introduction

Bangladesh is one of the developing countries with highest population density, of which 50 percent is under poverty level, 70 percent is under nourished and a vast population is unemployed. Even more that 30,000 people get blind at childhood every year due to deficiency in vitamin A (BARC, 1990). An earlier survey indicated that 93 percent family in Bangladesh suffering from vitamin C deficiency, 85 percent in riboflavin, 81 percent in vitamin A and calcium, 60 percent in protein and 59 percent in calorie requirement (Mahmud, 1985). There are about 18-20 million families in Bangladesh, most of them live in rural areas having a homestead for each. The homestead of rural Bangladesh are generally under utilized or crowded with unproductive spaces. About fifteen millions of homestead is there in the country which can help producing sufficient vegetables and fruits for the concerned families. In spite of agricultural country, the people are lack in production and consumption of fibrous food with a ratio of cereal and fiber at 5.1. More than 30000 children are suffering from blindness each year and majorities of its population are lack in required amount of vitamins, minerals and protein. Farmers' practices different patterns of vegetable and fruit in the vicinity of house hold but almost all are unplanned, poor yielder, uneconomic and non-scientific. On-Farm Research Division (OFRD) of Bangladesh Agricultural Research Institute has developed different Vegetables Production Models. To popularize these models, a production program was under taken at different locations (AEZ) with the financial assistance of Integrated Crop Management (ICM) program of DANIDA.

Objectives

i. To ensure appropriate utilization of all the available spaces in the homestead area with vegetables and fruit species
ii. To supply vegetables and fruits for the family members round the year and protect malnutrition hazards.
iii. To use family labours especially women and children in productive activities and assists in saving and/or generating additional cash income.

Materials and Methods

Before going to implement the project activities a household survey was carried out and detail information in respect of livelihoods maintained by the selected households were documented. Accordingly action plan for each of the selected households was prepared considering their available resources, needs and choice with active participation of the family members (both the male and female). The cooperator farmers (both the male and female) were given orientation on the program activities prior to implement. During the implementation period of project activities, Site working group meeting, review workshop, field day cum field visit and training for farmers (both the male and female) and field staffs were organized. Socio-agro-economic data of each of the program activities of all the selected households were recorded and all collected data considering averagely (6-12 farmers) were analyzed using simple statistical tools and their results have incorporated in this report.

PABNA

More or less nine production niches of the homestead were brought under cultivation with the suggested vegetables of Goyeshpur model. Before initiation of the program, 6 farmers (4 ICM club members and 2 Demo) were selected on the basis of available resources and potentials for homestead farming under small farm category. Each farm families consist of average 5 members. The selected farmers were provided training by the FSRD team on year round vegetable production following Goyeshpur model. The farmers were introduced with nine production units of their homestead. The crops were selected for the 9 production units on the basis of farmers' choice and preference. Production methodology was followed as per Goyeshpur Model. For sustainable production and intake participatory planning, implementation, monitoring and evaluation approach was followed. In the whole process farmers' need were given priority. Data were collected from vegetable sector mainly and some cases lemon and guava included and other new plantation and existing fruit trees were excluded. The data on total production and disposal pattern were collected and documented in a register day by day.

Table 1. Goyeshpur model

	Spaces		Cropping patterns
1.	Open land	a.	Radish - Stem Amaranth - Indian spinach
		b.	Cabbage - Brinjal - Red Amaranth
		c.	Tomato -Spinach - Okra
2.	Roof	a.	Bottle gourd - Wax gourd
3.	Trellis	a.	Bottle gourd - sweet gourd
4.	Tree support	a.	Country bean - Yard long bean
		b.	Bitter gourd - Ribbed gourd - Sponge gourd
		c.	Snake gourd - Potato Yam
5.	Partial shady area	a.	Elephant foot yam
		b.	Leaf aroid (moulavi kachu)
		c.	Ginger
		d.	Perennial chilli
6.	Marshy land	a.	Pani kachu
7.	Fence	a.	Bitter gourd - Yard long bean -Bitter gourd
8.	Homestead boundary	a.	Papaya (3-5 plant)
		b.	Guava (1-2 plant)
		c.	Lemon (1-2 plant)
9.	Back yard/waste land	a.	Laizna (1-2 tree)
		b.	Plantain Banana (1-2 plant)

SHYAMPUR, RAJSHAHI

The experiment was started during the Rabi season, 2007-08 at MLT site Shibpur, Rajshahi in 4 homesteads. The families of selected homesteads are medium, poor and marginal. Different vegetable patterns were tested in different homestead as per the needed of farmers following Goyeshpur model. The annual work plant was also chalked, in this regard, OFRD, Shyampur Station, Rajshahi supplied the critical imputes like vegetable and fruit seed/seedlings, net, fence, watering can etc. For the open sunny place and other places round the year vegetable patterns are as follows.

Table 1 : Utilization of different homestead spaces in different cropping seasons at Shibpur MLT site, Rajshahi during 2006-2008.

Space	Before intervention	After intervention			
		Bed	Rabi	Kharif-1	Kharif-2
Open sunny place	Fallow	Bed-1	Radish	Katuadata	Red amaranth
		Bed-2	Cabbage	Brinjal	Spinach
		Bed-3	Tomato	Spinach	Spinach
Fence crop	Never used	6 pit	Bitter gourd		
Homestead boundary	Never used	Guava, Jujubee, Muringa, Banana, Papaya, bottle gourd			
Trellis	Traditional management	Country bean, bottle gourd, Sweet gourd			
Marshy place	Never used	Panikachu			
Semishade	Never used	Taro, Kangkong			

BARIND, RAJSHAHI

The homestead gardening was carried out at Bijoynagar, Godagari, Rajshahi from rabi 2008-2009 in the Bijoynagar ICM club (club no.12714) member’s home of High Barind Tract. Six farmers were selected among the ICM club members by helping SAAO, Godagari, Rajshahi as well as President and Secretary of the club. Then the farmers’ resources, needs and choice assessments were done with active participation of the family members (both male and female). A farmers’ participatory program

planning discussion was carried out on homestead vegetables and fruit production on September 2008. The activities of the program were prioritized based on farmers' needs, problems, family nutrition and cash income. The year round vegetable production pattern was designed with the following of "Barind Model". The annual work plan was also chalked out in this regard. OFRD, Barind Station, Rajshahi supplied the critical inputs like fruit and vegetable seed/seedlings, net (for fencing) etc. OFRD provided technical support to the selected farmers' as per local need. In *rabi* season, bed preparation was done on 10-14 October 2008. The seed sowing was conducted on 15-18 October 2008 following "Barind Model". Entrepreneurship was developed for quality seeds and seedlings with technical assistance from OFRD. Now vegetables cultivation in homestead is still running. A base line survey among the homestead farmers was done before intervention. Data on socio-agro economic aspect from all the selected households were recorded from November - 20 May 2008-09 period that have been incorporated in this report.
On the basis of farming component two types of program were designed, which was as below:

Program A: Year round homestead vegetable production following "Barind Model"

Program B: Plantation of quick growing fruit trees in homestead area

Table 1. Space utilization by year round vegetables cultivation at farmers' homestead area under "Barind Model" during 2008-2009

Nitchi/space	*Cropping pattern for year round homestead vegetable production*		
	Rabi	*Kharif-I*	*Kharif-II*
Open sunny land			
Bed-1	Red amaranth + Brinjal	Kangkong	Kangkong
Bed-2	Spinach	Indian spinach	Red amaranth
Bed-3	Radish	Stem amaranth	Red amaranth
Bed-4	China cabbage (*Batishak*)	Okra + Red amaranth	Red amaranth
Bed-5	Bushbean	Chili + Red amaranth	Chili
Cottage roof/top	Country bean, bottle gourd	Sweet gourd, White gourd	-
Trellis	Country bean, bottle gourd	Sweet gourd, yard long bean, bitter gourd	-
Fences/Boundry wall	Country bean	Bitter gourd, yard long bean	-
Non-fruit trees	-	White gourd, potato yam	
Partially shady land	Coriander leaf	Zinger, turmeric, aroids	-
Homestead areas	Brinjal, onion, garlic	Plantain banana, papaya, drumstick	-
Pond/ditch banks and slope	Bottle gourd, country bean	Indian spinach, sweet gourd, bitter gourd	-

COMILLA

Six homesteads those who are IPM/ICM club member, five (5) from Daudkandi, and one (1) from Homna were selected with the help of DAE for this purpose. Tangail model was used for Comilla. For vegetables production we have made five (5) beds for vegetables in each farmer`s house. Red amaranth, amaranth, cabbage, cauliflower, tomato, brinjal, kangkong, spinach, Indian spinach, ladies finger, summer onion, papaya and guava seeds/seedlings were given and sown/planted in the homesteads. Bitter gourd seedlings were given as the trail crop. Zinger and turmeric seeds will also be given around the homesteads.

NOAKHALI

Homestead gardening Model (Atkapalia Model) was introduced among the 10 Resources Poor Farmers (RPF) within 25-35 m homestead area for year round vegetable production. In the homestead area 6 number of vegetables (red amaranth, batishak, radish, spinach, tomato, brinjal) was introduced for cultivation.
Table 1. Atkapalia Model.

Niche/space		Year round homestead vegetable pattern		
		Rabi	Kharif I	Kharif II
Open sunny space	Bed 1	Lalshak-Radish-Tomato	Amaranths	Indian spinach
	Bed 2	Batishak-Tomato	Okra	Danta
	Bed 3	Cauliflower-Lalshak + Brinjal	Gimakalmi	Gimakalmi
	Bed 4	Cabbage-Spinach	Okra	Lalshak
	Bed 5	Radish-Batishak	Indian spinach	Amaranths
Roof top		Country bean/Bottle gourd	Ash gourd	
Trellis		Bottle Gourd	Ribbed gourd/Cucumber/Bitter gourd	

PATUAKHALI

Six homesteads were used at FSRD site, Razakhali, Patuakhali for vegetables production round the year in 2008-2009. Five beds of each 8 m × 1.5 m were taken for Lebukhali model. A fence was made with bamboo. Vegetables were cultivated round the year one after another. From September, 2008 to May, 2009 yield data was recorded. Lebukhali model for year round vegetable production in the open sunny place and other homestead spaces were utilized. Mainly female and school going boys/girls did the major activities.

Table 1. Utilization of spaces in homestead

Spaces	Cropping pattern for year round homestead vegetable production		
	Rabi	Kharif-I	Kharif-II
Open sunny land			
Bed-1	Red amaranth + Radish	Brinjal	Summer onion
Bed-2	Bush bean	Okra	Indian spinach
Bed-3	Coriander leaf + cabbage	Stem amaranth	Kangkong
Bed-4	Red amaranth – Potato	Stem amaranth	Kangkong
Bed-5	Red amaranth + Tomato	Indian spinach	Indian spinach
Roof	Bottle gourd	Wax gourd	Bottle gourd
Fence	Bitter gourd	Yard long bean	-
Trellis	Country bean	Ribbed gourd	-
Non-fruit trees	-	Sponge gourd	Sponge gourd
Pond/ditch slope	Bottle gourd	Bitter gourd	-

RANGPUR

The experiment was conducted at Mominpur (ICM club) under Lahirirhat FSRD site, Rangpur in high and medium high land areas of the Tista Meander Floodplain (AEZ 3) during 2008-09. The area experiences annual rainfall of around 2160 mm with relatively early onset and late cessation. Similarly, the onset of winter is 15 days earlier and duration of winter is about a month longer compared to other parts of the country. Two each of marginal, small and landless farmers were selected for this purpose. The homestead resources, needs and choice assessments were done with the active participation of the family members. Scientist and extension personnel act as a facilitator. More or less 6 to 10 production niches of the homestead were identified and brought under cultivation following Rangpur model. The niches were open sunny place, relatively shady place, slightly marshy land, marshy land, roof top, trellis, boundaries, fence, unproductive trees and back yard places. Farmer's group meeting was done to give an orientation about the utilization pattern and production practices of the homestead fruits and vegetables following Rangpur model. The activities of the programme were prioritized based on farmers needs, problems, nutrition and income. Then a work plan was developed with the farmers' participation. Thirty to 40 m^2 open sunny area was used for implementing pattern based vegetable cultivation. Each area was divided into five beds, thus the area of each bed varied from 6m x 5m to 8m x 5m. Thirteen vegetables viz., radish, cabbage, tomato, brinjal, spinach, garlic, napasak, lalsak, okra, Indian spinach, kangkong, data and patsak were selected for year round vegetable cultivation in the beds. A partial shady place was utilized by ginger and turmeric. Slightly marshy land and marshy land were utilized by latiraj, panikachu and moulabi kachu. The creepers like bottle gourd and ash gourd was grown on the roof top. Trellis was provided with bean and snake gourd. Six to nine papaya seedlings were planted on the boundaries. The fence was utilized by bitter gourd and ribbed gourd. Potato yam was allowed to grow on the unproductive trees and papaya in the backyard. Some homestead also provided with each of one of jujube, guava and mango trees. The vegetable pattern was initiated from kharif-II and plantations of some quick growing fruits were started thereafter. The production methodology used following Rangpur model. Data on yield, consumption, distribution, sale and some other socio-economic data were taken and presented in the following Tables

Table-1. Rangpur model for homestead vegetables and fruits cultivation

No. of Bed	Pattern (Unit, open sunny place)		
	Rabi	Kharif-1	Kharif-2
Bed-1	Radish	Lalsak	Kangkong
Bed-2	Cabbage	Data	Coriander Sak
Bed-3	Brinjal+Lalsak	Indian spinach	Spinach
Bed-4	Tomato+Napa shak	Okra	Lalsak
Bed-5	Garlic	Patsak	Okra

Land under partial shady place

Cropping pattern	Rabi	Kharif-1	Kharif-2
CP-1	Ginger	Ginger	Ginger
CP-2	Turmeric	Turmeric	Turmeric

Slightly marshy land

Cropping pattern	Rabi	Kharif-1	Kharif-2
CP-1	Latiraj	Latiraj	Latiraj

Marshy land

Cropping pattern	Rabi	Kharif-1	Kharif-2
CP-1	Kalokachu	-	-

Other resources

Cropping pattern	**Rabi**	**Kharif-1**	**Kharif-2**
Roof top	Bottle gourd	Ash gourd	Bottle gourd
Trellis	BARI sim-1	Sweet gourd	-
Boundary ail	Papaya	Papaya	Papaya
Fence	Bitter gourd	Ribbed gourd	-
Un productive tree	Potato yam	Potato yam	Potato yam
Back yard	Papaya	Papaya	Papaya

TANGAIL

The production program was conducted at the MLT site Ghatail, Tangail during 2008-09 under AEZ#9. The study was followed as Palima model (BARI developed homestead model) with 6 farm families. Farmers are the members of Pakutia ICM club who were selected with the help of local DAE personnel. Twelve to 20 sqm open sunny area was used irrespective of homesteads. The unit bed size was 2-3m x 1m for each vegetable. To test Palima model, four different patterns were included in the study. Four patterns consisting 10 different kinds of vegetable e.g. radish, tomato, brinjal, lalshak, spinach, stem amaranth, cabbage, okra, Indian spinach and kangkong were considered for cultivation round the year. Recommended seedling age, spacing and fertilizer dose were followed for all the vegetables. Partial shady and marshy place also utilized by ginger, turmeric, and aroid. The tested patterns in open sunny place were as follows (Palima model).

Palima model: (Open sunny place)

No. of Bed	Pattern (Unit: Open sunny place)		
	Rabi	Kharif-I	Kharif-II
Bed-1	Radish- Tomato	Okra	Indian Spinach
Bed-2	Brinjal + Lalshak	Indian Spinach	Okra-Lalshak
Bed-3	Spinach/Lalshak-Stem Amaranth	Gima kalmi	Kangkong
Bed-4	Cabbage	Stem/Red amaranth	Indian Spinach

Land under the trellis: (Partial shady place)

Cropping pattern	Rabi	Kkarif -I	Kharif-II
CP-1	Ginger	Ginger	Ginger
CP-2	Turmeric	Turmeric	Turmeric

Slightly marshy land

Cropping pattern	Rabi	Kkarif -I	Kharif-II
CP-1	Latiraj	Latiraj	Latiraj

JAMALPUR

The vegetable cultivation program at homestead area was carried out at the Farming Systems Research and Development (FSRD) Site, Kushumhati, Sherpur following the "Narekeli Model" from Kharif 2008 to Rabi 2009. Before initiation of activities an individual case study of each household was conducted to identify the resource base and potentials of different farm category. Finally eight households of marginal and small farmers were selected for this program. The vegetable crops were selected according to the choice of the farmers through participatory method. Before conducting the activities a comprehensive training was provided to the selected farmers following the Narikeli Model. The FSRD team provided technical assistance to the co-operator farmers regularly to cultivate vegetable successfully. In Kharif-I, different vegetables were Indian spinach, Kangkong, Okra, Chilli, Latiraj kachu; in Kharif-II were Data and continuation of Kangkong, Okra, Chilli and Latifaj kachu; and in Rabi Tomato, Lalsak, Cabbage, Coriander, Onion, Spinach, Garlic, Carrot and Bitter gourd. The plot size was 5m x 1m. Recommended seed rate, spacing and fertilizer doses were used for all the vegetables. When the vegetables were harvested, the data were recorded for each crop. Finally the data were averaged. The product value was calculated by the local market price on each crop.

Table 1. Narekeli model includes the following vegetables pattern

Nitch/space		Year round vegetable production pattern in homestead		
		Rabi	Kharif I	Kharif II
Open sunny place	Bed 1	Tomato	Indian spinach	Data
	Bed 2	Lalshak+Cabbage	Kangkong	Kangkong
	Bed 3	Coriander+Onion	Okra	Okra
	Bed 4	Spinach+Garlic	Chilli	Chilli
	Bed 5	Carrot+Bitter gourd	Latiraj kachu	Latiraj kachu
Roof top		Country bean	White gourd	-
Trellis		Country bean	Yardlong bean	-
Fence		Bitter gourd	-	-
Marshy land		-	Latiraj kachu	-
Unused tree		-	Potato yam	-

SYLHET

The Golapgonj Model of homestead utilization system was used. The model included the following production units in available spaces: This model designed for homestead vegetables under four cropping patterns in a 5m × 1m per bed. But the size of the bed is not fixed. Panikachu (var. latiraj) was transplanted surrounding the whole beds. Near by vegetable beds, we used at least one decimal of land for cultivation creeper vegetables like wax gourd followed by country bean which were supported by bamboo structure (commonly called macha). Under the macha, we used shade loving crops like turmeric, ginger, mukhikachu.

Table 1. Golapgonj Model vegetable production.

Sl.#	Production units	Cropping pattern
1.	Sunny area	Bed I – Radish + Tomato-Amaranth- Indian spinach . Bed II-Laishak+ Cabbage- Amaranth-Okra. Bed III- Brinjal +Lalshak-Gimakalmi. Bed IV-French bean-Lalshak- Yard long bean Panikachu (var.latiraj) was transplanted just outside the whole bed area. Bombai chilli was transplanted on four corners of the beds.
2.	Trelli	Wax gourd - Country bean.
3.	Under trellis	Turmeric, ginger and mukhikachu.
4.	Tree support	Black papper, Potato yam.
5.	Marshy land	Panikachu (latiraj).
6.	Homestead boundary	Plantation of guava, litchi, lemon, mango, coconut etc.
7.	Slope area	Pineapple, citrus (not feasible in Sunamgonj

BOGRA

The experiment was started during rabi season of 2008-09 at the MLT site, Shibganj, Bogra. The study was followed as Goyeshpur model with 6 farm families. It was conducted in ICM club member's land, selection with the help of local DAE personnel. The activities of the program were prioritized based on farmer's needs, problems, family nutrition and cash income. Then the farmer's were introduced with nine production units of their homestead. The crops were selected for the units on the basis of farmers' choice and preference. Production technology was followed as per Goyeshpur model. The cost of all operations except family labour was beard by ICM project. The data on total production and disposal pattern were collected and documented in a register day by day. Weekly monitoring was done and all operations were guided by OFRD team members.

Result and Discussion

PABNA

Vegetable production

More or less nine production niches of the homestead were brought under cultivation with the suggested vegetables of Goyeshpur model at FSRD site Pushpapara during the rabi season of 2008 to kharif season 2009. It was observed that the production of vegetables was higher at open sunny space followed by trellis and Roof top (Table-1). Among the season, more crops and production units were covered in kharif-2 season.

Utilization of vegetables

Disposal of different vegetables produced under homestead was recorded regularly. The result indicated that disposal pattern of vegetables varied with different months. The intake was higher in Ashar and lower in chaitra month. Vegetable intake per day per head was 230 g (Table-2). The distribution and sell of vegetables per year were recorded 151.65 kg and 425.7 kg respectively. Distribution and sale amount of vegetables were higher in the month of Ashar and lower in chaitra. Its indicated that the month chaitra is the lean period. The better utilization of homestead area with optimum management by their effective family labour might be enhanced optimum vegetable production and subsequent intake, distribution and sell.

Income

Total income recorded from a homestead was Tk.11932. The net income round the year recorded by medium, small and marginal farmer was Tk.10736 where as total cost was only Tk. 1196.

Apparent Nutrient intake

Apparent nutrient intake especially protein, iron, carotene, vit.B_1 and vit. C by a 5 members' family through year round vegetables consumption were estimated (Table 3). Nutrient intake was varied with different vegetable growing months. Intake of nutrient was positively correlated with vegetable consumption and also with production. Nutrients such as iron, carotene, vit. B_1 and vit. C intake by a family were higher in Ashar month but protein intake was higher in Sraban month and lower in all nutrient intake was found in chaitra month.

Apparent nutrient supplementation

For better growth and development of human body, necessary nutrient requirement are to be fulfilled daily especially vit-C. The supplementation of nutrients from the vegetables intake by a family member of a homestead was calculated. The result showed that the percentage of the requirement of protein supplied from the homestead source were 8.49 for male and 9.34 for female (Table 4). The percentage of iron and vit-A supplementation were 67.61 and 164.90 both male and female members. The percentage of vit-B, supplementation were 26.50 and 31.80 for male and female members respectively. Vitamin-C was supplemented 111.80% for the both male and female members of a family from homestead vegetables.

Farmers reaction

Farmers opined that homestead vegetable production is very helpful for fulfilment their daily vegetable requirement, for establishing relationship with the neighbour and some extra income. But seed is main problem for the program continuation, because its different niches required very small amount of seed with different species.

Table 1. Round the year vegetables production from different niches of homestead at FSRD site, Pushpopara, Pabna during April 2008 to March 2009.

Niches		Rabi (kg)	Kharif-1 (kg)	Kharif-2 (kg)	Total (Kg)
		Aasheen-Falgun	Chaitra-Jaistha	Aashar-Bhadra	
Open sunny space	Bed 1	28.66	44.92	37.33	110.91
	Bed 2	45.17	8.08	11.04	64.29
	Bed 3	17.84	8.63	14.58	41.05
Roof top		74.75	-	29.75	104.5
Trellis		104.58	10.25	29.50	144.33
Shady place		26.00	2.38	37.60	65.98
Marshy land		21.80	-	33.10	54.90
Unproductive tree		7.00	-	-	7.00
Fence		-	11.63	4.17	15.8
Back yard		-	4.00	25.00	29.00
House Boundary		112.42	19.85	225.88	358.15

Table 2. Round the year vegetables production and utilization pattern in homestead at FSRD site, Pushpopara, Pabna during April 2008 to March 2009.

.Bengali month	Name of vegetable	Total production (Kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income
			Intake	Distribution	Sell				
Baishakh	Data, Binjal, Lady`s finger, Moulobi Kachu, Long yard bean	43.74	14.49	5.58	23.67	165	386	-	-
Jaistha	Indian spinach, Brinjal Lady`s finger, Sweet gourd	45.51	21.04	5.47	19.00	375	737	-	-
Aashar	Indian spinach, Brinjal Ladys finger, Sweet gourd,Moulobi Kchu	278.38	76.53	38.45	163.4	1521	2790	-	-
Sraban	Indian spinach, Brinjal, Ladys finger, gourd,Moulobi Kchu	109.67	49.98	14.65	45.04	686	1415	-	-
Bhadra	Brinjal, gourd,Moulobi Kchu	41.30	17.73	4.37	19.2	459	848	-	-
Aasheen	Papaya, Water taro	53.08	23.75	6.83	22.5	178	387	-	-
Kartik	Papaya, Water taro	44.47	19.42	4.75	20.3	188	359	-	-
Agrahaon	Spinach, Bottle gourd, Bean, Elephant foot yam, Potato yam, Papaya	95.67	54.25	19.00	22.42	238	748	-	-
Poush	Raddish, Cabbage, Spinach, Bottle gourd, Elephant foot yam, Papaya, Potato yam	100.92	54.17	22.75	24.00	250	844	-	-
Magh	Raddish, Cabbage, Bottle gourd, Elephant foot yam, Papaya,	94.09	44.92	15.00	34.17	1043	2471	-	-
Falgun	Cabbage, Tomato, Data, Bottle gourd,, Papaya,	73.5	34.58	11.92	27.00	330	841	-	-
Chaitra	Data, Potato yam, Papaya	15.58	7.7	2.88	5.00	38	106	-	-
Total		995.91	260 230g $head^{-1}$ day^{-1}	151.65	425.7	5471	11932	1196	10736

Table 3. Apparent nutrient intake by a family under homestead vegetables production program at FSRD site, Pushpopara, Pabna during April 2008 to March 2009.

Bengali month	Protein (gm)	Iron (mg)	Vit-A (RE)	Vit-B_1 (mg)	Vit-C (mg)
Baishakh	158.33	333.92	5430.50		
Jaistha	378.00	457.81	246686.66	35.23	2700.50
Aashar	1321.08	1936.61	611600.50	92.81	25658.20
Sraban	2346.33	1898.20	506043.33	64.66	19866.97
Bhadra	512.00	815.02	122433.16	59.29	3648.83
Aasheen	476.50	533.67	61201.00	53.32	1105.6
Kartik	258.33	252.00	32703.50	44.11	410.00
Agrahaon	784.25	387.58	21657.16	50.53	2961.67
Poush	824.33	1380.42	144709.66	62.29	11840.83
Magh	1121.25	527.00	46696.33	74.51	7322.50
Falgun	470.75	340.17	3710.66	29.93	3158.33
Chaitra	78.10	138.60	2810.50	8.45	1694.00
Total	8529.25	9001.00	1805683.00	581.15	81621.60

Table 4. Apparent nutrient supplemented from a homestead production vegetables on the basis of per head per day requirements at FSRD site, Pushpopara, Pabna during April 2008 to March 2009 (5 member's family).

Category	% Protein	% Iron	% Vit-A	%Vit-B_1	%Vit C
Male	8.49	67.61	164.90	26.50	111.80
Female	9.34	67.61	164.90	31.80	111.80

SHYAMPUR, RAJSHAHI

From the result Table 1 it was observed that highest amount of vegetables was collected from bottle gourd (294 kg) followed by Sweet gound (108 kg). Katuadata is one at the most popular vegetables in Rajshahi region. The lowest amount of vegetables was collected from aroids (3 kg) followed by Indian Spinach (5.8 kg). Above data were collected up to1st week of May, 08. But these vegetables Katuadata, Indian Spinach and Okra still on the bed and bottle gourd on the trellis and Papaya on homestead boundary and bitter gourd on fence. On the other hand, Radish, Tomato and Cabbage harvesting was completed. From the table 2 it was showed that highest distributed vegetables was bottle gourd (27 kg) followed by Katuadata (7.0 kg) and consummated bottle gourd (75 kg.) followed by Sweet gourd (44 kg). Some fruits like Jujube and guava also produced in last year planted plants.

Farmers' reactions

This homestead activity created a significant impact on the improvement of health availability of vegetables in the local area because the utilized homestead spaces were mostly fallow and under utilized previously.

A good impact was created among the farmers to adopt the modern technologies need in homestead spaces utilization. It was observed that the supplied technology (Goyeshpur vegetables production model) was spreading among the neighboring farmers. It was created a good relationship with neighbors and side by side food habit of farm families is also changing day by day in a positive direction. Nutrient deficiency problems at a good number at family members were reduced due to intake of increased amount of fresh and safe vegetables from their homestead. Before interaction the homestead activity, the lesser period of their family members were used in unproductive purpose such as TV watch, gossiping etc. but now, most of the lesser time of their family members including man, women, and children etc are used in their homestead garden.

Table 1. Average production, utilization and distribution of homesteads vegetables and fruits at MLT site, Shibpur, Rajshahi from Rabi season 2007-2008 to Kharif 2009.

Crop	Average homestead consumption (kg) or no.	Average homestead distribution (kg)	Average homestead sold (kg)	Total production (kg) or no.
Radish	13.9	5.5	5.6	25
Cauliflower	9.3	3.0	5.7	18
Tomato	8.2	2.0	4.3	14.5
Katuadata	15	7.0	10	32.0
Bottle gourd	25 no (75 kg)	9 no (27 kg)	64 no (192 kg)	98.0 no. (294 kg)
Indian Spinach	5.8	0	-	5.8
Okra	8.4	2.0	-	10.6
Drum stick	5	0	7	12
Green banana	-	-	1 bunch (8 kg)	8
Jujubee	3	0	-	3
Guava	3	0	-	2
Country bean	16.2	4.0	15.8	36
Papaya	26	0	54	80
Aroids	3	0	-	3
Brinjal	3	0	-	8
Sweet gourd	11 no (44 kg)	2 no (8 kg)	14 no (56 kg)	27 no. (108 kg)
Cabbage	12	0	0	12
Bitter gourd	2.3	0	0	2.3
Total	253.1	58.5	358.6	674.2

N. B : Each value is a mean of 4 observations i.e. four homestead.

BARIND, RAJSHAHI

Vegetables production per homestead during November to 20 May 2008-09

In January 2009, the maximum amount of vegetables (46.84 kg) was produced from each homestead. The second highest fresh vegetables was produced in December 2008 (43.63 kg) and sharply declined after January to March 2009 (Table 1). The month March is late rabi season so that lowest vegetables was produced. Kharif cultivation was started from April 2009 resulted vegetables production chronologically increased. Ten vegetable crops viz., brinjal, red amaranth, spinach, radish (with leaf), bush bean, China cabbage (*batisha),* kangkong, Indian spinach, okra and katua data were grown in five beds of open sunny place produced 12.02, 11.57, 13.11, 36.06, 4.19, 27.39, 24.61, 27.36, 3.45 and 3.5 kg fresh vegetables, respectively during the growing period. However Brinjal and red amaranth were grown in same bed simultaneously. On the other hand, two creeper vegetable crops viz., bottle gourd and country bean were grown on the farmers' cottage roof and trelli gave 20.70 and 20.50 kg fresh vegetables per homestead. It was observed that the highest amount of vegetable was produced in Radish (36.06 kg). Actually radish is a modified root having maximum percent of water. The unit radish weight was higher resulted to highest yield. In growing period, it was revealed that a total of 204.46 kg fresh vegetables were produced per homestead.

Vegetables intake per family during November to 20 May 2008-09

The maximum amount of vegetables (27.12 kg) was consumed by each family in the month January, followed by December (23.86 kg) and November (20.47 kg) and after January it was declined (Table 3). The each farmer's family intake were 7.32, 7.79, 21.32, 14.45, 3.68, 11.02, 16.33, 14.16, 3.45, 3.5, 17.7 and 9.2 kg fresh red amaranth, spinach, radish, China cabbage (batishak), bush bean, brinjal, kangkong, indian spinach, okra, katua, bottle gourd and country bean, respectively from the month November 2008 to 20 May 2009. It was observed that each family (5 members) consumed a total of 129.92 kg fresh vegetables during the period.

Vegetables distributed by a family

In December, the highest amount of vegetables (12.88 kg) was distributed to farmers' relatives and neighbors (Table 4). Each family distributed 2.58, 3.78, 7.95, 8.11, 0.50, 1.00, 6.28, 4.20, 9.20 and 3.50 kg fresh red amaranth, spinach, radish, China cabbage (batishak), bush bean, brinjal, kangkong, indian spinach, bottle gourd and country bean, respectively from the month November 2008 to 20 May 2009. During the period the total amount of distributed vegetables by a family was 48.10 kg.

Vegetables sold by a family

Each farmer's family sold 1.67, 1.54, 6.78, 4.83, 2.00, 8.00, and 10.00 kg fresh red amaranth, spinach, radish, China cabbage (batishak), kangkong, indian spinach and country bean, respectively from the month November 2008 to 20 May 2009. During the season there were 35.62 kg fresh vegetables were sold by a farmer family (Table 5).

Average production and disposal pattern per family

Data presented in Table 6 found that the average total vegetables production was 204.46 kg per homestead during the month November 2008 to 20 May 2009. Among the total production, own consumption, free distribution and selling were 129.92 kg, 48.10 kg and 35.62 kg respectively and the ultimate percentage of consumption, free distribution and selling were 63.54%, 23.53% and 17.42% , respectively. The average consumption per person per day was 144.36 g. From above it was found that intake of vegetable increased a significant level (on the average 144.36 g/h/day instead of 40 g/h/day base mark), which helped the farmers to meet the demand of vegetables and to reduce the daily expenditure of vegetable purchase. Though the intake of 144.36 g was below than the recommended daily vegetable consumption (200 g/h/day), despite that wide spread malnutrition was reduced to a marked level, hence nutrition and food insecurity was marginalized. Farmers also earned a small amount of cash income from vegetable selling after meeting their daily requirement and free distribution among the relatives and neighbors and it was found that the average net cash income was Tk.321 per homestead during that time frame.

Economic return per homestead

After implementation of the project during *rabi* season each farm family produced 11.57, 13.11, 36.06, 27.39, 4.19, 12.02, 24.61, 27.36, 3.45, 3.50, 20.70 and 20.50 kg fresh red amaranth, spinach, radish, china cabbage (batishak), bush bean, brinjal, kangkong, indian spinach, okra, katua, bottle gourd and country bean, respectively from the month November 2008 to 20 May 2009. During this period each family sold a portion of the products after fulfill their family requirements. Each farm family earned 1687.97 and 13.77 Taka gross and net return, respectively in respect of local market value of the products during the period (Table 7).

Work distribution (%) per family

Table 8. showed that maximum work of the homestead gardening was done by women and children viz., intercultural operations, harvesting and cooking. Men did only a portion of land preparation, seed sowing and marketing work.

B. Plantation of quick growing fruit trees and management of existing fruit trees

Fruits contain vitamins, minerals and other nutrients that are essential for proper human growth and development. It can also supply timber, fuel and fodder. In high Barind area the poor and marginal farmers can not consumed the minimum requirements of fruits for nutrition. Considering the above facts OFRD, Barind Station, BARI, Rajshahi took an attempt to distribute fruit saplings to the ICM club farmers. In this regard, total 250 fruits saplings were distributed to the ICM farmers where were 50 fruit saplings of jujube (Apple kul and BAU kul), 50 of pamelo (BARI batabi lebu-1) and 150 of Papaya (Shahi).

Table 1. Vegetables production per homestead during November to 20 May 2008-2009.

Mon	Vegetable production/bed (kg/5m^2)										B.gourd (kg)	Bean (kg)	Total (kg)
	R.ama.	Spin.	Rad.	B.shak	B.bean	Brin.	Kang.	I.Spin	Okra	Katua			
Nov	11.57	13.11	5.36	-	-	-	-	-	-	-	-	-	30.04
Dec	-	-	20.70	13.43	-	-	-	-	-	-	5.00	4.50	43.63
Jan	-	-	10.00	13.96	2.41	4.67	-	-	-	-	8.00	7.80	46.84
Feb	-	-	-	-	1.78	4.85	-	-	-	-	4.50	4.70	15.83
Mar	-	-	-	-	-	2.50	2.70	3.20	-	-	3.20	3.50	15.10
April	-	-	-	-	-	-	12.58	11.33	-	-	-	-	23.91
May	-	-	-	-	-	-	9.33	12.83	3.45	3.5			29.11
Total	11.57	13.11	36.06	27.39	4.19	12.02	24.61	27.36	3.45	3.5	20.7	20.5	**204.46**

Table 2. Vegetables intake per family during November to 20 May 2008-2009.

Mon	Vegetable production/bed (kg/5m^2)										B. gourd (kg)	Bean (kg)	Total (kg)
	R. ama.	Spin.	Rad.	B. shak	B. bean	Brin.	Kang.	I. Spin	Okra	Katua			
Nov	7.32	7.79	5.36	-	-	-	-	-	-	-	-	-	20.47
Dec	-	-	8.96	8.70	-	-	-	-	-	-	4.00	2.20	23.86
Jan	-	-	7.00	5.75	1.90	3.67	-	-	-	-	6.00	2.80	27.12
Feb	-	-	-	-	1.78	4.85	-	-	-	-	4.50	2.70	13.83
Mar	-	-	-	-	-	2.50	2.00	2.00	-	-	3.20	1.50	11.20
April	-	-	-	-	-	-	8.00	6.33	-	-	-	-	14.33
May	-	-	-	-	-	-	6.33	5.83	3.45	3.5	-	-	19.11
Total	7.32	7.79	21.32	14.45	3.68	11.02	16.33	14.16	3.45	3.5	17.7	9.2	**129.92**

Table 3. Vegetables distributed per family during November to 20 May 2008-2009.

Mon	Vegetable production/bed (kg/5m^2)										B. gourd (kg)	Bean (kg)	Total (kg)
	R. ama.	Spin.	Rad.	B. shak	B. bean	Brin.	Kang.	I. Spin	Okra	Katua			
Nov	2.58	3.78	-	-	-	-	-	-	-	-	-	-	6.36
Dec	-	-	4.95	4.73	-	-	-	-	-	-	2.20	1.00	12.88
Jan	-	-	3.00	3.38	0.50	1.00	-	-	-	-	2.80	2.00	12.68
Feb	-	-	-	-	-	-	-	-	-	-	2.70	0.50	3.20
Mar	-	-	-	-	-	-	0.70	1.20	-	-	1.50	-	3.40
April	-	-	-	-	-	-	4.58	1.00	-	-	-	-	5.58
May	-	-	-	-	-	-	1.00	3.00	-	-	-	-	4.00
Total	2.58	3.78	7.95	8.11	0.50	1.00	6.28	4.20	-	-	9.20	3.50	48.10

Table 4. Vegetables sold per family during November to 20 May 2008-2009.

Mon	Vegetable production/bed (kg/5m^2)										B.gourd (kg)	Bean (kg)	Total (kg)
	R.ama.	Spin.	Rad.	B.shak	B.bean	Brin.	Kang.	I.Spin	Okra	Katua			
Nov	1.67	1.54	-	-	-	-	-	-	-	-	-	-	3.21
Dec	-	-	6.78	-	-	-	-	-	-	-	-	2.30	9.08
Jan	-	-	-	4.83	-	-	-	-	-	-	-	5.00	9.83
Feb	-	-	-	-	-	-	-	-	-	-	-	1.50	1.50
Mar	-	-	-	-	-	-	-	-	-	-	-	2.00	2.00
April	-	-	-	-	-	-	-	4.00	-	-	-	-	4.00
May	-	-	-	-	-	-	2.00	4.00	-	-	-	-	6.00
Total	1.67	1.54	6.78	4.83	-	-	2.00	8.00	-	-	-	10.80	35.62

Table 5. Average vegetable production and disposal pattern per family at Bijoynagar ICM club, Rajshahi during November to 20 May 2008-2009 in HBT.

Total vegetable production in 6 months (kg/homestead)	Total own consumption (kg)	Own consumption (g/head/day)*	Free distribution (kg)	Sold (kg)	Total cash income (Taka)
204.46	129.92 (63.54)**	144.36	48.1 (23.53)	35.62 (17.42)	321

** Five members in a family were considered*
*** Figure in parenthesis indicates percentage*

Table 6. Economic return per homestead during November to 20 May 2008-2009 in HBT .

Vegetables name	Total vegetable production (kg bed^{-1})	Vegetable price (Tk./kg)	Gross return (Tk.)	Total cost (Tk.)	Net return (Tk.)
Red amaranth	11.57	8	92.56	310.00 (Without family labour)	1377.90
Spinach	13.11	10	131.10		
Radish	36.06	6	216.00		
Batishak	27.39	5	136.95		
Bush bean	4.19	15	62.85		
Brinjal	12.02	15	180.30		
Kangkong	24.61	6	147.66		
Indian Spinach	27.36	5	136.80		
Okra	3.45	15	51.75		
Katua	3.50	5	17.50		
Bottle gourd	20.70	10	207.00		
Country bean	20.50	15	307.50		
		Total	1687.97		

Table 7. Average work distribution (%) among the family members for the homestead vegetable production at ICM club, Bijoynagar, Godagari, Rajshahi.

Sl. no.	Operations	Men	Women and children
1.	Land preparation	90	10
2.	Seed/seedling sowing	60	40
3.	Intercultural operations	15	85
4.	Harvesting	08	92
5.	Cooking	0	100
6.	Marketing	80	20

Table 8. Different fruit saplings distributed to the ICM club farmers' at Bijoynagar.

Sl. No.	Name of fruit	No. of fruit saplings distributed	Plant survivability (%)	Present status
1.	Jujube (Apple kul and BAU kul)	50	90	Vegetative stage
2.	Pamelo (BARI Batabi lebu-1)	50	80	Do
3.	Papaya (Shahi)	150	80	Do
	Total =	**250**	**-**	**-**

Output

- Due to use of modern varieties the homestead vegetable production has been increased.
- Farmers are being familiar with the BARI released improved vegetable varieties.
- Use of farmers' homestead resources like cowdung, poultry litter, compost, pond water, different fallow land, non-fruit tree and family labour have increased at homestead area.
- Women employment has been increased which ensure women participation in agricultural activities as well as made positive effect on equity within the family and in community.
- Consumption of fresh vegetables by the family has been increased and also has changed the consumption habit towards vegetables.
- Farmers' dependency on local vegetable market has been decreased due to own homestead vegetable production.
- Above all the nutrition demand of the farmer's family is fulfilled as well as they earn some money to sell the products in the local market.

Limitations

- Drought and high temperature affected adversely the programme during kharif .
- Lack of sufficient water for growing vegetables in drought season especially in kharif-I.
- Most of the cowdung is being used as cooking fuel due to severe fuel crisis in the Barind area.

Opportunity

1.

The program should be extended in other location of Barind area to ensure the family nutrition of the poor farmer's family.

COMILLA

Among the selected six farmers, four farmers could successfully establish and got benefit from their homestead. The results of those four farmers are given in the table 1. Farmer Jashim Kabir got highest amount of vegetables, more than 182 Kg of vegetables and maximum amount were taken by themselves, and only 44.5 Kg vegetables were sold in the market. Mr. Kabir got more than 2072 Taka. from that small piece of land (1.25 decimal) within only six month time. In the Kharif season there is a great shortage of vegetables in the market, because most of our land goes under water. There is only one alternative way, to grow vegetables in the homestead. In the following four farmers homestead there are at least ladies finger, brinjal, amaranth, kangkong, indian spinach, bitter gourd, and papaya present in there own homestead garden.

Table 1: Vegetable Production and Gross Return of different homesteads in Daudkandi and Homna

Farmers/ vegetables	Bed 1		Bed 2		Bed 3		Bed 4		Bed 5			Total Veg (Kg)	Gross return (tk)
	Tomato - Ladies finger		Amarenth + Brinjal- Amarenth		Cauliflower - Kangkong		Casbbage -Indian spinach		Radish + Bushbean - Summer onion –Summer onion				
Jashim Kabir	47 Kg	Fruiting stage	24.5 Kg	20 Kg	26 piece (8 Kg)	Running	26 piece (50 Kg)	Running	20 Kg	2.5 Kg bean and 0.75 Kg seed	3 Kg	182	2072
Shilpi Akter, Husband- Md. Mamin Mia	14 Kg	Fruiting stage	Damaged due to rain	7 Kg	23 piece (6 Kg)	Running	74 pieces (50 kg)	Running	2 Kg	11 Kg	5 kg	88	1605
Husband- Haju Mia Dekrikhola, Daudkandi	21.5 Kg	Fruiting stage	4 Kg	3.5 kg	38 piece (8.5Kg)	Running	3 piece (4Kg)	Running	2 Kg	3.5 Kg	2.5 Kg	49.5	1077
Anwara khatun, Husband- Maharam Ali	17.5 Kg	Fruiting stage	7.5 Kg	3.5 Kg	40 piece (9Kg)	Running	26 piece (19Kg)	Running	1.5 Kg-	4.7 Kg	Running	91.2	1035.50

Note: Red amarenth, kangkong = 15.00 Tk/ Kg, amaranth = 15.00 Tk/Kg, Tomato = 20.00 Tk/Kg, Bushbean = 30.00 Tk/kg., Brinjal = 30.00 Tk/Kg.

NOAKHALI

Homestead gardening was introduced among the 10 Resources Poor Farmers (RPF). In respect of different agro-ecological situation "Atkapalia Model" was followed here within 25-35 m^2 homestead yard area for year round vegetable production. In the homestead 10 numbers of vegetables (red amaranth, batishak, radish, indian spinach, tomato, okra, kangkong, amaranth, gimakolmi and brinjal) were introduced for cultivation. Each homestead harvested vegetable on an average of 245 kg. The area of homestead is very small but from nutritional point of view, its importance is higher. However, the amount is small but it helped very positively in mitigating daily need of nutrient. Particularly marginal and landless farmers have increased their food security. They had to purchase the daily requirements of vegetables from the market. But, now with the increased production of vegetables in homestead, they almost don't have to go to market for purchasing vegetables. Among the participated resources poor farmers (RPF), it was observed that dietary habit has been changed which was found more pronounced among landless and marginal farmers. They have developed their tendency to take vegetables that are more nutritious. In addition, it created a very positive impact on family member, neighbors and visitors due to good performance and yield, which helped in family nutrition and proper utilization of homestead area.

Table 1a**:** Production, Intake, Sell, Distribution to neighbors and income of one family (Average from 10 farm families) in Kharif 2008.

Sl. No.	Name of the Vegetables	Total Production (kg)	Intake (kg)	Sell (kg)	Distribution (kg)	Total (Tk)	Cash (Tk)
1	Red amaranth	11	7	2	2	132	24
2.	Indian spinach	29	15	10	4	232	80
3.	Gimakalmi	35	18	12	5	210	72
4.	Okra	27	13	12	2	270	120
5.	Amaranths	25	13	8	4	175	56
	Total	127	66	44	17	1019	352
	%	-	52	35	13	-	34

Table 1b**:** Production, Intake, Sell, Distribution to neighbors and income of one family (Average from 10 farm families) in rabi 2008-09.

Sl. No.	Name of the Vegetables	Total Production (kg)	Intake (kg)	Sell (kg)	Distribution (kg)	Total (Tk)	Cash (Tk)
1.	Red amaranth	25	10	10	5	300	120
2.	Kangkong	17	10	5	2	204	60
3.	Radish	19	9	7	3	109	70
4.	Batishak	20	12	5	3	140	35
5.	Tamato	18	9	7	2	216	84
6.	Brinjal	19	8	8	3	190	152
Total		118	58	42	18	1159	521
%		-	50	35	15	-	44

Price (Tk. kg^{-1}) : Red Amaranth = 12, Indian Spinach = 8, Gimakalmi = 6, Okra = 10, 5. Amaranth = 7, 6. Kangkong = 12, Red Amaranth = 10, Batishak = 7, Tamato = 12, Brinjal = 10.

Table 2a: Nutrient Intake by a family in Kharif 2008 (from beds)

Sl. No.	Name of Vegetable	Intake (kg)	Energy (kcal)	Protein (g)	Iron (mg)	Carotene (mg)	Vit B_1 (mg)	Vit B_2 (mg)	Vit C (g)
1.	Red Amaranth	7	3010	371	-	8358	7	9.1	30.1
2.	Indian Spinach	15	4050	330	1500	1923	3	54	9.6
3.	Gimakalmi	18	8200	324	702	19332	2.5	4.6	7.6
4.	Okra	13	5590	234	195	21710	5.2	20.8	13.0
5.	Amaranths	13	247	11.7	234	34	1.3	23.4	0.13
	Total	66	21097	972.2	2631	51367	19	111.9	60.4

Table 2b : Nutrient Intake by a family in Rabi 2008-09.

Sl. No.	Name of Vegetable	Intake (kg)	Energy (kcal)	Protein (g)	Iron (mg)	Carotene (mg)	Vit B_1 (mg)	Vit B_2 (mg)	Vit C (g)
1.	Red Amaranth	10	4300	530	-	11940	10	13	43
2.	Kangkong	10	3000	330	1000	8470	3	9	15
3.	Radish	9	2520	117	450	-	3.8	-	30.6
4.	Batishale	12	-	-	-	-	-	-	-
5.	Tamato	19	4140	342	324	3420	12.6	1.8	55.8
6.	Brinjal	19	7980	324	171	1615	22.8	15.2	95.0
	Total	50	21940	1643	1945	25445	30.2	39	239.4

Note: Nutrient conversion source: Krishi Diary, 2009

PATUAKHALI

Average yield of different vegetables of six homesteads were placed in Table 2. Most of its production was used for family consumption. Seed, fertilizer and fencing cost were approximately Tk. 1530.00. Total value of the vegetables from September, 2008 to May, 2009 was about Tk. 5627.00. Main benefit was consumption of fresh and pesticide free vegetables round the year. Consumption rate was 158 g/day/head considering 5 members family. In this nine month total average production was 459 kg and among its family consumption was 213 kg, distribution was 43 kg and sell was 203 kg which generated Tk. 2413.00 net cash after consumption and distribution. This concept is very good and highly accepted by the farmers. This program should be continued and more households should be brought under the program from the next year.

Table 2. Round the year vegetables production and utilization pattern of homestead (average of six homesteads) at FSRD site, Razakhali, Patuakhali from September 2008 to April 2009.

Month	Name of vegetables	Total prodn. (kg)	Vegetables utilization (kg)			Cash income (Tk)	Total income (Tk)
			Intake	Distribution	sell		
Sept.	Bitter gourd, Summer onion, Sponge gourd	14	13	1	-	-	210.00
Oct.	Summer onion, Bitter gourd	12	12	-	-	-	180.00
Nov.	Bottle gourd, Bean, Bitter gourd, Red amaranth	38	23	4	11	154.00	532.00
Dec.	Bottle gourd, Bean, Bitter gourd, Red amaranth, Radish	56	28	5	23	276.00	672.00
Jan.	Radish, Bottle gourd, Bean, Bitter gourd, Red amaranth, Cabbage, Cor. leaf	81	30	8	43	473.00	891.00
Feb.	Tomato, Bush bean, Bitter gourd, Cabbage,	76	28	7	41	410.00	760.00
March	Tomato, Potato, Bitter gourd, Brinjal	83	30	8	45	540.00	996.00
April	Yard long bean, Stem amaranth, Bitter gourd, Brinjal, Okra	48	25	5	18	252.00	672.00
May	Yard long bean, Stem amaranth, Bitter gourd, Brinjal, Okra, Kangkong, Snake gourd, Ribbed gourd	51	24	5	22	308.00	714.00
Total		**459**	**213**	**43**	**203**	**2413.00**	**5627.00**

RANGPUR

Vegetable production

Irrespective of farm categories it was observed that season wise vegetable production was highest in rabi season (214.05 kg/farm in landless, 235.85 kg/farm in marginal and 247.17 kg/farm in small) followed by kharif II (113.35 kg/farm in landless, 140.15 kg/farm in marginal and 127.00 kg/farm in small farm) season (Table 1, 3 &5). The lowest amount of vegetable production was recorded from kharif-1 season. The result also evident that irrespective of season, the higher amount of vegetable was produced by small farm categories (460.67 kg/year) followed by marginal (446.00 kg/year) and landless (428.30 kg/year) (Table 7, 5 &3). This suggests that vegetable production declined towards poor farmer this was probably because of involvement in other income generating activities.

Disposal pattern

a) Consumption

The consumption of vegetable varied among the farm categories. The total consumption was highest in small (274.57 kg/year) followed by marginal (263.00 kg/year) and landless (223.30 kg/year) farm (Table 6, 4 & 2). The average vegetable intake per head per day was higher in small farm (188.06 g) followed by marginal (180.14 g) and landless (122.36 g) farm (Table 8). The results revealed that intake was lower towards poor farms. This was probably because of more selling of vegetables in the market to meet up their instant need.

b) Distribution

The distribution pattern of vegetable was presented in Table 6, 4 & 2. The highest amount of vegetable was distributed by small farm (51.80 kg/year) followed by marginal (41.00 kg/year) and landless farm (34.00 kg/year).

c) Selling

Each farm family sold some amount of vegetables to the market to meet up their instant need. The highest amount of vegetables sold by landless farm (171.00 kg/year) followed by marginal (142.00 kg/year) and small farm (134.30 kg/year) (Table 2, 4 & 6). The pattern of selling indicated that selling increased towards poor farmer. Resource poor farmers in some cases might have no alternative than selling vegetables to meet up their instant need compared to resource rich farmers. The over all results indicated that production, intake and distribution of vegetables increased from landless towards small farmer while selling increased towards poor farmers.

Economic return

Each farm family sold a portion of their produce to the local market to meet up their daily necessities. However, economic return was also calculated on the basis of total production. The highest cash income by selling vegetables was recorded from landless farm (Tk 1789.45/year) followed by marginal (Tk 1442.00/year) and small farm (Tk 1404.30/year) (Table 8).The highest total income (Tk 4534.86/year) and net income (Tk 3791.86/year) was earned by small farmer followed by marginal and landless (Table 7). This trend was probably influenced by their total vegetable production.

Table 1. Year round vegetable production from different niches by landless group of farmers at Mominpur (ICM Club) under FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Niches	Rabi	Kharif-1	Kharif-II	Total (kg)
	Mid. Oct.-Mid March (Kg)	Mid March-Mid June (Kg)	Mid June-Mid Oct. (Kg)	
Open sunny place				
Bed-1	23.00	17.00	16.00	56.22
Bed-2	18.00	14.00	22.00	54.00
Bed-3	23.00	13.00	5.00	41.00
Bed-4	28.00	6.00	3.00	37.00
Bed-5	4.00	4.00	22.00	30.00
Roof Top	44.00	5.00	3.00	52.00
Trellis	23.00	8.00	3.35	34.00
Shady place	23.00	-	11.00	34.13
Marshy land	7.30	-	-	7.30
Fence	5.00	3.00	7.00	15.00
Boundary	15.75	6.00	21.00	36.25
Total	214.05	76.00	113.35	428.30

Table-2. Year round vegetable production and utilization pattern of landless farmer at Mominpur (ICM Club) under FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Month	Name of vegetable	Total Production (kg)	Vegetable utilization			Cash income (Tk)	Total income (Tk)
			Consumption (kg)	Distribution (kg)	Sale (kg)		
June/08	Indian spinach, Okra, Sweet gourd, Ribbed gourd	21.00	7.20	2.00	11.95	107.55	189.00
July/08	Indian spinach, Okra, Kangkong Sweet gourd, kalakachu, Ribbed gourd	18.00	2.60	2.00	14.00	126.00	162.00
August/08	Indian spinach, Okra, Kangkong Sweet gourd, kalakachu	30.00	20.2	3.00	11.00	143.00	300.00
Sept./08	Okra, lalsak, Indian spinach, kalakachu, Kangkong	24.00	5.0	2.00	17.00	221.00	312.00
Oct./08	Papaya	53.00	23.8	3.800	26.00	364.00	742.00
Nov./08	Papaya, Radish Sak, lalsak Potato yam	35.00	8.50	2.20	13.30	106.40	280.00
Dec./08	Spinach, Bottle gourd, Bean, Potato Yam, Papaya, Napasak, Radish	42.00	31.00	3.00	14.00	112.00	336.00
Jan./09	Radish, Cabbage, Spinach, Bottle gourd, Yam, Papaya	48.00	21.00	4.00	22.00	242.00	528.00
Feb./09	Radish, Cabbage, Bottle gourd, Papaya, Tomato, Bitter gourd, Turmeric, Ginger	47.30	32.00	4.00	13.00	117.00	425.70
Mar./09	Tomato, Data, Bottle gourd, Papaya, , Brinjal, Garlic, Turmeric, Ginger	41.20	28.00	4.00	10.00	90.00	369.00
Aprl./09	Data, Patsak, Indian spinach , lalsak	35.00	30.00	1.00	9.00	63.00	245.00
May/09	Data, , Okra, kalakachu, Indian spinach, lalsak	34.00	14.00	3.00	9.75	97.50	340.00
	Total	428.30	223.30	34.00	171.00	1789.45	4318.70

Table 3. Year round vegetable production from different niches by marginal group of farmer at Mominpur (ICM Club) under FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Niches	Rabi	Kharif-1	Kharif-2	Total (kg)
	Mid. Oct.-Mid March (Kg)	Mid March-Mid June (Kg)	Mid June-Mid Oct. (Kg)	
Open sunny place				
Bed-1	23.200	14.00	20.800	58.00
Bed-2	13.650	13.00	21.350	48.00
Bed-3	26.00	12.00	12.000	50.00
Bed-4	28.000	6.00	3.000	37.00
Bed-5	4.000	2.50	23.500	30.00
Roof Top	48.000	5.00	3.000	56.00
Trellis	23.000	7.500	3.500	34.00
Shady place	25.000	-	12.000	37.00
Marshy land	8.00	-	-	8.00
Fence	5.000	5.500	11.500	22.00
Boundary	32.00	4.50	29.15	66.00
Total	235.85	70.00	140.15	446.00

Table 4 Year round vegetable production and utilization pattern of marginal farmers at Mominpur (ICM Club) under FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Month	Name of vegetables	Total Production (kg)	Vegetable utilization			Cash income (Tk)	Total income (Tk)
			Consumption (kg)	Distribution (kg)	Sale (kg)		
June/08	Indian spinach, Okra, Ribbed gourd, Sweet gourd,	25.00	11.00	2.00	12.00	108.00	225.00
July/08	Indian spinach, Okra, Sweet gourd, kalakachu Ribbed gourd, Kangkong	18.00	4.00	3.00	11.00	99.00	162.00
August/08	Indian spinach, Okra, kalakachu, Kangkong	31.00	17.00	3.00	11.00	143.00	403.00
Sept./08	kalakachu, Kangkong, Okra, Indian spinach , Lalsak	15.00	6.00	2.00	7.00	91.00	195.00
Oct./08	Papaya	38.00	15.00	2.00	21.00	294.00	532.00
Nov./08	Papaya, Potato yam, Radish Sak, lalsak	21.00	10.00	2.00	9.00	72.00	168.00
Dec./08	Spinach, Bottle gourd, Bean, Potato Yam, Papaya, Napasak, Radish sak	50.00	31.00	6.00	13.00	104.00	400.00
Jan./09	Radish, Cabbage, Bottle gourd, Papaya, Tomato	59.00	38.00	5.00	16.00	176.00	649.00
Feb./09	Radish, Cabbage, Bottle gourd, bitter gourd, Papaya, Turmeric, Ginger	55.00	40.00	3.00	12.00	108.00	495.00
Mar./09	Cabbage, Tomato, Data, Bottle gourd, Papaya, Garlic, lalsak , Turmeric, Ginger	46.00	31.00	5.00	10.00	90.00	414.00
Aprl./09	Data, Patsak, Indian spinach , lalsak	53.00	40.00	4.00	9.00	63.00	371.00
May/09	Data, , Okra, kalakachu, Indian spinach, lalsak	35.00	20.00	4.00	11.00	110.00	350.00
	Total	446.00	263.00	41.00	142.00	1442.00	4364.00

Table 5. Year round vegetable production from different niches by small group of farmer at Mominpur (ICM Club) under FSRD site Lahirirhat, Rangpur during June 2008 to May 2009.

Niches	Rabi	Kharif-1	Kharif-2	Total (kg)
	Mid. Oct.-Mid March (kg)	Mid March-Mid June (kg)	Mid June-Mid Oct . (kg)	
Open sunny place				
Bed-1	26.00	28.00	21.40	75.40
Bed-2	27.00	8.50	25.20	60.70
Bed-3	27.00	13.00	11.70	51.70
Bed-4	30.00	6.00	5.00	41.00
Bed-5	7.00	4.00	20.00	31.00
Roof Top	41.00	6.00	3.00	50.00
Trellis	23.00	11.00	4.20	38.20
Shady place	26.00	-	15.00	41.00
Marshy land	10.17	-	-	10.17
Fence	6.00	5.00	7.50	18.50
Boundary	24.00	5.00	14.00	43.00
Total	247.17	86.50	127.00	460.67

Table 6. Year round vegetable production and utilization pattern of small farmers at Mominpur (ICM Club) under FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Month	Name of vegetable	Total Production (kg)	Vegetable utilization			Cash income (Tk)	Total income (Tk)
			Consumed (kg)	Distributed (kg)	Sole (kg)		
Jun/08	Indian spinach, Okra, Sweet gourd, Ash gourd	21.20	10.20	3.00	8.00	72.00	190.80
Jul/08	Indian spinach, Okra, Sweet gourd , lalsak, kalakachu, Kangkong	18.50	4.50	3.00	11.00	99.00	166.50
Aug/08	Indian spinach, Okra, kalakachu, Kangkong, lalsak	35.00	20.00	4.00	11.00	143.00	455.00
Sep./08	Kalkachu, Kangkong, Indian spinach, okra, lalsak	17.00	4.50	2.50	10.00	130.00	221.00
Oct./08	Papaya	40.5	22.50	10.00	8.00	112.00	567.00
Nov./08	Papaya, potato yam, Radish sak, lalsak	12.87	3.87	3.00	6.00	48.00	102.96
Dec./08	Spinach, Bottle gourd, napasak, radish, Bean, Potato Yam, Papaya,	52.10	30.5	6.00	15.6	120.00	416.80
Jan./09	Radish, Cabbage, Bottle gourd, Papaya, bean, tomato	57.00	34.00	4.00	19.00	209.00	627.00
Feb./09	Cabbage, Bottle gourd, bean ,tomato, Papaya, Turmeric, Ginger	58.50	41.00	3.50	14.00	126.00	526.50
Mar./09	Tomato, Brinjal, lalsak, Datasak, Bottle gourd, Turmeric, Ginger bean, Papaya, Bitter gourd	55.2	40.00	5.00	10.2	91.80	496.80
Apr./09	Data, Patsak, lalsak, brinjal, Indianspinach , Tomato,	54.5	40.00	4.00	10.5	73.50	381.50
May/09	Data, Okra, snake gourd kalakachu, patsak, lalsak, Indian spinach	38.3	23.50	3.80	11.0	110.00	383.00
	Total	460.67	274.57	51.80	134.30	1404.30	4534.86

Table 7. Year round total vegetable production and utilization pattern and net income of different group of farmers at Mominpur (ICM Club) under OFRD, Rangpur during June 08 to May 09.

Farmers group	Production (kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income (Tk)
		Consumption	Distribt.	Sale				
Landless	428.30	223.30	34.00	171.00	1789.45	4318.70	487.00	3831.70
Marginal	446.00	263.00	41.00	142.00	1442.00	4364.00	637.00	3727.00
Small	460.67	274.57	51.80	134.30	1404.30	4534.86	743.00	3791.86
Total	1334.97	760.87	126.80	447.30	4635.75	13317.56	1867.00	11350.56
Mean	444.99	253.62	42.27	149.10	1545.25	4405.85	622.33	3783.52

Table 8. Disposal pattern and intake of vegetables by different farm categories at Mominpur (ICM club) under FSRD site, Lahirirhat, OFRD, Rangpur.

Farm Category	No. of Average family member	Before Intervention (2007-2008)**					After Intervention(2008-2009)				
		Total Production (kg)	Disposal			Intake/ head/ day(g)	Total production (kg)	Disposal			Intake/ head/ day(g)
			Consumption (kg)	Distribution (kg)	Sale (kg)			Consumption (kg)	Distribu-tion (kg)	Sale (kg)	
Landless	05	180.0	98.0	26.0	56.0	53.59	428.30	223.30	34.00	171.0	122.36
Marginal	04	202.0	127.0	32.0	43.0	86.98	446.00	263.00	41.00	142.0	180.14
Small	04	233.0	136.0	40.0	57.0	93.15	460.67	274.57	51.80	134.30	188.06

TANGAIL

Among the six farmers studied/intervened two farmers produced and consumed more than that of their requirements (120-135%) (Table 1). The other four farmers produced and consumed around 68-78% of their requirements. Whereas earlier, they consumed on average only 20% of their requirement. So, it may be told that through the initiation of ICM activities, the production as well as the consumption of vegetable has been increased remarkably.

Table 1. Vegetable production and distribution of farmers at Ghatail, Tangail during 2008-09

Farmers	Family members	Total Production (kg)	Consumption (kg)	Distribution (kg)	Sale (kg)	Vegetable requirement/ day (g)	% fulfilled of requirement/ day (g)
1	6	530.75	371.0	43.5	116.25	1500	1016 (68%)
2	5	539.5	357.5	46.0	136.0	1250	979 (78%)
3	3	527.85	328.35	43.0	156.5	750	900 (120%)
4	5	557.0	350..5	45.0	161.5	1250	960 (77%)
5	6	601.8	426.3	40.0	135.5	1500	1167 (78%)
6	3	538.0	369.5	36.5	132.0	750	1012 (135%)

JAMALPUR

Year round vegetable production

The performance of vegetable crops grown in homestead area of the marginal farmers is presented in Table 1. After intervention of "Narikeli Model" by the marginal group of farmers the total vegetable production was 317.50 kg of which 250.50 kg and 67.00 kg were from open spaces and creeper vegetable, respectively. Before intervention, the vegetable production was only 97.00 kg. Therefore, the production was increased by 227% (Table 1). From small farmers group after intervention of this Model, the total vegetable production was 249.75 kg of which open spaces and creeper vegetables contributed 194.00 kg and 55.75 kg, respectively. On the other hand, before intervention the vegetable production was only 83.50 kg. Therefore, the production was increased by 119% (Table 2).

Disposal Pattern of vegetables

From marginal group, the total vegetables production was 97.50 kg of which 44.50 kg, 4.00 kg and 49.00 kg were consumed, distributed and sold, respectively and on the basis of disposal pattern the consumption per day per person was 30 g before intervention of the model. On the other hand, after intervention the total vegetables production was 317.50 kg of which 134.00 kg 21.00 kg and 162.00 kg were disposed as consumed, distributed and sold, respectively. The consumption per day per person was 92 g after intervention of the model (Table 3). In case of small farmers group, the total vegetables production was 83.50 kg of which 45.00 kg, 12.50 kg and 25.00 kg were consumed, distributed and sold, respectively and on the basis of disposal pattern the consumption per day per person was 25 g before intervention of the model. On the other hand, after intervention the total vegetables production was 249.75 kg of which 132.50 kg, 27.50 kg and 89.75 kg were disposed as consumed, distributed and sold, respectively. The consumption per day per person was 73 g after intervention of the model (Table 4). It was observed that farmers might be benefited in nutritional point of view. Moreover, they would earn some cash. The cash income of marginal farmers were higher than small farmers probably they sold more of their vegetables.

Output of the program

- Farmers are being familiar with the improved vegetable varieties.
- Consumption of fresh vegetables by the family has increased and also has changed the consumption habit towards vegetables.

- Farmers dependency on local vegetable market has been decreased due to own homestead vegetable production.
- Above all, the nutrition demand of the farm family member is fulfilled as well as they earn some money by selling the products in the local market.

Farmers' reaction

Farmers were interested to involve themselves in the home gardening due to fresh harvest of vegetable to meet their daily demand as well as to earn some cash also.

Table 1. Vegetable production and utilization pattern of homestead for marginal farmers (averaged of 4 farm house) at FSRD Site, Kushumhati, Sherpur during 2008-09

Season	Before intervention			After intervention			Increased (%)
	Open space vegetable kg)	Creeper vegetable (kg)	Total (kg)	Open space vegetable (kg)	Creeper vegetable (kg)	Total (kg)	
Rabi	42.50	13.50	55.00	155.00	35.50	170.50	
Kharif I	21.50	7.00	28.00	67.50	19.50	78.00	
Kharif II	7.00	6.00	13.00	28.00	12.00	40.00	227
Total	71.00	26.50	97.50	250.50	67.00	317.50	

Table 2. Vegetable production and utilization pattern of homestead for small farmers (averaged of 4 farm house) at FSRD Site, Kushumhati, Sherpur during 2008-09

Season	Before intervention			After intervention			Increased (%)
	Open space vegetable kg)	Creeper vegetable (kg)	Total (kg)	Open space vegetable (kg)	Creeper vegetable (kg)	Total (kg)	
Rabi	38.50	11.00	49.50	114.50	28.25	154.75	
Kharif I	12.00	6.00	18.00	55.00	16.50	71.50	
Kharif II	9.50	5.50	16.00	24.50	11.00	35.50	199
Total	60.00	22.50	83.50	194.00	55.75	249.75	

Table 3. Disposal pattern vegetable production and utilization pattern of homestead for marginal farmers (averaged of 4 farm house) at FSRD Site, Kushumhati, Sherpur during 2008-09

Vegetable	Total harvest (kg)	Consumed (kg)	Distributed (kg)	Sold (kg)	Consumed/person/day (g) (Family memebr 5)
Before intervention:					
a) Open space	71.00	30.00	3.00	38.00	
b) Creeper	26.50	14.50	1.00	11.00	30
Total	97.50	44.50	4.00	49.00	
After intervention:					
a) Open space	250.00	114.00	14.00	122.00	
b) Creeper	67.00	20.00	7.00	40.00	92
Total	317.50	134.00	21.00	162.00	

Table 4. Disposal pattern vegetable production and utilization pattern of homestead for small farmers (average of 4 farm house) at FSRD Site, Kushumhati, Sherpur during 2008-09

Vegetable	Total harvest (kg)	Consumed (kg)	Distributed (kg)	Sold (kg)	Consumed/person/day (g) (Family memebr 4)
Before intervention:					
a) Open space	60.00	35.00	10.00	15.00	
b) Creeper	22.50	10.00	2.50	10.00	25
Total	83.50	45.00	12.50	25.00	
After intervention:					
a) Open space	194.00	100.00	14.50	79.50	
b) Creeper	55.75	32.50	13.00	10.25	73
Total	249.75	132.50	27.50	89.75	

Table 5. Vegetable production and utilization pattern of homestead for marginal farmers (average of 4 farm house) at FSRD Site, Kushumhati, Sherpur during 2008-09

Month	Name of vegetable	Total production (kg)	Total utilization (kg)			Cash income (Tk)	Total income (Tk)
			Consumed	Distribution	Sold		
Nove	Potato yam	10.50	6.50	1.00	3.00	36.00	126.00
Dece	Lalshak, Copriander, Indian spinach, Shim	40.50	15.00	4.50	21.00	168.00	324.50
Jan	Cabbage, Carrot, Bitter gourd, Brinjal, Shim	42.00	20.00	3.50	18.50	185.00	420.00
Feb.	Onion, Garlic, Tomato, Bitter gourd, Brinjal Shim	82.00	30.00	3.00	49.00	343.00	574.00
March	Shim	3.00	3.00	-	-	-	36.30
April	Kangkong, Puishak	10.00	8.00	-	2.00	10.00	50.00
May	Latiraj kachu (Stolon), Dharesh, Kangkong, Puishak, Yardlong bean, Red amaranth, White gourd	45.50	16.50	4.00	25.00	300.00	546.00
June	Latiraj kachu (Stolon), Dharesh, Kangkong, Puishak, Yardlong bean, Bitter gourd, Red amaranth	40.00	14.00	3.00	23.00	276.00	480.00
July	Latiraj kachu (Stolon), Dharesh, Kangkong, Bitter gourd	28.00	5.00	2.00	21.00-	252.00	336.00
August	Kanhkong	8.00	8.00	-	-	-	40.00
September	Kangkong	4.00	4.00	-	-	-	20.00
October	Kangkong	4.00	4.00	-		-	20.00
Total		317.50	134.00	21.00	162.00	1570.00	2972.00

Table 6. Vegetable production and utilization pattern of homestead for small farmers (average of 4 farm house) at FSRD Site, Kushumhati, Sherpur during 2008-09

Month	Name of vegetable	Total product (kg)	Total utilization (kg)			Cash income (Tk)	Total income (Tk)
			Consumed	Distribution	Sold		
November	Potato yam	8.50	5.00	1.00	2.50	30.00	102.00
December	Lalshak, Copriander, Indian spinach, Shim	28.50	18.00	6.50	4.00	32.00	228.00
January	Cabbage, Carrot, Bitter gourd, Brinjal, Shim	38.00	17.00	6.50	14.50	145.00	380.00
February	Onion, Garlic, Tomato, Bitter gourd, Brinjal, Shim	56.00	32.00	5.00	19.00	133.00	392.00
March	Shim	4.00	4.00	-	-	-	48.00
April	Kangkong, Puishak	7.00	7.00	-	-	-	35.00
May	Latiraj kachu (Stolon), Dharesh, Kangkong, Puishak, Yardlong bean, Red amaranth, White gourd	33.50	13.50	4.00	16.00	192.00	402.00
June	Latiraj kachu (Stolon), Dharesh, Kangkong, Puishak, Yardlong bean, Bitter gourd, Red amaranth	34.00	17.00	3.00	14.00	168.00	408.00
July	Latiraj kachu (Stolon), Dherosh, Kangkong, Bitter gourd	23.25	5.00	1.50	16.75	201.00	279.00
August	Kanhkong	6.00	6.00	-	-	-	30.00
September	Kangkong	5.00	3.00	-	2.00	10.00	25.00
October	Kangkong	6.00	5.00	-	1.00	5.00	30.00
Total		249.75	132.50	27.50	89.75	916.00	2359.00

SYLHET

Production, utilization and income from vegetables are shown in table 1. Production of the vegetables round the year was 461 kg and their gross return was Tk 5020. The utilization pattern of vegetable showed that the farmers not only consumed their produces but also distributed a portion of the produce to relatives and neighbours, and a portion was sold.

Farmer's reaction

Farmers expressed their satisfaction with the cultivation of different vegetables round the year in their homestead area. They opined that they achieved consistently higher rates of vegetables consumed and in maintaining remission of malnutrition and also gaining additional cash income.

Table 1. Average performance of year round vegetables in homestead area at BARI technology village, Hashampur under FSRD site, Jalalpur, Sylhet (average of six farmers)

Crop	Amount harvested (kg)	Return Tk.	Amount distributed (kg)	Own consumption (kg)	Amount sold (kg)
Bed I					
Radish	17	136	7	10	-
Tomato	32	384	6	11	15
Amaranth	17	170	2	10	5
Indian spinach	25	125	5	10	10
Bed II					
Laishak	3	60	-	1	2
Cabbage	28	280	6	12	10
Amaranth	19	190	3	7	9
Okra	6	120	1	2	3
Bed III					
Brinjal	24	240	4	12	8
Lalshak	8	128	2	2	4
Gimakalmi	28	224	10	10	8
Bed IV					
French bean	8	176	1	4	3
Lalshak	6	96	1	2	3
Yard long bean	5	110	1	2	2
Total	226	2439	49	95	82
Boundary of bed					
Stolon	22	220	4	12	6
Trelli					
Wax gourd	34	510	2	18	14
Country bean	76	912	6	30	40
Total	132	1442	12	60	60
Under trellis					
Turmeric	58	464	5	25	28
Mukhikachu	45	675	10	30	5
Total	**103**	**1139**	**15**	**55**	**33**
Grand total	**461**	**5020**	**76**	**210**	**175**

Price Tk/kg: Radish 8.00, Tomato 12.00, Amaranth 10.00, Indian spinach 5.00, Laishak 20.00, Cabbage 10.00 Okra 20.00, Brinjal 10.00, Lalshak 16.00, Gimakalmi 8.00, French bean 22.00, YLB 22.00, Country bean 12.00, Mukhikachu 15.00, Stoton 10.00, Turmeric 8.00, Wax gourd 15.00.

Bogra

Yield of different vegetables of homestead are shown in Table 1. Most of its production was used for family consumption. The average per day production per family was 2.25 kg. The total vegetable production from open sunny land, roof trellis, tree support and fence were 191.46 kg with family consumption 108.17 kg, distribution 19.93 kg and sell was 63.36 kg. The harvesting period was December to February.

Economic return

The total economic net return per homestead was 2147.10. The highest gross return was obtained from bottle gourd (Tk. 385.3) which was followed by cabbage (Tk. 384.8).

Farmers' reaction: Farmers are more interested to grow vegetables and fruits in their homestead. Consumption of fresh vegetables and fruits has increased and also changed the consumption habit. Extra income can be earned.

Table 1: Vegetable production per homestead of the MLT site, Shibganj, Bogra during rabi 2008-09

Name of place	Name of Vegetables	Vegetable utilization (kg)			Total harvest
		Consumption	Distribution	Sold	
Open place	Radish	22.41	3.00	7.25	32.66
	Cabbage	25.70	4.28	8.50	38.48
	Tomato	24.88	2.25	7.45	34.58
	Spinach	10.95	1.00	6.30	18.25
Roof	Bottle gourd	5.51	4.35	7.30	17.16
Trellis	Bottle gourd	3.52	1.75	16.10	21.37
Tree support	Country bean	11.95	2.00	5.16	19.11
Fence	Bitter gourd	3.25	1.30	5.30	9.85
Partial shady area	Elephant foot yam				
	Leaf aroid (Moulovi Kachu)				
	Baromashi Marich				
	Ginger				
	Termaric				
Marshy land	Latiraz				
Homestead boundary	Papaya = 3				
	Guava = 2				
Back yard/ waste land	Laizna = 3				
	Banana = 3				
Total		108.17	19.93	63.36	191.46

Table 2. Economic return per homestead at the MLT site, Shibganj, Bogra during 2008-09 (up to February 09)

Vegetable	Total vegetable production (kg)	Vegetable price (Tk/kg)	Gross return (Tk)	Total cost (Tk)	Net return (Tk)
Radish	32.66	10.00	326.6	400	2147.10
Cabbage	38.48	10.00	384.8		
Tomato	34.58	20.00	691.6		
Spinach	18.25	12.00	219.0		
Bitter gourd	9.85	16.00	157.6		
Bottle gourd	38.53	10.00	385.3		
Country bean	19.11	20.00	382.2		
Total			2547.10	400 (without family labour)	2147.10

Conclusion

Year round vegetable production in the homestead area through models was a successful approach for homestead resource utilization and family nutrition. Vit-A and C can supplement fully from homestead vegetables but protein should be supplement from animal source to fulfil ones requirements. Other minerals requirements might be fulfilled if the new planted fruit trees started fruiting and the existing fruits were considered for nutrient calculation. Farmers in the site area are not conscious about their family nutrition. It is therefore imperative to carryout more motivational program with intensive vegetable production, food processing, cooking and quality maintain for ensuring nutritional requirement and dissemination in more homestead.

Production Programme of Urea Super Granule (USG) on Upland Crops

Abstract

An experiment was conducted at the MLT site, Domar, Nilphamari, MLT site, Bijoynagar, Godagari, Rajshahi, MLT site, Paba, Rajshahi, MLT site, Bhabanipur, Sujanagar, Pabna, MLT site, Ghatail, Tangail, FSRD Site, Kushumhati, Sherpur, MLT site, Netrakona Sadar, MLT site Kendua, Netrakona, MLT site, Sunamgonj and MLT site, Manikganj during 2008-09 to demonstrate the performance of USG for upland crops (potato, tomato, cabbage, cauliflower, brinjal, banana and maize) in comparison to prilled urea. Two levels of N viz. T_1: Recommended dose of N as prilled urea and T_2: 20% less than recommended dose of N as USG were considered as two treatments. USG application showed higher yield and economic return in all the locations.

Introduction

Nitrogen is an important nutrient element for crop production. It is needed in each and every crop in large quantity. Among all the fertilizers, the efficiency of nitrogenous fertilizers is lowest due to various losses (gaseous, leaching, run off etc). It is reported that about 40% of applied N is used by crop and rest amount is lost from the soil. Nitrogen is mostly used as prilled urea in the oxidized zone of the soil where it dissolves quickly and enters to loss process. The loss may be minimized if it applied as super granules to the reduced zone. Moreover, crisis of urea is a burning issue throughout the country. The USG releases nitrogen slowly to the crop for a longer period of time. Thus, the N use efficiency as well as yield of crops as increased. Effect of USG as a source of N had very promising results in upland vegetables and fruits observed from the previous study. Hence, the production programme was undertaken to demonstrate the performance of USG for upland crops like potato, tomato, cabbage, cauliflower, brinjal, banana and maize etc. cultivation in comparison to prilled urea.

Materials and Methods

An experiment was conducted at the MLT site, Domar, Nilphamari, MLT site, Bijoynagar, Godagari, Rajshahi, MLT site, Paba, Rajshahi, MLT site, Bhabanipur, Sujanagar, Pabna, MLT site, Ghatail, Tangail, FSRD Site, Kushumhati, Sherpur, MLT site, Netrakona Sadar, MLT site Kendua, Netrakona, MLT Sunamgonj and MLT site, Manikganj during 2008-09 in medium high land irrigated situation to demonstrate the performance of USG for cabbage cultivation in comparison to prilled urea. The study was laid out in RCB design with six dispersed replications (farmers). Farmers are the members of ICM club/FFS who were selected with the help of local DAE personnel. Two levels of N from two sources were considered as two treatments. T_1: Recommended dose of N as prilled urea for HYG and T_2 : 20 % less than recommended dose of N as USG for HYG. Variety, spacing, planting time, harvesting time and fertilizer dose are presented in the Table 1. Full dose of TSP, MP, Gypsum, Zinc sulphate, Boric acid and cowdung were applied during final land preparation. Prilled urea was applied in installments depending upon the crops. USG was applied in ring method or furrow method. Collected data were analyzed statistically following Crop Stat analytical package. Cost and return analysis was done also.

Table 1. Crop management practices done of different crops in different locations

Location	Variety	Spacing (cm)	Planting time	Harvesting time	Fertilizer dose (N as prilled) (N-P-K-S-Zn-B-CD kg/ha)
Potato					
Rangpur	Granula	60 x 25	2-4 Dec, 2008	2-5 Mar, 09	138-40-135-30-4-1-5000
Shyampur	Diamant	60 x 25	1st week Dec.	3-8 Mar.09	140-44–130-22-2-2
Bogra	Granola	60 x 25	17 -26Nov. 08	6 - 12, Feb. 08	155-20- 96- 10.97-1.57-0.77
Tomato					
Barind	Sabal (Hybrid)	60 x 40	15 - 17 Sept. 2008	15 Dec.08 to 12 Jan.09	253--
Tangail	Ratan	60 x 40	15 Nov. 2008	28 Feb. to 10 March 2009	205--
Sylhet	Epok	75 x 60	25 Nov.2008		
Jamalpur	Udayan	60 × 40	Nov16, 2008	Jan. 22, 09 to Mar. 15, 09	260-75-95-20-1-1
Rangpur	Ratan	60 x 45	28 Nov. 2008	20 Febr. to 8 April, 2009	150-40-140-30-4-1-5000
Cabbage					
Rangpur	Green 621	60 x 45	8-12 Nov. 2008	14 Jan. to 6 Feb. 2009	172-25-24-38-2-1-6000
Pabna	Atlas -70	60 x 45	Nov. 24, 2009	February 15-20, 2009	138-50-124-36
Sylhet	Atlas -70	75 x 60	20Nov.08		
Tangail	Green crown	60 x 50	28 Sept. to 6 Oct.08	1-15 Jan. 2009	172-50-150-13
Jamalpur	Atlas 70		14Nov.2008	Jan.19 to Feb 17, 2009.	160-50-150-1($MgSO_4$)
Comilla	Atlas 70		16- 25Nov.08		190-75-30-15- 3-1
Kishoreganj	Atlas 70	60 × 45	17-18 Nov.08	3-5 Feb. 2009	190-36-145-35-1
Cauliflower					
Rangpur	Snow crown	60 x 45	5-10 Nov. 2008	30 Jan to 5 Febr.09	155 – 70 - 120 -32 -4-1 -5000
Shyampur		60 x 45	3-5 Nov.08	1-10 Jan./2009	120-40-120-16-2-1
Tangail	Poushali	60 x 50	25 Sept to 6 October, 2008	29 Dec. 08 to 13 Jan.09	138-50-112-13
Pabna	Snow white	60 x 45	Nov. 23, 2009	30 Jan. to 10 Febr, 09	138-50-124-36
Brinjal					
Shyampur		70 x 70			175-
Banana					
Rangpur	Sagar*	2m x 2m	15 March, 2008		0.30 -0.08-0.015-4 (per pit)
Bogra	Sagar*	2 m × 2m	October 20, 2007		345-98-313-90-4-0.85
Maize					
Rangpur	NK-40’	75 x 25	2-5 Dec. 2008	2-5 May, 2009	196-36-75-30-3-1-5000
Bogra	900-M	75 × 25	Dec. 15 to 18, 2008	6 -11 March.09	253-55-83-0.94
Pabna	BHM-5		Dec. 21 to 24, 2008	10- 12 May 2009	253-52-110-47-3-1-3000
Tangail	BHM-5	75 x 25	19-22 Nov. 2008	12-15 April 2009	253-52-110-36-3.58-1
Manikganj	BHM-5	75 x 25	15 Nov.2008	11-13 April 2009	256-52-111-47-5.4-5.1-2500

*Rangin Meher Sagar

Results and Discussion

Potato: The yield variation of potato due to application of USG (<20% of recommended dose) and prilled urea (100% recommended dose) was not significant in Rangpur and Borga (≤ 0.5 t/ha) (Table 2). In Rajshahi it was 4.65 t/ha. Gross margin was also associated with the yield.

Tomato: Due to the application of USG, the yield of tomato was 5.63 to 12.32 % and gross margin was 7.37 to 21.12% higher over the prilled urea in different locations (Table 3).

Cabbage: Except Pabna, the head yield varied from 69.58 to 99.46 t/ha in USG treated plots whereas it was 63.62 to 80.80 t/ha in different locations (Table 4). The poor yield (about 50 t ha^{-1}) in Pabna might be due to late sowing and infestation of aphids and foggy weather. The gross margin or net return varied from Tk. 111596 to 552530 /ha and Tk. 89308 to 488366 /ha due to application of USG and prilled urea, respectively.

Cauliflower: The curd of cauliflower was 2.75 to 4.88 t/ha (5.80 to 25.01%) higher in the plots where USG was used compared with prilled urea in average of different locations (Table 5). The gross margin was Tk. 21733 to 68820 /ha (7.26 to 39.55%) higher over prilled urea treatment.

Brinjal: The yield was about 3 t/ha and gross margin about Tk. 30000 ha^{-1} were higher in USG over prilled urea treatment in Shyampur, Rajshahi (Table 6).

Banana: The effect of USG over prilled urea was not found in banana (Table 6).

Maize: Higher yield (3-7%) was found in different locations due to applications USG over prilled urea. Higher gross margin was also found in USG treatment.

Farmers' opinion

Farmers are interested to apply USG in crop production. But they opined that USG must be available in the market during the growing season. They needed easy application methods of USG and availability of the same in the local market.

Conclusion

From the results it may be concluded that use of urea super granule (USG) is better for different crops and even 20 % less than recommended dose of N as USG is more profitable than recommended dose of N as prilled urea. The result is very encouraging. It may be recommended as extension message for large scale production

Table 2. Yield and gross margin of potato by prilled urea and USG at different locations during 2008-09.

Treatment	Yield (t ha^{-1})			Gross margin ($Tk.ha^{-1}$)		
	Rangpur	Rajshahi	Bogra	Rangpur	Rajshahi	Bogra
Prilled urea (Rec.)	25.76	28.03	22.12	113016	201395	136669
USG (<20% Rec.)	26.26	32.68	22.51	118496	252695	141238

Table 3. Yield and gross margin of tomato by prilled urea and USG at different locations during 2008-09.

Treat.	Yield (t ha^{-1})					Gross margin ($Tk.ha^{-1}$)				
	Rajshahi	Tangail	Sylhet	Sherpur	Rangpur	Rajshahi	Tangail	Sylhet	Sherpur	Rangpur
T_1	42.53	51.53	66.13	71.2	62.49	230860	412860	552995	217552	344851
T_2	46.65	57.88	74.02	79.5	66.01	271857	489996	631910	263502	370263

T_1 : Prilled urea (Rec.), T_2 : USG (<20% Rec.)

Table 4. Yield and gross margin of cabbage by prilled urea and USG at different locations during 2008-09.

Treatment	Head Yield (t ha^{-1})							
	Rangpur	Pabna	Sylhet	Tangail	Sherpur	Daudkandi	Homna	Netrakona
Prilled urea (Rec.)	63.62	49.18	70.14	80.80	74.98	72.63	74.53	75.70
USG (<20% Rec.)	69.58	52.22	78.18	99.46	81.22	81.49	86.53	80.40
	Net return/Gross margin ($Tk.ha^{-1}$)							
Prilled urea (Rec.)	383224	206410	488366	389640	170990	217890	89308	148600
USG (<20% Rec.)	425820	223330	552530	501914	201230	244470	111596	158850

Table 5. Yield and gross margin of cauliflower by prilled urea and USG at different locations during 2008-09.

Treatment	Curd Yield (t ha^{-1})				Gross margin ($Tk.ha^{-1}$)			
	Gobindoganj	Rajshahi	Tangail	Pabna	Gobindoganj	Rajshahi	Tangail	Pabna
Prilled urea (Rec.)	47.45	29.62	19.51	35.00	389470	319078	174010	195250
USG (<20% Rec.)	50.20	33.56	24.39	37.90	417755	371428	242830	216983

Table 6. Yield and gross margin of brinjal (2008-09) and banana (2007-08) by prilled urea and USG at different locations.

Treatment	Brinjal		Banana			
	Rajshahi		Gobindoganj		Bogra	
	Yield (t ha^{-1})	GM (Tk.ha^{-1})	Yield (t ha^{-1})	GM (Tk.ha^{-1})	Yield (t ha^{-1})	GM (Tk.ha^{-1})
Prilled urea (Rec.)	68.5	596450	62.12	352175	71.00	718410
USG (<20% Rec.)	71.42	626313	61.65	350690	71.43	857160

Table 7. Yield and gross margin of maize at different locations during rabi 2008-09.

Treat.	Yield (t ha^{-1})					Gross margin (Tk.ha^{-1})				
	Kurigram	Bogra	Pabna	Tangail	Manikganj	Kurigram	Bogra	Pabna	Tangail	Manikganj
T_1	8.63	10.31	7.49	8.02	8.36	46487	58492	45480	7200	13732
T_2	8.90	10.99	8.01	8.27	9.46	52513	68162	56698	10825	31846

T_1 : Prilled urea (Rec.), T2 : USG (<20% Rec.)

Effect of Baicao-1 in Controlling Insect Pest of Different Crops

Abstract

The experiment was carried out at MLT site Shibpur, Rajshahi, MLT site, Madhupur, Tangail, Noakhali Sadar, Mominpur ICM club under FSRD site, Lahirirhat Rangpur during 2008-09. The experiment was laid out in RCB design with six dispersed replications. The treatments were Baicao-1, Nimbicidine, and control and crops were country bean, okra and yard long bean. Baicao-1 is more effective in controlling aphid and Jassid.

Introduction

Country bean, Okra and yard long bean are popular high value crops. But these crops are highly affected by different insect pest, which is sometimes beyond controlled by traditional pesticides. Baicao-1 is an organic plant extract, which is found effective against sucking and chewing type insect past through preliminary trial and available literature. Farmers usually use traditional chemical pesticides to control that pest which cause serious environment pollution. Bio- pesticide is environment friendly and gaining popular throughout the world. Before use in large scale it is need to assess the efficacy of the bio- pesticide. Keeping these views, the experiment is undertaken to see the efficiency of Baicao-1 to control harmful insect for growing high value crops.

Materials and methods

The experiment was carried out at MLT site Shibpur, Rajshahi, MLT site, Madhupur, Tangail, ICM club farmer's field in Noakhali Sadar Upazilla and at Mominpur ICM club under FSRD site, Lahirirhat Rangpur. The experiment was laid out in RCB design with six dispersed replications. The three treatments were considered as T_1 : Baicao-1, T_2 : Nimbicidine (Neem oil) and T_3 : Control (No pesticide). In Rajshahi, additional one treatment Chemical (Malathion) was included. The treatments were imposed on country bean, okra and string bean field when infestation was found. The crop establishment was due by the farmers. Data was collected after 3 and 7 days of spraying. The spray strength of insecticides was Baicao-1 @ 1 ml/L, Nimbicidine 4 ml/L water and malathion @ 2.5 ml/L water. Necessary data on yield and insect incidence was collected and analyzed mathematically.

Results and Discussion

Country bean

Rajshahi : Three days after spraying Malathion 87 EC gave the highest reduction of Aphid (100%) followed by Baicao-1 (84%) and Nimbicidine (74%) at vegetative stage (Table 1). Seven days after spraying, reduction of Aphid increased in Baicao-1 (96%) and in Nimbicidine (84%). At flowering stage, 3 days after spraying Malathion 57 EC gave the highest reduction of aphid (100%) followed by Baicao-1 (78%) and Nimbicidine (76%) and seven days after spraying, reduction of aphid increased in 92% by Baicao-1 and 82% by Nimbicidine. There was no significance difference of yield and yield contributing characters among the application of Baicao-1, Nimbicidine and Malathion 57 EC. The control treatment produced the lowest yield. In an observation it was found that growth and duration of crop was increased in Baicao-1 applied plots.

Noakhali : After spraying of 3 days it was found that there was no Aphid i.e.100% Controlled but in case of 7 days after spraying there was aphid population which than either infested one and might be its rapid reproductive capacity. Mosaic virus was observed in control one.

Rangpur : The highest pod yield (13.20 t ha^{-1}) was recorded in Baicao-1 and the lowest pod yield (9.36 t ha^{-1}) was obtained from control. After first spraying it was observed that incase of baicao-1, 60% aphid was controlled and incase of Nimbicidin it was 55%. After 2^{nd} and 3^{rd} spraying we also found minimum aphid control by using Baicao–1. Nimbicidin also control aphid but it was lower than Baicao-1. It was the first year observation but before recommendation it needs further verification in a well design and control management system.The highest gross return and gross margin were obtained from Baicao-1.

Okra

Tangail : Baicao-1 is more effective in controlling aphid (90% dead) and Jassid (82% dead) over that of Nimbicidine (94% & 76% dead). No leaf miner infestation was observed.

Yard long bean

Tangail : Baicao-1 is more effective in controlling aphid (94% dead) and Jassid (87% dead) over that of Nimbicidine (91% & 82%). But in case of controlling leaf miner, Nimbicidine was more active (56% dead) over that of Baicao-1 (47% dead) (Table 7).

Farmers' opinion

Farmers' showed keen interest as the organic pesticides killed the insects remarkably. They opined that they would try to apply in next season

Table 1 : Percent reduction of aphid infestation in different treatments on country bean at different growth phase of crop during 2008-2009 at MLT site, Puthia, Rajshahi.

Infestation stage	Aphid population (no.)	Treatments	Infestation (%) reduction over untreated control after 3 days of spray	Infestation (%) reduction over untreated control after 7 days of spray
Young Twigs at vegetative stage	18	Bicao-1	84	96
		Nimbicidine	74	84
		Malathion	100	100
		Control	-	-
Flower cluster at flowering stage	43	Baicao-1	78	92
		Nimbicidine	76	82
		Malathion	100	100
		Control	-	-

Table 2 : The yield and yield attributes and cost and return analysis of country bean influenced by different bio and chemical insecticides under MLT site, Shibpur, Rajshahi during 2008-2009

Treatment	Pod/plant	Pod yield/plant	Yield (t/ha)	Gross income (Tk/ha)	Variable cost (Tk/ha)	Gross income (Tk/ha)
Baicao-1	307.83 a	2.37 a	14.37 a	172440	76835	95605
Nimbicidine	300.16 a	2.40 a	14.07 a	168840	77683	91157
Malathion	304.67 a	2.32 a	13.98 a	167760	76920	90840
Control	147.33 b	1.45 b	6.53 b	78360	75320	-

Price (Tk. kg^{-1}): Urea 12, TSP 80, MOP 70, gypsum 5, Boron 350, Cowdung 0.5, Country bean 12.

Table 3. Effect of Baicao-1 on fruit setting of country bean and yard long bean in Noakhali in 2008-09

Crops	Flowers/per twig	Pod
Country bean	6	6
	4	4
	4	4
Yard long bean	4	4
	3	3
	3	3

Table 4. Effect of Baicao-1 on the yield and yield contribution characters and cost and return of country bean at Mominpur under FSRD site, Rangpur during rabi season 2008-09

Treatment	Length of pod (cm)	Weight of pod (g)	No. of pod $plant^{-1}$	Yield (t ha^{-1})	Gross Return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)
Baicao-1	10.67	9.00	355.0	13.20	198000	80588	117412
Nimbicidn	9.67	8.67	325.0	12.02	180300	80288	100012
Control	8.00	7.33	281.7	9.36	140400	78805	61595
CV%	7.06	10.95	3.16	4.75			

Price (Tk. kg^{-1}): Shim = 15, Urea= 11.80, TSP=74.36, MP=55, Zinc sulphate= 140, Borax=160, Gypsum= 7

Table 5. Percentage of aphid infestation of country bean Mominpur under FSRD site, Rangpur during rabi season 2008-09

Treatment	Aphid control after first spray	% of Aphid control after 2nd spray	% of aphid control after 3rd spray
Baicao-1	60%	80%	88%
Nimbicidin	55%	72%	81%
Control	0%	0%	0%

Table 6. Percent dead and alive insects per plant as obtained after seven days of application in okra at the MLT site, Modhupur, Tangail.

Treatment	Aphid		Jassid		Leaf miner	
	Dead	Alive	Dead	Alive	Dead	Alive
Baicao-1	90	10	82	18	-	-
Nimbicidin	94	6	76	24	-	-
Control	12	88	8	92	-	-

Table 7. Percent dead and alive insects per plant as obtained after seven days of application in yard long bean at the MLT site, Modhupur, Tangail.

Treatment	Aphid		Jassid		Leaf miner	
	Dead	Alive	Dead	Alive	Dead	Alive
Baicao-1	94	6	87	13	47	53
Nimbicidin (Neem oil)	91	9	82	18	56	44
Control	10	90	5	95	2	98

Response of Boron in Wheat under Farmers' Field

Abstract

An experiment was conducted simultaneously at the MLT sites, Modhupur and Ghatail Tangail during 2008-09 in medium high land and irrigated situation under AEZ 9 and AEZ 28, respectively to observe the performance of boron in wheat cultivation in comparison to no boron. The trial was laid out in RCB design with six dispersed replications. Two levels of boron i.e. (1) 1.5 kg ha^{-1} boron and (2) No boron were considered as two treatments. The highest grain yield was found in both Modhupur (3.335 t ha^{-1}) and Ghatail (3.42 t ha^{-1}) from plants treated with 1.5 kg ha^{-1} boron. The higher gross return was also obtained from boron treated plots in both sites.

Introduction

Wheat (*Triticum aestivum*) is the second most important cereal crop next to rice, cultivated during rabi season in Bangladesh. The area of wheat has markedly decreased and production also declining. This declining is probably associated with climatic change, improper management, decreasing soil fertility, deficiency of micronutrient and lacking of quality seed availability during the sowing time. The farmers of Tangail usually use only NPK fertilizer in wheat cultivation. They don't apply the micronutrient in wheat. As a result, grain yield and quality are decreasing day by day. In last years, deficiency symptoms of boron were observed in wheat production under farmers' field situation at the said sites. Micronutrient, especially boron deficiency in wheat at Modhupur and Ghatail area has already been detected by DAE. Hence, the experiment was conducted to determine the optimum dose of B in wheat for the locality and to increase production and economic return.

Materials and Methods

The experiment was conducted at the multi location testing (MLT) sites, Modhupur and Ghatail, Tangail during 2008-09 in the medium highland situation under AEZ 9 and AEZ 28. The study was laid out in RCB design with six dispersed replications (farmers). Farmers are the members of ICM club/FFS who were selected with the help of local DAE personnel. Two levels of boron i.e., (1) 1.5 kg/ha boron and (2) no boron were considered as two treatments. The unit plot size was 30m x 20m and the plants were spaced at 20cm x 5cm. Wheat variety Shatabdi was used as the planting material. The seeds were sown on 20 November at Modhupur and 2-6 December, 2008 at Ghatail. Other fertilizer doses for the crop were calculated on the basis of AEZ 28 and AEZ 9 (FRG, 2005). At Modhupur, the blanket dose was 92-32-23-21 kg ha^{-1} of N-P-K-S while 100-36-25-22 kg ha^{-1} of N-P-K-S was at Ghatail. Urea was top dressed once at 20-25 days after sowing. Two to three irrigations and one to two weedings were done irrespective of locations. Different pest management practices were also done during cropping period which needed. The crop was harvested during 22-29 March 2009 over the locations. Data were collected plot wise and converted to per hectare. Five square meter area in different places of the plot were considered for per plot yield.

Results and Discussion

Number of grains per spike, 1000 grain weight and grain yield significantly varied due to boron application at both the experimental sites. In Modhupur the higher number of grains/spike (38) was obtained from the plot where 1.5 kg/ha boron was applied but in control plot, the lower number of grains per spike (33) was recorded. Significantly the higher 1000 grain wt. (40g) was obtained from the boron treated plot while it was 37g in no boron plot. The grain yield (3.33 t ha^{-1}) was recorded from the boron treated plot, which was significantly higher than the control plot (2.64 t ha^{-1}). In Ghatail situation, almost similar trends were also observed in al the characters studied. The number of grains per spike and 1000 grain weight significantly higher over control plot. As such, the grain yield (3.43 t/ha) was higher in boron treated plot. The results indicate that boron is highly response in grain formation and yield of wheat at both the sites of Modhupur and Ghatail.

Cost and return analysis

Higher gross returns and gross margins were obtained in both the site of Modhupur (Tk. 53,280 & Tk. 12,303) and Ghatail (Tk. 54,720 ha^{-1} & Tk. 15,093 ha^{-1}) in plots treated with 1.5 kg per ha boron. Around 26-28% higher gross return was obtained in boron treated plots over no boron plots.

Farmers' opinion

As application of boron increased yield and gross return by 26-28% the farmers opined that they would apply boron in wheat in coming season.

Table 1. Response of boron in wheat at MLT site, Modhupura and Ghatail, Tangail during 2008-09

Treatment	Plant height (cm)	No. of spikes m^{-2}	No. opf grains $spike^{-1}$	1000-grain wt (g)	Yield (t ha^{-1})
Modhupur					
T_1: 1.5 kg/ha boron	104	243	38	40	3.33
T_2: No boron	103	246	33	37	2.64
Ghatail					
T_1: 1.5 kg/ha boron	95	256	36	42	3.42
T_2: No boron	93	251	32	36	2.67

Table 2. Cost and return analysis of wheat cultivation as influenced by boron at MLT site, Modhupur, and Ghatail Tangail during Rabi 2008-09.

Treatment	Gross return (Tk. ha^{-1})		TVC (Tk. ha^{-1})		Gross margin (Tk. ha^{-1})	
	Modhupur	Ghatail	Modhupur	Ghatail	Modhupur	Ghatail
T_1: 1.5 kg/ha boron	53,280	54,720	40977	39,627	12303	15,093
T_2: No boron	42,240	42,720	39850	38,502	2390	4,218

Price (Tk/kg): Wheat = 16.00 Urea = 12.00, TSP= 76.00, MP = 50.00, Gypsum = 12.00, Boric acid= 150

On-Farm Trial of Potato Varieties under Farmers' Field

Abstract

An experiment was conducted at the MLT site, Modhupur, Tangail, MLT site, Shibpur, Puthia, Rajshahi MLT site, Ulipur, Kurigram and MLT site, Baruara, Comilla and FSRD site, Razakhali, Patuakhali during 2008-09 in medium high land irrigated situation to verify the performance of modern potato varieties under farmers' situation. The trial was laid out in RCB design with six dispersed replications. Potato varieties Diamant, Cardinal, Felsina, Raja, Aestrix BARI TPS 1 were compared with existing local variety. Higher tuber yield was obtained from the variety Diamant at Tangail and Rangpur, Asterix in Rajshahi and Patuakhali and Granola in Comilla.

Introduction

Potato (*Solamun tuberosum*) is the major tuber crop in Bangladesh. Yield potentiality of local/traditional variety is very poor and susceptible to pest and diseases. Thus farmers get very poor economic return. BARI has developed several modern varieties of potato, which are supposed to be higher yielder and less susceptible to pest and diseases. Therefore, an adaptive trial with BARI developed potato varieties was conducted to introduce the modern potato varieties in the locality and to get higher yield and economic return.

Materials and Methods

The trial was conducted in medium high land irrigated condition at the farmers' field at the MLT site, Modhupur, Tangail, MLT site, Shibpur, Puthia, Rajshahi MLT site, Ulipur, Kurigram, MLT site, Barura and FSRD site, Razakhali, Patuakhali during rabi 2008-2009 to observe the performance of modern potato varieties. Potato varieties Diamant, Cardinal, Felsina, Raja, Ganola, Aestrix and BARI TPS-1 were compared with existing local variety. The trial was conducted in six farmers' field considering as six replications. Farmers were the members of ICM club/FFS who were selected with the help of local DAE personnel. The crop was fertilized with N-P-K-S-Zn-B (Table 1). Two third of urea and all amount of other fertilizers were applied during final land preparation. The remaining urea was applied at the time 1st earthing up. Two irrigations at 25 and 50 days after planting were provided. One hand weeding was done at 30 days after sowing. Other necessary managements were done as and when necessary. Spacing, sowing time, harvesting time and fertilizer rate of different locations are presented in the Table 1. Necessary data were collected plot wise and analyzed statistically.

Table 1. Crop management practices used in different locations

Location	Tangail	Shyampur	Rangpur	Comilla	Patuakhali
Spacing (cm)	60 x 20	60 x 15	60 x 25	60 × 25	60 x 25
Sowing time	4 Dece.2008	3-9 Dece.08	4-7 Dec. 2008	27 Nov. 07	13 Dec. 2008
Harvesting time	7-14 Feb.08	30.12.08 to 10.01.09	Last week of March	16 Feb. 09	14-15 Mar.09.
Fertilizer dose (N-P-K-S-Mg-Zn-B kg ha^{-1})	108-27-117-0-20-3	160-40-130-16-0-2-2	143-18-45-3-15-1.33-0.5	70-9-65-8	

Results and Discussion

Tangail : The number of tuber per plant (7) was similar among the modern varieties and it was higher over the local one (6 plant^{-1}) (Table 2). Tuber weight per plant was higher in variety Aestrix (291g) which was at per with cardinal (275g) and Diamant (285g). The lowest tuber weight per plant (229g) was obtained from local one. The highest tuber yield (17.56 t ha^{-1}) was obtained from the variety Diamant which was at par with Cardinal (16.47 t ha^{-1}) and Aesterix (16.04 t ha^{-1}). The lowest tuber yield (12.02 t ha^{-1}) was recorded from the variety local one. The yield performance of the modern varieties along with the local one was lower compared to their potential yields due to unfavorable weather prevailed during the production period.

Rajshahi : Number of tuber per plant was statistically similar among the modern varieties. `The individual weight of tuber was highest in Diamant (334 g) which was similar to Asterix (324.3 g). The variety Asterix (25.97 t ha^{-1}) produced the highest yield followed by Diamant (25.37 t ha^{-1}). They are also statistically similar. The variety Raja (21.97 t ha^{-1}) produced the lowest yield. From the economic analysis, it was found that the highest gross margin and BCR was produced by Asterix followed by Diamant.

Rangpur : Number of tubers per hill was also highest with Diamant (8.75 $hill^{-1}$) which was identical to Felsina (8.37 $hill^{-1}$). The highest weight of tuber per hill was recorded from Diamant (393.5 g) which differed significantly from other varieties. The increase in yield with Diamant was 26% higher over local check cardinal. The lowest yield was recorded from cardinal. This was probably because of use of 4th generation seed preserved by the farmers. Due to foggy weather, incidence of late blight disease was higher but it was properly controlled by spraying fungicides. Incidence of cut warm or other insect was not observed.

The highest gross return (Tk.237960 ha^{-1}) and gross margin (Tk.120054 ha^{-1}) were obtained from the variety 'Diamant'. The lowest gross return (Tk.188640 ha^{-1}) and gross margin (Tk.70734 ha^{-1}) were obtained from check variety 'Cardinal'. This might be due to use of 4th generation seed preserved by the farmers.

Comilla : Tuber number per plant was recorded from Granola (10.68) and that is statistically identical with other variety. Lowest tuber number per plant was recorded in (8.33) from the variety Raja. Tuber weight is also similar with the variety BARI TPS-1 (327.00 gm) and Diamant (320 gm). Significantly the highest tuber yield (24.63 t ha^{-1}) was recorded in the variety Granola which was followed by BARI TPS-1 (20.19 t ha^{-1}) and that was identical with Diamant (18.70 t ha^{-1}) and Asterix (17.59 t ha^{-1}) (Table 5). The lowest tuber yield was found in Raja (13.89 t ha^{-1}). Granola produced the highest yield because of highest tuber weight per plant was recorded from Granola (340.00 gm).

Patuakhali : Diamant and Asterix gave statistically similar and highest yield followed by Cardinal and Multa (Table 6). Scab infestation was high (20-30%) in all varieties except Asterix (5-10%). This was first year result and should be continue for the next year.

Farmers' reaction

Tangail Although the yield potentiality of modern varieties was lower, but the farmers are happy with the varieties. They urged for the availability of seed of the varieties next year.

Patuakhali Farmers are highly interested to grow potato as a cash crop. Seed availability is a problem. There is no storage facility of their seed.

Rangpur Farmers prefer 'Diamant' only for its higher yield, taste and economic return. Few plants were infested by Bacterial wilt in 'Asterix'.

Conclusion

BARI developed varieties performed better yield. This was the first year trial, it may be repeated for next year.

Table 2. Performance of potato varieties at MLT site, Modhupur,Tangail during 2008-09.

Treatment	Plant population (m^2)	Tubers plant^{-1} (no.)	Tuber weight plant^{-1} (g)	Yield (t ha^{-1})
Diamant	14	7	285	17.56
Cardinal	13	7	275	16.47
Aesterix	13	7	291	16.04
Local	13	6	229	12.02
LSD (0.05)	0.29	0.48	23.94	1.96
CV (%)	1.8	5.8	7.2	10.2

Table 3. Yield and yield attributes of potato varieties and Cost and return at MLT site, Shibpur, Rajshahi during 2008-09

Variety	No. of tuber plant^{-1}	Wt. of potato plant^{-1}	Yield (t ha^{-1})	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Cardinal	5.7 a	289.17 bc	23.29 bc	279480	134965	144515
Diamant	5.57 ab	334.0 a	25.37 ab	304440	134965	169475
Asterix	6.03 a	324.3 ab	25.97 a	311640	134965	176675
Raja	3.03 b	267.17 c	21.97 c	263640	134965	128675
CV (%)	8.41	11.67	9.09			

Table 4. Yield and yield attributes of potato varieties and Cost and return at MLT site, Ulipur,. Rangpur during 2008-09.

Variety	No. of potato plant^{-1}	Wt. of potato plant^{-1}	Yield (t ha^{-1})	GR (t ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Diamant	8.75a	393.5a	26.44a	237960	117906	120054
Asterix	8.17b	357.8b	24.00b	216000	117906	98094
Felsina	8.37ab	364.8b	24.16b	217440	117906	99534
Cardinal (Ck.)	7.72c	316.3c	20.96c	188640	117906	70734
CV (%)	3.15	4.41	5.45	237960	117906	120054

Table 5. Yield and yield contributing characters of different potato varieties at MLT site, Barura, Comilla during 2008-09.

Variety	Plant height (cm)	Shoot plant^{-1} (no.)	Tuber plant^{-1} (no.)	Tuber wt plant^{-1} (g)	Yield (t ha^{-1})
Raja	71.8 ab	3.2	8.33	219 b	13.89 c
Granola	51.3 b	3.8	10.67	340 a	24.63 a
TPS	95.2 a	3.7	9.87	327 a	20.19 b
Diamant	62.5 b	5.2	10.13	320 a	18.70 b
Asterix	67.6 ab	4.4	8.60	233 b	17.59 b
CV (%)	22.13	24.78	17.79	9.76	7.97

Table 6. Yield of potato varieties at Razakali, Patuakhali in 2008-09.

Variety	No. of tuber plant^{-1}	Weight tuber^{-1} (g)	Tuber wt. plant^{-1} (g)	Yield (t ha^{-1})
Cardinal	4.0	58.66	690	23.96b
Multa	4.33	62.66	642	23.66b
Granola	4.33	51.33	710	22.19c
Asterix	4.66	58.00	718	25.24a
Diamant	4.66	52.00	715	25.03a
CV (%)				10.32

On-farm Verification Trial of Country Bean

Abstract

A verification trial was conducted in the farmers' field situation at the MLT site, Ghatail, Tangail, MLT sites Barura and Sadar Upazilla of Comilla, MLT site, Shibpur, Rajshahi and MLT site, Shibganj, Bogra during 2008-09. Four varieties viz. BARI Shim-1, BARI Shim-2, BARI Shim-3, IPSA Shim-1 and local one were tested. Higher yield of BARI shim 1 was found in Tangail, Comilla and Rajshahi but BARI shim 3 in Bogra.

Introduction

Country bean (*Dolichos lablab*) is a common and protein-rich leguminous vegetable crop traditionally grown throughout Bangladesh during the winter season. It contains 86.1% water, 0.9% minerals, 1.8% frbre, 3.8% protein, 0.7% fat and 6.7% carbohydrate per 100g edible portion. The average yield of country bean in Bangladesh is low compared to other bean growing countries of the world. This low yield may be due to the cultivation of the low yielding local varieties, incidence of diseases and insects, lack of technical know–how etc. BARI and BSMRAU have developed some high yielding country bean varieties with several high quality parameters. These varieties have potential to help generate farmers' income in very short period of time. The present study was undertaken to evaluate the performance of the varieties under farmer's field condition and popularize them among the farmers to promote their adoption in this area.

Materials and Methods

The trial was conducted in the farmers' field situation at the MLT site, Ghatail, Tangail, MLT sites Barura and Sadar Upazila of Comilla, MLT site Shibpur, Rajshahi and MLT site, Shibganj, Bogra during 2008-09 during rabi 2008-09. The trial was laid out in Randomized completely block design with six dispersed replications. Farmers' members of ICM club/FFS were selected with the help of local DAE personnel. Four varieties viz. BARI Shim-1, BARI Shim-2, BARI Shim-3, IPSA Shim-1 and local one were tested. The unit plot size was 6m x 4m and plant spacing was 2m x 2m. The seeds were sown during 12-13 November, 2008 in Tangail and the end of June to 1st of July in Comilla, 20-22 October/08 in Shyampur, Rajshahi and January 19, 2009 in Bogra. The crop was fertilized with recommended dose of fertilizer. Half of urea and MP and all other fertilizers were applied before sowing in pit and rest half urea and MP were applied 15-20 days after emergence. Mutcha was provided for climbing the crop. Two irrigations at 30 and 80 days after sowing were provided. Weeding and pest management practices were done as and when necessary. The harvesting started at the maturity stage.

Results and Discussion

Tangail: Significantly the highest pod yield (14.63 t ha^{-1}) was obtained from the variety BARI Shim 1, followed by BARI Shim 2 (11.85 t ha^{-1}) (Table 1). The lowest yield (10.25 t ha^{-1}) was obtained from local one and it was at par with IPSA Shim 1 (10.85 t ha^{-1}). The higher yields were obtained in BARI Shim 1 and BARI Shim 2 as because of higher pod length and breadth and number of pods per plant were higher in those varieties.

Comilla: In case of BARI Shim first flower appear around 56-64 days after sowing but in local variety it required 80-85 days for flowering (Table 2). Pod harvesting starting from 78-85 days after sowing in BARI Shim, but in case of local variety it required 90-110 days for harvesting. It was observed that BARI Shim showed better performance in case of yield as well as it comes early than the local one. On the other hand local variety of Shim is not palatable like BARI shim. Among the BARI Shim, BARI Shim 1 showed also better than among the BARI Shim 2. The highest yield was found in BARI Shim 1 (14.20 t ha^{-1}) and the lowest was found in local one (5.94 t ha^{-1}).

Rajshahi: The result (Table 3) showed that the variety IPSA Shim-1 (48.4 days) was the earliest in flowering and 1st harvesting (76.0 days). BARI Shim-1 (54.8 days) and BARI Shim-2 (54.17 days) were statistically similar in flowering. The highest number of pods plant^{-1} was produced by IPSA Shim-1 (331.3) followed by BARI Shim-2 (309.7). The lowest pods plant^{-1} was produced by local variety (288). The highest pod yield plant^{-1} was produced by IPSA Shim-1 (2.38 g) and BARI Shim-1 (2.31 kg) which were statistically identical. The lowest pod yield plant^{-1} was produced by local (1.82 kg) variety. The highest pod yield ha^{-1} was produced by IPSA Shim-1 (15.85 t ha^{-1}) which was statistically identical to BARI Shim-1 (15.39 t ha^{-1}). The lowest pod yield was produced by local (11.57 t ha^{-1}) variety. Cost and return analysis indicated that the highest gross margin (Tk.113165 ha^{-1}) was produced by IPSA Shim-1.

Bogra: Significant variation was found among the treatments in all characters. Number of pod per plant was found maximum in BARI shim-3 (70.74) which was statistically similar to IPSA shim-1 (70.28) and BARI shim-2 (69.96). The highest pod weight per plant was also recorded from BARI shim-3 (2.8 kg plant^{-1}) and it was statistically different to all other varieties. The local variety produced the lowest yield (5.68 t ha^{-1}). The highest gross return (Tk.158750 ha^{-1}), net return (Tk.48170 ha^{-1}) and benefit cost ratio (1.73) was calculated from BARI shim-3 due to higher yield (Table 4).

Farmers' opinion

Tangail : Farmers chose BARI Shim 1 and IPSA Shim 1 because of its attractive colour and consumer's choice. They also chose BARI Shim 2 due to its higher yield performance.

Comilla : Farmers are interested to grow BARI Shim as it is soft and Palatable and also early.

Shyampur : Farmers were interested to grow IPSA Shim-1 due to it high yield and earliness. Farmers were collected seeds of IPSA Shim-1 for next year cultivation. They also express positive sign to BARI Shim-1.

Bogra : Farmers are interested to grow BARI shim-3 for its higher yield but it should be planted early for early market.

Conclusion

BARI Shim 1 showed better performance in most of the locations.

Table 1. Performance of country bean varieties at MLT site, Ghatail, Tangail, during 2008-09.

Treatment	Pods plant^{-1} (no.)	Pod breadth (cm)	Pod length (cm)	Yield (kg plot^{-1}) (24 m^2)	Yield (t ha^{-1})
BARI shim-1	223	2.08	8.10	39.6	14.63
BARI shim-2	211	1.80	8.10	32.04	11.85
IPSA shim-1	197	1.60	7.68	29.34	10.85
Local	199	1.55	7.62	27.90	10.25
LSD (0.05)	20.86	0.64	0.37	0.19	1.07
CV (%)	8.3	3.0	3.8	8.9	7.5

Table 2. Yield and yield contributing characters of Country bean at MLT sites Barura and Sadar Upazilla of Comilla during 2008-09.

Treatment (variety)	Days to flowering	Days to harvesting	Pod Yield (t ha^{-1})
BARI Shim-1	56-64	78-85	14.20
BARI Shim-2			12.59
Local	80-85	90-110	5.94

Table 3. Yield and yield attributes and of cost and return analysis country bean at MLT site, Shibpur, Puthia, Rajshahi during 2008-09.

Variety	Days to flowering	Pods plant^{-1}	Pod yield plant^{-1} (kg)	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
BARI Shim-1	54.8 a	309.17 b	2.31 a	15.39 a	184680	77035	107645
BARI Shim-2	54.17 ab	301.5 c	2.03 b	13.51 b	162120	77035	85085
IPSA Shim-1	48.0 c	331.33 a	2.38 a	15.55 a	190200	77035	113165
Local	53.58 b	288.0 d	1.82 c	11.57 c	138840	77035	61805
CV (%)	2.6	2.7	8.91	5.63			

Price (Tk. kg^{-1}): Urea:12, TSP: 80, MoP: 70, Gypsum: 6, $ZnSo_4$: 120, Boric acid: 350, Country bean seed: 350, Country bean: 12, Labour wage: 150.

Table 4. Yield and yield attributes of Country bean varieties at the MLT site, Shibganj, Bogra during 2008-09.

Treatment	No. of pod plant^{-1}	Wt. of pod plant^{-1} (kg)	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Cost of production (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
BARI shim-2	69.96 a	1.84 c	6.35 c	158750	110580	48170	1.44
BARI shim- 3	70.74 a	2.80 a	7.65 a	191250	110580	80670	1.73
IPSA shim -1	70.28 a	2.71 b	6.88 b	172000	110580	61420	1.56
Local	59.23 b	1.74 d	5.68 d	142000	110580	31420	1.28
CV (%)	2.14	2.06	3.86				

Means is a column having same letter did not differ significantly
Market price of country bean Tk 25 kg^{-1}.

On-Farm Trial of Sweet Gourd Variety

Abstract

The experiment was carried out at MLT site, Manikganj and MLT site, Gobindagonj during the rabi season of 2008-09 to popularize and disseminate the BARI high yielding sweet gourd variety among the farmers. The result revealed that BARI mistikumra-1 variety gave higher yield and economic return compared to local variety.

Introduction

Sweet gourd (*Cucurbita moschata*) is the most important vegetable grown in Bangladesh. It is mostly used for making curry in our country. It contains about 1.4 g protein, 48 mg calcium, 0.7 mg iron, 7200 ug carotene, 0.07 mg vitamin B_1, 0.06 mg vitamin B_2 and 26 mg vitamin C per 100 g of edible product. This crop has potentialities to generate higher income compared to many other vegetables. Recently, BARI has developed two high yielding varieties of sweet gourd. The performances of these varieties need to be evaluated under field conditions. Considering the above facts, the trial was undertaken to evaluate the performance of sweet gourd variety in the farmer's field and to popularize and disseminate the BARI developed Sweet gourd variety in the farmer's field.

Materials and Methods

The experiment was carried out under Okiara ICM club, Garpara at MLT site, Manikganj and MLT site, Gobindagonj during the rabi season of 2008-09. The trial was laid out in randomized complete block design with six dispersed replications. The BARI developed sweet gourd variety viz. BARI Mistikumra-1 was tested with the local variety. Seeds were sown on 25 November 2008 in Manikganj and 10-12 February, 2009 in Gobindaganj maintaining the spacing of 2m × 2m. The crop was fertilized with 86-30-50-2-4.3-1-20000 kg ha^{-1} of N-P-K-S-Zn-B-CD was used in Manikganj and 50-

23-63-15.5-1.1-1-15000 kg ha^{-1} of N-P-K-S-Zn-B-CD in Gobindaganj. Entire amount of cowdung, TSP, Gypsum, Zinc sulphate, borax (or boric acid) and 2/6 of MOP were applied during pit preparation 7 days before transplanting. Urea and rest MOP were applied in 4 equal installments at 15, 35, 55 and 75 DAP. Different intercultural operations, irrigation were taken as per crop requirement. The crop was harvested from 25 March to 5 April 2009 in Manikganj and 12 June, 2009 in Gobindaganj. Data on yield and yield contributing characters were recorded and statistically analyzed.

Results and Discussion

Manikganj : The results showed that the BARI mistikumra-1 produced higher in fruits plant^{-1}, fruit weight, fruit length and diameter, fruit yield plant^{-1} compared to local variety.The highest yield produced from BARI mistikumra-1 (34.6 t ha^{-1}) where as local was 28.3t ha^{-1}. Higher economic return was found in BARI mistikumra-1 compared to local variety due to higher fruit yield.

Gobindaganj : The highest length of fruit was measured from BARI Mistikumra-1 (17.97 cm). The lowest length was recorded from local check (13.97 cm). The highest number of fruits per plant was recorded from BARI Mistikumra-1 (4.15 plant^{-1}). The highest weight of individual fruit was recorded from BARI Mistikumra-1 (4.32 kg fruit^{-1}). The highest fruit yield (44.29 t ha^{-1}) was obtained from BARI Mistikumra-1 compared to local variety. The local variety gave the lowest yield (31.07 t ha^{-1}). The colour of BARI Mistikumra-1 was light yellow and the colour of local variety was yellow. The sweetness of BARI Mistikumra-1 was more compared to local variety. The highest gross return (Tk.177160 ha^{-1}) and gross margin (Tk.144974 ha^{-1}) were obtained from BARI Mistikumra-1.

Farmer's reaction

Farmers preferred BARI Mistikumra-1 for its higher yield, size, flesh color and taste.

Conclusion

The BARI Mistikumra-1 variety is proven to be promising, it may be recommended as extension message for large scale production.

Table 1. Yield contributing characters and yield of sweet gourd varieties at MLT site, Manikganj during the rabi season of 2008-09

Treatments	Fruits plants^{-1} (no)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield plant^{-1} (kg)	Flesh thickness (cm)	Yield (t ha^{-1})
BARI Mistikumra-1	3.8	4.76	28.4	24.2	20.2	3.79	34.6
Local	2.6	4.15	22.2	21.2	16.6	4.22	28.3
CV(%)	8.96	13.09	15.59	10.56	5.93	7.89	10.31

Table 2. Cost and return analysis of sweet gourd varieties at MLT site, Manikganj during the rabi season of 2008-09

Treatments	Gross Return (Tk ha^{-1})	Total production cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
BARI Mistikumra-1	259500	90300	169200	2.87
Local	212250	90300	121950	2.35

Price (Tk.kg^{-1}): Urea=14, TSP=80, MOP=56, Gypsum=8, $ZnSO_4$=60, Boric Acid=260, Sweet gourd =7.50.

Table 3. Performance of sweet gourd varieties at MLT site, Gobindogonj Rangpur during 2008-09

Variety	Length of fruit (cm)	Circumference of fruit (cm)	Thickness of flesh (cm)	No. of fruit plant^{-1}	Fruit wt. (kg)	Fruit yield (t ha^{-1})
BARI Mistikumra -1	17.97	65.47	4.80	4.15	4.32	44.29
Local	13.97	52.07	3.68	3.68	3.23	31.07
CV (%)	3.27	8.82	7.18	3.90	7.05	8.09

Table 4. Economic performance of sweet gourd varieties at MLT site, Gobindaganj, OFRD Rangpur during late rabi season 2008-09

Varieties	Fruit yield (t ha^{-1})	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
BARI Mistikumra -1	48.29a	177160	32186	144974
Local	33.06b	124240	32106	92134

Price Tk. kg^{-1}): Sweet gourd = 4, Urea= 11.80, TSP=74.36, MP=55, Zinc sulphate =140, Boric acid=180, Lab= 112/day, Gypsum=7

Controlling of Fruit Fly of Cucurbits with Sex Pheromone

Abstract

A demonstration trial on controlling of cucurbit fruit fly with sex pheromone with IPM technique was set at different locations viz. Comilla, Rangpur Bogra, Rajshahi, Tangail, Pabna and Manikganj during the rabi 2008-09 and kharif 2009 on different cucurbit crops like bitter gourd, pointed gourd, sweet gourd, ash gourd, cucumber and water melon. The experiment is still at the field in some of the crops in some locations. However, the sex pheromone with IPM technique showed excellent results and farmers showed their positive attitude towards sex pheromone.

Introduction

Cucurbits are major group of summer vegetable crops in Bangladesh. Because it is cheap and highly nutritious, it is available throughout the year in all parts of the country. But the productions of these vegetables are not hopeful because of cucurbit fruit fly (*Bractrocera cucurbitae* Coquillett). About 50-70%, fruits were damaged due to infestation of cucurbit fruit fly .Farmers use huge amount of insecticides to control this pest, which is very harmful for human health as well as environment. Sex pheromones are species-specific organic compounds emitted by female insect to attract the males for matting. Sex pheromones are very much effective in cucurbit fruit fly control. So this demonstration trial was undertaken in different locations to control cucurbit fruit fly.

Materials and Methods

The demonstration trial was conducted in Sayedpur block of Comilla Sadar upazilla, Paikan Nayapara Mithapukur, Rangpur, MLT site, Sherpur, Bogra, MLT site, Shibpur, Puthia and Bijoynagar, Godagai of Rajshahi, MLT site, Ghatail, Tangail, Choukibari village, Pabna sadar and MLT site, Manikganj during the rabi 2008-09 and kharif 2009. The trial was set in ICM/IPM club/FFS members' lands selected with the help of local DAE personnel. Different cucurbits sweet gourd, ash gourd and watermelon were used. Treatment T_1 (sex pheromone trap +IPM technique) were compared with T_2 (control). In Shyampur, Rajshahi, another addition treatment (chemical control) was used. The pheromone bait trap comprises the pheromone and the locally fabricated water trough. The whole system consists of a 3-liter capacity, 22 cm tall rectangular or round clear plastic container. A triangular opening is cut in any two opposite sides starting 3-4cm from the bottom. Soap water of 3-

4cm height is maintained inside the container (trap) throughout the season. A cotton wad measuring 2.5 x 1.5cm and soaked with 7-10 drops of "cuelure" 4-(p-acetoxyphenyl)-2 butane} or {4-(3-oxobutyl-phenylacetate)} is hung through the centre of the lid of the plastic container by means of a thin wire in such a way that the cotton wad remains 3-4cm above the soap water. The trap is then placed just above the crop canopy by means of a bamboo support. The pheromone remains active and continues to attract male flies for 2-3 months. Data were collected randomly from 100 sq. m from the total land of the study area. The experiment is still at the field in most of the locations.

Results and Discussion

Bitter gourd

Rangpur: Significantly the highest number fresh fruit per plant (10 plant^{-1}) was obtained from plant treated with sex pheromone +IPM technique. The lowest number of fresh fruit per plant (5.8) was recorded from control. The infested fruit was 21 % and higher fruit yield (17.6 t ha^{-1}) in T_1 (sex pheromone trap +IPM) than that of 52 % and 10.4 t ha^{-1} in control. The highest gross margin was found from Sex pheromone +IPM technique.

Table 1. Yield of bitter gourd as influenced by sex pheromone trap at Mithapukur, Rangpur, during 2008-09.

Treatments	No of fresh fruit plant^{-1}	No of infested fruit plant^{-1}	Wt. of fresh fruit plant^{-1} (kg)	% of infested fruit	Fruit yield (t ha^{-1})	TVC (Tk. ha^{-1})	GR (Tk. ha^{-1})
Pheromone+IPM tech	10.0	2.1	360	21	17.6a	39595	136405
(Control)	5.8	6.2	241	52	10.4b	35278	68722

Comilla : The infestation was 6.3% where sex pheromone +IPM technique used. Yield was recorded more than 15.2 t ha^{-1} of bitter gourd.

Table 2. Yield of Bitter Gourd and percent of infestation in Comilla during 2008-09

Location	Variety	% Infestation	Yield (t ha^{-1})
Sayedpur	Bulbuli, Tia	6.3	15.2

Sweet gourd

Rangpur : Significantly the highest number fresh fruit per plant (5.4 plant^{-1}) was obtained from plant treated with sex pheromone +IPM technique. The number of infested fruit significantly reduced where sex pheromone+ IPM technique was used. The number of infested fruit was only 0.38 per plant in sex pheromone treated plot while it was 1.75 per plant in control plot. The infested fruit was 7.03 % in T_1 (sex pheromone trap +IPM) and 46.6% in control. The higher fruit yield (30.35 t ha^{-1}) was obtained from sex pheromone treated plot and the lowest (24.75t ha^{-1}) from control plot. The increase in yield with sex pheromone trap + IPM technique was 22 % higher over control which resulted higher gross return.

Table 3. Yield of bitter gourd as influenced by sex pheromone at Mithapukur, Rangpur, during 2008-09.

Treatments	No of fresh fruit plant^{-1}	No of infested fruit plant^{-1}	Wt. of fresh fruit plant^{-1} (kg)	% of infested fruit	Fruit yield (t ha^{-1})	TVC (Tk. ha^{-1})	GR (Tk. ha^{-1})
Pheromone+ IPM tech	5.4	0.38	3.50	1.33	7.03	29076	122649
(Control)	3.75	1.75	3.00	6.12	46.6	25076	98674

Bogra : Significant variation was found among the treatments in all characters. The treatment T_1 produced higher yield (29.49 t ha^{-1}) due to higher no of healthy fruit plot (319 $plot^{-1}$) and lowest percentage of fruit fly infestation (10.33 %). Higher gross return (Tk 294900 ha^{-1}) and net return (Tk 259000 ha^{-1}) were recorded from T_1.

Table 4. Effect of IPM package against fruit fly in sweet gourd at the MLT site, Sherpur, Bogra during 2008-09.

Treatment	No of healthy fruit $plot^{-1}$	No of infested fruit $plot^{-1}$	Infestation (%)	Fruit Yield (t ha^{-1})	Cost of production (Tk. ha^{-1})	Net return (Tk. ha^{-1})
Pheromone + IPM tech.	319	37	10.33	29.49	35900	259000
Control	164	58	25.91	14.71	33550	113550

Tangail : The higher number of fresh fruits (2-3 $plant^{-1}$ & 3923 ha^{-1}) was obtained from plants treated with sex pheromone trap. The lower number of fresh fruits (1-2 $plant^{-1}$ & 2,289 ha^{-1}) was obtained from the farmers' practice. About 71% higher yield/gross return was found by using only sex pheromone trap.

The highest gross return (Tk. 1,17,690 ha^{-1}) was obtained from plants treated with sex pheromone trap. The lowest gross return (Tk. 68,670 ha^{-1}) was found from farmers' practice.

Table 5. Performance of sex pheromone trap on the production of sweet gourd at the MLT site, Ghatail, Tangail during 2008-09.

Treatment	Fresh $plant^{-1}$ (no.)	Fresh ha^{-1} (no.)	Gross return (Tk. ha^{-1})	% higher yield/return over control
Sex pheromone + IPM technique	2-3	3,923	117690	71
Farmers' practice (Control)	1-2	2,289	68670	-

Barind, Rajshahi : Maximum numbers of fruits per plant (3.20) were produced when sex pheromone trap was used, of which fresh fruits per plant were 2.95 and the rest 0.25 was infested fruit that occupied 7.81% of the total production. On the other hand, without applying sex pheromone a total number fruits per plant was 2.58 of which, 1.71 was fresh fruit and rest 0.87 was infested that possess 33.72% of the total product. When pheromone trap was used, average individual fruit weight was higher (6.45 kg) than that of without using trap (4.62 kg). By applying trap, maximum fruit yield (21.26 t ha^{-1}) was found where as lower yield (13.95 t ha^{-1}) was observed by not applying pheromone trap and yield increased over control 20.76%. Higher economic return was found from Sex pheromone + IPM technique treatment.

Table 6. Performance of sweet gourd as influenced by sex pheromone at Bijoynagar ICM club member of Godagari, Rajshahi during 2009.

Treatments	Total fruits $plant^{-1}$ (No.)	Infested fruit $plant^{-1}$		Fresh fruit $plant^{-1}$ (No.)	Individual fruit weight (kg)	Yield (t ha^{-1})	Yield increased over control (%)
		No.	%				
Sex pheromone + IPM technique	3.20	0.25	7.81	2.95	6.45	21.26	20.76
Control (farmer's practice)	2.58	0.87	33.72	1.71	4.62	13.95	-

Table 7. Cost and return analysis of sweet gourd as influenced by sex pheromone at Bijoynagar ICM club member of Godagai, Rajshahi during 2009.

Treatments	Gross return (Tk. ha^{-1})	Total cultivation cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
Sex pheromone + IPM technique	106300	28125	78175	3.78
Control (farmer's practice)	69750	30750	39000	2.27

Price: Sweet gourd Tk kg^{-1}: 5.0, urea : 12.00, TSP : 45, MP: 40 , Gypsum :7, Boron : 100.

Shyampur, Rajshahi : The highest number of infested fruit was found in the control treatment (32.73%) followed by insecticide treatment (27.25%). The sex pheromone trap placed plot showed the lowest infestation (3.3%) but the highest number of edible fruit. Individual fruit weight was found higher in sex pheromone trap (5.1 kg) followed by control (4.4 kg). The sex pheromone placed treatment produced the highest yield (37.44 t ha^{-1}) followed by insecticide (23.23t ha^{-1}) and control (21.3 t ha^{-1}). Though the yield was insignificant in insecticide treatment and control, the insecticides spray was not economically effective to control fruit fly in sweet gourd. From the economic analysis, it was revealed that the highest gross margin was obtained from sex pheromone applied field.

Table 8. Effect of sex pheromone trap on performance of sweet gourd at MLT site, Shibpur, Puthia Rajshahi during 2008-09.

Treatment	% infested fruit	No. of fresh fruit $plant^{-1}$	Fruit weight (kg)	Yield (t ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
T_1 (Sex pheromone)	3.3	5.69 a	5.1 a	37.44 a	73621	188459
T_2 (with insecticide)	27.25	4.12 b	4.4 b	23.23 b	78621	83989
T_3 (without insecticide)	32.75	3.24 c	4.1 b	21.3 b	69125	79975
CV (%)	-	11.17	13.49	12.97		

Price (Tk.kg^{-1}) : Sweet gourd : 7, Seed : 8000, Urea: 12, TSP : 80, MP : 70, Gypsum : 6 Boric Acid :120, Zinc Sulphate : 100, CD : 0.5, Labour wage : 150.

Manikganj: The highest number fresh fruits (15920 no. ha^{-1}) were obtained from the sweet gourd plot treated with sex pheromone. The lowest number of fresh fruits was recorded from farmers practice. The inverse trend observed in case of infested fruit in this study. The highest yield (36.05 t ha^{-1}) was record from pheromone trap tested plot. Apparently fewer insects were observed in sweet gourd in pheromone trap method compared to farmers practice. The net return (Tk. 135425 ha^{-1}) was also found higher is sex pheromone trap method than farmer practice.

Table 9. Effect of pheromone on the production of sweet gourd at the MLT site, Manikganj, 2009.

Treatment	No. of fresh fruit ha^{-1}	No. of infested fruit ha^{-1}	No. of damaged fruit ha^{-1}	Total yield (kg ha^{-1})	GR (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})
T_1: Sex pheromone + IPM tech.	15920	540	1680	36.05	234325	88900	135425
T_2: Farmers practice	9067	1417	5258	24.51	152315	106400	52915

Ash gourd

Tangail : A sharp variation was found between the treatments. The higher number of fresh fruits (4-6 $plant^{-1}$ & 12330 ha^{-1}) was obtained from plants treated with sex pheromone trap. The lower number of fresh fruits (3-4 $plant^{-1}$ & 9360 ha^{-1}) was obtained from the farmers' practice. About 32% higher yield/gross return was found by using only sex pheromone trap.The highest gross return was obtained from plants treated with sex pheromone trap

Table 10. Performance of sex pheromone trap on the production of ash gourd at the MLT site Modhupur (Dhanbari), Tangail during $Kharif^{-1}$, 2009.

Treatment	Fruits $plant^{-1}$ (no.)	Fruits ha^{-1} (no.)	Gross return (Tk. ha^{-1})	% Higher yield/return over control
Sex pheromone + IPM tech	4-6	12330	123300	32%
Farmer practice (control)	3-4	9360	93600	-

Average fruit price = Tk. 10/piece

Manikganj : The highest number fresh fruits (25300 no. ha^{-1}) was obtained from the sweet gourd plot treated with sex pheromone. The lowest number of fresh fruits was recorded from farmers practice. The inverse trend observed in case of infested fruit in this study. Higher yield (27.50 t ha^{-1}) was record from pheromone trap tested plot. Apparently fewer insects were observed in sweet gourd in pheromone trap method compared to farmers practice. The net return (Tk. 93760 ha^{-1}) was also found higher is sex pheromone trap method than farmer practice.

Table 11. Effect of pheromone on the production of ash gourd at the MLT site, Manikganj, 2009

Treatment	No. of fresh fruit ha^{-1}	No. of infested fruit ha^{-1}	No. of damaged fruit ha^{-1}	Total yield (kg ha^{-1})	GR (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})
T_1: Sex pheromone + IPM technique	25300	750	2550	27.50	178750	84990	93760
T_2: Farmers practice	15648	2421	8931	22.30	133800	92100	41700

Cucumber

Pabna : The results revealed that harvesting period is about one week more in sex pheromone plot than farmers practice (Table 12). It might be due to the negative effect of toxicity of chemical pesticides used by the farmers injudiciously. It indicates that the plant of sex pheromone treatment start early fruiting. Incase of fruits plant^{-1}, the highest no. and percentage of affected fruits were counted from farmers practice plot. On the other hand higher number and percentage of non affected fruits plant^{-1} were counted from sex pheromone treatment. Non affected and affected individual fruit weight was more or less same in both treatments. So, it was found that by using sex pheromone trap fruit fly infestation could reduce and it was 13.17% where as infestation was more than 25% in farmers traditional practice. Yield plant $^{-1}$ and per hectare was also higher in sex pheromone treatment.

From the economic analysis, it was revealed that higher net return and benefit cost of ratio was obtained from sex pheromone treatment. It is mainly due to higher yield and relatively less cost than farmers practice.

Table 12. Performance of cucumber as affected by different controlling method against fruit fly at Choukibari village, Pabna during the year of 2008-09.

Treatment	Harvesting period (day)	Fruits plant^{-1}				Wt. fruit^{-1} (Kg)		Yield* (kg plant^{-1})	Yield* (t ha^{-1})
		Non affected		Affected		Non affected	Affected		
		No.	%	No.	%				
Sex pheromone + IPM technique	60	9.03	86.83	1.37	13.17	0.15	0.09	1.46	25.99
Farmers practice	53	7.43	74.23	2.58	25.77	0.15	0.11	1.31	24.11

** Cumulative yield of non affected and affected fruits only which are edible.*

Table 13. Cost and return analysis of cucumber as affected by different controlling method against fruit fly at Choukibari and Trimohon village, Pabna during the year of 2008-09.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
Sex pheromone+ IPM	213287	70925	142362	3.01
Farmers practice	186812	99041	87771	1.89

Rangpur : Significantly the highest number fresh fruit per plant (23.8 plant^{-1}) was obtained from plant treated with sex pheromone +IPM technique .The lowest number of fresh fruit per plant (9.0) was recorded from control. The number of infested fruit significantly reduced where sex pheromone + IPM technique was used. Significantly lower weight of infested fruit was found from the plot treated with sex pheromone. The infested fruit was 4.52 % in T_1 (sex pheromone trap +IPM) and 56.07% in control. The higher fruit yield (41.4 t ha^{-1}) was obtained from sex pheromone treated plot and the lowest (17.5 t ha^{-1}) from control plot. The highest gross return and gross margin were also recorded from without pheromone treatment.

Table 14.Yield of cucumber as influenced by sex pheromone trap at Mithapukur, Rangpur during 2008-09.

Treatments	No of fresh fruit $plant^{-1}$	No of infested fruit $plant^{-1}$	Wt. of fresh fruit $plant^{-1}$ (g)	Wt. of infested fruit $plant^{-1}$ (g)	Infested fruit (%)	Fruit yield (t ha^{-1})	Gross return ($Tk.ha^{-1}$)	TVC ($Tk.ha^{-1}$)	GM ($Tk.ha^{-1}$)
Sex pheromone + IPM technique	23.8a	0.6b	5069a	153b	4.52b	41.4a	414000	69384	344616
Control	9.0b	12.0a	2295b	3060a	56.06a	17.5b	175000	65520	109480
CV (%)	7.46	8.98	6.35	9.58	6.43	5.33			

Price (Tk./kg): Urea=11.80 , TSP= 74.36, MP= 55, Gypsum= 7, Zinc sulphate= 140, Boric acid =180, Cucumber= 10.

Water melon

Noakhali : Sex pheromone + Sanitation method performed better yield economic than the farmers' practice (Table 15). During the season of 2008-09, the higher the fruit fly capture the lesser was the fruit infestation and higher was the yield (Table 16).

Table 15. Effect of sex pheromone in watermelon in at Hazirhat, Noakhali during 2008-09.

Effects of pest control measures	Sex pheromone + Sanitation method	Farmers practice insecticide spray 08 times
Pest control cost (Tk. ha^{-1})	4050/= (3950/= less costly)	8,000/= above depend on infestation of cucurbit fruit fly
Watermelon yield (t ha^{-1})	28 t ha^{-1} (8 ton higher yield)	20 t ha^{-1}

Table 16. Fruit fly capture, yield and fruit infestation in watermelon at Hazirhat, Noakhali during 2008-09.

Pest control measures	Fruit fly captured (No.)	Yield (t ha^{-1})	% of infested fruits (total no. of fruits n=90)
Cuelure+ Sanitation	3,573	28	4.5
Control (exposed to fruit fly oviposition)	-	18	36

Patuakhali : After set up pheromone 15-30 male flies were trapped every three days and trapping rate was decreasing overtime. Farmers are astonished to see the no. of flies trapped and they called it a magic box. At fruiting stage a heavy hailstorm was occurred at Kuakata on 31 March 2009 and 50% crop was damaged. Vegetative growth and fruit setting was satisfactory. However, it was 1st year demo and damaged, it should be continued for the next year for dissemination.

Farmers' reaction

Farmer opined that sex pheromone trap is very much effective to control cucurbit fruit fly. They are interested to use of sex pheromone trap in cucurbit vegetable cultivation. They needed low price of sex pheromone trap and availability of the same in the local market.

Conclusion

Numerical less insect infestation was observed in sex pheromone treatment compared to pesticides used or control treatment. The yield and gross return were also found higher in sex pheromone treatment. This experiment created a good awareness to the sweet gourd growers because of good yield and economic return and environment friendly technique.

Control of Brinjal Shoot and Fruit Borer by Sex Pheromone

Abstract

The experiment was carried out at Joardoho village, extrapolation area of FSRD site Pushpopara, Pabna during 2008-2009 to evaluate the sex pheromone trapping performance in controlling BSFB. Yield, yield attributes and brinjal harvesting period were found higher in sex pheromone trapping plot. Higher brinjal equivalent yield and the maximum economic return was recorded in sex pheromone trapping with IPM treatment.

Introduction

Brinjal is an important vegetable in Bangladesh, which is available in round the year. The well-known problem in brinjal cultivation is the brinjal shoot and fruit borer. Chemical control is the main way to control this borer which affects both human health and environments. Entomology division, BARI developed sex pheromone trapping technique to effectively control the BSFB with friendly environment. Hence, the present study has been undertaken to observe the performance of sex pheromone trapping technique in controlling BSFB.

Materials and Methods

A study was carried out at Joardoho village, an extrapolation area of FSRD site, Pushpopara, Pabna at 2008 to see the performance of sex pheromone trapping technique in controlling BSFB. Before start of the program a discussion meeting was organized with intending vegetable grower farmers at Joardoho village. The farmer groups were trained up on pesticides free vegetables and fruit production. Generally farmers of this location cultivate brinjal as intercropping with chili and turmeric. Finally six co-operator farmers with 4000 m^2 of such like intercropped land were selected for experimentation with sex pheromone and another 6 farmer's practiced field was selected only for data collection. The experiment was laid out in RCB design with six replications (one farmer one replication). There were two treatments viz. T_1 = Sex pheromone+ IPM technique (including sanitation) and T_2= Farmers practice. This program was implemented in participating approach, except insect control the participating farmers procured all inputs. For T_1 treatment sex pheromone trap "zadur phad" and biological control agents including Trichogramma, Bracon etc. was supplied and farmers clipped and damaged the affected brinjal shoot and fruit two days in a week. Trichogramma was applied @ 1 vial per hectare, 3 times at 10 days intervals of the crop cycle. Trichogramma are minute wasp parasitic on eggs of Lepidopteron insect's pests. It lays its eggs in the host insect eggs, multiply therein, thus preventing hatching of host insect larvae. Bracon was applied @ 1 bunker per hectare, 3 times at 10 days intervals at the total crop duration. Bracon habetor are medium sized wasp parasitic on larvae of wide range of insect pests. Bracon is an aggressive ecto-parasite. Female Bracon at first inject venom and thus paralyze insect larvae. A female Bracon can paralyze 500-1000 larvae. Paralyzed larvae cannot survive. It then lays its eggs on the host larvae, multiply therein and thus destroying the pests. Sex pheromone traps were set up 10 m apart in square system (100 boxes per hectare). In T_2 treatment farmers sprayed Sobicrone/Kartaf/Majic/Fancord etc. as single or cocktail at every 2 days interval and Score/Tilt and Okojim at 10 days interval. Fertilizers were used as farmers' local dose (18 t cowdung + 115-20-99-2.3-1.27 Kg N-P-K-Zn-B ha^{-1}).Brinjal seedling, Chili seedling and Turmeric corm were planted on 06-07 June,10-12 June and 02-04 June, 2008 respectively maintaining the spacing 2 X 2 m^2, 1 X 1 m^2 and 0.60 X 0.20 m^2 respectively. Local varieties were used for brinjal (Shoyla – as like Kajla), Chili (Konache dhani) and Turmeric (Arani) in the intercropping system. During the flowering to fruiting stages first 2 months fruit setting of brinjal was seriously hampered due to frequent rainfall. Finally full scale brinjal harvesting was started from 16 November, 2008 and continuing upto 26 January, 2009 incase of sex pheromone treatment and upto 09 January, 2009 incase of farmers practice plot. Other intercultural operations were done when necessary. Necessary data were collected and mean data are presented here.

Results and Discussion

Sex pheromone with other IPM practice was always better than farmers practice i.e. chemical pesticides uses. Fruit setting was higher in sex pheromone treatment (Table 1). Though higher no. of affected fruits plant^{-1} was obtained from sex pheromone plot but the percentage of affected fruit was less than farmers practice (FP) plot. Higher number and percentage of non affected fruits plant^{-1} was counted in sex pheromone treatment. Brinjal fruit yield per hectare was higher in sex pheromone treatment than chemical pesticide used (FP) plot. It was also found that other component crops of the intercropping system i.e. Chili and Turmeric gave higher yield in sex pheromone treatment than FP treatment. This trend might be due to negative and toxic effect of chemical pesticide on farmers practiced crops. It was also observed that Brinjal harvest duration was longer in sex pheromone treatment than FP treatment. Finally, the Brinjal equivalent yield was higher in sex pheromone treatment than FP treatment.

From the economical point of view, it was found that net return and BCR was higher in sex pheromone treatment than FP treatment both in three component crop cultivation or single brinjal cultivation system.

Farmers Reaction

- Sex pheromone trapping system gave longer period brinjal harvesting opportunity
- Pesticide using is less profitable because the lion share of the benefit has to share with pesticide diller
- and the total fruit setting become less
- Pesticide is hazardous for our health especially it creating vomited matter, pain in stomach and giddy
- Sex pheromone, beneficiary insect should be available at local area with low price
- It required community approach which may be problem in some times.

Scientific staff opinion

- Should make the farmers more aware about the trapping system for more success.
- Trap supplied from the company should be genuine

Conclusion

Sex pheromone trapping with IPM system is very helpful and non hazardous for farmers and consumers. But sex pheromone and biological agents should be available timely and sufficiently in local market.

Table 1. Performance of Brinjal under deferent treatment at Joardoh under extrapolation area of FSRD site Pushpapara Pabna during 2008-09.

Treatment	Fruits plant^{-1}				Fruit yield (t ha^{-1})	
	Non affected		Affected		Non affected	Affected
	No.	%	No.	%		
T_1: Sex pheromone + IPM	565.2	87.74	79.6	12.26	19.15	2.46
T_2: FP	79.18	75.16	25.15	24.84	11.62	4.90

Table 2.Yield performance of Brinjal + Chilli + Turmeric under deferent treatment at Joardoha extrapolation area of FSRD site Pushpapara Pabna during 2008-2009.

Treatment	Brinjal Yield (t ha $^{-1}$)		Chilli (t ha $^{-1}$)	Turmeric Yield (t ha $^{-1}$)	Brinjal equivalent yield (t ha $^{-1}$)
	Non affected	Affected			
T_1- Sex pheromone + IPM	19.15	2.46	3.90	11.56	34.28
T_2- FP	11.62	4.90	3.50	4.69	22.58

Table 3. Cost and return analysis of Brinjal + Chilli + Turmaric cropping system at Joardoh extrapolation area of FSRD site Pushpapara, Pabna during 2008-2009.

Treatment	Brinjal equivalent yield (t ha $^{-1}$)	Gross return (Tk ha $^{-1}$)	Total cost (Tk ha $^{-1}$)	Net return (Tk ha $^{-1}$)	BCR
T_1- Sex pheromone + IPM	34.28	617058	126530	490528	4.89
T_2- FP	22.58	406382	141530	264852	2.87

Table. 4: Cost and return analysis of sole Brinjal under Brinjal + Chilli + Turmaric intercropping system at Joardoh extrapolation area of FSRD site, Pushpapara, Pabna during 2008-2009.

Treatment	Brinjal yield (t ha $^{-1}$)		Gross return (Tk ha $^{-1}$)	Total cost (Tk ha $^{-1}$)	Net return (Tk ha $^{-1}$)	BCR
	Non affected	Affected				
T_1- Sex pheromone + IPM	19.15	2.46	369246	48535	320711	7.61
T_2- FP	11.62	4.90	258070	66035	192035	3.91

Production Programme of Mustard Varieties in Mustard-Boro-T.Aman Cropping Pattern

Abstract

The trial on production programme of mustard varieties in Mustard-Boro-T.aman or Mustard-Boro cropping pattern was conducted in Tangail, Manikganj, Mymensingh, Jamalpur, Bogra and Shyampur (Rajshahi) during rabi 2008-09 under the farmers' field condition to evaluate the BARI developed mustard varieties suitable for the cropping pattern. Tested varieties were BARI Sarisha-9, BARI Sarisha-14, BARI Sarisha-15 & Tori-7 (local). Among the tested varieties, BARI Sarisha-14 gave the higher seed yield in different locations.

Introduction

Bangladesh is to import a huge amount of vegetable oil and oil seed every year to meet up the deficiency. Mustard is the major oil seed crop grown in Bangladesh. It covers about 70% of the total oil seed production. The yield of this crop in Bangladesh is found much lower than the other countries of the world due to lower yield potential of existing local varieties and the poor management practices. The national average yield of mustard is 0.74 t ha^{-1} (Mondal and Wahab, 2001). Oil Seed Research Center (ORC) of BARI has developed some advanced promising varieties/lines of mustard which have been proved high yielder less diseases susceptible and higher oil content (44%). The mustard varieties (*Brassica camprestis*) are also resistant to white rust (Woods-DL and Falk. KC, 2001). Farmers normally use local varieties and as such they get lower yield. The average yield of mustard can be increased by using high yielding varieties. BARI developed short duration varieties may be used as the replacement of the existing low yielding varieties without disturbing the cropping pattern Mustard-Boro-T.aman. Hence, the study was under taken to evaluate the performance of newly released varieties of mustard in the cropping pattern under farmers' field condition.

Materials and Methods

The trial on suitability of mustard varieties in Mustard-Boro-T.aman or Mustard-Boro cropping pattern was conducted at MLT site, Ghatail, Tangail, Okiara ICM club, Garpara at MLT site, Manikganj, Mymensingh, Jamalpur, and MLT site, Gabtali, Bogra during rabi 2008-09 in farmers' field condition to evaluate the BARI developed mustard varieties suitable for the cropping pattern. The trial was laid out in RCB design with three dispersed replications (farmers). It was conducted in ICM club farmers' land, Tested varieties were BARI Sarisha-9, BARI Sarisha-14 and BARI Sarisha-15. In Bogra, production programme was taken on only BARI Sarisha-14. Crop management practices followed at different locations are presented in the presented Table 1. Two third of urea and all amount of fertilizers were applied during final land preparation .Remaining urea was applied at 30 days after sowing as top dress. One hand weeding operation was done at 30 days after sowing (DAS). Two irrigations at 20 and 45 DAS were provided. Intercultural operations were done when necessary. Data were analyzed statistically using CropState/Mstat-C analytical package

Table 1. Crop management practices done in different locations

Location	Tangail	Manikganj	Mymensingh	Jamalpur	Bogra	Rajshahi
Sowing time	13-15 Nov. 2008	04 Nov.2008	11-17 Nov. 2008	13-19, Nov.08	6-16 Nov. 08	5-7 Nov. 08
Harvesting time	27 Jan .to 6 Feb.09	20-23 Jan. 09	3-5 Feb. 2009	1-7 Feb. 2009	22-24 Jan.09	3-7 Jan.09
Fertilizer dose (kg ha^{-1}) (N-P-K-S-Zn-B)	127-32-37-23-1	74-34-45-29-4-1.7	100-25-60-20	120-38-36-20-1	60-20-50-10-0.6	115-34-40-25-2-2

Results and Discussion

Tangail : All the three varieies matured at almost similar time (77-78 days). The highest number of siliqua per plant (51) was found in variety BARI Sarisha-9 followed by BARI Sarisha-14 (Table 2). The lowest number of siliqua per plant (29) was recorded from the variety BARI Sarisha-14. Significantly the highest number of seeds per siliqua (28) and 1000-grain weight (2.85 g) were obtained from the variety BARI Sarisha-14, followed by BARI Sarisha-15 (20 and 2.47g). The highest seed yield (1406 kg ha^{-1}) was obtained from BARI Sarisha-14 which significantly differed from BARI Sarisha-15 and BARI Sarisha-9. The yield performance of all the three varieties was lower due to unusual weather (Foggy and no sunlight around 12 days) prevailed their flowering and siliqua formation stages. However, the results indicate that BARI sharisha-15 is more suitable for existing Mustard-Boro-T.Aman rice cropping pattern in the context of yield and duration.

Manikganj: The mustard varieties days to maturity were 77-80 days (Table 3). Plant population, plant height, pods $plant^{-1}$ and 1000-seed weight did not varied significantly but other plant characters like number of seeds pod^{-1}, seed and stover yield varied significantly. Number of seeds pod^{-1} was significantly higher in BARI Srisha-14 which contributed to higher seed yield (1.23 t ha^{-1}) and it was followed by BARI Sarisha-9 (0.86 t ha^{-1}) and BARI Sarisha-15 (0.81 t ha^{-1}). Stover yield was also higher (2.36 t ha^{-1}) in BARI Sarisha-14 followed by BARI Sarisha-15 and BARI Sarisha-9. Higher economic return was found higher in BARI sarisha-14 due to higher seed yield compared to other varieties (Table 4).

Netrakona (Mymensingh) : The mustard varieties matured within 78-81 days (Table 5). Plant population did not varied significantly but other plant characters as plant height, number of siliqua $plant^{-1}$, number of seeds $siliqua^{-1}$, 1000 seed weight, seed and stover yields varied significantly. Number of seeds $siliqua^{-1}$ and 1000 seed weight were significantly higher in BARI sarisha-14 which contributed to higher seed yield (1.32 t ha^{-1}) and it was followed by BARI sarisha-9 with seed yield (1.21 t ha^{-1}).

Sherpur (Jamalpur) : The number of plants m^{-2} was found insignificant due to varieties variation (Table 6). The highest number of siliqua $plant^{-1}$ was noted from BARI Sharisha 9 and was identical to

BARI Sharisha 15. The lowest number of siliqua plant^{-1} was recorded from BARI Sharisha 14. The highest number of seeds siliqua^{-1} was found in BARI Sharisha 14. The second highest seeds siliqua^{-1} was recorded from BARI Sharisha 15 while the lowest number of seeds siliqua^{-1} was recorded in BARI Sharisha 9. The 1000-seed weight was statistically insignificant. The highest seed yield was recorded from BARI Sharisha 14 (1650 kg ha^{-1}). BARI Sharisha 15 (1460 kg ha^{-1}) and BARI Sharisha 9 (1389 kg ha^{-1}) produced identical seed yield. All the BARI varieties matured more or less at the same time.The highest gross return (Tk. 66,000 ha^{-1}), gross margin (Tk. 28,465 ha^{-1}) and benefit cost ratio (1.75) were obtained from BARI Sharisha 14.

Bogra : Satisfactory grain yield (1.44 t ha^{-1}), attractive gross return (44125 Tk. ha^{-1}) and benefit cost ratio (2.25) was achieved with improved management practices might be due to sowing at optimum time and timely proper management practices like irrigation, weeding, thinning and pest management (Table 7).

Rajshahi : Plant height, seeds silique^{-1} and yield were significantly influenced by different varieties (Table 8). The variety BARI Sarisha-9 was earlier (80 days) in maturity followed by BARI Sarisha-15 (85 days). All the varieties failed to produce significant difference in case of siliqua plant^{-1}, 1000-grain weight, secondary branch plant^{-1} and plant population. The highest seeds siliqua^{-1} was found in BARI Sarisha-14 (24.1) followed by BARI Sarisha-15 (20.17). The lowest seed siliqua^{-1} was produced by BARI Sarisha-9 (13.58). The variety BARI Sarisha-14 produced the highest seed yield (1133.3 kg ha^{-1}) which was statistically identical to BARI Sarisha-15 (1048.57 kg ha^{-1}). The lowest seed yield was produced by the variety BARI Sarisha-9 (873.57 kg ha^{-1}).

Farmers' opinion

Tangail : Though the yield was higher in BARI Sharisha-14, they chose both BARI Sharisha-14 and BARI Sharisha 15 due to their short cultivation periods. They opined that the varieties do not hamper the transplanting time of succeeding boro crop.

Manikganj: Farmers' are interested to cultivate BARI Sarisha-14 due to its short duration and reasonable higher seed yield. It can be easily fitted in the cropping pattern without hampering the succeeding boro rice crop.

Netrakona (Mymensingh) : The Farmers are very much interested to grow the BARI mustard varieties for their higher yield and economic returns. Farmers preferred the BARI sarisha 14 and BARI sarisha 9 and they kept those seeds but other interested farmers demanded the seeds of those varieties for next year sowing.

Sherpur (Jamalpur) : Farmer could realize that BARI varieties were better than their traditional variety and may be cultivated in between T.Aman and Boro.

Bogra : Farmers could realize that the BARI Sharisha-14 was better than their local variety and may be cultivated in between T.Aman and Boro rice. They preserved their seeds and will go for cultivation in the next year.

Rajshahi: Farmers are interested to cultivate BARI Sarisha-14 due to its higher seed yield and its field duration is also acceptable and will not delay the succeeding boro rice.

Conclusion

As BARI sarisha-14 yielded higher and short durated, can easily be fitted in the cropping pattern Mustard-Boro-T.aman without delaying the succeeding boro crop. The variety is proven to be promising, it may be recommended as extension message for large scale production.

References

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Table 2. Performance of mustard varieties at the MLT site, Ghatail during 2008-09.

Variety	Plant population (m^2)	Days to flowering (50%)	Days to maturity	Plant height (cm)	Siliquas plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	1000 seed wt. (g)	Seed yield (kg ha^{-1})
BARI Sarisha-9	60	29	77	101.9	51	15	2.28	997
BARI sarisha-14	58	29	77	93.3	29	28	2.85	1406
BARI sarisha-15	66	31	78	119.7	34	20	2.47	1128
LSD (0.05)	7.25	1.02	1.05	3.68	3.50	1.81	0.14	125.88
CV (%)	9.2	2.7	1.0	2.7	7.1	6.8	4.1	8.3

Table 3. Yield contributing characters and yield of mustard varieties at MLT site, Manikganj during 2008-09.

Variety	Days to maturity	Plant height (cm)	Plant m^{-2} (No.)	Pod plant^{-1} (No.)	Seeds Pod^{-1} (No.)	1000 seed wt.(g)	Seed yield (t ha^{-1})
BARI Sarisha-9	80	76.4	138	33.8	15.2b	2.61	0.86b
BARI Sarisha-14	77	77.7	100	33.0	27.0a	2.35	1.23a
BARI Sarisha-15	79	79.7	110	32.6	17.8b	2.22	0.81b
CV (%)		3.74	21.87	13.84	14.96	7.97	13.37

Table 4. Yield and economic analysis of mustard varieties at the MLT site, Manikganj during the rabi season of 2008-09

Treatment	Gross return (Tk. ha^{-1})	Total Cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
BARI Sarisha-9	34400	28800	5600	1.19
BARI Sarisha-14	49200	28800	20400	1.71
BARI Sarisha-15	32400	28800	3600	1.13

Price (Tk.kg^{-1}): Urea=14, TSP=80, MOP=56, Gypsum=8, ZnO=100, Boric Acid=260, Mustard =40.

Table 5. Yield and yield contributing characters of mustard varieties under Mustard-Boro-T. aman rice cropping pattern at Netrakona, 2008-09

Treatment	Days to maturity	Plant population m^{-2}	No. of siliqua plant^{-1}	No. of seeds siliqua^{-1}	1000-seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
BARI sarisha 9	78	110	57.86a	15.2b	2.81b	1.21b	2.84b
BARI sarisha 14	80	107	51.35b	23.4a	2.91a	1.32a	2.59c
BARI sarisha 15	81	106	51.76b	15.7b	2.74c	1.11c	3.23a
CV (%)	-	5.13	5.33	6.47	1.5	2.32	5.75

Table 6. Yield and yield contributing character of different mustard varieties at FSRD site, Sherpur during 2008-09

Variety	Siliqua plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	1000-seed wt. (g)	Seed yield (kg ha^{-1})	Maturity (days)	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GR (Tk. ha^{-1})
BARI sarisha 9	71.4 a	15.4 c	3.37	1389 b	83 c	55560	37535	18025
BARI sarisha 14	57.3 b	36.0 a	3.54	1650 a	84 b	66000	37535	28465
BARI sarisha 15	60.0 ab	22.99 b	3.57	1460 b	85 a	58400	37535	20865
CV (%)	10.46	9.64	7.00	8.94	3.41			

Price of mustard= Tk.40.00/kg

Table 7. Performance of BARI Sharisha-14 at the MLT site, Gabtali, Bogra during 2008-09

Plant population m^{-2}	Effective siliqua $plant^{-1}$ (no.)	Seed $siliqua^{-1}$ (no.)	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Cost of production (Tk. ha^{-1})	Gross rerun (Tk. ha^{-1})	BCR
42	42.5	22.6	3.20	1.44	1.85	19648	43200 + 925 = 44125	2.25

Price (Tk. kg^{-1}): Mustard= 30, Straw= 0.5

Table 8. Yield and yield contributing characters of different Mustard varieties grown in Mustard-Boro-T. Aman cropping pattern at MLT site Shibpur, Rajshahi during 2008-09.

Varieties	Days to Maturity	Siliqua $plant^{-1}$	Seed $siliqua^{-1}$	TGW (g)	Plant population (m^2)	Yield (kg ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
BARI Sarisha-9	80	58.15	13.58 b	2.89	53.33	873.57 b	16694	13881
BARI Sarisha-14	86	63.30	24.1 a	3.05	47.67	1133.3 a	16694	22971
BARI Sarisha-15	85	60.25	20.17 a	2.97	50.5	1048.57 a	16694	2006
CV (%)	-	17.9	8.81	6.35	14.95	7.82		

NB : Urea @ 12 Tk/kg, TSP @ 80 Tk/kg, MOP @ 70 Tk/kg, Gypsum @ 6 Tk/kg, Zn @ 120 Tk/kg, Boric acid @ 350 Tk/kg and Mustard seed @ 80 Tk/kg. Cost of output : Mustard @ 35 Tk/kg.

On-Farm Trial of New Hybrid Varieties of Vegetables

Abstract

A field experiment was conducted at the farmers; field of Mominpur village, Nayapara (ICM club), Mithapukur upazilla, MLT site, Gobindagonj and on–station, OFRD Rangpur during rabi and kharif season 2008-09 to evaluate the hybrid varieties of vegetables. The experiment was laid out in a randomized complete block design with six dispersed replications. Three hybrid tomato varieties viz., Cibellia, Nowara and 74 -108 compared with BARI tomato -14 (check), four hybrid brinjal varieties viz., Andrea, Brigitte, Angela and 10- 707 compared with BARI begun -8 (check), three cucumber varieties Massa, Condesa and 22-52 were evaluated with locally available hybrid variety ‘Alavi’ (check), hybrid carrot variety Monanta Nantes 5 compared with local Japani hybrid (check), hybrid broccoli viz., ‘Agassi’ was compared with Japani hybrid, four melon varieties viz., Giorgio, Natal, Ducral and Caribian gold compared with local Bengi (check) and local mistikumra (check), two hybrid cauliflower varieties viz., Bishop and Divita compared with Snow crown (check). All the tested hybrid varieties of tomato and brinjal were susceptible to bacterial wilt. Significantly the highest fruit yield was obtained from BARI tomato -14, BARI begun -8 and locally cultivated cucumber variety Alavi. The broccoli variety Agassi’ performed 20% higher over local check. The higher and similar yield was obtained from hybrid cauliflower varieties Bishop and Divita.

Introduction

Tomato, brinjal, cucumber, cauliflower, broccoli, carrot and melon etc. are the popular high value vegetables crop grown all over the country. Tomato and cucumber mostly used as salad in our country. These crops have potentialities to generate higher income compared to many other vegetables. However, farmers are grown locally available hybrid varieties imported by the seed companies. The performances at these varieties need to be evaluated under field conditions. Considering the above facts, the trial was undertaken to evaluate and popularize the hybrid varieties of among the farmers.

Materials and Method

The experiment on tomato varieties was conducted at the farmers' field of Mominpur village cucumber varieties at Nayapara (ICM club) Mithapukur upazilla, carrot, cauliflower varieties at MLT site, Gobindoganj, Broccoli and melon varieties at the on-station, OFRD, Rangpur during rabi and kharif season 2008-09. The land was medium high and the soil was sandy loam in texture which belongs to AEZ No. 3. Three hybrid varieties of tomato viz. Cibellia, Nowara and 74 -108 and BARI tomato -14 as check, four hybrid brinjal varieties viz., Andrea, Brigitte, Angela,10- 707 compared with BARI begun -8 (check), three cucumber varieties Massa, Condesa and 22-52 were evaluated with locally available hybrid variety 'Alavi' (check), hybrid carrot variety Monanta Nantes 5 compared with local Japani hybrid (check), hybrid broccoli viz., 'Agassi' was compared with Japani hybrid, four melon varieties viz., Giorgio, Natal, Ducral and Caribian gold compared with local Bengi (check) and local mistikumra (check), two hybrid cauliflower varieties viz., Bishop and Divita compared with Snow crown (check).The experiment was laid out in a randomized complete block design with six dispersed replications among the ICM farmers. Sowing time, harvesting time and fertilizer were for different crops are presented in the Table 1. The entire amount P, S, Zn, B and half of each of N and K were applied during final land preparation. The rest of N and K were applied as top dress depending upon the crops. Other intercultural operations were done as and when necessary. Data on yield, yield contributing characters disease reactions were recorded and analyzed statistically following MSTAT-C software package.

Table 1. Management practices in different crops

Crops	Sowing time	Harvesting time	Fertilizer (N-P-K-S-Zn–B-CD kg ha^{-1})
Tomato	10-15 Nov.08	28 Jan. – 26 Feb.09	250-90-125-30-4-1-5000
Brinjal	1-5 Nov. 2008	25 Jan.–30 Feb. 2009	170-30-50-30-4-1-5000
Cucumber	1-4 March, 2008	var. Massa : 58-62 DAT. var. Condesa : 60-62 DAT var. 22-52 at 55-60 DAT var. Alavi at 60-65 DAT	80-30-100-20-5-2-0
Carrot	21-23 Nov. 2008	10 March, 2009	140-46-105-28-6000
Broccoli	16 November, 2008	5 February, 2009	130-48-80-24-3-1.8-0.6-8000
Melon	8 February, 2009	28 April to 30May, 2009	80-35-75-18-4.3-1.7-2000
Cauliflower	1-5 November 2008	25 Jan.–15 Feb.2009	155 – 77 -120 -30 -4 -1

Results and Discussion

Tomato

The plant height of hybrid tomato "74-108" (254.50cm) was more than double than BARI tomato -14 (112.8 cm) (Table 1). Significantly the highest number of fruit per plant were recorded from the variety "74 -108". The highest individual fruit weight was recorded from BARI tomato -14 which was identical to Cibellia and Nowara. The lowest individual fruit weight (5g) was recorded from "74-108". The highest fruit yield (81.66 t ha^{-1}) was obtained from BARI tomato -14 which differed significantly from other varieties. The lowest yield (36.94t ha^{-1}) was obtained from "74-108". The performance of tested hybrid tomato varieties was not good. The yield potential of those varieties was poor compared to check variety (BARI tomato -14). Moreover, all the tested hybrid varieties were susceptible to bacterial wilt. The infestation of bacterial wilt of these varieties varied from 5 -11 % plant. Due to higher yield, economically BARI tomato -14 was more viable than others.

Brinjal

Significantly the highest number of fruit per plant was recorded from BARI begun -8 (check) variety (Table 2). The highest fruit weight per plant (2.31kg) was recorded from the variety "10- 707" which differed significantly from other varieties. The lowest fruit weight per plant (1.47kg) was recorded from Angela. The highest fruit yield (48.83t ha^{-1}) was obtained from BARI begun -8 (check), which differed significantly from other varieties. The lowest fruit yield (29.48 t ha^{-1}) was obtained from

Angela. The performance of tested hybrid brinjal varieties was not good. The yield potential of these varieties were poor compared to check (BARI begun -8) variety. Moreover, all the tested hybrid varieties were susceptible to bacterial wilt. The infestation of bacterial wilt of these varieties varied from 9 –11 % plant.

The highest gross return (Tk. 732450 ha^{-1}), gross margin (Tk. 662716 ha^{-1}) and benefit cost ratio (10.50) was obtained from BARI begun -8 (check). The lowest gross return (Tk. 442200 ha^{-1}), gross margin (Tk. 372466 ha^{-1}) were obtained from "Angela" variety.

Cucumber

The length of fruit varied significantly due to different cucumber varieties (Table 3). The highest length of fruit (22.02 cm) was recorded from Massa which was identical to 22-52 (21.62 cm). Different varieties of cucumber had a significant effect on the number of fruits per plant. The highest number of fruits per plant (21.86) was obtained from Alavi (check). The weight of individual fruit was highest with Massa (276.2 g) which was identical to 22-52 (267.2 g). The highest fruit yield (36.26 t ha^{-1}) was obtained from Alavi (check) which differed significantly from others varieties. The increase in yield with Alavi was particularly due to its higher number of fruits per plant. The lowest yield was obtained from Condessa (26.67t ha^{-1}). The check variety Alavi has attractive colour. The colour of the tested hybrid varieties were not attractive compared to Alavi. Similarly, the market demand of the tested variety was very poor compared to Alavi particularly because of their poor colour.

The highest gross return (Tk.398860 ha^{-1}), gross margin (Tk. 327434 ha^{-1}) and benefit cost ratio (5.58) was obtained from "Alavi" (check). The lowest gross return (Tk. 213360 ha^{-1}) and gross margin (Tk. 142334 ha^{-1}) was obtained from "Condessa" variety.

Carrot

Significantly the highest number of leaves per plant, root length, diameter of root and total weight of plant were recorded from check variety (Table 4). Similarly, the highest root weight per plant was also recorded from check variety. The highest root yield (28.10 t ha^{-1}) was also obtained from check variety compared to Monanta Nantes-5. The performance of Monanta Nantes-5 found very poor compared to check variety. The colour, taste, sweetness etc also poor in Monanta-5. The core of the root was also more in Monanta Nantes-5 which reflects a question mark on its quality. No disease or insect infestation was observed in the crop field

The highest gross return (Tk.365300 ha^{-1}), gross margin (Tk.289795 ha^{-1}) and benefit cost ratio (4.84) was obtained from locally available Japani hybrid varieties of carrot (check). The lowest gross return (Tk.293800 ha^{-1}) and gross margin (Tk.218295 ha^{-1}) were obtained from 'Monanta Nantes-5'

Broccoli

Different Broccoli varieties had a significant effect on the length of curd per plant (Table 5). The highest length of curd was obtained from 'Agassi' (17.12 cm). Similarly, the highest circumference of curd was also obtained from 'Agassi' (43.57 cm). The highest weight of curd varied significantly due to different Broccoli varieties. The highest weight of curd per plant was obtained from 'Agassi' (0.872 kg $curd^{-1}$). Significantly the highest curd yield was also obtained from 'Agassi' (32.31 t ha^{-1}) which was about 20% higher over local check. No marked infestation of *Alternaria* leaf spot and wilt disease was observed in 'Agassi' however, infestation of Alternaria leaf spot disease was much higher in local check. Few plants of both the varieties were infested by cut warm. The insect and disease infestation was properly controlled by hand picking and spraying. Eating of tender leaves of broccoli of both the varieties was started by' Bubuli' bird at the vegetative stage, however, it was driven by bird boy.

highest gross return (Tk.323100 ha^{-1}), gross margin (Tk.234396 ha^{-1}) and benefit cost ratio (3.64) was obtained from the hybrid variety 'Agassi'. The lowest gross return (Tk.269000 ha^{-1}) and gross margin (Tk.180296 ha^{-1}) were obtained from locally available Japani hybrid variety of broccoli (check).

Melon

Length of fruit varied significantly due to different varieties (Table 6). The highest length of fruit was measured from local mistikumra (9.97 cm). The lowest length was recorded from Caribian (4.00 cm). The circumference of fruits was highest with mistikumra (68.13 cm) which differed significantly from Giorgio, Natal, Dueral, Caribian gold and local bangi. The thickness of flesh was also the highest with mistikumra (3.41cm). Different varieties had a significant effect on the number of fruits per plant. Significantly the highest number of fruits per plant was recorded from Giorgio (7.51 plant^{-1}). But significantly the highest thickness of flesh (3.41cm) and individual fruit weight (2.96kg) was obtained from local mistikumra and the lowest thickness flesh (2.5 cm) was obtained from local bangi and the lowest individual fruit weight (1.12 kg) was recorded from Caribian. Local mistikumra gave the highest fruit yield (32.17 t ha^{-1}) which was statistically differed from Giorgio, Natal, Ducral, Caribian gold, Local Bengi(check). The lowest fruits yield (6.35 t ha^{-1}) was recorded from Caribian gold.The highest gross return (Tk.128680 ha^{-1}), gross margin (Tk.98864 ha^{-1}) and benefit cost ratio (4.32) was obtained from mistikumra. The lowest gross return (Tk.42750 ha^{-1}) and gross margin (Tk.13534 ha^{-1}) were obtained from local check.

Cauliflower

Significantly the highest perecycle of curd (49.98cm), diameter of curd (19.58 cm) and weight of curd (1.41 kg) were recorded from Bishop which differed significantly from snow crown (check) (Table 8). The highest curd yield (52.30 t ha^{-1}) was recorded from Bishop, which was identical to Divita. The lowest yield (37.44 t ha^{-1}) was recorded from snow crown (check). The performance of tested hybrid cauliflower varieties was good. The yield potential of those varieties was good compared to snow crown (check).

The cost and return analysis of different cauliflower varieties are presented in Table 2. The highest gross return (Tk. 523000 ha^{-1}), gross margin (Tk. 417755 ha^{-1}) and benefit cost ratio (6.15) was obtained from Bishop. The lowest gross return (Tk. 374400 ha^{-1}) and gross margin (Tk.289370 ha^{-1}) were obtained from Snow crown (check).

Farmers' opinion

Tomato: Farmers opined that cost of staking of these varieties was high and yield was very lower than check variety. They did not prefer the tested hybrid varieties under study. The fruit size of the variety 74-108 is too much small so that the customer in the market did not prefer this variety. The farmers could not able to sell this variety. All these hybrid varieties are susceptible to wilt. So they are not interest to grow these varieties.

Brinjal : They opined that the yield of hybrid varieties were poor compared to check variety. The harvesting period was also less . Moreover the hybrid varieties were susceptible to bacterial wilt. So, they are not interested to grow these varieties

Cucumber : Because of low yield, poor colour and less market demand farmers do not prefer new hybrid varieties under study.

Carrot : Because of poor yield and economic performance as well as its poor colour, taste and sweetness farmers were not interested to grow Monanta Nantes-5 variety.

Melon : Farmers are unknown about the crops. Its uses are also unknown to them. Market demand is very poor. They did not like this crop.

Cauliflower : Market demand was higher due to attractive color

Conclusion

All these hybrid varieties of tomato and brinjal are susceptible to wilt. Again, the yield and economic performance of the tested varieties was also poor and susceptible to bacterial wilt. So the varieties under study may not be recommended for the farmers.

Table1. Yield and yield contributing characters of hybrid varieties of tomato at Mominpur under FSRD site, OFRD, Rangpur, 2008-09.

Varieties	Plant height (cm)	No. of fruits plant^{-1}	Individual fruit wt (g)	Yield (t ha^{-1})	% of wilting	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Cibellia	174 .00 b	32 b	53 a	56.53 b	11	395710	99569	296141
Nowara	152.70 c	28 b	61 a	56.80 b	10	397600	99569	298031
74-108	254.50 a	210 a	5 c	36.94 c	5	258580	99569	159011
BARI tomato-14	112.80 d	35 b	63 a	81.66 a	0	571620	99569	472051
CV (%)	6.06	7.89	10.3	7.31				

Price (Tk./kg): Urea=11.80 , TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160 , Cow dung = 1, Sibilia , Nowara , BARI tomato-14 = 7, 74-108=5.

Table 2. Yield and yield contributing characters of hybrid varieties of brinjal at Mominpur under FSRD site, OFRD, Rangpur, during rabi season, 2008-2009.

Varieties	Plant height (cm)	No. of fruits plant^{-1}	Individual fruit wt (g)	Yield (t ha^{-1})	% of wilting	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Cibellia	73.25a	8.00c	1.61b	32.06d	11	480900	69734	411166
Nowara	72.75a	8.08c	1.76b	35.25c	10	528750	69734	459016
74-108	70.38a	7.08c	1.47b	29.48e	11	442200	69734	372466
BARI tomato-14	73.65a	10.17 b	2.31a	46.06b	9	690900	69734	621166
BARI begun -8	73.75a	22.15a	2.21a	48.83a	0			
CV (%)	5.83	8.46	6.25	5.56				

Price (Tk./kg): Urea=11.8 , TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160 , Cow dung = 1, Brinjal =15

Table 3. Performance of different hybrid varieties of cucumber at Mithapukur under OFRD, Rangpur during kharif-I season 2008-09

Varieties	Length of fruit (cm)	Circum-ference (cm)	No. of fruit plant^{-1}	Indv. fruit wt (g)	Fruit yield (t ha^{-1})	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Massa	22.02a	15.83b	19.06b	276.2a	32.59b	260720	71426	189294
Condesa	19.87b	14.63c	16.32c	244.7c	26.67c	213360	71026	142334
22-52	21.62a	20.37a	19.67ab	267.2ab	33.62b	268960	71426	197534
Alavi	16.32c	15.10bc	21.86a	248.5bc	36.26a	398860	71926	327434
CV (%)	5.82	4.77	10.28	6.51	5.44			

Price : Cucumber(Alavi) = Tk. 11/kg, Cucumber (others) =Tk. 8/kg, Urea= 11.80/kg, TSP=Tk. 74.36/kg, MP=Tk. 55/kg, Gypsum= Tk. 7/kg, Zinc sulphate= Tk. 140/kg, Boric acid= Tk. 180/kg, Lab. 110/day

Table 4. Performance of different hybrid carrot at Gobindogonj MLT site, Rangpur during rabi season 200809.

Variety	Root length (cm)	Diameter of root (cm)	Total wt. of plant (g)	Root weight of plant (g)	Root yield (kg ha^{-1})	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Monanta Nantes 5	12.97b	8.80b	105.3b	70.67b	22.60b	293800	75505	218295
Local (Hybrid)	15.42a	10.50a	116.0a	82.00a	28.10a	365300	75505	289795
CV (%)	4.43	5.06	5.91	5.49				

Price(Tk.kg^{-1}) : Carrot=13, Urea= 11.80, TSP=74.36, MP=5, Zinc sulphate =140, Boric acid=18, Lab= 112, Gypsum=7

Table 5.Yield and yield contributing characters of hybrid varieties of Broccoli at OFRD, Rangpur during rabi, 2008-2009.

Variety	Duration (days)	Length of curd (cm)	Circumf. of curd (cm)	Wt. of curd/plant (kg)	Yield (t ha^{-1})	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Agassi	82a	17.12a	43.57a	0.872a	32.31a	323100	88704	234396
Japani (Ck.)	74b	14.15b	37.73b	0.683b	26.90b	269000	88704	180296
CV (%)	3.76	6.90	7.98	7.91	8.01			

Price : Broccoli=Tk.10.00

Table 6. Performance of different melon varieties at OFRD, ARS, Rangpur during kharif season 2008-09

Variety	Length of fruit (cm)	Circumf-erence of fruit (cm)	Thickness of flesh (cm)	No. of fruit /plant	Weight of Indv. fruit (kg)	Yield $plant^{-1}$ (kg)	Fruit yield (t ha^{-1})
Local (Bangi)	0.03a	59.80b	2.50c	6.81b	2.28b	14.22a	25.08b
Giorgio	7.67b	40.20c	3.16b	7.51a	1.23c	10.17b	18.33c
Natal	9.60a	39.53c	3.20ab	6.85b	1.21c	8.06c	15.73d
Ducral	5.93c	38.33c	3.13b	6.26bc	1.19c	7.33c	14.25d
Caribian gold	4.00d	39.00c	3.16ab	5.86cd	1.12c	6.35c	14.87d
Pumpkin	9.97a	68.13a	3.41a	5.60d	2.96a	15.23a	32.17a
CV (%)	5.90	7.97	6.47	7.70	9.46	10.7	10.08

Table 7. Economic performance of new hybrid varieties of melon at OFRD, ARS, Rangpur during kharif season 2008-09.

Varieties	Gross return (Tk ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
Local Bangi	77400	29516	47884
Giorgio	54990	29216	25774
Natal	47190	29216	17974
Ducral	42750	29216	13534
Caribian gold	56610	29216	27394
Pumpkin	128680	29816	98864

Mistikumra = Tk. 4/kg, Melon varieties =3

Table 8. Yield and yield contributing characters of hybrid varieties of cauliflower at Gobindoganj MLT site, OFRD ,Rangpur, during rabi season, 2008-2009.

Varieties	Periecycle $curd^{-1}$ (cm)	Diameter $curd^{-1}$ (cm)	Wt of individual curd (kg)	Yield (t ha^{-1})	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})
Bishop	49.98a	19.58a	1.41a	52.30a	523000	85030	417755
Divita	49.57a	16.97ab	1.32a	48.84a	488400	85030	389470
Local	39.60b	13.53b	1.01b	37.44b	374400	85030	289370
CV (%)	7.25	14.66	9.65	6.50			

Price (Tk./kg): Cauliflower =10.

Effect of Liming on the Wheat-T.Aman Rice and Chickpea-T.Aman Rice Cropping Patterns in High Barind Tract Soil

Abstract

A study was undertaken at Multi Location Testing (MLT) site, Amnura, Chapai Nawabganj during 2008-2009 to determine the optimum dose of lime for Wheat-T.aman rice and Chickpea- T. aman rice cropping patterns in High Barind Tract soil. The experiment was designed with four treatments, laid out in a randomized complete block design with three replications. The treatments for wheat and chickpea were: T_1: Control; T_2: Lime @ 1 t ha^{-1}; T_3: Lime @ 1.5 t ha^{-1}; T_4: Lime @ 2 t ha^{-1}. Result showed that grain and straw yield of crops were significantly influenced by the different doses of lime application. The highest grain yield 3.88 t ha^{-1} was obtained from treatment T_4 (lime @ 2 t ha^{-1}) which was at par with T_3 (lime @ 1.5 t ha^{-1}). The maximum seed yield (1.44 t ha^{-1}) of chickpea was obtained from treatment T_3 (lime @ 1.5 t ha^{-1}) that was significantly different from all other treatments and it was 41% higher over control.

Introduction

High Barind Tract (AEZ 26) comprises parts of Rajshahi, Chapi Nawabganj and Naogoan district, characterized by grey terrace soil, low organic matter, low rainfall, low pH (pH< 6), very low P content and high temperature. Barind soil is mostly red soil and acidic (pH< 6). Soil acidity is harmful for plant growth due to nutritional disorders (e.g. deficiency of Ca and Mg, decreased availability of P and Mo) as well as the toxicity of soluble Al, Mn and H ions. Soils are acid because their parent materials were acid and initially low in basic cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+) or because these elements have been removed from the soil profile by normal rainfall leaching or the harvesting of crops (Kamprath and Foy, 1972). Basic cations (Ca^{2+}, Mg^{2+}, K^+ and Na^+) are leached down from upper portion to lower portion of the soil profile due to heavy rainfall in Bangladesh. Leaching of cations is dominant in light textured soils compared to heavy texture ones and consequently, surface soils are becoming more and more acidic. Furthermore, farmers of Bangladesh are practicing intensive cultivation with high yielding modern varieties. Modern varieties give higher crop yields but remove/uptake more nutrients from the soils than local varieties because of higher amount of potential biomass production. Generally, farmers pull out the crop residues (such as wheat and rice straw) for feed and fuel purpose from the field. So, the crop residues' recycling is nearly stopped in this country. Unbalanced fertilization is common in Bangladesh for crop production. Generally, farmers use over doses for nitrogen fertilizer, while they use sub-optimal doses of others (e.g. P, K, S) and rarely do they use $Ca^{2+}$and Mg^{2+} fertilizers. These factors also increase the severity of soil acidity. Soil acidification is intensified by the use of acid forming nitrogenous fertilizers (Pierre *et al.*, 1971). Soils become acidified rapidly as a consequence of intensive cultivation of cereals with application of ammonium based N fertilizers (Mahler and Macdole, 1985).

Wheat-T. aman rice and Chickpea-T. aman rice are the two major cropping patterns in this area. The majority of farmers grow wheat and chickpea in the same land after harvest of transplant aman rice. The average yield of wheat, chickpea and T. aman rice in the High Barind Tract is low compared to the other parts of the country. Many reviewers reported that liming increased soil pH as well as nutrient availability in soil and increased crop production in acid soil. Aitken *et al.* (1990) reported that lime needed to raise pH depends on the current pH, target pH and the buffer capacity of soil. Datta and Gupta (1983) reported that significant increase in grain yield of wheat was produced with the application of 2 and 2.5 t ha^{-1} of lime. Li *et al.* (2001) found that lime significantly increased the dry matter production at anthesis and grain yields of wheat compared with the un-limed treatments. Mishapa *et al.* (2001) reported that seed yield of chickpea increased in lime treated plot than un-limed treated plot.

The concentration of Al, Fe or Mn that is often high to be toxic to plants in an acid soil. On the other hand Ca, Mg, Mo and P are deficient in an acid soil. For this reason the majority of crop plants produce yields less than their potential. A judicious application of lime to may help overcome this problem. Too much addition of lime can decrease the availability of Fe, Mn, Zn and Cu sufficiently to cause deficiencies of those plant nutrients. So, estimation of an accurate lime requirement rate of a soil to bring soil pH to an expected value is essential for maintaining soil health and thus, improved crop productivity. No research works have been taken on liming in High Barind Tract soil. Hence, a research has been undertaken to estimate lime requirement for wheat-T.aman rice and chickpea-T.aman rice cropping pattern in High Barind Tract soil.

Materials and Methods

Field experiment was conducted in farmer's field at Multi Location Testing (MLT) site, Amnura, Chapai Nawabganj during 2008-2009 to determine the optimum dose of lime for wheat-T.aman rice and chickpea- T. aman rice cropping patterns in High Barind Tract soil. The soil of the experimental plots belongs to Amnura series under AEZ 26 and composed of grey terrace soils of silty loam to silty clay loam in texture with a pH value of 5.7 (Slightly acidic). The soil contained 0.89% organic matter (Low), 0.08% total N (Very low), 8 ppm available P (Very low), 0.23 me% exchangeable K (Medium), 15 ppm available S (Low), 0.1 ppm available B (Low) and 1.2 ppm available Zn (Medium). The experiment was designed with four treatments, laid out in a randomized complete block design with three replications. The lay out of the plots was kept constant for the following crop. The field of wheat and chickpea for the first crop was prepared by bullock drawn country plough and ladder but the land was prepared for following crops by hand spading. The treatments for wheat and chickpea were: T_1: Control; T_2: Lime @ 1 t ha^{-1}; T_3: Lime @ 1.5 t ha^{-1}; T_4: Lime @ 2 t ha^{-1}. Lime applied 15 days before sowing of wheat and chickpea. Fertilizers for wheat and chickpea were 120-30-60-13-1.5-1 kg N-P-K-S-Zn-B ha^{-1} and 8-20-30-15-1.5-1 kg N-P-K-S-Zn-B ha^{-1}, respectively. The sources of nutrients were urea for N, TSP for P, MP for K, Gypsum for S, Zinc oxide for Zn and Borax for B. For wheat, two third of urea and all other inorganic fertilizers were applied at the time of final land preparation. The rest urea was top dressed at 25 DAS. For Chickpea, all fertilizers were applied at the time of final land preparation. The unit plot size was 4m × 5m. Wheat seed (Variety: Shatabdi) at the rate of 120 kg ha^{-1} were sown on 25 November 2008. The seeds were sown in rows 20 cm apart. The crop was harvested at maturity on 28 March 2009. Chickpea seed (Variety: BARI Chola 5) at the rate of 50 kg ha^{-1} were sown on 20 November 2008. The seeds were sown continuously in lines at 30 cm apart. Intercultural operations viz. weeding, irrigation and insecticide spray were done as and when required. Data on yield and yield contributing characters of wheat and chickpea were recorded. Observations were made on yield components from 10 randomly selected plants per plot. All the data were statistically analyzed following the F-test and the mean comparisons were made by DMRT at 5% level (Gomez and Gomez, 1984).

Results and Discussion

Effect of liming on wheat

Yield components: Yield contributing characters of wheat responded significantly to different doses of lime application in wheat-T aman cropping pattern except 1000 grain weight (Table 1). Plant height of different treatments showed a significant difference. Lime application @ 2 t ha^{-1} (T_4) produced taller plants (86.25 cm) and it was statistically identical to treatment T_3 but lowest (65.48 cm) in control plot (T_1). The number of spike per m^2 differed significantly in different treatments. The maximum number of spike per m^2 (285) and filled grain per spike (41) were obtained from treatment T_4 (Lime application @ 2 t ha^{-1}) which was at par with T_3 and the lowest number were obtain from control plot (T_1). The result is agreed with that of Li *et al.* (2001) who reported that panicle length and number of filled grain per spike increased with lime treated plot in low pH soil. Thousand grain weights remained unaffected by lime application.

Grain yield: Lime application had a significant and beneficial effect of wheat in wheat-T. aman rice cropping pattern (Table 2). The application of lime @ 2 t ha^{-1} produced maximum grain yield wheat compared to other treatments. The grain yield of wheat, on average ranged from 2.54 t ha^{-1} to 3.88 t ha^{-1}. The highest grain yield 3.88 t ha^{-1} was obtained from treatment T_4 (lime @ 2 t ha^{-1}) which was at par with T_3 (lime @ 1.5 t ha^{-1}) showing an increase value of 53% over control. The lowest grain yield (2.54 t ha^{-1}) produced from control (T_1). Treatment T_4 (lime @ 2 t ha^{-1}) produced higher grain yield due to the maximum number of spike per m^2 and filled grain per spike. The results support the findings of Venkatesh *et al*. (2002).

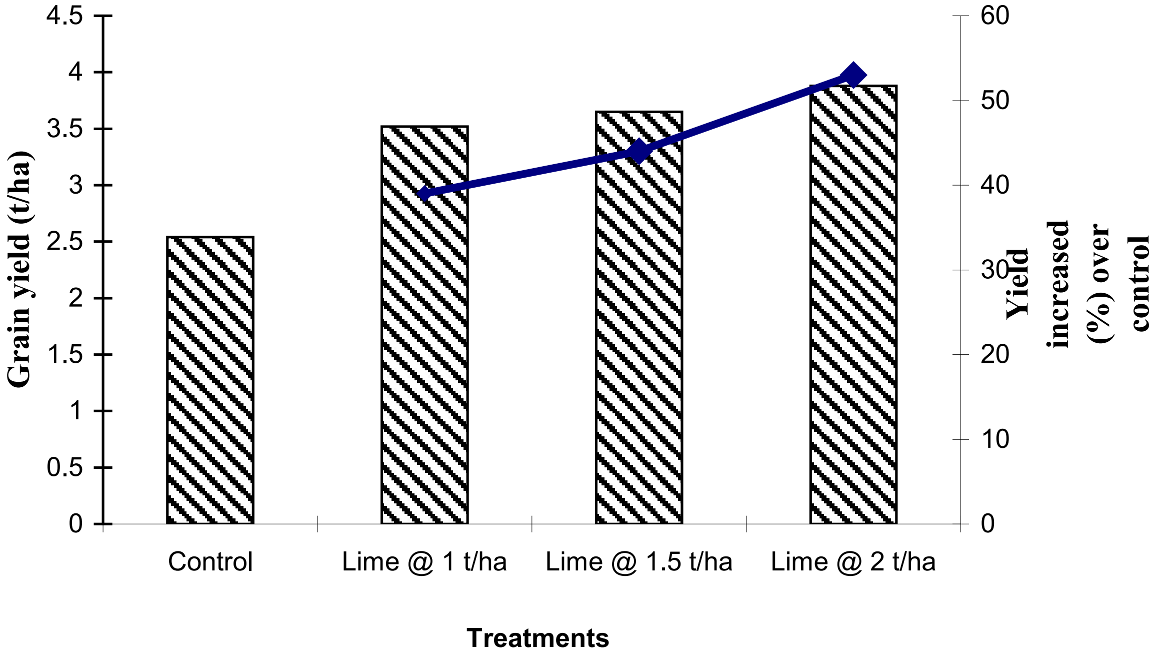

Fig. 1: Yield of wheat as influenced by liming and % yield increase over control

Straw yield: Like grain yield, straw yield of wheat was significantly affected by different doses of lime application in wheat-T. aman rice cropping pattern (Table 2). Treatment T_4 (lime @ 2 t ha^{-1}) produced significantly higher straw yield of wheat than other nutrient treatments. The maximum straw yield 5.86 t ha^{-1} was recorded from treatment T_4 (lime @ 2 t ha^{-1}) which was followed by T_3 (lime @ 1.5 t ha^{-1}). The lowest straw yield was observed from control plot.

Effect of liming on Chickpea

Nodulation: Nodule number per plant, nodule dry weight and shoot dry weight were significantly influenced by Liming (Table 3). Maximum nodule number (61.75) as well as nodule dry weight (0.87 g) was obtained from treatment T_3 (lime @ 1.5 t ha^{-1}), which significantly differed from all other treatments. The result is agreed with that of Mishapa *et al.* (2001) who reported that liming enhanced nodulation in acid soil. Treatment T_3 (lime @ 1.5 t ha^{-1}) produced higher nodule dry weight per plant (5.51 g) and it was at per with treatment T_4 (lime @ 2 t ha^{-1}).

Yield components: Lime application had a significant effect on pods per plant and 1000 seed weight except plant height and seeds per pod (Table 4). Among four treatments, treatment T_3 (lime @ 1.5 t ha^{-1}) produced higher number of pods per plant (65.22) and it was significantly differ from other treatments. Plant height and seeds per pod remained unaffected by lime application. The weight of 1000 seeds varied significantly due to different doses of lime application. The maximum weight of 1000 seeds (158.38 g) was obtained from treatment T_3 (lime @ 1.5 t ha^{-1}) and the minimum (151.81 g) in control.

Seed yield: Seed yield of chickpea were markedly influenced by different doses of lime application (Table 5). The maximum seed yield (1.44 t ha^{-1}) was obtained from treatment T_3 (lime @ 1.5 t ha^{-1}) which was significantly different from all other treatments and it was 41% higher over control. The lowest seed yield (1.02 t ha^{-1}) was found in un-limed plot. The result supports the findings of Mutunal *et al.* (1998).

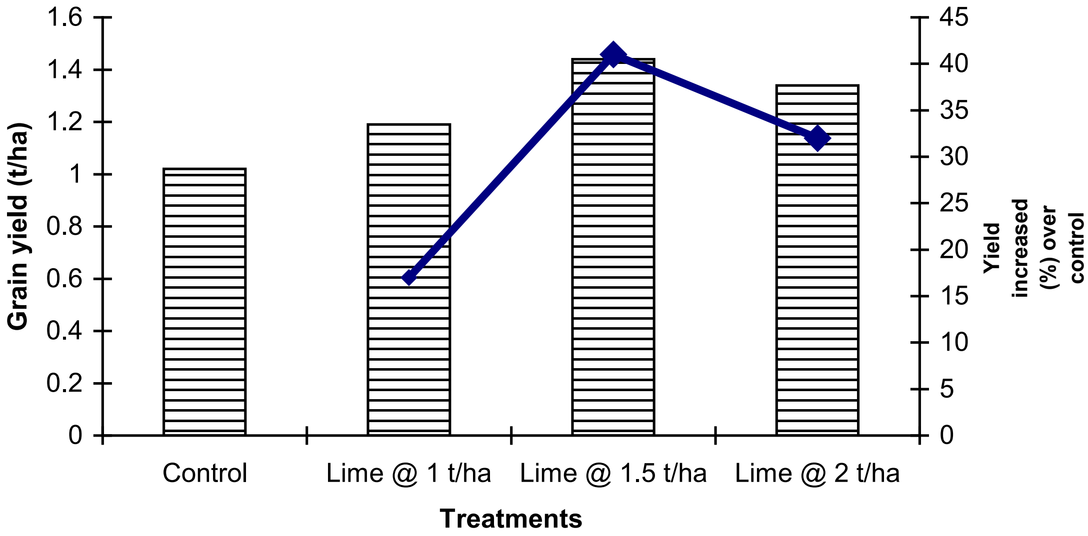

Fig. 2: Yield of chickpea as influenced by liming and % yield increase over control

Stover yield: Like seed yield, stover yield was also differed significantly in different lime applicatioin. The maximum stover yield (2.48 t ha^{-1}) was recorded in T_3 (lime @ 1.5 t ha^{-1}) and minimum (1.78 t ha^{-1}) in un-treated lime plot. Protein content of chickpea seed was unaffected by lime application. The highest seed protein (22.1%) content in T_3 (lime @ 1.5 t ha^{-1}) and the lowest 21.35% was found in control plot.

Conclusion

From the results of this investigation, it may be concluded that application of lime @ 2 t ha^{-1} was found maximum yield of wheat and application of lime @ 1.5 t ha^{-1} was optimum for chickpea production in wheat-rice and chickpea-rice cropping pattern in High Barind Tract soil. So, the lime dose 2 t ha^{-1} for wheat and 1.5 tha^{-1} for chickpea were optimum for growing of wheat and chickpea in High Barind Tract soil.

Table 1. Yield component of wheat as affected by different doses of liming in wheat-T.aman cropping pattern during 2008-2009

Treatments	Plant height (cm)	No. of plants m^{-2}	No. of filled grain $spike^{-1}$	1000 grain weight (g)
Control	65.48c	202.77e	25.00d	28.45
Lime @ 1 t ha^{-1}	75.40bc	234.33d	30.00cd	29.26
Lime @ 1.5 t ha^{-1}	85.56a	284.33a	38.75ab	29.54
Lime @ 2 t ha^{-1}	86.25a	285.00a	41.25a	30.23
CV (%)	9.16	3.02	12.95	9.67
LSD (0.05)	10.75	10.87	7.14	NS

Table 2. Yield of wheat as affected by different doses of liming in wheat-T.aman cropping pattern during 2008-2009

Treatments	Grain yield (t ha^{-1})	% Yield increased over control	Straw yield (t ha^{-1})
Control	2.54c	-	4.25c
Lime @ 1 t ha^{-1}	3.52b	39	5.12b
Lime @ 1.5 t ha^{-1}	3.65ab	44	5.33ab
Lime @ 2 t ha^{-1}	3.88a	53	5.86a
CV (%)	8.32	-	10.23
LSD (0.05)	0.84	-	1.23

Figures in a column having same letter do not differ significantly at 5% level by DMRT, NS=Not significant

Table 3. Effect of different doses of liming on the nodule number, nodule dry weight and shoot dry weight of chickpea during 2008-2009

Treatments	Nodule number plant^{-1} (No.)	Nodule dry weight plant $^{-1}$ (g)	Shoot dry weight plant^{-1} (g)
Control	46.53b	0.693c	4.28c
Lime @ 1 t ha^{-1}	53.92ab	0.776b	5.12b
Lime @ 1.5 t ha^{-1}	61.75a	0.868a	5.48a
Lime @ 2 t ha^{-1}	58.34ab	0.832a	5.51a
CV (%)	5.34	5.93	8.67
LSD (0.05)	12.77	0.041	0.732

Table 4. Yield of wheat as affected by different doses of liming in wheat-T.aman cropping pattern during 2008-2009

Treatments	Plant height (cm)	Pods plant^{-1}	Seeds pod^{-1}	1000 seed weight (gm)
Control	48.87	46.33c	1.20	151.81ab
Lime @ 1 t ha^{-1}	48.97	55.83b	1.21	152.59b
Lime @ 1.5 t ha^{-1}	48.88	65.22a	1.25	158.38a
Lime @ 2 t ha^{-1}	48.10	56.67b	1.20	157.48a
CV (%)	7.06	3.66	7.53	3.73
LSD (0.05)	NS	2.50	NS	5.75

Table 5. Yield of chickpea as affected by different doses of liming in chickpea -T.aman cropping pattern during 2008-2009

Treatments	Seed yield (t ha^{-1})	% Yield increased over control	Seed protein content (%)	Stover yield (t ha^{-1})
Control	1.02c	-	21.63	1.78c
Lime @ 1 t ha^{-1}	1.19b	17	21.35	1.98b
Lime @ 1.5 t ha^{-1}	1.44a	41	22.10	2.48a
Lime @ 2 t ha^{-1}	1.35ab	32	21.66	2.21ab
CV (%)	4.55	-	2.69	10.97
LSD (0.05)	0.12	-	NS	0.15

Figures in a column having same letter do not differ significantly at 5% level by DMRT, NS = Not significant

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Determination of Fertilizer Doses for Maize as a Succeeding Crop Following Potato in a Potato- Maize-T.Aman Rice Cropping Pattern

Abstract

A field experiment was conducted at the Multilocation Testing site (MLT), Sherpur, Bogra during November, 2007 to October, 2008 to find out a suitable fertilizer dose for maize as a succeeding crop following potato in Potato- Maize- T.Aman rice cropping pattern. The treatments were, T_1= Soil test based (STB) fertilizer dose of NPKS following FRG, 2005, T_2= STB of 75% recommended dose of PKS + full N, T_3 = STB of 50% recommended dose of PKS + full N and T_4= Farmers practice. The results showed that the highest grain yield (7.49 t ha^{-1}) was obtained from the treatment T_2 and the lowest grain yield (6.40 t ha^{-1}) was observed in the treatment T_4 (Farmers' practice). The cost and return analysis showed that the highest gross return (Tk 97815 ha^{-1}) and net return (Tk. 55475 ha^{-1}) was found in the treatment T_2 but the highest benefit cost ratio (2.53) was recorded from the treatment T_4 (Farmers' practice) due to less fertilization cost.

Introduction

Potato –Maize- T.Aman rice is one of the promising cropping patterns in Sherpur upazila under Bogra district. But potato and maize are highly exhaustive crops. Therefore, appropriate nutrient management is necessary for sustainable higher yield. Farmers of that area apply lower dose of fertilizer (sometimes use only urea) in maize. They grow maize in residual nutrients of preceding potato crop. It was observed that nutrient deficiency is a common problem in maize that ultimately decreases the yield. Considering, the above facts, the trial was undertaken to find out the suitable fertilizer dose for maize as a succeeding crop of potato.

Materials and Methods

The experiment was conducted at the MLT site, Sherpur, Bogra during rabi season of 2007-08. Before conducting the experiment, soil samples were collected at a depth of 0-15 cm for laboratory analysis. The first crop potato of this pattern was planted in November 27-30, 2007 with five replications. The fertilizers were used in potato @ 356- 244- 197- 78- 5-9 kg Urea, TSP, MoP, Gypsum, Zinc sulphate and Borax per hectare (Farmers' practice). The full dose of TSP, MOP, Gypsum, Zinc Sulphate, Borax and half of Urea were applied at the final land preparation. Remaining Urea were applied at the side row and covered with soil at 30-35 days after planting. Irrigation was provided after 15-20 and 35-40 DAS, fungicide was sprayed three times during the whole growth period. In case of maize four different fertilizer packages viz. T_1: Soil test based (STB) of NPKS following FRG, 2005, T_2: Soil test based full N + 75% recommended dose of PKS, T_3: Soil test based full N + 50% recommended dose of PKS and T_4: Farmers' practice (average of 40 farmers) were tested. The estimated fertilizer doses were T_1 = 425- 183- 186- 139-5.4 kg urea, TSP, MOP, Gypsum and Zinc sulphate ha^{-1}, T_2 = 425- 137- 140- 104- 4.05 kg Urea, TSP, MoP, Gypsum and Zinc sulphate ha^{-1}, T_3 = 425- 91- 93- 70- 2.7 kg Urea, TSP, MoP, Gypsum and Zinc sulphate ha^{-1} and T_4 = 225- 37- 37- 22 kg Urea, TSP, MOP and Gypsum ha^{-1}, respectively. Half of Urea and all TSP, MoP, Gypsum and Zinc sulphate were applied as broadcast prior to sowing. Remaining Urea was applied as side dress at 8-10 leaf stage followed by irrigation. Seeds of maize were sown in 75 cm × 20 cm spacing during March 1-5, 2008 and the crop was harvested at June 15-18, 2008. The third crop of this pattern was T.Aman rice. The fertilizer was used on T.Aman rice @ Urea 195 kg, TSP 82 kg, MoP 68 kg and Gypsum 26 kg per hectare. The full amount of TSP, MOP and Gypsum were applied as broadcast and incorporated with soil during final land preparation. Urea was applied in three equal splits at 15 days after transplantation, rapid tillering stage and 5-7 days before panicle initiation stage. Thirty to thirty five days old seedlings were transplanted in July 17-25, 2008. Two weeding were done at the time of 1st and 2nd top dress. The crop was harvested at 29 October, 2008 to 16 November, 2008. All data were compiled and analyzed statistically.

Results and Discussion

Significant variation was found among the treatments on the yield and other yield contributing characters of maize except plant height and no of grains per cob (Table 1). The highest length of cob (18.32 cm) was recorded from the treatment T_2 which was statistically similar to T_1 and T_3 and the lowest length (17.28 cm) was found in T_4 (Farmers' practice). The highest 1000 grain weight (324g) was obtained from treatment T_2 and it was statistically different with all other treatments. The highest grain yield (7.49 t ha^{-1}) was found in the treatment T_2 and it was statistically similar with T_1. The lowest grain yield (6.40 t ha^{-1}) was found in T_4 (Farmers' practice). The highest stover yield was also recorded from treatment T_2 and it was statistically similar with T_1 and T_3. The cost and return analysis of maize showed that the highest gross return (Tk. 97815 ha^{-1}) and net return (Tk. 55415 ha^{-1}) were obtained from the treatment T_2 but the highest benefit cost ratio (2.53) was observed in the treatment T_4 (Farmers' practice) due to less amount of fertilizer. The yield of potato and T.Aman rice were shown in Table 2.

Conclusion

From the above discussion, the treatment T_2 is suitable for maize as a succeeding crop grown after potato. From the economic point of view, the same treatment gave higher gross and net return. But due to less cost of production the treatment T_4 (Farmers' practice) gave the higher BCR for maize as a succeeding crop in Potato –Maize –T.Aman rice cropping pattern.

Table 1. Effect of fertilizer management packages used for succeeding crop maize in preceding potato.

Treatment (Fertilizer level U-TSP-MoP- Gyp- $ZnSO_4$ Kg ha^{-1})	Plant height (cm)	Length of cob (cm)	No. of grains cob^{-1}	1000 grain weight (g)	Yield (t ha^{-1})	Stover yield (t ha^{-1})
T_1 (425- 183- 186- 139-5.4)	184 a	17.68 ab	487 a	320 b	7.34 a	4.13 a
T_2 (425- 137- 140- 104-4.05)	185 a	18.32 a	491 a	324 a	7.49 a	4.20 a
T_3 (425- 91- 93- 70-2.7)	181 a	17.64 ab	483 a	314 c	6.85 b	3.86 ab
T_4 (225- 37- 37- 22-0)	178 a	17.28 b	475 a	314 c	6.40 c	3.62 b
CV (%)	3.22	3.86	4.18	2.63	4.09	8.56

Means is a column having same letter did not differ significantly

Table 2. Yield of potato and T. Aman in Potato–Maize–T. Aman rice cropping pattern during 2007-08 at Sherpur MLT site

Name of crop	Yield (t ha^{-1})			
	Tuber	Green plant	Grain	Straw
Potato	12.45	1.9	-	-
T. Aman rice	-	-	3.85	6.63

Table 3. Agro-economic performance for maize as succeeding crop following potato in a Potato - Maize-T.Aman rice cropping pattern during 2007-08 at the MLT site Sherpur, Bogra.

Treatment	Gross return (Tk. ha^{-1})	Cost of production (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	95940	45847.20	50092.80	2.09
T_2	97815	42340.00	55475.00	2.31
T_3	89815	38424.20	50990.80	2.31
T_4	84190	33342.40	50847.60	2.53

Note: Inputs cost

1. Seed = Tk. 160 kg^{-1}
2. Insecticide = Tk. 1000 kg^{-1}
3. Labour = Tk. 120 /day
4. Ploughing = Tk 1500 /plough /ha
5. Irrigation = Tk. 1500 /irrgation /ha

6. Fertilizer

a) Urea = Tk. 6 /kg
b) TSP = Tk. 35 /kg
c) MoP = Tk. 35 /kg
d) Gypsum = Tk. 6 /kg
e) Zinc sulphate = Tk. 60/ka

Products :

1. Maize grain = Tk.12.50 /kg
2. Stover = Tk 0.50 /kg

Verification of Different Fertilizer Management Options for Coriander in Faridpur

Abstract

The experiment was carried out at the FSRD site, Hatgobindpur, Faridpur during rabi season, 2008-09 to find out an optimum and economic fertilizer dose for coriander. The trial was conducted in five dispersed replications with 5 m x 5 m unit plot size. Four different fertilizer dose viz. T_1: recommended fertilizer dose for high yield goal (100-30-40-10 kg N-P-K-S ha^{-1}), T_2: IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (77-22-15-10 kg N-P-K-S ha^{-1}), T_3: Farmers practice (80-15-20-11 kg N-P-K-S ha^{-1}), and T_4: Native fertility were used as treatments. BARI dhania 1 was used as test crop. IPNS basis fertilizer dose with 5 t ha^{-1} cowdung slurry gave significantly highest yield followed by farmers' practice. The highest gross return was found in IPNS with 5 t ha^{-1} CD slurry but highest gross margin and MBCR was fond in farmers practice.

Introduction

Coriander is one of the most important spices crop in Bangladesh. It is used in almost all the curries in the country. It is an important cash crop in Faridpur area. In 2007-08 seasons about 10,000 ha land was under coriander cultivation in Faridpur and Rajbari districts. It is the only crop with very minimum insects-pests attack. Farmers in this area use no or only nitrogenous fertilizer in this crop. So they do not get optimum yield due to use of imbalanced fertilizers. Balanced uses of fertilizers can produce optimum and economic yield. So, verification and find out an optimum and economic fertilizer dose for coriander is necessary.

Materials and Methods

The trial was conducted at FSRD Site, Hatgobindpur, Faridpur during Rabi season, 2008-09 with objective to find out an optimum and economic fertilizer dose for coriander. The experiment was laid out in RCB design with five dispersed replications. The unit plot size was 5 m x 5 m with 30 cm line to line distance. Four different fertilizer dose viz. T_1: recommended fertilizer dose for high yield goal (100-30-40-10 kg N-P-K-S ha^{-1}), T_2: IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (77-22-15-10 kg N-P-K-S ha^{-1}), T_3: Farmers practice (80-15-20-11 kg N-P-K-S ha^{-1}), and T_4: Native fertility were used as treatments. BARI dhania 1 was used as test crop. The crop was sown on 2 December, 2008. All TSP, MOP, gypsum and half urea were applied during the final land preparation. The remaining half of urea was applied 35 DAS. Intercultural operations were done as and when necessary. One irrigation was done before urea top dressing. The crop was harvested on 17 March, 2009. The yield and yield contributing characters were collected and analyzed statistically.

Results and Discussion

The yield and yield contributing characters are presented in Table 1. It was found that plant height, number of plants per square meter and 1000 seed weight do not differ significantly among the fertilizer treatments. The highest plant height was found in treatment T_2 where IPNS basis fertilizer dose for HYG was applied along with 5 ton poultry slurry per hectare. The number of pods per plant was significantly influenced by different fertilizer dose. Highest number of pods per plant was found in treatment 2 (195.2) followed by treatment 1 (162.0) and the lowest from native fertility. Significantly highest seed yield of coriander (1422.3 kg ha^{-1}) was produced in T_2 followed by farmers practice. But the yield produced by recommended fertilizer dose for high yield goal and farmers' practice are statistically identical. Native fertility produced the lowest yield. The highest gross return was found in IPNS with 5 t ha^{-1} CD slurry but highest gross margin and MBCR was fond in farmers practice.

Farmers' opinion

Farmers opined that use of cowdung slurry with chemical fertilizer gave good yield but cowdung is not available in huge quantity.

Table 1. Yield and yield attributes of coriander as affected by different fertilizer management options at FSRD site, Faridpur during rabi, 2008-09

Treatment	Plant height (cm)	No. of plants m^{-2}	No. of pods $plant^{-1}$	1000 seed wt. (g)	Seed yield (kg ha^{-1})
T_1=Recommended fertilizer dose for high yield goal	68.33	127	162.0b	5.67	1141.7b
T_2=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	69.60	110	195.2a	5.33	1422.3a
T_3=Farmers' practice	68.20	135	122.8c	5.47	1275.0b
T_4=Native fertility	53.40	154	101.0d	5.60	704.3c
CV (%)	5.25	7.36	8.36	5.25	11.36

Table 2. Cost and return analysis of wheat by application of different fertilizer treatments at Faridpur during rabi, 2008-09 (Mean of 3 sites)

Treatments	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	MBCR (Over native fertility)
T_1: Inorganic fertilizer for high yield goal	45680	15580	30100	1.15
T_2: IPNS with 5 t ha^{-1} CD slurry	56880	16175	40705	1.78
T_3: Farmers practice	51000	9950	41050	2.29
T_4: Native fertility	28160	0	28160	-

Fertilizer Management Options for Groundnut Intercropping with Onion

Abstract

The experiment was carried out at the FSRD site, Hatgobindpur, Faridpur and Hossainpur MLT site, Kishoreganj during rabi season, 2008-09 to determine an optimum and economic fertilizer dose for groundnut + onion intercropping systems. The trial was conducted in four replications with 4 m x 4 m unit plot size. Three intercropping system namely i) monoculture of groundnut (40 cm x 15 cm spacing), ii) monoculture of onion (15 cm x 8 cm spacing) and iii) intercropping of groundnut and onion (two rows of onion in between two 40 cm apart rows of groundnut) were tested with four different fertilizer dose viz. T_1: recommended fertilizer dose for high yield goal (100-30-40-10 kg N-P-K-S ha^{-1}), T_2: IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (77-22-15-10 kg N-P-K-S ha^{-1}), T_3: Farmers practice (80-15-20-11 kg N-P-K-S ha^{-1}), and T_4: Native fertility. Results revealed that the highest groundnut equivalent yield was found from intercropping (3.07 t ha^{-1}) followed by sole onion at Faridpur. Intercropping of groundnut with onion gave highest LER and gross return as well as gross margin. At Kishoreganj the treatment T_2 (120-40-75-20-5-1 kg ha^{-1} of NPKSZnB) produced higher groundnut yield (1.67 t ha^{-1}), onion yield (2.72) as well as groundnut equivalent yield (3.22 t ha^{-1}) with higher gross return (Tk.112700 ha^{-1}).

Introduction

Groundnut is a long duration slow growing crop especially in Rabi season. It is grown with wide row spacing, which allows long term fallowing of interspaced. Onion is the most popular and economic spices which need much shorter duration for their maturity. The inter row spaces of groundnut could be utilized for growing this crop as short duration. BARI has developed intercropping technologies i.e. groundnut + onion with stable row management. So, if groundnut and onion can be grown as intercrop in the same piece of land, the farmers may be benefited economically. Therefore, an experiment was undertaken to verify the different nutrient management options with improved row arrangement for groundnut and onion intercropping system for higher yield and economic return.

Materials and Methods

The trial was conducted at FSRD Site, Faridpur and Hossainpur MLT site, Kishoregonj during Rabi 2008-09. The experiment was laid out in RCB design with four replications. The unit plot size was 4 m x 4 m. The experiment was conducted with three intercropping systems namely i) monoculture of groundnut (40 cm x 15 cm spacing), ii) monoculture of onion (15 cm x 8 cm spacing) and iii) intercropping of groundnut and onion (two rows of onion in between two 40 cm apart rows of groundnut). Fertilizers were applied at the rate 30-44-83-30-4-1kg N-P-K-S-Zn-B ha^{-1} for sole groundnut, for sole onion- 120-40-75-20-5-1 kg N-P-K-S-Zn-B ha^{-1} and for intercrop 90-44-83-30-4 kg N-P-K-S-Zn ha^{-1} (FRG, 2005). BARI chinabadam-6 and local variety of onion were used as test crops. The seedlings of onion and groundnut were sown on 24 and 28 January, respectively. The onion and groundnut crop was harvested on 16 April, 09 April and 7 June, 09, respectively. In Kishoreganj, the variety of groundnut was BARI badam-6. Seeds of groundnut and seedlings of onion were sown/transplanted on 01 January and 03 February 2009, respectively and harvested on 5 April and 09 May 2009, respectively. Intercultural operation was done as and when necessary. The data was analyzed statistically.

Results and Discussion

Location: Faridpur

The yield components of groundnut and onion as influenced by intercropping are presented in Table 1. Sole groundnut produced higher number of pods per plant and seeds per pod than intercropping. Similarly, sole onion gave higher base diameter and single bulb weight. Table 2 showed the yield of groundnut and onion, LER and economics of groundnut-onion intercropping. Sole groundnut and onion produced 2.17 t ha^{-1} of seed and 6.95 t ha^{-1} of bulb, respectively. Highest groundnut equivalent yield was found from intercropping (3.07 t ha^{-1}) followed by sole onion. The intercropping gave the LER value 1.41. Groundnut + onion intercropping gave the highest gross return (Tk. 153500) followed by sole onion (Tk. 139000). Intercropping and sole onion also gave the highest gross margin.

Table 1. Yield components of groundnut and onion as affected by intercropping at FSRD site during rabi season 2008-09

Treatment	Plant height (cm	Plant pop. m^{-2}	No. of pods $plant^{-1}$	No. of seed pod^{-1}	Base diameter of onion (cm)	Single bulb wt. of onion (g)
T_1= Sole groundnut (30-44-83-30-4-1kg N-P-K-S-Zn-B ha^{-1})	41.2	22	13.73	1.83	-	-
T_2= Sole onion (120-40-75-20-5-1 kg N-P-K-S-Zn-B ha^{-1})	32.7	72.3	-	-	3.10	17.39
T_3= Groundnut + Onion intercropping (90-44-83-30-4 kg N-P-K-S-Zn ha^{-1}) (FRG, 2005)	39.2 + 35.5	23 + 40	12.53	1.76	2.95	16.15

Table 2. Yield of groundnut and onion and groundnut equivalent yield, LER and economics as affected by intercropping with garlic and onion at FSRD site, Hatgobindpur

Treatment	Yield (t ha^{-1})		Groundnut equivalent yield (t ha^{-1})	LER	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross margin (Tk.ha^{-1})
	Groundnut	Onion					
T_1= Sole groundnut (30-44-83-30-4-1kg N-P-K-S-Zn-B ha^{-1})	2.17	-	2.17	1.00	108500	33000	75500
T_2= Sole onion (120-40-75-20-5-1 kg N-P-K-S-Zn-B ha^{-1})	-	6.95	2.78	1.00	139000	38000	101000
T_3= Groundnut + Onion intercropping (90-44-83-30-4 kg N-P-K-S-Zn ha^{-1}) (FRG, 2005)	1.85	3.05	3.07	1.41	153500	42500	111000

Out-put price (Tk kg^{-1}): Onoin= 20, Groundnut= 50

Location: Kishoreganj

Except seed pod^{-1} the entire yield contributing characters and nut yield were statistically insignificant in different treatments (Table1). Significantly the higher number of seeds pod^{-1} was recorded from treatment T_2 which followed by T_3 but seeds pod^{-1} was statistically identical to treatment T_1 and T_3. Yield of groundnut decreased with introduce of intercropped onion but higher groundnut equivalent yield was recorded from treatment T_2 followed by T_3 with the higher gross return (Tk.112700 ha^{-1}). The benefit cost ratio (1.61) was also higher in the same treatment.

Table 3. Yield and yield components of groundnut as affected by different fertilizer management options during rabi 2008-09.

Treatment	Population m^{-2}	Maturity (days)	Plant height (cm)	Pods plant^{-1} (No.)	Seed pod^{-1} (No.)	100-kernel wt. (g)	Nut yield (t ha^{-1})
T_1	21	125	54	19	1.73	33	1.59
T_2	22	127	52	22	1.77	35	1.67
T_3	21	129	52	18	1.75	32	1.58
CV (%)	5.13	6.01	10.01	8.02	7.56	8.45	4.81
LSD (0.05)	ns	ns	ns	ns	0.13	ns	ns

T_1= 30-45-85-30-4-1 kg ha^{-1} of NPKSZnB (Sole groundnut dose), T_2= 120-40-75-20-5-1 kg ha^{-1} of NPKSZnB (Sole onion dose), T_3= 90-44-83-30-4 kg ha^{-1} of NPKSZnB (FRG 2005)

Table 4. Yield of groundnut, onion and dnut equivalent yield at different fertilizer management options during rabi 2008-09.

Treatment	Yield (t ha^{-1})		Groundnut equivalent yield (t ha^{-1})
	Groundnut	Onion	
T_1	1.59	2.25	2.88
T_2	1.67	2.72	3.22
T_3	1.58	2.41	2.96

Table 5. Cost and return analysis of groundnut intercropping with onion at different fertilizer management options during rabi 2008-09.

Treatment	Gross return (Tk. ha^{-1})	Cost of cultivation (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1	100800	64268	36532	1.56
T_2	112700	69839	42861	1.61
T_3	103600	66368	37232	1.56

Farmers' opinion

Farmers opined that two rows of onion in between two rows of groundnut was a suitable combination due to moderate yield of groundnut with additional higher yield of onion. They demanded the short duration groundnut varieties. They also opined that if they sow onion bulb directly instead off onion seedling then it might be more profitable.

Conclusion

From one year study, it may concluded that the treatment T_2 (sole onion dose) is superior to other treatments. Gross return, gross margin and benefit cost ratio (BCR) was also found higher in T_2. Considering the yield and benefit cost ratio T_2 (sole onion dose) may be recommended for higher groundnut equivalent yield.

Integrated Nutrient Management for Tomato Production in Gazipur Sadar

Abstract

The experiment was conducted under irrigated medium high land soils at Dhirasharm MLT site, Gazipur Sadar under AEZ 28 during rabi season of 2008-09 to find out the optimum and economic fertilizer dose for tomato production at Gazipur Sadar. The hybrid variety Roma was included in this experiment. Three different nutrient packages- T_1 = Soil test basis inorganic fertilizer for high yield goal (HYG), T_2 = Integrated plant nutrient system (IPNS) basis fertilizer management for HYG with cowdung (CD), T_3 = IPNS basis fertilizer management for HYG with poultry manure (PM) were tested along with farmers practice and absolute control (no fertilizer).

The highest yield of tomato (119.1 t ha^{-1}) was obtained from IPNS based fertilizer dose with PM (T_3) followed STB dose (104.1 t ha^{-1}) and IPNS with CD (102.4 t ha^{-1}). Higher gross return and gross margin were calculated from T_3 followed by T_1 and T_2 treatments. MBCR was also higher in IPNS with PM (55.1) due to higher gross return and lower fertilizer cost. However, both the fertilizer management packages (T_3 and T_2) may be beneficial for sustaining crop production as well as soil fertility.

Introduction

Tomato (*Lycopersicon esculentum*) is a nutritious, palatable economically profitable vegetable in Bangladesh. It is very important crop as it has heavy demand in the international market and also in the local. Soil fertility and productivity status of Gazipur Sadar area (Dhirasharm) are not satisfactory due to low organic matter content in soil, imbalance use of inorganic fertilizer, less use of organic manure and use of high yielding modern crop varieties. A crop production system with high yield targets can not be sustainable unless balanced nutrient inputs are supplied to soil against nutrient removal by crops (*Bhuiyan et al. 1991*). The basic concept underlying the integrated plant nutrient systems (IPNS) is to provide an ideal nutrition for a crop through a proper combination of various nutrient sources and their optimum utilization along with maintenance of soil productivity. The sustainable crop production might be possible through the integrated use of organic and inorganic sources might be helpful in obtaining higher yield of vegetables in our country. *Rahman et al (1998)* reported that the highest yield of tomato was obtained by the application of organic and inorganic fertilizers. Soil test and judicious application of fertilizers for target yield of crops is one of the approaches to overcome the problem of nutrient mining from soils. The beneficial effects of organic manure in vegetable production have been demonstrated by many workers (Robin, 19949., *Singh et al., 1970* and Subhan, 1991). Brown (1958) observed that poultry manure contained growth promoting hormones, which produced better root growth. Application of organic fertilizer @ 5 and 10 tha^{-1} from three sources (cowdung, poultry manure and compost) along with inorganic fertilizer significantly increased the yield of cabbage (Anon, 2007). Although fertilizer is one of the most important factor of increasing the productivity of crops but due to high cost of fertilizers and economic condition of Bangladesh farmers, its use should be economized. One of the alternatives to economize the use of chemical fertilizers is to incorporate crops residues or apply farm yard manure in combination with chemical fertilizers (Sarker *el al.*, 1996). Now it is felt that with the introduction of modern varieties of crops and use of relative higher quantity of fertilizer, it needs to develop fertilizer management practices for proper management of soil health and also for economically viable nutrient balanced. Therefore keeping all these in mind, the present study was conducted to find out the proper nutrient management packages and to determine the economic dose of fertilizer for tomato production under irrigated medium high land soil condition at the MLT site, Dhirasharm, Gazipur Sadar, AEZ 28.

Materials and Methods

The field experiment was carried out under irrigation condition at the medium high land during the rabi season of 2008-09 at Dhirasharm MLT site, Gazipur Sadar under AEZ 28. The soil of the experimental area was silty clay in texture with low organic matter content (1.62%) and acidic in nature with P^H 5.7 having total nitrogen content 0.0614%, available P was 51.8 µg/g, exchangeable k was 0.132 meq/ 100 g soil and available S, B and Zn were 12.2, 0.194 and 3.04 µg/g, respectively. The experiment was laid out in randomized complete block design with five dispersed replications. The unit plot size was 3m×2m with spacing of 60 cm ×40 cm. Fertilizer were applied as per treatment based on soil analysis and Fertilizer Recommendation Guide 2005. Farmers dose was selected from the average of the fertilizer doses used by the farmers of the village Dhirasharm, Gazipur during 2007-08. Five different nutrient packages were employed for the experiment. The treatments were T_1 = Soil test basis inorganic fertilizer for high yield goal (HYG), T_2 = Integrated plant nutrient system (IPNS) basis fertilizer management for HYG with cowdung (CD), T_3 = IPNS basis fertilizer management for HYG with poultry manure (PM), T_4 = Farmers Practices (FP) and T_5 = Absolute control.

Details of the treatments stated, below:

Treatment	Nutrient rate (kg ha^{-1})						
	N	P	K	S	B	CD	PM
T_1= STB fertilizer for HYG	145	22	56	12	1	-	-
T_2 =IPNS with CD	130	19	41	12	1	5000	-
T_3 = IPNS with PM	115	15	35	12	1	-	3000
T_4 = FP	100	35	45	10	-	2500	2000
T_5 = Absolute Control	0	0	0	0	0	0	0

NPKS and B were applied through urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. The entire amount of PKSB, cowdung, poultry manure and one fourth of N were applied at final land preparation and the remaining ¾ of N were applied in three equal splits of 21, 35 and 45 days after transplanting. Thirty days old seedling of Roma Hybrid variety were transplanted during 18-19 November 2008 and harvested from 5 February to 7 March 2009. Intercultural operations such as weeding, pruning, staking and pest control were done as and when needed to maintain the normal crop growth properly. Ten plants from each plot were selected randomly for data collection. Data on yield and yield attributes were recorded properly and analyzed. Economic analysis was done for gross return and benefit cost over control for different fertilizers packages.

Results and Discussion

Yield attributes of tomato were significantly influenced by the different fertilizer doses (Table 1). The application of IPNS based fertilizer treatments (T_3) with poultry manure produced higher plant height (89.2 cm) which was increased 21% over control (T_5). Treatment T_4, T_2 and T_1 were statistically similar but different from control (69.9 cm). There was no significant difference of number of fruits per plant in all the treatments except T_4 and T_5. Number of tomato fruits per plant varied from 24.0 to 35.2 among the treatments. Fruit yield plant^{-1} was found highest in IPNS with poultry manure (3.3 kg). The treatment T_2 and T_1 gave statistically similar yield which were significantly higher than T_4 and T_5 treatments. Fruit length and fruit diameter were statistically similar in T_1, T_2 and $T_{3,}$ respectively. The control treatment gave lowest fruit length and breathes (3.9 cm and 3.7 cm). The treatment T_3 (IPNS with PM) produced significantly highest fruit yield (119.1 t ha^{-1}) and treatment STB fertilizer with HYG and IPNS with CD gave higher yield (104.1 and 102.4 t ha^{-1}) which were statistically similar to each other. Farmers' practices gave moderate yield (63 t ha^{-1}) and lowest yield (32.9 t ha^{-1}) in control treatment due to poor fertility. The highest yield was found in IPNS fertilizer with poultry manure that was perhaps might be due to quick mineralization and decomposition of PM than cowdung. Poultry manure showed superior result over cowdung, Smith (1950) supported that uric acid, which constituted 60 percent of the nitrogen in poultry manure, changes rapidly to ammoniacal form, which is utilized by the plants. Another important factor contributing to the higher yield with PM might be their higher N content or increased availability of native soil nitrogen through increased biological activity. The field under experiment was poor in N content. This result is in agreement with the findings of *Prezotti et al. (1988)* who stated that combined application of organic and inorganic fertilizer increased to productivity by 48% of tomato.

Cost and return analysis

The cost and return analysis of tomato production of this study are presented in Table 2. The highest gross return was obtained from IPNS fertilizer dose with poultry manure (T_3) which was 12.5% higher than T_2 (IPNS with CD) and 12.6% and 47% higher than T_1 and T_4, respectively IPNS with cowdung and STB fertilizer dose gave similar gross return. The highest marginal benefit cost ratio (MBCR) was found in T_3 treatment due to less amount of fertilizer cost. Farmers practice also showed lower MBCR due to low yield and higher cost of fertilizer and manure.

Table 1. Effect of different nutrient management packages on the yield and yield attributes of Tomato at MLT site, Dhirasharm, Gazipur during the rabi season of 2008-09

Treatments	Plant height (cm)	No. of fruits plant^{-1}	Fruit weight^{-1} plant (kg)	Fruit length (cm)	Fruit diameter (cm)	Yield (t ha^{-1})
T_1	83.2 c	33.1 a	2.8 b	5.2 a	5.1 a	104.1 b
T_2	85.6 bc	33.4 a	2.8 b	5.2 a	5.2 a	102.4 b
T_3	89.2 a	35.2 a	3.3 a	5.2 a	5.1 a	119.1 a
T_4	86.0 b	28.1 b	1.7 c	4.7 b	4.6 b	63.0 c
T_5	69.9 d	24.0 c	0.9 d	3.9 c	3.7 c	32.9 d
CV (%)	2.45	6.30	10.12	5.77	7.61	9.64

Table 2. Cost and return analysis of different nutrient management packages of Tomato at MLT site Dhirasharm, Gazipur Sadar during 2008-09

Treatments	Gross return (Tk ha^{-1})	* variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	MBCR (over control)
T_1	10,41000	20550	1020450	34.7
T_2	10,42000	19802	1022198	36.0
T_3	11,91000	15631	115369	55.1
T_4	6,30000	24487	605513	12.3
T_5	329000	0	329000	-

** Fertilizer cost only*

Farmers' reaction

Farmers of Dhirasharm area are highly pleased to see the positive effect of IPNS and estimated dose of fertilizer for HYG. They opined that in future they will use IPNS dose for tomato cultivation.

Conclusion

From one year study, it is evident that the treatment T_3 (IPNS with PM) was superior to other fertilizer management packages in respect of fruit yield, gross return and MBCR for tomato. The highest marginal benefit cost ratio (55.1) was found in T_3. The second highest was found in T_2 (IPNS with CD) followed and T_1 (STB dose). Considering the yield and soil fertility for sustaining crop production, IPNS practices can be recommended for farmers' use.

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Effect of Urea Super Granule (USG) as a Source of Nitrogen on Potato

Abstract

The experiment was carried out at MLT site Jhikorgacha, Jessore during 2008-09 to see the efficiency of USG on potato and to find out the optimum and economic dose of USG for the crop. Treatments were T_1 = Recommended dose of nitrogen as prilled urea, T_2 = Recommended dose of nitrogen as urea super granule (USG), T_3 = 10% less recommended dose of nitrogen as USG, T_4 = 20% less recommended dose of nitrogen as USG and T_5 = Farmers practice. Results showed that **s**ignificantly higher yield of potato (18.57 t ha^{-1}) was obtained with recommended dose of nitrogen as USG (T_2). Recommended dose of nitrogen as prilled urea gave identical yield with 10% less of nitrogen as USG and with farmers practice

Introduction

Nitrogen requirement of potato is very high. Farmer's of Bangladesh grown potato in different regions with prilled urea with other fertilizers. The efficiency of the prilled urea is very low. Urea super Granule (USG) is one of the popular nitrogenous fertilizers which are now available in the market and the farmers are already using in rice culture. In some parts of the country Urea Super Granule has also been used in upland vegetables and fruits. The On-Farm Research Division of BARI has also conducted some experiments on upland crops across the country and found promising results from the use of USG. Jessore is a vegetables growing area and potato is grown widely in greater Jessore. The efficiency of USG on potato compared to prilled urea needs to be verified. Therefore, the experiment was designed to evaluate the efficiency of USG as a source of nitrogen on Potato.

Objectives

i) To evaluate the efficiency of USG on potato
ii) To find out the optimum dose of USG for potato

Materials and Methods

The experiment was carried out at multi location testing (MLT) site, Jhikorgacha, Jessore during 2008-09. The experiment was laid out in RCB design with six dispersed replications. The unit plot size was 5 m x 6 m. Treatments were T_1 = Recommended dose of nitrogen as prilled urea, T_2 = Recommended dose of nitrogen as urea super granule (USG), T_3 = 10% less recommended dose of nitrogen as USG, T_4 = 20% less recommended dose of nitrogen as USG and T_5 = Farmers practice. Other fertilizers were applied as recommended dose @ 40-90-20-2-1 kg PKSZn and B ha^{-1} in the form of Triple Super Phosphite, Murate of Potash, gypsum, Zink sulphate and boric acid, respectively. Half of murate of potash was applied at 15 days after planting (DAP) and remaining half at 30 DAT. USG was applied at 15 DAT as ring method, 9-10 cm apart from plant stalk and 7-8 cm depth covering with soil. Potato was planted from 14 November to 04 December, 2008 and harvested from 18 to 20 February 2009. The data on yield and yield contributing characters were recorded from 10 randomly selected plants in each plot and plot yield was taken and converted to t ha^{-1}. All necessary data were analyzed statistically.

Results and Discussion

Different plant characters and yield contributing characters did not vary significantly among the treatments. But tuber yield had shown significant difference among the treatments. Significantly higher yield of potato (18.57 t ha^{-1}) was obtained with recommended dose of nitrogen as USG (T_2). Recommended dose of nitrogen as prilled urea gave identical yield with 10% less of nitrogen as USG and with farmers practice (Table 1).

Conclusion

Urea Super Granule performed better than prilled urea in potato in Jessore. Even 10% less of nitrogen as USG gave similar yield with recommended dose of prilled urea.

Table 1. Effect of urea super granule (USG) on the yield and yield attributes of potato at MLT site, Jhikorgacha, Jessore during 2008-09

Treatments	Plant height (cm)	No. of plants m^{-2}	Tuber $hill^{-1}$ (no)	Tuber weight $hill^{-1}$ (g)	Tuber Yield (t ha^{-1})
Prilled urea (Rec.)	61.27	6.67	5.93	265.67	15.27
USG (Rec.)	60.00	7.33	6.60	300.00	18.57
USG (10% <Rec.)	49.70	6.33	6.67	312.00	15.53
USG (20% <Rec.)	52.77	6.67	7.67	301.33	14.40
Farmers practice	54.733	6.00	6.80	350.33	15.40
CV (%)	6.83	14.64	25.10	21.02	2.61
LSD (0.05)	NS	NS	NS	NS	0.78

Integrated Nutrient Management for Sustaining Soil Fertility and Yield of Mustard-Mungbean-T.Aman Cropping Pattern

Abstract

The experiment was carried out in the farmer's field at MLT site Tularampur, Narail and MLT site Jhikorgacha, Jessore during cropping season 2007-2008. Five fertilizer treatments along with a control; T_1 (120-36-70-40-3-1 kg NPKSZnB ha^{-1}), T_2 (160-36-70-40-3-1 NPKSZnB ha^{-1}), T_3 (120-54-70-40-3-1 kg NPKSZnB ha^{-1}), T_4 (120-36-105-40-3-1 kg NPKSZnB ha^{-1}) and T_5 (Control) were tested. At Narail, the highest yield of Mustard (2.10 t ha^{-1}), Mungbean (1.90 t ha^{-1}) and T. aman (4.58 t ha^{-1}) were found in the treatment T_2 (160-36-70-40-3-1 kg NPKSZnB ha^{-1}), T_3 (25-10-70-40-3-1 kg NPKSZnB ha^{-1}) and T_4 (120-36-105-10 kg NPKS ha^{-1}) respectively. But at Jhikorgacha, no significant difference in yield was found in mustard among the treatments except with control. In case of mungbean, the highest seed yield (1.57 t ha^{-1}) was obtained from the treatment T_2 (25-10-0-0-0-0 NPKSZnB kg ha^{-1}) followed by T_3. In T. aman rice the highest grain yield (4.90 t ha^{-1}) was obtained from the treatment T_3 (80-54-70-10-0-0 NPKSZnB kg ha^{-1}) followed by T_2. The lowest yield was found in control in all the three crops at two locations.

Introduction

Mustard-Mungbean-T. aman cropping pattern is going to be a popular pattern in south west region of Bangladesh. In a four year's trial at Jessore and Ishurdi, it was found that inclusion of a pulse crop between two cereal crops in a cropping pattern (Mustard-Mungbean-T.aman) would reduced the requirement of chemical fertilizers maintaining a good soil health through biological fixation of nitrogen and addition of organic matter to soil. About 30-40 kg N, 20-22 kg P, 120-130 kg K, 6-8 kg S and remarkable amount of micronutrient were added in soil system when 15-20 t ha^{-1} biomass of mungbean was ploughed down after grain harvest. Sustainable yield of Mustard-Mungbean-T.aman were obtained in all year. However, on farm verification of this technology is required to document its performance at different agro-ecological zones of the country where Mustard-Mungbean-T. aman cropping pattern is practiced. Present study was therefore, conducted with the following objectives: 1) To find out the efficiency of individual nutrient for maximizing the yield of the cropping pattern. 2) To estimate the requirement of individual nutrient for maximizing the yield for year-round production plan of AEZ basis.

Materials and Methods

The experiment was carried out in the farmer's field at the MLT site Tularampur, Narail and MLT site Jhikorgacha, Jessore during rabi 2007-08. The experiment was laid out in a RCBD with 4 replications. Five fertilizers treatments with control viz. T_1 (120-36-70-40-3-1 kg NPKSZnB ha^{-1}), T_2 (160-36-70-40-3-1 NPKSZnB ha^{-1}), T_3 (120-54-70-40-3-1 kg NPKSZnB ha^{-1}), T_4 (120-36-105-40-3-1 kg NPKSZnB ha^{-1}) and T_5 (Control) were tested. The unit plot size was 6m x 5m. Seeds of BARI Sharisa-9 were sown on 11 November 2007 maintaining a spacing of 30cm between rows. Seeds of BARI mung-5 were sown on 09-10 March 2008 maintaining a spacing of 30 cm between rows. Seedlings of BRRI dhan 39 were transplanted on 16 July 2008 maintaining a spacing of 30cm between rows. N P K S Zn & B fertilizers of different treatments were applied in the form of urea TSP, MP, Gypsum, Zinc oxide and Boric acid, respectively. Half of recommended urea and entire amount of other fertilizer were applied as basal and remaining urea was applied before flowering in mustard. In mungbean All PKSZn, cowdung and half of N were applied at the time of final land preparation and remaining half of N was applied before flowering. Similarly, in T.Aman rice, all PKS were applied at the time of final land preparation and N was applied in two equal split i.e. 20 and 40 DAT. Different intercultural operations were done properly to ensure normal plant growth and development. Required data were collected properly and the data were analyzed statistically.

Results and Discussion

Location: Tularampur MLT site, Narail

Mustard: Yield, straw yield and thousand grain weight has shown significant difference among the treatments. The highest seed yield of mustard (2.10 t ha^{-1}) was found in T_2 (160-36-70-40-3-1 kg NPKSZnB ha^{-1}) treatment. Other treatments produced similar yield except in control treatment. The lowest yield (0.92 t ha^{-1}) was found in control treatment (Table 1). Thousand grain weight and straw yield did not varied considerably among the treatments except with control.

Mungbean: Yield number of seeds per siliqua, number of siliqua per plant and number of branches per plant has shown significant differences among the treatments. Significantly the highest seed yield of mungbean (1.90 t ha^{-1}) was found in treatment T_3 (25-10-70-40-3-1 kg NPKSZnB ha^{-1}) followed by T_2. Similar yield was also produced in T_1 and T_4. The lowest yield was obtained from control treatment.

T. aman: Grain yield of T.Aman rice did not vary significantly among the treatments except with control. However, the highest yield (4.58 t ha^{-1}) was found in the treatment T_4 (120-36-105-10 kg NPKS ha^{-1}). The control treatment gave the lowest yield (2.40 t ha^{-1}) (Table 3).

Table 1. Effect of fertilizer on the yield and yield contributing character of mustard at MLT site Tularampur, Narail during 2007-2008

Treatments	Plant height (cm)	No. of plants m^{-2}	No. of siliqua plant^{-1}	No. of grains siliqua^{-1}	1000 grain weight (g)	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	76.93	157	75.10	16.45	3.10	1.89	2.32
T_2	88.01	161	99.11	13.08	3.08	2.10	2.51
T_3	85.20	158	79.13	14.80	3.32	1.99	2.31
T_4	85.90	144	95.10	15.91	3.34	1.89	2.40
T_5	59.12	150	38.01	14.27	2.15	0.92	1.45
CV (%)	9.06	16.91	15.12	15.37	8.75	14.72	14.06
LSD (0.05)	NS	NS	NS	NS	0.82	0.23	0.73

T_1= 120-36-70-40-3-1 kg NPKSZnB ha^{-1}, T_3= 120-54-70-40-3-1 kg NPKSZnB ha^{-1}, T_2= 160-36-70-40-3-1 kg NPKSZnB ha^{-1}, T_4= 120-36-105-40-3-1 kg NPKSZnB ha^{-1} , T_5= Control

Table 2. Effect of fertilizer on the yield and yield contributing character of mungbean at MLT site Tularampur, Narail during 2007-08

Treatments	Plant height (cm)	No. of plant m^{-2}	No. f branches $plant^{-1}$	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	1000-grain weight (g)	Seed yield (kg ha^{-1})
T_1	62.80	37.00	2.75	45.55	10.43	33.90	1.63
T_2	72.65	36.75	3.28	50.65	11.95	34.35	1.79
T_3	69.28	34.50	2.93	50.60	12.00	34.28	1.90
T_4	72.43	32.25	3.45	46.95	11.15	34.02	1.68
T_5	58.80	34.50	2.50	41.25	9.85	32.98	1.27
CV (%)	7.51	11.92	9.47	8.02	6.64	2.26	5.49
LSD (0.05)	7.77	NS	0.44	5.75	1.13	NS	0.14

T_1= 25-10-70-40-3-1 kg NPKSZnB ha^{-1}, T_2= 25-10-70-40-3-1 kg NPKSZnB/ha, T_3= 25-10-70-40-3-1 kg NPKSZnB/ha, T_4= 25-10-105-40-3-1 kg NPKSZnB/ha T_5= Control

Table 3. Effect of fertilizer on the yield and yield contributing character of T. aman at MLT site Tularampur, Narail during 2007-08

Treatments	Plant height (cm)	Plant Pop. m^{-2} (no)	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	99.68	298.05	23.45	4.37	4824
T_2	104.00	281.48	23.88	4.27	5108
T_3	102.18	277.23	23.86	4.35	4783
T_4	101.85	314.30	23.90	4.58	4733
T_5	85.38	218.65	22.56	2.40	2625
CV (%)	2.62	7.03	2.54	6.22	8.16
LSD (0.05)	3.99	30.10	0.91	0.38	555.20

T_1= 120-36-70-10 kg NPKS/ha ,T_2= 160-36-70-10 kg NPKS/ha ,T_3= 120-54-70-10 kg NPKS/ha ,T_4= 120-36-105-10 kg NPKS/ha, T_5= Control

Location: Jhikorgacha, Jessore

In mustard, no significant difference in yield was found among the treatments except with control. However, numerically higher yield was found in T_2 (160-36-70-40-3-1 NPKSZnB kg ha^{-1}). The lowest (1.36 t ha^{-1}) yield was obtained from the control treatment T_5 (Table 6).

In case of mungbean, the highest seed yield (1.57 t ha^{-1}) was obtained from the treatment T_2 (25-10-0-0-0-0 NPKSZnB kg ha^{-1}) followed by T. Similar yield was found in T_1 and T_3 treatment. The lowest seed yield was found in control plot (Table 7).

In case of T. aman rice the highest grain yield (4.90 t ha^{-1}) was obtained from the treatment T_3 (80-54-70-10-0-0 NPKSZnB kg ha^{-1}) followed by T_2. The lowest (4.04 t ha^{-1}) yield was in T_1 (80-36-70-10-0-0 NPKSZnB kg ha^{-1}) (Table 8). Straw yield almost follow the same trend like grain yield.

Table 4. Effect of fertilizer on the yield and yield contributing character of mustard at MLT site Jhikorgacha, Jessore during 2007-2008

Treatments	Plant height (cm)	Plant Population m^{-2} (no.)	Siliqua $plant^{-1}$ (no.)	Seed $siliqua^{-1}$ (no.)	1000-grain weight (g)	Seed yield (t ha^{-1})
T_1	77.21	1.53	71.10	16.08	1.87	2.30
T_2	85.01	1.55	92.31	14.28	2.08	2.49
T_3	84.41	1.61	72.05	14.80	1.97	2.29
T_4	86.30	1.43	91.23	16.71	1.83	2.38
T_5	56.67	1.50	38.22	13.20	0.92	1.36
CV (%)	8.21	6.10	12.99	14.07	12.03	13.82
LSD (0.05)	NS	NS	NS	NS	0.21	0.62

Table 5. Effect of fertilizer on the yield and yield contributing character of mungbean at MLT site Jhikorgacha, Jessore during 2007-08

Treatments	Plant height (cm)	Plant population m^{-2} (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000-grain weight (g)	Seed yield (t ha^{-1})
T_1	77.97	26.15	28.40	11.45	37.10	1.44
T_2	78.52	27.50	30.25	11.65	37.85	1.57
T_3	79.90	26.50	30.95	11.00	37.30	1.41
T_4	83.55	29.85	33.75	12.00	38.90	1.48
T_5	76.30	28.00	26.10	9.90	34.65	1.21
CV (%)	5.82	7.86	7.54	5.03	2.09	1.68
LSD (0.05)	NS	NS	3.47	0.87	1.20	0.05

Table 6. Effect of fertilizer on the yield and yield contributing character of T. aman at MLT site Jhikorgacha, Jessore during 2007-08

Treatments	Plant height (cm)	Plant Population m^{-2} (no)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	107.25	290.00	24.12	4.04	6.78
T_2	100.50	278.75	23.77	4.55	6.10
T_3	100.50	285.75	23.97	4.90	6.15
T_4	101.00	278.50	24.10	4.41	6.02
T_5	101.50	286.25	23.70	4.21	5.83
CV (%)	4.95	3.97	3.24	6.60	11.1
LSD (0.05)	NS	NS	NS	0.45	0.73

Appendix Table I. Treatment combinations of Mustard-Mungbean-T.aman cropping pattern at Jhikargacha, Jessore

Treatments	NPKSZnB kg ha^{-1}		
	Mustard	Mungbean	T. aman rice
T_1	120-36-70-40-3-1	25-10-0-0-0-0	80-36-70-10-0-0
T_2	160-36-70-40-3-1	25-10-0-0-0-0	120-36-70-10-0-0
T_3	120-54-70-40-3-1	25-10-0-0-0-0	80-54-70-10-0-0
T_4	120-36-105-40-3-1	25-10-0-0-0-0	80-36-105-10-0-0
T_5	0-0-0-0-0-0	0-0-0-0-0-0	0-0-0-0-0-0

Effect of Nitrogen Levels on the Growth and Yield of Batishak

Abstract

The experiment was conducted in farmers' field at Satkhira MLT site, Satkhira and Agricultural Research Station, Daulatpur, Khulna during Rabi season, 2008-'09 to observe the effect of nitrogen (N) application on the yield of Batisak (*Brassica chinensis)*. Three levels of N (40, 80, and 120 kg ha^{-1}) were used in the study. The results showed that the highest level of N- fertilizer i.e. 180 kg N ha^{-1} gave the highest yield in both the sites which were 25 and 28 t ha^{-1}, respectively.

Introduction

Batisak is a leafy vegetable crop in Bangladesh. It is quick growing, nutritionally rich and suitable for growing in any time of the year. Since it is a leafy vegetable, it requires more nitrogen. Nitrogen was reported to be the most important fertilizer in the production of Batisak (Salunkle et al. 1987). Ahmad and Shahjahan (1991) and Sardar (1992) obtained the highest yield of Batisak by applying increasing leave of nitrogen. Miah (1987) reported that yield of Batisak was increased with the increase in nitrogen level from 80 kg to 172 kg ha^{-1}. The soil of greater Khulna district is low of organic matter and nitrogen. The present investigation was, therefore, undertaken to determine optimum nitrogen dose for the production of Batisak and popularize the crop in this locality.

Materials and Methods

The experiment was conducted at the ARS, Daulatpur, Khulna and MLT site, Satkhira during the Rabi season, 2008-09. The treatments composed of 3 levels of N-doses (0, 40 and 80 kg-N ha^{-1}). The experiment was conducted in randomized complete block design (RCBD) with three replications. Seeds were sown on the second week of November, 2008. The unit plot size was 3.5m X 3.0m. Fertilizers were applied as basal during final land preparation at the rate of 30 kg P, 100 kg K and 13.45 kg S per hectare in the form of triple super phosphate, muriate of potash and gypsum. As a source of nitrogen urea was applied in two equal splits at 10 days interval after planting. All other intercultural operations were done as and when necessary. There were no pest infestations in the plots. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C and means were separated with DMRT. During the experimental period, the salinity range of the plots of two locations were from 2.57 to 4.53 dS/m.

Results and Discussion

The level of nitrogen applications had a marked influence on different yield components and yield of Batisak (Table 1,2). The plant height was found to be increased significantly with the increase of nitrogen level and the tallest plant (35 cm and 36cm for MLT site, Satkhira and ARS, Daulatpur, Khulna) was obtained from the highest nitrogen dose (80 kg N ha^{-1}). Then shortest plant was found in control of both sites. The number of leaves produced per plot showed the same pattern of response as of plant height to nitrogen application. The level of nitrogen also influenced the length of leaves, breadth of leaves etc. In case of ARS, Daulatpur, Khulna, the highest fresh weight of plant produced from 40 kg N ha^{-1} and it was statistically identical with fresh weight of 80 kg N ha^{-1} while fresh weight obtained from Satkhira MLT site was 312 g $plant^{-1}$ which was significantly dissimilar with the other two treatments. Yield, in both the locations were increased significantly with increase in the level of nitrogen and it was 25 ton and 28 ton per hectare respectively.

Farmers' reaction

The batisak was introduced recently by the farmers in this area. The farmers of the area are interested about the crop because of its high yield and good taste. But, they showed their negative attitude because of its low market price.

Conclusion

The highest yield was found in 80 kg N ha^{-1}. This is the first year experiment, it needs trial in next year for confirmation of N-dose and dissemination in the locality.

Table 1. Yield and yield attributing characters of batishak at Satkhira MLT site during Rabi season, 2008-09

N-levels	Plant pop^n m^{-2}	Plant height (cm)	Leaves $plant^{-1}$ (no.)	Length of leaves (cm)	Breadth of leaves (cm)	Fresh wt. $plant^{-1}$ (g)	Green biomass (t ha^{-1})
0-Kg ha^{-1}	7	30	6	24	20	221	15
40-Kg ha^{-1}	8	33	6	33	24	250	23
80Kg ha^{-1}	8	35	7	37	62	312	25
LSD(0.05)	1.77	6.58	1.51	4.50	2.72	25.07	4.40
CV(%)	9.91	8.87	9.68	6.29	3.38	4.24	9.21

Table 2. Yield and yield attributing characters of batishak at ARS, Daulatpur, Khulna during Rabi season, 2008-09

N-levels	Plant pop^n m^{-2}	Plant height (cm)	Leaves plant^{-1} (no.)	Length of leaves (cm)	Breadth of leaves (cm)	Fresh wt. plant^{-1} (g)	Green biomass (t ha^{-1})
0-Kg ha^{-1}	8	27	5	28	34	200	18
40-Kg ha^{-1}	8	34	6	32	35	255	23
80Kg ha^{-1}	9	36	6	35	37	230	28
LSD(0.05)	0.75	7.08	1.85	5.28	4.34	27.72	3.46
CV(%)	3.90	9.64	13.61	7.34	5.58	4.68	6.64

Effect of Nutrient Management on Garlic under Zero Tillage Condition

Abstract

The experiment was carried out during the rabi season of 2008-09 at MLT site, Atghoria, Pabna to find out optimum nutrient management for maximizing garlic yield under zero tillage condition and to increase economic return. The experiment was laid out in randomized complete block (RCB) design with three treatments and six dispersed replications. The identically higher bulb yield was attained in recommended fertilizer dose (T_2) followed by HYG treatment. Maximum economic return in terms of net return and benefit cost ratio was recorded in HYG treatment.

Introduction

Garlic is one of the important spices crop in Bangladesh. In Pabna region, it is mainly grown on upland condition with intensive management. But in the past few years, farmers of the northern upazilas of Pabna are growing garlic with zero tillage condition just after receding of flood water especially in the low lying areas. The area coverage under this practice is increasing day by day. But farmers harvest smaller bulbs and are not getting optimum production probably due to lack of proper nutrient and agronomic management. Optimum fertilization may provide necessary nutrients to the plants for better bulb growth and development resulted higher yield of garlic. Keeping these views, the experiment was carried out with following objectives.

Objectives

i) To find out optimum nutrient management for maximizing garlic yield under zero tillage condition
ii) To increase economic return
iii) To see farmers reaction

Materials and Methods

The experiment was carried out during the rabi season of 2008-09 at MLT site, Atghoria, Pabna. Before starting the experiment, initial composite soil samples (0-15 cm depth) were collected from the experimental plots and were analyzed. The analytical result indicated that the soil was clay loam with very low organic matter content (0.57%) and neutral (pH-6.8) in nature. Nitrogen (0.18%) was low and P (13.0 µg g^{-1} soil), K (0.22 meq/100g) and B (0.40 µg g^{-1})was medium. S (48.0 µg g^{-1}) and Zn (6.0µg g^{-1}) content of the soil was very high. The experiment was laid out in randomized complete block (RCB) design with six dispersed replications. The unit plot size was 6m X 5m. Three different nutrient managements viz. T_1 = Soil test based for high yield goal (60– 28 – 43–105 – 0 – 0 kg N – P – K – S – Zn – B ha^{-1}), T_2 = Recommended dose (161– 50– 130–27– 3 – 0 kg N – P – K – S – Zn – B ha^{-1} + CD 5 t ha^{-1}), T_3 = Farmers practice(70– 63 – 76 - 41- 4 - 0 kg N – P – K – S – Zn – B ha^{-1}) were tested for the crop. The bulb of garlic (var. local) was sown on November 03, 2008. Three times irrigation were applied at December 12, January 15 and February 12, 2009. Fungicide was applied two times for the control of purple blotch diseases at last week of December and second week of January. Standard crop management practices were used for maintain the productivity of the crop. The crop was harvested on March 21, 2009. All necessary data were collected and analyzed statistically.

Results and Discussion

Yield and yield attributes of garlic did not differ significantly among the treatments. However, the higher bulb diameter was observed in recommended fertilizer dose (T_2). The higher bulb yield was attained in recommended fertilizer dose (T_2) followed HYG and FP treatment. This higher yield may be obtained due to balance supply of nutrient from organic and inorganic source of recommended fertilizer dose. During the vegetative growth stage two weeks of heavy foggy weather hampered plant growth which might be resulted the poor yield in all treatments.

Maximum economic return in terms of net return and benefit cost ratio was recorded in HYG treatment and it is mainly due to less production cost.

Farmer's reaction

We have learned from this research work that less seed is required for cultivation if we maintain line sowing and it reduces cultivation cost. In addition to that, proper fertilizer management and line sowing resulted in comparatively large bulb and higher yield and economic return.

Conclusion

The result revealed that among the tested fertilizer management, soil test based High yield goal treatment showed relatively better performance in relation to economical point of view though its yield is slightly and insignificantly lower than recommended dose.

Table 1. Yield contributing characters and yield of garlic affected by nutrient management under zero tillage condition during the rabi season of 2008-09 at MLT site, Atghoria, Pabna.

Treatments	Plant height (cm)	Plant population m^2 (no.)	Diameter bulb^{-1} (cm)	Bulb yield (t ha^{-1})
T_1= HYG (soil test based)	70.46	94.00	280	4.62
T_2 = Rec. dose	71.04	94.98	3.02	4.68
T_3 = FP	71.00	94.20	2.80	4.63
CV (%)	4.50	4.42	7.91	5.19
LSD	NS	NS	NS	NS

Table 2. Cost and return analysis of garlic as affected by different dose during the rabi season of 2008-09 at MLTsite, Atghoria, Pabna.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1= HYG (soil test based)	115500	84279	31221	1.37
T_2 = Rec. dose	117000	109548	7452	1.07
T_3 = FP	115750	99279	16471	1.16

Effect of Different Doses of N P K on Ber

Abstract

The experiment was carried out at FSRD site, Pushpapara, Pabna during 2008-09 to find out optimum and economic fertilizer dose for Ber cultivation. From the results it was found that T_6 (N_{500} P_{220} K_{250} S_{50} Zn_5 B_{01} g plant^{-1}) treatment showed better performance in relation to yield, quality and economical point of view. T_{10} (Farmers practice) treatment showed poor performance.

Introduction

In the recent years Ber is tremendously gaining its popularity as an important fruit crops for income generation in different part of Bangladesh especially in northern region. But still no recommended fertilizer packages are available to the farmers for maximizing yield and quality of Ber. In most cases, a wide variation in fertilizer application is observed among the farmers. As a result yield and quality of Ber vary greatly and mostly optimum production is not ensured due to heterogeneous fertilizer management which results in lower market price and economic return. It is imperative to standardize fertilizer management for optimizing the yield and quality of Ber. So far we know no research attempts have been taken on fertilizer management of Ber and the information on this area are not available. Regarding this views, the present study will be carried out with the following objectives

Objectives

i) To find out optimum and economic fertilizer dose for Ber cultivation
2) To increase production and economic return

Materials and Methods

The experiment was carried out during 2008-2009 in High Ganges River Flood Plain Soil (AEZ-11) at Modhupur under FSRD site, Pushpapara, Pabna to find out optimum and economic fertilizer dose for Ber cultivation. The soil of the experiment plot was slightly alkaline, organic matter; total nitrogen and P were very low. Status of S was medium where as K & Zn was low. Before starting the experiment four farmers were selected on the basis of same land, Ber variety, Ber plant age and spacing. Finally, 15 months older Apple kul variety with 6m X 6m spacing land was selected for the experiment. The following ten fertilizer treatments were employed for the experiment: T_1: N_{375} P_{175} K_{250} S_{50} Zn_5 B_{01}, T_2: N_{500} P_{175} K_{250} S_{50} Zn_5 B_{01}, T_3: N_{625} P_{175} K_{250} S_{50} Zn_5 B_{01}, T_4: N_{500} P_{130} K_{250} S_{50} Zn_5 B_{01}, T_5: N_{500} P_{175} K_{250} S_{50} Zn_5 B_{01}, T_6: N_{500} P_{220} K_{250} S_{50} Zn_5 B_{01}, T_7: N_{500} P_{175} K_{190} S_{50} Zn_5 B_{01}, T_8: N_{500} P_{175} K_{250} S_{50} Zn_5 B_{01}, T_9: N_{500} P_{175} K_{310} S_{50} Zn_5 B_{01}, T_{10}: N_{138} P_{75} K_{313} S_{95} Zn_7 B_{03} g plant^{-1} and Farmers' practice (Av. of 20 farmers.)

N as USG in 3 splits of 40, 40 & 20% and K as MP in 3 splits as 30, 30, 40% were top dressed in June 17-20, August 08-09 and November 06-07, 2008 respectively. P as TSP, S as gypsum, B as boric acid and Zn as Zinc sulphate were applied with other fertilizers as 50% in June 17-20 and 50% in August 08-09, 2008 respectively. Generally, Ber (specially Apple kul variety) of that area including experimental plot were severely affected with both leaf black spot fungal disease and nut weevil insect and Score and Sobicrone were sprayed two times respectively for controlling them at first week of October and first week of November. Fruit setting was also hampered due to continuous rainfall during the flowering stage. Standard crop management practices were used for maintain the productivity of the crop. The crop harvesting was started as per treatment from January 20 to February 04, 2009. Necessary data were collected and analyzed statistically.

Results and Discussion

Yield and yield attributes were responded significantly due to different nutrient management (Table-1). Harvest durations were differed insignificantly among the treatment. However, harvest duration was less in the plant where higher amount of K applied (T_2). No. of branches plant^{-1} was higher in the plot where maximum amount of N was applied (T_3) and lower in the plant where P dose was low (T_4). Maximum no. of deformed and blackish fruits was found in T_6 treatment where as T_{10} showed the minimum no. of deformed shape fruits and it might be due to the higher amount of B applied in T_{10} treatment. Fruit size was relatively bigger in T_6 treatment where P applied in higher amount and significantly smaller size fruits were obtained from T_1 treatment.

The highest fruit yield plant^{-1} and ha^{-1} were obtained from T_6 treatment where higher amount of P was applied which were also identical with other treatments except T_{10}. Nutrient P might have a positive effect on fruit size and bearing. TSS was higher in T_9 and T_6 treatments where K and P applied higher doses respectively. However, TSS was less in T_7 treatment where K was applied in poor amount. From the economic point of view, it was fond that higher gross return, net return and BCR were higher in T_6 treatment and farmers practice dose (T_{10}) showed the poor performance in all cases.

Farmers' reaction

Farmers opined that they did not know the applying method and amount of fertilizer for ber cultivation before the experiment conduction. They expressed their happiness with higher yield and quality fruit getting form the T_6 treatment. This experiment will be helpful for other ber growers.

SFM

Conclusion

From the experiment it was clearly revealed that fertilize especially N, P and K had the effect on plant growth, fruit yield and quality of ber. Nutrient P might be helped for higher fruit setting and yield and K had the effect on early ripening and sweetness. However, this is first year trial and this year the crop hampered due to insect and disease affectation, so, the experiment should be continued for the next year for a solid conclusion.

Table 1. Yield and yield contributing characters of Ber as affected by deferent doses of N P K during 2008-09 at FSRD site, Pushpapara, Pabna.

Treatment	Harvest duration (days)	Branch plant^{-1} (no.)	Deformed fruits plant^{-1} (no.)	100 Fruit wt. (kg)	Yield plant^{-1} (kg)	Yield (t ha^{-1})	T.S.S (%)
T_1 (N_{375}+)	24	7.50ab	47.75a	1.12c	11.53ab	3.21ab	17.63a
T_2 (N_{500}+)	24	7.00ab	45.00a	1.15abc	12.68ab	3.53ab	16.14ab
T_3 (N_{625}+)	24	8.75a	41.75a	1.20abc	12.95ab	3.60ab	17.06ab
T_4 (P_{130}+)	22	5.50b	40.00a	1.24ab	11.31ab	3.14ab	16.69ab
T_5 (P_{175}+)	24	7.75ab	51.50a	1.17abc	12.95ab	3.60ab	16.80ab
T_6 (P_{220}+)	24	7.25ab	52.00a	1.26a	16.42a	4.56a	17.67a
T_7 (K_{190}+)	24	8.50a	47.50a	1.13bc	12.47ab	3.47ab	15.20b
T_8 (K_{250}+)	24	7.75ab	45.00a	1.13bc	10.18b	2.83b	16.40ab
T_9 (K_{310}+)	19	8.00ab	42.00a	1.18abc	12.28ab	3.31ab	17.68a
T_{10} (FP)	24	6.50ab	33.75a	1.1c	10.10b	2.81b	17.23ab
CV%	-	23.97	29.02	7.15	23.70	31.65	8.93
LSD	-	2.59	18.79	0.12	5.68	1.56	2.18

Table 2. Cost and return analysis of Ber cultivation during they ear 2008-09 at FSRD site, Pushpapara, Pabna.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1 (N_{375}+)	158564	41616	116948	3.81
T_2 (N_{500}+)	174236	42033	132203	4.15
T_3 (N_{625}+)	174310	42486	131824	4.10
T_4 (P_{130}+)	155193	40532	114661	3.83
T_5 (P_{175}+)	178006	42033	135973	4.23
T_6 (P_{220}+)	226917	43534	183383	5.21
T_7 (K_{190}+)	172005	41366	130639	4.16
T_8 (K_{250}+)	140233	42033	98200	3.34
T_9 (K_{310}+)	175974	42645	133329	4.13
T_{10} (FP)	55523	39267	16256	1.41

Effect of Bio-Slurry and Boric Acid in Controlling Common Scab of Potato

Abstract

A field experiment was conducted at the Gobindoganj MLT and FSRD site, OFRD, Rangpur during Rabi season, 2008-09 to observe the effect of bio-slurry & boric acid in controlling common scab of potato for quality tuber production. Six fertilizer treatments viz., T_1=Rec.dose + cow dung slurry @ 5 t ha^{-1}, T_2 = Rec.dose + poultry slurry @ 3 t ha^{-1}, T_3 = Rec.dose + cow dung @ 5 t ha^{-1}, T_4 =poultry manure @ 3 t ha^{-1}, T_5 = Rec.dose + seed treatment with boric acid @ 3% and T_6 = Farmers' practice were evaluated for this purpose. The experiment was laid out in a randomized complete block design with six dispersed replications. The highest tuber yield was obtained from T_2 treatments which was identical to other treatments except farmers practice at the both sides .Percentage of common scab was less in $T_{5\ \text{which}}$ was statistically deferred from other treatments at the both sites. No significant impact of slurry or manure was observed in reducing scab of potato. The highest gross margin (Tk. 184402 ha^{-1} in Gobindagonj and Tk. 153003 in FSRD site) and benefit cost ratio (2.76 in Gobindagonj and 2.47 in FSRD site) was obtained from T_2.

Introduction

.Common scab, caused by *Streptomycin scabies* is one of the widely distributed major diseases of potato in Bangladesh (Ali and Dey,1995).Though the disease does not causes appreciable reduction in yield however, it can cause great loss due to reduction of market value of tubers (Dutt, 1979). Moreover, infected seed tuber served as a primary source of inoculums in the next crops (paharia and pushkarnath,1963).In an observation trial, bio- slurry reduced potato scab at Lahirirhat, FSRD site Rangpur. Sufficient information, on reduction of scab on potato using bio- slurry is not available. So, the effect of bio slurry on quality tuber production through reduction of scab is needed to be investigated for quality potato tuber production. The present investigation was, therefore, undertaken with following objectives to observe the effect of bio-slurry &boric acid in controlling common scab of potato for quality tuber production and to identify suitable organic fertilizer(s)

Materials and Method

The experiment was conducted at Gobindoganj MLT site and FSRD, Lahirirhat, OFRD, Rangpur during Rabi season, 2008-09 to observe the effect of bio-slurry & boric acid in controlling common scab of potato for quality tuber production and to identify suitable organic fertilizer(s). Six treatments viz., T_1= Rec. dose + cow dung slurry @ 5 t ha^{-1}, T_2 = Rec .dose + poultry slurry @ 3 t ha^{-1}, T_3 = Rec. dose + cow dung @ 5 t ha^{-1}, T_4 = Rec. dose + poultry manure @ 3 t ha^{-1}, T_5 = Rec. dose + seed treatment with boric acid @ 3% and T_6 = Farmers' practice were evaluated for this purpose. The details of the treatments are shown in Table 1.In $T_{5,}$ seed potato was treated with 3 % boric acid (30 g boric acid litre^{-1} of water) before sprouting.

Table1. Details of different treatments studied in potato

Treatments	N-P-K-S--Zn-B–CD/CS/PM/PS kg ha^{-1})
T_1= Rec. dose + cow dung slurry @ 5 t ha^{-1}	85-20-92-33 -3.5-1.7 -5000
T_2 = Rec .dose + poultry slurry @ 3 t ha^{-1}	50-0-82- 33 -3.5-1.7-3000
T_3 = Rec. dose + cow dung @ 5 t ha^{-1}	95-21-92-33 -3.5-1.7-5000
T_4 = Rec. dose + poultry manure @ 3 t ha^{-1}	70- 12-95-33 -3.5-1.7-3000
T_5 = Rec. dose + seed treatment with boric acid @ 3%	108-27-117-33 -3.5-1.7-0
T_6 = Farmers' practice	

The land type was medium high which belongs to AEZ No. 3. The experiment was laid out in a randomized complete block design with six dispersed replications. The unit plot size was 3m x 5m. The potato variety Diamant as test crop was used at both sites. The crop was on 15 November, 2008 at Gobindoganj and 20 November, 2008 at FSRD, maintaining 60cm x 20cm plant spacing. The entire amount of cow dung slurry, cow dung manure, poultry slurry, poultry manure were applied 5 days before final land preparation. The amount of N, P, K, S, Zn, B and ½ of N were applied during final land preparation. The rest of nitrogen was applied at 35 DAP following earthing up. The second earthing up was done at 50 DAP. The crop was irrigated thrice at 35, 50 and 70 DAP. To control late blight, melodiduo @ 2.0 g/litre of water was sprayed at the early stage of crop growth and Secure @ 2.0 g/litre of water was sprayed at the later stage of crop growth. The crop was harvested on 26 February,2009 at Gobindoganj and 28 February , 2009 at FSRD.

Results and Discussion

The yield and yield contributing characters of potato are presented in Table-1 & 2. The yield and scab infested tuber did not vary due to different fertilizer treatments at both the sites. The highest tuber yield was obtained from T_2 (poultry slurry @3 t ha^{-1}) which was identical to T_1, T3, T4 and T_5treatments but differed from farmers practice at both the sites. Percentage of common scab infested tuber was less in T_5 but deferred from other treatments at both the sites. No significant impact of slurry or manure was observed in reducing scab of potato.

Cost and return analysis

The cost and return analysis of different treatments are presented in Table 3 & 4. The highest gross margin (Tk. 184402 ha^{-1} in Gobindagonj and Tk. 153003 in FSRD site) and benefit cost ratio (2.76 in

Gobindagonj and 2.47 in FSRD site) was obtained from T_2. The lowest gross margin and benefit cost ratio was obtained from T_6 (farmers practice) in both the sites.

Table 2. Effect of different fertilizer dose on yield and Yield contributing characters of potato Gobindoganj MLT site during rabi 2008-09.

Treatments	No. of tuber hill^{-1}	Wt. of tuber hill^{-1} (g)	Tuber yield (t ha^{-1})	Infested tuber (%)
T_1= Rec. dose + cow dung slurry @ 5 t ha^{-1}	15.18a	368a	28 .77a	35.40 b
T_2 = Rec .dose + poultry slurry @ 3 t ha^{-1}	15.51a	368a	28.93a	34.53 b
T_3 = Rec. dose + cow dung @ 5 t ha^{-1}	14.50a	365a	28 .11a	36.53 b
T_4 = Rec. dose + poultry manure @ 3 t ha^{-1}	14.20a	343a	28.72a	36.10 b
T_5 = Rec. dose + seed treatment with boric acid @ 3%	15.40a	364a	27.63a	27.90a
T_6 = Farmers' practice	9.16b	293b	19.29b	36.70 b
CV (%)	5.24	6.25	6.41	6.23

Table 3. Effect of different fertilizer dose on yield and Yield contributing characters of potato FSRD site during rabi 2008-09.

Treatments	No. of tuber hill^{-1}	Wt.of tuber hill^{-1} (g)	Tuber yield (t ha^{-1})	Infested tuber (%)
T_1= Rec. dose + cow dung slurry @ 5 ton / ha	14.12a	320a	25.28a	36.12 b
T_2 = Rec .dose + poultry slurry @ 3 ton / ha	14.61a	331a	25.72a	35.55 b
T_3 = Rec. dose + cow dung @ 5 ton / ha	13.66a	319a	24.45a	35.29 b
T_4 = Rec. dose + poultry manure @ 3 ton /ha	13.54a	322a	24.90a	35.88 b
T_5 = Rec. dose + seed treatment with boric acid @ 3%	14.21a	316a	24.33a	26.68a
T_6 = Farmers' practice	9.11	260b	19.97b	33.35b
CV (%)	6.23	5.54	7.20	7.15

Table 4. Cost and return analysis of different treatments on potato at Gobindoganj MLT site, OFRD, Rangpur during rabi season, 2008-09

Treatments	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1= Rec. dose + cow dung slurry @ 5 t ha^{-1}	28 .77	287700	114081	173619	2.52
T_2 = Rec .dose + poultry slurry @ 3 t ha^{-1}	28.93	289300	104898	184402	2.76
T_3 = Rec. dose + cow dung @ 5 t ha^{-1}	28 .11	281100	114707	166393	2.45
T_4 = Rec. dose + poultry manure @ 3 t ha^{-1}	28.72	287200	111301	175899	2.58
T_5 = Rec. dose + seed treatment with boric acid @ 3%	27.63	276300	115021	161279	2.4
T_6 = Farmers' practice	19.29	192900	100000	92900	1.93

Price (Tk. /kg): Urea=11.80, TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160
Poultry manure and slurry =1 & 3 /-, Cow dung manure and slurry =1 & 1.5/- , Potato = 10/-

Table 5. Cost and return analysis of different treatments on potato at FSRD, OFRD, Rangpur during rabi season, 2008-09

Treatments	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1= Rec. dose + cow dung slurry @ 5 t ha^{-1}	25.28	252800	113081	139719	2.24
T_2 = Rec .dose + poultry slurry @ 3 t ha^{-1}	25.72	257200	104197	153003	2.47
T_3 = Rec. dose + cow dung @ 5 t ha^{-1}	24.45	244500	113809	130691	2.15
T_4 = Rec. dose + poultry manure @ 3 t ha^{-1}	24.90	249000	110609	138391	2.25
T_5 = Rec. dose + seed treatment with boric acid @ 3%	24.33	243300	114066	129234	2.13
T_6 = Farmers' practice	19.97	199700	99898	99802	3.00

Price (Tk. /kg): Urea=11.80, TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160
Poultry manure and slurry =1 & 3 /-, Cow dung manure and slurry =1 & 1.5/- , Potato = 10/-

Effect of Poultry Manure Applied in Combination with Chemical Fertilizer on the Yield of Groundnut

Abstract

A field experiment was conducted at the Ulipur MLT site, OFRD, Rangpur during Rabi season, 2008-09 to investigate the yield potentiality of groundnut in the farmer's field. Three treatments viz., T_1= 20-45-50-20-2-1 kg NPKSZnB+4 t PM +2 t Lime ha^{-1}, T_2= 20-30-50-20-2-1 kg NPKSZnB+2 t PM +2 t Lime ha^{-1} and T_3 =Farmers practice were compared for this purpose. The experiment was laid out in a randomized complete block design with three dispersed replications. Significantly the highest grain yield (2.38 t ha^{-1}) was obtained from T_1 compared to T_3 and it was statistically similar to T_2. The highest gross margin (Tk. 38450 ha^{-1}) and benefit cost ratio (1.74) was obtained from T_2. The lowest gross margin (Tk. 24050 ha^{-1}) and benefit cost ratio (1.60) was obtained from T_3 (farmers practice)

Introduction

The Non-Calcareous Grey Floodplain Soil under AEZ 3 at grater Rangpur region is extremely acidic with low level of soil fertility. The vast area can be brought under successful crop cultivation through proper organic and inorganic fertilization. Three years on station trials revealed that the yield of groundnut can be maximized with the application of 4 t poultry manure along with 20 kg N and 45 kg P ha^{-1}. A blanket dose of 2 t lime ha^{-1} once in the 1st year reduced soil acidity with the rise in soil pH which ultimately increased the availability of major plant nutrients and it may sustain for three years. Poultry manure may be supplied a major portion of plant nutrients in soil and improved soil health. However, the results should be verified through on farm trials before handed over the technology to the end users. The present investigation was therefore, undertaken to investigate the yield potentiality of groundnut, to study the changes in dry matter production and to determine the total nutrient uptake as influenced by poultry manure in combination with chemicals fertilizer.

Materials and Methods

The experiment was conducted at Ulipur MLT site, OFRD, Rangpur during Rabi season, 2008-09 to investigate the yield potentiality of groundnut in the farmer's field. Three treatments viz., T_1= 20-45-50-20-2-1 kg NPKSZnB+4 t PM +2 t Lime ha^{-1}, T_2= 20-30-50-20-2-1 kg NPKSZnB+2 t PM +2 t Lime ha^{-1} and T_3 =Farmers practice were evaluated for this purpose. The land type was medium high which belongs to AEZ No. 3. The experiment was laid out in a randomized complete block design with three dispersed replications. The unit plot size was 4m x 5m. The seeds were sown on 11 December, 2008, maintaining 30 cm x15 cm plant spacing. Lime @ 2 t ha^{-1} (dolomite) was applied one month before sowing in T_1 and T_3 treatment. All the fertilizers and poultry manure was applied l during final land preparation. The crop was harvested on 26 May,2009.

Results and Discussion

The yield and yield contributing characters are presented in Table-1. The highest number of pods $plant^{-1}$ was obtained from T_1 (15.73) which were statistically similar to T_2 (14.47) but differed significantly from T_3 (farmers practice). The number of seeds pod^{-1} did not vary due to fertilizer treatments. Significantly the highest 100 seed weight (53.40 g) was recorded from T_1 .The highest pod yield (2.38 t ha^{-1}) was obtained from T_1 which was statistically similar to T_2 (2.26 t ha^{-1}) treatments but deferred significantly from T_3 (farmers practice)

Economic performance

The cost and return analysis of different treatments are presented in Table 2. The highest gross margin (Tk. 38450 ha^{-1}) and benefit cost ratio (1.74) was obtained from T_2. The lowest gross margin (Tk. 24050 ha^{-1}) and benefit cost ratio (1.60) was obtained from T_3 (farmers practice)

Table 1. Effect of different fertilizer dose on yield and Yield contributing characters of groundnut at Ulipur MLT site during rabi 2008-09.

Treatments	No. of pods plant^{-1}	No. of seeds pod^{-1}	100 seed weight (g)	Yield (t ha^{-1})
T_1	15.73 a	1.77 a	53.40 a	2.38 a
T_2	14.47 a	1.73 a	52.60 b	2.26 a
$T_{3\ (FP)}$	13.00 b	1.71 a	50.07 c	1.60 b
CV (%)	4.32	1.80	2.11	2.98

T_1= 20-45-50-20-2-1 kg NPKSZnB + 4 t PM + 2 t Lime/ha, T_2= 20-30-50-20-2-1 kg NPKSZnB + 2 t PM + 2 t Lime/ha and T_3 =Farmers practice .

Table 2. Cost and return analysis of groundnut at Ulipur MLT site, OFRD, Rangpur during rabi season, 2008-09.

Treatments	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1	2.38 a	95200	57950	37250	1.64
T_2	2.26 a	90400	51950	38450	1.74
T_3	1.6 b	64000	39950	24050	1.60

Price (Tk. /kg): Urea=11.80, TSP= 75, MP= 55, Gypsum= 8, Zinc sulphate= 150, Boric acid = 160, Ground nut = 40/-

On-Farm Verification of Nutrient Management for Garlic Production

Abstract

The experiment was conducted at the MLT site Shibpur, Rajshahi during Rabi 2008-09 in High Ganges River Floodplain soil (AEZ-11). The experiment was laid out in RCB design with 4 replications The unit size was 3m x 3 m with 20x 15cm spacing. There was four treatments, T_1= 150-50-100 kg ha^{-1} NPK respectively, T_2 = 150-50-100-40 kg ha^{-1} NPK and S respectively + 5 t ha^{-1} CD, T_3 = 150-50-100-40-5-2 kg ha^{-1} NPKS Zn and B respectively + 5 t ha^{-1} CD and T_4 = Farmers practice (86-30-56-15-3) kg ha^{-1} NPKS and Zn + 8 t ha^{-1} CD respectively. The variety was BARI Rashun-1 and the management package T3(5.93 t ha^{-1}) gave highest yield followed by T4 (5.25 t ha^{-1}).

Introduction

Garlic (*Allium sativum* L) is an important crop and used as spice throughout the worlds. The average yield of garlic in Bangladesh is 2.66 t ha^{-1} (BSS.2004) It is very low as compared to other countries of the world like China 15.05 t ha^{-1} (FAO,2003) However, the yield of garlic can be improved through the cultivation of high yielding varieties, proper fertilizer management. Reports included that apart from NPK fertilizer, sulphur (as play a vital role increasing the yield of garlic (Ahmed *et. al* 1998) On the other hand, Sulphur deficient plant may limit the crop growth at any stage resulting in yield reduction. The addition of boron tends to improve bulb quality. In addition to NPKSZn and B nutrient application of organic manure improve the efficiency of chemical fertilizer and also improve the soil condition for the production of crops. The present study might be undertaken in the farmers' field to verify the effect of different nutrient on the yield of garlic.

Materials and methods

The experiment was carried out at the MLT site, Shibpur, Rajshahi during rabi 2008-09 in high ganges river flood plain soil (AEZ-11). The experiment was laid out in RCB design with 4 replications. The unit size was 3m x 3 m with 20x 15cm spacing. The variety was BARI Rashun-1. There was four treatments, T_1 = 150-50-100 kg ha^{-1} NPK respectively, T_2 = 150-50-100-40 kg ha^{-1}

NPK and S respectively + 5 t ha^{-1} CD, **T_3** = 150-50-100-40-5-2 kg ha^{-1} NPKS Zn and B respectively + 5 t ha^{-1} CD and T_4 = Farmers practice (86-30-56-15-3) kg ha^{-1} NPKS and Zn + 8 t ha^{-1} CD respectively. All cowdung, P, S, Zn, B half MOP and $^1/_3$ urea were applied at the time of final land preparation. Remaining N and K were applied in two equal split at 25 and 50 days after planting. A systemic insecticide (cypermethr) was arrayed at seedling stage to control thrips. The crop was sown on 4 November/08 and the crop was irrigated 4 times during its life cycle. Rovral (2 g/L water) was applied 2 times at 15 days interval to control purple blotch. The crop was harvested on 3 April/09 and necessary data were collected and analysis statistically.

Result and Discussion

The results indicated that all the characters vary significantly by the influence of different fertilizer management package. The highest plant height was found in T_3 (54.12 cm) and T_4 (52.0 cm) which were statistically identical. The lowest plant height was produced by T_1 (43 cm). The statistically identical leaves $plant^{-1}$ was produced by T_2 (5.05), T_3 (5.3) and T_4 (4.98) and the lowest was produced by T_1 (4.55). The highest individual bulb weight was produced by T_3 (17.73 g). The treatment T_2 (16.15 g) and T_1 (15.9 g) produced second highest bulb weight. The treatment T_1 (14.33 g) produced the lowest individual bulb weight. The treatment T_1 , T_2 and T_3 produced the highest number of clob/bulb. The treatment T_3 (5.93 t ha^{-1}) produced the highest yield followed by T_4 (5.25 t ha^{-1}). The treatment T_2 (4.95 t ha^{-1}) produced the similar yield to T_4. The treatment T_4 (4.5 t ha^{-1}) produced the lowest yield. It seems that combination of micro, macro and organic matter in nutrient management package T_3 ensure the longterm and balance supply of nutrient to the plant that increase growth development of plant and finally yield increases. Cost and return analysis (Table 2) indicated that treatment T_3 (N_{100}-P_{50}-K_{100}-S_{40}-Zn_5-B_2+ CD 5 t ha^{-1}) produced the highest yield (5.93 t ha^{-1}), gross income (190670 Tk kg^{-1}) and BCR (5.1).

Table 1. Yield and yield attributes of garlic influenced by different nutrient management package at Shibpur MLT site, Rajshahi

Treatment	Plant height (cm)	Leaves $plant^{-1}$	Bulb weight (g)	No. of clob $bulb^{-1}$	Yield (t ha^{-1})
T_1	43.0 c	4.55 b	15.9 b	18.75 a	4.5 c
T_2	47.17 b	5.05 a	16.15 b	17.35 ab	4.95 bc
T_3	54.12 a	5.3 a	17.73 a	19.65 a	5.93 a
T_4	52.0 a	4.98 a	14.33 c	15.08 b	5.25 b
CV (%)	4.53	5.0	6.04	11.06	7.39
LSD (0.05)	3.56	0.39	1.54	3.13	0.61

Table 2. Cost and return analysis of garlic influence by different fertilizer management package at MLT site, Shibpur, Rajshahi during 2008-2009

Treatment	Yield (t ha^{-1})	Gross income (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross income (Tk. ha^{-1})	BCR
T_1	4.5	180000	34406	145594	-
T_2	4.95	198000	40740	157260	4.86
T_3	5.93	237200	46530	190670	5.1
T_4	5.25	210000	48663	161337	4.31

NB : Cost : Urea @ 12 Tk/kg, TSP @ 40 Tk/kg, MOP @ 35 Tk/kg, Gypsum @ 6 Tk/kg, $ZnSo_4$ @ 120 Tk/kg, Boric acid @ 350 Tk/kg, CD @ Tk/kg, Garlic seed @ 45 Tk/kg, and garlic @ 40 Tk/kg.

Response of Chickpea to Newly Developed Bio-Fertilizer in the Farmers' Field

Abstract

The experiment was carried out at FSRD site, Jalalpur, Sylhet during 2008-09 to find out the response of newly developed *Rhiozobium* strain on chickpea. The experiment was laid out in RCB design with 6 dispersed replications. Two treatments were used as viz. T_1-50-22-42-20 NPKS ha^{-1} and T_2- 0-22-42-20 kg NPKS + inoculums. Inoculums with other fertilizers produced higher yield (1607 kg ha^{-1}) than another treatment (1261.68 kg ha^{-1}).

Introduction

Biofertilizers contain beneficial microorganisms in a viable state intended for seeds or soil application. It improves soil fertility and help plant growth by increasing the number and biological activity of desired microorganisms in the root environment. Bacteria belonging to the genus Rhizobium lives freely in soil and in the root region of leguminous plants by infecting their roots and forming nodules on them. It has capacity to fix atmospheric nitrogen through the symbiotic association with leguminous plants. The practice of applying artificially prepared cultures of rhizobia to leguminous seed before sowing can be referred to as legume inoculation and the prepared materials cultures of rhizobia to leguminous seed before sowing can be referred to as legume inoculation and the prepared materials are called inoculants.

Objective

The experiment was undertaken to see the response of chickpea to newly developed bio-fertilizer in the farmers' field.

Materials and Methods

The experiment was conducted at FSRD site Sylhet during 2008-09 to find out the yield and suitability of *Rizobium* on chickpea after harvest T.aman rice in Sylhet. Two treatment were used viz. 50-22-42-20 kg NPKS ha^{-1} and 0-22-42-20 kg NPKS ha^{-1} + inoculum. Treatments were arranged in the RCB design with 6 replications. The plot size was 4m x 5m. The seeds were sown on 20 Nov. and spacing 40 cm x 10 cm. All fertilizers were applied before final land preparation. Intercultural operations were done when necessary.

Results and Discussion

From Table 1 it was found that bio-fertilizer produced higher yield (1607.72 kg ha^{-1}) than without bio-fertilizer (1261.29 kg ha^{-1}). Different yield contributing characters also showed positive response to biofertilizer in chickpea.

From one year experimental result, it was found that bio-fertilizer has significant effect to increase the yield on chickpea for this area.

Farmers' reaction

Inoculum is beneficial to chickpea cultivation. Farmers are very much interest to cultivate chickpea with bio-fertilizer.

Table 1. Effect of bio-fertilizer on yield and yield contributing characters of chickpea at FSRD site, Jalalpur during 2008-09

Yield & yield contributing characters	With bio-fertilizer	Without bio-fertilizer
Plot length (cm)	51.75	46.5
Pod plant^{-1}	26.12	24.14
Seeds pod^{-1}	1.40	1.35
1000 seed wt. (g)	184.62	177.37
Seed yield (kg ha^{-1})	1607.72	1261.29

Effect of Liming on the Performance of Chickpea in the Farmers' Field

Abstract

The experiment was conducted at the MLT site, Sunamganj (AEZ 20) to see the response of liming on chickpea and to determine the optimum dose of liming for maximum yield and profitability during 2008-09. Five treatments consisted of $CaCO_3$ at the rate of 0, 500, 1000, 1500, 2000 kg ha^{-1} were considered. The highest yield was obtained from the application of 1500 kg ha^{-1} $CaCO_3$. Different yield contributing characters almost follow the similar trend. The higher economic returns were also found in the same treatment.

Introduction

Soil acidity limits agricultural yield in extensive areas in the world. Calcium deficiency (Ritchey et al., 1982) and Al toxicity (Pavan et al., 1982) are considered major yield-limiting factors of tropical and subtropical acid soils. Soil acidity problems are commonly corrected by applying limestone. Results of field studies show that the movement of lime to depth varies according to the timing and the rates of liming, soil type, weather conditions, management of acidic fertilizers, and cropping systems (Moschler et al., 1973; Blevins et al., 1978; Oliveira and Pavan, 1996; Rheinheimer et al., 2000; Gascho and Parker, 2001; Conyers et al., 2003). In addition, lime act as a soil cover thus reduces water losses by evaporation and provides greater available moisture in the top layers, which may promote nutrient uptake under adverse acidic soil conditions (Caires and Fonseca, 2000). These effects raise doubts as to the optimum surface liming rates needed for providing high yields in this cropping system.

In Sylhet region, the land and soil is more feasible to cultivate vegetables like chickpea. But due to high acidity, optimum yield is not found. It can be reclaimed and increased soil pH through liming the soil. We evaluated the amelioration of soil acidity with lime and the yields of crops after surface application of lime at various rates to obtain a suitable method for surface liming recommendation in this cropping system.

Therefore the present experiment was undertaken to fulfillment the following objectives.

Objectives

i) To find out the response of liming on chickpea and
ii) To determine the optimum dose of liming for maximum yield and profitability.

Materials and Methods

The experiment was performed at MLT site, Sunamgonj on a acidic soil of AEZ 20. The P^H of the soil was 5.2. The experiment was laid out in RCB design with 6 dispersed replications. Plot size was 8m x 5m. The treatments consisted of $CaCO_3$ (limestone) at the rates of 0, 500, 1000 and 1500 kg ha^{-1}. The lime as $CaCO_3$ was applied just one month before the crop was transplanted.

According to BARC FRG, 2005, N, P and K were applied as urea, triple super phosphate, and potassium chloride respectively. Pod was harvested from 10 random simple plants and yield was expressed as t ha^{-1}. Weeds were controlled mechanically and pests and diseases were controlled by appropriate insecticide and pesticide treatments.

Results and Discussions

The highest yield was obtained from the 1500 kg ha^{-1} $CaCO_3$, which was significantly different from all other treatments followed by 1000 kg ha^{-1}. Regarding economics, the higher returns were also obtained from higher doses of lime treatments for the crop studied in this area was obtained from the 1500 kg lime ha^{-1} followed by 1000 kg ha^{-1} which was 4.40. But the lowest BCR (2.92 only) was found from 2000 kg ha^{-1}. This might be due to reduce the soil acidity as well as increased phosphorus and nitrogen use efficiency.

Conclusion

From one year result, it was found that liming has significant effect to reduce the soil acidity and 1500 kg ha^{-1} may be the optimum dose to get maximum yield of Chickpea for this area.

Table 1. Effect of different doses of liming on the yield and yield attributes of chickpea at MLT site, Sunamganj (2008-09).

$CaCO_3$ (kg ha^{-1})	Plant height (cm)	No. of pod plant^{-1}	No. of seed pod^{-1}	1000 seed wt. (g)	Seed yield (kg ha^{-1})
T_1-0	42.15	26.53	1.21	172.50	872
T_2-500	43.17	29.49	1.32	174.50	1151
T_3-1000	44.15	30.72	1.44	176.80	1457
T_4-1500	45.16	30.40	1.49	179.90	1636
T_5-2000	42.20	32.46	1.24	172.10	1220
$LSD_{0.05}$	0.17	1.89	0.06	2.17	105.90

Table 2. Effect of different doses of liming on the yield and economics of chickpea at MLT site, Sunamganj (2008-09).

$CaCO_3$ (kg ha^{-1})	Yield (kg ha^{-1})	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1-0	872	52320	15205	37295
T_2-500	1151	69060	17310	51750
T_3-1000	1457	87420	19825	67595
T_4-1500	1636	98160	21825	76335
T_5-2000	1220	73200	23010	48190

Effect of Bio-slurry on the Performance on different Vegetable Crops

Abstract

The experiment was carried out at Gazipur, Tangail, Pabna, Rangpur, Bogra, Comilla and Narshingdi during the rabi season of 2008-09 to evaluate the comparative performance of bio- slurry on cabbage, cauliflower, Tomato, Potato, Brinjal and cucumber. Different crops were tested at different locations. Three nutrient management packages viz. soil test based inorganic fertilizers, IPNS with poultry manure/cowdung and IPNS with poultry slurry/cowdung slurry along with farmers' dose were tested on different vegetable crops. The number of treatments was slightly varied and absolute control was included at some locations for some crops. A positive response of vegetables to bioslurry (cowdung slurry or poultry slurry) was observed at all the locations. Significantly higher head and curd yield was recorded from IPNS with bioslurry treatment in cabbage and cauliflower irrespective of locations. Similarly, the highest fruit yield of tomato was obtained with the same treatment at all the locations. A significant effect of bioslurry was also found in Potato. The highest tuber yield was recorded from IPNS with bioslurry at Tangail and Bogra. At Rangpur, higher and identical yield was found in IPNS with bioslurry (cowdung and poultry manure) treatment. But no considerable yield difference among the treatments was observed at Comilla. Significantly higher fruit yield in brinjal was found in IPNS with CD bioslurry at Narshingdi. The same treatment also produced significantly higher cucumber yield at Pabna. More or less similar trend was found incase of economic return. Higher economic return was found in IPNS treatment due to higher yield almost in all crops at different locations.

Introduction

In Bangladesh, major food crops remove about 2.98 m tons of nutrients annually against a total addition of 0.72 m ton. According to an appraisal report of Bangladesh soil resources, soils of about 6.10 m ha contain very low (less than 1%) organic matter, 2.15 m ha contain low (1-2%) organic matter and the remaining 0.90 ha contain more than 2 % organic matter (Mondal, 2000).

The organic matter content as well as the fertility status of Bangladesh soil is low. Now it is well agreed that depleted soil fertility is a major constrain for higher crop production in Bangladesh and indeed, yield of several crops are declining in some soils (Bhuiyan, 1991). Maintenance of soil fertility is a prerequisite for long term sustainable agriculture and it is certain that organic manure (cowdung, poultry manure and their slurry) can play a vital role in the sustainability of soil fertility and crop production. A huge number of biogas plants have been established in our country through GOs and NGOs initiatives. But due to lack of proper management a quantity of bio-slurry is being deteriorated and remained unused. Biogas slurry is an improved type of organic manure which is applied in the form of semi liquid, dry or compost. Biogas-slurry contains 20-30% higher plant nutrients than that of traditional cowdung, poultry manure, farm yard manure and compost. Biogas slurry when applied along with inorganic fertilizers, it reduces as well as save the quantity of inorganic fertilizers. In addition it adds organic matter to the soil. Bio-slurry can be used as an excellent organic fertilizer. Fertilizer crisis is a burning issue across the country. Use of bio-slurry can play a vital role to minimize the fertilizer crisis. Moreover as organic manure bio-slurry may help soil fertility in the long run. Research work on the bio-slurry is lacking in our environment. Information of bio-slurry research is meager in our country. Our farmers are also less aware about the use of bio-slurry in crop production. Therefore, it is very important to evaluate the efficiency of bio-slurry on performance on different vegetable crops. Cabbage, cauliflower, tomato, potato are the major winter vegetables in Bangladesh and widely grown all over the country. Therefore, the present study was carried out (i)) to evaluate the effect of bio-slurry on the performance of different vegetable crops, ii) to compare performance of bio-slurry or slurry compost with inorganic fertilizer and iii) to find out the optimum and economic dose of bio-slurry for cabbage and cauliflower.

Materials and Methods

The experiment was carried out at the Gazipur, Pabna, Tangail, Rangpur, Narshingdi, Comilla, Rajshahi during the rabi season of 2008-2009. The experiment was laid out in Randomized completely block design (RCBD) design with three replications. Unit plot size was 5m x 4m.

Four different treatments were:
T_1: Soil test based (STB) inorganic fertilizer for high yield goal
T_2: IPNS with poultry manure/cowdung for high yield goal
T_3: IPNS with poultry slurry/cowdung slurry for high yield goal
T_4: Farmers dose

In some locations absolute control was included and in some locations only bioslurry was used in IPNS treatment. Both the sources of bioslurry from poultry and cowdung was applied in different vegetable crops at Rangpur. Detailed fertilizer packages for different crops at different locations are given in Appendix Table 1. Fertilizers were applied as per treatment based on soil analysis and BARC fertilizer recommendation guide 2005. Seedlings of proper age were transplanted at different dates at different locations. The entire amount of organic manure (CD, PM, PM slurry), P, S, B and one half of K were applied during final land preparation. Total amount of urea and remaining one half of K were applied as top dress in three equal splits. Intercultural operations such as weeding, irrigation and pest control measures were done in order to maintain the normal crop growth. The crops were harvested on proper time. Data on yield and yield attributes along with other parameters were collected properly and subjected to statistical analysis. Different crop management practices followed for different crops at different locations are shown in Appendix Table 2.

Results and Discussion

Location: Gazipur

Cabbage

Significant variation was not found in plant height and yield attributing characters like head length, head breadth and weight per plant due to different nutrient management practices (Table 1). Weight per plant varied from 3.85 to 4.17 gm in different treatments. Marketable weight per plant was the highest in the slurry treatment (T_3) but it was statistically similar with the treatment of soil test based inorganic fertilizer (T_1). Although higher yield was obtained from the T_3 treatment where poultry slurry was used but it was not significant from soil test based inorganic fertilizer and IPNS with poultry manure. Lower yield was found in the farmers' practice. The yield from the poultry slurry was 6, 9 and 11 percent higher than that of inorganic fertilizer, IPNS with poultry manure and farmers' practice, respectively.

Gross return was associated with the total production (Table 2). Higher gross return was found in the treatment T_3 due to its higher yield. Due to application of huge amount of phosphorus and higher amount of cowdung the total cost was higher in farmers' dose (T_4). Net return and benefit cost ratio (BCR) were higher in the treatment T_3 where poultry slurry was used and less fertilizer cost involved.

Table 1. Yield and yield attributes of cabbage as influenced by different treatments at Pajulia, Gazipur during the rabi season of 2008-09

Treatment	Plant height (cm)	Head length (cm)	Head breadth (cm)	Weight plant^{-1} (kg)	Marketable weight plant^{-1} (kg)	Yield (t ha^{-1})
T_1	35.97	12.67	24.60	4.06	3.46ab	82.67ab
T_2	35.21	12.33	24.23	3.92	3.33bc	80.33ab
T_3	35.99	13.03	25.00	4.17	3.57a	87.50a
T_4	34.72	12.63	24.27	3.85	3.24c	79.00b
CV (%)	2.05	3.51	2.80	13.03	16.84	5.13

T_1 : STB basis HYG, T_2 : IPNS with 3 t ha^{-1} Poultry manure, T_3 : IPNS with 3 t ha^{-1} poultry slurry, T_4 : Farmers practices

Table 2. Cost and return analysis of cabbage as influenced by different treatments at Pajulia, Gazipur during the rabi season of 2008-09

Treatment	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk.ha^{-1})	BCR
T_1	413350	70500	342850	5.86
T_2	401650	67500	334150	5.95
T_3	437500	63500	374000	6.89
T_4	395000	84000	311000	4.70

Cauliflower

Plant height and different yield attributes except curd length were influenced by the different nutrient management packages (Table 3). Higher but statistically similar plant height was obtained from the poultry manure (T_2) and poultry slurry (T_3) treated plots. The height curd breadth was found in the treatment T_3 where poultry slurry was used but statistically no variation was found among the treatments of inorganic fertilizer (T_1), IPNS with poultry manure (T_2) and farmers' practice (T_4). Statistically significant highest marketable weight per plant and yield were obtained from IPNS with bio-slurry (T_3) which gave about 24% higher yield than T_1, T_2 and T_4, respectively

Higher gross return and less fertilizer cost as well as less total cost resulted higher net return and higher BCR in the treatment T_3 where poultry slurry was used (Table 4).

Table 3. Yield and yield attributes of cauliflower as influenced by different treatments at Pajulia, Gazipur during the rabi season of 2008-09

Treatment	Plant height (cm)	Curd length (cm)	Curd breadth (cm)	Whole plant weight per plant (kg)	Marketable weight per plant (kg)	Yield (t ha^{-1})
T_1	58.55b	13.23	16.79b	2.45ab	1.81b	44.75b
T_2	60.48ab	13.41	17.16b	2.38b	1.88b	44.92b
T_3	62.75a	13.98	17.97a	2.75a	2.25a	55.48a
T_4	58.10b	13.39	16.95b	2.29b	1.79b	44.50b
CV (%)	2.23	4.63	1.45	7.22	6.10	6.78

Table 4. Cost and return analysis of cauliflower as influenced by different treatments at Pajulia, Gazipur during the rabi season of 2008-09

Treatment	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	447500	88000	359500	5.09
T_2	449200	84500	364700	5.32
T_3	554800	83500	471300	6.64
T_4	445000	109000	336000	4.08

Location: Pabna

Cabbage

The yield and yield contributing characters were significantly difference among the treatments (Table 5). The highest cabbage yield was attained in IPNS with 5 t ha^{-1} cowdung slurry (T_3) followed by high yield goal (T_1). The cumulative effect of plant height, head length, head breadth and weight $cabbage^{-1}$ might have significant contribution to achieve highest yield. Farmers practice gave lowest yield. Slurry plot gave higher yield than cowdung manure and it might be due to more moisture content and decomposed, nutrient in more available from, disease and weed seed freeness of slurry which enhanced quick plant growth.

From economic analysis, it was revealed that the highest net return and benefit cost ratio (2.67) were obtained from IPNS with 5 t ha^{-1} cowdung slurry (T_3) due to higher gross return, which was followed by T_1 and T_2 nutrient packages. Lowest BCR obtained from farmer practice treatment.

Table 5. Effect of slurry as organic manure on yield and yield contributing characters of Cabbage during the rabi season of 2008- 09 at MLT site, Atgharia, Pabna.

Treatments	Plant height (cm)	Leaves plant^{-1} (no.)	Whole plant wt. (kg)	Marketable wt. (Kg)	Head length (cm)	Head breadth (cm)	Yield (t ha^{-1})
T_1 = HYG	27.25a	6.47a	3b	2.61ab	25.23ab	14.3a	116.30ab
T_2 = IPNS (CD)	26.22b	6.27a	2.9bc	2.43b	23.9c	13.93a	107.99b
T_3 = IPNS (CDS)	27.85a	6.37a	3.37a	2.85a	25.6a	14.4a	126.96a
T_4 = FP	26.33b	6.23a	2.8c	2.14c	24.7b	13.8a	95.26c
CV (%)	2.05	4.72	5.67	8.91	2.5	6.72	8.91
LSD (0.05)	0.6796	0.361	0.2096	0.2752	0.7646	1.178	11.67

Table 6. Cost and return analysis of cabbage as affected by slurry during the rabi season of 2008-09 at MLT site, Pakshi, Pabna.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1 = HYG	232592	97322	135270	2.39
T_2 = IPNS (CD)	215999	94969	121030	2.27
T_3 = IPNS (CDS)	253935	95002	158933	2.67
T_4 = FP	190518	85329	105189	2.23

Cauliflower

Location: Pabna (Atgharia)

The yield and yield contributing characters were significantly difference among the treatments (Table 7). The highest curd yield was attained in IPNS with 3 t ha^{-1} poultry slurry treatment (T_3) which is statistically different with rest of the treatments. The cumulative effect of weight curd^{-1}, curd length and curd breadth might have significant contribution to attain highest yield. The second highest yield obtained from IPNS with 3 t ha^{-1} PM (T_2). The lowest yield obtained from high yield goal treatment. Farmers practice treatment showed slightly better performance that HYG treatment.

From economic analysis, it was revealed that the highest net return and benefit cost ratio was obtained from IPNS with 3 t ha^{-1} poultry slurry (T_3) due to lower total cost and higher yield, which was followed by T_2 nutrient package (Table 8).

.Table 7. Effect of slurry as organic manure on yield and yield contributing characters of cauliflower during the rabi season of 2008- 09 at MLT site, Atgharia, Pabna.

Treatments	Plant height (cm)	Leaves plant^{-1} (no.)	Whole plant wt. (kg)	Marketable wt. (Kg)	Curd length (cm)	Curd breadth (cm)	Curd yield (t ha^{-1})
T_1 = HYG	54.12c	12.97a	1.83c	1.00c	17.2b	10.97a	44.89c
T_2 = IPNS (PM)	55.32bc	13.1a	1.96bc	1.21a	17.17b	11.03a	50.25b
T_3 = IPNS (PS)	57.67^{a}	13.2a	2.16a	1.28a	19.00a	11.4a	56.74a
T_4 = FP	56.03b	12.8a	2.03ab	1.10b	17.23b	11.1a	49.26bc
CV (%)	2.10	4.43	7.22	7.47	4.65	5.56	7.46
LSD (0.05)	1.44	0.7091	0.1783	0.1030	1.025	0.8984	4.596

Table 8. Cost and return analysis of cauliflower affected by slurry as organic manure during the rabi season of 2008-09 at MLT site, Atgharia, Pabna.

Nutrient managements	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1 = HYG	134666	91288	43378	1.48
T_2 = IPNS (PM)	150777	86789	63988	1.74
T_3 IPNS (PS)	170222	83073	87149	2.05
T_4= Farmer practice (PF)	147777	90329	57448	1.64

Cauliflower

Location: Pabna (Pushpapara FSRD site)

Yield and yield contributing characters were significantly difference among the treatments (Table 9). Higher curd yield was attained in IPNS with 5 t ha^{-1} cowdung slurry (T_3) which is statistically identical with rest of the treatments. The cumulative effect of weight curd^{-1}, curd length and curd breadth might have significant contribution to attain higher yield. The second higher yield obtained from HYG (T_1) treatment. Lower yield obtained from farmers practice plot.

From economic analysis, it was revealed that the highest benefit cost ratio (BCR) was obtained from HYG due to lower variable cost than IPNS treatment though gross return is less, which was followed by T_2 and T_3 nutrient packages. The bioslurry nutrient package gave highest gross return due to its higher yield (Table 10).

Table 9. Effect of cowdung slurry as organic manure on yield and yield contributing characters of Cauliflower during the rabi season of 2008- 09 at the FSRD site, Pabna.

Treatments	Curd length (cm)	Curd breadth (cm)	Curd diameter (cm)	Weight curd^{-1} (kg)	Curd yield (t ha^{-1})
T_1 = HYG	10.80b	19.80ab	58.13b	1.55a	57.03a
T_2 = IPNS (CD)	11.13b	20.06a	58.67ab	1.52ab	55.82a
T_3 =IPNS (CDS)	11.60a	20.33a	59.40a	1.56a	57.77a
T_4 = FP	10.80b	19.20b	58.00b	1.44b	52.92a
CV (%)	10.02	7.88	8.71	9.57	8.08
LSD (0.05)	0.45	0.74	0.83	0.11	5.67

Table 10. Cost and return analysis of Cauliflower as affected by cowdung slurry as organic manure during the rabi season of 2008-09 at the FSRD site, Pabna.

Nutrient managements	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1 = HYG	281150	90753	190397	3.10
T_2 = IPNS (CD)	279100	92766	186334	3.01
T_3 = IPNS (CDS)	286850	96520	190330	2.97
T_4 = FP	266400	89895	176505	2.96

Cucumber

Yield and yield contributing characters of cucumber differed significantly due to different treatments (Table 11). Maximum plant height was observed in high yield goal followed by other treatments. The highest number of fresh and infested fruits plant^{-1} was recorded in integrated plant nutrient systems with 5 t ha^{-1} cowdung slurry followed by high yield goal. The similar trend of response was also observed in weight fruit^{-1} and fruit weight plant^{-1}. The poor performance of all yield contributing characters was recorded in farmers practice. The highest fresh and infested fruit yield was obtained from integrated plant nutrient systems with 5 t ha^{-1} cowdung slurry followed by high yield goal. The lowest fresh and infested fruit yield was attained from farmers practice.

From economic view, the maximum net return and benefit cost ratio was achieved from integrated plant nutrient systems with 5 t ha^{-1} cowdung slurry probably due to higher production. The minimum economic return was recorded in farmers practice (Table 12).

Table 11. Effect of slurry as organic manure on yield and yield contributing characters of cucumber during the rabi season of 2008- 09 at the FSRD site, Pushpapara, Pabna.

Treatments	Plant height (cm)	No. of fruits plant^{-1}		Weight fruit^{-1} (g)		Fruit weight plant^{-1} (kg)		Fruit yield (t ha^{-1})	
		Fresh	Infested	Fresh	Infested	Fresh	Infested	Fresh	Infested
HYG	56.32a	12.10b	0.98ab	193	112	2.33b	0.12ab	31.01b	1.48b
IPNS (CDS)	55.35b	12.93a	1.25a	202	122	2.63a	0.15a	35.05a	2.07a
FP	55.12b	11.53c	0.97b	180	107	2.08c	0.10b	27.76c	1.39b
CV (%)	4.85	8.52	11.23	5.03	7.68	6.49	10.73	7.49	11.23
LSD (0.05)	0.62	0.54	0.28	ns	ns	0.13	0.04	1.81	0.53

Table 12. Cost and return analysis of cucumber as affected by slurry during the rabi season of 2008-09 at the FSRD site, Pushpapara, Pabna.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
HYG	270926	46247	224679	5.86
IPNS CDS)	308264	44436	263828	6.93
FP	242877	53500	189377	4.54

Location: Tangail

Cabbage

Table 13 reveals that the highest individual head weight (2.31 kg) was recorded from the plant treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung-slurry (T_3), which was at par (2.04 kg) with IPNS base fertilizer dose for HYG with 5 t ha^{-1} cowdung (T_2). The lowest individual head weight (1.54 kg) was recorded from the plants of farmers practice. The highest head yield (85.29 t ha^{-1}) was obtained from the plot treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest yield (52.24 t ha^{-1}) was recorded from plants of farmers practice (T_4). Similar trend was also obtained in cost and return analysis (Table 14). The highest gross return (Tk. 469095 ha^{-1}) and net return (Tk. 386114 ha^{-1}) were obtained from plants treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest gross return (Tk. 287320 ha^{-1}) and net return (Tk. 230741 ha^{-1}) was found farmers' practice.

Table 13. Yield of cabbage as influenced by slurry (CD) at the MLT site Modhupur, Tangail during 2008 -09.

Treatments	Head circumference (cm)	Individual head wt. (kg)	Yield (t ha^{-1})
T_1= Soil test based fertilizer dose for high yield goal (HYG)	24.3	2.01	74.46
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	24.8	2.04	75.29
T_3= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	25.7	2.31	85.29
T_4= Farmers practice	21.8	1.54	52.24
LSD (0.05)	1.93	0.35	11.92
CV (%)	5.0	11.2	10.4

Table 14. Cost and return analysis.

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1= Soil test based fertilizer dose for high yield goal (HYG)	409530	76536	332994	5.35
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	414095	82797	330298	5.00
T_3= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	469095	82981	386114	5.65
T_4= Farmers practices	287320	56579	230741	5.08

Price (Tk. kg^{-1}) : Cowdung = 2.00, Cowdung slurry = 2.50, Urea = 12.00, TSP = 80.00, MoP = 53.00, Gypsum = 12.00, Boric acid = 110.00 and Cabbage = 5.50

Cauliflower

Table 15 reveals that the highest individual curd weight. (1.99 kg) was recorded from the plant treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung-slurry (T_3), which was at par with (T_2) IPNS base fertilizer dose for HYG with (5 t ha^{-1}) cowdung (1.75 kg). The lowest individual curd weight (1.22 kg) was recorded from the plants of farmers' practice. The highest curd yield (43.73 t ha^{-1}) was obtained from the plot treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3) and it was at par with the plots treated with fertilizer dose for HYG with 5 t ha^{-1} cowdung (38.50 t ha^{-1}). The lowest yield (26.74 t ha^{-1}) was recorded from plants of farmers' practice (T_4). Similar trend was also obtained in cost and return analysis (Table 16). The highest gross return (Tk. 590355 ha^{-1}) and net return (Tk. 505484 ha^{-1}) were obtained from plants treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest gross return (Tk. 360990 ha^{-1}) and net return (Tk. 291377 ha^{-1}) were found from farmers' practice.

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Table 15. Yield of cauliflower as influenced by slurry (CD) at the MLT site, Modhupur, Tangail during 2008-09.

Treatments	Individual curd wt. with outer leaves (kg)	Individual curd wt. (kg)	Yield (t ha^{-1})
T_1= Soil test based fertilizer dose for high yield goal (HYG)	2.54	1.64	35.89
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	2.48	1.75	38.50
T_3= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	2.75	1.99	43.73
T_4= Farmers' practice	1.79	1.22	26.74
LSD (0.05)	0.27	0.24	5.50
CV (%)	7.6	9.0	9.5

Table 16. Cost and return analysis.

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1 = Soil test based fertilizer dose for high yield goal (HYG)	484515	78426	406089	6.18
T_2 = IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	519750	84521	435229	6.15
T_3 = IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	590355	84873	505484	6.96
T_4 = Farmers' practice	360990	69613	291377	5.19

Price (Tk. kg^{-1}) : Cowdung = 2.00, Cowdung slurry = 2.50, Urea = 12.00, TSP = 80.00, MoP = 53.00, Gypsum = 12.00, Boric acid = 110.00 and Cauliflower = 13.50

Tomato

Table 17 reveals that significantly the highest number of fruits per plant (26), individual fruit weight (56.3g) and fruit yield per plant (1.44 kg) were recorded from the plant treated with (T_2) IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry.

Similar trend was also obtained in cost and return analysis (Table 18). The highest gross return (Tk. 575400 ha^{-1}) and net return (Tk. 363080 ha^{-1}) were obtained from plants treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_2). The lowest gross return (Tk. 416280 ha^{-1}) and gross margin (Tk. 214730 ha^{-1}) was from farmers practice.

Table 17. Effect of cowdung-slurry on the performance of tomato at the FSRD site, Elenga Tangail during 2008-09.

Treatment	Plant height (cm)	No. of fruits $plant^{-1}$	Individual fruit wt (g)	Fruit weight $plant^{-1}$ (kg)	Yield (t ha^{-1})
T_1= Soil test based fertilizer dose for high yield goal (HYG)	93.9	22	51.4	1.18	39.01
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	94.8	26	56.3	1.44	47.95
T_3= Farmers' practice	92.3	21	48.5	1.05	34.69
LSD (0.05)	1.15	1.53	2.66	0.89	2.91
CV (%)	1.0	5.2	4.0	5.7	5.6

Table 18. Cost and return analysis of tomato production at the FSRD site, Elenga, Tangail.

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})
T_1= Soil test based fertilizer dose for high yield goal (HYG)	468132	208325	259807
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	575400	212320	363080
T_3= Farmers' practice	416280	201550	214730

Potato

Table 19 reveals that at FSRD site, Elenga situation, significantly the highest number of tubers per plant (7g) was recorded from the plant treated with (T_2) IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry. The highest tuber weight per plant (242g) was also obtained from the same treatment and lowest weight (206g) was found from farmers' practice. The highest tuber yield (20.17 t ha^{-1}) was obtained from the plot treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest yield (17.96 t ha^{-1}) was recorded from plants of farmers practice (T_3). A similar trend was also obtained in cost and return analysis (Table 20). The highest gross return (Tk. 302550 ha^{-1}) and net return (Tk. 215641 ha^{-1}) were obtained from plants treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_2). The lowest gross return (Tk. 269400 ha^{-1}) and net return (Tk. 187975 ha^{-1}) was from farmers' practice.

Almost similar trend of yield (Table 21) and economic performances (Table 22) are found under Modhupur situation.

Table 19. Yield of potato as influenced by slurry (CD) at the FSRD sites Ellenga, Tangail during 2008 -09.

Treatments	No. of tuber $plant^{-1}$	Wt of tuber $plant^{-1}$	Yield (t ha^{-1})
T_1 = Soil test based fertilizer dose for high yield goal (HYG)	6	222	18.28
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	7	242	20.17
T_3= Farmers' practice	6	206	17.96
LSD (0.05)	0.72	21.54	2.32
CV (%)	8.7	7.5	9.6

Table 20. Cost and return analysis of potato production at the FSRD site Elenga, Tangail

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1= Soil test based fertilizer dose for high yield goal (HYG)	274200	82527	191673	3.32
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	302550	86909	215641	3.48
T_3= Farmers' practice	269400	81425	187975	3.30

Price (Tk. kg^{-1}) : Cowdung = 2.00, Cowdung slurry = 2.50, Urea = 12.00, TSP = 75.00, MoP = 45.00, Gypsum = 9.00, Boric acid = 110.00 and Potato = 15.00

Table 21. Yield of potato as influenced by slurry (CD) at the MLT site Modhupur,Tangail during 2008 -09.

Treatments	No. of tubers $plant^{-1}$	Tuber weight $plant^{-1}$ (g)	Yield (t ha^{-1})
T_1 = Soil test based fertilizer dose for high yield goal (HYG)	6	248	17.33
T_2 = IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	7	286	19.98
T_3 = Farmers' practice	5	196	12.71
LSD (0.05)	0.49	38.75	4.033
CV (%)	5.0	8.8	10.7

Table 22. Cost and return analysis of potato production at the MLT site Modhupur, Tangail

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1= Soil test based fertilizer dose for high yield goal (HYG)	259950	128420	131530	2.02
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	299700	134906	134794	2.22
T_3= Farmers' practice	190650	121218	69432	1.57

Price (Tk kg^{-1}) : Cowdung slurry = 2.50, Urea = 12.00, TSP = 80.00, MoP = 53.00, Gypsum = 12.00, Boric acid = 150.00 Zinc sulphate = 80.00 and Potato = 15.00

Location: Rangpur

Cauliflower (Cowdung slurry)

The yield and yield contributing characters of Cauliflower as affected by different fertilizer treatments are presented in Table 23. The highest curd yield $plant^{-1}$(1075 g) was found in STB fertilizer dose for HYG and the lowest curd yield $plant^{-1}$ (827 g) was obtained from farmer practice. The highest curd yield (39.42 t ha^{-1}) was obtained from cowdung slurry which differed significantly from other treatments. The lowest curd yield (30.42 t ha^{-1}) was obtained from farmers practice. The increase in yield with cowdung slurry was 29 percent higher over farmers practice. The highest net return Tk 240778 ha^{-1} and benefit cost ratio (4.22) was obtained from cowdung slurry (Table 24). From this result, it was evident that cowdung slurry may play a vital role in increasing cauliflower production and economic return of the farmer.

Table 23. Effect of cowdung slurry on yield and yield contributing characters of Cauliflower at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatment	Plant height (cm)	Curd length (cm)	Curd breadth (cm)	Curd diameter (cm)	Curd yield $plant^{-1}$ (g)	Curd yield (t $ha^{-1)}$
T_1=STB fertilizer dose for HYG	57.42	11.07	17.85a	47.83a	1075.0a	34.83b
T_2=IPNS (5 t ha^{-1} CD slurry) fert. dose for HYG	58.46	11.88	18.85a	48.15a	1050.0b	39.42a
T_3=Farmers practice	58.09	11.81	17.10b	45.56b	827.5c	30.42c
CV (%)	4.35	8.46	9.45	1.77	6.50	6.49

Table 24. Effect of poultry bio-slurry on the yield and economics of cauliflower at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during 2008-09

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	34.83	278640	75891	202749	3.67
T_2	39.42	315360	74582	240778	4.22
T_3	30.42	243360	59530	18380	4.08

T_1=STB inorganic fert. Dose for HYG, T_2=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG, T_3=Farmers practice

Cauliflower (Poultry slurry)

The yield and yield contributing characters of Cauliflower as affected by different fertilizer treatments are presented in Table 25. The highest curd yield plant^{-1} (911 g) was recorded from poultry bio-slurry. The lowest yield plant^{-1} (793 g) was obtained from farmers practice. The highest curd yield was obtained from poultry slurry in (33.41 t ha^{-1}) which was identical to T_1(STB fertilizer dose for HYG). The lowest yield (29.10 t h^{-1}) was obtained from farmers practice. The highest net return Tk.202384 ha^{-1} and benefit cost ratio 4.11 was obtained from poultry slurry (Table 26). The result indicated that combination of organic and inorganic fertilizer particularly poultry slurry with inorganic fertilizer may play a great role in increasing the yield and economic return of the farmers. This treatment (T_2) may be one of the best alternatives to the farmer.

Table 25. Effect of poultry slurry on the yield and yield contributing characters of Cauliflower at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatment	Plant height (cm)	Curd length (cm)	Curd breadth (cm)	Curd diameter (cm)	Curd yield plant^{-1} (g)	Curd yield (t ha$^{-1)}$
T_1	55.38	11.20b	17.85a	46.60b	855.0ab	31.35ab
T_2	55.25	12.25a	18.50a	47.60a	911.3a	33.41a
T_3	53.75	10.55b	16.58b	45.50c	793.8b	29.10b
CV (%)	2.78	4.56	4.65	1.16	4.95	4.94

T_1=STB inorganic fert. Dose for HYG, T_2=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG, T_3=Farmers practice

Table 26. Effect of poultry slurry on the yield and economics of cauliflower at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during 2008-09

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	31.35	250800	72036	178764	3.48
T_2	33.41	267280	64896	202384	4.11
T_3	29.10	232800	60935	171865	3.82

T_1=STB inorganic fert. Dose for HYG, T_2=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG, T_3=Farmers practice

Tomato (Cowdung slurry)

The yield and yield contributing characters of tomato as affected by different fertilizer treatments are presented in Table 27 & 28. The highest fruit yield was obtained from cowdung slurry in both the years (104.67 t ha^{-1} in 2007-08 and 69.11 t ha^{-1} in 2008-09). The lowest yield was obtained from native fertility in 2007-08 (52.95 t ha^{-1}) and from farmers practice in 2008-09(52.11 t ha^{-1}). The highest net return (Tk 340580 in 2008-09) and benefit cost ratio (5.59) was obtained from cowdung slurry. From two years result, it was evident that cowdung slurry has a great potentiality in increasing tomato production and economic return of the farmer.

Table 27. Effect of cowdung slurry on the yield and yield contributing characters of tomato at FSRD site Lahirirhat Rangpur during 2007- 08

Treatment	No. of fruits plant^{-1}	Wt. of fruits plant^{-1} (kg)	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	38.4c	2.88c	85.89c
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	43.7b	2.91b	96.83b
T_3=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG	48.8a	3.14a	104.67a
T_4=Farmers practice	37.9c	2.43c	80.88c
T_5=Native fertility	26.8d	1.59d	52.95d
CV (%)	6.2	6.1	6.1

Table 28. Effect of cowdung slurry on the yield and yield contributing characters of tomato at FSRD site Lahirirhat Rangpur during 2008-09

Treatment	No. of plants m^{-2}	No. of fruit plant^{-1}	Yield plant^{-1} (kg)	Wt. of individual fruit (g)	Yield (t ha^{-1})
T_1	3.70	32.33	2.77b	68.33b	62.67b
T_2	4.11	32.67	2.43bc	64.00bc	59.00c
T_3	3.82	36.33	3.34a	77.67a	69.11a
T_4	4.17	31.67	2.15c	58.33c	52.11d
CV (%)	7.54	7.02	6.46	4.47	3.81

Table 29. Effect of cowdung slurry on the yield and economics of tomato at FSRD site Lahirirhat Rangpur during 2008-09

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	62.67	376020	80079	295941	4.69
T_2	59.00	354000	83956	270044	4.21
T_3	69.11	414660	74080	340580	5.59
T_4	52.11	31260	67581	245079	4.62

T_1= Soil test based fertilizer dose for high yield goal, T_2= Cowdung 5 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG, T_3= CD bio slurry 5 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG, T_4= Farmers practice

Tomato (Poultry slurry)

The yield and yield contributing characters of tomato as affected by different fertilizer treatments are presented in Table 30 & 31. The highest yield plant^{-1} was recorded from poultry slurry in both the years. The lowest yield plant^{-1} was obtained from native fertility in 2007-09 and from farmers practice in 2008-09. The highest yield was obtained from poultry slurry in both the years (105.0 t ha^{-1} in 2007-08 and 82.22 t ha^{-1} in 2008-09). The lowest yield was obtained from native fertility in 2007-08 and from farmers practice in 2008-09. The highest net return (Tk.417304 ha^{-1}) in 2008-09 and benefit cost ratio (6.69) was obtained from poultry slurry. From two years result, it was evident that poultry slurry has a great potentiality in increasing tomato production and economic return of the farmer.

Table 30. Effect of slurry (poultry) on the yield and yield contributing characters of tomato at FSRD site Lahirirhat Rangpur during 2007- 08

Treatment	No. of fruits plant^{-1}	Wt. of fruits plant^{-1} (g)	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	23.5b	2.53b	78.3b
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	31.9a	3.08a	102.5a
T_3=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG	31.4a	3.15a	105.0a
T_4=Farmers practice	21.4b	2.35b	67.2b
T_5=Native fertility	12.5c	1.23c	36.2c
CV (%)	13.8	5.6	11.3

Table 31. Effect of slurry (poultry) on yield and yield contributing characters of tomato at the FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatment	No. of fruits plant^{-1}	Yield plant^{-1} (g)	Wt. of individual fruits plant^{-1}	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	33.36b	3.01b	73.67ab	64.33b
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	31.32b	2.47c	66.67bc	63.67b
T_3=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG	41.33a	3.84a	81.00a	80.22a
T_4=Farmers practice	32.67b	2.28c	64.33c	55.56c
CV (%)	4.82	6.78	5.82	3.93

Table 32. Effect of poultry slurry on yield and yield economics of tomato at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during 2008-09

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	64.33	385980	80679	305301	4.78
T_2	63.67	382020	81946	300074	4.66
T_3	80.22	481320	71874	417304	6.69
T_4	55.56	333360	67581	265779	4.93

Potato

The yield and yield contributing characters of potato as affected by different fertilizer treatments are presented in Table 33, 34 & 35. In Lahirirhat FSRD site, the highest tuber yield was obtained from IPNS (5 t ha^{-1} cowdung slurry for HYG in both the years (29.10 t ha^{-1} in 2007-08 and 25.61 t ha^{-1} in 2008-09). The yield difference between IPNS (5 t ha^{-1} cowdung slurry for HYG) and farmers practice in 2007-08 and between IPNS (5 t ha^{-1} cowdung slurry for HYG) and IPNS (5 t ha^{-1} cowdung manure for HYG in 2008-09 was identical. The lowest yield was obtained from native fertility in 2007-08 and from farmers practice in 2008-09. In Domar MLT site, the highest tuber yield was also obtained from cowdung slurry (27.51 t ha^{-1}), which differed significantly from other treatments. The lowest yield (18.57 t ha^{-1}) was obtained from farmers practice. In FSRD site, the highest mean net return (Tk.167173 ha^{-1}) and benefit cost ratio (2.41) was obtained from cowdung slurry. Similarly, the highest net return (Tk.158515 ha^{-1}) and benefit cost ratio (2.35) was also obtained from cowdung slurry at Domar MLT site. From two years result, it was evident that cowdung slurry has a great potentiality in increasing tuber production and economic return of the farmer.

Economic performance

The cost and return analysis of different fertilizer treatments are presented in Table 36 & 37. In FSRD site, two years mean gross return (Tk.285715 ha^{-1}), net (Tk.167173 ha^{-1}) and benefit cost ratio (2.41) was highest from cowdung slurry which was followed by cowdung manure. Similarly, in MLT site, the gross return (Tk.275100 ha^{-1}), net return (Tk.158515 ha^{-1}) and benefit cost ratio (2.35) was also highest from cowdung slurry. The lower gross return, net return and benefit cost ratio was obtained from native fertility and farmers practice in FSRD and MLT site, respectively.

Table 33. Effect of slurry (cowdung) on the yield of potato at FSRD site Laharirhat, Rangpur during 2007- 08

Treatment	No. of tubers plant^{-1}	Wt. of tubers plant^{-1} (g)	Tuber yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	7.13a	478a	25.74b
T_2=IPNS (5 t ha^{-1} cowdung manure) fert. dose for HYG	7.10a	484a	26.64b
T_3=IPNS (5 t ha^{-1} cowdung bio-slurry) fert. dose for HYG	7.05a	498a	29.10a
T_4=Farmers practice	7.06a	480a	28.89a
T_5=Native fertility	5.67b	247b	15.32c
CV (%)	13.7	9.0	6.1

Table 34. Effect of slurry (cowdung) on yield and yield contributing characters of potato at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatments	Plant height (cm)	No. of stems hill^{-1}	No. of tubers hill^{-1}	Wt. of tubers hill^{-1} (g)	Yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	54.37bc	2.06b	7.00bc	327.5b	21.08b
T_2=IPNS (5 t ha^{-1} CD manure) fert. dose for HYG	57.53b	2.16ab	7.66b	348.3ab	23.42a
T_3=IPNS (5 t ha^{-1} CD bio-slurry) fert. dose for HYG	60.97a	2.30a	8.83a	373.3a	25.61a
T_4=Farmers practice	51.43c	2.00b	6.33c	317.5b	18.83c
CV (%)	4.90	7.59	7.58	7.71	8.24

Table 35. Effect of slurry (cowdung) on yield and yield contributing characters of potato at Domar MLT site, OFRD, ARS, Rangpur during rabi 2008-09

Treatments	Plant height (cm)	No. of stems hill^{-1}	No. of tubers hill^{-1}	Wt. of tubers hill^{-1} (g)	Yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	59.22a	2.13ab	7.70b	391.5a	24.27b
T_2=IPNS (5 t ha^{-1} CD bio-slurry) fert. dose for HYG	60.35a	2.28a	8.10a	399.8a	27.51a
T_3=Farmers practice	58.68a	1.96b	7.16c	307.0b	18.57c
CV (%)	6.48	6.63	3.72	4.26	8.04

Table 36. Cost and return analysis of potato as influenced by cowdung slurry at FSRD site, Lahirirhat, Rangpur during 2007-08 and 2008-09

Treat-ment	Yield (t ha^{-1})		Gross return (Tk. ha^{-1})		Total cost (Tk. ha^{-1})		Net return (Tk. ha^{-1})		Mean gross return (Tk. ha^{-1})	Mean total cost (Tk. ha^{-1})	Mean net return (Tk. ha^{-1})	BCR
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09				
T_1	25.70	21.08	268830	210800	93916	132507	174914	78293	239815	133211	106604	1.80
T_2	26.64	23.42	282160	234200	102108	134615	180062	99585	258180	118361	139819	2.18
T_3	29.10	25.61	315330	256100	103006	134078	212324	122022	285715	118542	167173	2.41
T_4	28.89	18.83	317000	188300	112290	130109	204710	58191	252650	121199	131451	2.08
T_5	15.32	-	162160	-	78940	-	83220	-	83220	78940	4280	1.05

Price (Tk. kg^{-1}):
2007-08: Potato= 9, Urea= 5.90, TSP=15.60, MoP=22.88, Gypsum=6, Zincsulphate=120, Boric acid=160, Labour= 112/day,
2008-09: Potato= 10, Urea= 11.80, TSP=74.36, MP=55, Zinc sulphate=140, Boric acid=180, Gypsum=7, Cowdung manure=1.00, Cowdung bio-slurry=1.50, Labour= 112/day,

Table 37. Cost and return analysis of potato influenced by cowdung slurry at MLT site Domar, OFRD, Rangpur during 2008-09.

Treatment	Tuber yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	24.27	242700	116650	126050	2.08
T_2	27.51	275100	116585	158515	2.35
T_3	18.57	185700	111020	74680	1.67

Price (Tk. kg^{-1}): Potato= 10, Urea= 11.80, TSP=74.36, MP=55, Zinc sulphate=140, Boric acid=180, Labour= 112/day, Gypsum=7, Cowdung manure=1.00, Cowdung bio-slurry=1.50

Potato (PM slurry)

The yield and yield contributing characters of potato as affected by different fertilizer treatments are presented in Table 38, 39 & 40. In Lahirirhat FSRD site, the highest tuber yield was obtained from IPNS (3 t ha^{-1} poultry slurry) for HYG in both the years (19.36 t ha^{-1} in 2007-08 and 26.72 t ha^{-1} in 2008-09).). In FSRD site, the tuber yield obtained from IPNS (3 t ha^{-1} poultry slurry) for HYG differed significantly from other fertilizer treatments in 2007-09 while in 2008-09 it was identical to from IPNS (3 t ha^{-1} poultry manure) for HYG. The lowest yield was obtained from native fertility in

2007-08 and from farmers practice in 2008-09. In Domar MLT site, the highest tuber yield was also obtained from poultry slurry (26.77 t ha^{-1}), which differed significantly from other treatments. The lowest yield (19.34 t ha^{-1}) was obtained from farmers practice.

Economic performance

The cost and return analysis of different fertilizer treatments are presented in Table 41 & 42. In FSRD site, the highest mean gross return (Tk.231600 ha^{-1}), net return (Tk.113919 ha^{-1}) and benefit cost ratio (1.97) was obtained from poultry slurry. Similarly, in MLT site, the highest gross return (Tk.267700 ha^{-1}), net return (Tk.148364 ha^{-1}) and benefit cost ratio (2.24) was also obtained from poultry bio-slurry. The lower gross return, net return and benefit cost ratio was obtained from native fertility and farmers practice in FSRD and MLT site, respectively.

Table 38. Effect of slurry (poultry) on the yield of potato at FSRD site Lahirirhat Rangpur during 2007- 08

Treatment	No. of tubers plant^{-1}	Wt. of tubers plant^{-1} (g)	Tuber yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	7.87a	295a	14.13b
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	7.83a	318a	15.39b
T_3=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG	7.67a	370a	19.36a
T_4=Farmers practice	7.03ab	323a	15.88b
T_5=Native fertility	6.43b	177b	7.97c
CV (%)	8.0	5.2	6.4

Table 39. Effect of slurry (Poultry) on yield and yield contributing characters of potato at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatments	Plant height (cm)	No. of stems hill^{-1}	No. of tubers hill^{-1}	Wt. of tubers hill^{-1} (g)	Yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	54.97c	2.10c	7.88b	336.1c	22.47b
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	57.80b	2.20b	8.33b	373.3b	25.27a
T_3=IPNS (3 t ha^{-1} poultry bio-slurry) fert. dose for HYG	61.69a	2.33a	9.22a	402.2a	26.72a
T_4=Farmers practice	52.61d	2.01d	7.11c	294.4d	19.50c
CV (%)	4.08	3.64	5.76	6.66	6.57

Table 40. Effect of slurry (poultry) on yield and yield contributing characters of potato at Domar MLT site, OFRD, ARS, Rangpur during rabi 2008-09

Treatments	Plant height (cm)	No. of stems hill^{-1}	No. of tubers hill^{-1}	Wt. of tubers hill^{-1} (g)	Yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	59.20a	2.03ab	7.65ab	389.3a	24.63b
T_2=IPNS (3 t ha^{-1} Poultry bio-slurry) fert. dose for HYG	61.70a	2.20a	7.98a	401.5a	26.77a
T_3=Farmers practice	59.08a	1.86b	7.23b	311.2b	19.34c
CV (%)	6.23	6.47	5.55	4.99	5.65

Table 41. Cost and return analysis of potato as influenced by poultry slurry at FSRD, Lahirirhat, Rangpur during 2007-08 and 2008-09.

Treatment	Yield ($t\ ha^{-1}$)		Gross return ($Tk.\ ha^{-1}$)		Total cost ($Tk.\ ha^{-1}$)		Net return ($Tk.\ ha^{-1}$)		Mean gross return ($Tk.\ ha^{-1}$)	Mean total cost ($Tk.\ ha^{-1}$)	Mean net return ($Tk.\ ha^{-1}$)	BCR
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09				
T_1	14.13	22.47	141000	224700	89589	132507	51411	92193	182850	111048	71802	1.65
T_2	15.39	25.27	153900	252700	97407	134111	56493	118589	203300	115759	87541	1.76
T_3	19.36	26.72	196000	267200	99785	135578	96215	131622	231600	117681	113919	1.97
T_4	15.88	19.50	158800	195000	107482	130109	51318	64891	176900	118795	58105	1.49
T_5	7.97	-	79700	-	72495	-	7205	-	79700	72495	7205	1.10

Potato (2007-08) = Tk 9/kg, Urea= 5.90/kg, TSP=15.60/kg, MP=22.88/kg, Zinc sulphate =120/kg, Boric acid=160/kg, Lab= 112/day, Gypsum=6/kg
Potato (2008-09) = Tk 10/kg, Urea= 11.80/kg, TSP=74.36/kg, MP=55/kg, Zinc sulphate =140/kg, Boric acid=180/kg, Lab= 112/day, Gypsum=7/kg, Poultry manure=1.50/kg, Poultry bio-slurry=3.00/kg

Table 42. Cost and return analysis of potato as influenced by poultry slurry at MLT site, Domar, OFRD, Rangpur during rabi season 2008-09

Treatment	Tuber yield ($t\ ha^{-1}$)	Gross return ($Tk.\ ha^{-1}$)	Total cost ($Tk.\ ha^{-1}$)	Net return ($Tk.\ ha^{-1}$)	BCR
T_1	24.63	246300	116650	129650	2.11
T_2	26.77	267700	119336	148364	2.24
T_3	19.34	193400	111020	82380	1.74

Potato (2008-09) = Tk 10/kg, Urea= 11.80/kg, TSP=74.36/kg, MP=55/kg, Zinc sulphate =140/kg, Boric acid=180/kg, Lab= 112/day, Gypsum=7/kg, Poultry manure=1.50/kg, Poultry bio-slurry=3.00/kg

Location: Bogra

Potato

The yield and yield contributing characters were significantly varied among the treatments except plant height (Table 43). The maximum no of haulms plant^{-1} (6.6), no and wt of tuber plant^{-1} (7.6 and 340g) was obtained from the treatment T_3 (IPNS fertilizer with cowdung slurry for HYG) followed by T_2 (IPNS Fertilizer with CD for HYG). The highest tuber yield (28.21 t ha^{-1}) was obtained from treatment T_3 (IPNS fertilizer with cowdung slurry for HYG) which was significantly different from other treatments. The treatment T_2 (IPNS Fertilizer with CD for HYG) offered the 2nd highest yield and it was statistically similar to treatment T_1 (STB for HYG) and T_4 (Farmer's practices). Higher gross return, net return and BCR was recorded from the treatment T_3 followed by T_2 and the lowest was in T_4 (Table 44).

Table 43. Yield and Yield attributes of potato as affected by cowdung slurry along with inorganic fertilizers

Treatments/Inorganic+ Organic fertilizers (Urea-TSP-MoP-Gyp.-$ZnSO_4$-Boricacid-CD-CD slurry kg ha^{-1}).	Plant height (cm)	No. of haulms plant^{-1}	No. of tubers plant^{-1}	Tuber weight plant^{-1} (g)	Tuber yield (t ha^{-1})
T_1 = STB for HYG (327-^{1}11- 288- 85 – 7.5-6 - 0 - 0)	54.47 a	5.4 b	5.3 c	308 ab	23.79 b
T_2 = IPNS Fert. with CD for HYG (264 – 6 – 189 – 35 – 7.5-6-5000 – 0)	56.63 a	6.2 ab	7.0ab	335 a	25.00 b
T_3 = IPNS Fert. with CD slurry for HYG (249 – 0 – 180 – 21 – 7.5-6- 0 – 5000)	57.87 a	6.6 a	7.6a	340 a	28.21 a
T_4 = Farmer's practices (333 – 333 – 210– 0– 0-0-5000 – 0)	55.93 a	5.4 b	6.0 bc	279 b	22.77 b
CV %	4.78	9.44	11.44	6.22	5.54

Note : STB- Soil test based ; HYG – High yield goal; IPNS- Integrated plant nutrient system; CD- Cowdung ; CD slurry – Cowdung slurry and U- Urea .

Table 44. Agro-economic performance of potato as influenced by slurry during rabi season of 2007-08 at the MLT site, Joypurhat, Bogra

Treatments/Inorganic+ Organic fertilizers(Urea-TSP-MoP-Gyp.-$ZnSO_4$-Boric acid-CD-CD slurry kg ha^{-1}).	Product yield (kg ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1 = STB for HYG (327^{-1}11- 288- 85 – 7.5-6 - 0 – 0)	23.79	237900	92570	145330	2.56
T_2 = IPNS Fert. with CD for HYG (264 – 6 – 189 – 35 – 7.5-6-5000 – 0)	25.00	250000	86537	163463	2.89
T_3 = IPNS Fert. with CD slurry for HYG (249 – 0 – 180 – 21 – 7.5-6- 0 – 5000)	28.21	282100	86470	195630	3.26
T_4 = Farmer's practices (333 – 333 – 210– 0– 0-0-5000 – 0)	22.77	222700	95012	127688	2.34

[Market price of potato Tk 10/kg.

Location: Shyampur, Rajshahi

Potato

Effect of different fertilizer management packages on yield and yield attributes are presented in Table 45. The result revealed that the highest plant height was found in T_2 (49.95 cm) which was statistical identical in treatment T_1 (47.25 cm) followed by treatment T_3 (41.36 cm). The highest tuber yield was found in bio-slurry reach treatment T_2 (25.82 t ha^{-1}) followed by recommended package T_1 (22.68 t ha^{-1}) and lowest yield was found in farmers the treatment T_3 (20.96 t ha^{-1}). It was found that application of bio-slurry in potato increased yield. Manna and Hazra (1996) also observed the same result in maize. Stem $hill^{-1}$, No. of potato $plant^{-1}$ wt. of potato $plant^{-1}$ also performed better in T_2 among the treatments.

Table 45. Effect of slurry on yield and yield attributes of potato at Puba MLT site, Rajshahi during 2008-09.

Treatment	Plant height (cm)	No. of stem $hill^{-1}$	No. of potato $plant^{-1}$	Weight $plant^{-1}$ (g)	Yield (t ha^{-1})
T_1	47.25 a	2.53 a	6.95 a	205.5 b	22.68 b
T_2	49.95 a	2.65 a	7.21 a	240.8 a	25.82 a
T_3	41.36 b	2.3 b	5.54 b	195.8 b	20.96 c
CV (%)	6.70	7.03	13.12	9.61	5.37
LSD (0.05)	3.979	3.979	1.109	26.38	1.601

Table 46. Cost and return analysis of slurry on yield at potato production at Paba MLT site, Rajshahi during 2008-09.

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1	22.68	272160	105470	166690	2.58
T_2	25.82	309840	98170	211670	3.16
T_3	20.96	251520	100157	151363	2.51

NB: Price of potato @ 12 Tk/kg, potato seed @ 30 Tk/kg, Urea 12 Tk/kg, TSP @ 40 Tk/kg, MOP @ 35 Tk/kg Gypsum @ 5 Tk/kg, Boric Acid @ 120 Tk/kg and Bio-slurry @ 0.5 Tk/kg.

From the economic analysis in Table 46 it was evident that the highest net return (Tk. 211670 ha^{-1}) was obtained form bio-slurry applied field (T_2) followed by recommended package T_1 (Tk. 166690 ha^{-1}). Farmers package produced the lowest net return (Tk. 151363 ha^{-1}). Considering, BCR it was found that bio-slurry treated plot was height (3.16) followed by T_1 (2.58) treatment and lowest BCR was found T_3 (2.51) treatment.

Location: Comilla

Potato

Yield and yield attributes of potato are shown in Table 47. There were significant differences in tuber number per plant, tuber weight per plant and yield, but there were no significant difference in plant population, plant height and shoot plant^{-1}. Highest tuber number plant^{-1} (10.43) was found in farmers practice (T_4) and lowest (8.66) was in chemical fertilizer for high yield goal (T_1) treatment which was at per with IPNS basis fertilizer + cowdung (5 t ha^{-1}) and IPNS basis fertilizer + cowdung slurry (5 t ha^{-1}) treatments.

Highest tuber weight was found in T_4 (farmers practice), which was followed by T_3 (IPNS basis fertilizer + 5 t ha^{-1} cowdung slurry). Lowest tuber weight was found in T_1 (Chamical fertilizer for high yield goal) followed by T_2 (IPNS basis fertilizer + 5 t ha^{-1} cowdung). Highest yield was found in T_3 (IPNS basis fertilizer + 5t ha^{-1} CD slurry) which was at per with T_1 (chemical fertilizer for high yield goal) and T_4 (farmers practice). Lowest yield was found in T_2 (IPNS basis fertilizer + 5 t ha^{-1} cowdung).

Table 47. Yield and yield attributes of potato with/without slurry on Potato production during Rabi 2008-09 at Nuritala, Chandina, Comilla

Treatment	No. of plants m^{-2}	Plant height (cm)	No. of shoots plant^{-1}	No. of tuber plant^{-1}	Tuber wt. plant^{-1} (g)	Yield (t ha^{-1})
Chemical fertilizer (T_1)	6.58	92.3	3.75	8.66 b	476.8 b	22.67 a
IPNS basis fertilizer + Cowdung (5 t ha^{-1}) (T_2)	6.55	93.0	4.2	9.31 b	492.1 b	21.99 b
IPNS basis fertilizer + Cowdung slurry (5 t ha^{-1}) (T_3)	6.54	91.8	4.02	8.74 b	501.8 ab	22.88 a
Farmers practice (T_4)	6.52	93.8	3.91	10.43 a	525.2 a	22.59 a
LSD (0.05)	NS	NS	NS	1.81	53.53	0.89
CV (%)	2.63	7.7	24.0	11.3	6.2	2.32

T_1=Chemical fertilizer) , T_2 = IPNS basis fertilizer + Cowdung (5 t ha^{-1}), T_3 = IPNS basis fertilizer + Cowdung slurry (5 t ha^{-1}) , T_4= Farmers practice

Location: Shibpur, Narshingdi

Brinjal

The highest plant height was recorded in T_3 treatment (152.94cm) followed by T_2 treatment (140.24cm) and the lowest in T_5 treatment (120.04cm). No. of branches plant^{-1}, No of fruits plant^{-1}, weight of individual fruits(g) and weight of fruits plant^{-1} (kg) were also found to be the highest in T_3 treatments followed by T_2. Maximum fruit yield (t ha^{-1}) was recorded in T_3 treatment (108.87 t ha^{-1}) followed by T_2 treatment (84.87 t ha^{-1}) which was influenced by yield contributing characters such as higher no. of fruits plant^{-1} and individual fruit weight. The lowest yield was recorded in T_5 treatment (29.53 t ha^{-1}). From economic analysis, it was revealed that the highest BCR was obtained in T_3 treatment IPNS based fertilizer dose for HYG with 5 t ha^{-1} cowdung which was followed by T_1 & T_2 treatments (Table 48 & 49).

Table 48. Yield and yield attributes of brinjal as influenced by different treatment at the MLT site, Shibpur, Narsingdi during 2008-09

Treatment	Plant height (cm)	No. of branches plant^{-1}	No. of fruits plant^{-1}	Weight of individual fruits(g)	Wt. of fruits plant^{-1} (kg)	Fruit yield (t ha^{-1})
T_1 STB for HYG	129.54	4.13	46.67	66.80	3.15	7.20
T_2 IPNS with cowdung	140.24	5.60	58.93	78.47	4.64	84.87
T_3 IPNS with cowdung slurry	152.94	6.60	66.53	91.40	6.04	108.87
T_4 Farmers practice	124.81	4.20	42.80	62.13	2.74	49.89
T_5 Native fertility	120.04	3.27	32.27	49.73	1.65	29.53
LSD(0.05)	7.581	0.655	7.076	5.34	0.613	13.31

Table 49. Cost and return analysis of Brinjal

Treatment	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BC R
T_1 : STB inorganic fertilizers for HYG	4,57,600	1,52,694	3,04,906	2.99
T_2 : IPNS with 5 t ha^{-1} cowdung	6,78,960	1,55,832	5,23,128	4.35
T_3 : IPNS with cowdung slurry	8,70,960	1,49,850	7,21,110	5.80
T_4 : Farmers practice	3,99,120	1,49,273	2,49,847	2.67
T_5 : Native fertility	2,36,240	1,37,700	98,540	1.7

Price (Tk/kg): Urea= 6.5/-, TSP= 30.00, MoP= 30, Sulpher= 5.00, Zn-sulpher= 120.00, B= 110/-, CD= 1.00, CDS=1.00

Farmers' reaction

Gazipur : Farmers showed their positive attitude towards the bio-slurry as organic manure. They are interested to biogas plant but the initial cost is high.

Narshingdi : Farmers were highly pleased with the higher yield and positive effect of bioslurry.

Tangail : Farmers showed keen interest regarding the use of bio-slurry as organic manure. But they opined that biogas plants are not easy available due to its higher cost involvement in establishment.

Rangpur : Farmers were very much impressed by getting higher yield and economic return from bio-slurry but they expressed their concern regarding its non-availability in the locality and carrying hazard.

Pabna : Cowdung slurry and Poultry slurry showed better performance over chemical fertilizer, so, if it would be available they like to use it. They also opine that management of slurry is slightly problematic.

Rajshahi : Farmers are very much impressed to have satisfactory potato yield (25.82 t ha-1) and income (211670 Tk ha-1) in bio slurry applied field (T_2). They also observed that plant greenness duration and tillering was maximum in T_2. If quality bio slurry is available in locality they will use it extensively in crop fields for reducing inorganic fertilizer cost and increase yield and income.

Bogra : Farmers were very much impressed to have satisfactory higher tuber yield, from cowdung slurry and no cost of TSP fertilizer. Most of the farmers choose cowdung slurry. They opined that in future they will use cowdung slurry for optimizing potato production.

Conclusion

A positive response of different vegetable crops to bioslurry was found at all the locations tested. Higher yield and economic return was obtained from IPNS with bioslurry treatment. Fertilizer crisis is a burning issue across the country. Use of bio-slurry can play a vital role to minimize the fertilizer crisis. Moreover, as organic manure bio-slurry will help to improve soil fertility in the long run. Mostly the results were first year trial. Therefore, the trial should be repeated in the next year for further verification.

Appendix Table 1. Detailed ferilizer dose for different vegetable crops at different location

Table 1 (a). Fertilizer dose (kg ha^{-1}) for Cabbage and Cauliflower at Gazipur

Treatment	N-P-K-S-B + PM or PS	
	Cabbage	Cauliflower
T_1 : STB for HYG	216-40-45-20-0.5+0	170-40-45-20-0.5
T_2 : IPNS with 3 t ha^{-1} PM	190-30-10-20-0.5 +3000 PM	120-15-20--20-0.5 + 3000 PM
T_3 : IPNS with 3 t ha^{-1} PM	186-21-4-20-0.5 + 3000 PS	140-21-14-20-0.5 + 3000 PS
T_4: FP	98-62-47-19-0 + 8000 CD	98-62-47-19-0 + 8000 CD

PM : Poultry manure, PS : Poultry slurry, FP: Farmers practice

Table 1 (b). Fertilizer dose (kg ha^{-1}) for Cabbage and Cauliflower at Pabna

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS	
	Cabbage	Cauliflower
T_1 : STB for HYG	216-40-45-20-4-0.5+0	138-56-116-18-3-0.5 116-45-75-17-1.8-0.6
T_2 : IPNS with 5 t ha^{-1} CD	190-30-10-20-0.5 +5000 CD	108-37-95-18-3-0.4 + 3000 PM 101-40-60-17-1.8-0.6 + 5000 CD
T_3 : IPNS with 5 t ha^{-1} CD	186-21-4-20-0.5 + 5000 CS	103-25-95-18-3-0.4 +3000 PS 93-37-50-17-1.8-0.6 + 5000 CDS
T_4: FP	152-41-58-21-1.5-2.0 + 8000 CD	98-62-47-19-0 + 8000 CD

PM : CD : Cowdung, CDS : Cowdung slurry, Poultry manure, PS : Poultry slurry, FP: Farmers practice

Table 1 (c). Fertilizer dose (kg ha^{-1}) for Tomato and Cucumber at Pabna

Treatment	N-P-K-S-B + PM or PS	
	Tomato	Cucumber
T_1 : STB for HYG	98-40-25-9-1.45-0.3	47-25-29-22-0-0
T_2 : IPNS with 5 t ha^{-1} CD	83-35-10-9-1.45-0.3 +5000 CD	-
T_3 : IPNS with 5 t ha^{-1} CD	75-32-0-9-1.45-0.3 + 5000 CDS	24-17-4-22-0-0 + 5000 CDS
T_4: FP	53-20-33-26	73-24-45-21-0-0.6 + 5000 CD

CD : Cowdung, CDS : Cowdung slurry, FP: Farmers practice

Table 1 (d). Fertilizer dose (kg ha^{-1}) for Tomato and Cauliflower at Rangpur

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS	
	Tomato	Cauliflower
T_1 : STB for HYG	150-40-140-30-4-1	138-40-125-25-4-0.5
T_2 : IPNS with 5 t ha^{-1} CD	144-38-138-30-4-1+5000 CD 144-38-138-30-4-1+3000 PM	-
T_3 : IPNS with 5 t ha^{-1} CD	137-33-115-30-4-1 + 5000 CDS 137-33-115-30-4-1 + 3000 PS	115-32-100-25-4-0.4 +5000 CDS 104-0-104-25-4-0.4 + 3000 PS
T_4: FP	101-34-62-9-0 + 2000 CD	106-25-60-0-0 + 4000 CD
T_5 : Native fertility	0-0-0-0	0-0-0-0

PM : CD : Cowdung, CDS : Cowdung slurry, Poultry manure, PS : Poultry slurry, FP: Farmers practice

Table 1 (e). Fertilizer dose (kg ha^{-1}) for Potato at Rangpur

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS	
	Potato	
	FSRD Site	MLT site
T_1 : STB for HYG	135-25-140-17-15-3-1.5	135-10-85-13-4-1
T_2 : IPNS with 5 t ha^{-1} CD	129-20-132-17-15-3-1.5 + 5000 CD 129-20-132-17-15-3-1.5 + 3000 PM	-
T_3 : IPNS with 5 t ha^{-1} CD	112.5-18-115-17-15-3-1.5 + 5000 CDS 112.5-18-115-17-15-3-1.5 + 3000 PS	112-2-60-13-4-1 + 5000 CDS
T_4: FP	110-25-160-20-0-4-1	124-7.5-69-12-0
T_5 : Native fertility	0-0-0-0-0	0-0-0-0-0

PM : CD : Cowdung, CDS : Cowdung slurry, Poultry manure, PS : Poultry slurry, FP: Farmers practice

Table 1 (f). Fertilizer dose (kg ha^{-1}) for Cabbage and Cauliflower at Tangail

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS	
	Cabbage	Cauliflower
T_1 : STB for HYG	138-40-100-14-1	125-35-111-10-1
T_2 : IPNS with 5 t ha^{-1} CD	126-35-85-14-1 +5000 CD	112-30-39-10-1 +5000 CD
T_3 : IPNS with 5 t ha^{-1} CD	117-33-75-14-1 + 5000 CS	104-27-88-10-1 +5000 CDS
T_4: FP	57-17-31-5	114-33-42-15

CD : Cowdung, CDS : Cowdung slurry, FP: Farmers practice

Table 1 (g). Fertilizer dose (kg ha^{-1}) for Potato at Tangail

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS	
	Potato	
	Elenga	Modhupur
T_1 : STB for HYG	108-27-118-20-4-1.5	107-27-116-20-4-1.5
T_2 : IPNS with 5 t ha^{-1} CD	-	-
T_3 : IPNS with 5 t ha^{-1} CD	85-20-93-20-4-1.5 + 5000 CDS	85-20-91-20-4-1.5 + 5000 CDS
T_4: FP	120-40-50-15	85-37-46-0

CD : Cowdung, CDS : Cowdung slurry, FP: Farmers practice

Table 1 (h). Fertilizer dose (kg ha^{-1}) for Potato at Rajshahi and Comilla

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS	
	Potato	
	Rajshahi	Comilla
T_1 : STB for HYG	185-36-125-20-2 (B)	120-25-110-13-1
T_2 : IPNS with 5 t ha^{-1} CD	-	IPNS with 5 t ha^{-1} CD
T_3 : IPNS with 5 t ha^{-1} CDS	160-28-100-20-2 + 5000 CDS	IPNS with 5 t ha^{-1} CDS
T_4: FP	175-40-112-18-2	200-75-115 + 10.0 t ha-1 CD

CD : Cowdung, CDS : Cowdung slurry, FP: Farmers practice

Table 1 (i). Fertilizer dose (kg ha^{-1}) for Brinjal at Narshingdi

Treatment	N-P-K-S-Zn-B + PM/CD or PS/CDS
T_1 : STB for HYG	116-32-134-5-0.5-0.35
T_2 : IPNS with 5 t ha^{-1} CD	101-27-119-5-0.5-0.35 + 5000
T_3 : IPNS with 5 t ha^{-1} CDS	94-25-109-5-0.5-0.35 + 5000 CDS
T_4: FP	69-20-60-0-0
Native fertility	0-0-0-0

CD : Cowdung, CDS : Cowdung slurry, FP: Farmers practice

Appendix table 2. Crop management practices for different vegetable crops at different locations

Site	Crop	Variety	Planting time	Harvesting time
Gazipur	Cabbage Cauliflower	Autumn queen Siragiku	13 November 23 October	26-27 January 6-7 January,
Comilla	Potato	Diamont	19 Nov. - 15 Dec.	15 Feb. – 10 March
Bogra	Potato	Granola	18-20 November	
Tangail	Cabbage Cauliflower Tomato Potato	- - - Granola	8-11 December 20-23 November 17-18 November 2-8 December	10-25 March 1-12 February 10 Feb. – 10 March 5-28 February
Rangpur	Tomato Cauliflower Poitato	- -	3-6 December 21-25 November 4-6 December	20-22 February 1st week – 3rd week of Feb. 3-6 March
Narshingdi	Brinjal	Local	18 December	15 March – 15 Aug.
Rajshahi	Potato	Diamont	20 November	3-8 March
Pabna	Cabbage Cauliflower Tomato Cucumber	Atlas-70 XL/Candycharm Surakkha (hybrid) Local	27 November 27 Nov./16-18 Nov. 26-27 November 24 December	1-3 March 20-25 Feb. /3-5 February 22-29 March 2 April – 8 May

On-Farm Verification of Wheat with Bio-slurry

Abstract

The experiment was carried out at Faridpur, Rajbari, Tangail, Modhupur, Rangpur, Kushtia, Rajshahi and Pabna during rabi season, 2008-09 to evaluate the effect of properly managed slurry on performance of wheat. Two nutrient management packages viz. inorganic fertilizer and IPNS with cowdung slurry along with existing farmers' dose were tested on wheat. Treatment combinations were slightly varied at some locations. Results showed that significantly higher grain yield of wheat was obtained in IPNS with bioslurry treatment at all the locations except Pabna. In Pabna, IPNS with bioslurry and only inorganic fertilized plots gave similar yield. Farmers practice produced the lowest yield at all the locations. Similarly, higher economic returns were also obtained from the same treatment due to higher yield and less requirement of inorganic fertilizers.

Introduction

The gradual decrease of soil fertility status of the country is now becoming a critical issue. More than 60% of our cultivated soil contains organic matter at low level (< 1.7%). So, the maintenance of organic matter is a burning issue both for the farmers and agricultural scientists. Recycling of organic matter is essential for maintaining soil fertility. More than twenty five thousand biogas plants have been established by different agencies in different parts of the country. Biogas slurry can be used as an excellent organic fertilizer. The management and utilization of slurry of these biogas plants was not properly taken care off. Positive effect of integrated use of slurry along with inorganic fertilizers was found in some tested crops in some locations. Wheat is one of the most important cereal crop in Bangladesh and grown all over the country. Previous studies revealed that wheat performed better when it grown with IPNS approach. Therefore, it is important to use slurry which is properly managed under farmers' condition. To ensure the proper management of slurry under farmers' condition and thereafter it is also important to verify the effect of slurry on the performance of wheat in different agro-ecological zones.

Materials and Methods

The experiment was conducted in medium high land under irrigated condition at the farmers' fields of different FSRD and MLT sites of Faridpur, Tangail, Kushtia, Rajshahi, Rangpur and Pabna and MLT site, Rajbari during rabi season, 2008-09. The objectives were to verify the effect of properly managed slurry on the performance of wheat grown at different locations and to compare the performance of integrated use of slurry or slurry compost along with inorganic fertilizers. The experiment was conducted in RCB design with five replications in each location.

Three different treatments were:

T_1: Soil test based (STB) inorganic fertilizer for high yield goal
T_2: IPNS with poultry slurry/cowdung slurry for high yield goal
T_3: Farmers dose

In some locations IPNS with cowdung was included as an additional treatment. Both the sources of bioslurry from poultry and cowdung was applied at Rangpur. Detailed fertilizer packages for different crops at different locations are given in Appendix Table 1.

The unit plot size was 5 m x 5 m. Two third of urea and entire amount of other fertilizers were applied as basal and the rest one third urea was applied at crown root initiation (CRI) stage. Seeds were sown at different dates at different locations. Intercultural operations such as weeding, irrigation and pest control measures were done in order to maintain the normal crop growth. The crops were harvested on proper time. Data on yield and yield attributes along with other parameters were collected properly and subjected to statistical analysis. Different crop management practices followed at different locations are shown in Appendix Table 2.

Location: Faridpur (Hatgobindpur and Rajbari)

In FSRD site, Hatgobindpur, significantly highest grain yield (3.68 t ha^{-1}) was found from T_2 where five ton cowdung slurry per hectare was applied along with IPNS basis fertilizer for HYG which was at par with T_1 where inorganic basis fertilizer dose for high yield goal was applied (3.43 t ha^{-1}) (Table 1). Farmers practice gave the significantly lowest grain yield (2.82 t ha^{-1}). In this site, yield contributing characters like number of spikes per square metre differ significantly among the treatments. Highest number of spikes per square metre was produced in T_2 followed by T_1. Number of grain per spike and 1000 grain weight do not differ significantly among the treatments.

In MLT site, Rajbari, similar trend of results were observed (Table 2). Treatment T_1 where five ton cowdung slurry per hectare was applied along with IPNS basis fertilizer for HYG gave significantly highest grain yield of wheat (4.03 t ha^{-1}) followed by treatment T_2 (3.92 t ha^{-1}). Treatment T_3 i.e. farmers practice gave the lowest yield (3.85 t ha^{-1}) which was at par with inorganic basis fertilizer dose. In this site, the yield contributing characters like number of spike per square meter also differ significantly among the treatments. But number of grain per spike and 1000 grain weight failed to show significant difference among the treatments.

Table 1. Effect of slurry on the performance of wheat at FSRD site, Hatgobindpur, Faridpur during rabi, 2008-09

Treatments	Plant height (cm)	No. of spike m^{-2}	No. of grain $spike^{-1}$	1000 grain wt. (g)	Grain yield (t ha^{-1})
T_1= Inorganic basis fertilizer dose for HYG	92.2	292a	33.39	41.83	3.43a
T_2= Cowdung slurry @ 5 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG	94.6	301a	35.75	42.55	3.68a
T_3= Farmers practice	89.5	267b	33.25	42.38	2.82b
CV (%)	9.63	13.14	10.52	5.15	8.26

Table 2. Effect of slurry on the performance of wheat at MLT site, Rajbari, Faridpur during rabi, 2008-09

Treatments	Plant height (cm)	No. of spike m^{-2}	No. of grain $spike^{-1}$	1000 grain wt. (g)	Grain yield (t ha^{-1})
T_1= Inorganic basis fertilizer dose for HYG	83.2	307a	30.15	39.15	3.92b
T_2= Cowdung slurry @ 5 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG	86.2	328a	36.38	40.25	4.03a
T_3= Farmers practice	79.8	274b	30.0	38.25	3.85b
CV (%)	10.25	10.25	7.58	4.20	7.25

Location: Faridpur (Krishannagar)

In Krishnanagar 1 site, significantly highest grain yield (3.60 t ha^{-1}) was found from T_3 where five ton cowdung slurry per hectare was applied along with IPNS basis fertilizer for HYG which was at par with T_2 where 5 ton cowdung per hectare was applied along with IPNS basis fertilizer for HYG (Table 3). The yield from STB fertilizer dose for HYG and farmers' practice are identical. In this site, yield contributing characters like number of spikes per metre and 1000 grain weight do not differ significantly among the treatments. Only number of grains per spike differs significantly among the treatments. Highest number of grain was produced from T_3 followed by T_2. The highest straw yield was found in T_3.

In Krishnanagar II site, similar trend of results of Krishnanagar I site were also observed. Treatment 3 where five ton cowdung slurry per hectare was applied along with IPNS basis fertilizer for HYG gave significantly highest grain yield of wheat (3.57 t ha^{-1}) followed by treatment 2 (3.48 t ha^{-1}) which was at par. But the yield obtained from T_2, T_1 and T_4 are also identical. Farmers' practice (T_4) gave the lowest yield. In this site, the yield contributing characters like spike length, number of grain per spike and 1000 grain weight also differ significantly among the treatments. The straw yield in T_3 and T_2 are identical (Table 4).

In Piarpur site, significantly highest grain yield of wheat was found in T_3 (3.41 t ha^{-1}) which was identical with T_2 and T_1. Except 1000 grain weight other yield contributing characters do not differ significantly among the treatments. Highest 1000 grain weight was found in T_3 which was at par with T_1 and T_4. The straw yield also does not differ significantly among the treatments (Table 5).

Considering 3 sites, the highest gross return (Tk. 51750) and net return (Tk. 37963) were found from Treatment 3 where 5 ton cowdung slurry along with IPNS basis inorganic fertilizers was applied (Table 6). Because of high price of fertilizer during sowing time and low price of wheat in harvesting time both the gross return and net returns are low. The lowest gross return and net return were found from farmers practice.

Table 3. Yield and yield contributing characters of wheat as affected by slurry in FSRD site, (Krishnanagar I), Faridpur during rabi, 2008-09

Treatment	Plant height (cm)	No. of spike m^{-2}	Spike length (cm)	No. of grain $spike^{-1}$	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	74.2c	299.1	9.00	34.0b	44.2	3.27b	3.53b
T_2=CD 5 t ha^{-1} + IPNS basis fertilizer dose for HYG	76.9b	300.2	8.75	36.0a	44.2	3.51a	3.86a
T_3=CD slurry 5 t ha^{-1} + IPNS basis fert. for HYG	77.8b	300.1	9.05	36.4a	44.3	3.60a	4.08a
T_4=Farmers practice	80.2a	290.8	8.45	35.2b	44.6	3.17b	3.48b
CV (%)	2.75	5.16	8.25	6.31	1.95	5.57	9.37

Table 4. Yield and yield contributing characters of wheat as affected by slurry in FSRD site, (Krishnanagar II), Faridpur during rabi, 2008-09

Treatment	Plant height (cm)	No. of spike m^{-2}	Spike length (cm)	No. of grain $spike^{-1}$	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1=	78.4b	297.2	8.23c	35.0b	42.7b	3.25b	3.62b
T_2=	79.0b	299.7	8.91b	36.1b	43.9a	3.48ab	3.88a
T_3=	80.0b	300.1	9.76a	37.4a	44.2a	3.57a	3.89a
T_4=	83.4a	288.1	8.39c	34.7b	42.6b	3.14b	3.54b
CV (%)	4.59	5.43	6.12	6.00	2.48	4.98	6.15

Table 5. Yield and yield contributing characters of wheat as affected by slurry in FSRD site, (Piarpur), Faridpur during rabi, 2008-09

Treatment	Plant height (cm)	No. of spike m^{-2}	Spike length (cm)	No. of grain $spike^{-1}$	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1=	93.3	277.3	8.47	36.0	43.0ab	3.21ab	3.55
T_2=	91.4	280.7	8.71	34.2	42.2b	3.38a	3.62
T_3=	92.6	289.7	8.99	34.7	44.7a	3.41a	3.72
T_4=	90.7	275.0	8.47	34.0	42.7ab	3.05b	3.35
CV (%)	9.83	6.15	8.21	8.75	3.18	7.71	9.16

Table 6. Cost and return analysis of wheat by application of different fertilizer treatments at Faridpur during rabi, 2008-09 (Mean of 3 sites)

Treatments	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1: Inorganic fertilizer for high yield goal	48600	19425	29175
T_2: IPNS with 5 t ha^{-1} CD	51750	18825	32925
T_3: IPNS with 5 t ha^{-1} CD slurry	52800	14837	37963
T_4: Farmers practice	46800	18915	27885

Location: Kushtia

The yield and yield contributing characters were significantly varied among the treatments (Table-3). The highest grain yield (4.5 t ha^{-1}) was obtained from treatment T_2 (Slurry). The notable and conspicuous (aspect) of the treatment T_2 with slurry required no TSP and lower level of MOP. The second highest yield (4.0 t ha^{-1}) was obtained from inorganic basis fertilizer dose to HYG (T_1). The lowest yield (3.6 t ha^{-1}) was obtained from farmers practices. The highest gross return (Tk. 68300 ha^{-1}), net return (Tk. 33065 ha^{-1}) and benefit cost ratio (BCR) (1.99) were obtained from treatment T_2 (Table 8).

Table 7: Yield & yield contributing character of wheat as influenced by slurry during rabi season at Kushtia, 2008-2009.

Treatment	Plant population m^{-2}	Plant height (cm)	Spieklet spike^{-1}	Grain spike^{-1}	1000 grain wt. (g)	Yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1= IBFD for HYG (80-20-60-10-1.3-06 kg NPKS Zn & B ha^{-1})	366	104	18	36	46	4.0	4.7
T_2= IPNS fert. With CD slurry for HYG (15-0-20-10-1.3-0.6 kg NPKS Zn & B ha^{-1})	374	106	19	38	48	4.5	4.90
FP= 104-24-38-18 kg NPKS ha^{-1}	358	102	17	35	45	3.6	4.5
LSD (5%)	NS	1.95	0.76	0.76	NS	0.51	0.64
CV (%)	3.05	0.64	1.74	0.86	2.13	10.02	7.72

Table 8: Economic performance of wheat as influenced by slurry during rabi season of 2008-09 at Kushtia sadar

Treatment	Yield (kg ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1= IBFD for HYG (80-20-60-10-1.3.-06 kg NPKS Zn & B ha^{-1})	4.0	61400/-	35979/-	25421	1.71
T_2= IPNS fert. With CD slurry for HYG (15-0-20-10-1.3-0.6 Kg NPKS Zn ha^{-1})	4.5	68300/-	34305	33065	1.99
FP= T_3 (104-24-38-18 Kg NPKS ha^{-1})	3.6	55800/-	34938	25717	1.60

Price: 1 kg wheat =15 Tk, TVC= Total variable cost

Location: Shympur, Rajshahi

Effect of different fertilizer management packages on yield and yield attributes are presented in Table 9. The highest grain yield was found in slurry rich treatment T_2 (4020 kg ha^{-1}) followed by Recommended package T_1 (3634 kg ha^{-1}) and T_3 (2959 kg ha^{-1}). It was found that application of Slurry in wheat increased grain yield. Manna and Hazra (1996) also observed the same result in Maize. Considering others yield parameters such as Spike m^{-2} (399.3), grain spike^{-1} (46.88) and TGW (45.45g) also performed better in T_2 among the treatments.

Table 9. Effect of Slurry on yield and yield attributes of wheat at Paba MLT site, Rajshahi in 2008-09.

Treatments (Fertilizers elements) (kg ha^{-1})	Maturity days	Plant height (cm)	Spike m^{-2}	Grain spike^{-1}	TGW (g)	Grain yield (kg ha^{-1})
T_1 = 100-26-50-20-1 kg ha^{-1} NPKS & B respectively	116	98-6 b	343.1 b	43.75 b	44.06 b	3634 b
T_2 = 77-18-25-20-1-5000 kg ha^{-1} NPKSB and slurry respectively	119	100.9 a	399.3 a	46.88 a	45.45 a	4020 a
T_3 = 65-22-35-20-1 kg ha^{-1} NPKS and B respectively	115	95.75 c	312.8 c	40.0 c	43.3 b	2959 c
CV (%)	-	1.41	5.10	4.5	1.68	6.17
LSD (0.05) (%)	-	1.48	19.25	2.10	0.799	234

Table 10. Cost and return analysis of different fertilizer management packages on wheat production at Paba MLT site during 2008-09.

Treatments	Yield (kg ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})
T_1	3634	54510	38570	15940
T_2	4020	60300	37120	23180
T_3	2959	44385	35807	8578

Price (Tk. kg^{-1}): Wheat= 15, wheat seed=40, Urea= 12, TSP= 40, MoP= 35, Gypsum= 5, Boric Acid= 120 and Slurry= 0.5.

From the economic analysis in Table 10 it was evident that the highest net return (Tk. 23180 ha^{-1}) was obtained form slurry applied field (T_2) followed by recommended package T_1 (Tk. 15940 ha^{-1}). Farmers package produced the lowest net return (Tk. 8578 ha^{-1}).

Location: Tangail

Table 11 reveals that at FSRD site, Elenga significantly the highest number of plants (83 m^{-2}) was recorded from the plants treated with (T_2) IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry and the lowest numbers were in treatment T_1 (81 m^{-2}) and T_3 (81 m^{-2}). The highest number of spikes (219 m^{-2}) was recorded from the plants treated with (T_2) IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry. The highest number of grains per spike (50), the 1000-grain weight (34.5g) and subsequently the highest grain yield (3.71 t ha^{-1}) was obtained from the plot treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest grain yield (2.41 t ha^{-1}) was recorded from farmers practice (T_3). If we consider cost and return analysis (Table-2), the highest gross return (Tk. 59360 ha^{-1}) and net return (Tk. 8602 ha^{-1}) were obtained from plants treated with IPNS basis fertilizer dose for HYG with cowdung slurry 5 t ha^{-1} (T_2). The lowest gross return (Tk. 38560 ha^{-1}) and net return (Tk. 629 ha^{-1}) was from farmers' practice.

If we consider Table 13 and Table 14 it will be observed that a similar trend of yield and economic performances are found under Modhupur situation.

Table 11. Yield of wheat as influenced by slurry (CD) at the FSRD sites Ellenga,Tangail during 2008 -09.

Treatment	Plant pop^n m^{-2}	Plant height (cm)	Spike m^{-2} (no.)	Grains $spike^{-1}$ (no.)	1000 grain wt (g)	Yield (t ha^{-1})
T_1= Soil test based fertilizer dose for high yield goal (HYG)	81	100	209	39	32.83	2.76
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	83	104	219	50	34.50	3.71
T_3= Farmers' practice	81	99	203	37	31.67	2.41
LSD (0.05)	0.87	1.87	5.65	1.61	0.62	0.27
CV (%)	0.8	1.4	2.1	3.0	1.5	7.1

Table 12. Cost and return analysis of wheat production at the FSRD site, Elenga, Tangail.

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1= Soil test based fertilizer dose for high yield goal (HYG)	44160	41861	2299	1.05
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	59360	50758	8602	1.17
T_3= Farmers' practice	38560	37931	629	1.02

Price (Tk kg^{-1}) : Cowdung slurry = 2.50, Urea = 12.00, TSP = 75.00, MoP = 45.00, Gypsum = 9.00, Boric acid = 110.00 and wheat = 16.00

Table 13. Yield of wheat as influenced by slurry (CD) at the MLT sites Madhupur, Tangail during 2008 -09.

Treatment	Plant population m^{-2}	Plant height (cm)	Spike m^{-2} (no.)	Grains $spike^{-1}$ (no.)	1000-grain wt (g)	Yield (t ha^{-1})
T_1 = Soil test based fertilizer dose for high yield goal (HYG)	87	105	272	38	38.3	3.57
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	88	106	280	42	41.0	4.20
T_3= Farmers' practice	87	103	260	36	36.3	3.20
LSD (0.05)	4.21	6.07	31.04	1.93	2.28	0.51
CV (%)	1.8	2.6	5.1	2.2	2.6	6.2

Table 14. Cost and return analysis of wheat production at the MLT site Modhupur, Tangail.

Treatments	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1= Soil test based fertilizer dose for high yield goal (HYG)	57120	54965	2155	1.04
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	67200	64128	3072	1.05
T_3= Farmers' practice	51200	49078	2122	1.04

Price (Tk kg^{-1}) : Cowdung slurry = 2.50, Urea = 12.00, TSP = 80.00, MoP = 53.00, Gypsum = 12.00, Boric acid = 150.00 and wheat = 16.00

Location: Rangpur

Wheat (CD slurry)

The yield and yield contributing characters of wheat as influenced by different fertilizer treatments are presented in Table 15 & 17. In FSRD site, the highest grain yield was obtained from cowdung slurry (4.11 t ha^{-1}). The lowest yield was obtained from farmers practice. In Ulipur MLT site, the highest grain yield (4.21 t ha^{-1}) was also obtained from cowdung slurry and the lowest from farmers practice. From this result, it was evident that cowdung slurry has a great potentiality in increasing wheat production and economic return of the farmers.

Economic performance

The cost and return analysis of different fertilizer treatments are presented in Table 16 & 18. In FSRD site, the highest gross return (Tk.65760 ha^{-1}), net return (Tk.16026 ha^{-1}) and benefit cost ratio (1.32) was obtained from cowdung slurry. Similarly, in MLT site, the highest gross return (Tk.67360 ha^{-1}), net return (Tk.17974 ha^{-1}) and benefit cost ratio (1.36) was also obtained from cowdung slurry. The lower gross return, net return and benefit cost ratio was obtained from $T_{1=}$ STB inorganic fertilizer dose for HYG in FSRD and from farmers practice at MLT site, respectively.

Table 15. Effect of cowdung slurry as an organic manure on wheat at FSRD site, Rangpur during rabi season 2008-09

Treatment	Plant height (cm)	Length of spike (cm)	No. of grain $spike^{-1}$	1000-grain wt (g)	Yield (t ha^{-1})
T_1=STB inorganic fertilizer for HYG	89.87 ab	12.87 b	31.27 bc	40.23	3.13 bc
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	92.60 a	13.60 b	33.20 b	40.70	3.45 b
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	95.87 a	15.00 a	38.00 a	40.57	4.11 a
T_4= Farmers practice	86.07 b	11.60	28.43 c	39.77	2.87 c
LSD (0.05)	6.120	0.7992	3.810	NS	0.3895
CV (0%)	3.36	3.02	5.83	6.35	5.76

Table 16. Cost and return analysis of wheat as influenced by cowdung slurry at FSRD, Lahirirhat, Rangpur during 2008-09.

Treatment	Grain yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1=STB inog fert. dose for HYG	3.13	50080	48150	1930	1.04
T_2=IPNS (5t ha^{-1} cowdung menure) for HYG	3.45	55200	50258	4942	1.09
T_3=IPNS (5t ha^{-1} cowdung slurry for HYG	4.11	65760	49734	16026	1.32
T_4=Farmers practice	2.87	45920	40186	5734	1.14

Wheat= Tk 16 kg^{-1}

Table 17. Effects of cowdung slurry as organic manure on wheat at Ulipur MLT site during rabi season 2008-09.

Treatment	Plant height (cm)	No of spikelet $spike^{-1}$	No of grains $spike^{-1}$	1000 grain weight (gm)	Yield (t ha^{-1})
T_1=STB inorganic fertilizer for HYG	94.42b	18.07b	57.37ab	41.77	3.97a
T_2=IPNS (5 t ha^{-1} cowdung slurry) for HYG	97.00a	18.63a	58.23a	42.12	4.21a
T_3= Farmers practice	93.98b	17.33c	55.83b	41.97	3.34b
LSD (0.05)	2.25	0.14	1.87	NS	0.24
CV (%)	7.84	2.02	2.55	3.87	4.91

Table 18. Cost and return analysis of wheat as influenced by cowdung slurry at MLT site, Ulipur, OFRD, Rangpur during rabi season 2008-09

Treatment	Grain yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1=STB inog fert. dose for HYG	3.97	63520	46728	16792	1.35
T_2=IPNS (5t ha^{-1} cowdung slurry for HYG	4.21	67360	49386	17974	1.36
T_3=Farmers practice	3.34	53440	41810	11630	1.27

Location: Rangpur (PM bioslurry)

The yield and yield contributing characters of wheat as affected by different fertilizer treatments are presented in Table 19 & 21. In FSRD site, the highest grain yield was obtained from poultry bio – slurry 4.03 t ha^{-1} which was identical to poultry manure (3.52 t ha^{-1}). In MLT site, the highest grain yield was obtained from poultry slurry (3.94 t ha^{-1}) which differed significantly from other fertilizer treatment.. The lowest yield was obtained from farmers practice in both the sites.

Economic performance

The cost and return analysis of different fertilizer treatments are presented in Table 20 & 22. In FSRD site, the highest gross return (Tk.64480 ha^{-1}), net return (Tk.13436 ha^{-1}) and benefit cost ratio (1.26) was obtained from poultry slurry. Similarly, in MLT site, the highest gross return (Tk.63040 ha^{-1}), net return (Tk.12827 ha^{-1}) and benefit cost ratio (1.25) was also obtained from poultry slurry. The lower net return and benefit cost ratio was obtained from $T_{1=}$ STB inorganic fertilizer dose for HYG in FSRD site and from farmers practice at MLT site, respectively.

Table 19. Effect of poultry slurry on yield and yield contributing characters of wheat at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatment	Plant height (cm)	Length of spike (cm)	No. of grain $spike^{-1}$	1000-grain weight (g)	Yield (t ha^{-1})
T_1=STB inorg. fertilizer for HYG	91.33b	12.07c	31.27b	40.30	3.12b
T_2=IPNS (3 t ha^{-1} poultry manure) for HYG	93.47ab	13.20b	33.60b	40.40	3.52ab
T_3=IPNS (3 t ha^{-1} poultry slurry) for HYG	97.07 a	14.20a	37.20a	40.97	4.03a
T_4=Farmers practice	88.67 b	11.73c	31.27b	39.80	3.05b
LSD (0.05)	5.262	0.7789	3.383	NS	0.7866
CV (%)	2.84	3.05	5.08	10.19	4.48

Table 20. Cost and return analysis of wheat as influenced by poultry slurry at FSRD, Lahirirhat, Rangpur during 2008-09

Treatment	Grain yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1=STB inog fert. dose for HYG	3.12	49920	48150	1770	1.03
T_2=IPNS (t ha^{-1} poultry manure) for HYG	3.52	56320	47186	9134	1.19
T_3=IPNS (3t ha^{-1} poultry slurry) for HYG	4.03	64480	51044	13436	1.26
T_4=Farmers practice	3.05	48800	40186	8614	1.21

Table 21. Effect of poultry slurry on yield and yield contributing characters of wheat at MLT site, Ulipur, OFRD, ARS, Rangpur during rabi 2008-09

Treatment	Plant height (cm)	No of spike let spike^{-1}	No of grain spike^{-1}	1000 grain weight (g)	Yield (t ha^{-1})
T_1=STB inorg. fertilizer for HYG	93.12ab	18.23a	56.80a	41.95	3.70b
T_2=IPNS (3 t ha^{-1} poultry slurry) for HYG	94.00 a	18.20a	57.97a	41.75	3.94a
T_3=Farmers practice	90.73 b	15.90b	54.67b	42.03	3.18c
LSD (0.05)	1.07	3.34	2.12	NS	0.44
CV (%)	7.90	4.53	2.93	1.94	5.93

Table 22. Cost and return analysis of wheat as influenced by poultry slurry at MLT site, Ulipur, OFRD, Rangpur during rabi season 2008-09

Treatment	Grain yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
T_1=STB inog fert. dose for HYG	3.70	59200	48228	10972	1.23
T_2=IPNS (3t ha^{-1} poultry slurry for HYG	3.94	63040	50213	12827	1.25
T_3=Farmers practice	3.18	50880	41810	9070	1.21

Location: Pabna

Yield and yield attributes differed significantly among the treatments (Table 23). The highest grain and straw yield was obtained from slurry used plot which was also identical with HYG treatment. This results is supported by yield contributing characters especially plant population, grains spike^{-1} and 1000 grain weight. Though farmer generally used higher amount of cowdung but yield and yield attributes showed poor performance and it might be due to imbalance fertilizer use especially omit of Zn and B. From the economic point of view, it was found that higher gross return and net return and BCR was calculated from IPNS with slurry treatment. It is mainly due to higher yield and less cost of slurry and less amount of chemical fertilizer needed.

Table 23. Performance of wheat as affected by different nutrient management MLT site, Bhabanipur, Sujanagor, Pabna during 2008-09

Treatment	Plant height (cm)	Plant population m^2 (no.)	Spike length (cm)	Grains spike^{-1} (no.)	1000 grain wt (gm)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1= HYG	100.2a	279.33ab	10.73b	43.70b	45.53a	3.68a	2.30a
T_2=IPNS(CD)	102.0a	282.33a	11.88a	45.77a	45.92a	3.77a	2.35a
T_3=FP	94.73a	276.83b	10.11c	39.47c	45.18b	3.44b	2.19b
LSD (%)	18.09	5.493	0.4475	1.023	0.2848	0.1151	0.0575
CV (%)	13.22	11.53	13.18	11.85	6.49	12.48	11.70

Table 24. Cost and return analysis of wheat produced under different nutrient management

Treatment	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1= HYG	56350	41310	15040	1.36
T_2=IPNS(CD)	57725	37745	19980	1.53
T_3=FP	52695	40312	12383	1.31

Farmers' reaction

Tangail : Farmers showed keen interest regarding the use of slurry as organic manure. But they opined that biogas plants are not easy available due to its higher cost involvement in establishment.

Rangpur : Farmers were very much impressed by getting higher yield and economic return from slurry but they expressed their concern regarding its unavailability in the locality and carrying hazard.

Pabna : Cowdung slurry and Poultry slurry showed better performance over chemical fertilizer, so, if it would be available they like to use it. They also opine that management of slurry is slightly problematic.

Rajshahi : Farmers are very much impressed to have satisfactory wheat yield in bio-slurry applied field (T_2). They also observed that plant greenness duration and tillering was maximum in T_2. If quality bio slurry is available in locality they will use it extensively in crop fields for reducing inorganic fertilizer cost and increase yield and income.

Kushtia : Farmers were very much impressed to see the increased grain yield of wheat from cowdung slurry and less use of inorganic fertilizers.

Conclusion

Wheat responded positively to IPNS approach with bioslurry almost at all the locations tested. Higher grain yield and economic return was obtained from IPNS with bioslurry treatment. Use of slurry can play a vital role to minimize the present fertilizer crisis. Moreover, organic manure slurry will help to improve soil fertility in the long run. Results obtained mostly from first year trial. Therefore, the trial should be repeated in the next year for further verification.

Appendix Table I: Detailed fertilizer dose for wheat at different locations

Table 1(a). Fertilizer treatment at Lahirirhat FSRD site and Ulipur MLT site, Ranpur

Treatment	Fertilizer dose (N-P-K-S-B-Zn-CD/CS kg ha^{-1})	
	Lahirirhat	Ulipur
T_1=STB inorganic fertilizer for HYG	130-20-80-30-1.5-4-0	135-20-75-30-1.5-4-0
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	124-15-72-30-1.5-4-5000	-
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	108-13-55-30-1.5-4-5000	112-13-60-30-1.5-4-5000
T_4= Farmers practice	70-23-32-12-0-0-1500	65-23-35-10-0-0-1000

Table 1(b): Fertilizer treatment at Lahirirhat FSRD site, Rangpur.

Treatment	Fertilizer dose (N-P-K-S -Zn-B+PM/PS kg ha^{-1})	
	Lahirirhat	Ulipur
T_1=STB inorg. fertilizer for HYG	130-20-80-30-1.5-4-0	135-20-75-30-1.5-4-0
T_2=IPNS (3 t ha^{-1} poultry manure) for HYG	118-11-59-30-1.5-4-3000	-
T_3=IPNS (3 t ha^{-1} poultry slurry) for HYG	116-10-57-30-1.5-4-3000	121-11-54-30-1.5-4-3000
T_4=Farmers practice	70-23-32-12-0-0-1500	65-23-35-10-0-0-1000

Table 1(c). Fertilizer treatment at Faridpur

Treatment	Fertilizer dose (N-P-K-S-B-Zn-CD/CS kg ha^{-1})
T_1=STB inorganic fertilizer for HYG	100-35-50-10-1
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	77-27-25-10-1 + 5000
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	70-20-20-10-1 + 5000
T_4= Farmers practice	84-37-45-0

Table 1(d). Fertilizer treatment at Shympur, Rajshahi

Treatment	Fertilizer dose (N-P-K-S-B-Zn-CD/CS kg ha^{-1})
T_1=STB inorganic fertilizer for HYG	100-26-50-20-1
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	-
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	77-18-25-20-1 + 5000
T_4= Farmers practice	84-37-45-0

Table 1(e). Fertilizer treatment at Elenga FSRD site and Modhupur MLT site, Tangail

Treatment	Fertilizer dose (N-P-K-S-B-Zn-CD/CS kg ha^{-1})	
	Elenga	Modhupur
T_1=STB inorganic fertilizer for HYG	92-32-22-20-1.0	91-32-22-20-1.0
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	-	-
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	69-24-0-20-1.0 + 5000 CDS	69-24-0-20-1.0 + 5000 CDS
T_4= Farmers practice	92-20-30-12-0	76-12-62-8-0

Table1(f). Fertilizer treatment at Pabna

Treatment	Fertilizer dose (N-P-K-S-B-Zn-CD/CS kg ha^{-1})
T_1=STB inorganic fertilizer for HYG	116-38-29-15-0.38-0.36
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	-
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	93-30-4-15-0.38-0.36 + 5000 CDS
T_4= Farmers practice	84-23-19-21-0 + 6000 CD

Table1 (g). Fertilizer treatment at Kushtia

Treatment	Fertilizer dose (N-P-K-S-B-Zn-CD/CS kg ha^{-1})
T_1=STB inorganic fertilizer for HYG	80-20-60-10-1.3-0.6
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	-
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	15-0-20-10-1.3-0.6 + 5000 CDS
T_4= Farmers practice	104-24-38-18

CD= Cowdung, CS= Cowdung slurry, HYG = High yield good, IPNS= Integrated plant Nutrient system

Appendix table 2. Crop management practices followed at different locations

Site	Crop	Variety	Planting time	Harvesting time
Faridpur	Wheat	Shatabdi	27 November	23 March
Kushtia	Wheat	-	10 November	10 March
Tangail	Wheat	Shatabdi	4-8 December	23-29 March
Rangpur	Wheat	-	Last week of Nov – 1st week of Dec.	last week of March to 1st week of April
Rajshahi	Wheat	Shatabdi	30 November	5 April
Pabna	Wheat	Shatabdi	8 December	26 March

Effect of Cowdung Slurry as a Source of Organic Manure on Maize

Abstract

The experiment was conducted at Lahirirhat FSRD site during 2007-08 and 2008-09 and Gobindaganj MLT Site Rangpur and Pushpopara FSRD site Pabna during 2008-09 to evaluate the effect of slurry on the performance of maize production in farmer's field. Three nutrient management packages viz. soil test based inorganic fertilizers, IPNS with poultry manure/cowdung and IPNS with poultry slurry/cowdung slurry along with farmers' dose were tested on maize. The highest grain yield was obtained from IPNS with bioslurry (5 t ha^{-1} CD or 3 t ha^{-1} P)) for HYG at Lahirirhat FSRD site and Gobindaganj MLT Site Rangpur. Similarly, the significantly highest grain yield of maize was obtained in IPNS with 5 t ha^{-1} cowdung slurry (T_3) followed by IPNS with 5 t ha^{-1} cowdung manure in Pabna. From the cost and return analysis it was found that higher gross return and net return was recorded with the same treatment in Rangpur and Pabna.

Introduction

Different organic materials like cowdung, poultry liters, human faces, crop residues household wastes etc. are used as substrate in biogas plant. After emission of biogas semi liquid cowdung or poultry manure derived from outlet, is called biogas slurry. Biogas slurry is an improved type of organic manure which is applied in the form of semi-liquid, dry or compost. It contains considerable quantities of plant nutrients than traditional cowdung, poultry manure, farmyard manure and compost which may be used to improve soil fertility and thus the use of chemical fertilizers can be reduced to a great extent. Application of slurry gave significantly higher yield in vegetables (Joshi, *et.al*., 1994). Jayakumar and Elangovan found that biogas slurry @ 300 g per pot produced the largest head of sun flower (1993). Application of biogas slurry increased cob yield of maize as was reported by Manna and Hazra (1996). Soil fertility is declining day by day though the magnitude of variation varies in different Agro-ecological zone. This is caused due to deterioration of soil physical, chemical and biological properties. It occurs due to imbalance use of fertilizer and loss of nutrient from the soil. This situation is further aggravated by low organic matter content of the soil. A good soil should have organic matter content more than 3.5 percent. However, most soils have organic matter content less than 1.7 percent even in many cases it is less than 1 percent. The organic matter content of the soil is declining day by day which reduces productivity of the soil. To cope with this situation proper use of organic manure along with inorganic fertilizer is urgently needed to arrest soil health deterioration. Slurry in this regard can play a vital role in combination with chemical fertilizer. Further, management and utilization of slurry still was not properly taken care off. Under these circumstances, the trial was undertaken to evaluate the performance of slurry on maize production.

Materials and Methods

The experiment was conducted at Lahirirhat FSRD Site, Rangpur during 2007-08 to 2008-09 and at Gobindagonj MLT site, Rangpur and Pushpopara FSRD site, Pabna during 2008-09. The land was medium high and the soil was sandy loam in texture. Four nutrient management packages viz. T_1 = Soil test based fertilizer dose for HYG, T_2= Integrated plant nutrient systems with 5 t ha^{-1} cowdung (IPNS with CD), T_3= Integrated plant nutrient systems with 5 t ha^{-1} cowdung slurry (IPNS with CDS), T_4= Farmers practice were tested. The treatments were slightly varied in Rangpur. IPNS with poultry slurry and a native fertility (no fertilizer) treatment was included as additional treatments at FSRD site Rangpur. The experiment was laid out in a RCB design with three compact replications which was also replicated in three dispersed farmer's field while in Gabindaganj MLT site the experiment was laid out in a RCB design with six dispersed replications. The unit plot size was varied from 3m x 10m to 6m x 5m. The entire amount of cowdung/poultry manure and cowdung/poultry slurry was applied 4 days before final land preparation. The whole of P, K, S, Mg, Zn, B and $^1/_3$ of N were applied during final land preparation. The rest N was applied in two equal installments as top dress at 25 and 50 DAE One weeding was done at 25 DAE. The crop was irrigated properly. Plant protection measures and other intercultural operations were done as and when necessary. The crop was planted

2-14 December at Rangpur and 23 December in Pabna with a spacing of 75cm X 25 cm. Maize variety NK-40 was used in Pabna. The crop was harvested through 20-30 April in Rangpur and 19 may in Pabna. Data on yield and yield contributing characters were taken and statistically analyzed following MSTAT software package.

Location: Rangpur

The yield and yield contributing characters of maize as affected by different fertilizer treatments are presented in Table 1, 2 & 3. In 2007-08 at FSRD site, the tallest plant (184 cm) was obtained from IPNS (5 t ha^{-1} cowdung slurry) for HYG which was identical to IPNS (5 t ha^{-1} cowdung manure) (180 cm) but in 2008-09 no significant effect on plant height was observed. Similarly, in Gobindagonj MLT site, different fertilizer treatment failed to produce any significant effect on plant height (2008-09). The number of grains per cob and 100 grains weight was significantly highest with IPNS (5 t ha^{-1} cowdung slurry) for HYG in 2007-08 at FSRD site while the number grain per cob and weight of grains per cob was significantly highest in 2008-09. Similarly, the number grains per cob and weight of grains per cob was significantly higher with cowdung slurry at Gobindagonj MLT site in 2008-09 though in both cases the result was identical to STB inorganic fertilizer dose for HYG. In FSRD site, the highest grain yield was obtained from cowdung slurry in both the years (6.24 t ha^{-1} in 2007-08 and 9.74 t ha^{-1} in 2008-09) which differed significantly from other fertilizer treatments. However, the yield difference between cowdung manure and STB inorganic fertilizer dose for high yield goal (HYG) in 2008-09 was identical. The lowest yield was obtained from native fertility in 2007-08 and from farmers practice in 2008-09. In Gobindagonj MLT site, the highest grain yield was also obtained from cowdung slurry (9.40 t ha^{-1}), which differed significantly from other fertilizer treatments. The lowest yield (6.38 t ha^{-1}) was obtained from farmers practice.

Table 1. Effects of cowdung bio slurry on the yield and yield contributing characters of maize at Lahirirhat FSRD site, during rabi season, 2007-08

Treatments	Plant height (cm)	No. of grains cob^{-1}	100-grain weight (g)	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	175b	441ab	26.6c	4.57d
T_2=IPNS (5 t ha^{-1} cowdung manure) fert. dose for HYG	180a	480ab	28.4bc	5.69b
T_3=IPNS (5 t ha^{-1} cowdung slurry) fert. dose for HYG	184a	512a	32.3a	6.24a
T_4=Farmers practice	176b	426b	29.3b	5.09c
T_5=Native fertility	170c	349c	22.8c	3.85e
CV (%)	2.0	10.2	4.3	5.0

Table 2. Effects of cowdung bio slurry on the yield and yield contributing characters of maize at FSRD site, Lahirirhat, Rangpur during rabi season, 2008-09

Treatments	Plant height (cm)	Length of cob (cm)	Circumference of cob (cm)	No. of grains cob^{-1}	Wt of grain cob^{-1} (g)	100-grain weight (g)	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	199.0a	19.48ab	16.95a	429.0b	180.3bc	34.77a	8.32bc
T_2=IPNS (5 t ha^{-1} cowdung manure) fert. dose for HYG	203.3a	20.54a	17.65a	449.5ab	184.9b	35.88a	8.92b
T_3=IPNS (5 t ha^{-1} cowdung slurry) fert. dose for HYG	208.6a	20.78a	18.06a	465.4a	199.1a	37.86a	9.74a
T_4=Farmers practice	195.5a	18.82b	16.63a	403.3c	171.8c	33.44a	7.99c
CV (%)	5.68	7.50	8.24	5.18	5.38	11.42	7.58

Table 3. Effects of cowdung bio slurry on the yield and yield contributing characters of maize at Gobindogonj MLT site, during rabi season, 2008-09

Treatments	Plant height (cm)	Length of cob (cm)	Diameter of cob (cm)	No. of grains cob^{-1}	Wt of grain cob^{-1} (g)	100-grain weight (g)	Yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	208.0a	16.22b	3.27ab	424.2ab	162.7a	32.50a	8.83b
T_2=IPNS (5 t ha^{-1} CD bio-slurry) fert. dose for HYG	212.8a	18.68a	4.03a	436.8a	169.8a	33.17a	9.40a
T_3=Farmers practice	201.6a	15.17b	2.45b	415.7b	123.5b	31.67a	6.38c
CV (%)	5.93	7.82	5.26	3.06	3.77	8.89	5.33

Economic performance

The cost and return analysis of different fertilizer treatments are presented in Table 4. In FSRD site, the higher gross return (Tk.118320 ha^{-1}), net return (Tk.58306 ha^{-1}) and benefit cost ratio (1.97) was obtained from cowdung slurry. Similarly, in MLT site, the highest gross return (Tk.114250 ha^{-1}), net return (Tk.48012 ha^{-1}) and benefit cost ratio (1.70) was also obtained from cowdung slurry. The lower gross return, net return and benefit cost ratio was obtained from farmers practice both in FSRD and MLT site. From two years result, it was evident that cowdung slurry has a great potentiality in increasing production and economic return of the farmer.

Table 4. Cost and return analysis of maize as influenced by cowdung slurry at FSRD site, Lahirirhat and MLT site, Gobindagonj OFRD, Rangpur during 2008-09.

Treatment	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Gross return (Tk ha^{-1})	Total cost (t ha^{-1})	Net return (Tk ha^{-1})	BCR
FSRD site, Lahirirhat						
T_1	8.32	9.75	101270	58431	42839	1.73
T_2	8.92	10.42	108540	60461	48079	1.79
T_3	9.74	11.18	118320	60014	58306	1.97
T_4	7.99	9.15	97040	57034	40006	1.70
MLT site, Gobindagonj						
T_1	8.83	10.11	107240	63616	43624	1.65
T_2	9.40	10.85	114250	66238	48012	1.70
T_3	6.38	7.65	77830	51680	26150	1.47

Price (Tk. kg^{-1}): Maize: 11, Maize Straw: 1, Urea= 11.80, TSP=74.36, MP=55, Zinc sulphate =140, Boric acid=180, Lab= 112/day, Gypsum=7, Cowdung manure=1.00, Cowdung slurry=1.50

Location: Rangpur (PM slurry)

The yield and yield contributing characters of maize as affected by different fertilizer treatments are presented in Table 5, 6 & 7. In FSRD site, the tallest plant was recorded from IPNS (3 t ha^{-1} poultry slurry) for HYG in both the years however, the result obtained from IPNS (3 t ha^{-1} poultry slurry) for HYG, IPNS (3 t ha^{-1} poultry manure) for HYG and STB inorganic fertilizer dose for HYG was identical in 2007-08 and from poultry slurry and poultry manure was identical 2008-09. In Gobindagonj MLT site different fertilizer treatments failed to produce any significant effect on plant height. In FSRD site, the number of grains per cob was significantly higher with poultry slurry in both the year (512 cob^{-1} in 2007-08 and 471.6 cob^{-1} in 2008-09) but the result obtained from poultry slurry and poultry manure was identical is 2007-08. In Gobindagonj MLT site, the number of grains per cob was also highest with poultry slurry (441.5 cob^{-1}) which was identical to STB inorganic fertilizer dose for HYG. In FSRD site, the 100 grains weight was also significantly higher with poultry slurry in 2007-08 while in 2008-09 different fertilizer treatments failed to produce any significant effect on 100 grains weight. Regarding 100 grains weight no significant effect was observed in Gobindagonj MLT site. The weight of grains per cob in 2008-09 was significantly higher with poultry slurry in both FSRD and MLT site but the differences between poultry slurry and poultry manure in FSRD site and between poultry slurry and STB inorganic fertilizer dose at MLT site was identical. In FSRD site, the highest grain yield was obtained from poultry slurry in both the years (6.76 t ha^{-1} in 2007-08 and 9.80

t ha^{-1} in 2008-09) which differed significantly from other fertilizer treatments. The lowest yield was obtained from native fertility in 2007-08 and from farmers practice in 2008-09. In Gobindagonj MLT site, the highest grain yield was also obtained from poultry slurry (9.60 t ha^{-1}), which differed significantly from other fertilizer treatments. The lowest yield (6.52 t ha^{-1}) was obtained from farmers practice.

Table 5. Effects of poultry bio slurry on the yield and yield contributing characters of maize at Lahirirhat FSRD site, during rabi season, 2007-08

Treatments	Plant height (cm)	No. of grains cob^{-1}	100-grain weight (g)	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	181a	439ab	27.6c	5.47c
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	180a	510a	28.6bc	6.19b
T_3=IPNS (3 t ha^{-1} poultry Slurry) fert. dose for HYG	182a	512a	32.5a	6.76a
T_4=Farmers practice	175b	436b	29.0b	5.58c
T_5=Native fertility	171c	346c	23.0c	4.15d
CV (%)	1.5	9.5	4.9	5.4

Table 6. Effects of poultry bio slurry on the yield and yield contributing characters of maize at FSRD site, Lahirirhat, Rangpur during rabi season, 2008-09

Treatments	Plant height (cm)	Length of cob (cm)	Circumference of cob (cm)	No. of grains cob^{-1}	Wt of grain cob^{-1} (g)	100-grain weight (g)	Yield (t ha^{-1})
T_1=STB inorganic fert. dose for HYG	194.0b	19.76bc	17.14a	430.9c	188.7b	35.93a	8.60bc
T_2=IPNS (3 t ha^{-1} poultry manure) fert. dose for HYG	200.5ab	20.37ab	17.72a	449.8b	194.9ab	36.27a	8.85b
T_3=IPNS (3 t ha^{-1} poultry slurry) fert. dose for HYG	207.2a	21.15a	18.05a	471.6a	201.9a	37.34a	9.80a
T_4=Farmers practice	190.8b	18.70c	16.83a	395.6d	174.2c	35.13a	8.01c
CV (%)	6.05	6.95	8.06	3.75	4.98	11.54	7.55

Table 7. Effects of poultry bio slurry on the yield and yield contributing characters of maize at Gobindogonj MLT site, during rabi season, 2008-09

Treatments	Plant height (cm)	Length of cob (cm)	Circumference of cob (cm)	No. of grains cob^{-1}	Wt of grain cob^{-1} (g)	100-grain weight (g)	Yield (t ha^{-1})
T_1=STB fertilizer dose for HYG	209.6a	16.93ab	13.85a	426.0ab	167.8a	32.83a	8.96b
T_2=IPNS (3 t ha^{-1} poultry slurry) fert. dose for HYG	213.4a	17.95a	14.30a	441.5a	175.0a	33.67a	9.60a
T_3=Farmers practice	205.8a	15.82b	13.03b	416.5b	120.7b	31.50a	6.52c
CV (%)	3.12	9.19	4.30	3.41	4.45	9.03	5.93

Economic performance

The cost and return analysis of different fertilizer treatments are presented in Table 8. In FSRD site, the highest gross return (Tk.118970 ha^{-1}), net return (Tk.62412 ha^{-1}) and benefit cost ratio (2.10) was obtained from poultry slurry. Similarly, in MLT site, the highest gross return (Tk.116850 ha^{-1}), net return (Tk.64493 ha^{-1}) and benefit cost ratio (2.23) was also obtained from poultry slurry. The lower gross return, net return and benefit cost ratio was obtained from farmers practice both in FSRD and MLT site. From two years result, it was evident that poultry slurry has a great potentiality in increasing production and economic return of the farmer.

Table 8. Cost and return analysis of maize as influenced by poultry slurry at FSRD site, Lahirirhat and MLT site, Gobindagonj, OFRD, Rangpur during rabi season 2008-09

Treatment	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Gross return (Tk ha^{-1})	Total cost (t ha^{-1})	Net return (Tk ha^{-1})	BCR
FSRD site Lahirirhat						
T_1	8.60	9.93	104530	58631	45899	1.78
T_2	8.85	10.21	107560	60813	46747	1.76
T_3	9.80	11.17	118970	56558	62412	2.10
T_4	8.01	9.27	97380	57034	40346	1.70
MLT site, Gobindagonj						
T_1	8.96	10.42	108980	63616	45364	1.71
T_2	9.60	11.25	116850	52357	64493	2.23
T_3	6.52	7.78	79500	52680	26820	1.50

Price (Tk. kg^{-1}): Maize: 11, Maize Straw: 1, Urea= 11.80, Urea= 11.80, TSP=74.36, MP=55, Zinc sulphate =140, Boric acid=180, Lab= 112/day, Gypsum=7, Poultry manure=1.50, Poultry slurry=3.00

Location: Pabna

The yield and yield contributing characters of maize affected significantly due to different treatments except ear height and number of grains cob^{-1} (Table 9). The highest plant height was found in IPNS with 5 t ha^{-1} cowdung slurry (T_3) followed by high yield goal (T_1) and IPNS with 5 t ha^{-1} cowdung manure (T_2). Maximum length of cob was achieved from IPNS with 5 t ha^{-1} cowdung slurry (T_3) followed by farmers practice and IPNS with 5 t ha^{-1} cowdung manure (T_2). The highest weight of 100 grain was also obtained from IPNS with 5 t ha^{-1} cowdung slurry followed by farmers practice. The minimum length of cob and weight of 100 grain was observed in high yield goal. The highest grain yield was attained from IPNS with 5 t ha^{-1} cowdung slurry which was followed by IPNS with 5 t ha^{-1} cowdung manure and farmers practice. The cumulative effect positive of maximum cob length, number of grains cob^{-1} and weight of 100 grain might be contributed to the highest grain yield of maize in IPNS with 5 t ha^{-1} cowdung slurry. The lowest grain yield was found in high yield goal. Probably the availabilty and balanced uptake of of different nutrients enhanced optimum plant growth and development and finally attributed to better performance on yield and yield contributing characters. From economic analysis, it was revealed that the highest net return and benefit cost ratio were obtained from IPNS with 5 t ha^{-1} cowdung slurry (T_3), which was followed by high yield goal (T_1) and IPNS with 5 t ha^{-1} cowdung manure (T_2). The lowest economic return in terms of net return and BCR was attained from farmers practice (Table 10).

Table 9. Effect of slurry as organic manure on yield and yield contributing characters of maize during the rabi season of 2008- 09 at FSRD site, Pushpapara, Pabna.

Treatments	Plant height (cm)	Ear height (cm)	Cob length (cm)	Grains cob^{-1} (no.)	100 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1 = HYG	164.10ab	83.06	17.80b	473	32.27b	7.10b	7.14b
T_2 = IPNS (CD)	163.50ab	82.87	17.91ab	459	32.36b	7.14ab	7.56ab
T_3 = IPNS (CDS)	167.40a	86.06	18.53a	493	34.09a	8.24a	7.92a
T_4 = FP	162.30b	82.84	18.28ab	439	33.12ab	7.11ab	7.27b
CV (%)	4.65	5.76	3.65	10.22	3.75	10.75	7.85
$LSD_{0.05}$	4.23	ns	0.64	ns	1.20	1.13	0.57

Table 10. Cost and return analysis of maize as affected by slurry during the rabi season of 2008-09 at FSRD site, Pushpapara, Pabna.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1 = HYG	102343	68666	33677	1.49
T_2 = IPNS (CD)	107976	77555	30421	1.39
T_3 = IPNS (CDS)	122753	74370	48383	1.65
T_4 = FP	106793	78666	28127	1.36

Farmers' reaction

Rangpur Farmers were very much impressed by getting higher yield and economic return from slurry but they expressed their concern regarding its non-availability in the locality and carrying hazard.

Pabna Cowdung slurry showed better performance over inorganic fertilizers. Because of high price of inorganic fertilizers, farmers would like to use bioslurry. So It should be made available to them for growing different crops. They also opine that management of slurry is slightly problematic.

Conclusion

Response of maize to bioslurry with IPNS was observed at Rangpur and Pabna. Higher seed yield and economic return was obtained from IPNS with bioslurry treatment. Use of slurry can play a vital role to minimize the present fertilizer crisis. Moreover, organic manure slurry will help to improve soil fertility in the long run. Extension service providers and farmers should be motivated for using bioslurry in crop production.

Appendix Table I. Detailed fertilizer dose for Maize at Rangpur and Pabna

Table 1(a): Fertilizer treatment at Lahirirhat FSRD site and Gobindagonj MLT site, Rangpur

Treatment	Lahirirhat (N-P-K-S-Zn-B+CD/CS kg ha^{-1})		Gobindagonj (N-P-K-S-Mg-Zn-B+CD/CS kg ha^{-1})
	2007-08	2008-09	2008-09
T_1=STB inorg. fertilizer for HYG	220-18-37-12-5-2-00	220-18-37-12-5-2-0	220-44-37-12-3-3-2-0
T_2=IPNS (5 t ha^{-1} cowdung manure) for HYG	211-13-29-12-5-2-5000	211-13-29-12-5-2-5000	-
T_3=IPNS (5 t ha^{-1} cowdung slurry) for HYG	198-11-12-12-5-2-5000	198-11-12-12-5-2-5000	195-36-12-12-3-3-2-5000
T_4=Farmers practice	104-19-65-11-3-1-0	104-19-65-11-3-1-1500	160-24-35-8-0-0-0-0
T_5=Native fertility	0-0-0-0-0-0-0	-	-

CD= Cowdung, CS=Cowdung Slurry, HYG=High yield goal, IPNS=Integrated Plant Nutrient System.

Table 1(b): Fertilizer treatment at Lahirirhat FSRD site and Gobindagonj MLT site, Rangpur.

Treatment	Lahirirhat (N-P-K-S-Zn-B+CD/CS kg ha^{-1})		Gobindagonj (N-P-K-S-Mg-Zn-B+CD/CS kg ha^{-1})
	2007-08	2008-09	2008-09
T_1=STB inorg. fertilizer for HYG	220-18-37-12-5-2-0	220-18-37-12-5-2-0	220-40-37-12-3-3-2-0
T_2=IPNS (3 t ha^{-1} poultry manure) for HYG	214-16-35-12-5-2-3000	214-16-35-12-5-2-3000	-
T_3=IPNS (3 t ha^{-1} poultry slurry) for HYG	186-0-16-12-5-2-3000	186-0-16-12-5-2-3000	160-0-2-12-3-3-3-2-3000
T_4=Farmers practice	104-19-65-11-3-1-0	104-19-65-11-3-1-0	160-24-35-8-0-0-0-0
T_5=Native fertility	0-0-0-0-0-0-0	-	-

MP= Poultry manure, PS=Poultry Slurry, HYG=High yield goal, IPNS=Integrated Plant Nutrient System.

Table 1 (c): Different fertilizer doses for Maize at Pabna

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	181-59-79-31-2.23-0.75
T_2 = IPNS with 5 t ha^{-1} CD manure	166-54-64-31-2.23-0.75 + 5 t ha^{-1} CD manure
T_3 = IPNS with 5 t ha^{-1} CD slurry	158-51-54-31-2.23-0.75 + 5 t ha^{-1} CD slurry
T_4 = FP (Average of 20 farmers)	262-56-140-31-5.40-1.93

Effect of Slurry as a Source of Organic Manure on Boro Rice

Abstract

The experiment was carried out at Barind (Rajshahi), Mymensingh, Kishoreganj, Khulna, Kushtia, Tangail and Pabna during the year of 2008-09 to see the comparative performance of slurry and inorganic fertilizer and find out the optimum and economic dose of slurry for the Boro rice. Three nutrient management packages viz. inorganic fertilizer, IPNS with cowdung manure and IPNS with cowdung slurry along with farmers` dose were tested. The significantly highest rice yield was obtained in IPNS with 5t ha^{-1} cowdung slurry treatment at Barind and Pabna. Higher and identical yield was also obtained in IPNS with cowdung manure and IPNS with cowdung slurry treatment at Tangail, Mymensingh and Kishoreganj. Similar yield was found in IPNS with bioslurry and Farmers' practice at Khulna. However response of bioslurry was not evident at Kushtia. Economic returns were also higher with same treatments due to higher yield and less requirement of inorganic fertilizers.

Introduction

The gradual degradation of soil fertility status of Bangladesh is now becoming a critical issue. A good soil should have at least 2.5% organic matter, but in Bangladesh most of the soils have less than 1.5% and some soil even less than 1% organic matter (BARC, 2005). Maintenance of organic matter is a burning issue both for the farmers and agricultural scientists. Recycling of organic matter is essential for maintaining soil fertility. It is agreed that the organic sources of nutrients applied to preceding crop can benefit the succeeding crop (Singh et al., 1996 and Hedge, 1998) and the system productivity becomes sustainable through integrated use of organic and inorganic sources of nutrients (Singh and Yadav, 1992). Recently, Govt. and different NGO established biogas plant in deferent parts of the country. The bi-product of the biogas plant i.e. slurry can be used as an excellent organic fertilizer to reduce the use of chemical fertilizer. Research work and data on the slurry is meager in our country. Boro rice is the main crop in our country. There is an ample scope to use slurry as organic manure in Boro rice. Therefore, it is very important to evaluate the efficiency of slurry as organic manure in Boro rice.

Material and Methods

The experiment was carried out at Barind (Rajshahi), Mymensingh, Kishoreganj, Khulna, Kushtia, Tangail and Pabna during the year of 2008-09. The experiment was laid out in RCB design with three compact replications, which was also replicated in three dispersed farmer` field. Unit plot size was 5m x 4m. Four fertilizer treatments viz. T_1: Soil test based inorganic fertilizer for high yield goal, T_2: IPNS (Integrated plant nutrient systems) with 5 t ha^{-1} cowdung for high yield goal, T_3: IPNS with 5 t ha^{-1} cowdung slurry for high yield goal and T_4: Farmers practice i.e average of 20 farmers. The treatment IPNS with 5 t ha^{-1} cowdung (T_2) was excluded at some locations. Forty days aged rice seedlings were transplanted with a spacing of 20 cm x 20 cm at different dates at different locations. Entire amount of TSP, Gypsum, Zinc sulphate, organic manure and MP were applied as basal as per treatment specification. Total prilled urea was applied in there installments 15, 35 and 45 DAT. Irrigations, weedings and pest control measures were done in order to support normal plant growth and development. The crop was harvested at proper time. Necessary data were collected and analyzed statistically. The economic analysis was done for gross return, net return and benefit cost ratio (BCR) for different treatments following the method suggested by Perrin *et al*. (1979). The gross return and benefit cost ratio (BCR) were estimated by using the following formula: Gross return (Tk.ha^{-1})= Yield (t ha^{-1}) × Average market price (Tk. kg^{-1}) × 1000

$$\text{BCR} = \frac{\text{Gross return}}{\text{Total cultivation cost}}$$

Data on yield and yield attributes along with other parameters of boro rice were collected properly and analyzed statistically by Duncan's New Multiple Range Test (DMRT).

Result and Discussion

Location: Barind, Rajshahi

Significant variation was observed among the different nutrient packages on yield and yield attributes of boro rice (Table 1). Significantly the tallest plant was obtained in T_3 (80.89 cm) which is statistically identical to T_1 (78.84 cm) and T_2 (78.22 cm) and the shortest plant was produced in T_4 (76.58 cm). Among the treatments, T_3 produced the highest number of effective tillers hill^{-1} (26.42) that is identical to T_1 (25.27) and T_2 (24.72) and the significantly lowest tillers hill^{-1} was obtained from T_4 (23.51). Same trend was observed in numbers grains panicle^{-1}. Higher number of grains panicle^{-1} was obtained from T_3 (81.64) that is identical to T_1 (77.67) and T_2 (71.44) and the significantly lowest grains panicle^{-1} was obtained from T_4 (54.71). Thousand grain weight was significantly varied among the packages and significantly the heaviest seed was produced by T_3 (22.29 g) followed by T_2 (21.58 g), T_4 (21.38 g) and T_1 (21.31 g).

Grain yield and straw yield of boro rice was varied significant observation among the nutrient packages (Table 1). Higher grain yield (7.63 t ha^{-1}) was obtained from T_3 probably due to the cumulative effect of higher numbers of effective tillers hill^{-1} (26.42), higher number of productive grains panicle^{-1} (81.64) and thousand grain weight (22.92 g). Treatment T_2, T_1 and T_4 produced 7.20, 6.68 and 6.38 t ha^{-1}, respectively. Same trend was observed in straw yield and higher straw yield was obtained from T_3 (7.93 t ha^{-1}) followed by T_2 (7.58 t ha^{-1}) and T_1 (7.18 t ha^{-1}) and the lowest straw yield recoded in T_4 (7.00 t ha^{-1}).

Cost and return analysis

From economic analysis (Table 2), higher gross return was obtained from T_3 (Tk. 103005 ha^{-1}) followed by T_2 (Tk.97580 ha^{-1}) and lower amount gross return was found from T_4 (Tk. 86750 ha^{-1}). Same trend was obtained in net return, higher net return was obtained from T_3 (Tk. 46533 ha^{-1}) followed by T_2 (Tk.41108 ha^{-1}) and lower amount gross return was found from T_4 (Tk. 28014 ha^{-1}) due to high cost involved of using TSP and MP. Considering benefit cost ratio (BCR), higher BCR was recoded in T_1 (1.82) followed by T_2 (1.77) and lower BCR from T_4 (1.47).

Table 1. Effect of slurry as organic manure on the yield and yield attributes of boro rice at Bijoynagar under FSRD site, Kadamshahar, Rajshahi during 2008-09

Treatments	Plant height (cm)	Tillers hill^{-1} (No.)	Grains panicle^{-1} (No.)	TSW (g)	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1 = Inorganic fertilizer	78.84ab	25.27ab	77.67a	21.31b	6.68b	7.18ab
T_2 = IPNS with 5 t ha^{-1} CD manure	78.22ab	24.72ab	71.44a	21.58ab	7.20ab	7.58a
T_3 = IPNS with 5 t ha^{-1} CD slurry	80.89a	26.42a	81.64a	22.29a	7.63a	7.93a
T_4 = FP (Average of 15 farmers)	76.58b	23.51b	54.71b	21.38b	6.38b	7.00b
LSD (0.05)	3.22	1.80	11.00	0.84	0.80	0.47
CV (%)	4.21	7.40	11.69	4.78	8.66	6.58

Table 2. Cost and return analysis as affected by slurry as organic manure on boro rice at Bijoynagar, Godagai, Rajshahi during 2008-09

Treatments	Yield (t ha^{-1})		Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
	Grain	Straw				
T_1 = Inorganic fertilizer	6.68	7.18	90680	51161	39519	1.77
T_2 = IPNS with 5 t ha^{-1} CD manure	7.20	7.58	97580	56472	41108	1.73
T_3 = IPNS with 5 t ha^{-1} CD slurry	7.63	7.93	103005	56472	46533	1.82
T_4 = FP (Average of 15 farmers)	6.38	7.00	86750	58736	28014	1.47

Price: Boro rice: Grain Tk.12.50 kg^{-1} and straw Tk.1.00 kg^{-1}, Urea Tk.612 kg^{-1}, TSP Tk.45 kg^{-1}, MP Tk.40 kg^{-1}, Gypsum Tk.7 kg^{-1}, Boron Tk.100 kg^{-1}

Location: Kushtia

The yield and yield contributing characters were significantly varied among the treatments (Table 3). The highest grain yield (8.83 t ha^{-1}) was obtained from treatment T_1 and the second highest yield (8.27 t ha^{-1}) in T_2. The lowest yield (7.50 t ha^{-1}) was obtained from farmer's practices. Economic analysis revealed that the highest benefit cost ratio (2.26) was obtained from IPNS with bio-slurry for HYG (T_2). Gross return (Tk. 126040 ha^{-1}) and net return (Tk.66775 ha^{-1}) were the highest in the treatment T_1 (Table 4).

Table 3. Yield and Yield contributing character of Rice as influenced by slurry during rabi season of 2008-2009 at Bharamara, Kushtia

Treatment	Plant pop^n m^{-1}	Plant height (cm)	No. of tiller $hill^{-1}$	Spicklet $Spike^{-1}$	Grain yield m^{-2} (g)	1000 grain wt. (g)	Yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1= Inorganic fertilizer for HYG	20	99.66	9.00	178.66	883.00	29.0	8.83	12.60
T_2 = IPNS with 5 t ha^{-1} CD slurry	20	96.00	9.00	170.66	828.66	29.0	8.27	12.43
T_3 = Farmers practice	19.66	93.33	8.0	155.66	750.00	29.0	7.50	11.25
CV (%)	1.68	1.99	8.91	3.52			1.30	1.30
LSD (5%)	NS	4.34	NS	13.57			0.24	0.37

Price :1 kg Rice =15 Tk

Table 4. Economic Performance of Rice as influenced by slurry at Bharamara, Kushtia during rabi 2008-09

Treatment	Yield (t ha^{-1})	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1= Inorganic fertilizer for HYG	8.83	126040	59265	66775	2.13
T_2 = IPNS with 5 t ha^{-1} CD slurry	8.23	117490	51886	65604	2.26
T_3 = Farmers practice	7.50	107625	58473	59152	1.84

Location: Mymensingh

Yield contributing characters and yields of boro rice as influenced by slurry have been presented in Table 5. The results of economic analysis are shown in Table 6. Table 5 shows that yield of boro rice varied significantly in all farmers plots. But other yield contributing character were not varied significantly except No. of filled grain per panicle in Farmer 1 and plant height in Farmer 2. IPNS based fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry gave significantly better yield parameters and yields which were identically followed by IPNS based fertilizer dose for HYG with 5 t ha^{-1} cowdung. Farmers' practice gave lower yields than all the STB fertilizer doses. The highest grain yields were 7.30 t ha^{-1}, 8.15 t ha^{-1} and 7.87 t ha^{-1} in Farmer 1, Farmer 2 and Farmer 3, respectively in IPNS based fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (Table 5). However, the average highest grain and straw yields were 7.77 t ha^{-1} and 7.39 t ha^{-1}, respectively in IPNS based fertilizer dose for HYG with cowdung slurry 5 t ha^{-1} (Table 6). Higher crop yields due application of bio slurry were also reported by Joshi *et al*. (1994), Jayakumar and Elangovan (1993), Manna and Hazra (1996). The treatment T_4 (Farmers' practice) gave the lowest grain (6.39 t ha^{-1}) and straw (6.08 t ha^{-1}) yields.

IPNS based fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry gave the highest gross return (Tk. 116170 ha^{-1}) and net return (Tk. 54206 ha^{-1}) and a better BCR of 1.87 which were followed by IPNS based fertilizer dose for HYG with 5 t ha^{-1} cowdung. Farmers' practice gave lower gross return (Tk. 95540 ha^{-1}) but the highest BCR (1.91) due to lower cost involvement in this treatment (Table 6).

Table 5. Yield and yield contributing characters of boro rice as affected by slurry at Phulpur, Mymensingh during 2009 (**Farmer 1)**

Treatments	Plant height (cm)	No. of tillers $hill^{-1}$	No. of filled grains $panicle^{-1}$	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	90.3	10.84	102.8ab	25.83	6.82b	6.50a
T_2	91.6	11.17	105.7a	26.18	7.23a	7.03a
T_3	92.9	11.40	105.5a	26.33	7.30a	7.03a
T_4	90.3	10.29	98.5b	25.67	6.18c	5.83b
LSD (0.05)	NS	NS	5.86	NS	0.40	0.57
CV (%)	2.64	11.55	2.84	2.50	3.86	4.31

Farmer 2

Treatments	Plant height (cm)	No. of tillers hill^{-1}	No. of filled grains panicle^{-1}	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	88.3b	11.31	103.5	26.18	7.18c	6.93b
T_2	89.5a	11.65	108. 3	26.33	7.82b	7.50a
T_3	90.3a	11.95	111.4	26.17	8.15a	7.67a
T_4	87.7b	10.75	100.5	25.50	6.52d	6.23c
LSD (0.05)	0.88	NS	NS	NS	0.19	0.21
CV (%)	1.50	6.24	7.06	2.81	4.26	4.51

Farmer 3

Treatments	Plant height (cm)	No. of tillers hill^{-1}	No. of filled grains panicle^{-1}	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	89.5	11.07	103.2	25.67	7.07bc	6.82b
T_2	90.1	11.57	107.7	26.50	7.65ab	7.30a
T_3	91.3	11.61	111.1	26.83	7.87a	7.50a
T_4	87.8	10.40	101.7	25.77	6.50c	6.18c
LSD (0.05)	NS	NS	NS	NS	0.72	0.45
CV (%)	4.86	6.32	4.44	2.25	4.96	3.29

Table 6. Grain and straw yields and economic performance of boro rice as affected by slurry at Phulpur, Mymensingh during 2009 (Average of three farmers)

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1	7.02	6.74	105020	60213	44807	1.74
T_2	7.56	7.28	113120	61964	51156	1.83
T_3	7.77	7.39	116170	61964	54206	1.87
T_4	6.39	6.08	95540	49956	45584	1.91

* Total cost includes cost of seedling, fertilizer, insecticide, cowdung, slurry, irrigation man and animal labour cost.
Price (Tk. kg^{-1}): Urea= 12, TSP= 40, MoP = 35, Gypsum= 7, Zinc sulphate= 60, Cowdung/Slurry= 1, Rice grain= 14, Rice straw= 1

Location: Pabna

The yield and yield contributing characters were significantly difference among the treatments (Table 7) except panicle length. The highest grain yield of boro rice was obtained from IPNS with 5 t ha^{-1} cowdung slurry followed by high yield goal. The cumulative positive effect of number of panicle m^2, panicle length, number of fill grain panicle^{-1}, and weight of 1000 gains might be contributed to the highest grain yield in IPNS with 5 t ha^{-1} cowdung slurry. The lowest grain yield was attained from farmers practice probably the poor performance of yield contributing characters. The highest straw yield was recorded in high yield goal followed by IPNS with 5 t ha^{-1} cowdung slurry. The availability of nutrients and balanced uptake might be enhanced optimum plant growth and finally maximized grain yield in IPNS with 5 t ha^{-1} cowdung slurry compare to other treatments.

From economic analysis, it was revealed that the highest net return and benefit cost ratio was obtained from high yield goal and it was similar to IPNS with 5 t ha^{-1} cowdung slurry. Probably slightly higher cost involvement in slurry reduced little economic return over high yield goal. The lowest net return and BCR obtained from farmer practice.

Table 7. Effect of slurry as organic manure on yield and yield contributing characters of boro rice during the rabi season of 2008- 09 at FSRD site, Pushpapara, Pabna.

Treatment	No of panicle m^2	Panicle length (cm)	No of filled grain panicle^{-1}	No of unfilled grain panicle^{-1}	1000 grain wt (gm)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
HYG	299.6a	26.14	117.6ab	28.50ab	21.51b	6.14b	7.49a
IPNS (CD)	278.6b	26.20	129.6a	17.06c	21.82ab	5.80c	6.40c
IPNS (CDS)	306.3a	26.34	130.6a	31.59a	21.97a	6.58a	6.98b
FP	259.9c	25.98	112.0b	20.07bc	21.71ab	5.54d	6.18c
CV (%)	4.24	2.49	12.51	37.86	1.68	3.93	7.12
$LSD_{0.05}$	11.79	ns	14.90	8.95	0.35	0.23s	0.47

Table 8. Cost and return analysis of boro rice as affected by slurry during the rabi season of 2008-09 at FSRD site, Pushpapara, Pabna.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1 = HYG	84059	59332	24727	1.42
T_2 = IPNS (CD)	78050	61906	16144	1.26
T_3 = IPNS (CDS)	87985	63529	24456	1.38
T_4 = FP	74685	59338	15347	1.26

Location: Khulna

Yield and yield attributing characters of Boro rice differed significantly due to different nutrient package (Table 9, 10). At Satkhira, the highest grain yield of rice was obtained from IPNS with cowdung slurry. Probably the cumulative effect of number of grains panicle^{-1} and weight of 1000 grain might be contributed to increased yield in T_2 fertilizer management. At the same time farmers practice gave the highest yield (5.78 t ha^{-1}) at Dumuria. It was probably due to its higher number of tillers hill^{-1} and grains panicle^{-1}. In both locations, soil test based inorganic fertilizer for HYG gave the lowest yield. It was due to its low number of grains panicle^{-1} and 1000 grain weight. Lower tillers number hill^{-1} also attributes to decrease the yield of T_1.

Table 9. Effect of slurry as organic manure on the yield and yield attributing characters of Boro rice at Satkhira MLT site, Satkhira during 2008-'09

Treatment	Plant ht. (cm),	Panicle length (cm)	Tillers hill^{-1}	Grain panicle^{-1}	1000-grain wt	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Inorganic basis fertilizer dose for HYG	91.53c	22.90b	13.77b	128.87b	21.00b	5.60b	6.00b
CD t ha^{-1}+IPNS	99.03a	24.93a	15.43a	143.80a	22.33a	6.20a	6.37a
Farmers practice	94.87b	24.40a	14.70a	143.73a	22.67a	6.17a	6.23a
LSD	2.031	0.9096	1.549	7.960	1.851	0.811	0.44
CV (%)	0.94	1.67	4.67	2.53	3.71	5.97	3.09

Table 10. Effect of slurry as organic manure on the yield and yield attributing chracters of Boro rice at Dumuria MLT site, Khulna during 2008-'09

Treatment	Plant ht. (cm),	Panicle length (cm)	Tillers hill^{-1}	Grain panicle^{-1}	1000-grain wt	Grain yield (t ha^{-1})	straw yield (t ha^{-1})
Inorganic basis fertilizer dose for HYG	92.42	24.22	16.44	66.11	21.00	4.38	6.50
CD t ha^{-1}+IPNS	97.86	23.09	21.44	68.67	26.67	5.33	6.48
Farmers practice	90.06	23.40	32.33	74.55	23.33	5.78	6.49
LSD (0.05)	12.29	2.75	4.42	19.42	5.81	1.17	0.072
CV (%)	5.80	5.15	1.97	12.28	10.94	10.01	0.56

Location: Tangail

Table 11 reveals that at FSRD site, Elenga situation, significantly the highest plant height (98.7cm) was recorded from T_3 (IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry). The highest number of panicle per hill (16) was also obtained from the same treatment and lowest panicle number per hill (14) was found from farmers' practice. The highest grain yield (7.67 t ha^{-1}) was obtained from the IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest yield (6.43 t ha^{-1}) was recorded from plants of farmers practice (T_4). A similar trend was also obtained in cost and return analysis (Table 12). The highest gross return (Tk. 92040 ha^{-1}) and net return (Tk 35945 ha^{-1}) were obtained from IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3).

If we consider Table 13 and Table 14 a similar trends in yield and economic return will also be observed at Modhupur situation..

Table 11. Yield of boro rice as influenced by slurry (CD) at the FSRD site, Elenga, Tangail during 2008-09.

Treatments	Plant height	Panicle $hill^{-1}$	Filled grain $panicle^{-1}$	1000 grain wt (g)	Yield t ha^{-1}
T_1=Soil test based fertilizer dose for high yield goal	98.5	15	92	21.38	6.95
T_2=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	98.2	15	94	21.45	7.27
T_3=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	98.7	16	95	21.58	7.67
T_4=Farmers practices	98.3	14	91	21.32	6.43
LSD (0.05)	2.0	0.36	4.10	0.42	0.61
CV (%)	1.7	2.0	3.7	1.6	7.1

Table 12. Cost and return analysis of boro rice production at FSRD site Elenga, Tangail

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})
T_1=Soil test based fertilizer dose for high yield goal (HYG)	83400	52406	30995
T_2=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	87240	54905	32336
T_3=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	92040	56095	35945
T_4=Farmers practices	77160	48773	28388

Price (Tk kg^{-1}) : Cowdung = 1.00, Cowdung slurry = 1.50, Urea = 12.00, TSP = 40.00, MP = 35.00, Gypsum = 8.00 and rice = 12.00

Table 13. Yield of boro rice as influenced by slurry (CD) at the MLT site, Madhupur, Tangail during 2008-09.

Treatments	Plant height	Panicle $hill^{-1}$	Filled grain $panicle^{-1}$	Unfilled grain $panicle^{-1}$	1000 grain wt (g)	Yield t ha^{-1}
T_1= Soil test based fertilizer dose for high yield goal	93.7	13	95	27	22.15	5.79
T_2=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	86.9	13	98	26	22.42	6.16
T_3=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	86.6	14	100	23	22.58	6.42
T_4=Farmers practices	95.7	13	86	35	21.28	3.35
LSD (0.05)	2.36	0.55	3.40	3.16	0.40	0.48
CV (%)	2.2	3.4	3.0	9.5	1.5	7.4

Table 14. Cost and return analysis of boro rice production at MLT site, Modhupur, Tangail

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})
T_1=Soil test based fertilizer dose for high yield goal (HYG)	69480	52369	17111
T_2=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	73920	59773	14147
T_3=IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	77040	60873	16167
T_4=Farmers practices	40200	51433	-11233

Price (Tk kg^{-1}) : Cowdung = 2.00, Cowdung slurry = 2.50, Urea = 12.00, TSP = 40.00, MP = 35.00, Gypsum = 10.00 and rice = 12.00

Farmers' reaction

Tangail — Farmers showed keen interest regarding the use of slurry as organic manure. But they opined that biogas plants are not easy available due to its higher cost involvement in establishment.

Pabna — Cowdung slurry and Poultry slurry showed better performance over chemical fertilizer, so, if it would be available they like to use it. They also opine that management of slurry is slightly problematic.

Barind — Farmers used slurry in the homestead for vegetables cultivation; but slurry as organic fertilizer in the rice crop is a new approach to the farmers. They are very much happy to see the higher yield and high cash return from boro rice cultivation by using slurry. They opined that they will use slurry in the rice production in future if it is available in the crop season.

Kushtia — Farmers were very much impressed to see the increased grain yield of wheat from cowdung slurry and less use of inorganic fertilizers.

Khulna — Farmers are interested to use slurry in their crop field. They also mentioned that it may also use in fishery gher as fish meal.

Mymensingh — Farmers are interested to use biogass slurry in their crop field. They also mentioned that it is also useful as fish meal.

Kishoreganj — Farmers are interested to use biogas slurry in their crop production field if it is available in their locality.

Conclusion

Response of Boro rice to bioslurry with IPNS was observed almost at all the locations tested. Higher grain yield and economic return was obtained from IPNS with bioslurry or IPNS with cowdung treatment. Use of slurry can play a vital role to minimize the present fertilizer crisis. Moreover, as organic manure slurry will help to improve soil fertility in the long run. Farmers should be motivated in this regard.

Appendix Table I. Detailed ferilizer dose for Boro rice at different locations

Table 1(a): Different fertilizer doses for Boro rice at Barind, Rajshahi

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	121 – 0 - 0 – 4 - 1
T_2 = IPNS with 5 t ha^{-1} CD manure	98 - 0 - 0 – 4 - 1 + 5 t ha^{-1} CD manure
T_3 = IPNS with 5 t ha^{-1} CD slurry	98 - 0 - 0 – 4 - 1 + 5 t ha^{-1} CD slurry
T_4 = FP (Average of 20 farmers)	103 - 15 - 19

Table 1(b). Fertilizer Treatment combination at Satkhira and Dumuria MLT sit during 2008-'09.

Treatments	Satkhira	Dumuria
T_1= Inorganic fertilizer	150-3-21-12-4	82-24-11-0-0
T_2= IPNS+5 t ha^{-1} cowdung slurry	128-0-0-12-3.5 +5t ha^{-1} CD slurry	59-16-0-0-0 +5t ha^{-1} CD slurry
T_3= Farmers practice	138-30-75-27-7	88-20-49-0-0

Table 1(c): Different fertilizer doses for Boro rice at Pabna

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	156-31-58-17-1.5
T_2 = IPNS with 5 t ha^{-1} CD manure	141-26-43-17-1.5 + 5 t ha^{-1} CD manure
T_3 = IPNS with 5 t ha^{-1} CD slurry	133-23-33-17-1.5 + 5 t ha^{-1} CD slurry
T_4 = FP (Average of 20 farmers)	105-23-30-21-1.76

Table 1(d): Different fertilizer doses for Boro rice at Kushtia

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	120-14-36-8-10
T_2 = IPNS with 5 t ha^{-1} CD manure	-
T_3 = IPNS with 5 t ha^{-1} CD slurry	65-0-0-0-1-1 + 5 t ha^{-1} CD slurry
T_4 = FP (Average of 20 farmers)	-

Table 1(e). Fertilizer Treatment combination at Elenga and Modhupur, Tangail

Treatments	Elenga	Modhupur
	N – P – K - S – Zn - B (kg ha^{-1})	
T_1= Inorganic fertilizer	122-16-40-10-4	120-16-40-10-4
T_2= IPNS+5 t ha^{-1} cowdung slurry	106-10-25-10-4 +5000 CD	105-10-25-10-4 +5000 CD
T_3= IPNS+5 t ha^{-1} cowdung slurry	98-8-15-10-4 +5000 CDS	96-10-25-10-4 +5000 CDS
T_3= Farmers practice	115-10-20-9	152-16-20-10

Table 1 (f): Different fertilizer doses for Boro rice at Mymensingh

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	130-24-100-20-1
T_2 = IPNS with 5 t ha^{-1} CD manure	110-16-82-20-1 +5000 CD
T_3 = IPNS with 5 t ha^{-1} CD slurry	110-16-82-20-1 +5000 CDS
T_4 = FP (Average of 20 farmers)	109-10-13-5-0

Table 1 (g): Different fertilizer doses for Boro rice at Kishoreganj

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	126-24-85-14
T_2 = IPNS with 5 t ha^{-1} CD manure	104-17-60-14 +5000 CD
T_3 = IPNS with 5 t ha^{-1} CD slurry	103-16-60-16 +5000 CDS
T_4 = FP (Average of 20 farmers)	116-24-40-0

Appendix table 2. Crop management practices of Boro rice at different locations

Site	Crop	Variety	Planting time	Harvesting time
Mymensingh	Boro	BRRI dhan 29	22-25 January	11-13 May
Kushtia	Boro	-	26 December	6 May
Tangail	Boro	BRRI dhan 29	01-12 February	18-26 May
Barind	Boro	Parija	31 Jan. – 5 Feb.	5-10 may
Pabna	Boro	BRRI dhan 29	2 February	17 May
Kishoreganj	Boro	BRRI dhan 29	25-29 January	11-13 may
Khulna	Boro	BRRI dhan 28	20-25 January	26 April

Effect of Slurry on Performance of Mustard

Abstract

The experiment was carried out at MLT site, Atgharia, Pabna and FSRD site, Ellanga, Tangail during the rabi season of 2008-2009 to see the comparative performance of slurry with inorganic fertilizers. Three nutrient management packages viz. soil test based inorganic fertilizers for HYG, IPNS with cowdung manure and IPNS with cowdung slurry for HYG along with farmers` dose were tested. in mustard. In Pabna the highest seed yield was attained in IPNS with 5 t ha^{-1} cowdung slurry which was statistically different with other treatments. Similarly, the highest seed yield of mustard was obtained with the same treatment followed by IPNS with cowdung manure treatment (T_2) in Tangail. Cost and return analysis also showed that the highest gross return and net return was obtained from IPNS with 5 t ha^{-1} cowdung slurry at both the locations.

Introduction

Mustard is one of the most important oil seed crops in Bangladesh but its yield comparatively lower than other countries. The main causes of their low yield are poor management practices and low organic matter in soil. The gradual decrease of soil fertility status of the country is now becoming a critical issue. More than 60 % of our cultivated soil contains organic matter at low level (<1.7%). So, the maintenance of organic matter is a burning issue both for the farmers and agricultural scientists. Recycling of organic matter is essential for maintaining soil fertility. More than twenty five thousand biogas plants have been established by different agencies in different parts of the country. The management and utilization of slurry of these biogas plants was not properly taken care off. By improving the management of slurry it can be used as an excellent organic fertilizer. Research work on the slurry is lacking in Bangladesh. Therefore, it is very important to evaluate the efficiency of slurry on the performance of mustard.

Objectives

1) To observe the effect of slurry on performance of mustard
2) Comparative performance of slurry with cowdung manure.
3) Comparative performance of integrated use of manure or slurry along with inorganic fertilizer and use of only inorganic fertilizer.

Materials and Methods

The experiment was carried out during the rabi season of 2008-2009 at MLT site, Atgharia, Pabna and FSRD site, Ellanga, Tangail. The experiment was laid out in RCB design with three compact replications and these were also replicated at 3 farmer's field. Unit plot size was 5m x 6m. Four fertilizer treatments viz. T_1 = Soil test based fertilizer dose for high yield goal, T_2 = Cowdung 5 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG (IPNS with CD), T_3 = Cowdung slurry 5 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG (IPNS with CDS) and T_4 = Farmers practice were employed for the experiment.

The nutrient requirement was calculated following the nutrient content of cowdung slurry and cowdung manure. The seeds of mustard (var. BARI sarisha-11) were sown on November 22, 2008 at Pabna and on 20 November 2008 in Tangail. Entire amount of all fertilizer including cowdung manure or cowdung slurry and ½ urea were applied as basal. The remaining ½ urea was applied at 30 DAS. Different intercultural operations such as weeding, thinning, irrigation, disease and other pest management practices were done as and when necessary. Crop was harvested on March 06, 2009 in Pabna and 10 February 2009 in Tangail. Necessary data were collected and analyzed statistically.

Results and Discussions

Location: Pabna

The yield and yield contributing characters were significantly difference among the treatments (Table 1). The highest seed yield was attained in IPNS with 5 t ha^{-1} cowdung slurry (T_3) which is statistically different with other treatments. The cumulative effect of yield attributes might have significant contribution to attain higher yield.The second highest yield was obtained from IPNS with 5 t ha^{-1} cowdung manure (T_2) which was also identical with HYG treatment. The lowest yield obtained from farmers practice plot. From the general observation, it was found that due to scarcity of rainfall plant establishment was poor in all treatment.

From economic analysis, it was revealed that the highest gross return was obtained from IPNS with 5 t ha^{-1} cowdung slurry (T_3) which was followed by T_2 nutrient packages. But the highest net return and BCR were calculated from farmers practice treatment due to less variable cost.

Table 1. Performance of Mustard as affected by different nutrient management at MLT site, Atgohria, Pabna during 2008-09

Treatments	Plant population m^{-2} (no.)	Plant height (cm)	Siliqua plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	1000 seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	40.00a	133.9a	130.4ab	9.72a	2.59a	1159.4b	1888.9a
T_2	40.21a	134.8a	122.1bc	9.62a	2.59a	1173.9b	1872.2a
T_3	40.23a	128.3ab	142.7a	9.71a	2.69a	1211.7a	1955.5a
T_4	38.73a	125.6b	114.8c	8.56b	1.67b	1117.2c	1861.1a
CV (%)	10.74	5.86	11.98	8.26	7.57	8.42	5.97
$LSD_{0.05}$	4.18	7.45	14.87	0.76	0.18	27.48	110.00

Table 2: Cost and return analysis of wheat produced under different nutrient management

Treatment	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1	50846	46292	4554	1.10
T_2	51331	49351	1980	1.04
T_3	52983	50662	2321	1.05
T_4	48969	36465	12504	1.34

Location: Tangail

Table 3 reveals that the highest plant height. (97.2 cm) and number of siliqua per plant (59) was recorded from the plants treated with (T_3) IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung-slurry. The highest number of seeds per siliqua (15) was obtained in all the plots from T_1, T_2 and T_3 and that of the lowest (12) was in T_4 i.e, farmers' practice. The highest 1000-seed wt. (2.51g) was also obtained from the plants treated with (T_2) IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung, which was at par with T_3 and the lowest (2.47g) seed weight was found in farmers' practice. The highest seed yield (1303 kg ha^{-1}) was obtained from the plot treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest seed yield (957 kg ha^{-1}) was recorded from plants of farmers practice (T_4). The highest straw yield (2138 kg ha^{-1}) was also obtained from the plot treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest straw yield (1794 kg ha^{-1}) was recorded from plants of farmers practice (T_4). Similar trend was also obtained in cost and return analysis (Table 4). The highest gross return (Tk. 54258 ha^{-1}) and net return (Tk. 20832 ha^{-1}) were obtained from plants treated with IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry (T_3). The lowest gross return (Tk. 40074 ha^{-1}) and net return (Tk. 3303 ha^{-1}) was from farmers' practice.

Table 3. Effects of cowdung slurry on the performance of mustard (BARI Shariha-9) at the FSRD site, Elenga, Tangail during, 2008-09

Treatment	Plant polatiom m^{-2}	Plant height cm	Siliqua plant-[1]	Seed $siliqua^{-1}$	1000 grain wt. (g)	Yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	66	92.0	53	15	2.49	1229	1932
T_2	67	92.0	56	15	2.51	1273	2051
T_3	66	97.2	59	15	2.50	1303	2138
T_4	66	90.6	48	12	2.47	957	1794
LSD (0.05)	7.44	3.82	2.98	0.73	0.52	57.28	121.35
CV (0.05)	9.1	3.3	4.5	4.1	1.7	3.9	5.0

T_1= Soil test based fertilizer dose for high yield goal
T_2= Cowdung 5 t ha^{-1}+ IPNS basis inorganic fertilizer for high yield goal (HYG)
T_3= Cowdung-slurry 5 t ha^{-1}+ IPNS basis inorganic fertilizer for high yield goal (HYG)
T_4= farmers practice

Table 4. Cost and return analysis.

Treatments	Gross return (Tk ha^{-1})	Total cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
T_1= Soil test based fertilizer dose for high yield goal (HYG)	51092	39054	12038	1.31
T_2= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung	52971	35457	17514	1.50
T_3= IPNS basis fertilizer dose for HYG with 5 t ha^{-1} cowdung slurry	54258	33426	20832	1.63
T_4= Farmers' practice	40074	36771	3303	1.09

Price (Tk kg^{-1}): Cowdung = 2.00, Cowdung slurry = 2.50, Urea = 12.00, TSP = 75.00, MoP = 45.00, Gypsum = 9.00, Boric acid = 110.00 and Mustard seed = 40.00, Straw = 1.00

Farmers' reaction

Pabna Farmers opined that slurry is good for mustard production by it is not available, transportation is problematic and cost is high.

Tangail Farmers showed keen interest regarding the use of slurry as organic manure. But they opined that biogas plants are not easy available due to its higher cost involvement in establishment.

Conclusion

Cowdung slurry along with inorganic fertilizers in IPNS produced higher seed yield of mustard at both the locations. Higher economic return was also obtained from the same treatment. Slurry could be a very good source of organic manure for crop production. However, results obtained mostly from first year trial. Therefore, the trial should be repeated in the next year for further verification.

Appendix Table I. Detailed fertilizer dose for Mustard at Pabna and Tangail

Table 1 (a): Different fertilizer doses for Mustard at Pabna

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	124-32-54-33-2.50-0.58
T_2 = IPNS with 5 t ha^{-1} CD manure	109-27-39-33-2.54-0.58 + 5 t ha^{-1} CD manure
T_3 = IPNS with 5 t ha^{-1} CD slurry	101-24-29-33-2.54-0.58 + 5 t ha^{-1} CD slurry
T_4 = FP (Average of 20 farmers)	87-23-19-14-1.7-0.82

Table 1 (b): Different fertilizer doses for Mustard at Tangail

Treatments	N – P – K - S – Zn - B (kg ha^{-1})
T_1 = Inorganic fertilizer	92-30-35-22-4
T_2 = IPNS with 5 t ha^{-1} CD manure	78-25-20-22-4 + 5 t ha^{-1} CD manure
T_3 = IPNS with 5 t ha^{-1} CD slurry	70-22-10-22-4 + 5 t ha^{-1} CD slurry
T_4 = FP (Average of 20 farmers)	115-30-37-18

Effect of Slurry as Organic Manure on Jute

Abstract

The experiment was carried out at the FSRD site, Faridpur during kharif, 2008 to see the comparative performance of slurry and inorganic fertilizer and find out the optimum and economic dose of slurry for jute. Three nutrient management packages viz. inorganic fertilizer, IPNS with poultry manure and IPNS with poultry slurry along with farmers' dose and native fertility were tested. The significantly highest fiber yield of jute was attained in IPNS with 3 t ha^{-1} poultry slurry treatment which was at par with inorganic fertilizer for high yield goal, IPNS with 3 t ha^{-1} poultry manure and farmers' practice except in one site.

Introduction

Declining of soil fertility is a common scenario in Bangladesh though magnitudes vary in different Agro-Ecological Zones (AEZ). It occurs through a combination of lowering of soil organic matter and loss of nutrients. In Bangladesh, depletion of soil fertility is mainly due to exploitation of land without proper replenishment of plant nutrients in soils. A good soil should have an organic matter content of more than 3.5 percent. But in Bangladesh, the most soils have less than 1.7 per cent, and some soils have less than 1% organic matter. The average organic matter content of top soils has decline by 20-46% over past 20 years due to intensive cultivation. More than twenty five thousand biogas plants have been established by different agencies in different parts of the country. Biogas slurry can be used as an excellent organic fertilizer. The management and utilization of slurry of these biogas plants was not properly taken care off. Positive effect of integrated use of slurry along with inorganic fertilizers was found in some tested crops in some locations. Jute is a very important fiber crop in Bangladesh and widely grown in grater Faridpur. To arrest further declination of soil fertility proper use of slurry along or in combination with inorganic fertilizers may be good options. Proper use of slurry in maintaining needs research attentions. An experiment was conducted to evaluate the performance of slurry on jute.

Materials and Methods

The experiment was conducted in triplicate set in medium high land under irrigated condition at the farmers' field of FSRD site, Hatgobindpur, Faridpur during kharif season, 2008 with objectives to observe the effect of slurry on the perfoprmance of jute grown in AEZ 12 and to compare the performance of slurry or slurry compost with aerobically decomposed organic manure. The experiment was conducted in RCB design with three replications in each set. The treatment details are given below-

T_1= Soil test based fertilizer dose for high yield goal (85-12-50-5 kg N-P-K-S ha^{-1})

T_2= Poultry manure 3 t ha^{-1} + IPNS basis inorganic fertilizer dose for HYG (50-0-28-5 kg N-P-K-S ha^{-1})

T_3= Poultry slurry 3 t ha^{-1} +IPNS basis inorganic fertilizer dose for HYG (50-0-28-5 kg N-P-K-S ha^{-1})

T_4= Farmers practice (112-25 kg N-P ha^{-1})

T_5= Native fertility

In this trial the poultry slurry was used as organic manure. The unit plot size was 5 m x 5 m. Local jute variety was used as test crop and sown in line with 25 cm apart. Two-third urea and all other fertilizers were applied as basal and rest urea as top dress after first irrigation at 35 days after sowing. Seeds were sown on 15 April, 2008. Two hand weeding and thinning were done at 30 and 50 DAS. The crop was harvested on 05 August, 2008.

Results and Discussion

In set I, significantly highest fiber yield (2.88 t ha^{-1}) was found from T_3 where five ton cowdung slurry per hectare was applied along with IPNS basis fertilizer for HYG which was at par with T1, T2 and T3 but significantly higher from native fertility. In this site, yield contributing characters like plant height and number of plants per square metre do not differ significantly among the treatments. Only the base diameters at 15 cm height differ significantly among the different fertilizer treatments. Significantly highest base diameter was found from T1 followed by T_3 and T_2. Native fertility produced the lowest base diameter.

In set II, similar trend of results of set I were also observed. In this site, treatment 3 where five ton cowdung slurry per hectare was applied along with IPNS basis fertilizer for HYG were gave significantly highest fiber yield of jute (2.79 t ha^{-1}) followed by treatment 2 (2.73 t ha^{-1}) which was at par but significantly highest from farmers practice and native fertility. Native fertility (T_5) gave the lowest yield. Only the yield contributing character base diameter differs significantly among the treatments and highest base diameter was found in T_2 which is identical with T_1, T_3 and T_4.

In set III, similar results were found like set I and set II. In this set, significantly highest fiber yield of jute was found in T3 (2.72 t ha^{-1}) which was identical with other treatments except T_5 (native fertility). Treatment 5 produced only 1.62 jute fibers per hectare. In this set, the yield contributing characters do not differ significantly among the treatments.

Considering 3 sets, the highest gross return (Tk. 69750) and net return (Tk. 63075) were found from Treatment 3 where 3 ton poultry slurry along with IPNS basis inorganic fertilizers was applied.

Set-I

Table 1. Yield and yield contributing characters of jute as affected by slurry in FSRD site, Faridpur during kharif, 2008

Treatment	Plant height (cm)	No. of plants m^{-2}	Base diameter at 15cm height (cm)	Fiber yield (t ha^{-1})
T_1= STB fertilizer dose for HYG	222	74.43	0.82a	2.77a
T_2= CD 5 t ha^{-1} + IPNS basis fertilizer dose for HYG	208	78.86	0.79a	2.79a
T_3= CD slurry 5 t ha^{-1} + IPNS basis fert. for HYG	224	76.20	0.81a	2.88a
T_4= Farmers practice	200	78.86	0.69b	2.72a
T_5=Native fertility	160	74.63	0.54c	1.79b
CV (%)	7.25	4.25	8.25	10.47

Set-II

Table 2. Yield and yield contributing characters of jute as affected by slurry in FSRD site, Faridpur during kharif, 2008

Treatment	Plant height (cm)	No. of plants m^{-2}	Base diameter at 6" height (cm)	Fiber yield (t ha^{-1})
T_1= STB fertilizer dose for HYG	235	58.00	0.91a	2.70a
T_2= CD 5 t ha^{-1} + IPNS basis fertilizer dose for HYG	241	56.88	0.92a	2.73a
T_3= CD slurry 5 t ha^{-1} + IPNS basis fert. for HYG	239	59.00	0.91a	2.79a
T_4= Farmers practice	236	56.00	0.89a	2.51b
T_5=Native fertility	208	57.66	0.74b	1.89c
CV (%)	8.42	5.20	7.42	9.65

Set-III

Table 3. Yield and yield contributing characters of jute as affected by slurry in FSRD site, Faridpur during kharif, 2008

Treatment	Plant height (cm)	No. of plants m^{-2}	Base diameter at 6" height (cm)	Fiber yield (t ha^{-1})
T_1= STB fertilizer dose for HYG	231	60.76	0.83	2.57a
T_2= CD 5 t ha^{-1} + IPNS basis fertilizer dose for HYG	231	63.00	0.82	2.68a
T_3= CD slurry 5 t ha^{-1} + IPNS basis fert. for HYG	232	62.80	0.85	2.72a
T_4= Farmers practice	228	62.66	0.83	2.57a
T_5=Native fertility	189	64.86	0.73	1.62b
CV (%)	5.58	8.25	4.87	10.54

Table 4. Cost and return analysis of jute by application of different fertilizer treatments at Faridpur during kharif, 2008 (Mean of 3 sites)

Treatments	Gross return Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1: Inorganic fertilizer for high yield goal	67000	14550	52450
T_2: IPNS with 5 t ha^{-1} CD	68250	6675	61575
T_3: IPNS with 5 t ha^{-1} CD slurry	69750	6675	63075
T_4: Farmers practice	65000	4916	60084
T_5: Native fertility	44000	0	44000

Effect of Liquid Bio-Slurry in Growing Year Round Vegetables and Quick Growing Fruit Trees in Homestead

Introduction

Bangladesh is one of the developing countries with highest population density, of which 50 percent under poverty level, 70 percent under nourished and a vast population unemployed. Even more than 30,000 people get blind at childhood every year due to deficiency in vitamin A (BARC, 1990). An earlier survey indicated that 93 percent family in Bangladesh suffering from vitamin C deficiency, 85 percent in riboflavin, 81 percent in vitamin A and calcium, 60 percent in protein and 59 percent in calorie requirement (Mahmud, 1985). There are about 18-20 million families in Bangladesh most of them live in rural areas having a homestead for each. These homesteads are the most effective and common production units for supplying food, fuel, timber and other family needs and employing family labours. When produced in homesteads, the consumption rate is naturally increased and more family nutrition is obtained through supply of fresh fruits and vegetables round the year. As reported by Hussain *et, al.* (1988) only 13 percent homestead area was under vegetable cultivation. The fresh vegetables produced from the farmers homestead can meet up the demand of nutrition of a small landless or marginal farm family round the year. The female members of the family can easily nurse the homestead crops that may create a chance of their employment.

liquid bio-slurry will be used in development activity vegetable and fruit grown in homestead areas are not properly managed and fertilized and was results yield in low. There is scope of increasing yield by proper management in homestead.

Farmers practices different patterns of vegetable and fruit in the vicinity of house hold but almost all are unplanned, poor yielded and uneconomic, non-scientific. On-Farm Research Division (OFRD) of

Bangladesh Agricultural Research Institute developed Goyeshpur Vegetables Production Model. Under these circumstances, the year round homestead vegetable production programme has been undertaken

Objectives

i) To utilize homestead resources following scientific procedure for producing fresh vegetables over space and time.

ii) To meet up the nutrient requirements of the family though the year and involve the female members.

iii) To see the effect of Liquid bio-slurry on performance of different crops grown in homestead.

Materials and Methods

The trial was conducted at MLT site, Atgharia, Pabna and MLT site Shibganj, Bogra during 2008-09. The Goyeshpur model of homestead utilization system was used in Pabna and Bogra. It included nine production units under following patterns.

Sl #	Spaces		Cropping patterns
1.	Open land	a.	Radish - Stem Amaranth - Indian spinach
		b.	Cabbage - Brinjal - Red Amaranth
		c.	Tomato -Spinach – Okra
2.	Roof	a.	Bottle gourd - Wax gourd
3.	Trellis	a.	Bottle gourd - sweet gourd
		b.	Bitter gourd - Ribbed gourd - Sponge gourd
		c.	Snake gourd - Potato Yam
4.	Tree support	a.	Country bean - Yard long bean
5.	Partial shady area	a.	Elephant foot yam
		b.	Leaf aroid (moulavi kachu)
		c.	Ginger
		d.	Perennial chilli
6.	Marshy land	a.	Pani kachu
7.	Fence	a.	Bitter gourd - Yard long bean -Bitter gourd
8.	Homestead boundary	a.	Papaya (3-5 plant)
		b.	Guava (1-2 plant)
		c.	Lemon (1-2 plant)
9.	Back yard/waste land	a.	Laizna (1-2 tree)

Before initiation of the program, farmers were selected on the basis of available resources and potentials for homestead farming under marginal farm category. Each farm families consist of average 4 members. A discussion made with the selected women farmers by the site team on year round vegetable production following Goyeshpur model. The farmers were introduced with nine production units of their homestead. The crops were selected for the 9 production units on the basis of farmers' choice and preference. Production methodology was followed mainly as per Goyeshpur Model except fertilizer. Liquid bio-slurry was used for different vegetables production @ 1kg dry basis bio-slurry per m^2. Data were collected from vegetable sector mainly. The data on total production and disposal pattern were collected and documented in a register day by day.

Results and Discussion

Vegetable production

More or less nine production niches of the homestead were brought under cultivation with the suggested vegetables of Goyeshpur model at MLT site Atghoria during the rabi season of 2008 to kharif season 2009. It was observed that the production of vegetables was higher at open sunny space followed by Roof top and trellis (Table 1). Among the season, more crops and production units were covered in kharif-2 season. On the other hand higher amount of vegetables produced in Jaistha month and Lower in Sraban month (Table 2)

Utilization of vegetables

Disposal of different vegetables produced under homestead was recorded regularly. The result indicated that disposal pattern of vegetables varied with different months. The intake was higher in Jaistha and lower in Asheen month. Vegetable intake per day per head was 198 g (Table 2). The distribution and sell of vegetables per year were recorded 84.20 kg and 129.35 kg respectively. Distribution and sale amount of vegetables were higher in the month of Jaisthe and lower in chaitra. Its indicated that the month chaitra is the lean period. The better utilization of homestead area with optimum management by their effective family labour might be enhanced optimum vegetable production and subsequent intake, distribution and sell.

Income

Total income recorded from a homestead was Tk.5538. The net income round the year was Tk.3521 where as total cost was Tk. 2017.

Apparent nutrient intake

Nutrient intake especially protein, iron, carotene, vit.B_1 and vit. C by a 4 members family through year round vegetables consumption was estimated (Table 3). Nutrient intake was varied with different vegetable growing months. Intake of nutrient was positively correlated with vegetable consumption and also with production. Nutrients intake by a family were relatively higher in Baishakh, Jaistha, Ashean, Sraban and Agrahan Monthly.

Apparent nutrient supplementation

The supplementation of nutrients from the vegetables intake by a family member of a produced in homestead was calculated. The result showed that the percentage of the requirement of protein supplied from the homestead source were 6.40 for male and 7.04 for female (Table 4). The percentage of iron and vit-A supplementation were 20.36 and 161.95 both male and female members. The percentage of Vit-B supplementation was 107.5 and 129 for male and female members respectively. Vitamin-c was supplemented 71.80 for the both male and female members of a family from homestead vegetables.

Table 1. Round the year vegetables production from different niches of homestead at MLT site, Atghoria, Pabna during April 2008 to March 2009.

Niches		Rabi (kg)	Kharif-1 (kg)	Kharif-2 (kg)	Total (kg)
		Aasheen-Falgun	Chaitra-Jaistha	Aashar-Bhadra	
Open sunny space	Bed 1	61.4	21.0	21	103.4
	Bed 2	36.6	11.5	8.0	55.1
	Bed 3	63.2	0.8	5.7	85.7
Roof top		-	35.00	12	47
Trellis		36.3	-	7.0	43
Shady place		-	-	18.3	18.3
Marshy land		-	-	-	-
Unproductive tree		3.00	19	5.25	27.25
Fence		15.6	-	5.8	21.4
Back yard		-	13	5	18.0
House Boundary		9.1	-	10.9	20

Table 2. Round the year vegetables production and utilization pattern in homestead at MLT site, Atghoria, Pabna during April 2008 to March 2009

Bengali month	Name of vegetable	Total production (kg)	Vegetable utilization (kg)			Cash income (Tk.)	Total income (Tk.)	Total cost (Tk.)	Net income
			Intake	Distribution	Sell				
Baishakh	Data, Binjal, Lady`s finger, Long yard bean, Sweet gourd, Rebbet gourd, Indian spinach,	58.5	36	7	15.5	158	598		
Jaistha	Indian spinach, Brinjal Lady`s finger, Sweet gourd, Green banana, Rebbet gourd, Spong gourd	77.3	44.6	14.9	17.8	185	831		
Aashar	Brinjal Ladys finger, Ash gourd,Moulobi Kchu, Green banana, , Spong gourd	27.7	19.1	5.45	2.5	27	306		
Sraban	Brinjal, Moulobi Kchu, Ash gourd, Papya, Spong gourd	23.3	18.9	4.4	-	120	283		
Bhadra	Battle gourd, Papya ,Moulobi Kchu, Ash gourd, Red amaranth	38.8	13.5	5.3	10	80	404		
Aasheen	Papaya, Red amaranth,Battle gourd	23.5	12.8	3	7.7	72	213		
Kartik	Papaya, Battle gourd, Country bean	28	13.8	6.2	8	126	267		
Agrahaon	Spinach, Country bean, Radish	43.1	21	8.9	13.2	243	405		
Poush	Radish, Spinach, Country bean, Tomato	51.9	16.6	10	25	183	567		
Magh	Cabbage, Bitter gourd, Tomato	42.65	19.65	6.25	16.75	149	583		
Falgun	Data, Better gourd, Cabbage	65.6	44.4	10.30	10.9	118	711		
Chaitra	Data, Indian spinach, banana,	33.5	29	2.5	2	22	371		
Total		**513.85**	**289.35 198 g/day/head**	**84.2**	**129.35**	**1483**	**5538**	**2017**	**3521**

Table 3. Apparent nutrient intake by a family under homestead vegetables production program at MLT site, Atghoria, Pabna during April 2008 to March 2009.

Bengali month	Protein (gm)	Iron (mg)	B carotene (ug)	Vit-B_1 (mg)	Vit-C (mg)
Baishakh	644.7	1187.9	2823535	19.31	8622
Jaistha	468	788	2496120	15.8	4735
Aashar	280	2142.8	89840	13.2	763
Sraban	159.3	1955.7	422200	22.72	518
Bhadra	310	69.3	686380	28.32	2710
Aasheen	400.4	50.5	766220	16.7	3019
Kartik	234	167.6	97440	20.95	638
Agrahaon	1682.8	906.3	731770	249.71	9299
Poush	302.4	398.2	307670	1430.41	1422.5
Magh	260.8	273.6	4554	60.41	5678
Falgun	160.5	117.6	332850	6.95	3125
Chaitra	238	246	30600	5.7	1400
Total	5140.9	8323.5	8512269 Vit A (RE) = 1418711.5	1890.28	41929.5

Table 4. Nutrient supplemented from a homestead production vegetables on the basis of per head per day requirements FSRD site, Pushpopara, Pabna during April 2008 to March 2009 (4 members family).

Category	% Protein	% Iron	% Vit-A	%Vit-B_1	%Vit C
Male	6.40	20.36	161.95	107.5	71.80
Female	7.04	20.36	161.95	129	71.80

Note-Average family member '4' family $^{-1}$

Location: Bogra

Yield of different vegetables of homestead are shown in Table 5. Most of its production was used for family consumption. The total vegetable production from open sunny land, roof trellis, tree support and fence were 393.25 kg with family consumption 224 kg, distribution 23 kg and sale was 146.25 kg. The average per day production per family was 2.79 kg. The harvesting period was November, 2008 to March, 2009.

Economic return: The economic return of the model on presented in Table 6. The total economic net return per homestead was Tk. 4865.50. The highest gross return was obtained from bottle gourd (Tk. 3315) which was followed by bitter gourd (Tk. 364).

Table 5. Vegetable production per homestead at South Nataipara, Bogra during Rabi 2008-09

Name of place	Name of Vegetables	Vegetable utilization (kg)			Total harvest
		Consumption	Distribution	Sold	
Open place	Radish	33.5	5.50	-	39.00
	Cabbage	40.00	6.00	-	46.00
	Tomato	17.00	-	-	17.00
	Spinach	15.00	2.00	-	17.00
Roof	Bottle gourd	20.75	7.50	24.25	52.50
Trellis	Bottle gourd	48.50	-	120.00	168.50
	Country bean	22.00	2.00	-	24.00
Unproductive tree	Bitter gourd	3.00	-	-	3.00
	Mach alu	-	-	-	-
Fence	Bitter gourd	19.75	-	-	19.75
Partial shady area	Elephant foot yam	-	-	-	-
	Leaf aroid (Moulovi Kachu)	3.50	-	-	3.50
	Baromashi Marich	-	-	--	-
	Ginger	-	-	-	-
	Termaric	-	-	-	-
Marshy land	Latiraz	-	-	-	-
Homestead boundary	Papaya	-	-	-	-
	Guava	-	-	-	-
	Citrus	1.00	-	2.00	3.00
Back yard/ waste land	Laizna	-	-	-	-
	Banana	-	-	-	-
	Total	224.00	23.00	146.25	393.25

Table 6. Economic return per homestead at South Nataipara, Bogra during 2008-09 (up to March 09)

Vegetable	Total vegetable production (kg)	Vegetable price (Tk kg^{-1})	Gross return (Tk)	Total cost (Tk)	Net return (Tk)
Radish	39.00	4.00	156.00	1527.00	3338.50
Cabbage	46.00	6.00	276.00		
Tomato	17.00	20.00	340.00		
Spinach	17.00	6.00	102.00		
Bitter gourd	22.75	16.00	364.00		
Bottle gourd	221.00	15.00	3315.00		
Country bean	24.00	12.00	264.00		
Leaf aroid (MK)	3.50	1.00	3.50		
Citrus	3.00	15.00	45.00		
Total			4865.50	1527.00 (without family labour)	3338.50

Farmers' reaction

Pabna Farmers opined that homestead vegetable production is very helpful for fulfillment their daily vegetable requirement for establishing relationship with the neighbor and some extra income. But seed and bio-slurry is main problem for the program continuation, because its different niches required very small amount of seed with different species and liquid boi-slurry handling is very problematic

Bogra Farmers are highly pleased with the higher yield and showed their positive attitude towards the bio-slurry as because slurry remained unused, if it promotes to use in crop production they could use and buy it in future.

Conclusion

Vegetables production in the homestead area through Goyeshpur model was a successful approach for homestead resource utilization and family nutrition. Vit-A and B_1 can supplement fully from homestead vegetables but protein should be supplement from animal source to fulfill ones requirements. Other minerals requirements might be fulfilled if the total production systems run properly.

On the other hand bio-slurry was not available this year due to higher chemical fertilizer cost, some times the crop suffered due to unavailability of sufficient nutrient. So, if the bio-slurry would be available the total production and quality might be increase.

A. PLAIN LAND

On-Farm Verification Trial of Hybrid Maize-Sweet Potato Intercropping System at Farmers' Field

Abstract

The experiment was conducted at MLT site Kholishakundo, Kushtia during the rabi season of 2008-09 to observe the performance of hybrid maize sweet potato intercropping and to popularize it to the farmers' level. The experiment was laid out in RCB design with four treatment combinations and three replications. The highest maize equivalent yield (9.16 t ha^{-1}) was obtained from maize paired row + 2 rows of sweet potato paired row. The highest gross return (Tk. 118950 ha^{-1}), net return (Tk. 38797 ha^{-1}) and benefit cost ratio (1.48) were recorded maize paired row + 2 rows sweet potato paired row (T_2).

Introduction

Maize is the third important cereal crop in our country. Now a day Maize is cultivated about ninety three thousand hectare land in our country. Maize mainly used as feed, fodder, fuel and bakery industry. Sweet potato plays an important role in the daily diet in other countries of the world. It also compares favorably in terms of nutritional value with other root crops, such as cassava, yam and other root crops. Hence, the study was undertaken to observe the performance of the system and to popularize it to the farmer's level.

Materials and Methods

The experiment was conducted at Kholishakundo, Kushtia during the rabi season of 2008-09. The experiment was laid out in a RCB design with 3(three) replications. There were four treatment combinations viz T_1 = sole Hybrid Maize (75 cm × 25 cm), T_2= Maize paired-row (37.5 cm /150 cm / 37.5 cm × 25 cm) + 2 rows sweet potato (60 cm × 30 cm) in between two maize paired-row, T_3= Maize normal row (75 cm × 25 cm) + 1 row sweet potato in between two Maize rows and T_4= sole sweet potato (60 cm × 30 cm). The hybrid maize variety Pacific-11 and sweet potato variety BARI sweet potato-8 were used in this trial. The size of each unit plot was (3m × 4.5m). Seeds of maize and cutting of sweet potato were sown in the field on 17 November, 2008. Fertilizers were applied at the rate of 250-60-130-30-4-1 kg NPKS Zn and B ha^{-1} for sole maize and intercrop. Half of N and all other fertilizers were applied as basal during final land preparation. Rest N was applied as top dressed in two equal splits at 35 and 65 DAS. Sole sweet potato was fertilized with 125-50-125-18-2-1 kg NPKS Zn and B ha^{-1}. Half of N and all other fertilizers were applied as basal. Rest N was applied as top dressed after 35 DAS followed by earthling up and irrigation. Plant protection measures were taken when required. The field duration of maize and sweet potato were 134 and 140 days, respectively. Maize and potato were harvested on 1 and 15 April, 2009, respectively.

Results and Discussion

The yield and yield contributing characters of maize were significantly different among the treatments except plant m^{-2} and cobs plant^{-1} (Table 1). The highest grain yield (6.5 t ha^{-1}) was recorded from sole maize followed by maize normal row + 1 rows sweet potato row (5.90 t ha^{-1}). The yield contributing characters of sweet potato were significant except plant m^{-2} and tubers plant^{-1} (Table 2). The highest tubers yield (10.90 t ha^{-1}) recorded from sole sweet potato followed by maize paired-row + 2 rows sweet potato paired-row (7.5 t ha^{-1}). The highest maize equivalent yield (9.15 t ha^{-1}) was found in maize paired-row + 2 rows sweet potato paired-row. The highest gross return (Tk. 118950 ha^{-1}) and net return (Tk. 38797 ha^{-1}) were also recorded from maize paired-row +2 rows sweet potato paired-row (Table 3). The highest benefit cost ratio (1.48) was found in maize paired-row + 2 rows sweet potato.

Farmers' reaction

Intercropping is very much popular to the farmers Meherpur, Kholishakundo, Alamdanga and Kushtia. The farmers are interested to apply this intercropping system. As two crops are cultivated in a land there is no risk for crop damage.

Conclusion

From the two years results it may be concluded that maize paired-row + 2 rows of sweet potato intercropping systems was found economically profitable than any other intercropping and sole cropping.

Table 1. Yield and yield contributing characters of hybrid maize in intercropping with sweet potato at MLT site Kholishakundo, Kushtia during the year of 2008-09.

Treatment	No. of plants m^{-2}	No. of cobs $plant^{-1}$	No. of grains cob^{-1}	1000-grain wt. (g)	Grain yield ($t\ ha^{-1}$)
Sole Maize	5	1	430	325	6.5
Maize paired row + 2 rows sweet potato paired row	4	1	450	330	5.69
Maize normal row +1 row SP in between two maize rows.	5	1	440	305	5.90
Sole sweet potato	-	-	-	-	-
LSD (0.05)			8.19	2.30	0.83
CV (%)			1.09	1.55	6.30

Price: Maize = 13 Tk /kg, sweet potato = 6 Tk/kg

Table 2. Yield and yield contributing characters of sweet potato in intercropping with maize at MLT site Kholishakundo, Kushtia during the year of 2008-09.

Treatment	No. of plants m^{-2}	No. of tuber $plant^{-1}$	Weight of tuber $plant^{-1}$ (g)	Tuber yield ($t\ ha^{-1}$)
Sole Maize	-	-	-	-
Maize paired row + 2 rows sweet potato paired row	2	4	150.0	7.5
Maize normal row +1 row SP in between two maize rows.	3	4	145.0	6.5
Sole sweet potato	5	5	275.0	10.90
LSD (0.05)		NS	17.06	2.87
CV (%)		13.45	12.15	3.57

Table 3. Economic performance of hybrid maize and sweet potato intercropping system at MLT site Kholishakundo, Kushtia during the year of 2008-09.

Treatment	Equivalent maize yield ($t\ ha^{-1}$)	Gross return ($Tk.\ ha^{-1}$)	Total cost ($Tk.\ ha^{-1}$)	Net return ($Tk.\ ha^{-1}$)	BCR
Sole Maize	6.5	84500	80903	3597	1.04
Maize paired row + 2 rows sweet potato paired row	9.15	118950	80153	38797	1.48
Maize normal row +1 row SP in between two maize rows.	8.9	115700	80903	34.807	1.43
Sole sweet potato	10.90	65400	61883	3517	1.06

Performance of Different Management Options of Lentil Relaying with T.Aman

Abstract

The experiment was carried out in the village Piarpur, Faridpur sadar, Faridpur in RCB design in medium high land during the rabi season of 2008-09 to study the production suitability and effective methods for increasing the yield of relay lentil. The trial was laid out in RCB design with five dispersed replications. Four different management practices were used as treatments viz. T_1: Relay lentil with seed treatment; T_2: Relay lentil with seed treatment + weeding; T_3: Relay lentil with seed treatment + weeding + RFD and T_4: Farmers practice (lentil relay with T.aman). Significantly highest yield was attained in treatment T_3 where T_2 gave the second highest yield. The lowest yield was obtained by farmers' practice.

Introduction

Faridpur region is the lentil growing area and lentil is mostly grown as a single crop for a long period. But a lot of plant is damaged at seeding stage due to unavailable or over soil moisture, soil born diseases etc. which causes low plant stand and as a result lower yield. It was found that relay lentil decreases the mortality of lentil. Again, sometimes sowing is delayed due to late 'zoe' condition. Relay lentil with proper management practices like seed treatment, weeding and proper fertilization can increase the yield considerably. Considering the above reasons the study was undertaken with the following objectives.

i) To study the production suitability of lentil in relay method compared to conventional
ii) To find out the effective methods for increasing the yield of relay lentil.

Materials and Methods

The trial was conducted at Piarpur, Faridpur sadar, Faridpur during the rabi season of 2008-09 in medium highland. The experiment was conducted in RCB design with five dispersed replications. Four different management practices were used as treatments viz. T_1: Relay lentil with seed treatment (Provex 200 @ 3 g kg^{-1} seed); T_2: Relay lentil with seed treatment (Provex 200) + weeding (one time at 25-30 days after rice harvest); T_3: Relay lentil with seed treatment (Provex 200 @ 3 g kg^{-1} seed) + weeding (1 HW) + RFD (20-16-15 kg N-P-K ha^{-1}) and T_4: Farmers practice (lentil relay with T.aman). The unit plot size was 5 m x 5 m with broadcast sowing. BARI mashur 4 was the test variety. The crop was sown on 6 November, 2008 and harvested on 23 February, 2009. Fungicide Rovral was sprayed one time during the foggy weather. The yield and yield contributing characters of lentil was collected and analyzed statistically.

Results and Discussion

The yield and yield contributing characters of lentil as affected by different management practices are presented in Table 1. Number of plants per square meter, plant height and 1000 seed weight do not differ significantly among the treatments. But number of pods per plant and seed yield differs significantly among the management practices. Highest number of pods per plant was observed in treatment T_3 where lentil was sown with seed treatment + weeding + recommended fertilizer dose followed by treatment T_1 and T_2 where seed treatment and seed treatment + weeding was done. Lowest number of pods per plant was given by farmers' practice. Other yield contributing characters i.e. number of plants per square meter and 1000 seed weight do not differ significantly among the practices. Significantly highest seed yield of lentil was produced from treatment T_3. The second highest seed yield was obtained from T_2 treatment with was significantly different from T_1 and T_4 treatment. Lowest yield produced from farmers' practice. The highest gross return was obtained from T_3 i.e. full package but T_2 gave the highest marginal return. Only seed treatment gave the highest marginal benefit cost ratio (MBCR) followed by seed treatment + weeding (T_2).

Farmers' reactions

Farmers' in this village usually grow lentil and lathyrus as relay crop. Heavy foggy weather reduced the lentil yield. They were interested for seed treatment but the seed treating chemical was not available in the local market.

Table 1. Yield and yield attributes of relay lentil as affected by different management options during the rabi season of 2008-09 at Faridpur

Treatment	No. of plants m^{-2}	Plant height (cm)	No. of pods plant^{-1}	1000 seed wt. (g)	Seed yield (kg ha^{-1})
T_1= Relay lentil with seed treatment	82.5	30.0	24.10b	19.00	552.6c
T_2= Relay lentil with seed treatment + weeding	86.6	31.2	24.81b	21.00	676.6b
T_3= Relay lentil with seed treatment + weeding + RFD (20-16-15 kg N-P-K ha^{-1})	86.7	31.7	28.33a	21.33	774.4a
T_4= Farmers practice	80.1	29.1	23.84c	20.00	423.3d
CV (%)	8.32	5.36	12.36	4.25	8.88

Table 2. Cost and return analysis of relay lentil by application of different management practices during the rabi season of 2008-09 at Faridpur.

Treatments	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Marginal gross return (Tk. ha^{-1})	MBCR (Over farmers practice)
T_1= Relay lentil with seed treatment	35920	315	35605	8405	26.6
T_2= Relay lentil with seed treatment + weeding	43980	2265	41715	16465	7.3
T_3= Relay lentil with seed treatment + weeding + RFD (20-16-15 kg N-P-K ha^{-1})	50336	9840	40496	22821	2.4
T_4= Farmers practice	27515	0	27515	-	-

Effect of Herbicide in Controlling Broad Leaf Weed in Wheat

Abstract

The experiment was carried out at FSRD site, Hatgobindpur, Faridpur in medium highland during the rabi season of 2008-09 with objectives to find out the effective and economic control measures of broad leaf weed in wheat field and to popularize the chemical control of weeds in wheat. The trial was laid out RCB design with six dispersed replications. Four treatments were used in the trial, namely U46D fluid @ 1 ml/litre water, Ronstar @1 ml/litre water, only one hand weeding (25-30DAS) and no weeding. Significantly the highest grain yield was found by applying Ronstar which was statistically with U46D fluid. No weed spraying treatment gave the lowest yield. Herbicide application gave highest MBCR.

Introduction

Wheat is the second most important staple food of Bangladesh next to rice. The demand of wheat is increasing day by day in the country. But the area as well as production of wheat is decreasing every year. The main reasons of decreasing wheat area are high input price, high labour cost as well as low yield. Broad leaf weed namely "Bathua" is the main problem in wheat cultivation. Farmers usually do not weeding the wheat field due to high labour cost. It was reported by Wheat Research Center (WRC) that broadleaf weed can reduce wheat yield up to 25%. So, control of Bathua by chemical will decrease the production cost as well as increase the yield. Keeping this views in mind the study was undertaken with the following objectives.

i) To find out the effective and economic control measure of broad leaf weed in wheat field.
ii) To popularizing the chemical of weeds in wheat.

Materials and Methods

The trial was conducted at FSRD Site, Hatgobindpur, Faridpur during the rabi season of 2008-09. The experiment was laid out in RCB design with six dispersed replications. Four treatments were used in the trial, namely T_1: U46D fluid @ 1 ml/ litre water, T_2: Ronstar @ 1 ml/litre water, T_3: Only one hand weeding (25-30 DAS) and T_4: No weeding. The unit plot size was 5 m x 4.5 m with 30 cm row spacing. The land was fertilized with 100-26-33-20-5-1 kg N-P-K-S-Zn-B per hectare. All TSP, MoP, Gypsum, Zinc and Boron and two-third urea were applied before final land preparation. The rest urea was applied after 1st irrigation at 18 days after sowing. The crop was sown on 20 November, 2008. Second irrigations were applied 51 days after sowing (DAS). Two hand weeding was done 17 and 44 DAS. Intercultural operations were done as and when necessary. The crop was harvested on 8 March, 2009.The The yield and yield contributing characters of wheat were collected and analyzed statistically.

Results and Discussion

The yield and yield contributing characters of wheat as affected by different herbicides are presented in Table 1. Significantly highest grain yield of wheat was found in T_2 where Ronstar @ 1 ml/litre was applied (3.59 t ha^{-1}) which are statistically identical to U 46 D fluid @ 1 ml/litre. One hand weeding (25-30 DAS) gave significantly lower yield than herbicide application and no weeding gave the lowest yield among the treatments (2.77 t ha^{-1}). The yield contributing characters of wheat, i.e. number of grain per spike differ significantly among the treatments. Highest number of grains per spike was produced from T_2 followed by T_1 and lowest from no weeding (T_4). Plant height, number of plants per square meter and 1000 seed weight do not statistically differ among the treatments. Highest straw yield was also found from T_2 followed by T_1. The significant cumulative effect of yield contributing characters supported the highest yield. Application of Ronstar gave the highest gross return and gross margin but U 46 D fluid gave the highest MBCR followed by Ronstar.

Farmers' reactions

'Bathua' is the major problem in wheat cultivation in this area. Farmers preferred chemical control of Bathua. By observing the experiment farmers already started to apply chemical for Bathua control. It is very easy and economic.

Table 1. Yield and yield attributes of wheat as affected by herbicide in controlling broad leaf weed during the rabi season of 2008-09 at FSRD site, Faridpur .

Treatment	Plant population m^{-2}	Plant height (cm)	No. of grain spike^{-1}	1000 seed wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1= U46D fluid @ 1 ml/litre water	297.5	85.9	37.26a	45.56	3.55a	4.15a
T_2= Ronstar @ 1 ml/ litre water	292.2	88.4	38.10a	45.46	3.59a	4.26a
T_3= Only one hand weeding (25-30 DAS)	283.1	83.7	32.73b	44.80	3.20b	3.66b
T_4= No weeding	285.3	80.9	29.10b	44.10	2.77c	3.25b
CV (%)	5.25	8.32	8.36	3.26	9.54	10.58

Table 2. Cost and return analysis of wheat by application of herbicide at FSRD site, Faridpur during rabi, 2008-09

Treatments	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Marginal gross return (Tk. ha^{-1})	MBCR (Over no weeding)
T_1= U46D fluid	53250	325	52925	11700	36
T_2= Ronstar	53850	425	53425	12300	29
T_3= Only one hand weeding	48000	3900	44100	6450	1.65
T_4= No weeding	41550	0	41550	-	-

Performance of B.Aus Rice Variety in the cropping Pattern Wheat or Maize B.Aus-T.Aman Rice at the Charland

Abstract

A trial was conducted in the farmers' field situation of charland area at the MLT site, Bhuapur, Tangail during the kharif-I season of 2008 to observe the field performance of BRRI developed modern B.aus rice varieties in Wheat or Maize-B.aus-T.aman rice cropping pattern. It was laid out in RCB design with four dispersed replications. Five varieties viz. BR 26, BRRI dhan 27, BRRI dhan 42, BRRI dhan 43 and local one were tested. The highest grain yield was obtained from the variety BR 26 (3.45 t ha^{-1}). Due to short duration, farmers favored BRRI dhan 42 and BRRI dhan 43, as because the varieties can escape from early flood frequently occurred in the char areas.

Introduction

Wheat or Maize-B.Aus-T.Aman rice is one of the existing dominant cropping patterns in charland area at the MLT site Bhuapur, Tangail. The pattern covers around 25-30% of the cultivated land of the locality (DAE, Tangail 2007). Farmers grow local varieties of B. aus in rainfed situation and obtain very poor yield and economic returns. BRRI has developed several modern varieties of B.aus, which are higher yielder and less susceptible to pest and diseases. A super-imposed trial of BRRI developed B. aus variety may be conducted for higher yield and economic return. Hence, the trial was under taken to improve the existing cropping pattern and to increase economic return of farmers.

Materials and Methods

The trial was conducted in the farmers' field situation of charland area at MLT site, Bhuapur, Tangail during the kharif-I season of 2008 to observe the field performance of BRRI developed modern B.aus rice varieties in Wheat or Maize-B.aus-T.aman cropping pattern. The trial was laid out in RCB design with four dispersed replications. Five varieties viz. BR 26, BRRI dhan 27, BRRI dhan 42, BRRI dhan 43 and local one were tested. The unit plot size was 10m x 8m and line to line spacing was 25cm with continuous sowing. The seeds were sown on May 9-10, 2008. The crop was fertilized with 146-50-74-33-5 kg ha^{-1} urea-TSP-MoP-Gypsum-Zinc sulphate, respectively. Half of urea and all other fertilizers were applied during final land preparation. The rest urea was applied at 30-32 days after sowing. Necessary weeding and pest management practices were done as and when necessary. The crop was harvested during 19-25 August, 2008. Necessary data were collected and analyzed statistically.

Results and Discussion

Table 1 reveals that the highest grain yield was obtained from the variety BR 26 (3.45 t ha^{-1}), which significantly differed from all other varieties tested. The lowest yield (3.05 t ha^{-1}) was obtained from BRRI dhan 43, but it was at par with BRRI dhan 42 (3.17 t ha^{-1}), BRRI dhan 27 (3.08 t ha^{-1}) and local one (3.10 t ha^{-1}). The yield obtained in BRRI dhan 42 and BRRI dhan 43 were though similar to local variety, but due to short duration and fine quality rich, farmers favored these two verities. The short duration varieties can escape from early flood frequently occurred in the char areas.

Farmers' opinion

The yield of BR 26 was higher besides, BR 26, BRRI dhan 42 and BRRI dhan 43 are short duration crop, fine quality rice. So farmers are interest to cultivate BRRI dhan 42 and 43 varieties.

Conclusion

The crop may be recommended for large scale production in char areas where BR 26 as higher yielder, BRRI dhan 42 and 43 as short duration and BRRI dhan-27 as scented rice.

Table 1. Performance of modern B. aus varieties at the MLT site, Bhuapur, Tangail during the kharif-I season of 2008.

Variety	Plant height (cm)	Days maturity	No. of panicles m^{-2}	Panicle length (cm)	No. of filled grains $panicle^{-1}$	No. of unfilled grains $panicle^{-1}$	1000-grain wt (g)	Yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)
BR 26	102.2	112	137	22.4	114	21	23.9	3.45	4.55
BRRI dhan 27	135.3	127	118	24.4	97	35	29.4	3.08	5.58
BRRI dhan 42	112.5	104	145	22.6	93	21	26.5	3.17	4.15
BRRI dhan 43	108.5	105	140	22.1	99	20	23.8	3.05	4.23
Local	137.9	117	119	25.0	105	36	26.9	3.10	6.09
LSD (0.05)	3.20	4.02	14.79	0.75	3.84	3.54	1.82	0.33	0.68
CV (%)	1.7	3.4	7.3	2.1	2.5	8.6	4.5	6.8	9.0

Performance of Different Mustard Varieties under Charland Situation

Abstract

An experiment was conducted under charland situation at the MLT site, Bhuapur, Tangail during two consecutive years of 2007-08 and 2008-09 to evaluate the performance of BARI developed mustard varieties under farmers' field condition. Tested varieties were Tori 7, BARI Sarisha 9, BARI Sarisha 6, BARI Sarisha 11, BARI Sarisha 13 and BARI Sarisha 15, Among the varieties tested BARI Sharisa 13 gave the highest seed yield (1675 kg ha^{-1}), which was at par with BARI sarisha 6 (1528 kg ha^{-1}). The lowest yield was obtained from Tori 7 (715 kg ha^{-1}). Tori 7 and BARI sarisha 9 took shorter duration (75 and 78 days) and the highest duration was recorded in BARI sarisha 11 (92 days).

Introduction

Bangladesh is to import a huge amount of vegetable oil and oil seed every year to meet up the demand. Mustard is the major oil seed crop in Bangladesh. It covers about 70% of the total oil seed production. The yield of this crop in Bangladesh is found much lower than the other countries due to lower yield potentiality of the existing local varieties along with the poor management practices. The national average yield of mustard is 0.74 t ha^{-1} (Mondal and Wahab, 2001). Oilseed Research Centre (ORC) of BARI has developed some advanced promising varieties of mustard which are supposed to be high yielder, less disease susceptible and higher oil content (44%). Developed mustard varieties (*Brassica camprestis*) has higher oil and protein contents and also well resistant to white rust (Woods-DL and Falk. KC, 2001). The varieties needed to validate their performance under farmers situation. Hence, the study was under taken to evaluate the performance of the variety under farmers' field condition.

Materials and Methods

The trial was conducted in the charland area at the MLT site, Bhuapur, Tangail during two consecutive years of 2007-08 and 2008-09 under farmers' field condition. It was laid out in RCB design with four dispersed replications. Tested varieties were Tori-7, BARI Sarisha-6, BARI Sarisha-9, BARI Sarisha-11, BARI Sarisha-13,and BARI Sarisha-15. Unit plot size was 10m x 10m and the seed rate was 6-7 kg ha^{-1}. The seeds were sown during 16-18 November, Fertilizer dose used was as per Production Technology of Oil Crops, 2001 Urea- TSP-MoP-Gypsum-$ZnSO_4$ and boric acid were applied as 225-160-80-130-10-10 kg ha^{-1}, respectively. All the Fertilizers were applied as basal except Urea. Urea was applied in two equal splits as top dress at 15-20 and 35-40 days after sowing (DAS). One weeding cum thinning was done 18 DAS. Irrigation, pests and other crop management practices were done as and when necessary. The crop was harvested variety wise during 1-15 February, 2009. The data on different plant characters, yield components and seed yield were recorded from 10 plants randomly selected in each plot. Data were analyzed statistically using CropStat package and presented in Table 1. No sunshine was observed and unusual foggy weather prevailed during the crop growing period (3-17 January, 2009)

Results and Discussion

Table 1 reveals that plant height, days to maturity, seed yield and yield attributes were significantly influenced by different varieties. The result shows that Tori-7 matured more earlier (75 days) followed by BARI sarisha-9 (78 days) while the maximum duration in maturity was recorded in BARI sarisha-11 (92 days). The BARI sharisha-6 and BARI sarisha-13 occupied the 2nd highest time in maturity (89 days). Significantly the highest plant height was obtained from BARI sarisha-11 (113 cm) and the shortest plant was observed in Tori-7 (63.6 cm). The highest number of siliqua per plant (86) was obtained from BARI sarisha-11 and the lowest number of siliqua per plant obtained from BARI sarisha-6 (42). Both the variety BARI Sarisha-6 and BARI sharisa 13 produced the highest number of seeds per siliqua (21). The variety BARI sarisha-13 provided the highest 1000-seed weight (2.88 g) and the lowest seed weight (2.16 g) was obtained from BARI Sarisha 11. The variety BARI Sarisha-13 produced the highest seed yield (1675 kg ha^{-1}). The lowest yield was obtained from variety Tori-7 (705 kg ha^{-1}). The unusual weather prevailed during the cropping period hindered the crop growth and development. As such the yields reduced of almost all varieties compared to previous year.

Farmers' reaction

Farmers are interested to cultivate BARI sarisha-11 and BARI sarisha-13 for their higher yields. It can easily be fit in the existing cropping pattern Mustard–B.aus/Jute-T.aman. They chose the varieties for their attractive seed color. BARI sarisha-9 can be fitted in cropping pattern Mustard-Boro rice-T.aman rice.

Conclusion

BARI sarisha-11 & BARI sarisha-13 provided the higher seed yield. It may be recommended for cultivation in the charland area of Bhaupur and other charland area or high land where Boro is not cultivated.

Table 1. Yield and yield contributing parameters of BARI developed mustard varieties at the MLT site, Bhuapur during the rabi season of 2008-09.

Treatment	Days to maturity	Plant height (cm)	No. of siliqua plant^{-1}	No. of seeds siliqua^{-1}	1000-seed wt. (g)	Grain yield (t ha^{-1})	
						2008-09	2007-08
Tori-7	75	63.6	44	10	2.42	715	1017
BARSarisha-9	78	89.4	65	13	2.40	953	1300
BARSarisha-6	89	105.0	42	21	2.36	1528	1345
BARSarisha-11	92	113.0	86	11	2.16	1425	1660
BARSarisha-13	89	101.7	48	21	2.88	1675	1917
BARSarisha-15	79	95.5	44	16	2.20	905	1417
LSD (0.05)	3.06	3.21	4.13	1.76	0.12	82.20	277.12
CV (%)	2.0	2.3	5.0	7.6	3.3	4.5	6.0

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Performance of Different Rapeseed and Mustard Varieties in Charland

Introduction

Rapeseed and mustard is one of the most important oil seed crop in Bangladesh. The shortage of edible oil has been prevailing in Bangladesh during the last several decades. In Bangladesh, yield of this crop is lower compared to other mustard growing countries. The reason behind this lower yield is attributed to the genetically low yield potential of local varieties and poor management practices. Thus, there was need for varieties with high yield potential of oil seed crop. To meet up the need oil seed research centre of BARI has developed some varieties. Besides this in char area of Kishoregonj one of the existing cropping pattern is Fellow-Jute-T.aman. There is a scope of introducing any rabi/winter crop in the cropping pattern. BARI developed modern varieties of mustard, which may be considered as winter crop to fit in the pattern. Therefore, the study was undertaken with the following objectives.

1. To select the suitable variety of mustard for char area.
2. To increase the total yield and economic return of the farmers'.

Materials and Methods

The experiment was conducted at MLT site Hossainpur, Kishoregonj during the rabi season of 2008-09. Four mustard varieties viz. BARI sarisha-9, BARI sarisha-14, BARI sarisha-15 and Tori-7 (check) were used in the study. The experiment was laid out in randomized complete block design with six dispersed replications. The unit plot size was 8m x 5m. The crop was fertilized at the rate of 115-34-43-26-1.8-1 kg per ha of NPKSZnB, respectively. Half of N and all other fertilizers were applied during final land preparation. Rest half of N was used as top dress at 30 days after sowing. The seeds were sown on November 04, 2008 with broadcast method. One irrigation was applied at 20-25 days after sowing. One weeding and thinning was done at 14 days after sowing. The crop was harvested variety wise on 14-21 January, 2009. Plant protection measures were taken as and when required. Data on yield and yield parameters were collected and analyzed.

Results and Discussions

All the plant characters significantly were influenced by the varieties of rapeseed and mustard except field duration, plant m^{-2} and 1000-seed weight. The highest plant height (93 cm) was found in the variety BARI sarisha-15 that was followed by BARI sarisha-14 (91cm). The variety Tori-7 produced the shortest plant (65 cm). The number of siliqua plant^{-1} was recorded from BARI sarisha-15 and BARI sarisha-9 which was statistically similar. The lowest number of siliqua plant^{-1} was recorded by Tori-7. The higher number of seeds siliqua^{-1} and thousand seed weight were recorded from the variety BARI sarisha-14 which was statistically similar to BARI sarisha-15. Tori-7 had lowest number of seed siliqua^{-1} and thousand seed weight. The higher seed yield was obtained from BARI sarisha-15 and it was statistically similar to BARI sarisha-14. It might be the cumulative effect of higher number of siliqua plant^{-1}, seeds plant^{-1} and thousand seed weight. The lowest seed yield was obtained from the variety Tori-7

Farmers' reaction

Farmers preferred BARI sarisha-14 and BARI sarisha-15 due to its good yield and similar field duration in comparison to Tori-7.

Conclusion

From the study, it may be concluded that BARI sarisha-14 and BARI sarisha-15 are suitable variety for the existing cropping pattern of char area in Hossainpur MLT site, Kishoregonj for increasing the total productivity and income of the farmers'.

Table 1. Yield and yield contributing characters of different mustard varieties during the rabi season of 2008-09 at MLT site Hossainpur, Kishoreganj.

Variety	Field duration (days)	No. of plants m^{-2}	Plant height (cm)	No. of siliqua plant^{-1}	No. of seeds siliqua^{-1}	1000 seed weight (g)	Grain yield (t ha^{-1})
BARI sariasha-9	78	69	91	56	16	2.40	1.39
BARI sariasha-14	77	64	74	52	18	2.90	1.42
BARI sariasha-15	79	63	93	56	17	2.80	1.44
Tori-7	73	72	65	43	14	2.40	1.10
LSD (0.05)	NS	NS	8.48	4.91	2.64	NS	2.96
CV (%)	9.12	11.32	8.75	18.91	14.83	6.35	24.41

Adaptive Trial on Lentil Varieties in the Surma-Kushiyara Floodplain

Abstract

A field experiment was conducted at FSRD site Jalalpur, Sylhet during the rabi season of 2008-09 to evaluate and select the suitable lentil variety in Sylhet region. BARI mosur 4, 5 and 6 were tested in the farmers' field. Results indicated that BARI masur 6 performed better then other two varieties. BARI mosur-6 gave the significant highest yield (1020 kg ha^{-1}) which was followed by BARI mosur-5 (910 kg ha^{-1}). The lowest yield was found from BARI mosur-4 (820 kg ha^{-1}).

Introduction

Pulses area an important source of protein in the daily diet of the people of Bangladesh. Pulses provide fodder for farm animals, either directly or grazing or as fodder after harvesting the grain. Pulses cover more than 5 percent of the local cropped area (Elias, 1991). It covers an area of about 4.6 lakh ha (BBS, 2001). Lentil contains about 25 percent protein, 56 percent carbohydrate, 2 percent fat, 4 percent minerals and 0.4 percent vitamins. The present consumption of pulse in our country is about 12 g/day/person which is much lower then the FAO/WHO recommendation i.e. 80 g/day/person (Hossain, 1991). Among the total production of pulses, 10.5 percent comes from lentil. There is a little scope of horizontal expansion of pulses area in our country due to the limitation of cultivated area and also competition with other crops. There fore the productivity of pulses can be increased vertically through the adoption of location specific BARI masur technology and other pulses.

Objectives

1) To evaluate the yield and economic performance and adaptability of different BARI released lentil varieties.
2) To select the suitable variety of lentil

Materials and Methods

The experiment was conducted at FSRD site, Jalalpur during the rabi season of 2008-09. The experiment was laid out in RCB design with 6 replications. The experiment plot was 5 decimal and treatment were used VIZ Ver BARI mosur 4, 5, 6. Fertilizer were used BARC fertilizer recommendation abide 2005. The sowing date was November-25, 2008. Irrigation and other intercultural management were done when necessary. Data were collected from 10 randomly selected plants from each plot and grain yield was recorded from whole plant. The record data were analyzed statistically and the means separated by DMRT.

Result and Discussions

The results revealed that BARI mosur 5 matured earlier (104) than BARI mosur 6 (110 days). Significantly the highest plant height was obtained from BARI mosur 6 which was followed by BARI mosur-5.

The highest number of pod was found from BARI mosur -6 which was followed by BARI mosur -5. The lowest pod/plant was found from BARI mosur -4. The highest 100 seed was found from BARI mosur -4 which was followed by BARI mosur -6. The lowest 100 wt was found from BARI mosur -5. In case of yield performance BARI mosur -6 were higher then other varieties. BARI mosur-6 gave the highest yield (1020 kg ha^{-1}) which was followed by BARI mosur-5 (910 kg ha^{-1}). The lowest yield was found from BARI mosur-4 (820 kg ha^{-1}). Regarding economics analysis, the highest BCR was found from BARI mosur-6 (5.49) which was followed by BARI mosur -5 (4.90). The lowest BCR was found from BARI mosur-4 (4.38).

Farmers' reaction

Farmers are very much interest to cultivate BARI mosur 5, 6 if seed is available. It also implied that in the existing situation the local variety of lentil could be replaced by BARI mosur-3 and BARI mosur-4 varieties.The gross margin was increased Tk. 6233 ha^{-1} in adopter's then non adopter's.

Conclusion

According to result, BARI mosur 5, 6 were suitable variety for that area.

Table 1. Yield and yield contributing character at FSRD site, Jalalpur, Sylhet during the rabi season of 2008-09.

Treatments	Plant height (cm)	Days to flowering	Days to maturity	No. of pods $plant^{-1}$	100 seed wt (g)	Yield (kg ha^{-1})
BARI sarisha-4	34	63	105	25	2.39	820
BARI sarisha-5	36	65	104	35	2.19	910
BARI sarishs-6	40	62	110	45	2.28	1020
LSD (0.05)	1.86	ns	2.93	3.13	0.12	46.01

Table 2. Yield and Economic analyses of lentil at FSRD site, Jalalpur, Sylhet during the rabi season of 2008-09.

Treatment	Yield (kg ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
BARI mosur 4	820	45100	10292	34808	4.38
BARI mosur 5	910	50050	10205	39845	4.90
BARI mosur 6	1020	56100	10209	45891	5.49

Mosur Tk. 55/Kg

Adaptive Trial of Improved Varieties of Sweet Potato

Abstract

An experiment was conducted in the charland area at the MLT site, Bhuapur, Tangail during rabi season of 2008-09 to introduce the modern varieties of sweet potato in the locality. Three modern varieties viz: BARI sweet potato 5, BARI sweet potato 6, and BARI sweet potato 7 were tested against local check. BARI sweet potato 7 produced the highest tuber yield of 33.45 t ha^{-1} which was similar to that of BARI sweet potato 6 (33.15 t ha^{-1}) and BARI sweet potato-5 (29.85 t ha^{-1}). The local cultivar gave the lowest tuber yield (18.15 t ha^{-1}).

Introduction

Sweet Potato (*Ipomea batatas*) is the fourth major food crop in Bangladesh. It is a tropical tuber in starch content, used as a staple food as well as a vegetable. It is used for preparing Halua, Chips, Jams, Jally etc. and to some extent alternate to rice. Farmers grow intensively sweet potato at the charland area of Bhuapur. They use their local varieties. Yield potentiality of local/traditional variety is poor and susceptible to pest and diseases. As such, they get very poor economic return. BARI has developed a good number of modern varieties of sweet potato, which are higher yielder and less susceptible to pest and diseases. An adaptive trial with BARI developed sweet potato varieties may be conducted at the charland areas for higher yield and economic return. Hence, a trial was carried out to introduce the modern sweet potato varieties in the locality and to increase economic return of farmers.

Materials and Methods

The experiment was conducted in the charland area at the MLT site, Bhuapur, Tangail during the rabi season of 2008-09 to introduce the modern varieties of sweet potato in the locality. Three modern varieties viz. BARI sweet potato 5, BARI sweet potato 6, and BARI sweet potato 7 were tested against a local check. The unit plot size was 10m x 6m and plant spacing was 30cm x 15cm. The crop was fertilized with 150-125-172 kg ha^{-1} urea-TSP-MoP, respectively. One fourth of urea and MoP and full amount of TSP were used during final land preparation. Remaining urea and MoP were top-dressed after 45 days after transplantation (DAT). The potato vines were planted on 11 November 2008. One weeding was done during the period of 15-20 DAT. The experimental plot was irrigated once at 45 DAT followed by top dress. There was no incidence of disease and pest attack. The crop was harvested during 15-18 April 2009. Necessary data were collected and analyzed statistically.

Results and Discussion

Performance of sweet potato varieties tested at the MLT site, Bhuapur are presented in Table 1. Modern variety BARI sweet potato 7 produced the highest tuber yield of 33.45 t ha^{-1} which was statistically similar with that of BARI sweet potato 6 (33.15 t ha^{-1}) and BARI sweet potato 5 (29.85 t ha^{-1}). The local variety gave the lowest tuber yield (18.15 t ha^{-1}).

Farmers' opinion

Farmers' are happy with the high yield potentiality of the modern varieties. They opined that tubers would be harvested 25-30 days earlier than local variety.

Conclusion

It was the results of first year trial. For, further verification, the trial should be repeated next year for concrete conclusion.

Table 1. Performance of sweet potato varieties at the MLT site, Bhuapur, Tangail during the rabi season of 2008-09.

Variety	Individual tuber weight (g)	Tuber yield $plant^{-1}$ (g)	Tuber yield (t ha^{-1})	% increased over local one
BARI sweet potato 5	156.0	317.7	29.85	64-84
BARI sweet potato 6	159.3	337.4	33.15	-
BARI sweet potato 7	158.2	347.8	33.45	-
Local	94.0	189.3	18.15	-
LSD (0.05)	9.05	24.65	2.73	-
CV (%)	5.3	6.9	7.9	-

Adaptive Trial of Onion Variety at the Charland

Abstract

An experiment was carried out in the charland area at the MLT site, Bhuapur Tangail during the yeaf of 2008-09 in the medium high land under AEZ # 8. It was laid out in RCB design with 6 replications. The variety BARI Peaj-1 gave the higher bulb yield (8.39 t ha^{-1}) and it was 60% higher over that of local cultivar (5.24 t ha^{-1}).

Introduction

Onion (*Allium cepa*) is the major spices crop in Bangladesh. Farmers of the charland area of Bhuapur grow onion sporadically. They use their local varieties. Yield potentiality of local/traditional variety is very poor and susceptible to pest and diseases. Thus they get very poor economic returns. BARI has developed some modern varieties of onion, which are higher yielder and less susceptible to pest and diseases. An adaptive trial with BARI developed onion varieties may be conducted there for higher yield and economic return. Hence, a trial was set to introduce the modern onion varieties in the locality and to increase economic return of farmers.

Materials and Methods

The experiment was carried out in the charland area at the MLT site, Bhuapur, Tangail during the year of 2008-09 in the medium high land under AEZ#8. The experiment was laid out in RCB design with 6 replications. The unit plot size was 6m x 5m with plant spacing 15 cm x 10 cm. The treatments were two varieties, BARI Peaj-1 and local one. The crop was fertilized with 260-200-160-80-20-7 kg ha^{-1} Urea-TSP-MP-gypsum-Zinc sulphate-boric acid, respectively. Weeding, irrigation and other crop managements were done as and when necessary. Data on yield and yield contributing parameters were recorded and were analyzed statistically.

Results and Discussion

Table 1 reveals that the variety BARI Peaj-1 produced the higher individual bulb weight (15.4 g $plant^{-1}$). The variety BARI Peaj-1 also gave the higher bulb yield (8.39 t ha^{-1}) and it was 60% higher over that of local variety (5.24 t ha^{-1}).

Farmers' reaction

Farmers are interested to cultivate BARI Peaj-1 due to its higher yield.

Conclusion

It is the results of first year trial. For concrete decision the trial should be repeated.

Table 1. Yield and other yield contributing parameters of onion variety BARI Peaj-1 at the MLT site Bhuapur during the year of 2008-09.

Treatment	Indvidual bulb weight (g)	Yield (t ha^{-1})	% yield increased over local one
BARI Peaj-1	15.4	8.39	60
Local	10.1	5.24	-
LSD (0.05)	0.82	0.71	-
CV (%)	6.8	11.0	-

Performance of Different Mustard Varieties

Abstract

The experiment was carried out at the MLT site, Zokigonj, Sylhet during the rabi season of 2008-09 to compare and select the best rapeseed mustard varieties. Four rapeseed mustard varieties were evaluated for their yield and other agronomic characters. The highest yielder was BARI Sarisha-13 at 1500 kg ha^{-1} followed by BARI Sarisha-8 at 1420 kg ha^{-1}. BARI Sarisha-9 gave the lowest yield 1090 kg ha^{-1}.

Introduction

In Sylhet region T,Aus rice (MV)- T.Aman rice MV- Fallow is the major cropping pattern in the high land and medium highlands of Surma Kushyara flood plan soils. But during winter season about 3 lac hectors of land remain fallow due to irrigation problem and lack of awareness about modern technology as well as new crop varieties. Mustard is a crop which can be grown easily in this fallow land of this area. BARI developed a number of mustard varieties which are high yielder and less susceptible to pest.

Objectives

To popularize and select the suitable BARI released mustard variety in Zakigonj area of Sylhet

Materials and Methods

The trial was carried out at the MLT site Zokigonj, Sylhet during the rabi season of 2008-09. Four rapeseed/mustard varieties viz. V_1= BARI Sarisha-8, V_2= BARI Sarisha-9, V_3= BARI Sarisha-11 and V_4= BARI Sarisha-13 were used in the experiment. The plot size was 4m $\times$3m. Fertilizers were applied at the rate of 120-30-60-24-1 kg ha^{-1} of N, P, K, S and B, respectively. The seeds are sown on 21 November, 2008 line maintaining 30 cm row to row distance with continuous seeding. The crop was harvested during 2nd week of February to 1st week of March, 2009. Data were collected on yield and attributes of mustard and analyzed.

Results and Discussion

The results revealed that the highest yield was obtained from BARI sarisha-13 (1500 kg ha^{-1}) which statistically different from other varieties. The second highest yield was obtained from BARI sarisha 8 (1420 kg ha^{-1}). The lowest yield was found from BARI sarisha 9 (1090 kg ha^{-1}). The significant cumulative effect of yield contributing characters supported higher yield of the crop.

Conclusion

BARI-13 gave the highest yield than other variety. Farmer are very much interest to cultivate this variety.

Table 1. Yield and yield contributing characters of four mustard and rapeseed varieties at MLT site, Zokigonj, Sylhet during the rabi season of 2008-09.

Variety	No. of siliqua plant^{-1}	No. of seeds siliqua^{-1}	1000 seed wt. (g)	Seed yield (kg ha^{-1})
BARI sarisha 8	70.01	20.08	3.4	1420
BARI sarisha 9	85.02	15.10	2.75	1090
BARI sarisha 11	102.52	12.95	3.05	1240
BARI sarisha 13	75.05	24.12	3.50	1500
LSD (0.05)	4.10	2.65	0.40	46.23

Table 2. Agronomic characteristics of four mustard and rapeseed varieties at MLT site, Zokigonj, Sylhet during the rabi season of 2008-09.

Variety	Plant height (cm)	Days to 50% flowering	Days to maturity
BARI sarisha 8	102.01	42	93
BARI sarisha 9	77.92	31	82
BARI sarisha 11	102.12	41	96
BARI sarisha 13	85.04	38	92
LSD (0.05)	2.45	2.20	2.41

Performance of Different Radish Varieties

Abstract

The experiment was carried out at MLT site, Zokigonj, Sylhet during the rabi season of 2008-09 to observe the performance of BARI released radish varieties at farmer's field. The root yield was observed from BARI Mula-1which was followed by BARI Mula-2. Though BARI Mula-3 performed lower yield but it was earlier than the other varieties.

Introduction

Radish is a most common and popular winter vegetable widely grown in Bangladesh. In Bangladesh, yield of the radish is poor compared to other radish growing countries. The research behind this lower yield is the lack of high yielding variety of radish. Horticulture research centre of BARI has developed some high yielding radish varieties which needed multilocations tasting for wider adaptability. Therefore, the study was undertaken to observe the performance of BARI released radish varieties at MLT site, Zokigonj.

Materials and Methods

The experiment was conducted at MLT site, Zokigonj, Sylhet during the rabi season of 2008-09. The radish variety BARI Mula-1 (Tasakisan), BARI Mula-2 (Pinky) and BARI Mula-3 (Druti) was included in the study. The experiment was laid out in RCB design with five dispersed replications. The unit plot size 8m x 5m. The land was fertilized with cowdung and NPKS at the rate of 10 ton and 150-45-120-24 kg ha^{-1}, respectively. The entire amount of cowdung, P and half of N and K were applied during final land preparation. The rest half of N and K were used as top dress after 20 and 30 days of sowing. The seeds were sown at 25 November, 2008.

Results and Discussion

From table-1 it was revealed that BARI Mula-1 becomes ready for harvest after 45 days. Average root yield is about 61 t ha^{-1}. In case of BARI Mula-2 roots are pink with soft leaves. The first harvest start after 45 DAS and continued up to 72 DAS. Average root yield is 54 t ha^{-1}. It also produced seed under local climatic condition. In case of BARI Mula-3 roots are white with cylindrical in size. It becomes ready for harvest after 37 DAS. Average root yield is about 39 t ha^{-1}. It also produces seeds locally.

Conclusion

BARI Mula-1 gave the highest yield 61 t ha^{-1}. For this region farmers are very much interest to cultivate this variety if seeds are available.

Table 1. Yield of three varieties of Radish at FSRD site, MLT site Jokigonj during the rabi season of 08-09.

Variety	Harvesting (DAS)		Yield
	First	Last	(t ha^{-1})
BARI Mula-1	45	70	61
BARI Mula-2	45	72	54
BARI Mula-3	37	56	39
LSD (0.05)	2.42	1.88	2.45

B. HIGH BARIND TRACT

Effect of Planting Date and Bulb Size on the Seed Yield and Seed Quality of Summer Onion in the High Barind Area

Abstract

The experiment was carried out in the FSRD site, Kadamshahar, Godagari, Rajshahi during the year of 2007-08 and 2008-09 to investigate the effects of bulb size and planting date on the yield and quality of onion seeds of BARI Peaj-2. The trial was laid out in factorial RCB design with three bulb size (5±2g, 10±2g and 15±2g) and three planting date (20 Oct., 05 Nov. and 20 Nov.). The result of the study revealed that bulb size and planting date had significant effect on the yield and quality of onion seed. Significantly higher seed yield (558.42 t ha^{-1}) and the lower seed yield (499.23 t ha^{-1}) were obtained when bulbs were planted on 20 November and 20 October, respectively. Significantly higher seed yield (551.07 kg ha^{-1}) was produced by using large bulb (15±2 g) that is identical to medium bulb (10±2g) and the lowest seed yield (521.46 kg ha^{-1}) obtained by using small bulb (5±2g). The interaction effect of planting date and bulb size did not vary significantly, but their combined effects were significant except 1000 seed weight. The maximum seed yield (596.67 kg ha^{-1}) was obtained by using large bulb (15±2g) planted on 20 November and lower seed yield (463.83 t ha^{-1}) was found from small bulb (5±2g) planted on 20 October.

Introduction

Onion (*Allium cepa*) is one of the most important spices crop in Bangladesh. Among the spices crops, it ranks first with an annual production of 589 thousand metric tons that is very low compared to the estimated annual requirement of about 836 thousand metric tons (Krisi Dairy, 2007). Seed has a unique role to increase onion production. The average seed yield of onion in our country (370-500 kg ha^{-1}; HRDP, 1995) is very low as compared to the other countries of the world (1000-1200 kg ha^{-1}; Brewster, 1994). Annually Bangladesh produced only 150 metric tones of onion seed as against the requirement of 300 metric tones (Rahim *et al.*1993). Therefore, a great scarcity of onion seed is noticed every year.

Different study revealed that planting time and bulb size are two important key factors for quality seed production. Brewster (1994) observed various differences in average seed yield as it depends on genotype, locality, season and method of seed production. Abedin et. al.(1999) reported that mother bulb size markedly influence the yield and quality of onion seed. Moreover planting date is a prime factor for yield and quality of onion seed. In case of early planting heavy dews adversely affect the seed crops and contrarily the late planted crop may also affect by early rain that lead to total crop failure.

On the other hand, Barind is a potential area for quality seed production of its inherent environmental conditions. Usually less humid condition prevails throughout the whole rabi season and so comparatively less pest attack is occurred during that time. That is why, area under onion seed production in High Barind Tract (HBT) is increasing day by day. Therefore, considering above facts, the present study was undertaken to find out the optimum planting time and bulb size to grow good quality onion seeds.

Materials and Methods

The experiment was conducted at Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during the year of 2007-08 and 2008-09 to find out the optimum planting date and bulb size to produce good quality seeds of summer onion in the High Barind Tract. The soil belongs to Amnura series under AEZ 26 and composed of silty clay loam in texture with having a pH value of 5.8. The treatments comprised three bulb size (5±2g, 10±2g and 15±2g) and three planting date (20 October, 05 November and 20 November).

The experiment was laid out in a factorial randomized complete block design with three replications. Onion variety BARI Peaj-2 was used in the study. The unit plot size was 3m x 2m. The bulbs were transplanted at the spacing of 25cm x 20cm. The soil of experimental plot was treated by Furadan @ 1kg/bigha before transplanting the bulbs. *Rovral* (@ 2 g/L water) and *Bavistin* (1 g/L water) were used simultaneously after 8-10 days intervals during vegetative stage as preventive measure of *purple blotch* disease. *Sumition* 57 EC @ 2 ml/L water was used to control *Apids* at 35 DAT. The plot was irrigated 10 times at 7-10 days intervals before seed maturity stage. Other operations viz. mulching, weeding etc. were done in order to support normal plant growth. The crop was harvested at maturity on 20 March to 10 April 2009. Observations were made on yield components from 10 randomly selected plants per plot. Yield data was taken as plot wise and thereafter converted into kg ha^{-1}. The data were analyzed statistically and the mean differences were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

I. Effect of planting date (2008-09)

Significant variation was observed in seed yield and yield attributes of onion among planting dates except 1000 seed weight (Table 1). Significantly taller plant (71.98 cm) was obtained when seed bulb planted on 20 Nov. which is identical to planting date on 05 Nov. (69.75 cm) and significantly smallest plant was produced seed bulb planted on 20 Oct. Significantly maximum number of seeded fruits $umbel^{-1}$ (309.67) and higher seed weight $umbel^{-1}$ (2.70 g) were obtained when the seed bulb was planted on 20 Nov. and these attributes resulting the significantly higher seed yield (558.42 kg ha^{-1}). On the other hand, significantly the lower seed yield (499.23 kg ha^{-1}) was produced when seed bulb was planted on 20 October.

II. Effect of bulb size (2008-09)

Bulb size offered significant effect on the seed yield and yield attributes of onion (Table-2). Large bulb was significantly produced the highest number seeded fruits $umbel^{-1}$ (334.22) followed by small bulb (322.33) and the lowest number seeded fruits $umbel^{-1}$ (287.56) obtained by using medium bulb. Significantly the highest amount seed $umbel^{-1}$ (2.58 g) was found from large bulb followed by medium size (2.43 g) that is identical to small bulb size (2.16 g). Same trend was observed in 1000 seed weight. Large bulb size was significantly produced the large size umbel (6.62cm) followed by small bulb (5.80cm) that is identical to medium bulb (5.09cm). Significantly higher seed yield (551.07 kg ha^{-1}) was produced by using large bulb that is identical to medium bulb (530.73 kg ha^{-1}) and the lowest seed yield (521.46 kg ha^{-1}) obtained by using small bulb.

III. Interaction effect of planting date and bulb size (2008-09)

The interaction effect of planting date and bulb size did not vary significantly, but their combined effects were significant except 1000 seed weight (Table-3). The maximum seed yield (596.67 kg ha^{-1}) was obtained by using large bulb (15±2g) planted on 20 November due to cumulative effect of producing maximum number of seeded fruits $umbel^{-1}$ (366), maximum seed weight $umbel^{-1}$ (2.96 g), large size umbel dia (7.19 cm) and the highest 1000 weight (2.88 g). Lower seed yield (463.83 kg ha^{-1}) was found from small bulb (5±2g) planted on 20 October. Similarly maximum seed yield also obtained from large bulb size (15±2g) and planted on 21 Nov. during the year of 2007-08 (Table 4).

Farmers' reaction

Farmers are pleased to have satisfactory seed yield about 500-900 kg seed ha^{-1} in both the year. They are interest to produce seed in the coming year if they get bulb of BARI Peaj-2.

Conclusion

Large bulb (15±2g) sowing on first week of November to third week of November produced the higher seed yield that is significantly differed with other sowing date and bilb size. On the other hand the highest percentage of germination (76.67%) was found from large size bulb (15±2g) planted on 6 Nov. during the year of 2007-08. So recommendation will draw after germination test of this year (2008-09) produced seeds.

Table 1. Onion seed yield and yield attributes as affected by different two date at FSRD site, Kadamshahar, Rajshahi during the year of 2008-09.

Sowing date	Plant height (cm)	No. of seeded fruits umbel^{-1}	Seed weight umbel^{-1} (g)	1000 seed wt (g)	Umbel diameter (cm)	Yield (kg ha^{-1})
20 Oct.	63.92b	309.67ab	2.01b	2.97	5.92b	499.23b
05 Nov.	69.75a	303.22b	2.47a	2.86	5.93b	545.73a
20 Nov.	71.98a	331.22a	2.70a	3.13	6.66a	558.42a
LSD (0.05)	4.66	22.50	0.28	NS	0.42	23.17
CV (%)	4.94	7.16	11.59	12.18	4.90	3.15

Table 2. Onion seed yield and yield attributes as affected by different bulb size at FSRD site, Kadamshahar, Rajshahi during the rabi season of 2008-09.

Bulb size (g)	Plant height (cm)	No. of seeded fruits umbel^{-1}	Seed weight umbel^{-1} (g)	1000 seed wt (g)	Umbel diameter (cm)	Yield (kg ha^{-1})
Small (5±2)	67.33	322.33a	2.16b	2.70b	5.80b	521.46b
Medium (10±2)	68.65	287.56b	2.43ab	2.96ab	5.09b	530.73ab
Large (15±2)	69.66	334.22a	2.58a	3.30a	6.62a	551.07a
LSD (0.05)	NS	31.00	0.28	0.50	0.42	23.17
CV (%)	4.94	7.16	11.59	12.18	4.90	3.15

Table 3. Onion seed yield and yield attributes as affected by different bulb size and sowing date at FSRD site, Kadamshahar, Rajshahi during the rabi season of 2008-09.

Bulb size × Sowing date		Plant height (cm)	No. of seeded fruits umbel^{-1}	Seed weight umbel^{-1} (g)	1000 seed wt (g)	Umbel diameter (cm)	Yield (kg ha^{-1})
20 Oct.	5±2	63.00b	330.00ab	1.90e	2.70	5.40c	463.83c
	10±2	63.62b	269.67c	2.03de	2.98	5.99bc	504.86bc
	15±2	65.13ab	329.33ab	2.10de	3.23	6.37b	509.00bc
5 Nov.	5±2	68.87ab	313.33b	2.23ce	2.53	5.64bc	549.27b
	10±2	69.33ab	289.00bc	2.45ad	2.77	5.87bc	540.00b
	15±2	70.85ab	307.33bc	2.69ac	3.28	6.29b	547.53b
20 Nov.	5±2	70.13ab	323.67b	2.36be	2.87	6.35b	531.27b
	10±2	72.80a	304.00bc	2.78ab	3.12	6.43b	547.33b
	15±2	73.00a	366.00a	2.96a	3.41	7.19a	596.67a
LSD (0.05)		8.07	38.98	0.48	NS	0.72	4.13
CV (%)		4.94	7.16	11.59	12.18	4.90	3.15

Table 4. Onion seed yield and yield attributes as affected by different bulb size and sowing date at FSRD site, Kadamshahar, Rajshahi during the rabi season of 2007-08.

Bulb size × Sowing date		Plant height (cm)	No. of seeded fruits umbel^{-1}	Seed weight umbel^{-1} (g)	1000 seed wt (g)	Umbel diameter (cm)	Yield (kg ha^{-1})	Seed Germination (%)
6th Nov.	5±2	79.67	103.87c	0.97d	2.90	5.29b	668.00c	67.67bc
	10±2	78.87	164.33b	1.37c	3.03	5.68b	812.33b	75.00ab
	15±2	81.67	195.67ab	1.81b	3.24	6.36a	866.33ab	76.67a
21st Nov.	5±2	85.30	162.93b	1.39c	2.98	5.52b	773.00bc	57.33d
	10±2	86.53	187.20ab	1.78b	3.09	5.76b	876.33ab	60.67cd
	15±2	85.33	221.33b	2.17a	3.23	6.49a	995.33a	73.67ab
LSD (0.05)		5.12	44.51	0.33	130.6	NS	0.50	7.37
CV (%)		3.40	14.17	11.37	8.63	6.27	4.67	4.15

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Efficacy of Pesticides to Control Pod Borer of Chickpea in the High Barind Tract

Abstract

Efficacy of synthetic and biopesticides against pod borer, Helicoverpa armigera (Hubner) damage in chickpea was studied at the FSRD site, Kadamshahar, Godagari, Rajashahi Bangladesh during rabi cropping season of 2008-09. The treatments were T_1: Neem seed kernel extract (2 times spraying with 7 days interval from pod formation stage), T_2: Karate 2.5 EC (Lamda Cyhalothrin) (2 times spraying with 7 days interval from pod formation stage), T_3: Neem seed kernel extract (3 times spraying with 7 days interval from flowering stage), T_4: Karate 2.5 EC (Lamda Cyhalothrin) (3 times spraying with 7 days interval from flowering stage) and T_5: Untreated control. Synthetic and biopesticides reduced pod borer damage significantly. Significantly lowest pod damage was observed in Karate 3 times spray plot (2.55%) followed by Karate 2 times spray (4.23%).Significantly the highest yield (1338 kg ha^{-1}) obtained from Karate 3 times spray plots which was statistically identical to Karate 2 times spray (1279.75 kg ha^{-1}). The highest marginal benefit cost ratio (3.19) was recorded from Karate 2 times spray treatment. Hence, it might be concluded that Karate double spray with 7 days interval from pod formation stage is the best package in managing pod borer in chickpea considering efficacy and profitability.

Introduction

Chickpea, *Cicer arietinum* L. is one of the important pulse crops in Bangladesh. It is generally grown under rainfed or residual soil moisture conditions in rabi season. Among the major pulses grown in Bangladesh, chickpea ranked fifth in area and production but second in consumption priority. Chickpea is a popular pulse crop in high Barind tract. Chickpea is cultivated about 10,000 hectares of land in the High Barind Tract (Musa *et al.,* 1998).The national average yield of chickpea is measurably low (765 kg ha^{-1}) (BBS, 2002). Among many factors responsible for low yield, insect pests appear to be the most vital. In Bangladesh, chickpea is attacked by eleven species of insect pests (Rahman *et al.,*1982). The pod borer, *Helicoverpa armigera* (Hubner) is a major and most serious pest in most of the chickpea growing areas (Begum *et al.*, 1992). A country wide survey indicated that an average of 30 to 40 per cent pods was found to be damaged by pod borer with 400 kg ha^{-1} grain loss (Rahman, 1990). In favourable condition pod borer may cause 90-95 per cent pod damage (Sachan and Katti, 1994). The young caterpillar skeletonizes the leaves, while grown up caterpillar bores into the pods and feeds on the seeds. Chemical insecticides are generally used in pod borer control attacking chickpea due to their effectiveness and easy availability. Recently, *H. armigera* is reported to have developed resistance to many commonly used insecticides (Lande, 1992). Therefore, synthetic insecticides should be used cautiously for controlling insect pests in chickpea. Farmers do not know what pesticide and at what stage of chickpea, insecticides should be applied against pod borer for effective and economic return. Generally farmers sprayed insecticides at full podding or pod maturing stage when full-grown pod borer larvae are visible on the plant with boring pods. As a result the grown up pod borers are not killed instead it creates environmental pollution. Under these circumstances, the present investigation has been undertaken to find out the appropriate pesticide as well as application schedule for the effective and economic management of pod borer attacking chickpea.

Materials and Methods

An experiment was conducted at FRSD site, Kadamshahar, Rajshahi during rabi the year of 2008-09. Application of synthetic insecticide and bio-pesticides considered as treatments of the experiments which were: T_1 : Neem seed kernel extract (2 times spraying with 7 days interval from pod formation stage), T_2: Karate 2.5 EC (Lamda Cyhalothrin) (2 times spraying with 7 days interval from pod formation stage), T_3: Neem seed kernel extract (3 times spraying with 7 days interval from flowering stage), T_4: Karate 2.5 EC (Lamda Cyhalothrin) (3 times spraying with 7 days interval from flowering stage) and T_5: Untreated control. The experiment was laid out in randomized complete block design (RCBD) with four dispersed replications. The treatments were randomly allotted in each block. The unit plot size was 3m x 4m with a distance of 100 cm between the plots. The seeds of BARI-chola 5 of chickpea were sown ranging from 23-25 October 2008 in rows with the spacing of 40 cm. The seed rate was used 50 kg ha^{-1}. The land was fertilized with 12-19-17-10-1 N-P-K-S-B kg ha^{-1} (FRG, 2005) in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. All fertilizers were applied as basal after final land preparation. The spraying was done as per different treatments. For Karate, 2 ml litre^{-1} water was applied to the field. In case of Need seed, 50g grinded seeds was soaked in 1 litre water for overnight prior to spraying and then the neem seed extract was sprayed to the chickpea field. At maturity, all the pods were collected from 10 randomly selected plants from middle rows of each plot and examined. The damaged (bored) and total numbers of pods were counted and the per cent pod damage was determined.

Plants of middle four rows avoiding border rows of each plot comprising 4.8m^2 (1.6m x 3m) area was harvested on 20-25 February 2009. The pods were then threshed; grains were cleaned and dried in the bright sunshine. The seed yield of selected area was converted to kg ha^{-1}.The experimental data were analyzed by MSTAT-C software. The percent data were subjected to square root transformation for statistical analysis. Mean comparisons for treatment parameters were compared using Duncan's Multiple Range Test (Steel and Torrie, 1960) at 5% level of significance. The economic analysis was done for gross return, gross margin and marginal benefit cost ratio (MBCR) for different treatments following the method suggested by CIMMYT, 1988. The gross return and MBCR were estimated by using the following formula: Gross return (Tk. ha^{-1}) = Yield (kg ha^{-1}) × Average market price (Tk. kg^{-1}).

$$\text{MBCR} = \frac{\text{Marginal Value of Product (MVP)}}{\text{Marginal Value of Cost (MVC)}}$$

Results and Discussion

Effect of synthetic and bio-pesticide on pod borer damage and yield

Synthetic insecticides and biopesticides reduced pod borer damage significantly (Table 1). The lowest pod borer damage (2.55%) was observed in the treatment when Karate applied 3 times at 7 days interval from flowering stage. The next lowest pod infestation (4.23 %) was found in Karate double spraying treatment, starting from pod formation at 7 days interval. The highest pod borer damage (10.66%) was recorded when the crop was not sprayed with pesticides. The highest (43.20) number of pods plant^{-1} was found in the Karate 3 times spraying treatment which was statistically identical to Karate 2 times spraying treatment (41.32) and the lowest (32.40) at untreated control. This might be due to its high toxicity with fast acting activities of Karate produced quick knock down action to pod borer . In case of untreated control, some twigs, flowers and pods may be completely damaged and resulted to higher damage and lower number of pods plant^{-1}.

Yield of chickpea varied significantly with the level of pod borer damage depending on efficacy of different synthetic and bio-pesticide application (Table 1). Significantly the highest yield (1338 kg ha^{-1}) obtained from Karate 3 times sprayed plots which was statistically identical to Karate 2 times sprayed (1279.75 kg ha^{-1}) and lowest (1048.75 kg ha^{-1}) at untreated control. By applying Karate, the yield was increased 27.58% for 3 spray and 22.03 for 2 sprays over untreated control (Table 2). Neem seed extract was moderately effective for controlling of pod borer. Lower pod borer damage and higher number of pods plant^{-1} were found in Karate spraying contributed to higher yield of chickpea.

Cost and return analysis

The gross return, gross margin and marginal benefit cost ratio was varied depending on cost of pesticidal application (Table 2). The highest gross return (Tk. 53520 ha^{-1}) was recorded from Karate 3 times sprayed treatment followed by Karate 2 times sprayed (Tk.51190 ha^{-1}) and lowest (Tk. 41950 ha^{-1}) at untreated control. On the other hand maximum variable cost (Tk.5000 ha^{-1}) was calculated from Need seed extract with spraying thrice. The marginal benefit cost analysis of pesticide application revealed the highest monetary benefit from Karate 2 times sprayed treatment and the MBCR was 3.19. The lowest MBCR (0.45) was found when the crop was applied by Neem seed extract with twice. This variation was attributed due to the variation of seed yield of chickpea along with low cost involvement in Karate application. Hence, Karate 2.5 EC (Lamda Cyhalothrin) (2 times spraying with 7 days intervals from pod formation stage) determined to be the best package in managing pod borer in chickpea considering efficacy and profitability in High Barind Tract (HBT).

Conclusion

From the results of this investigation, it may be concluded that the treatment Karate double spray with 7 days interval from pod formation stage was found economically profitable and viable in managing pod borer in chickpea considering efficacy. This was first year result. The experiment should be continued for further conformation.

Table 1. Yield and yield attributes of Chickpea influenced by pesticides spray at FSRD site, Kadamshahar, Rajshahi during the rabi season of 2008-09.

Treat	Plant height (cm)	No. of plants m^{-2}	No. of pods plant^{-1}	100 seed wt (g)	Pod damage (%)	Seed yield (kg ha^{-1})
T_1 : Neem seed extract (2 spray)	32.10	33.25	38.05	13.14	7.19 (2.68)	1087.25
T_2 : Karate 2.5 EC (2 spray)	37.55	33.62	41.32	13.16	4.23 (2.06)	1279.75
T_3 : Neem seed extract (3 spray)	35.15	29.68	38.82	13.42	5.53 (2.35)	1145.50
T_4 : Karate 2.5 EC (3 spray)	34.25	36.00	43.20	13.47	2.55 (1.60)	1338.00
T_5: Untreated control	33.50	32.06	32.40	13.03	10.66 (3.27)	1048.75
LSD (0.05)	NS	NS	3.93	NS	0.22	141.00
CV (%)	6.68	12.15	4.70	2.31	4.18	5.53

NB: Value in parenthesis is transformed data

Table 2. Effect of synthetic and bio-pesticides application on gross margin and MBCR in chickpea at FSRD site, Kadamshahar, Rajshahi during the rabi season of 2008-09.

Treatments	Grain yield (kg ha^{-1})	Yield increase over control (%)	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	MBCR (Over control)
T_1: Neem seed extract (2 spray)	1087.25c	3.67	43490	3400	40090	0.45
T_2: Karate 2.5 EC (2 spray)	1279.75ab	22.03	51190	2900	48290	3.19
T_3: Neem seed extract (3 spray)	1145.50bc	9.23	45820	5000	40820	0.77
T_4: Karate 2.5 EC (3 spray)	1338.00a	27.58	53520	4350	49170	2.66
T_5: Untreated control	1048.75c	-	41950	-	41950	-

Variable cost means pesticide cost and labour cost for spraying pesticide

Price: Karate 2.5 EC = Tk.100/100 ml, Need seed = Tk.50 kg^{-1} and Chickpea= Tk. 40 kg^{-1}, Labour wage for spraying pesticides = Tk.150/day/labour (work 8 h/day)

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Minimization of Post Harvest Losses of Tomato in the High Barind Tract

Abstract

The experiment was conducted at the FSRD site office room, Kadamshahar, Rajshahi in High Barind Tract during the rabi season of 2008-2009 with a view to effect of postharvest treatments on physical change of early tomato in High Barind area. Six postharvest treatments were- T_1: Grading and store at 85 to 90% relative humidity (RH), T_2: Washing of tomato with sodium hypo-chloride solution (0.02%), T_3: Treating with Baiclean (5-10 min.), T_4: T_1+ T_2, T_5: T_1+ T_3 and T_6: Control (Farmers' practice) used in the experiment. It was found that the quality of fruits were decreased with the advancement of storage duration and lost their marketability at the later stage. Among the treatments used, grading and store at 85 to 90% RH showed better performance up to 24 days after storage (DAS) and Washing of tomato with sodium hypo-chloride solution (0.02%) showed better at the later of storage period in relation with percent weight loss and marketable fruits of tomato. But the farmers practice showed poor performance during storage period.

Introduction

Tomato (*Lycopersicon esculentum* Mill.), one of the important fruit vegetables is available both in fresh and processed form. Tomato is a popular vegetable in Bangladesh especially in the urban areas. The total tomato production in the country is about 1.03 lac metric ton (BBS, 2004). It has multipurpose demand in both home and industry. It is rich and cheap source of vitamins and minerals. Current food production of the world is about five billion metric tons for the hungry teeming millions. About 30-40% of the crop produce harvested in the developing countries never reach the consumer, mainly because of diseases and insect attack and pre and postharvest losses (Millar, 1976). Tomato is a perishable vegetable, so postharvest loss is high. Once it is fully ripe, the fruit becomes soggy, non-edible and marketing quality deteriorates rapidly. The perishability of fruits leads to adverse physiological changes like loss of weight due to respiration and transpiration, softening of flesh and loss of resistant to microbial attack.

A vast area of land of High Barind Tract is being used for cultivating early hybrid tomato to get high price in the early market. Farmers harvest green immature tomato fruits and ripen with the spraying of chemical. As a results huge amount of tomato are damaged. So, post harvest loss is very high in this area. It can be overcome by using some management practice. Under these circumstances, the present investigation has been undertaken how to minimize the post harvest losses of early tomato in High Barind area.

Materials and Methods

The experiment was carried out at the FSRD site office, Kadamshahar, Rajshahi during the rabi season of 2008-09. Firstly, tomato was grown in the farmers' field of Kadamshahar, Godagari under High Barind Tract for getting tomato fruits. The study was conducted in completely randomized design with three replications. The six post harvest treatments were assigned the experiment such as, T_1: Grading and store at 85 to 90%RH, T_2: Washing of tomato with sodium hypo-chloride solution (0.02%), T_3: Treating with Baiclean (5-10 min.), T_4: T_1+ T_2, T_5: T_1+ T_3, T_6: Control (Farmers' practice). The seed was sown in seed bed on 27 August 2008. The 29 days old seedlings were transplanted in the main plots on 26 September 2008 with spacing 60 cm row to row distance and 40 cm plant to plant distance. The experimental plot was fertilized with 250-90-125-30-1 kg ha^{-1} N-P-K-S-B, respectively in the form of urea, TSP, MoP, gypsum and boric acid, respectively and 10 t ha^{-1} cowdung (FRG, 2005). The TSP, boric acid and cowdung were applied during final land preparation as basal. The next MoP and urea fertilizers were used in two installment after 25 and 40 days after planting, respectively. The tomato hybrid variety Surakha was used as test crop. Irrigation was applied three times during the crop-growing period. Insecticide (Admire @ 0.5 ml/L water) and fungicide (Ridomil Gold @ 2g/L water) were sprayed four times for controlling insect and diseases of tomato plant. Weeding and other intercultural operations were done as per need for better growth and development of the crop plant.

The green mature tomato was harvested at afternoon on 5 January 2009. The main experiment was set at FSRD office room as per different treatments on the 5 January 2009. For each treatment, 5 kg of green mature and uniform tomato fruits was used. The number of tomato fruits of 5 kg for different treatments was counted separately. Relative humidity for specific treatment was controlled by hanging of water soaked gunny bag and closing the window as well as door in the room as was need. After washing by chemical, tomato fruits were air dried and stored on the floor of the room. Data on changes in different physical characters viz., % weight loss and % marketable fruits were recorded. Collected data were statistically analyzed with the helping of computer MSTAT-C program developed by Russell (1986). The mean differences were compared by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of post harvest treatments on percent weight loss

Different post harvest treatments exhibited significant variation on percent weight loss of tomato fruits at all days after storage (Table 1). Tomato fruits registered increasing trend in weight loss with the advancement of storage duration. The result is in close conformity with the results obtained by Dutta *et al*. (1991). It is due to evaporation, transpiration and respiration and dehydration loss. At 6 DAS the percent of weight of tomato ranged from 1.67 to 4.28%. The lowest percent of weight loss of tomato fruits (1.67%) was observed from the treatment grading and store at 85-90% RH (T_1) followed by combination grading and store at 85-90% RH and washing with Sodium hypochloride solution (T_4). The control treatment showed maximum percent of weight loss (4.12%). Similar trend of results were found at 12, 18 and 24 DAS. At 30 DAS the lowest percent of weight loss (18.60%) was found from washing tomato with NaHCl solution (T_2) and this treatment showed lower percent of weight loss both at 36 DAS (41.32%) and 42 DAS (59.54%).

These can be explained by the facts that at the beginning of the T_1 treatment the relative humidity was higher, so lower respiration and dehydration occurred resulted to lower percent of tomato weight loss found. At later period, tomato fruits became soggy and pathogenic activity may be higher resulted to higher weight loss. But in the treatment T_2 may be damaged resulted to lower percent of tomato weight loss was recorded at later period.

Effect of post harvest treatments on marketable tomato fruits

Post harvest treatments showed significant variations at 24, 30, 36 and 42 DAS in relation to percent of marketable fruits (Table 2). At 24 DAS maximum percent of marketable fruits was found in grading and store at 85 to 90% RH (T_1) (93.92%) followed by washing of tomato with sodium hypochloride solution (T_2) and minimum percent of marketable fruits was observed in farmers practice (74.72%). Although significant different was not showed at 6, 12 and 18 DAS but similar results of 24 DAS were recorded at the above mentioned DAS's. At both the 36 and 42 DAS, the highest percent of marketable tomato fruits were recorded when the fruits were washed with NaHCl solution and lowest at control treatment. Washing tomato with NaHCl solution (T_2) showed lower percent of weight loss both at 36 DAS (41.32%) and 42 DAS (59.54%) contributed to higher percent of marketable fruits.

Conclusion

From the above results, it can be concluded that among the postharvest treatments, grading and store at 85 to 90% RH showed better performance up to 24 days after storage (DAS) and Washing of tomato with sodium hypo-chloride solution (0.02%) showed better at later of storage period considering percent weight loss and marketable fruits of tomato. This study needs further investigation in the next year for concrete conclusion.

Table 1. Effect of postharvest treatments on percent of weight loss of tomato at days after storage (DAS)

Treatments	% weight loss						
	6 DAS	12 DAS	18 DAS	24 DAS	30 DAS	36 DAS	42 DAS
T_1: Grading and store at 85 to 90%RH	1.67 e	2.13 d	2.95 d	7.14 e	24.80 b	58.51 a	82.53 a
T_2: Washing of tomato with sodium hypochloride solution (0.02%),	2.70 c	5.01 b	5.86 c	11.30 cd	18.60 c	41.32 b	59.54 b
T_3: Treating with Baiclean (5-10 min.)	4.12 a	6.86 a	9.52 b	20.22 b	36.34 a	53.85 b	66.78 b
T_4: T_1+ T_2	2.38 d	4.06 c	5.04 c	10.33 d	22.79 b	53.19 b	77.33 a
T_5: T_1+ T_3	3.57 b	4.07 c	5.33 c	12.23 c	24.61 b	48.60 c	75.32 a
T_6: Control (Farmers' practice).	4.28 a	6.90 a	12.67 a	24.15 a	35.40 a	52.14 b	66.92 b
LSD (0.05)	0.18	0.65	1.10	1.01	2.71	2.76	7.25
CV (%)	3.21	7.57	8.96	3.98	5.62	3.02	5.71

Table 2. Effect of postharvest treatments on percent of marketable tomato fruits at days after storage (DAS)

Treatments	% marketable tomato fruits						
	6 DAS	12 DAS	18 DAS	24 DAS	30 DAS	36 DAS	42 DAS
T_1: Grading and store at 85 to 90%RH	99.54	99.54	98.60	93.92 a	76.13 b	42.33 cd	13.14 d
T_2: Washing of tomato with sodium hypochloride solution (0.02%),	98.67	96.68	95.68	91.52 ab	82.05 a	56.13 a	32.55 a
T_3: Treating with Baiclean (5-10 min.)	97.15	96.04	92.43	80.55 c	62.84 c	45.01 c	27.53 b
T_4: T_1+ T_2	98.22	96.91	95.49	88.09 b	76.54 b	43.22 cd	10.80 d
T_5: T_1+ T_3	97.72	97.71	95.94	90.03 ab	75.70 b	50.08 b	16.72 c
T_6: Control (Farmers' practice).	97.04	94.35	88.14	74.72 d	60.08 c	40.39 d	19.53 c
LSD (0.05)	NS	NS	NS	3.94	4.53	3.60	3.08
CV (%)	1.64	2.75	5.68	2.56	3.52	4.38	8.63

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C. COASTAL AREA

Productivity of Mungbean-T.aman Rice Crop Sequence under Different Fertilizer Levels for Coastal Region

Abstract

A field experiment was carried out at Banerpota farm, Satkhira during the year of 2008-09 with a view to observe productive potential of the pattern, cropping pattern based fertilizer recommendation and determine economic dose of fertilizer for the system. For this, crop (mungbean) residue managed in main plot. The management was as such, crop residue removed and crop residue incorporated in soil after picking of pods. The succeeding crop was T.aman (BINA dhan-7). The highest yield of T.aman was found in the plot fertilized with 120 kg N ha^{-1} and incorporation of mungbean in the soil.

Introduction

Southern part of Bangladesh is mainly rice based. The soil fertility and productivity of Satkhira is gradually declined due to intensive cultivation with modern varieties of rice crops and lack of soil management. Traditionally the farmers are not interested to cultivate green manuring crops as sole crop but mungbean is a crop which can provides both the biomass and seed yield at a time. Incorporation of mungbean biomass into the soil can improve the soil fertility status. Which may reduces the fertilizer application in succeeding crop. Besides this, addition of organic matter also decreases the soil salinity in some extent. The soil at Banerpota Farm, Satkhira is characterized by high soil salinity, high bulk density, low organic matter and low N. Therefore, the present study was undertaken to reduce the fertilizer dose through incorporation of mungbean biomass and maximize productivity of succeeding T.Aman.

Materials and Methods

The experiment was conducted at Banerpota farm, Satkhira during the year of 2008-09. Before implementing the experiment, initial soil samples were collected from the experimental plots and were analyzed. The experiment was land out in split plot design with 3 replications. Mungbean residue management is in main plot and fertilizer in sub plot. Unit plot size was 4.8m × 3.6m. Five fertilizers treatments viz. T_1: 40 kg N ha^{-1}, T_2: 80 kg N ha^{-1}, T_3: 120 kg N kg^{-1}, T_4: Farmers practice and T_5: Control were applied for the experiments. Thirty two days old seedlings (var. BINA dhan 7) was transplanted on 6 August, 2008 maintain spacing 20cm × 25cm. Entire amount of TSP, MoP and Gypsum and zinc were applied as basal at the rate of 175-50-20-4 kg ha^{-1} respectively. Total prilled urea was applied in three installments at 15, 30 and 45 days after transplanting (DAT). Due to sufficient rainfall no irrigation was done. Other management and pest control measures were taken as and when required. The crop was harvested on 25 October 2008. Yield and yield contributing characters were recorded and analyzed statistically.

Results and Discussion

Yield and yield contributing characters differ among the treatments (Table 1 & 2). The plot, incorporated with mungbean, gave the highest grain yield (5.27 t ha^{-1}) while mungbean removed plot gave yield 5.00 t ha^{-1}. It might be due to highest number of grains $panicle^{-1}$ in both cases. Farmers practice gave the highest yield next to 120 kg N ha^{-1}. Regardless, incorporation and removal of mungbean, the lowest yield was obtained from control (no nitrogen) plot.

Conclusion

From the results, it is revealed that the highest grain yield found from the plot incorporated with mungbean as previous crop. The experiment completed a full pattern in this year. For drawing a final conclusion, it should be repeated in the next year.

Table 1. Yield and yield attributing characters of T.aman rice (crop residue incorporated) during the year of 2008-09.

Fertilizer dose	Plant height (cm)	No. of tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	Wt. of 1000-grain (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
40 kg N ha^{-1}	91.66	19.00	23.00	121.00	25.17	3.73	4.27
80 kg N ha^{-1}	91.00	18.00	23.67	118.33	25.26	5.02	5.09
120 kg N ha^{-1}	100.00	22.00	28.00	122.00	25.18	5.27	5.09
Farmer practice	94.00	23.67	27.00	127.33	25.48	5.09	5.23
Control	71.67	14.00	16.33	71.67	24.17	2.15	2.13
LSD (0.05)	11.93	3.53	3.506	8.24	0.2729	0.509	0.039
CV (%)	7.06	9.70	7.76	3.90	0.57	6.29	4.78

Table 2. Yield and yield attributing characters of T.aman rice (crop residue removed) during the year of 2008-09.

Fertilizer dose	Plant height (cm)	No. of tillers hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	Wt. of 1000-grain (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
40 kg N ha^{-1}	87.67	19.33	22.67	115.33	25.10	3.31	4.31
80 kg N ha^{-1}	93.33	19.00	21.00	109.33	25.02	4.74	4.66
120 kg N ha^{-1}	101.00	18.33	24.00	121.00	25.17	5.00	5.21
Farmer practice	94.67	21.67	23.33	119.33	25.45	4.90	5.27
Control	63.67	15.67	17.67	54.00	24.88	2.40	2.25
LSD (0.05)	7.06	2.94	2.91	4.25	0.060	0.372	0.352
CV (%)	4.26	8.30	7.10	2.18	0.14	4.88	4.32

Performance of Mustard Varieties Relaying with T.aman Rice in Coastal Region of Bangladesh

Abstract

An on-farm trial was carried out at the MLT site, Satkhira during the rabi season of 2008-09 to compare and to select the suitable mustard varieties. Five mustard varieties were tested to evaluate their performance under relayed condition. The highest yield was obtained from BARI sarisha-9 (583 kg ha^{-1}) which was followed by BINA sarisha-5 (567 kg ha^{-1}) at Satkhira MLT site. Comparatively the short duration variety BARI Sarisha-9 gave reasonable seed yield (583 kg ha^{-1}).

Introduction

Bangladesh has an acute shortage of oil seeds in respect of its demand. The farmers of Satkhira area generally grow local mustard variety after harvest of T.Aman rice. The productivity of this mustard variety is very low. In most cases, farmers sow the mustard seed after harvest of long duration local T.Aman rice variety and resultantly, the yield reduced drastically due to its late planting and high soil salinity. In the context, the farmers of the locality wish to get a new mustard variety which can perform well without breaking the existing cropping pattern. Oil Seed Research Centre of BARI has developed some varieties of mustard which deserve the high yield potential and having less disease susceptibility. Mustard can be relayed with T.Aman to ensure the right sowing time. Keeping this view in mind the present experiment was undertaken.

Materials and Methods

The experiment was conducted at Satkhira during the rabi season of 2008-09 to evaluate the performance of mustard varieties. The experiment was laid out in RCBD with 3 replications. The name of the tested varieties were BARI Sarisha-9, BARI Sarisha-11, BARI sarisha-14, Tori-7 and BINA sarisha-5. The mustard seed was broadcasted in T.Aman paddy field before 15days of harvesting. T.Aman (Var. BINA dhan-4) was cultivated as short duration rice variety. The seed rate was 10 kg ha^{-1} and seeds were sown on 20 October 2008. Initially the experimental plots were fertilized with 250-170-85-150 kg ha^{-1} Urea, TSP, MoP and Gypsum, respectively. All the fertilizers were applied as basal except urea. Urea was applied as top dress on 20 and 35 days after sowing. The crop was harvested at the time of maturity. Intercultural operations and plant protection measures were taken as and when necessary. The data on different plant characters were collected from 10 plants randomly selected in each plot and yield was recorded plot wise. Data were analyzed statistically using the programme MSTAT-C. During the crop period salinity level was 2.56 to 8.62 dS m^{-1}.

Results and Discussion

The performance of different mustard varieties have been presented in Table 1. The variety Tori-7 and BARI saisha-9 took the shortest time for maturity (68 days), BARI sarisha-9 gave the highest yield (583 kg ha^{-1}) which was statistically similar with the variety BINA sarisha-5 (567 kg ha^{-1}). Higher plant population might be the cause of the highest seed yield of BARI sarisha-9. But it also took minimum time to get maturity (68 days). Tory-7 produced seed yield 450 kg ha^{-1} and the lowest seed yield was found in both BARI sarisha-11 and BARI sarisha-14 (433 kg ha^{-1}).

Farmers' reaction

- Farmers of this locality have preferably selected the variety BARI Sharisha-9 and Tori-7 because of their short days to maturity. They also interested to relaying mustard with T.Aman. Because, it is possible to cultivate with zero tillage and seedling can survive also in lower level of salinity in presence of adequate soil moisture.
- Cultivation of early maturing T.Aman rice (Var. BINA dhan-4) can be expanded to fit the Tory-7 and BARI sarisha-9 in T.Aman-Boro cropping pattern.

Conclusion

Considering the yield and days to maturity, BARI sarisha-9 and Tori-7 can be suggested in T.Aman-Fallow-Boro cropping pattern in coastal region of Satkhira. However, this is the first year results of the experiment and it needs further investigation before drawing final conclusion.

Table 1. Yield and yield attributing characters of mustard relaying with T.Aman at Satkhira MLT site during the rabi season of 2008-09.

Variety	Days to maturity	No. of plants m^{-2}	Plant height (cm)	No. of pod $plant^{-1}$	No. of seeds pod^{-1}	1000-seed weight (g)	Seed yield (kg ha^{-1}.)	Straw yield (kg ha^{-1}.)
BINA sarisha-5	73	134.00	40.87	14.07	10.67	5.17	566.67	1600.00
Tori-7	68	146.00	62.67	21.30	8.57	4.10	450.00	1416.67
BARI sarisha-9	68	149.67	73.23	26.83	10.27	4.10	583.33	186.67
BARI sarisha-11	83	98.03	91.73	30.43	9.07	4.33	433.33	2033.33
BARI sarisha-14	83	176.33	79.63	24.23	11.30	3.90	433.33	2050.00
LSD (0.05)	-	24.07	7.591	4.46	1.539	0.3904	235.7	261.80
CV (%)	-	9.08	5.78	10.13	8.20	4.78	25.37	7.75

On-Farm Verification Trial of Hybrid Maize-Sweet Potato Intercropping System

Abstract

The experiment was conducted at ARS, Daulatpur, Khulna during the rabi season of 2008-09 to evaluate the performance of hybrid maize intercropping with sweet potato. There were four combinations viz. T_1: Sole hybrid maize, T_2: Maize paired-rows + 2 row of sweet potato, T_3: Maize normal row + 1 row of sweet potato in between two maize row and T_4: Sole sweet potato. The highest maize equivalent yield (18.31 t ha^{-1}) was found from sole sweet potato, the highest gross return (Tk. 274650 ha^{-1}) and gross margin (Tk. 255760 ha^{-1}) was recorded from the same. But for intercropping systems the highest maize equivalent yield (12.30 t ha^{-1}) was obtained from maize paired-row + 2 rows of sweet potato.

Introduction

Maize is the third important cereal crop in our country. Now- a- days maize is being cultivated in about 300000 hectare of land in our country. Maize is mainly used as feed, fodder, fuel and bakery industry. Sweet potato plays an important role in the daily diet in other countries of the world. It also compares favorably in terms of nutritional value with other root crops, such as cassava, yam and other root crops. Hence the study was undertaken to show the performance of the maize-sweet potato planting system and to popularize it to the formers level.

Materials and Methods

The experiment was conducted at ARS, Daulatpur, Khulna during the rabi season of 2008-09. The experiment was laid out in RCB design with three replications. There were four treatment combinations viz. T_1: Sole hybrid maize (75cm × 25cm), T_2: Maize paired row (37.5cm/ 150cm/37.5cm X 25cm) + 2 row of sweet potato (60cm × 30cm), T_3: Maize normal row (75cm × 25cm) + 1 row of sweet potato in between two maize row and T_4: Sole sweet potato (60cm × 30cm). The hybrid maize variety pacific-11 and sweet potato BARI sweet potato-6 were used in this trial. Seeds of maize and cuttings of sweet potato were sown planted in the field on 08 December, 2008. Fertilizers were applied at 250-60-130-30-4-1 kg NPKSZn and B ha^{-1} for sole maize and intercropping. Half of N and all other fertilizers were applied as basal. Rest N was top dressed in two equal splits at 35 and 65 DAS. Sole sweet potato was fertilized with 125-50-125-18-2-1 kg NPKSZn and B ha^{-1}. Fertilization method was same as sole maize and intercrop. But in this case, rest N was top dressed at 35 DAS followed by earthing up and irrigation. Plant protection measures were taken as and when necessary. Both crops were harvested on 23 April, 2009. Data were collected and analyzed statistically.

Results and Discussion

Yield and yield contributing characters of maize and sweet potato were significantly differ among the treatments (Table 1 & 2). The highest grain yield (8.99 t ha^{-1}) was recorded from sole maize which was not identical with rest two treatments. The highest root yield (45.78 t ha^{-1}) was obtained from sole sweet potato and it was also statistically different from other two treatments. The highest maize equivalent yield (18.31 t ha^{-1}) was found in sole sweet potato. Highest gross return, gross margin and benefit cost ratio (BCR) were also recorded from the same treatment. In between two intercrops the maize equivalent yield and BCR (4.03) was obtained from maize paired row+2 row sweet potato.

Conclusion

This is the first year experiment. It should be continued in the next year for final conclusion.

Table 1. Yield and yield contributing characters of hybrid maize in intercropping maize with sweet potato at ARS, Daulatpur, Khulna during the rabi season of 2008-09.

Treatments	No. of plant plot^{-1}	No. of grains cob^{-1}	1000 grain weight (g)	Grain yield (t ha^{-1})
T_1: Sole maize	85.33	461.00	346.67	8.99
T_2: Maize paired-row + 2 rows sweet potato	70.33	420.67	340.00	8.20
T_3: Maize normal row + 1 rows in between two maize rows	71.33	431.67	302.67	7.25
LSD (0.05)	3.07	75.00	23.75	0.62
CV (%)	1.79	7.56	3.18	3.34

Table 2. Yield and yield contributing characters of sweet potato in intercropping maize with sweet potato at ARS, Daulatpur, Khulna during the rabi season of 2008-09.

Treatments	No. of plant plot^{-1}	No. of root plant^{-1}	Root wt plant^{-1} (g)	Root yield (t ha^{-1})
T_1: Sole maize				
T_2: Maize paired-row + 2 rows sweet potato	28.67	3.33	483.00	10.26
T_3: Maize normal row + 1 rows in between two maize rows	41.33	3.00	244.67	7.60
T_4: Sole sweet potato	69.00	3.53	896.67	45.78
LSD (0.05)	4.14	0.52	16.40	5.39
CV (%)	3.94	6.99	13.15	11.21

Table 3. Economic performance of hybrid maize-sweet potato intercropping system at ARS, Daulatpur, Khulna during the rabi season of 2008-09.

Treatments	Maize equivalent yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1: Sole maize	8.99	134850	41520	93330	3.24
T_2: Maize paired row + 2 rows sweet potato	12.30	184500	45760	138740	4.03
T_3: Maize normal row + 1 row sp in between two maize rows	10.29	154350	44000	110350	3.50
T_4: Sole sweet potato	18.31	274650	46890	255760	5.86

Price : Maize= Tk. 15 kg^{-1} & Sweet potato= Tk. 6 kg^{-1}

Intercropping Groundnut with Mungbean in Varying Plant Population

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Introduction

In Bangladesh continued population expansion has been forcing the farm households to utilize the available crop land more intensively to produce more food. Because of significant expansion of cultivated area in Bangladesh is not economically or environmentally sound option like most countries of the world. Intercropping or mixed cropping is a way for increasing crop production per unit land area. This has been reported from many countries viz. Bangladesh, India, China, Taiwan, Srilanka, Vietnam, Africa and Latin America (BEETs, 1977). Intercropping is widely practiced by the farmers in Bangladesh because of increased productivity and reliability in production. Moreover, intercropping gives a greater stability of yield over monoculture (willey and Reddy, 1981). Besides mixed or intercropping is widely practiced by the farmers because it often gives higher cash return and total production per hectare than growing one crop alone (Grims et al., 1983, Kurata, 1986, Evans, 1960) and ensure greater resource-use efficiency (Herrara and Harwood 1974, Pathick and Malla 1979). Groundnut is a long duration crop that requires about 130-140 days to mature if sown in December 15 to January. Groundnut is an important legumes crop in Bangladesh and can be grown as an intercrop with maize and sugarcane successfully. Mungbean is an important short duration legumes crop and can profitably be grown as with groundnut to avoid competition for lands with other crops. Therefore, there is a need for developing technology suitable for mungbean/groundunt intercropping. It is reported that the use of variety, row arrangement, spacing and plant population are some of the strategies that may prompt the yield of the intercrop (Herrara and Harwood 1974). Therefore the present study was undertaken to determine the suitable planting arrangement of groundnut and mungbean in intercropping systems and to assess the economic benefit of the systems.

Materials and Methods

The experiment was conducted at farmer's field of MLT site, Laxmipur during the Rabi season of 2008-09. The soil of the experiment area belongs to Young Meghna Estuarine Floodplain (AEZ 18 f) and Meghna Estuarine Floodplain (AEZ 18), respectively. The soils of the experimental plot were sandy loam in texture. The experiment was laid out in a randomized complete block design with three replications in each location. The treatments are as follows: T_1: Sole Groundnut, T_2: Sole Mungbean, T_3:100% Groundnut + 20% Mungbean, T_4: 100% Groundnut + 40% Mungbean, T_5: 100% Groundnut + 60% Mungbean. The unit plot size was 6m × 4m. The cultivar of groundnut and mungbean used were Dhaka-1 and BARI Mungbean-5, respectively. The crops were sown on last week of January in 2009. Spacing of groundnut was maintained at 40cm × 10 cm. The spacing of mungbean was varied according to treatment-to-treatment. Row to row distance was 40 cm and plant to plant was maintained as 5cm, 50 cm, 25 cm and 12 cm as according to the treatment T_2 {Sole groundnut (100%)}, T_3 (100% groundnut + 20% mungbean), T_4 (100% groundnut+ 40 % mungbean), T_5 (100% groundnut + 60 % mungbean) respectively. The land was fertilized with 20-30-25-7 kg ha^{-1} (N-P-K-S), the whole amount of P, K, S and half of N were applied at the time of final land preparation and remaining was applied at 30 DAS. Harvesting data varied from treatment to treatment and crop to crop. Groundnut equivalent yield, land equivalent ratio (LER) and economic analysis were done for each treatment on a hectare basis considering the market rate of crop. Groundnut Equivalent Yield (GEY) was calculated by converting the yield of mungbean to the yield of Groundnut as follows:

$$\text{GEY} = \frac{\text{Mungbean yield (kg ha}^{-1}\text{)} \times \text{Mungbean price (Tk. ha}^{-1}\text{)}}{\text{Groundnut price (Tk. ha}^{-1}\text{)}}$$

Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C.

Results and discussion

Yield and yield attributes of groundnut

The result indicated that most of the yield attributed of groundnut was influenced to intercropping system (Table 1). But plant height, Branches per plant and 100 kernel weights was found insignificant. The highest pods per plant (21) were found in sole groundnut which was statistically similar with 100% groundnut + 20% mungbean (19.50) and 100% groundnut + 40% mungbean (18.33) and lowest (15.33) was found in 100% groundnut + 60% mungbean. The highest no. of seeds per pod (1.77) was found in sole groundnut which was statistically similar with 100% groundnut + 40% mungbean (1.71) and the lowest (1.62) was found in 100% groundnut + 60% mungbean .The results also revealed that the highest groundnut yield was obtained from sole crop (2.35 t ha^{-1}) which was statistically different than the other intercropping combination but lowest was found in T_5 (1.74 t ha^{-1}).

Groundnut equivalent yield

All the intercropped system showed higher groundnut equivalent yield than sole groundnut except 100% groundnut + 60% mungbean. The highest groundnut equivalent yield was recorded from 100% groundnut + 40% mungbean (2502 kg ha^{-1}) and lowest in 100% groundnut + 60 % mungbean (2203 Kg ha^{-1}).

Cost and return analysis

The highest gross return and gross margin were obtained from 100% groundnut + 40 % mungbean though cost of cultivation was higher than sole groundnut. The highest LER was found in 100 %groundnut + 40% mungbean and lowest in 100% groundnut + 60% mungbean.

Yield of intercrop

Among the intercrop the higher yield was recorded from 100 % groundnut + 40% mungbean and lowest in 100 % groundnut + 20% mungbean.

Findings

100% groundnut + 40% mungbean were most feasible and profitable combination due to higher groundnut equivalent yield and LER

Farmers' reaction

They already cultivated the mungbean as broader crops. Farmers opined that 100 % groundnut + 40% mungbean was more suitable combination due to moderate yield of groundnut with additional yield of mungbean.

Table 1. Yield and yield contributing characters of groundnut as affected by varying plant population in groundnut-mungbean intercropping.

Treatments	Plant height (cm)	Branch per plant (No.)	Pods per plant (No.)	Seed per plant (No.)	100-kernal wt (g)	Yield (t ha^{-1})
Sole groundnut	41.82	6.20	21	1.77	31.83	2.35
100% Groundnut+ 20% Mungbean	39.70	5.72	19.50	1.63	30.83	2.07
100% Groundnut+ 40% Mungbean	36.86	5.64	18.33	1.71	30.17	1.92
100% Groundnut+ 60% Mungbean	35.43	5.63	15.33	1.62	30.00	1.75
LSD (0.05)	NS	NS	2.64	0.11	NS	0.27
CV (%)	16.15	8.43	11.56	5.29	7.63	10.83

Table 2. Groundnut equivalent yield, LER and economic analysis of groundnut and mungbean intercropping.

Treatment	Yeild		Groundnut equivalent yield (kg ha^{-1})	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	LER
	Groundnut (t ha^{-1})	Mungbean (kg ha^{-1})					
Sole groundnut	2.35	-	2350	70,500	30,550	39,950	1
Sole Mungbean	-	1031	-	46,935	16,290	30645	1
100% Groundnut+ 20% Mungbean	2.07	208	2382	71,460	31,423	40037	1.08
100% Groundnut+ 40% Mungbean	1.92	388	2502	75060	31560	43500	1.19
100% Groundnut+ 60% Mungbean	1.75	302	2203	66090	32260	33830	1.03

*TVC= Total variable cost *Market price of groundnut =30 Tk. kg^{-1}, Mmungbean = 45 Tk. kg^{-1}

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Intercropping of Foxtail Millet with Chilli in Varying Plant Population

Abstract

The experiments was conducted at farmer's field of MLT sits, Laxmipur during the growing season of 2008-09 to verify the performance of foxtail millet as intercrop with chilli. 20% foxtail millet with 100% chilli gave the highest net benefit of Tk. 125505.75 ha^{-1} with the highest equivalent yield of chilli (2.074 t ha^{-1}) of 1.31 at farmer's field of MLT site, Laxmipur.

Introduction

In Bangladesh total spices production is about 4.5-lakh tons and 11.5-lakh tons are imported to fulfill the national demand. Chilli is one of the major cash and spices crops in the coastal region of Bangladesh especially in the char areas of Noakhali and Laxmipur. The total area coverage under chilli cultivation in these districts is about 8,000 hectare (DAE, Noakhali & Laxmipur, 2007). The maximum land utilization in these districts is without irrigation water, but in some places where irrigation water is partially available from canals, ponds and ditches may be viable for intercropping. Here farmers traditionally grow foxtail millet as a mixed crop in some sporadic places with other crops like chilli, groundnut, tomato etc. But they never calculate the benefit cost ratio of such mixed crop. Moreover, foxtail millet is one of the most important drought tolerant crop, can even be cultivated without any chemical fertilizers. If foxtail millet is intercropped with chilli the input cost would not be much higher than the cultivation of sole chilli. Overall, the farmers may get an extra cereal supplementation by doing intercropping of foxtail millet with chilli. Successfully intercropping system gives higher cash return total production per unit area and diversifies crop production than that of growing sole crop (Hashem and Maniruzaman, 1998; Faruque *et al.,* 1996; Quayyum *et al*., 1990 and Mondal *et al*., 1998) and provides greater resource use efficiency (Pathic and Malla, 1979). In view with getting increased productivity, higher economic benefit, maximum LER and better utilization of natural resources (soil, water, sunlight etc.), this experiment is undertaken.

Materials and Methods

The experiment was conducted at farmer's field of MLT site of Laxmipur in the growing season of 2008-09. The soil of the experimental area belongs to Meghna Estuarine Floodplain (AEZ 18) respectively. The soils of the experimental plot were sandy loam in texture. The experiments were set in randomized complete block design with three replications. The experiment consisted of 5 treatments are as follows.

T_1: Sole chilli (100%), T_2: Sole foxtail millet (100%), T_3: 100% chilli + 20% foxtail millet (alternative row of foxtail millet and chilli), T_4: 100% chilli + 40% foxtail millet (2 row foxtail millet after 2 row chilli), T_5: 100% chilli + 60% foxtail millet (3 row foxtail millet after 2 row chilli).The seedlings were transplanted on the third week of January, 2009. The unit plot size was 5 m x 4 m. Spacing of chilli was maintained at 50cm x 30 cm. The spacing of foxtail millet was 20cm X 5 cm. The land was fertilized with 140-142-44-56 kg ha^{-1} Urea-TSP-MP and Gypsum, respectively. The whole amount of TSP, MP, Gypsum and $^1/_3$ of Urea were applied at the time of final land preparation and remaining urea was applied in two installments at 25 and 50 DAS. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. The land equivalent ratio (LER) and equivalent yield (EY) of the intercropping system were also calculated according to Willey (1979). During the experiment period the salinity range was 2.20 to 6.13 dS m^{-1}.

$$\text{CEY (Chilli Equivalent Yield)} = \frac{\text{Chilli yield (kg ha}^{-1}) \times \text{Foxtail millate price (Tk. kg}^{-1})}{\text{Chilli price (Tk. kg}^{-1})}$$

Results and Discussion

Different intercropping system showed a significant influence on different yield, yield contributing characters, economic study and LER of chilli and foxtail millet (Table 1 and 2).

Chilli: The longest plant height (50.17 cm) was found from T_1, which had statistically significant difference with other treatments. The shortest plant height was found from T_5 (42.60 cm). The highest number of branches/plant (10.93) was also found from T_1. All the treatments showed significant effect on Length of fruit. Treatment T_1 gave the highest number of fruit/plant (48.13) and the lowest was found from T_5 (17.57). The longest fruit (6.90 cm) was found from T_1, which was statistically significant difference with other treatments. The highest weight of fruits plant^{-1} was obtained from treatment T_1 (29.33 g) and the lowest (12.00) was found in T_5. The highest yield (1.94 t ha^{-1}) was also found from the treatment T_1 whereas the lowest yield (0.77 t ha^{-1}) was found in treatment T_5.

Intercropped yield: There was significant reduction in foxtail millet yield in intercropped situation but 75% of foxtail millet with 100% chilli showed more yield because of its more plant population than 50% and 25% of foxtail millet with 100 % chilli.

Foxtail millet: The highest yield (1. 87 t ha^{-1}) was found from the treatment T_2 whereas the lowest yield (0.798 t ha^{-1}) was found in treatment T_3 as intercropped.

Chilli equivalent yield: From the result it was observed that the highest chilli equivalent yield (2.074 t ha^{-1}) was found in T_2 where 20% of fixtail millate was intercropped as alternative row of foxtail millate & chilli.

Cost of benefit analysis: Though the treatment T_3 gave the lower yield of chilli than T_1 but it was gave the highest gross return (Tk. 186720 ha^{-1}) and the net benefit (Tk. 125505.75 ha^{-1}) was also highest in T_3. The second highest gross return (Tk. 174600 ha^{-1}) and benefit (Tk. 115350 ha^{-1}) was found in T_1.

Farmers' reaction

As the farmers got the yield of foxtail millet as additional crop. So, they are interested in this experiment.

Conclusion

Considering the yield and aforementioned discussion it can be concluded that, 20% of foxtail millet in between 100% of chilli intercropping system is the most profitable than the other treatments. From the consecutive of this experimentation it is evident that, intercropping is more profitable than the sole cropping and risk of cultivation of one crop can be reduced by intercropping. For more justification and information the experiment should be repeated in the next year.

Table 1. Yield and yield components of sole and intercropped chilli at MLT site, Laxmipur during the rabi season of 2008-09.

Treatment	Plant height (Cm)	No. of branch plant^{-1}	No. of fruit plant^{-1}	Length of fruit (cm)	Wt. of fruit plant^{-1} (g)	Yield (t ha^{-1})
T_1 (Sole chilli)	50.17	10.93	48.13	6.93	29.33	1.94
T_2 (Sole foxtail millet)	48.77	8.43	32.57	6.60	26.33	1.72
T_3 (100 % chilli + 20% foxtail millet)	44.10	7.73	26.23	6.36	22.67	1.37
T_4 (100 % chilli + 40% foxtail millet)	42.60	4.43	17.57	5.76	12.00	0.77
LSD (0.05)	4.317	1.397	4.318	0.816	2.029	0.261
CV (%)	4.66	8.87	6.94	6.37	4.90	8.94

Table 2. Yield of chilli and foxtail millet with economic study and LER in different Intercropping system at MLT site, Laxmipur during the rabi season of 2008-09.

Combination	Yield (t ha^{-1})		chilli equivalent yield (t ha^{-1})	Gross return (Tk. ha^{-1})	*TVC (Tk. ha^{-1})	Net benefit (Tk. ha^{-1})	BCR
	Chilli	Foxtail millet					
T_1 (Sole chilli)	1.94	-	1.940	174600	59250	115350	2.94
T_2 (Sole foxtail millet)	-	1.87	0.831	74800	26619	48181	2.81
T_3 (100 % chilli + 20% foxtail millet)	1.72	0.798	2.074	186720	61214	125506	3.05
T_4 (100 % chilli + 40% foxtail millet)	1.37	0.875	1.758	158300	62452	95848	2.53
T_5 (100 % chilli + 60% foxtail millet)	0.77	1.14	1.276	114900	64135	50765	1.79

∗ TVC = Total variable cost ∗ Market price: chilli = Tk. 90 kg^{-1}, foxtail millet = Tk. 40 kg^{-1}

Effect of Herbicides and Hand Weeding for Controlling Weed in Soybean

Introduction

Soybean is a popular oilseed crop in Noakhali district. It is exclusively grown in rabi season as a cash crop and covers about 41,000 ha area in greater Noakhali. However, the yield of soybean is low in comparison to that of the other countries of the world. Experimental result showed that Shohag produced 2.58 t ha^{-1} with proper management in farmers field while 1-1.5 t ha^{-1} was found in farmer practice in greater Noakhali. This low production is mainly due to infestation of weed. Weeds compete with crops for light, moisture, space and plant nutrients and other environment requirements and consequently interfere with the normal growth of crops. Like other oilseeds, farmers (only one weeding) do not normally weeding in soybean. Due to high cost of labour, farmers are not interested more than one weeding. If herbicides are applied, it may reduce the production cost. Competition due to weed infestation results in the yield losses of 30%-50% depending on the extent and nature weeds (Saxena, 1980*)*. *Chenopodium album* L. is the most important among the different types of weeds in soybean field. Therefore, the present study was undertaken to evaluate the effectiveness of pre-emergence herbicide and manual control of weeds at different stages of growth.

Materials and Method

The experiment was conducted at the farmer's field in Noakhali and Laxmipur during the year of 2008-09.Shohag was used as variety in the experiment. The layout of the experiment was in randomized complete block design (RCBD) with six replications. There were four treatments namely, Farmers practice (One hand weeding at 25 DAS), Ronstar/Dual Gold (@ 2 L ha^{-1} spraying at before sowing), Ronstar/Dual Gold (@ 2 L ha^{-1} spraying at before sowing) + One hand weeding at 45 DAS, Two hand weeding at 25 and 45 DAS, in each replication with at plot size 4 x 4 m^2. Herbicidal treatments were done with hand sprayer. Samples of individual weed species were collected at 25 and 45 days after sowing. Data on weed counts and weed biomass were recorded. Yield and yield contributing data were taken at harvest. Collected data were analyzed statistically.

Results and Discussion

Number of weed per square meter

Data indicated that the numbers of weeds per square meter were affected by herbicide and hand weeding in soybean (Table 1). It could be inferred from the data that maximum number of weeds were found from farmers practice at 25 (57) and 45 (85) DAS and the minimum number of weeds were found in two hand weeding at 25(15) and 45 (25) DAS which was related to Ronstar/Dual Gold (@ 2 L ha^{-1} spraying at before sowing) + one hand weeding at 45 DAS (16, 25 respectively), Ronstar/ Dual Gold @ 2 L ha^{-1} spraying at before sowing + one hand weeding controlled (>80%) *Chenopodium album* L.,<70 % Cynodon dactylon, about 70% Echinocloa colonum and > 60% of Digtaria sanguinalis.

Weed biomass (g per sq. m)

Data presented in Table 2 indicated that weed biomass was affected by herbicide and hand weeding in soybean. Maximum weed biomass was found in farmers practice at 25(42.59 $gm^{-2)}$ and 45 (64.58 gm^{-2}) DAS and the minimum was observed in Ronstar/Dual Gold @ 2 L ha^{-1} spraying at before sowing + one hand weeding it was at 25 (12.67 g^{-2}) and 45 (19.36 gm^{-2}) DAS and in two hand weeding at 25 and 45 DAS it was 11.70 gm^{-2}, 19.86 g^{-2}, respectively.

Plant height (cm)

Mean value of the data indicate that the tallest plant height (51.20 cm) was observed from two hand weeding at 25 and 45 DAS and the lowest plant height was observed in farmers practice (45.22cm).

No of branch per plant

There was no significant difference among the treatments incase of number of branch per plant (Table 3). The highest branch per plant (2.47) was observed in two hand weeding at 25 and 45 DAS and lowest (2.07) in farmers practice.

Pods per plant

Statistical analysis of the data revealed that different treatment had no significant effect on number of pods per plant. The highest pods per plant were observed in two hand weeding at 25 and 45 DAS (35) which was similar to Ronstar/Dual Gold @ 2 L ha^{-1} at before sowing + one hand weeding at 45 DAS(35) and the lowest pods per plant was found in farmers practice (32).

1000 Seed weight (g)

1000 seed weight was statistically non-significant among the treatment (Table 3). The maximum seed weight was found in two hand weeding at 25 and 45 DAS (110 g) and the minimum seed weight was found in farmers practice (100g).

Seed yield (kg ha^{-1})

It could the inferred from the data that maximum seed yield was recorded in two hand weeding at 25 and 45 DAS (2.29 t ha^{-1}) and which was statistically identical with Ronstar @ 2 L ha^{-1} at before sowing + one hand weeding at 45 DAS (2.15 t ha^{-1}) and the lowest yield was found in farmers practice (1.77 t ha^{-1}).

Cost and Return analysis

The highest gross margin (Tk. 52010) was found in treatment Ronstar (@ 2 L ha^{-1} spraying at before sowing) + One hand weeding at 45 DAS and the lowest (Tk. 38569) in Farmers practice (One hand weeding at 25DAS) (Table 4). This variation occurred due to the variation of yield of soybean and labour cost. On the other hand, the highest BCR was found in Ronstar @ 2 L ha^{-1} spraying at before sowing + One hand weeding at 45 DAS (3.42) that was closely related to two hand weeding at 25 and 45 DA (3.32). The lowest BCR in treatment farmers practice (2.97).

Farmers' reaction

Farmers are well known about weed problem in their soybean field. They are not interested about the weed control because of high labour cost involvement. In addition, they are not aware about the herbicide. They are now very much interested about Ronstar @ 2 L ha^{-1} spraying at before sowing + One hand weeding at 45 DAS .

Conclusion

Ronstar @ 2 L ha^{-1} spraying at before sowing + one hand weeding at 45 DAS and two hand weeding at 25 and 45 DAS effectively controlled (>80 % reduction number and biomass) *Chenopodium album* L. which is the major weed of soybean field in Noakhali and Laxmipur and this method may be recommended. Gupta (1984) reported that the soil active herbicides (pre-emergence) control weeds even before they germinate, thus eliminating early period of weed competition and they maintain weed control for considerable period after application. This is one factor and another factor is weeding at 45 DAS for effectively controlling weed in soybean field. If the chemical is unavailable in the market in that case two hand weeding is more profitable.

Table 1. Number of weeds as affected by different treatments in soybean at Noakhali and Laxmipur during the year o f 2008-09.

Treatments	No of weeds per 1 meter square								Total no of weed per m^2	
	Chenopodium album L.		*Cynodon dactylon*		*Echinocloa colonum*		*Digtaria sanguinalis*			
DAS	25	45	25	45	25	45	25	45	25	45
Farmers practice (One hand weeding at 25 DAS)	22	27	13	25	10	17	12	16	57	85
Ronstar/Dual Gold (@ 2 L ha^{-1} spraying at before sowing)	5 (77)	8 (70)	8 (38)	14 (44)	3 (70)	8 (53)	5 (58)	8 (50)	21 (63)	38 (55)
Ronstar /Dual Gold (@ 2 Lha^{-1} spraying at before sowing)+ One hand weeding at 45 DAS	4 (82)	4 (85)	6 (54)	9 64)	2 (80)	6 (65)	4 (67)	6 (63)	16 (72)	25 (71)
Two hand weeding at 25 and 45 DAS	4 (82)	5 (81)	5 (62)	10 (60)	3 (70)	5 (71)	3 (75)	5 (69)	15 (74)	25 (71)

DAS: Days after sowing; (Figure in parenthesis is the percent weed reduction value)

Table 2. Weed biomass (g m^{-2}) as affected by different treatments at Noakhali and Laxmipur during the year of 2008-09 .

Treatments	Dry weight of weeds (gm^{-2})								Total weed dry weight (gm^{-2})	
	Chenopodium album L.		*Cynodon dactylon*		*Echinocloa colonum*		*Digtaria sanguinalis*			
DAS	25	45	25	45	25	45	25	45	25	45
Farmers practice (One hand weeding at 25DAS)	11.46	14.26	8.72	17.92	7.85	13.12	14.91	19.28	42.59	64.58
Ronstar/Dual Gold @ 2 L ha^{-1} spraying at before sowing	2.54 (78)	4.51 (68)	5.13 (59)	9.92 (45)	2.14 (73)	6.47 (51)	6.25 (58)	9.26 (52)	16.06 (62)	30.16 (53)
Ronstar/Dual Gold @ 2 L ha^{-1} spraying at before sowing + One hand weeding at 45 DAS	1.97 (83)	2.02 (86)	4.15 (52)	6.12 (66)	1.62 (79)	4.30 (67)	4.92 (67)	6.92 (64)	12.67 (70)	19.36 (70)
Two hand weeding at 25 and 45 DAS	2.03 (82)	2.75 (81)	3.38 (61)	6.82 (62)	2.47 (69)	3.97 (70)	3.82 (74)	6.32 (67)	11.70 (73)	19.86 (69)

DAS: Days after sowing; (Figure in parenthesis is the percent weed biomass reduction value)

Table 3. Data regarding yield and yield components of soybean as affected by different treatments at Noakhali and Laxmipur during the year of 2008-09.

Treatments	Plant height (cm)	No. of branch $plant^{-1}$	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	1000-Seed weight (g)	Seed yield (kg ha^{-1})
Farmers practice (One hand weeding at 25 DAS)	45.22	2.07	32	1.90	100	1.77
Ronstar (@ 2 L ha^{-1} spraying at before sowing)	48.23	2.13	33	2.00	105	1.90
Ronstar (@ 2 L ha^{-1} spraying at before sowing) + One hand weeding at 45 DAS	50.25	2.20	35	2.00	107	2.15
Two hand weeding at 25 and 45 DAS	51.20	2.47	35	2.10	110	2.29
LSD(0.05)	Ns	NS	NS	NS	NS	0.35
CV (%)	8.61	17.60	10.68	3.74	5.08	8.67

DAS: Days after Sowing

Table 4. Cost and Return analysis for weed control in soybean production

Treatments	Total variable cost (Tk. ha^{-1})	Gross return (Tk. ha^{-1})	Gross margin (Tk)	BCR
Farmers practice (One hand weeding at 25DAS)	19531	58100	38569	2.97
Ronstar/Dual Gold(@ 2 L ha^{-1} spraying at before sowing)	20140	64750	44610	3.21
Ronstar/Dual Gold (@ 2 L ha^{-1} spraying at before sowing) + One hand weeding at 45 DAS	21490	73500	52010	3.42
Two hand weeding at 25 and 45 DAS	21940	72800	50860	3.32

Dual Gold = 90/- per 100 ml, DAS: Days after Sowing

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Performance of Sowing Date and Different Container on Seed Germination and Yield of Soybean

Abstract

The experiment was conducted in the farmer's field of MLT site, Laxmipur, under On-Farm Research Division, Bangladesh agricultural Research Institute (BARI) to identify the better storing techniques and sowing date for seed germination, yield and other attributes of soybean. It was observed that, the seeds of soybean stored in controlled moisture and temperature of BADC cold storage performed comparatively better in every sowing date. The germination of seeds observed higher (93%, 90%, 86% and 88%) in this treatment with respective sowing dates. It was also observed that, sowing dates after opening the seeds from container had a minimum effect whereas, different containers affected significantly on seed germination (%), plant population (%) at 20 days after emergence (DAE), plant population (%) at harvesting and insect infested seeds (%).

Introduction

Soybean is the major rabi crop in Laxmipur district. For cultivating soybean the farmers usually use their own preserved seed. But in some cases they purchase the seeds from seed market and BADC. A lot of seeds are damaged or lose their germination percentage and viability because of poor storage capacity. Miah (1985) reported that there are four levels of storage systems in Bangladesh i.e. farm level, commercial level, institutional level and government level. Usually the qualities of well dried and cleaned seeds are not deteriorated in the store. The farmers use traditional storage structures like earthen container, woven bamboo container, metal container and gunny bags etc. for storing seeds. On the other hand in the government and institutional level it is assumed that they preserved seeds in controlled environment i.e. controlled moisture percentage and temperature. However, the farmers of the district Laxmipur opined that the seed of soybean supplied by government organizations like BADC, BARI were substandard in quality (e.g. germination percentage) than that of their own preserved seeds in the rabi season of 2006-07. The reason behind this may be due to the processing and time consumed in distributing the seeds from warehouse to farmers as well as to sowing time. Therefore, with this view in mind, the present study is undertaken to evaluate either the farmers or the organizational seed preserving methods are better by seeding within 10 to 15 days after getting open from storage condition.

Materials and Methods

The experiment was conducted at the farmers' field of MLT site, Laxmipur, OFRD, Noakhali under Bangladesh Agricultural Research Institute (BARI) to identify the better storing techniques and sowing date for seed germination and other attributes of soybean. This site is located within Young Meghna Estuarine Floodplain of agro ecological zone 18 of Bangladesh where soybean was grown well previously. Soybean seeds were kept in storage using five storage containers such as earthen container, plastic container, polythene bag covered by gunny bag, metal container and BADC cold storage. The seeds of soybean variety BARI Soybean-5 from each container were sown in 4 different sowing dates such as 22 and 27 of January; 1 and 6 of February 2009. The seeds were opened on 20 January 2009 and kept in normal polythene packet fastened the inlet of packet with rope made of jute to the last date of sowing. The experiment was laid out completely randomized design with 3 replications.

Clean and well-dried good seeds of soybean were stored in each container up to 09 months. Data recorded were germination (%), Plant population (%) at 20 DAE and harvesting. Data regarding insect infested seeds (%) were recorded before sowing the seeds of each container. All the data were analyzed statistically using computer program MSTAT-C.

Fabrication of containers:

Earthen containers: Earthen containers (locally called kolshi) like BARI developed earthen containers were collected from local market smearing externally with bitumen.

Plastic containers: Thick plastic container with a small inlet to the top of the container.

Polythene bag: Seeds sealed in polythene bag (0.05 mm) were kept inside gunny bag and then the inlet of bag was fastened with rope made of jute.

Metal container: Rectangular metal container with a circular metal-lid was made from M.S. sheet following BARI developed metal container. Seeds were preserved directly in this container.

BADC cold storage: Cold storage of BADC, Feni.

Results and Discussion

Effect of sowing date: Effect of different sowing date on germination and other attributes of soybean was presented in Table 1. The effect of sowing date on germination (%), plant population (%) at 20 DAE, plant population (%) at harvesting and insect infested seeds (%) were significantly differed with each other. The highest germination (87%), plant population (79%) at 20 DAE, plant population (75%) at harvesting were found in S_1 and this trend was as reducing with the later sowing dates. But the highest insect infested seeds (4.9%) was found in S_4.

Effect of container: Types of containers significantly affected germination (%), plant population (%) at 20 DAE, plant population (%) at harvesting and insect infested seeds (%). Maximum germinated seeds (90%) were recorded from C_5 (BADC cold storage) whereas minimum level of germination (64%) was found in C_1 (earthen container). Similarly higher plant population (84%) at 20 DAE and plant population at harvesting (79%) were recorded in C_5. Insect infestation was higher (6.3%) in C_1 followed by C_3 (Table 2).

Combined effect: Sowing date in combination with different container significantly affected germination (%), plant population (%) at 20 DAE, plant population (%) at harvesting and insect infested seeds (%). The higher germination (93%) was found in the treatment combination of sowing date S_1 with C_5. All the C_5 treatment with various sowing date have given higher percentage of germination (93, 92, 86, 88). Plant population at 20 DAE (90%, 88%, 79% and 82%) was found higher in treatment combination of C_5 irrespective of sowing dates. It was observed that the magnitude of plant population at 20 DAE deteriorated with the delay of time from opening of seeds from the container. Incase of plant population (%) at harvesting time almost similar trend as plant population (%) at 20 DAE. Higher number of insect infested seeds was found in the seeds stored in earthen containers (5.7%, 6.0%, 6.4% and 7.1%) on respective sowing dates of S_1, S_2, S_3 and S_4. On the other hand, lower insect infestation (2.2%, 2.7%, 3.9% and 3.0%) was found in C_5 on respective sowing dates of S_1, S_2, S_3 and S_4. The other treatment combination effect was statistically similar with among others (Table 3).

Farmers' reaction

1. Usually use traditional earthen pots for storing soybean seeds.
2. They are starting to use plastic containers.
3. Individually store a small quantity, so did not go for BADC cold storage.

Conclusion

From aforementioned results and discussion, it might be concluded that sowing date from 22-01-09 to 06-02-09 had a minimum effect on seed germination (%), plant population (%) at 20 DAE, plant population (%) at harvesting and insect infested seeds (%). On the other hand, different containers affected significantly on seed germination (%), plant population (%) at 20 DAE, plant population (%)

at harvesting and insect infested seeds (%). In the previous years usually the farmers used more soybean seeds for broadcasting than that of recommended seed rate in field, so they thought that their seeds have more germination and viability percentage. But the two years results revealed that seed stored in controlled temperature and moisture condition is better than the traditional methods. It is recommended that farmers should use metal and plastic container for storing seeds in household for better performance than store in earthen container and polythene bag. If cold storage facility is available, farmers may store the seeds there.

Table 1 Effect of sowing date on seed germination and other attributes of soybean

Treatment	Germination (%)	Plant pop^n (%) at 20 DAE	Plant pop^n (%) at harvesting	Insect infested seeds (%)
sowing on 22-01-09	87	79	75	3.8
sowing on 01-02-09	85	80	75	4.1
sowing on 27-01-09	76	69	66	4.3
sowing on 06-02-09	78	72	67	4.9
LSD(0.05)	4.23	3.90	2.69	0.60

Table 2 Effect of container on seed germination and other attributes of soybean

Treatment	Germination (%)	Plant pop^n (%) at 20 DAE	Plant pop^n (%) at harvesting	Insect infested seeds (%)
Earthen container	64	60	58	6.3
Plastic container	88	81	76	4.1
Polythene bag	80	72	67	4.8
Metal container	83	78	74	3.5
BADC cold storage	90	84	79	2.6
LSD(0.05)	4.27	4.36	3.91	0.62

Table 3. Combined effect of sowing date and container on seed germination and other attributes of soybean

Treatment combination		Germination (%)	Plant pop^n (%) at 20 DAE	Plant pop^n (%) at harvesting	Insect infested seeds (%)
	C_1	62	60	59	5.7
	C_2	91	83	79	3.4
S_1	C_3	92	84	73	4.7
	C_4	91	87	82	2.9
	C_5	93	90	87	2.2
	C_1	69	65	62	6.0
	C_2	92	85	79	3.9
S_2	C_3	91	79	75	4.9
	C_4	90	83	78	3.4
	C_5	92	88	83	2.7
	C_1	62	57	56	6.4
	C_2	85	80	76	3.9
S_3	C_3	67	61	58	4.4
	C_4	79	72	68	3.9
	C_5	86	79	77	2.9
	C_1	64	60	58	7.1
	C_2	87	78	73	5.4
S_4	C_3	73	66	62	5.2
	C_4	73	69	65	4.1
	C_5	88	82	74	3.0
LSD (0.05)		7.91	7.13	7.09	1.004

Screening of Rabi Crops against Salinity

Abstract

The screening trial was conducted with eight selected rabi crops at the farmer's field of FSRD site, Noakhali during the rabi season of 2008-09 to select and evaluate their yield potentiality against salinity and adaptability in saline area. Significantly yield of different rabi crops varied in each replication owing to various level of salinity (2 to about 12 dS m^{-1}) and mortality (%) of plants. Among the crops barley, foxtail millet and chilli have given a good yield (1.53, 1.93 and 1.15 t ha^{-1} respectively). Cowpea has given satisfactory yield (0.98 t ha^{-1}), whereas mungbean (0.78 t ha^{-1}), soybean (1.75 t ha^{-1}) and groundnut (1.62 t ha^{-1}) have given moderate yield with the comparison against their yield in normal or non-saline condition. Sweet potato is also a good crop in saline areas. The most important message is that most of the crops suffered by salinity in between their germination to vegetative stage.

Introduction

In Bangladesh, more then 30% of the cultivable land is in the coastal area. Out of 2.83 million hectares in the 13 districts of coastal area in Bangladesh, about 0.84 million hectares are affected by varying degrees of soil salinity (Karim & Iqbal, 2001). It is a production constraint common to all rainfed coastal agriculture. According to the SRDI soil testing report it was observed that salinity level vary 0 to above 20 dS m^{-1} in Noakhali. During the rabi season salinity level is highly increased. Farmers of the Noakhali district grow mainly soybean, groundnut, chilli, cowpea, grass pea, sweet potato etc in the rabi season. But it is observed that, the yield of these crops is not in satisfactory level. This lower yield might be the result of varying salinity level in this area. Different rabi crops response to salinity variably. The germination percentages, shoot length, root length, number of functioning leaves per seedling and yield was affected significantly by different levels of salinity (Maurya *et al*., 1984). The reduction in germination and early vigor of crops due to salinity is attributed to the osmotic concentration of the media (Kaliappan *et al*., 1970; Kurian and Iyanger, 1967 and Daito, 1967). But a few systematic works has been done so far on the effect of salinity levels on the various growth stages and yield in the saline area of Noakhali for different rabi crops. With above objectives, the present study is undertaken.

Materials and Methods

The experiment was conducted at FSRD site, Noakhali under rainfed condition during the Rabi season of 2008-09 in the farmer's field. The experiment was laid out in RCB design with three replications for each crop. The plot size was 4m X 3m. There were eight crops to test in different salinity level. The rabi crops were sown/planted in the field on January 13, 2009. Each crop was harvested at its full maturity stage. All other intercultural operations were done as and when necessary. To set the experiment, the saline prone field was selected by testing salinity samples field in several spots prior to sowing. During the study period, the salinity data were recorded at different dates and physiological stages of the crop. The data recorded during the whole the crop growth period related plant characters, salinity, rainfall and temperature were compiled sequentially and cautiously.

Results and Discussion

The data observed in the experiment period about sowing and harvesting date, germination (%), plant population (%) at different stages and plant survivality (%) have been given in Table 1. The salinity related data of different crop growth stages rainfall of individual date and daily average temperature have been shown in the Table 2, 3 and 4, respectively.

Cowpea: The germination (%), survivality (%) and mortality (%) of cowpea were 80, 72 and 28, respectively. During the crop growth period it has suffered from the salinity range of 3.10-8.72 dS m^{-1}, but it has given comparatively satisfactory yield (0.98 t ha^{-1}).

Barley: Barley is the most tolerant crop against salinity beyond the salinity range above 7-8 dS m^{-1}. It showed higher plant survivality (76%) and gave satisfactory yield (1.59 t ha^{-1}).

Foxtail millet: Foxtail millet showed as good yield (1.93 t ha^{-1}) as barley with the mortality rate of 25%. It could also show tolerance against the salinity of 8.85 to 9.20 dS m^{-1}.

Mungbean: It is another crop, which can provide moderate yield (0.78 t ha^{-1}) against the salinity level between 4 and 6.5 dS m^{-1}.

Soybean: Soybean has given moderate yield (1.75 t ha^{-1}) in the salinity range of 2.65-7.83 dS m^{-1}, but suffered a lot in the vegetative stage with the mortality rate of 27%.

Chilli: It is known as a saline tolerant crop. A few number of plant mortality (10%) has shown by chilli in entire growth period. But during the flowering stage it might be hampered above the salinity of 8 dS m^{-1}. However, chilli has given reasonably good yield (1.15 t ha^{-1} in dry basis).

Sweet potato: Sweet potato is also known as a salt tolerant crop in the saline areas. It could be a valuable crop in between salinity range 3.70 and 8.57 dS m^{-1}. But it has also suffered in the vegetative stage beyond the salinity of 5.5 to 6.5 dS m^{-1}. It has given a moderate yield (13.60 t ha^{-1}) with the mortality rate of 22%.

Groundnut: In the vegetative stage, groundnut has suffered highly in the salinity range of 2.65 to 5.50 dS m^{-1} with the mortality rate of 30%. About 1.62 t ha^{-1} yield was found from groundnut which is moderately good performance. If the salinity remained below 5.00 dS m^{-1} it could perform much better.

It was observed that plants suffered by salinity mainly in the germination to vegetative stage but in the reproductive to maturity stage plants were not suffered severely. In some cases it is also observed that salinity level reduced due to soil covered by the canopy of the plants like cowpea, sweet potato, groundnut etc. With the advancement of the month of December 08 to May 09 the average maximum and minimum temperature raised positively which may be the main ncause of increasing salinity in the progress of rabi season from February to April.

Farmers' reaction

Cultivation of these crops is increasing in the fallow lands day by day.

Lack of quality seed in the local market.

Need large amount of salt tolerant varieties from GO and NGO's

Conclusion

From the above results and discussion it can be concluded that, cowpea, barley, foxtail millet, mungbean, soybean, chilli, sweet potato and groundnut are tolerant in some extent to the salinity level below 8 dS m^{-1}.

Table 1 Date of sowing, harvesting, yield, soil salinity levels and plant survivality (%) of different rabi crops

Crops	Date of sowing	Date of harvesting	Emergence (%)	Plant pop^n at 20 DAE(%)	Plant pop^n at harvest (%)	Mortality (%)	Yield (t ha^{-1})
Cowpea	13/01/09	7-28/05/09	80	75	72	28	0.98
Barley	13/01/09	25/04/09	87	80	76	24	1.59
Foxtail millet	13/01/09	25/04/09	95	90	75	25	1.93
Mungbean	13/01/09	18-30/03/09	78	75	69	31	0.78
Soybean	13/01/09	10/05/09	80	76	73	27	1.75
Chilli	13/01/09	27/04 to 05/06/09	95	90	90	10	1.15
Sweet potato	13/01/09	20/05/09	Cuttings were planted	80	78	22	13.60
Groundnut	13/01/09	28/05/09	75	75	70	30	1.62

Table 2. Degree of salinity level (dS m^{-1}) in different crop growth stages.

Crop	Before sowing	At 20 DAE	At 40 DAE	At Harvest
Cowpea	3.10	5.65	8.72	3.93
Barley	3.60	4.25	5.74	6.02
Foxtail millet	3.50	3.90	3.78	6.28
Mungbean	2.65	4.51	3.85	5.25
Soybean	3.10	2.65	6.37	7.83
Chilli	2.91	3.90	3.80	11.35
Sweet potato	4.20	5.29	5.35	3.17
Groundnut	2.65	5.50	4.58	6.60

Table 3. Date wise rainfall pattern during the crop growth period.

Date	Rainfall (mm)	Date	Rainfall (mm)	Date	Rainfall (mm)
Dec./08	Nil	16.04.09	13	16.05.09	18
01.01.09 to 27.02.09	Nil	17.04.09	89	17.05.09	01
28.02.09	02	01.05.09	13	18.05.09	62
01.03.09	Nil	02.05.09	24	24.05.09	45
25.03.09	-	03.05.09	62	25.05.09	76
26.03.09	05	10.05.09	07	26.05.09	67
29.03.09	10	13.05.09	09	31.05.09	10
31.03.09	19	15.05.09	02		

Table 4. Average maximum and minimum temperature of the months of December/08 to May/09.

Month	Maximum (°C)	Minimum (°C)
December 08	26.16	17.30
January 09	26.40	15.10
February 09	29.65	16.70
March 09	32.80	21.50
April 09	34.6	25.03
May 09	34.5	25.50

Late Sowing Potential of Tomato Varieties in Southern Region of Bangladesh

Abstract

A field experiment was carried out at multi location testing (MLT) site, Gournadi and Nazirpur during the rabi season of 2008-09 to find out the late planting potential of Tomato varieties in Barisal region of Bangladesh. Three varieties such as BARI Tomato 2, BARI Tomato 4 and BARI Tomato 8 were planted in three times viz. December 15, December 30 and January 15 in Nazirpur and two varieties BARI Tomato-2 and BARI Tomato-8 with three planting times were planted in Gouronadi. The result revealed that BARI Tomato 8 performed better among the varieties and planting time in all the locations.

Introduction

Tomato (*Lycopersion esculentum* L.) is an important winter vegetable in Bangladesh. It is a good source of vitamin A, B, C, calcium and iron. Its vitamin C contents are 31mg per 100g of Tomato (Matin *et al*., 1996). It is also processed into different products for consumption. Due to its popularity in fresh market as well as in processing its demands are increasing day by day. Tomato is a photo neutral but thermo sensitive crop and is grown during the winter season of Bangladesh. (Bhuiyan and Hoque, 1983.) Ideal planting time of Tomato is rabi season. Location specific research may be more useful for making any recommendation for a particular region. In rice based cropping system-sowing time of Tomato ranges from 2nd week of November till the 1st week of January. Non- saline phase of the Ganges Tidal Flood plain of Southern Bangladesh (AEZ-13) comprises part of Barisal, Patuakhali and Barguna districts, which characterized by tidal flooding of field, high rainfall during monsoon and short winter. During rabi season land mainly remains fallow in this region. Delay harvesting of transplanted aman rice and wetness of soil are the main reasons for remaining the land fallow in rabi season. Land become free and soil comes to working condition at the end of November to 1st week of January, which is not optimum time for sowing many rabi crops including vegetables. Therefore the present study has been under taken to find out the suitable variety/ varieties of Tomato for late planting potential in the Barisal region of Bangladesh.

Materials and Methods

The experiment was carried out at the multilocation testing site, Gournadi and Nazirpur during the rabi seasons of 2008-09. There were three dates of planting as December 15, December 30 and January 15 and three varieties of Tomato (*Lycopersicon esculanta*) BARI Tomato 2, BARI Tomato 4 and BARI Tomato 8 used in this experiment. The experiment was laid out in split plot design with time of planting in the main plot and varieties in the sub plot. The unit plot size was 5m x 4m .The land was fertilized with cowdung @ 5 t ha^{-1} and NPK @ 230-85-102 kg ha^{-1}, respectively in the form of Urea, Triple super phosphate and Muriate of potash in each planting date. Seedlings were planted at 60cm x 40cm spacing. Half of the cowdung and entire quantity of TSP were applied during final land preparation. Rest of cowdung was applied in the planting pits. Urea and MoP were equally applied in two installments 21 and 35 days after transplanting. Thirty days old seedlings were transplanted in each planting dates. The crop was irrigated in four times such as 21, 35, 45 and 50 days after planting. Plants were provided support by bamboo stick before flowering. Necessary intercultural operations and plant protection measures were taken as and when required. Data in respect of plant height, number of fruits $plant^{-1}$ and weight of fruits etc. were recorded from 10 randomly selected plants. Total fruit yield per plot was recorded to compute per hectare yield. The collected data were analyzed using statistical software programme.

Results and Discussion

In respect of yield and yield contributing characters were presented in (Table 1 & 2). The highest yield was obtained from BARI Tomato-8 in all the locations and planting times and lowest yield was obtained from BARI Tomato-4. Among the planting times in all varieties performed better when it was planted in 15 December due to low temperature. Lowest yield was obtained from 15 January planting in all cultivars probably due to high temperature during flowering and thus setting of less number of fruit. It might be due to drying up of stigma, specially its receptive part and/or pollen. The significant cumulative effect of yield contributing character supported the highest yield of BARI Tomato 8 in both the locations.

Cost and return analysis

The highest gross margin and BCR were obtained from BARI Tomato 8 variety with 15 December planting in both the locations followed by BARI Tomato 4 with 15 December planting. The lowest gross margin and BCR were found in BARI Tomato 4 in both the locations irrespective of planting time.

Farmers' reaction

1. Farmers are not interested to cultivate Tomato in small size plot
2. They are interested in cultivation of Tomato if quality seed is available in proper time

Conclusion

This is first year results, the experiment will be repeated in the next year for concrete conclusion.

Table 1. Yield and yield components of Tomato as affected by varieties and planting time during the rabi season of 2008-09 at MLT site, Nazirpur

Planting time	Variety	Plant height (cm)	Individual fruit wt (g)	No. of fruits cluster^{-1}	No. of fruit plant^{-1}	Yield (t ha^{-1})
15 December	V_1	78.80	66.66	7.26	31.00	58.66
	V_2	65.93	82.33	7.13	26.40	63.00
	V_3	66.66	38.66	7.40	21.26	40.00
30 December	V_1	78.73	71.33	7.13	28.66	50.60
	V_2	63.33	86.66	7.33	29.06	53.30
	V_3	67.20	39.00	6.00	21.53	38.60
15 January	V_1	71.40	60.33	6.20	24.13	28.82
	V_2	57.06	68.33	6.40	22.80	31.20
	V_3	62.67	32.66	5.40	18.93	25.00
CV(%)		4.66	4.31	4.54	2.68	5.80
LSD (0.05)		7.96	6.53	0.761	1.09	6.185

V_1= BARI Tomato 2, V_2= BARI Tomato 8, V_3= BARI Tomato 4

Table 2. Yield and yield components of Tomato as affected by varieties and planting time during the rabi season of 2008-09 at MLT site, Gournadi.

Planting time	Variety	Plant height (cm)	Individual fruit wt (g)	Fruits cluster^{-1} (no)	Fruit plant^{-1} (no)	Yield (t ha^{-1})
15 December	V_1	71.60	93.05	5.00	18.5	50.30
	V_2	72.60	98.05	5.44	18.2	53.90
30 December	V_1	71.97	89.39	4.11	20.61	42.76
	V_2	74.72	90.27	4.77	21.93	44.40
15 January	V_1	57.66	62.78	4.39	17.66	27.80
	V_2	59.05	63.17	4.33	18.716	29.96
CV (%)		4.24	4.82	7.88	9.04	4.78
LSD (0.05)		7.87	10.92	1.01	4.77	5.45

Table 3. Economic performance of Tomato varieties planted different dates during the rabi season of 2008-09 at MLT site, Gournadi

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
T_1V_1	50.30	352100	90000	262100	3.91
T_1V_2	53.90	377300	90000	287300	4.19
T_2V_1	42.76	299320	90000	209320	3.32
T_2V_2	44.40	310800	90000	220800	3.45
T_3V_1	27.80	194600	90000	104600	2.26
T_3V_2	29.96	209720	90000	119720	2.33

Table 4. Economic performance of Tomato varieties planted different dates during the rabi season of 2008-09 at MLT site, Nazirpur

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Benefit cost ratio (BCR)
T_1V_1	58.66	410620	113750	296870	3.60
T_1V_2	63.00	441000	113750	327250	3.87
T_1V_3	40.00	280000	113750	166250	2.46
T_2V_1	50.60	354200	113750	240450	3.11
T_2V_2	53.30	373100	113750	259350	3.28
T_2V_3	38.60	270200	113750	156450	2.37
T_3V_1	28.82	201740	113750	87990	1.77
T_3V_2	31.20	218400	113750	104650	1.92
T_3V_3	25.00	175000	113750	61250	1.53

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Late Sowing Potential of Mustard Varieties in the Southern Region of Bangladesh

Abstract

A field experiment was carried out at multi location testing (MLT) site, in Gournadi to determine the late sowing potential of mustard varieties (*Brassica* species.) for getting economic viable yield in the Barisal region of Bangladesh during the rabi season of 2008-09. The experiment included three sowing dates viz. 21 November, 01 December and 15 December with two varieties such as BARI sarisha 11 and BARI sarisha 14. The results revealed that the variety BARI 14 performed better in early sowing (893 kg ha^{-1}) but in late sowing BARI sarisha 11 also performed better and gave economically viable yield (566 kg ha^{-1}).

Introduction

Rapes and Mustard (*Brassica* sp.) is the most important oilseed crops in Bangladesh. It covers about 61.2% of the total acreage under oil seed and 52.6% of the total oil seed production (BBS, 2005). One of the main reasons for low yield of mustard in Bangladesh is delay sowing of seeds due to delay in recession of flood water and late monsoon rain especially in the low land areas (Ali and Shah 1985). Bangladesh Agricultural research Institute (BARI) has developed and recommended a few high yield potential as well as late sowing varieties of rape and mustard. These varieties may differ in their response to sowing dates for yield and yield components. The present study was undertaken to find out a suitable late sowing variety of mustard in the Barisal region.

Materials and Methods

The experiment was carried out at multi location testing site, Gournadi during the rabi season of 2008-09 under rainfed condition. The experiment was laid out in split plot design with 4 replications. Sowing dates were in main plot such as 21 November, 01 December and 15 December and cultivars were in sub plot viz. BARI sarisha 11 and BARI sarisha 14. The unit plot size was 5m x 4m. The land was fertilized with NPKS @ 95-27-40-25 kg ha^{-1} at final land preparation because crop was cultivated in rainfed condition. Seeds were sown in line with continuous seeding. The distance between row to row was 30 cm. One weeding and one thinning at 20-25 days after sowing were done to keep the crop weed free. The plants were sprayed with malathion for the control of aphid. Data were collected on plant height, branch plant^{-1}, siliqua plant^{-1} and seeds siliquae^{-1} from 10 randomly selected plants from each plot. For seed yield estimation 3m x 3m area from the middle of the treated plot was harvested. All the collected data were statistical analyzed and means were adjusted for LSD test.

Results and Discussion

Yield and yield attribute are presented in Table 1. The result revealed that in southern area early sowing of BARI sarisha 14 produced 893 kg ha^{-1} in Gournadi. It might be due to BARI sarisha 14 produced higher plant per square metre and higher siliqua per plant. But in late sowing (20 December) BARI sarisha 11 gave economic viable yield (566 kg ha^{-1}) in Gournadi.

Cost and return analysis

The highest gross return and BCR were obtained from BARI sarisha 14 with November 21 sowing which is followed by BARI sarisha 11.

Conclusion

This is first year results, the experiment will be repeated in next year for final conclusion

Table 1. Yield and yield components of mustard as affected by sowing time and varieties during the rabi of 2008-09 at MLT site Gournadi, Barisal.

Sowing time	Variety	Plants m^{-2} (no.)	Plant height (cm)	No. of siliqua $plant^{-1}$	No. of seeds $siliqua^{-1}$	Yield (kg ha^{-1})
November	V_1	64.13	89.23	68.58	8.30	866.66
21	V_2	63.90	86.86	59.45	8.33	893.33
December	V_1	55.53	96.66	74.27	8.67	793.33
01	V_2	57.66	91.66	74.00	10.0	833.33
December	V_1	55.53	61.80	40.30	7.3	566.66
20	V_2	57.66	66.36	42.70	7.8	466.33
CV (%)		3.59	6.65	6.96	4.42	7.73
LSD (0.05)		6.43	16.53	12.7	1.13	171.1

V_1= BARI sarisha 11, V_2= BARI sarisha 14

Table 2. Economic performance of mustard varieties of late sowing potential at MLT site, Gouranadi during the rabi season of 2008-09.

Treatment	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	Benefit cost ratio (BCR)
T_1V_1	866	34640	16000	18640	2.17
T_1V_2	893	35720	16000	19720	2.23
T_2V_1	793	31720	16000	15720	1.98
T_2V_2	833	33320	16000	17320	2.08
T_3V_1	566	22640	16000	6640	1.41
T_3V_2	466	18640	16000	2640	2.16

Yield = Tk. 35 kg^{-1},

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Performance of Salt Tolerant Barley Genotypes in the Coastal Region of Bangladesh

Abstract

The trial was conducted with three selected genotypes viz: BHL-19, BHL-18 and BHL-15 at the farmer's field of FSRD site, Noakhali during the rabi season of 2008-09 to select and evaluate their yield potentiality against salinity and adaptability in saline area. Significantly the highest grain yield (1834 kg ha^{-1}) was recorded from the genotype BHL-15 in Noakhali.

Introduction

Barley is one of the important cereals of the world. In Bangladesh barley is cultivated as minor cereal. It can be grown in less fertile soil with minimum inputs. Barley is grown as food for poor and unhealthy people. In foreign countries barley is used in beverage industries for processing alcohol, wine and some energy drinks such as, horlicks, maltova etc. It is known that barley is a salt tolerant crop. In coastal area, vast land remains fallow due to salinity and lack of irrigation water in rabi and early kharif season. Barley may be cultivated in saline area. BARI has recently developed some high yielding variety and is developing some new genotypes, which would be released as varieties after testing their performance at field level in the saline areas. The performance of these variety or genotypes needs to be evaluated in saline area at farmer's field. Keeping this in mind the trial was undertaken.

Materials and methods

The experiment was conducted under rainfed condition and saline soil at the farmer's field of FSRD site, Noakhali during the rabi season of 2008-09. Three genotypes of barley viz: BHL-15, BHL-18, BHL-19 were compared among each other. The experiment was laid out in RCB design with three replications. The plot size was 12 sqm, fertilizer @ 100-60-40 kg ha^{-1} of N-P-K was applied as basal during the final land preparation. The seeds were sown in line with 25 cm spacing with seed rate 100 kg ha^{-1} on January 01, 2009 in Noakhali. To set the experiment, the saline prone field was selected by testing salinity samples of the field in several spots. During the study period, the salinity data were recorded at different physiological stages of the crop. The data on yield and yield attributing characters were statistically analyzed by MSTAT-C programme.

Results and Discussion

Yield and yield attributes of three barley genotypes are presented in Table 1. The tallest plant height (66.25 cm) was found in BHL-18, which was followed by BHL-15 (65.29 cm) and the lowest (65.20 cm) was found in BHL-19. Number of effective tillers per m^2 did not differ significantly. The longest spike (9.3 cm) was found in BHL-19, which was significantly higher from the others. The genotype BHL-18 showed the highest number of grains spike^{-1} (40.5) but statistically non-significant with the others. In respect of 1000-grain weight genotype BHL-19 (32.7 g), BHL-18 (32.4 g), BHL-15 (32.2 g) were found identical. The highest grain yield (1834 kg ha^{-1}) was obtained from the genotype BHL-15 and the lowest yield (1601 kg ha^{-1}) was found in BHL-19 (Table 1). Significant cumulative effect of yield contributing characters supported the highest yield of barley genotypes.

Salinity tolerance level of Barley was recorded in various physiological stage of the crop period. A very interesting result observed in the field was that, the barley crop could tolerate a wide range of saline condition (2-10 dS m^{-1}) of the soil in various stages. It was also found that, the crop was severely affected in vegetative stage. Over the salinity level of 10 dS m^{-1}, it is economically not feasible to cultivate barley because of high mortality percentage. At the maturity stage salinity could not affect the plant adversely (0% mortality rate). But in the heading to maturity stage it is observed that, in salinity range above 8 dS m^{-1}, yield reduced 30 to 40% (Table 2).

Farmers' reaction

1. Harvesting and processing of barley is a troublesome work for the farmers.
2. Only use in household in medicinal purpose.
3. No demand in local market.

Conclusion

Barley is the most tolerant crop in this area, which can be grown in the salinity level from 03 to 10 dS m^{-1}. All the genotypes performed reasonably good yield against soil salinity.

Table 1. Performance of yield and yield contributing characters of different salt tolerant barley genotype in the saline area

Variety	Plant height (cm)	Effective tiller m^{-2} (no)	Spike length (cm)	Grain spike^{-1} (no)	1000 seed weight (g)	Grain yield (kg ha^{-1})
BHL-19	65.20	135.5	9.3	40.3	33.7	1601
BHL-18	66.25	134.0	7.9	40.5	32.4	1733
BHL-15	65.29	135.5	6.8	39.5	32.2	1834
LSD (0.05)	NS	NS	2.09	NS	NS	NS
CV (%)	7.46	8.81	15.10	11.09	11.31	10.12

Table 2. Relation between salinity and plant mortality of barley at different physiological stages.

Salinity range (dS m^{-1})	Plant Mortality (%)			
	Vegetative stage	Heading stage	Grain filling stage	Maturity stage
0-2	0	0	0	0
2-4	15	5	0	0
4-8	30	18	5	0
8-12	50	23	15	0
12->19	>60	>30	>20	0

Effect of Time of Sowing on the Growth and Yield of Chilli in the Southern Region of Bangladesh

Introduction

Chilli is an important spices crop in Bangladesh. After T.aman harvest farmers in this area either grow few rabi crops with less care or remain fallow. Farmers are growing chilli in this area in large scale but they get poor yield because of onrush and tidal water and due to late sowing and use of local chilli cultivar. It was observed that BARI lanka-1 performed better than local varieties. They grow local variety in the late January to February. Early sowing in December could save the water flash out.

Materials and Methods

The experiment was carried out in farmers' field during the rabi season of 2008-09 to find out the effect of sowing time on growth and yield of chilli. The experiment was laid out in RCB design having six replications with one varieties/lines in four sowing time. Unit plot size was 4 m x 5 m. Seedlings were transplanted in keeping spacing was 40cm x 20cm. BARI lanka-1 were used. Seeds were sown in three different sowing dates: 25 December, 2008, 05 January 2009, 15 January 2009 and 25 January 2009. Recommended fertilizer dose were used. Harvesting was started on 25 March, 2009, 03 April, 2009, 18 April 2009 and 25 April, 2009 respectively. Yield and yield attributes were recorded and analyzed statistically.

Results and Discussion

Yield and yield contributing characters were given in Table 1. Statistically significant difference was found in plant height and yield in respect of sowing time. The identical highest plant height was found in 25 December sowing and 05 January sowing followed by 15 January sowing. First and second transplanting were almost completed and harvesting of third and fourth transplanting ongoing. In that time crop was inundated caused by Aila on 25 May 2009. It was observed that early transplanting gave prolonged harvesting period and ultimately higher yield (2336 t ha^{-1}). However, it is the result of 1st year experiment; the trial should be continuing for the next year for final recommendation.

Farmers' reaction

1. Farmers are highly interested to cultivate BARI lanka^{-1} due to its fruit bearing habit and uniform fruit size.
2. At late sowing condition soil moisture reduced rapidly which affect the growth and yield of crop.
3. Market price is higher than local cultivar.

Table 1. Effect of time of sowing on yield and yield contributing characters of chilli in Patuakhali region at 2008-2009. (up to 20 May)

Treatment	Plant population m^{-2}	Plant height (cm)	No. of fruits plant^{-1}	100-capsules weight (g)	Yield (kg ha^{-1})
S_1: 25.12.08	10.83	51.66	69.33	64.8	2336a
S_2: 05.01.09	10.33	51.66	64.66	64.16	2245b
S_3: 15.01.09	8.5	51.33	60.83	65.16	1425d
S_4: 25.01.09	10.16	49.5	57.00	63.33	1220c

Screening of Different Rabi Crops Suitable for Saline Areas

Introduction

In Bangladesh more than 30% of the cultivable land is in the coastal area. Out of 2.83 million hectares in the 13 districts of coastal area in Bangladesh, about 0.84 million hectares are affected by varying degrees of soil salinity (Karim and Iqbal, 2001). It is a production constraint common to all rainfed agriculture. According to the SRDI soil testing report it was observed that salinity level vary 0 to above 20 dS m^{-1}. During the rabi season salinity level is highly increased. Farmers of Patuakhali region grow only watermelon to a satisfactory level, but other crops like chili, groundnut, cowpea, grasspea, sweet potato etc. do not perform satisfactory. This lower yield might be the result of varying salinity level in this area. Different rabi crops response to salinity variably. The germination percentage, shoot length, root length, number of functioning leaves per seedling and yield are affected significantly by different levels of salinity (Maurya *et.al.*, 1984). The reduction in germination and early vigour of crops due to salinity is attributed to the osmotic concentration of the media (Kaliappan et.al., 1970; Kurian and Iyangar, 1967 and Daito, 1967). But a few systematic works has been done so far to study the effect of salinity levels on the various growth stage and yield in the saline area at field condition for different rabi crops. With this point of view, the present study was undertaken.

Materials and Methods

The experiment was conducted in farmers' field at MLT site, Kuakata, Patuakhali during the rabi season of 2008-09. Suitability of different crops like Brinjal, Tomato, Cabbage, Potato, Sesame, Groundnut, BARI hybrid Maize, Mungbean, Chilli were tested against salinity with three replications. Unit plot size was 5 m × 4 m. Crops were transplanted/sown from 29.12.2008 to 05.01.2009 except Chilli and it was transplanted on 18.01.2009. Recommended spacing and fertilizer doses were maintained depending the nature of the crops. During the experimental period soil sample were collected at 10 days interval and salinity level was measured.

Results and Discussion

All the crops were damaged due to high salinity. The salinity levels were as follows:

Table 1. Salinity levels in the experimental plots at MLT site, Kuakata, Patuakhali durin the rabi season of 2008-09.

Date	Salinity level (dS m^{-1})
29.12.2008	3.42
10.01.2009	4.85
20.01.2009	5.72
30.01.2009	7.01
10.02.2009	8.96
20.02.2009	10.20

Effect of Time of Sowing on the Yield of Sesame in Patuakhali Region

Introduction

Sesame is the second edible oil seed crop in Bangladesh. It contains 42-45% oil and 20% protein. Sesame is quality edible oil. In Bangladesh sesame is mainly grown in early kharif season (March to May) under rain fed condition. During kharif season the crop faces drought at vegetative stage and faces heavy rainfall during the reproductive stage. Sometimes the crop damaged by the heavy rainfall or early flash flood. Especially in Patuakhali region production of sesame is hampered for above reasons. On the other hand after T.aman harvest farmers in this area either grow few rabi crops with less care or remain the land fallow.

Materials and Methods

The experiment was conducted in farmers' field and Patuakhali during the kharif season of 2008-09 to find out the suitability sowing data of sesame cultivation. The experiment was laid out in RCB design having six replications with one varieties/lines in five sowing time. Unit plot size was 4 m x 5 m. The variety was BARI Til-3. Seeds were sown in five different sowing dates: 21 January 2009, 31 January 2009, 10 February 2009, 20 February 2009 and 30 February 2009. Standard crop production technologies were used for the experiment. Yield and yield attributes were recorded and analyzed statistically.

Results and Discussion

Yield and yield contributing characters were given in Table 1. First and second sowing was harvested. After that third, fourth and fifth sowing crop was damaged by inundation caused by Aila on 25 May 2009. First sowing yielded 1290 kg ha^{-1} and second sowing yielded 1390 kg ha^{-1}. However, it is the result of 1st year experiment; the trial should be continuing for the next year for final recommendation.

Table 1. Effect of time of sowing on yield and yield contributing characters of sesame in Patuakhali region during the kharif season of 2008-09.

Treatment	Plant population m^{-2}	Plant height (cm)	No. of branch plant^{-1}	No. of capsule plant^{-1}	No. of seeds capsule^{-1}	100-seed weight (g)	Yield (kg ha^{-1})
S_1: 21.01.2009	39.00	74.25	2.00	24.25	55.50	2.5	1290
S_2: 31.01.2009	41.25	78.75	2.25	26.00	57.00	2.5	1390

Performance of Sweet Gourd with and after T.Aman rice Harvest

Introduction

A vast area in the southern region of Bangladesh remains fallow during the dry season. Only a few crops like mungbean, cowpea, Khesari, sweet potato, chilli etc are grown with less care. Few farmers grow sweet gourd after T.Aman rice harvest and get satisfactory yield without any management practice. This technology needs to be verified and improve.

Objectives

To identify optimum time of planting for sweet gourd

Materials and methods

The experiment was conducted at FSRD site, Razakhali, Patuakhali during the rabi season of 2008-09. Three treatments: T_1: Relay sowing of sweet gourd with T.Aman rice (15 days before T.aman rice harvest), T_2: Sweet gourd sowing just after T.aman harvest, T_3: Farmers practices were tested. The experiment was laid out in RCB design with six dispersed replications having unit plot size 10m x 10m. Spacing was 3m x 3m and var. BARI mistikumra-1 was used in this experiment. Sowing was done on 22-27 November 2008. Application method of fertilizer was followed as recommended. Standard cultural practices were done as and when necessary.

Results and Discussion

Vegetative growth and fruit setting was satisfactory in T_1 treatment than T_2 and T_3. Unfortunately the crop was damaged due to hailstorm on 27.03.09 at the time of fruit maturity.

Performance of Mustard Varieties relaying with T.Aman Rice in the Coastal Area of Bangladesh

Materials and Methods

The experiment was carried out in farmers' field at MLT site, Kuakata, Patuakhali during the rabi season of 2008-09 to see the performance of mustard varieties relaying with T.Aman rice in the coastal area. The experiment was laid out in RCB design with three replications. The unit plot size was 40 m^2. The crop was sown on November 29 to December 12, 2008. The two mustard varieties viz. BARI sarisha 9 and BARI sarisha 11 were used for the study. From the beginning of the experiment salinity level was measured.

Results

After germination within 25 days seedlings were damaged due to salinity. Salinity level was 6 to 8.7 dS m^{-1} in the experimental plots on 19.01.2008. In the previous year same result was obtained. Therefore, mustard relay with T.aman rice in the coastal area is not compatible.

D. HILLY AREA

Development of Alternate Cropping Pattern against Existing One at Hill Valley

Abstract

The development of cropping pattern was tested against existing pattern (Fallow-Fallow-T.aman) at Raicha, Bandarban during the year of 2008-09 to find out the suitable and profitable cropping pattern for Bandarban areas. Five different cropping patterns were viz. i) Maize-T.aman, ii) Chickpea-T.aman, iii) Mustard-T.aman, iv) Cucumber–T.aman and v) Existing (Fallow-Fallow-T.aman). The results showed that the cropping pattern Maize-T.aman produced highest gross margin (Tk. 53750 ha^{-1}) but the highest BCR (3.10) was produced by the cropping pattern Cucumber-T.aman.

Introduction

In Bandarban sadar areas major cropping pattern is Fallow-Fallow-T.aman which is covered by 1149 hectare and it was 16% of the total area of existing 11 cropping pattern. The second important cropping pattern is Boro-Fallow-T.aman, 930 ha (13%) followed by winter Vegetable-Fallow-T.aman, 200 ha (3%). Maize is the important crop in hilly areas which could be cultivated in rabi and kharif season. The local maize variety gave lower yield 1.5 t ha^{-1} while BARI hybrid maize and pacific 11 gave higher yield 8-10 t ha^{-1}. The area coverage of maize is increasing day by day due to high local demand of maize. Mustard is the dominant oil crop in Bandarban which is covered by 1605 acres and production 880m ton (200-04). In that case area and production could be increased by introducing BARI sarisha 11 in existing cropping pattern resulting farmers will get higher benefit from this crop. Chickpea is one of the new pulse crop in Bandarban. Introducing chickpea in existing cropping pattern can play a vital role to meet up the pulse deficit in hilly areas. Cucumber is one of the most important crop in Bandarban which grown popularly and largely. So, it is justified that it could be better to include in existing cropping pattern resulting land will not remain fallow. Considering the above circumstances this type of experiment has been undertaken.

Objectives

1. To test the suitability of proposed cropping pattern
2. To increase the total productivity of the locality
3. To increase the cropping intensity

Materials and Methods

The development of cropping pattern was tested against existing cropping pattern at Raicha, Bandarban during the year of 2008-09. The alternate pattern was tested with three disperse replications across the farmers field under same land type. The unit plot size was 40 m^2.

Cucumber: Local cucumber variety was sown at 1st week of May with maintaining the 1.5 m x 1.5 m line spacing. Fertilizers were applied for cucumber @ 80-30-85-50 kg N-P-K-S-Zn ha^{-1}, respectively. One third N and all other fertilizer were applied as basal and rest $^2/_3$rd were equally splited into two and applied at 25 Days after sowing (DAS) and 45 DAS, respectively. The Cucumber was harvested on 22-24 May 2008.

Maize: Maize was sown at 3rd week of December, 2008 with maintaining the spacing 75cm × 25cm. Fertilizers were applied for maize @ 250-55-144-34-13-1 kg N-P-K-S-Zn-B ha^{-1}, respectively. One third N and all other fertilizer were applied as basal and rest $^2/_3$rd N were equally splited into two equal parts and applied at 8-10 leaves stage and at tasseling stage, respectively. The maize was harvested on 22-24 April 2009. The maize variety BARI hybrid maize-3 was used.

Mustard: Mustard was sown at 3rd week of December,2008 with maintaining the 30cm apart line spacing. Fertilizers were applied for mustard @ 138-36-50-32 kg N- P- K-S-Zn ha^{-1}, respectively. One third N and all other fertilizer were applied during the final land preparation as basal and rest $^2/_3$rd N were splited into two equal parts and applied at 25 and 45 DAS, respectively. The mustard was harvested on 22-24 March 2009. The mustard variety BARI sarisa 11 was used.

Chickpea: Chickpea was sown at 3rd week of December, 2008 with maintaining the spacing 40cm apart line. Fertilizers were applied for chickpea @ 23-18-20 kg N-P-K ha^{-1}, respectively. All fertilizers were applied at final land preparation. The chickpea was harvested on 07-08 April 2009. The chickpea variety BARI chola 5 was used.

The yield and yield contributing character data of above crops were recorded from ten randomly selected plants. The collected data were recorded and analyzed.

Results and Discussion

Yield and economic analysis of different alternate cropping patterns of the experiment are present in Table 1. The results showed that the cropping pattern Maize-T.aman produced highest gross margin (Tk. 53750 ha^{-1}) but the highest BCR (3.10) was produced by the cropping pattern cucumber-T.aman. So there is a great scope to earn extra income in same piece of land through introducing new crop fit of the pattern.

Conclusion

Maize, chickpea, mustard, cucumber and other suitable crop can be introduce in existing of cropping pattern and increasing socio-economic condition of farmers of Bandarban district.

Table 1. Performance of different alternate cropping pattern at hilly areas in Bandarban district during the year of 2008-09.

Cropping patterns	Yield (t ha^{-1})	Gross return (Tk. ha^{-1})	Total cultivation cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
Maize-T.aman	9.5	114000	60250	53750	1.89
Chickpea-T.aman	1.5	63000	22300	37700	2.69
Mustard-T.aman	1.4	35000	25640	9360	1.36
Cucumber-T.aman	10	70000	22550	47500	3.10
Fallow-T.aman	-	-	-	-	-

Adaptive Trial of Advance Wheat Lines

Abstract

An on-farm adaptive trial of wheat was conducted at eight different locations with three candidate varieties BAW-1059, BAW-1064 and BAW-1104 along with Shatabdi as check. During the rabi season of 2008-09. The locations were Sherpur, Jamalpur, Jessore, Tangail, Jhenaidah, Narail, Durgapur, Rajshahi and Charghat, Rajshahi. Across locations BAW-1064 gave the highest average seed yield (4.12 t ha^{-1}) which was closely followed by BAW-1059 (3.91 t ha^{-1}). All the lines produced apparently higher average seed yield over Shatabdi.

Introduction

Wheat is the second major cereal crop next to rice and cultivated during the rabi season in Bangladesh. It has to compete with other important winter crops like maize, pulses, oilseeds, vegetables and boro rice. It occupies 1.38 million acres of land with a total production of 0.98 million tons (BBS, 2005). A high yield potential variety with short duration and with a good fit into the existing cropping pattern is needed for wheat cultivation in greater area. Wheat Research Center of BARI recently developed some improved wheat lines with high yield potential. Adaptive trial is the last step of variety development process. After hybridization, every promising line has to pass a series of evaluation trial like 1st screening, PYT, AYT, RYT etc. After completion of different evaluation, every selected line must be evaluated in farmer's field before release as a new variety. In this process, three promising wheat lines (BAW-1059 BAW-1064 and BAW-1104) were selected for adaptive trial at farmer's field in different Agro Ecological Zones (AEZs) to evaluate yield and different distinct characters including farmers' acceptability.

Materials and Methods

The experiment was conducted at eight different locations with three candidate varieties BAW-1059, BAW-1064 and BAW-1104 along with Shatabdi as check. The locations were Sherpur, Jamalpur, Jessore, Tangail, Jhenaidah, Narail, Durgapur, Rajshahi and Charghat, Rajshahi. It was laid out in RCB design with 3 replications having 4m x 5 m unit plot size. Seeds were sown on 26 November 2008 at Sherpur, 20 November 2008 at Melandah, Jamalpur, 25 December 2008 at Ghatail, Tangail, 25 November at Jhikargacha, Jessore, 24 November 2008 at Kaliganj, Jhenaidah, 18 November 2008 at Tularampur, Narail and on 23 rd November 2008 at Durgapur and Charghat, Rajshahi. Seeds were sown in lines in 20cm apart rows with a seed rate of 120 kg ha^{-1}. The recommended fertilizer dose of inorganic fertilizer (100-26-50-20-1 kg ha^{-1} NPKS and B respectively) was used. Two third of nitrogen and entire quantity of other fertilizers were applied as basal and rest one third of Urea was top dressed at CRI stage (18-21 DAS) followed by irrigation. One weeding was done three days after 1st irrigation. Three irrigations were also done at booting, grain filling stage and late grain filling stage (it was done due to drought). The crop was harvested during 19 March 2009 to 5 April 2009. All necessary Data were collected and analyzed statistically.

Result and Discussions

Kushumhati, Sherpur

All most all the yield contributing characters were significantly differed due to variety variation (Table 1). The plant height and the number of plants m-2 were found insignificant due to variety differentiation. The number of spikelets $spike^{-1}$ was found highest in BAW 1064 and was identical to BAW 1104. The second highest number of spikelets $spike^{-1}$ was recorded from BAW 1059 while the lowest was in Shatabdi. The longest spike was noted from BAW 1064 and it was identical to BAW 1104. The shortest spike was found in BAW 1059. The highest number of grains $spike^{-1}$ was found in BAW 1064 and it was different from other varieties. The second highest grains $spike^{-1}$ was noted from BAW 1104. The line BAW 1059 and Shatabdi produced identical number of grains $spike^{-1}$. The weight of 1000-grain was found highest in BAW 1064. It was statistically different from BAW 1059 and BAW 1104. The lowest 1000-grain weight was recorded from Shatabdi. However, the highest seed yield was obtained from BAW 1064 (4.69 t ha^{-1}) and it was statistically identical to BAW 1059 (4.31 t ha^{-1}). Shatabdi produced the lowest grain yield (3.26 t ha^{-1}). Shatabdi took the highest days for maturity.

Malancha, Melandah, Jamalpur

Yield and yield contributing characters of wheat conducted at MLT site, Malancha, Melandah, Jamalpur have been presented in Table 2. All most all the yield contributing characters were significantly differed due to variety variation. The tallest plant was found from Shatabdi and it was statistically identical to all varieties except BAW 1064 which produced the shortest plant. The number of plants m-2 was found insignificant due to variety differentiation. The number of spikelets $spike^{-1}$ was found highest in BAW 1064 which was identical to BAW 1059. The second highest number of spikelets $spike^{-1}$ was recorded from BAW 1104 while the lowest was in Shatabdi. The longest spike was noted from BAW 1064 and it was identical to BAW 1059 and BAW 1104. The shortest spike was found in Shatabdi. The number of grains $spike^{-1}$ was insignificant. The weight of 1000-grain was found highest in BAW 1104 and it was identical to BAW 1059 and Shatabdi. In this case, BAW 1104 gave the lowest-1000 grain weight. The highest seed yield was obtained from BAW 1064 (3.91 t ha^{-1}) and it was statistically identical to BAW 1104 (3.87 t ha^{-1}) and BAW 1059 (3.67 t ha^{-1}). Check variety Shatabdi produced the lowest grain yield (3.43 t ha^{-1}). The highest days were required by BAW 1064 while Shatabdi required a little bit less time to nature the crop.

Jessore, Jhenaidah and Narail

Performance of wheat varieties/lines in the farmer's field is presented in Table 4, 5 and 6. The lines BAW 1064 produced the highest grain yield (4.30 t ha^{-1}, 4.82 t ha^{-1}) at the MLT site Jhikargacha, Jessore and Kaliganj, Jhenaidah. The lowest yield (3.99 t ha^{-1}), was obtained from Shatabdi and BAW 1059 at the MLT site Jhikargacha, Jessore and Kaliganj, Jhenaidah The highest seed yield (4.63 t ha^{-1}) was found in BAW 1104 and lowest yield (4.12 t ha^{-1}) was obtained from BAW 1059 at the MLT site Tularampur, Narail.

Tangail

Yield and yield attributes of different varieties/lines were significantly influenced by the treatments (Table 1). The highest plant height was recorded from the variety Shatabdi (84.3cm) where as those of the lowest from BAW 1104 (82.8cm). Variation was also observed in spike length as obtained from BAW 1104 (9.3 cm). The highest number of grains per spike was obtained from BAW 1059 (39). The highest 1000-grain weight was in line BAW 1059 (39.5). The grain yield was also higher in line BAW 1059 (3.17 t ha^{-1}) and lowest in variety Shatabdi (2.41).

Durgapur and Charghat

At Shibpur, all the cultivars gave similar yield (Table 8). On the other hand at Holidagachi, Charghat. Shatabdi and BAW-1064 produced the highest yield viz. 3.97 t ha^{-1} and 3.80 t ha^{-1} respectively (Table 9). Both the candidate varieties were found 5-7 days earlier in maturity compare to best check Shatabdi. Considering thousand grain weight (TGW), the highest TGW was found in BAW-1059 followed by BAW-1064 and lowest TGW was found in the check variety, Shatabdi in both locations. BAW-1059 and BAW-1064 were lodging tolerant compared to Shatabdi.

Farmers' reaction

Sherpur and Jamalpur: Farmers' preferred both advance line of BAW 1064 and 1059 for their high yield potential and bold grain.

Jessore, Jhenaidah and Narail: Farmer's of this area were very much impressed with the wheat lines BAW 1104 and BAW 1064 for its high yield potential, bold size seed and amber color of seeds. They are interested to grow these lines.

Tangail: Farmers showed interest to the new lines. They are interested to get supply of seeds during the sowing time.

Durgapur and Charghat: Farmers are very much impressed due to satisfactory grain yield, bold seed and earlier maturity of BAW-1059 and BAW-1064 than Shatabdi.

Conclusion

Both the lines BAW 1064 and BAW 1059 produced higher grain yields across locations. So, they may be released as variety.

Table 1. Seed yield (t ha^{-1}) of different wheat cultivars across locations, 2008-09

Variety/Lines	Sherpur	Jamalpur	Jessore	Tangail	Jhenaidah	Narail	Durgepur Rajshahi	Charghat Rajshahi	Mean
Shatabdi	3.43	3.26	3.42	2.41	4.25	4.44	4.37	3.97	3.69
BAW-1059	3.87	4.31	3.67	3.17	4.30	4.12	4.37	3.53	3.91
BAW-1064	3.91	4.69	4.30	2.87	4.82	4.21	4.37	3.80	4.12
BAW-1104	3.67	3.77	4.18	2.46	3.99	4.63	-	-	3.78

Table 2. Yield and yield attributes of wheat line at FSRD site, Kushumhati, Sherpur during rabi, 2008-09

Treatment	Plant ht. (cm)	No. of spikelet $spike^{-1}$	Spike length (cm)	No. of grains $spike^{-1}$	TGW (g)	Grain yield (t ha^{-1})	Maturity (days)
Shatabdi	91.1	15.7 b	9.97 bc	38.5 c	43.3 c	3.26 c	112 a
BAW-1059	89.4	16.2 b	9.91 c	39.9 c	45.1 b	4.31 ab	108 b
BAW 1064	88.2	17.7 a	11.19 a	50.0 a	49.6 a	4.69 a	108 b
BAW 1104	90.3	16.3 ab	10.57 ab	43.2 b	45.6 b	3.77 bc	109 b
F	NS	**	**	**	**	**	**
CV (%)	6.29	8.07	6.01	8.38	3.78	9.09	2.53

Table 3. Yield and yield attributes of wheat line at MLT Site, Malancha, Melandah during rabi, 2008-09

Treatment	Plant ht. (cm)	No. of spikelets $spike^{-1}$	Spike length (cm)	No. of grains $spike^{-1}$	TGW (g)	Grain yield (t ha^{-1})	Maturity (days)
Shatabdi	89.9 a	15.3 c	9.2 b	36.3	43.5 a	3.43 b	109
BAW-1059	87.3 a	17.4 ab	10.0 ab	34.8	42.1 a	3.87 a	108
BAW 1064	80.9 b	17.8 a	11.17 a	39.8	43.7 a	3.91 a	108
BAW 1104	86.5 a	16.1 bc	10.37 ab	36.4	39.2 b	3.67 ab	109
F	**	*	*	NS	*	*	NS
CV (%)	5.61	4.51	6.04	5.03	2.81	8.72	5.04

Table 4. Yield and yield contributing characters of wheat at MLT site, Jhikargacha, Jessore during rabi 2008-09

Variety/ lines	Plant height (cm)	No. of plants m^{-2}	Spike length (cm)	No. of grains $spike^{-1}$	1000-grain wt. (g)	Grain yield (t ha^{-1})
Shatabdi	99.73	254.50	10.80	45.10	45.87	3.42
BAW 1059	90.37	3.46.00	11.17	40.27	48.67	3.67
BAW 1064	89.60	353.83	10.17	51.16	49.47	4.30
BAW 1104	88.83	327.00	12.12	44.37	53.33	4.18
CV (%)	2.13	3.56	3.13	5.54	1.75	5.94
LSD (0.05)	3.91	17.43	0.69	5.00	1.73	0.46

Table 5. Yield and yield contributing characters of wheat at MLT site, Kaliganj, Jhenaidah during rabi 2008-09

Variety/ lines	Plant height (cm)	No. of plants m^{-2}	Spike length (cm)	No. of grains $spike^{-1}$	1000-grain wt. (g)	Grain yield ($t\ ha^{-1}$)
Shatabdi	98.27	433.88	9.47	40.33	47.33	4.25
BAW 1059	92.43	407.77	9.40	37.60	48.00	4.30
BAW 1064	91.57	311.11	11.10	43.40	48.87	4.82
BAW 1104	94.57	409.44	11.40	40.11	47.00	3.99
CV (%)	21.84	19.31	1.84	1.33	1.18	5.43
LSD (0.05)	NS	NS	0.37	1.07	NS	0.46

Table 6. Yield and yield contributing characters of wheat at MLT site, Tularampur, Narail during rabi 2008-09

Variety/ lines	Plant height (cm)	No. of plants m^{-2}	Spike length (cm)	No. of grains $spike^{-1}$	1000-grain wt. (g)	Grain yield ($t\ ha^{-1}$)
Shatabdi	90.5	402.87	9.60	42.77	47.40	4.44
BAW 1059	89.10	363.4	9.70	38.23	48.07	4.12
BAW 1064	80.30	387.63	9.00	43.20	48.23	4.21
BAW 1104	89.91	331.87	11.03	46.03	48.47	4.63
CV (%)	2.98	8.50	5.31	6.73	0.91	0.96
LSD (0.05)	5.2	NS	1.05	NS	NS	0.09

Table 7. Yield and yield contributing parameters of wheat varieties/lines at the MLT site, Ghatail during 2008-09.

Treatments	Plant population (m^2)	Plant height (cm)	Spike length (cm)	No. of spikelets $spike^{-1}$	No. of grains $spike^{-1}$	1000-grain wt (g).	Grain yield ($t\ ha^{-1}$)
Shatabdi	270	84.3	9.1	18	37	30.8	2.41
BAW 1059	260	79.3	10	19	39	39.5	3.17
BAW 1064	253	80.9	9.2	18	35	38.2	2.87
BAW 1104	235	82.8	9.3	19	33	38.3	2.46
LSD (0.05)	29.48	8.81	0.53	1.55	3.91	1.52	0.50
CV (%)	5.8	5.4	2.8	4.3	5.4	2.1	9.2

Table 8. Effect of variety/Lines on yield and yield attributes under adaptive trial of wheat at Pali, Durgapur during 2008-2009.

Variety/Lines	Plant height (cm)	No. of spike m^{-2}	No. of spikelets $spike^{-1}$	TGW (g)	Days to maturity (days)	Yield ($t\ ha^{-1}$)
Shatabdi	98.08 a	440.16 a	49.44	44.50 b	120.0 a	4.37
BAW-1059	93.04 b	394.93 b	52.45	50.33 a	115.0 b	4.37
BAW-1064	90.20 b	382.05 b	51.94	45.50 b	113.3 c	4.37
LSD (0.05)	4.95	32.58	NS	1.65	2.00	NS
CV (%)	14.72	3.54	14.72	2.20	0.56	5.61

Table 9. Effect of variety/Lines on yield and yield attributes under adaptive trial (Set-2) of wheat at Holidagachi, Charghat in 2008-2009.

Variety/Line	Plant height (cm)	No. of spike m^{-2}	No. of spikelets $spike^{-1}$	TGW (g)	Days to maturity (days)	Yield ($t\ ha^{-1}$)
Shatabdi	93.12	398.87 a	42.37 a	44.50 b	120.0 a	3.97
BAW-1059	90.61	380.53 ab	39.62 b	53.64 a	115.7 b	3.53
BAW-1064	90.75	365.50 b	38.16 b	45.33 b	113.7 c	3.80
LSD (0.05)	NS	28.82	2.65	1.225	1.511	NS
CV (%)	2.06	3.33	2.92	1.13	0.56	17.74

Performance of BARI Released Wheat Varieties

Abstract

The experiment was conducted in farmers' field to find out the suitable variety of wheat for coastal region. Five varieties was tested in two different locations namely Laudove MLT site, Dacope and Southkhali, Bagerhat during Rabi season, 2008-'09. Among the varieties it was found that Prodip performed better (1.6 t ha^{-1}) at Laudove MLT site, whereas Bijoy gave the highest yield (2.42 t ha^{-1}) in Southkhali, Bagerhat.

Introduction

Wheat is the most important staple food of the world. In Bangladesh, it is one of the main food crops, next only to rice. It is grown on about 8.5 lakh hectares of land and the annual production is about 7.3 lakh metric tons. But yield of wheat is lower in our country than that of other wheat growing countries. It may be due to variety/environment or technological differences. In saline area soil salinity and irrigation crisis due to lack of fresh water are major problems to grow wheat successfully. Therefore, the present the experiment was conducted in the farmers field during Rabi season, 2008-'09 to verify the yield performance of the varieties in saline soils of coastal area.

Materials and Methods

The experiment was conducted in the farmers' field of Laudove MLT site, Dacope and Southkhali, Bagerhat. The experiment had three dispersed replications with RCB design. The unit plot size was 15m×10m. A total of five verities namely Prodip, Bijoy, Shatabdi, Sourav and Sufi were tested. The land was well prepared and seeds were sown on 03 Deember'08 and 07 December'08 at Laudove and Southkhali, respectively. The fertilizers Urea-TSP-MOP-Gypsum were applied at the rate of 180-180-50-90 kg ha^{-1}., respectively. The field was irrigated twice at 20 and 45 DAS. The crop was harvested at 15 March in both the locations. During this period soil salinity was 3.83-7.89 dS m^{-1} and 2.05 - 2.45 dS m^{-1} at Laudove and Southkhali, respectively. Rat attack was managed by rodenticide (Zinc Phosphide). Data were collected and analyzed by MSTAT-C.

Results and Discussion

Table 1. Grain yield of wheat across location in coastal area, 2008-09

Variety/Lines	Liaudore, Dacope Khulna	Southkhali Bagerhat	Mean
Prodip	1.60	2.05	1.82
Bijoy	1.55	2.42	1.98
Shatabdi	1.46	1.88	1.67
Sourav	1.36	2.32	1.84
Sufi	1.20	2.13	1.66

DS. Lau dove :3December, 2008, Southkhali :7 December, 2008

Laudove MLT site, Dacope: Among 5 wheat varieties, Prodip performed better and gave the highest yield (1.60 t ha^{-1}). It might be the higher number of grains $spike^{-1}$ and weight of 1000 grains of the variety. The next highest yield was found in Bijoy (1.55 t ha^{-1}). The lowest yield was recorded in Sufi.

Southkhali, Bagerhat: The highest grain yield was found in Bijoy (2.42 t ha^{-1}) and it was probably due to its number of grains per spike and 1000 grain weight. The lowest grain yield (1.88 t ha^{-1}) was found in Sourav. It is due to its lowest number of grains $spike^{-1}$.

Farmers reaction

Laudove, Dacope: Farmers were not habituated to grow wheat at all. They did not do it due to high salinity and poor irrigation facility. But in the last Rabi season, OFRD Khulna took initiative to grow wheat in muddy soil just after harvest of T.Aman rice. However, it needs further experimentation.

Bagerhat: Wheat was grown with minimum tillage which is a new technology to the farmers. So, most of the farmers are interested to grow wheat in this area.

Conclusion

Among the varieties, Prodip performed better at Laudove MLT site, Dacope and Bijoy at Southkhali, Bagerhat. This is the 2nd year experiment. So, it needs to be investigated in the next year.

Table 2. Yield and yield attributing characters of wheat at Laudove MLT site, Dacope during Rabi season, 2008-09.

Variety	Days to maturity	Plant population m^{-2}	Plant height (cm)	Spike length (cm)	Grains $spike^{-1}$ (no.)	Weight of 1000 grain (g)	Grain yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)
Prodip	98	197.04	60.77	6.83	31.14	30.32	1.60	1.27
Bijoy	100	197.24	59.76	6.71	29.94	29.88	1.55	1.26
Shatabdi	102	192.80	59.58	6.38	27.84	29.80	1.46	1.20
Sourav	80	188.60	55.21	6.42	27.44	29.48	1.36	1.12
Sufi	100	186.04	53.78	6.37	26.62	29.16	1.20	1.09
LSD(0.05)	-	3.778	4.26	0.27	1.67	0.65	0.073	0.073
CV(%)	-	1.46	5.49	3.06	4.36	1.63	3.73	4.54

Table 3. Yield and yield attributing characters of wheat at testing area of Southkhali, Bagerhat during Rabi season, 2008-09.

Variety	Days to maturity	Plant population m^{-2}	Plant height (cm)	Spike length (cm)	Grains $spike^{-1}$ (no.)	Weight of 1000 grain (g)	Grain yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)
Prodip	102	141b	87a	9.00a	28a	52.00a	2.05bc	3.53a
Bijoy	103	167a	90a	9.00a	29a	50.33a	2.42a	4.4a
Shatabdi	103	146b	87a	8.00a	28a	46.00b	1.88c	3.90a
Sourav	102	184a	84a	8.00a	30a	42.00c	2.32ab	3.60a
Sufi	99	166c	84b	7.33b	32b	40.00b	2.13b	3.57b
LSD(0.05)	-	19.51	14.43	2.573	2.561	2.538	0.3206	0.8710
CV(%)	-	6.44	8.87	16.53	4.63	2.93	7.86	12.18

On-Farm Verification Trial of Hybrid Maize

Abstract

The trail was conducted at Farming Systems Research and Development (FSRD) site, Pushpapara, Pabna, Lahirirhat, Rangpur, Gangni, Kushtia, Kalgan, Jhenaidah and hill valley of Bandarban Sadar during 2008-09 to compare the performance of BARI developed hybrid maize varieties with commercial hybrid maize cultivars. Eight variety/lines were evaluated. Across locations BHM 9 gave the highest yield (9.07 t ha^{-1}) followed by 900 M, NK 40 and BHM 6. However, different varieties/cultivar performed in different ways in various locations. BHM produced the highest grain yield at Rangpur and Jhenaidah.

Introduction

Maize is a very common, popular and multi uses cereal crop at present situation. Every year a huge amount of maize grain is required as feed and fodder for livestock sector and most of them are fulfilled by importing from other countries. Farmers are growing mainly imported hybrid varieties for their exceptionally high yields. BARI has developed several hybrid maize varieties with almost similar yield potentials to that of the imported varieties. To popularize the hybrid maize cultivation an adaptability trial of BARI hybrid maize-6, 7, 8 and 9 along with commercial hybrid maize DTC-09, DTC-14, 900 M and NK-40 was undertaken.

Materials and Methods

The experiment was conducted at Farming Systems Research and Development (FSRD) site, Pushpapara, Pabna, Lahirirhat, Rangpur, Gangni, Kushtia, Kaliganj, Jhenaidah and hill valley of Bandarban Sadar during 2008-09. Eight variety/cultivar was considered as test material viz. BARI hybrid maize (BHM)-6, BHM 7, BHM 8, BHM 9, 900M, NK 40, DTC 09 and DTC 14. The experiment was laid out in RCB design with three dispersed replications in the farmer's field. The unit plot size was 5m x 3m. Seeds of different varieties were sown on December 14-18,December 6-7, December15,December 11 and 25-28 November, 2008 at Pabna, Rangpur, Kushtia, Jhenaidah and Bandarban respectively with a spacing of 75 cm x 25 cm. The crop was fertilized with 250-120-120-40-5-1 kg N, P2O5-K2O-S-Zn-B ha^{-1}. One third urea and full amount of all other fertilizers were applied as basal at final land preparation, The rest urea was applied as top dress in two equal splits at 8 leaf and tasseling stages. Two times weeding and earthing up were done after each top dress. The crop was harvested at maturity on 10 May, 21-22 April, 26-30 April, 29 April and 25-29 April, 2009 at Pabna, Rangpur, Kushtia, Jhenaidah and Bandarban. The crop was irrigated at 20, 40, 70 and grain filling stage. Yield and yield attributes were recorded and analyzed statistically.

Result and Discussion

Pabna: The highest plant height was observed in DTC-14 followed by BHM-7, DTC-09 and BHM-9. (Table 2). The lowest plant height was attained from NK-40. The maximum ear height was recorded in DTC-14 which was statistically identical to DTC-09, BHM-7, BHM-6, 900M and BHM-8. Minimum ear height was observed in NK-40 and BHM-9. Plant population m^2 was statistically identical and higher in commercial hybrid maize compare to BARI developed hybrid maize. Maximum days to tasseling was recorded in DTC-09 and BHM9 followed by BHM-6, DTC-14 and 900M. Minimum days to tasseling found in NK-40, BHM-7 and BHM-8. Similar observation was found in case of days to silking. The maximum lodging (%) was observed in DTC-14 followed by DTC-09, BHM-9, 900M and BHM-7. The minimum lodging (%) was recorded in NK-40 probably due to dwarf stature of the plant. Husk cover (%) was statistically higher in all the tested varieties except DTC-09. The highest length of cob was attained from BHM-9 followed by NK-40, 900M, BHM-6 and DTC-14 while the lowest cob length was found in BHM-7. The significantly highest number of grains cob^{-1} was obtained from BHM-9 followed by BHM-6, DTC-14 and 900M. Other varieties produced the lowest number of grains cob^{-1}. The highest grain yield was recorded in 900M followed by BHM-9 and NK-40. The lowest grain yield was obtained from DTC-09 which was identical to BHM-6, BHM-8 and DTC-14.

Rangpur: The tallest plant (246.80 cm) was recorded from DTC-9 which was identical to DTC-14 (273.3 cm), BHM-7 (232.3cm) and BHM-6 (219.1 cm). The length of cob was highest with DTC-9 (22.55cm) which differed significantly from other varieties (Table 3). The highest number of grains per cob was recorded from BHM-9 (505.6 cob^{-1}) which was identical to BHM-8 (484.5 cob^{-1}). The weight of grains per cob was highest with BHM-9 (204.1 cm) which differed significantly from other varieties. The 100 grain weight varied significantly due to different maize varieties. The higher weight of 100 grains was recorded from NK-40 (37.2 g) which was identical to BHM-9 (37.1 g), BHM-8 (36.9 g), BHM-7 (36.8 g), DTC-9 (36.12 g) and DTC-14 (34.80 g). The highest grain yield was obtained from BHM-9 (10.61 t ha^{-1}) which differed significantly from other varieties. The lowest yield was obtained from 900M (8.16 t ha^{-1}).

Kushtia: The number of seeds cob^{-1} and weight of seeds cob^{-1} were highest in BHM-9 (Table 4). Thousand seed weight was the highest in BHM-9. The highest grain yield was recorded from BHM-9 (8.30 t ha^{-1}) and the lowest from NK-40 (5.98 t ha^{-1}).

Jhenaidah: The yield and all the yield contributing characters were statistically differed among the different maize variety and lines (Table 5). The highest yield was given by the advanced line NK-40

(10.55 t ha^{-1}) followed by the line NK-900M (10.9 t ha^{-1}) and the lowest yield was found in the line DTC-14 (7.49 t ha^{-1}).

Bandarban: Variety 900M gave the highest number of cobs m^{-2} (9.69) and heaviest 1000-seed weight resulting in highest yield (8.46 t ha^{-1}), which was statistically identical to the variety BHM-6, NK 46, and DTC 09. The lowest grain yield (6.06 t ha^{-1}) was recorded from BHM-8.

Farmer's reaction:

Pabna: Farmers opined that higher grain yield is their major demand and hence they choose 900M, BHM-9 and NK-40 variety. In addition to higher yield, NK-40 variety showed lodging resistance and farmers chose this variety for cultivation. The good quality, color and biomass of the three varieties also attract the farmers.

Rangpur: BHM-9 preferred by the farmers for its higher yield compared to other tested varieties.

Kushtia: The new variety BHM-9 was accepted by the farmers due to its higher yield and attractive colour.

Jhenaidah: The advanced line NK-40 produced the highest grain yield over all lines/variety. Farmer's choose this lines/variety for good quality grain and high yield.

Bandarban: Farmer's are showing interest to grow the line 900 M due to its higher yield as well as economic return.

Conclusion

Among the tested hybrid maize varieties, the grain yield of BARI developed hybrid maize- BHM-9 was comparable to popular commercial hybrid maize 900M and NK-40. The variety can be recommended for wider scale cultivation after completion of at least another year adaptation trial.

Table 1. Mean grain Yield of (t ha^{-1}) hybrid maize in different locations, 2008-09

Maize variety/lines	Location					
	Pabna	Rangpur	Kushtia	Jhenaidah	Bandarban	Mean
BHM-6	7.02c	8.79bc	7.78	8.80	7.94ab	8.06
BHM-7	7.63bc	9.37ab	8.20	7.62	6.83c	7.93
BHM-8	7.22c	8.80bc	8.08	8.77	6.06c	7.78
BHM-9	8.76ab	10.61a	8.30	10.73	6.96c	9.07
900M	9.25a	8.16c	7.82	10.19	8.46a	8.77
NK-40	8.75ab	8.61bc	5.98	10.55	7.45ab	8.26
DTC-09	6.84c	8.50bc	6.89	7.77	7.78ab	7.55
DTC-14	7.35c	8.37c	7.29	7.49	7.08b	7.52
CP-818(FP)	-	-	7.27	-	-	7.27

Table 2. Yield and yield contributing characters of different hybrid maize variety at FSRD site, Pushpapara, Pabna during the *rabi* season 2008-09.

Maize variety	Plant height (cm	Ear height (cm)	Plant pop^{n}. m^{2} (no.)	Days to tasseling	Days to silking	Lodging (%)	Husk cover (%)	Cob length (cm)	Grain cob^{-1} (no.)	100 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
DTC-09	197.48ab	105.07a	6.67a	93a	98a	33ab	95b	16.66bc	502c	26.63f	6.84c	9.77bc
DTC-14	201.06a	106.67a	6.62a	89b	94b	40a	100a	16.73abc	585b	27.73e	7.35c	10.38abc
900 M	185.10bc	101.81a	6.62a	88bc	93bc	30ab	100a	17.13ab	579b	34.40b	9.25a	12.44a
NK-40	162.23d	86.37b	6.67a	87c	92c	5c	100a	17.33ab	471c	36.40a	8.75ab	8.93c
BHM-6	181.00c	102.37a	6.44b	89b	94bc	18bc	99a	16.86abc	591b	24.47g	7.02c	11.99a
BHM-7	197.86ab	104.33a	6.44b	87c	92bc	22abc	100a	14.73d	498c	30.73c	7.63bc	9.11c
BHM-8	178.16c	101.76a	6.48b	87c	92bc	19bc	99a	15.46cd	500c	28.33d	7.22c	8.99c
BHM-9	186.00abc	87.43b	6.40b	93a	99a	33ab	100a	18.33a	693a	23.43h	8.76ab	11.55ab
CV (%)	4.81	7.12	2.34	3.48	4.45	17.57	3.88	5.63	7.60	3.67	8.53	11.65
LSD $_{0.05}$	15.67	12.41	0.11	2.31	2.39	20.62	1.54	1.64	63.87	0.34	1.17	2.12

Table 3. Performance of different hybrid maize varieties at FSRD site, Lahirirhat, OFRD, Rangpur during rabi season, 2008-09

Treatments	Plant height (cm)	Length of cob (cm)	No. of grains cob^{-1}	Wt of grains cob^{-1} (g)	100-grain weight (g)	Yield (t ha^{-1})	Ear height (cm)	Days to 80% emergence
DTC-9	246.8a	22.55a	459.7bc	161.2c	36.12a	8.50bc	122.4a	9.00a
DTC-14	237.3ab	19.27b	470.9bc	160.6c	34.80a	8.37c	92.22d	8.33a
900M	207.1c	17.44cd	471.9bc	149.9c	29.40b	8.16c	103.1c	8.33a
BHM-7	232.3abc	17.22d	449.1c	176.3b	36.80a	9.37c	113.1b	8.00a
NK-40	207.2c	18.89bc	458.4bc	163.0c	37.20a	8.61bc	104.8c	9.00a
BHM-8	210.3bc	17.44cd	484.5ab	164.4c	36.90a	8.80bc	116.0ab	8.00a
BHM-9	216.9bc	17.45d	505.6a	204.1a	37.10a	10.61a	109.7bc	7.66a
BHM-6	219.1abc	19.55b	458.0bc	162.8c	28.90b	8.79bc	102.9c	8.33a
CV (%)	6.63	4.27	3.40	3.58	5.87	5.50	3.79	9.40

Table 4. Effect of different varieties on yield and yield components of Maize at Kushtia during 2008-09

Treatments	Plant height (cm)	Ear height (cm)	No. of cob $15m^{-2}$	No. of seeds cob^{-1}	Seed wt $15m^{-2}$ (kg)	1000 grain wt. (g)	Yield (t ha^{-1})
DTC-09	165.0	75.0	78	451.0	10..33	325	6.89
DTC-14	186.0	76.0	78	460.0	10..93	331	7.29
BHM-6	177.0	84.0	77	520.0	11.67	363	7.78
BHM-7	196.0	91.0	73	530.0	12.30	370	8.20
BHM-8	196.0	76.0	74	521.0	12.13	371	8.08
BHM-9	190.0	83.0	71	540.0	12.47	375	8.30
900M	200.0	78.0	78	525.0	11.73	376	7.82
NK-40	156.0	60.0	73	352.0	8..97	318	5.98
CP-818 (FP)	177.0	68.0	79	467.0	10..9	361	7.27
LSD	8.25	5.67	4.02	14.53		7.62	0.314
CV (%)	2.64	4.26	3.08	1.73		1.24	2.43

Table 5. Yield and yield contributing characters of maize at MLT site, Kaliganj, Jhenaidah during rabi 2007-08

Variety/ lines	Plant height (cm)	Grain wt. cob^{-1} (g)	No. of seed cob^{-1}	100 grain wt. (g)	Yield (t ha^{-1})	Straw yield (t ha^{-1})
BHM-6	196.67	153.33	592.33	38.60	8.80	6.80
BHM-7	205.00	174.33	461.33	44.73	7.62	6.62
BHM-8	218.33	166.00	541.67	34.77	8.77	7.63
BHM-9	215.00	208.33	617.33	34.53	10.73	6.53
DTC-9	232.33	158.33	643.00	29.20	7.77	7.98
DTC-14	212.00	161.67	695.67	28.53	7.49	6.93
NK-40	190.00	164.00	483.67	45.00	10.55	5.97
NK-900M	202.33	203.33	618.00	39.73	10.19	6.77
CV (%)	1.64	5.79	4.60	0.49	3.49	4.09
LSD (0.05)	5.995	17.61	46.89	1.183	0.5482	49.53

Table 6.Yield and yield contributing characters of hybrid maize at hill valleys in Bandarban, 2008-09

Variety/Line	Plant height (cm)	No. of plant m^{-2}	No. of cobs m^{-2}	1000- grain wt.(g)	Grain yield (t ha^{-1})	Days to maturity
BHM – 6	238 d	4.25	7.82 bc	315	7.94 ab	145-150
BHM – 7	240 cd	4.51	7.17 c	310	6.83 c	144-148
BHM – 8	252 c	4.87	8.65 b	305	6.06 c	140-145
BHM – 9	265 b	4.95	8.77 b	320	6.96 c	144-147
900 M	254 e	5.13	9.69 a	330	8.46 a	145-150
NK 46	235 d	4.87	7.65 bc	325	7.45 ab	145-150
DTC – 09	279 a	4.63	8.16 b	321	7.78 ab	144-147
DTC – 14	256 bc	4.58	7.98 bc	319	7.08 b	144-148
CV (%)	9.87	5.41	6.32	5.21	9.51	-

Performance of Barley Genotypes in the Coastal Region

Abstract

On-Farm performance of three barley genotypes namely BHL-15, BHL-18 and BHL-19 were tasted at Banerpota, Satkhira, Laudove MLT site, Dacope, Khulna and Kuakata, Patuakhali during the year 2008-09. The highest average seed yield was obtained from cultivar, BHL-15 (1173 kg ha^{-1}) followed by two other cultivars.

Introduction

Barley is one of the important cereals of the world. In Bangladesh barley is cultivated as minor cereal. It can be grown in less fertile soil with minimum inputs. Barley is grown as food for poor people. In foreign country, barley is used in a beverage industry for processing alcohol and wine. It is known that barley is a salt tolerant crop. In coastal area, vast lands remain fallow due to salinity in Rabi and early Kharif season. Barley may be cultivated in saline area. BARI has recently developed some high yielding barley lines. The performance of these lines needs to be evaluated in saline area.

Materials and Methods

The trial was conducted at Banerpota site, Satkhira and Laudove MLT site, Dacope and Kuakata, Patuakhali during Rabi season, 2008-2009 with three Barley genotypes namely BHL–15, BHL-18 and BHL-19 in RCB design with 3 replications. The unit plot size was 3m×2m. The crop was sown on 06 December, 2008 at Khulna and Satkhira and 20 December, 2008 at Patuakhali as line sowing. Line to line spacing was 30cm. Fertilizer were applied at the rate of 100-60-40 kg ha^{-1} of N, P and K respectively in the form of urea, TSP and MoP. All Urea, TSP and MP were applied as basal. Two irrigations were given at initial stage. All the intercultural operations were done as and when necessary. Data on yield and yield attributes were collected and analyzed statistically. The soil salinity levels at Khulna and Satkhira sites were 3.00 to 7.65 dS m^{-1} and at Patuakhali it was 2.93-9.51 dS m^{-1}.

Results and Discussion

Khulna and Satkhira

The results revealed that the highest grain yield (983 kg ha^{-1} at Satkhira and 956 kg ha^{-1} at Laudove) was obtained from BHL-18 from both the locations and the lowest yield (832 kg ha^{-1} and 935 kg ha^{-1}) was found from BHL-19. The highest yield produced by BHL-18 might be due its highest plant population. The lowest yield produced by BHL-19 might be due to its lowest plant population and less weight of 1000 grain. However, the yield was much lower than its potential.

Patuakhali

The highest number of grains $spike^{-1}$ was observed in BHL-15 which was statistically identical to BHL-19 followed by BHL-18 (Table 4). 1000grain wt. was highest in BHL-15 followed by BHL-19 and BHL-18 and the last two was statistically identical. The highest grain yield (1610 kg ha^{-1}) was obtained from BHL-15 followed by BHL-19 (1318kg ha^{-1}). The lowest yield was obtained from BHL-18 (1195 kg ha^{-1}).

Farmers' reaction

Khulna and Satkhira: Farmers are not interested to grow barley in small scale. Farmers dislike its winnowing, threshing and processing procedure.

Patuakhali: Post harvest processing was not easy. Marketing was a problem. Farmers are not interested to cultivate barley. If it is sown within 15 November the grain yield would be satisfactory.

Conclusion

To popularize barley industrial use should be ensured for better price at farmer's level.

Table 1. Average grain yield (kg ha^{-1}) of Barley in three Coastal Saline area, 2008-09

Genotype	Khulna	Satkhira	Patuakhali	Mean
BHL-15	950	960	1610	1173
BHL-18	956	983	1195	1045
BHL-19	935	832	131.8	1028

Table 2. Yield and yield attributing characters of salt tolerant Barley genotypes at Banerpota Farm, Satkhira during Rabi season, 2008-09.

Genotypes	No. of spike m^{-2}	Plant height (cm)	Spike length (cm)	No. of grains spike^{-1}	WTG (gm)	Grain yield (kg ha^{-1})	Straw yield (t ha^{-1})
BHL-15	70b	60b	8b	37.06b	37b	960c	2.60b
BHL-18	71a	65a	9a	38.45a	36a	983a	2.30a
BHL-19	68a	70a	7a	35.98a	34a	832b	2.00a
LSD	14.87	17.92	3.206	10.62	6.412	79.69	0.7886
CV (%)	9.41	12.16	17.68	12.61	7.93	3.80	15.11

Table 3. Yield and yield attributing characters of salt tolerant Barley genotypes at Laudove MLT site, Dacope during Rabi season, 2008-09.

Genotypes	No. of spike m^{-2}	Plant height (cm)	Spike length (cm)	No. of grains spike^{-1}	WTG (gm)	Grain yield (kg ha^{-1})	Straw yield (t ha^{-1})
BHL-15	105c	64.00b	6.33b	26.27c	33b	950b	1.03b
BHL-18	115a	62.67a	8.00a	25.18b	33a	956a	1.07a
BHL-19	92b	65.67a	7.00a	32.11a	31a	935a	1.06a
LSD	1.302	8.104	2.389	3.131	2.617	51.41	0.1663
CV (%)	0.88	5.58	14.82	4.96	3.57	2.39	6.53

Table 4. Yield and yield contributing characters of barley genotypes during rabi 2008-2009 at Kuakata, Patuakhali

Genotypes	Plant height (cm)	Spike length (cm)	No. of effective tillers hill^{-1}	No. of grains spike^{-1}	1000 grain wt. (g)	Yield (kg ha^{-1})
BHL-15	55.1	7.4	3.6	46 a	29.00 a	1610 a
BHL-18	53.2	7.0	2.7	41 b	27.33 b	1195 c
BHL-19	54.8	7.2	2.3	43 b	27.55 b	1318 b
CV (%)	-	-	-	-	-	10.52

Table 5. Salinity levels in the experimental plots at Kuakata, Patuakhali

Date	Salinity level (dS/m)	Date	Salinity level (dS m^{-1})
25.12.2008	2.93	12.02.2009	6.98
09.01.2009	3.81	27.02.2009	7.80
21.01.2009	4.19	12.03.09	9.51
31.01.2009	5.53		

On-Farm Trial of Hull Less Barley in Saline Area

The trial of hull less barley was conducted at the MLT site, Laudove, Dacope during the Rabi season 2008-'09. Six lines along with one barley variety were used in this demonstration. Among the cultivars BHL-8 gave the highest yield (990 kg ha^{-1}). The lowest yield was found BHL-19 and it was 910 kg ha^{-1}.

Materials and Method

The trial was conducted at MLT site, Laudove, Dacope during Rabi season 2008-'09 with six hull less barley lines viz. BHL-03, BHL-08, BHL-13, BHL-15, BHL-18, BHL-19 and BB-4 as variety. The unit plot size was 10 X 5 m. The seed were sown continuously in line on 23 December, 2008 with 20 cm spacing. Fertilizers were applied at the rate of 180-125-85 kg ha^{-1} of urea, TSP, MOP respectively. All TSP, MOP and ½ of total urea applied as basal during final land preparation. Rest of the urea applied in two equal installments at 30 and 55 DAS. Two irrigations were applied at 30 and 45 DAS. The land was weeded two times at 30 and 60 DAS. No disease and insect pest infestation was seen. The crop was harvested on 30 March, 2009. Data of yield and yield attributes were taken.

Results and Discussion

Among the BARI released barley variety/lines included in this study BHL-08 produced the highest yield and it was 990 kg ha^{-1}. BHL-18, BHL-03 and BHL-15 gave yield 972 kg ha^{-1}, 950 kg ha^{-1} and 943 kg ha^{-1} respectively. The lowest yield was obtained from BHL-19 and it was 910 kg ha^{-1}.

The soil salinity during this period was 2.05-9.57 dS m^{-1}.

Farmer's reaction

Farmers are not interested to grow barley due to its difficult winnowing, threshing and processing procedures.

Conclusion

Barley is a promising cereal crop for saline area due to its salt tolerant property. It can also be fit in Fallow-T.aman-Fallow cropping pattern. But, an effort should be made for its easing its threshing, winnowing and processing.

Table 1. Yield and yield attributes of barley at MLT site, Laudove during Rabi season 2008-09

Variety/lines	Spike m^{-2} (no.)	Plant ht. (cm)	Spike length (cm)	Grains spike^{-1} (no.)	WTG (g)	Grain yield (kg ha^{-1})	Straw yield (t ha^{-1})
BHL-03	87	52.04	7.20	32	34	950	1.10
BHL-08	88	57.71	7.00	34	33	990	1.20
BHL-13	93	51.75	7.46	30	33	920	1.00
BHL-15	87	52.58	7.64	33	33	943	1.30
BHL-18	89	51.95	6.82	34	32	972	1.10
BHL-19	96	52.94	7.46	28	34	910	1.00
BB-4	109	53.72	7.38	27	31	912	1.00

On-Farm Trial of Hull Less Barley under Rainfed Condition

Abstract

The trial was conducted in the farmer's field of FSRD site, Kadamshahar, Rajshahi during rabi 2008-09 with a view to select early and high yielding barley lines to be release barley variety for drought areas. The trial consists of five barley genotypes namely, BHL-10, BHL-11, BHL-19, and BARI Barley-3 (check variety). Out of the five barley genotypes BHL-10 gave the highest grain yield (2.51 t ha^{-1}) followed by BHL-11 (2.50 t ha^{-1}) and BHL-19 (2.33 t ha^{-1}. The lowest seed yield was produced by BARI barley-3 (2.01 t ha^{-1}).

Introduction

Barley is the most adaptive cereal crop in different environment. It is used for making various delicious foods like baby food, horlicks, ovaltin etc. It contents about 12-14% protein. In respect of nutrient quality barley is better than wheat. In Bangladesh, the total area under barley cultivation is about 4000 hectare of land and the production is about 3000 metric ton (BBS, 2004). It has potentiality to grow under water stress condition. Several study revealed that it can be successfully grown after harvesting of T. aman rice under Barind water-stressed environment. Thus barley can be considered as beneficial crop in the drought prone areas like High Barind Tract (AEZ-26). Therefore, the field trial was taken to select early and high yielding lines to release as a new variety for drought areas.

Materials and Methods

The field trial was conducted at FSRD site, Kadamshahar, Rajshahi to select early and high yielding lines to release as a variety for drought areas during rabi season of 2008-09. The trial consists of four barley genotypes viz. BHL -10, BHL-11, BHL-19, and BARI Barley-3 (used as check variety). The unit plot size was 5m x 4m. Fertilizers were applied at the rate of 100-60-40-1 kg N, P_2O_5, K_2O and B ha^{-1} in the form of urea, triple super phosphate, muriate of potash and boric acid, respectively. All the fertilizers were incorporated with soil during final land preparation. The crop was sown on 12 December 2008. The spacing was line-to-line distance 25 cm with continuous sowing and seed rate was maintained 120 kg ha^{-1}. One hand weeding was done in all plots at 30 DAS. *Melathion* 57 EC @ 2 ml/L water was applied to control *Aphids* before flowering stage. The crop was harvested on 21 March 2009. Data were collected on different yield and yield components.

Results and Discussion

Results revealed that BHL-10 gave higher grain yield (2.51 t ha^{-1}) due to production of the highest number of effective tillers m^{-2} (297), longest panicle (8.45 cm) and the highest number of grains $spike^{-1}$ (59.4). All the genotypes required 65-69 days for 50% heading and 93-100 days for 50% maturity under rainfed condition in the high Barind Tract. Among the genotypes, BARI barley-3 was taken comparatively shorter time 65 days and 93 days for heading and maturity respectively and on the other hand, BHL-11 required comparatively longer time 69 days and 100 days for heading and maturity respectively under Barind stress situation.(Figure 1).

Farmers' reaction

Overall performance of barley genotypes was good in respect of yield under Barind situation. Farmers preferred genotypes BHL-10 and BHL-11 in comparison to BARI barley-3 for their better yield as well as resistant quality against different pest.

Conclusion

Among the tested cultivars BHL-10 produced better yield under rainfed conditions for last three years; so it may be released as variety.

Table 1. Performance of different barley genotypes under rainfed condition at HBT

Genotypes	Plant height (cm)	Effective tillers m^{-2}	Spike length (cm)	Grains Spike^{-1}	TSW (g)	Seed yield (t ha^{-1})
BHL-10	76.4	297	8.45	59.20	38.20	2.51
BHL-11	75.6	264	8.20	55.40	39.20	2.50
BHL-19	77.5	283	8.05	48.60	38.40	2.33
BB-3 (Check)	65.8	251	7.10	46.60	36.50	2.01

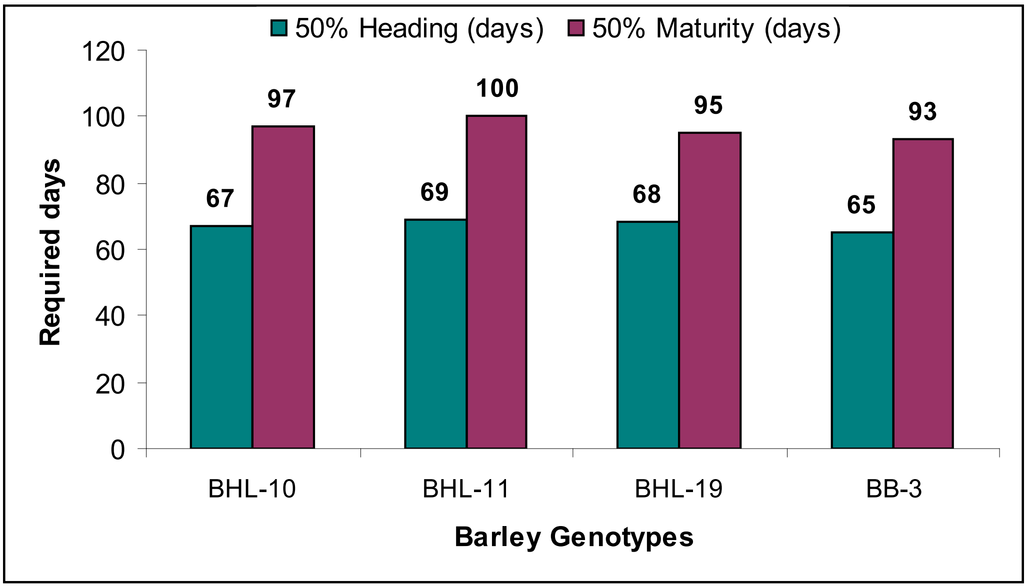

Figure 1. Fifty percent heading and maturity (days) affected by barley genotypes

Adaptive Trial with Latest Released Potato Varieties and Seedling Tuber Progenies

Abstract

A field trial was conducted at the farmer's field of Rangpur, Gazipur, Kushtia, Barind- Rajshahi, Jamalpur, Comilla, Razakhali and Kuakata of Patuakhali during the rabi season of 2008-09 with a view to evaluate newly released high yielding varieties of potato across the locations. The trial consists of five potato varieties viz., Granola, Raja, Asteroid, BARI TPS-1 and Diamant. Tuber yield widely differed among the varieties and locations due to time of planting and environments. Among five varieties, Granola produced the highest average tuber yield (20.66 t ha^{-1}) while Raja gave the lowest yield (15.34 t ha^{-1}).

Introduction

Potato is one of the most important tuber crops in Bangladesh. Potato can be fitted into the Potato-Fallow-T.aman rice cropping pattern after harvesting of short duration T.aman rice in Barind area, Patuakhali and other areas. However, the yield of potato is low over the years due to different reasons. Such low yield might be attributed to the lack of higher yielding and disease resistance varieties. The production of potato will be increased with adoption of high yielding varieties and through application of modern management practices. Recently BARI has developed and released some high yielding varieties of potato. It should be tested across locations for wider adoption.Considering these views, this present trail was initiated with the objective to popularize the newly released improved potato and seedling tuber progenies.

Materials and Methods

The field trial was conducted at FSRD site, Lahirirhat-Rangpur, Dhirashram-Gazipur, Kushtia, Barind- Godagari-Rajshahi, Jamalpur, Comilla, Razakhali and Kuakata of Patuakhali during rabi season of 2008-2009. Five potato varieties were evaluated viz., Granola, Raja, Asterix, BARI TPS-1 and Diamant. The unit plot size was 6 m x 3 m. Fertilizers were applied as TCRC dose of 106-27-90-20- 2.5-1 kg NPKSZnB ha^{-1} in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and borax, respectively and 5 t ha^{-1} cowdung. Full doses of cowdung, half of the urea and all other inorganic fertilizers were applied according to individual plot and mixed with soil at the time of final land preparation. The rest urea was top dressed at 35 DAS. Potato tubers were planted on 3-5 December, 2008 at Rangpur, 30 November, 2008 at Gazipur, 23 November, 2008 at Kushtia, 29 November 2008 at Barind, 4 December, 2008 at Jamalpur, 27 November, 2008 at Comilla and 10-20 December, 2008 at Patuakhali. The tubers were planted at the spacing of 60 cm × 20 cm. The crop was harvested at maturity during 25 February 2009 to 13 March 2009. Intercultural operations viz. earthling up, weeding, irrigation, fungicide and insecticide spray were done in order to support normal plant growth. Data yield contributing characters of potato were recorded. Observations were made on yield components from 10 randomly selected plants per plot. Tuber yield was recorded plot-wise and then converted to ton per hectare.

Results and Discussion

Rangpur

The tallest plant was measured from Felsina (75.95 cm) which was identical to Asterix (69.40cm). The number of tubers per hill had a significant effect due to different potato varieties (Table 2). The highest number of tubers per hill was recorded from Granula (9.46 $hill^{-1}$) which was identical to Diamant. The highest weight of tuber per hill was recorded from Granula (442g) which was identical to Diamant (440 g) and Felsina (426 g). The highest tuber yield (31.49 t ha^{-1}) was obtained from Granula which differed significantly from other varieties. The lowest yield was recorded from Asterix (19.08 t ha^{-1}). Few plant of 'Asterix' was infested by Bacterial wilt. Due to foggy weather, incidence of late blight disease was higher but it was properly controlled by spraying fungicides.

Gazipur

Tallest plant height (87.1 cm) was recorded from the BARI TPS1 variety (Table 3). The highest length of tuber was Diamant (7.62 cm) where as lowest was BARI TPS-1 (4.53cm) and same trend was observed in breath of tuber. The individual weight of tuber (89.7 g) was highest in Diamant which was followed by Granola (78.09 g), Asterix (73.89 g) and Raza (73.79 g). During this year the highest tuber yield (16 t ha^{-1}) was obtained from Diamant followed by Asterix (15 t ha^{-1}), Raza (10.75 t ha^{-1}) and Granola (10.5 t ha^{-1}) respectively. The crop did not perform well because of late blight disease infested.

Kushtia

Highest tuber yield (19 t ha^{-1}) was obtained from BARI TPS and the lowest (14.t ha^{-1}) from Asterix (Table 4).

Barind

Among five varieties, the highest plant height (67.20 cm) was found in the variety Diamant followed by BARI TPS-1 (66.40 cm) but lowest (43.00 cm) in Raja variety (Table 5). Granola produced the highest tuber yield (23.88 t ha^{-1}) followed by Diamant (23.33 t ha^{-1}) and BARI TPS-1 (18.88 t ha^{-1}) but lowest yield (12.22 t ha^{-1}) was from the variety Raja. The highest no. of tuber $plant^{-1}$ and average tuber weight were observed in the variety Granola and those contributed to higher tuber yield.

Jamalpur

The longest plant was recorded from Asterix and it was statistically different from other varieties (Table 6). Granola produced the second highest tuber yield (24.8 t ha^{-1}). Asterix and Raja produced identical tuber yield (22.3 t ha^{-1} and 21.5 t ha^{-1}, respectively). The lowest tuber yield was found in the check variety, Diamant (19.4 t ha^{-1}). All the varieties performed better than Diamant. The variety Diamant became susceptible to scab disease in the farmers field.

Comilla

Significant variation was observed in plant height, tuber weight $plant^{-1}$ and tuber yield but shoot $plant^{-1}$, tuber $plant^{-1}$ were did not differ significantly among the different varieties (Table 7). Significantly highest tuber yield (24.63 t ha^{-1}) was recorded in the variety Granola which was followed by BARI TPS-1 (20.19 t ha^{-1}) and that was identical with Diamant (18.70 t ha^{-1}) and Asterix (17.59 t ha^{-1}). Granola produced the highest yield because of highest tuber weight per plant (340 g).

Patuakhali

The highest tuber yield was obtained from BARI TPS-1(22.52 t ha^{-1}) and Diamant (22.01 t ha^{-1}) and the lowest tuber yield was obtained from Raja (11.50 t ha^{-1}). Soil salinity was mostly below critical level (4 dS m^{-1}).

Farmers reaction

Rangpur: Farmers prefer 'Granula' for its higher yield and economic return. They also opined that disease infestation particularly late blight is slightly less in Granola compared to other varieties.

Gazipur: Most of the potato varieties were new at Dhirasharm area, except Diamant. In this year farmers are not satisfied as the tested varieties gave comparatively lower yields than that of expected yield because the crop was severely affected by late blight disease.

Kushtia: Farmers reacted positively with new high yielding variety (BARI TPS-1). Farmers' preferences were due to big size, attractive shape & smooth seed coat etc of TPS variety. Farmers stored own tuber for growing in the next season.

Barind: The co-operator farmer and their neighbors were encouraged to observe the performance of Granola and Diamant variety. They expressed their willingness to cultivate variety Granula and Diamant in the next year on the availability of seed. Seeds of Granola variety were preserved by the co-operator farmers for the next year cultivation.

Jamalpur: Farmers choose TPS, Granola and Asterix for their shape, size, colour and higher yield.

Patuakhali: Farmers are highly interested to grow potato as a cash crop. Seed availability is a problem. There is no storage facility of their seed.

Conclusion

Across locations Granula, Diamant and BARI TPS-1 performed better. However, it needs further experimentation for making any conclusion.

Table 1. Mean tuber yield (t ha^{-1}) of Potato over locations, 2008-09

Variety/Lines	Rangpur	Gazipur	Kushtia	Barind	Jamalpur	Comilla	Patuakhali		Mean
							Razakhali	Kuakata	
Raja	19.63	10.75	15.0	12.22	21.5	13.89	18.23	11.50	15.34
Asterix	19.08	15.0	14.0	18.33	22.3	17.59	20.51	15.17	17.74
Granula	31.49	10.5	17.0	23.88	24.8	24.63	17.80	15.25	20.66
Diamant	27.19	16.0	18.0	23.33	19.4	18.70	22.01	11.83	19.55
BARI TPS-1	-	8.8	19.0	18.88	30.6	20.19	22.52	18.50	19.78
Felsina	24.18	-	-		-	-			-

Table 2. Performance of different potato varieties at FSRD site, Lahirirhat, OFRD, ARS, Rangpur during rabi 2008-09

Treatments	Plant height (cm)	No. of stems hill^{-1}	No. of tubers hill^{-1}	Wt. of tubers hill^{-1} (g)	Yield (t ha^{-1})
Raja	55.07c	2.65a	7.51bc	0.346	19.63d
Asterix	69.40ab	2.60a	6.86c	0.368b	19.08d
Granula	58.98c	3.06a	9.46a	0.442a	31.49a
Diamant	67.62b	2.91a	9.03a	0.440a	27.19b
Felsina	75.95a	2.68a	7.62b	0.426a	24.18c
CV (%)	9.14	11.07	7.23	5.33	7.28

Table 3. Yield attributes and yields of different potato varieties at MLT site, Dhirasharm Gazipur during the rabi season of 2008-09.

Treatment	Plant height (cm) at harvest	No. of tuber plant^{-1}	Length of tuber (cm)	Breath of tuber (cm)	Av. weight of tuber (g)	Yield (t ha^{-1})
Granola	59.2	5.2	5.81	4.81	78.0	10.5
Raza	61.0	5.3	6.79	4.64	73.7	10.75
Asterix	72.8	5.7	7.28	5.35	73.8	15.0
Diamant	62.9	6.2	7.62	5.75	89.7	16.0
BARI TPS 1	87.1	9.0	4.53	4.61	67.4	8.8

Table 4. Yield and Yield contributing characters of potato varieties at Gangni, Kushtia during 2008-09

Treatment	No. of plants m^{-2}	No. of tuber plant^{-1}	Tuber wt plant^{-1} (g)	Number of tuber kg^{-1}	Yield (t ha^{-1})	Plant height (cm)
Raja	8	5	226	20	15.0	55
Asterix	7	4	200	20	14.0	53
Granula	7	5	263	17	17.0	60
Diamant	7	7	323	15	18.0	64
TPS	8	7	346	14	19.0	50
CV (%)	9.29	11.43	5.97	7.84	4.86.0	3.67
LSD	NS	1.19	3.55	2.54	1.52.0	3.89

Table 5. Yield and yield components of potato varieties, Barind, Rajshahi, 2008-09

Varieties	Plant ht.(cm)	No. of haulm plant^{-1}	(%)Foliage coverage	No. of tuber plant^{-1}	Av. wt. of tuber (g)	Tuber yield (t ha^{-1})
Granola	45.60	4.80	90.00	13.00	81.50	23.88
Raja	43.00	5.00	75.00	9.25	78.00	12.22
Asterix	51.40	6	78.00	11.00	68.80	18.33
BARI TPS-1	66.40	5.60	92.00	9.60	76.80	18.88
Diamant	67.20	5.80	88.00	12.60	79.30	23.33

Table 6. Performance of potato varieties at MLT site, Malancha, Melandah, Jamalpur during rabi season, 2008-09

Variety	No. of plants m^{-2}	Plant height (cm)	No. of tuber plant^{-1}	Yield (t ha^{-1})
Asterix	8	52.9 a	5.7 c	22.3 c
Raja	8	43.5 c	11.3 a	21.5 c
Granula	8	50.2 b	10.0 b	24.8 b
Diamant	8	42.9 c	5.7 c	19.4 d
TPS	8	51.0 b	11.7 a	30.6 a
CV (%)	-	0.94	6.83	3.79

Table 7. Yield and yield contributing characters of different potato varieties, Comilla, 2008-09

Variety	Plant height (cm)	No. of shoot plant^{-1}	No. of tuber plant^{-1}	Tuber wt plant^{-1} (g)	Yield (t ha^{-1})
Raja	71.8 ab	3.2	8.33	219 b	13.89 c
Granola	51.3 b	3.8	10.67	340 a	24.63 a
TPS	95.2 a	3.7	9.87	327 a	20.19 b
Diamant	62.5 b	5.2	10.13	320 a	18.70 b
Asterix	67.6 ab	4.4	8.60	233 b	17.59 b
LSD $_{(0.05)}$	29.01	NS	NS	52.9	2.851
CV (%)	22.13	24.78	17.79	9.76	7.97

Table 8. Yield and yield contributing characters of some potato varieties in 2008-09 at FSRD site Razakhali and MLT site Kuakata, Patuakhali

Varieties/genotype	Tuber yield (t ha^{-1})	
	Razakhali	Kuakata
Diamant	22.01 a	11.83 c
BARI TPS-1	22.52 a	18.50 a
Granola	17.80 c	15.25 b
Asterix	20.51 b	15.17 b
Raja	18.23 c	11.50 c
CV (%)	8.52	10.91

Screening of Potato Varieties for Saline Areas

Abstract

Performance of seven potato varieties namely Almera, Sassy, Courage, Esprit, Lady Rosetta, Saikat and Diamant were evaluated at MLT site, Satkhira and Kuakata, Patuakhali during the Rabi season of 2008-’09. Among the varieties Courage gave the highest average yield (14.01 t ha^{-1}) followed by Almera (13.92 t ha^{-1}). However, yield difference between the two locations was large probably due to late planting at Patuakhali.

Introduction

Coastal area includes 30% of the cultivable land in Bangladesh. About 2.88 million hectares of these lands are affected by varying degrees of soil salinity (Karim and Iqbal, 2001). After harvesting of T.Aman a vast area of land remains fallow in this region. During Rabi season, the soil salinity levels increase through capillary movement. It is a production constraint common to all rain fed agriculture. In Khulna region, the total potato cultivation area is 1584 ha which is negligible (0.79%) in the context of total potato cultivated area of Bangladesh. Lack of saline tolerant variety and lack of irrigation facilities are the major bottlenecks to cultivate potato in this area. BARI has developed a good number of potato varieties having different characteristics. The performances of these varieties need to be evaluated for cultivation in this saline/coastal area.

Materials and Methods

The trial was conducted at MLT site Satkhira and Kuakata, Patuakhali during Rabi season, 2008-2009 with seven varieties namely Almera, Sassy, Courage, Esprit, Lady Rostta, Saikat and Diamant following RCB design with three replications. The unit plot size was 3 m×1.8 m. The seed was planted on 02 December 2008 at Satkhira and 17 December 2008 at Patuakhali in line keeping 60 cm×25 cm spacing. The experimental plots were fertilized with 250-150-250-120-10-10 kg ha^{-1} of Urea, TSP, MOP, Gypsum, Zinc sulphate and Borax, respectively. Total amount of all fertilizers and half of the total urea was applied as basal during final land preparation. Rest of the urea was applied after 20 and 45 DAS as top dressing. Three irrigations were given during the growth period. All the intercultural operations were done as and when necessary. The crop was harvested at maturity during 1-9 March, 2009. Data on yield and yield attributes were collected and analyzed statistically. The soil salinity levels at the experimental plot were 3.87 to 9.70 dS m^{-1} during crop growing period at Satkhira and 2.04 to 7.41 dS m^{-1} at Kuakata.

Results and Discussions

Satkhira

The major yield contributing characters viz. number of stem $plant^{-1}$, tubers $plant^{-1}$ and weight of tubers were significantly influenced by varieties (Table 2). Courage produced the highest tuber yield (19.27 t ha^{-1}) which was statistically similar with the yield of Diamant (19.13 t ha^{-1}). Esprit produced the lowest yield (11.67 t ha^{-1}). The highest tuber yield (19.27 t ha^{-1}) obtained from Courage might be due to maximum number of stem $plant^{-1}$ and tuber weight per plant. Similarly the lowest tuber yield (11.67 t ha^{-1}) obtained from Esprit might be due to the lowest number of plant population per square meter and stem per plant.

Patuakhali

Potato var. Almera produced the highest tuber yield (8.92 t ha^{-1}) which was statistically identical to Coukage (8.76 t ha^{-1}) followed by Lady Rosetta (8.05 t ha^{-1}). Esprit gave the lowest yield (3.76 t ha^{-1}). This lower yield might be due to salinity effect coupled with late planting. In 2007-08 Lady Rosetta gave 12.22 t ha^{-1} in this plot. Our previous study reveals that there are some crop fields within the salinity affected area, of which salinity has been washed out years after years keeping this land within polder. These areas should be explored for expansion of potato as well as other rabi crops. However, it is the result of 2nd year in the location the trial should be continued for the next year with same set of variety/lines.

Farmers' reaction

Satkhira: Farmers' choose Courage and Diamant for- higher yield and profitability

Patuakhali: Farmers are not satisfied to get this yield. If potato could be planted early it could be a profitable crop. Seed tuber availability is a problem in potato cultivation.

Conclusion

Courage, Almera, and Diamant can be grown after T.aman rice. This is the results of 2nd year experiment and it may be continued in the next year to draw a definite conclusion in this regard.

Table 1. Average tuber yield (t ha^{-1}) of potato in two coastal Saline area, 2008-09

Variety/Lines	Satkhira	Patuakhali	Means
Almera	18.52	8.92	13.92
Sassy	15.00	7.68	11.34
Courage	19.27	8.76	14.01
Sprite	11.67	3.76	7.71
Lady Rosette	13.83	8.05	10.94
Saikat	13.21	7.34	10.27
Diamant	19.13	-	-

Table 2. Yield and yield contributing characters of different potato varieties tested at Satkhira MLT site during Rabi season, 2008-09

Entry/ variety	Foliage coverage at 60 DAP (cm^2)	Plant pop^n m^{-2}	Plant ht. (cm40.87)	Stem plant^{-1} (no.)	Tubers plant^{-1} (no.)	Wt. of tubers plant^{-1}	Tuber yield (t ha^{-1}.)
Almera	1637.58	6.30	40.87	3.27	6.57	293.97	18.52
Sassy	1812.85	6.42	40.93	2.90	5.27	244.00	15.00
Courage	1978.56	6.24	44.47	3.67	6.70	308.81	19.27
Sprit	1712.84	5.50	40.13	2.47	6.17	232.67	11.67
Rostta	1849.92	6.48	37.00	2.80	5.67	213.42	13.83
Saikat	1590.69.	6.54	45.10	3.10	5.87	201.99	13.21
Diamant	2051.39	6.54	43.00	3.57	8.07	292.50	19.13
LSD(0.05)	316.2	0.4172	4.092	0.634	1.193	41.78	1.489
CV (%)	9.85	3.71	5.52	11.48	10.57	8.38	5.30

Table 3. Yield and yield attributes of 6 potato germplasm under salinity environment

Variety	Plant height (cm)	No. of tubers plant^{-1}	Tuber yield (t ha^{-1})
Courage	43.93	5.5	8.76a
Sassy	46.93	5.1	7.68b
Almera	41.46	5.7	8.92a
Saikat	48.26	5.0	7.34b
Lady Rosetta	37.33	5.3	8.05ab
Esprit	40.53	3.3	3.76c
CV (%)	-	-	12.52

Effect of Planting System on the Yield of Potato in Saline Area

Abstract

The experiment was conducted at MLT site, Satkhira during Rabi season of 2008-09 to find out the suitable planting method for higher yield. Six planting methods were included in the study and it was found that raised bed with mulch gave the highest yield (21.37t ha^{-1}) while normal flat and normal furrow planting system produced the lowest tuber yield- 14.63 and 14.81 t ha^{-1}, respectively.

Introduction

Agriculture of southern region of Bangladesh is mainly rice based. Cultivation of vegetable crops is very limited and some selected vegetables are grown in this area. Potato is a promising crop for this region. Potato is a vegetable highly enriched with carbohydrate that can be an alternative of minimizing the pressure on rice or in other words, it may be a supplementary crop to minimize the existing problem of food insecurity of our country. Currently, the production of potato in this region is very low. Soil salinity is one of main constraints to grow potato with satisfactory yield. Poor drainage system of the heavy soil is also another constraint for the crop. Farmers grow potato through normal furrow system. Modern planting method including mulching system may increase potato yield through conserving soil moisture as well as by reducing salinity. Keeping this view in mind, the study was under taken to find out the suitable planting technique of potato production in the coastal area.

Materials and Methods

The experiment was conducted at the farmers field at MLT site, Satkhira during the Rabi season of 2008-'09. Six planting methods viz. raised bed (15cm height), raised bed with mulch, normal flat, normal flat with mulch, furrow and furrow with mulch were treated as treatments in the experiment. The experiment was laid out in RCB design with 3 replications. The unit plot size was 3m×3m.

Urea, TSP, MOP, Gypsum, Zinc sulphate and Borax were applied at the rate of 250-150-250-120-10-10kg ha^{-1}, respectively. All fertilizers were applied as basal during land preparation except urea which was applied at two installments- 20 and 40 DAS. The potato tuber was planted on 28 November'08 with 60×25cm and harvesting was done on 23 February'09. Potato variety Diamant was used as seed. Three irrigations were applied and all other cultural operations were done as and when required. Data were recorded during harvesting and analyzed statistically and the means were separated with DMRT.

Results and Discussion

Among the six treatments the highest yield (21.37 t ha^{-1}) was obtained from the planting method of raised bed when mulching was used (Table 1). It might be due to raised bed and use of mulch by reducing soil salinity considerably. Number of tubers plant^{-1} and weight of tubers plant^{-1} were also found the highest in this treatment. The second highest yield (19.44 t ha^{-1}) was found in normal flat with mulch which was followed by normal furrow with mulch and raised bed. The yield of normal furrow with mulch (18.96t ha^{-1}.) and normal flat with mulch (19.44 t ha^{-1}) were found statistically identical. The lowest yield (14.81t ha^{-1}) was observed in the method of normal furrow planting system. Soil salinity was observed as high as 9.20 dS m^{-1} in the plot used furrow planting system that might affect the yield of potato.

Farmers' reaction

Farmers' choose the raised bed with mulch for-

- No risk of rotting tubers by stagnant water
- Conservation of soil moisture and control weed infestation
- Minimize soil salinity.

Conclusion

This is the 2nd year results of the experiment. The experiment needs to be continued in next year for confirmation of results.

Table 1. Yield and yield contributing character of potato as affected by planting method and mulching at Satkhira MLT site during Rabi season, 2008-09.

Planting methods	Days to maturity	Plant pop^n m^{-2}	Plant height (cm)	Hills plant^{-1} (no.)	Tubers plant^{-1} (no.)	Wt. of tubers plant^{-1} (g)	Tuber yield (t ha^{-1})
Raised bed with mulching	86	6.59	49.53	3.43	6.83	329	21.37
Raised bed	86	6.59	43.33	2.73	6.10	252	16.85
Normal flat with mulch	86	6.59	42.70	2.87	6.00	296	19.44
Normal flat	86	6.51	38.73	2.57	5.23	225	14.63
Normal furrow with mulch	86	6.51	41.60	2.67	6.73	299	18.96
Normal furrow	86	6.48	38.10	2.43	5.47	229	14.81
LSD(0.05)	-	1.1522	6.836	0.4108	0.7888	31.22	1.821
CV (%)	-	1.32	8.88	8.11	7.15	6.27	5.66

Table 2. Soil salinity level of the experimental soil during the crop growth period.

Salinity (dS/m)					
Raised bed with mulch	Raised bed	Normal flat with mulch	Normal flat	Normal furrow	Normal furrow with mulch
2.80-4.54	3.45-6.68	2.92-4.80	3.10-6.90	4.67-9.20	3.10-5.10

Effect of Planting System on the Yield of Sweet Potato

Abstract

The effect of vine planting system on the yield of sweet potato was observed in the farmers' field at MLT site, Satkhira during Rabi season of 2008-09. Three BARI released sweet potato varieties viz. BARI SP-6, BARI SP-7, BARI SP-8 and three planting systems viz. S_1 = 1m long vine planting in twist as a ring, S_2 = both the ends exposed of 50 cm long vine, S_3 = 30 cm long vine in normal planting system were used in this experiment. The interaction effect of variety and planting system showed that BARI SP-8 coupled with normal planting system of 30 cm long vine gave the highest root yield (38.89 t ha^{-1}).

Introduction

Sweet potato is a carbohydrate rich crop, which can be used as substitute of cereal crops in Bangladesh to meet up the food shortage. Generally, the poor people are the consumers of sweet potato. It is the main source of carbohydrate and carotene for their survival. Traditionally, farmers cultivate local variety of sweet potato which is lower yielder. Bangladesh Agricultural Research Institute (BARI) has developed some new varieties. Farmers in different places planted sweet potato vine in different methods. Normally, they planted 30 cm sweet potato vine remaining 2/3 nodes. In some places it is seen that vine planted in twist as a ring and vine exposed in both the ends. Therefore, to evaluate these planting methods in different sweet potato varieties, the experiment was taken.

Materials and Methods

The experiment was conducted at MLT site, Satkhira during Rabi season 2008-'09. The treatment of the experiment comprised of three BARI released sweet potato varieties (BARI SP-6, BARI SP-7 and BARI SP-8) and three planting systems (S_1 = 1m long vine planting in twist as a ring, S_2= both the ends exposed of 50 cm long vine, S_3 = 30 cm long vine in normal planting system). The experiment was laid out in a factorial randomized complete block design with three replications. The size of each plot was 1.8 X 1.5m. Vines were planted on 24 December, 2008 keeping 60 X 30cm spacing. The crop was fertilized with 160-130-190 kg ha^{-1} of Urea, TSP and MOP respectively. All TSP, ¼ Urea and ¼ MOP was applied as basal at the final land preparation. Rest of the Urea and MOP was side dressed at 60 DAP. Weeding and earthing up was done at 30 and 50 DAP. Weevil and caterpillar infestation was seen and necessary insecticide was applied duly. The crop was harvested on 18 May, 2009. Data of yield components were collected from 10 plants selected at random from each plot. The collected data were analyzed statistically.

Results and Discussion

Effect of variety

Variety produced a significant influence on yield and yield attributing characters (Table 1). Among three varieties BARI SP-8 gave the highest yield (36.05 t ha^{-1}). It was due to higher number of root $plant^{-1}$ and root wt. $plant^{-1}$.

Effect of planting system

Vine planting system also showed the significant difference on yield and yield attributing characters of sweet potato (Table 2). In planting system, the highest yield (36.63 t ha^{-1}) was found from S_3 i.e. 30 cm long vine in normal planting system. Rest two planting systems i.e. S_1 and S_2 gave yield 29.01 and 31.07 t ha^{-1} respectively and both are statistically identical.

Interaction effect of variety and planting system

The combined effect of varieties and planting systems was found significant for all the parameters other than plant population per square meter (Table 3). All the sweet potato varieties produced higher number of root per plant and root wt. $plant^{-1}$ in the 30 cm long vine in normal planting system.

Salinity

During the crop growth period the salinity was 3.21 to 8.95 dS m^{-1}.

Farmers' reaction

Farmers choose BARI SP-8 due to its higher yield.

Conclusion

This is the first year results of the experiment. It should be repeated in the next year for find conclusion.

Table 1. Effect of variety on the yield and yield attributing characters of sweet potato at MLT site, Satkhira during 2008-09

Variety	Plant population m^{-2}	Survival (%)	Root plant^{-1} (no,)	Root wt. plant^{-1} (g)	Root yield (t ha^{-1})
BARI SP-6	14.67	91.89	5.43b	613.78b	30.08b
BARI SP-7	15.00	96.00	4.91b	576.44b	30.58ab
BARI SP-8	14.00	95.67	6.26a	739.89a	36.05a
LSD (0.05)	NS	NS	0.99	72.69	5.572
CV (%)	4.48	2.37	7.74	5.00	7.62

Table 2. Effect of planting system on the yield and yield attributing characters of sweet potato at MLT site, Satkhira during 2008-09

Vine planting system	Plant population m^{-2}	Survival (%)	Root plant^{-1} (no.)	Root wt. plant^{-1} (g)	Root yield (t ha^{-1})
S_1	14.67	93.89	5.40	533.00c	29.01b
S_2	15.00	94.67	4.95	610.11b	31.07b
S_3	14.00	95.00	5.81	787.00a	36.63a
LSD (0.05)	NS	NS	NS	64.92	3.52
CV (%)	5.86	1.04	7.10	4.45	4.81

S_1: One long vine planting in twist as a ring, S_2: both the end exposed of 50cm long vine, S_3: 30cm long vine in normal planting system

Table 3. Interaction effect of variety and planting system on the yield and yield attributing characters of sweet potato at MLT site, Satkhira during 2008-09

Treatment combination		Plant	Survival	Root plant^{-1}	Root wt. plant^{-1}	Root yield
variety	Planting system	pop^n m^{-2}	(%)	(no.)	(g)	(t ha^{-1})
BARI SP-6	S_1	14.33	90.00b	5.60ab	493.00c	26.05d
	S_2	15.00	96.00a	5.27ab	602.67bc	27.53cd
	S_3	11.67	95.67a	5.33ab	603.33bc	33.46abcd
BARI SP-7	S_1	15.00	92.33ab	4.90ab	589.67bc	29.63bcd
	S_2	15.00	96.00a	4.27b	520.00c	27.78cd
	S_3	14.67	95.67a	5.57ab	720.67d	35.80ab
BARI SP-8	S_1	14.67	93.33ab	5.80ab	758.67bc	34.57abc
	S_2	15.00	96.00a	5.20ab	706.67d	36.42ab
	S_3	12.33	95.67a	6.43a	895.67a	38.89a
LSD (0.05)		NS	1.22	1.38	152.80	7.04
CV (%)		15.36	2.24	14.90	13.49	12.62

Screening of Germplasms/Varieties of Sweet Potato against Salinity

Abstract

The screening experiment of sweet potato was conducted in the farmer's field of Noakhali, Satkhira, Patuakhali and Cox,s bazar under rainfed conditions during the rabi season of 2008-09. Among the tested cultivars/varieties the highest average root yield was obtained from Sweet potato 264 (23.74 t ha^{-1}) followed by Sweet potato 498 (18.56 t ha^{-1}) and Sweet potato 213 (18.25 t ha^{-1}). The highest vine survival percent was in a range of 70-83% and was found in SP-264, SP-560, BARI SP- 6, BARI SP-7, BARI SP-8, BARI SP-9 and local variety at Noakhali.

Introduction

Sweet potato is a carbohydrate rich root crop, which can be used as substitute of cereal crops in Bangladesh to meet the up food shortage. Generally, the poor people are the consumers to sweet potato. In Bangladesh, the average yield of sweet potato is less than 10 t ha^{-1} (Krishi Projukti Hatboi, BARI). It is the main source of carbohydrate and carotene for their survival. Sweet potato grows well in non-saline char area of Bangladesh. A vast area of char, which contains varying degrees of salinity (2->20 dS m^{-1}), remains fallow in the rabi season. Farmers can grow here only T. aman. Therefore, the cropping intensity of the saline char area is very low. If crops like sweet potato could be fitted in that fallow period, the cropping intensity would be increased. Bangladesh Agricultural Research Institute (BARI) has developed some new varieties. BARI is also working with a number of sweet potato germplasms that have high yielding ability and contain high amount of carotene. These varieties/ germplasms require an on-farm screening trial to evaluate their performance and to identify the suitable variety/germplasm for saline/coastal area and to get feed back from the farmers. Thus the experiment was undertaken to evaluate the performance and survivability of sweet potato cultivars/varieties against salinity/coastal environments.

Materials and Methods

The experiment was conducted at FSRD site, Noakhali, Satkhira, Patuakhali and Cox,s bazar under rainfed conditions during the rabi season of 2008-09 in the farmer's field. The experiment was laid out in RCB design with three replications. The plot size was 1.8m X 1.5m. Two weeding were done on 19 January and 09 February 2009 during the crop growth period. There were nine germplasms of BARI developed sweet potato with one local variety to conduct the experiment viz. Sweet potato 213, Sweet potato 264, Sweet potato 271, Sweet potato 498, Sweet potato 560, BARI sweet potato 6, BARI sweet potato 7, BARI sweet potato 8, BARI sweet potato 9, SP 266 and local. Vines were planted in line with 50 cm X 30 cm spacing on 29 December, 2008 at Noakhali, 24 December 2008 at Satkhira, 20 December 2008 at Patuakhali and 2 December 2008 at Cox,s bazar. It was harvested at maturity during 12 April to 18 May 2009. In setting the experiment, the saline prone field was selected by testing salinity samples of the field in several spots. During the study period, the salinity data were recorded at different physiological stage of the crop. The data on yield and yield attributing characters were statistically analyzed by MSTAT-C programme.

Results and Discussion

Noakhali: The highest number of root per plant (3.50) was found in SP-264 that was non-significant with the other germplasms (Table 2). The lowest root per plant (2.50) was found in the germplasm SP 213. The range of the number of root per plant in all the germplasms was in between 2.50-3.50. The highest root weight per plant was found in SP-264 (515 g) because of its higher number of root per plant, which was also higher than the other germplasms. The highest yield (19.71 t ha^{-1}) was found in the SP 264 which was statistically at par with other germplasms because of their comparatively non-significant characters of root per plant. Sweet potato is a familiar crop to the farmers of saline area.

Satkhira: The highest root yield was found in SP-213 (37.04 t ha^{-1}). It was due to maximum root weight plot^{-1} as well as high plant population per square meter (Table 3). The lowest yield was found in SP-271 (14.07 t ha^{-1}) because of the entire yield attributing characters were lower than the others. BARI SP-498 gave the highest yield next to SP-213 which was statistically similar with BARI SP-6, SP-264 and SP-560. During the period the salinity range was 3.21 to 10.98 dS m^{-1} in the field.

Patuakhali: Tuber yield varied significantly due to genetic characteristics (Table 4). The highest tuber yield (14.7 t ha^{-1}) was obtained from BARI SP-7 followed by SP-494(13.2 t ha^{-1}) and SP (10.9 t ha^{-1}).

Cox,s bazar

Higher number of tubers plant^{-1} was recorded from SP-271(Table 6). The highest root weight plant^{-1} was found in SP-231 (310.3 g) which was statistically similar with SP-498, BARI SP-6 and SP-271. Higher root yield (12.00 t ha^{-1}) was showed by SP-498 which was statistically similar to BARI SP-6, SP-271 and SP-213. The lowest root yield was recorded in SP-560 (8.50 t ha^{-1}) which was statistically different from other BARI varieties.

Farmers' reaction

Noakhali

1. Farmers are fond of dark colored and even sized sweet potato, which have high market value.
2. Using closer spacing (50 cm line to line) could be helpful for canopy coverage as well as to reduce salinity.
3. Farmers liked BARI SP 9 for its cooking ability as vegetables.

Satkhira

Among the lines, farmers preferred SP-213 and SP-498 due to its higher production. Farmers also preferred red colored sweet potato for its taste and low dry matter content.

Cox,s bazar

The immediate reaction of co-operator farmer and neighboring farmers are as follows:

- Less tasty than local
- Bigger root size keeping quality will be poor and short
- It needs more fuel to boil it
- They want medium size with uniform shape high yielding variety.

Conclusion

The experiment should be repeated in the next year for precision of the conclusion.

Table 1. Root yield (t ha^{-1}) of Sweet Potato germplasm under Saline condition, 2008-09.

Variety/Lines	Noakhali	Satkhira	Patuakhali	Cox's bazar	Mean
Sweet Potato 213	13.32	37.04	12.5	10.17	18.25
Sweet Potato 264	19.71	27.78	-	-	23.74
Sweet Potato 271	15.91	14.07	9.8	1084	12.66
Sweet Potato 498	18.34	30.68	13.2	12.00	18.56
Sweet Potato 560	15.44	29.01		8.50	17.65
BARI Sweet Potato 6	17.42	29.75	9.5	11.00	16.92
BARI Sweet Potato 7	14.34		14.7	9.50	12.85
BARI Sweet Potato 8	18.80				-
BARI Sweet Potato 6	19.23				-
SP266			10.9		-
Local	18.77		8.4		8.4

Table 2. Yield & yield contributing characteristics with the root color of Sweet Potato germplasms.

Name of germplasm	Root plant^{-1} (no)	Root weight plant^{-1} (g)	Root yield^{-1} (t ha^{-1})	Vine survivality rate (%)	Root colour
SP 213	2.50	285	13.32	60	Brown to red
SP 264	3.5	515	19.71	70	Red
SP 271	3.17	326	15.91	68	Cream to red
SP 498	3.13	513	18.34	67	Red
SP 560	2.80	424	15.44	71	Cream
BARI SP 6	3.27	340	17.42	75	Cream
BARI SP 7	3.07	270	14.34	79	Red
BARI SP 8	3.23	334	18.80	73	Red
BARI SP 9	2.60	286	19.23	83	Cream
Local	2.97	349	18.77	80	
CV (%)	21.22	15.05	16.23	15.87	
LSD (0.05)	NS	NS	NS	19.82	

Table. 3. Yield and yield attributing characters of different sweet potato varieties in coastal saline area at MLT site Satkhira during 2008-'09.

Variety/lines	No. of plants m^{-2}	Plant survival (%)	No. of roots plot^{-1}	Root wt. plant^{-1} (kg)	Yield (t ha^{-1})	Root color
BARI SP-6	12.33 a	80.0 b	5.53 a	8.0 b	29.75 b	Cream
BARI SP-213	14.66 a	93.3 a	4.83 ab	10.00 a	37.04 a	Brown
BARI SP-264	15.00 a	100.00 a	3.93 bc	7.50 b	27.78 b	Red
BARI SP-271	7.66 b	66.66 c	2.66 c	3.80 c	14.07 c	Cream
BARI SP-498	15.00 a	100.00 a	5.00 ab	8.33 ab	30.86 ab	Brown
BARI SP-560	15.00 a	100.00 a	4.23 ab	7.83 b	29.01 b	Red
CV (%)	10.26	5.83	16.72	12.56	12.6	--
LSD (0.05)	2.48	9.54	1.32	1.73	6.42	--

Table 4. Yield and yield attributes of sweet potato germplasm against salinity , Kuakata, Patuakhali, 2008-09.

Germplasm	No. of tubers Plant^{-1}	Average tuber wt. (g)	Tuber yield (t ha^{-1})
BARI SP-6	3.3	72	9.5 e
SP-213	3.2	71	12.5 c
SP-266	3.4	78	10.9 b
SP-498	3.1	87	13.2 b
BARI SP-7	3.7	98	14.7 a
SP-271	2.9	81	9.8 e
Local	3.5	62	8.4 f
CV (%)	-	-	11.24

Table 5. Salinity levels of experimental plots at MLT site, Kuakata, Patuakhali in rabi, 2007-2008.

Date	Salinity level (dS/m)	Date	Salinity level (dS/m)	Date	Salinity level (dS/m)
31.12.2008	2. 8	15.02.2009	5.8	30.03.2009	8.9
15.01.2009	3.6	01.03.2009	7.6	15.04.2009	9.5
02.02.2009	4.4	15.03.2009	8.2	30.04.2009	10.3

Table 6 .Yield and yield attributes of sweet potato varieties at Cox's Bazar during rabi (2008-09)

Treatment/Variety	No. of tubers plant^{-1}	Tuber wt. plant^{-1} (g)	Yield (t ha^{-1})
BARI SP-6	3.08 b	307.0 a	11.00 ab
BARI SP-7	3.00 b	277.5 c	9.50 bc
SP-271	3.45 a	299.0 ab	10.84 ab
SP-498	3.08 b	305.0 a	12.00 a
SP-213	2.90 b	310.3 a	10.17 a
SP-560	2.25 b	290.3 b	8.50 c
CV (%)	3.88	10.93	8.16

On-Farm Adaptive Trial of Improved Varieties of Sweet Potato across Locations

Abstract

On farm performance of sweet potato varieties viz. BARI SP-8, BARI SP-9 and were evaluated against the farmers' local variety at, Kushtia, Cox's bazar, Kishoreganj and Patuakhali during the rabi season of 2008-2009. The highest mean root yield (25.82 t ha^{-1}) was produced by BARI SP-8 followed by BARI SP-9 (24.68 t ha^{-1}). Local variety produced the lowest root yield (14.64 t ha^{-1}).

Materials and Methods

The experiment was conducted at Kushtia, Cox's bazar, Kishoreganj and Patuakhali during the *rabi* season of *2008*-2009. Three varieties viz. BARI SP-8, BARI SP-9 were evaluated against the local variety in the farmers' field. The experiment was set up in randomized complete block design with four replications. The unit plot size was 6 m× 6 m. The vine was planted with a spacing of 40cm x 30 cm. The crop was fertilized with 70 – 25 - 88 kg ha^{-1} of NPK respectively. Half of urea and all others fertilizers were used at final land preparation. Remaining part of N fertilizer was applied at the side of the row in two equal splits at 30 & 60 DAT. The vines were planted on 17 November, 2008 at Kushtia, 12 November 2008 at Cox,s bazar, 12 November, 2008 at Kishoreganj and 17 December, 2008 at Patuakhali. One weeding and earthing up was done after 30 DAT. There was no remarkable disease and pest attack. The crop was harvested variety wise during 28 March to 5 May 2009. Data of yield components were collected from 10 plants selected at random in each plot and tuber yield was recorded plot wise. The collected data were analyzed statistically and means were separated by DMRT.

Result and Discussion

Kushtia: Number of tubers $plant^{-1}$, Tuber weight $plant^{-1}$ (kg), Tubers weight (kg m^{-2}) was affected by the varieties (Table 2). The highest tuber weight $plant^{-1}$ was recorded from BARI SP-8 which resulted higher tuber yield from same variety (22.53 t ha^{-1}).

Cox's bazar: Higher number of tubers $plant^{-1}$ was recorded from local variety (3.45). The highest root weight $plant^{-1}$ was found in BARI SP 8 (433 g) which was statistically similar with BARI SP 9 (424.5 g). Higher root yield (20.75 t ha^{-1}) was by BARI SP 8 (Table 3).

Kishoreganj: The result showed that vine length $plant^{-1}$, weight of roots $plant^{-1}$ and root yields was significantly different in sweet potato varieties (Table4). The higher vine length $plant^{-1}$ was recorded from variety BARI SP-9 that was statistically at par BARI SP-8. Local variety produced statistically shorter vine length (104 cm). All varieties produced statistically identical root wt. $plant^{-1}$ except local variety. Higher root yield (33.47 t ha^{-1}) was obtained from BARI SP-9 followed by BARI SP-8. BARI SP-9 gave the higher root yield due to higher number of roots $plant^{-1}$ and root weight $plant^{-1}$. Correspondingly, the farmers' variety gave the lowest root yield (18.40 t ha^{-1}) due to lower number of root $plant^{-1}$ and root weight $plant^{-1}$.

Patuakhali: Results reveal that the highest tuber yield was obtained from BARI sweet potato-8 (28.5 t ha^{-1}) which was identical to BARI SP-9 (25.5 t ha^{-1}) and the lowest tuber yield was observed in local variety (16.2 t ha^{-1})(Table 5). There was no disease development and pest infestation in this season.

Farmer's reaction

Kushtia: Among the three varieties, BARI Sweet potato-8 performed better for their yield and attractive colour. Although the yield of BARI sweet potato was higher but local variety had high demand among the farmers due to its better taste.

Cox's bazar: Less tasty than local. Due to bigger root size keeping quality will be poor and short. It needs more fuel to boil. They want medium size with uniform shape high yielding variety.

Kishoreganj: Farmers, showed interest to cultivate BARI sweet potato-9 due to its white colour, high yield and was not soft after boiling. Already 10 neighboring farmers' collected vine of BARI SP-9 from our cooperator farmer to cultivate it in the next season. Farmers' also opined that there was no incidence of insect and diseases in the new varieties.

Patuakhali: Farmers liked both BARI SP-8 and BARI SP-9, Vine availability is a major problem

Conclusion

For getting higher benefit BARI SP-9 and BAR SP-8 can be grown in the farmers' field. But for creating local demand and to popularize of BARI variety, motivational work would be fruitful for sustaining the variety at farmer's field.

Table1. Root yield (t ha^{-1}) of Sweet potato variety across locations, 2008-09.

Variety/Lines	Location				
	Kushtia	Cox's bazar	Kishoreganj	Patuakhali	mean
BARI Sweet Potato-8	22.53	20.75	31.51	28.5	25.82
BARI Sweet Potato-9	20.00	19.75	33.47	25.5	24.68
Local	9.15	14.82	18.40	16.2	14.64

Table 2. Effect of different varieties on yield and yield components of sweet potato at Kushtia Sadar during 2008-2009.

Treatment	Plant population m^{-2}	Number of tuber $plant^{-1}$ (no.)	Wt. of tuber $plant^{-1}$ (kg)	Tuber wt. m^{-2} (kg)	Tuber wt. (t ha^{-1})
BARI sp-8	6	4	415	2.15	22.53
MARI sp-9	6	4	395	2.05	20.0
Local	7	6	185	1.17	9.15
CV%	6.04	13.83	8.62		2.72
LSD	0.45	1.11	0.54		1.117

Table 3. Performance of sweet potato varieties at Cox's bazar MLT site during rabi (2008-09).

Treatment/Variety	No. of tuber $plant^{-1}$	Tuber wt. $plant^{-1}$ (g)	Yield (t ha^{-1})
BARI SP 8	2.85 b	433.0 a	20.75 a
BARI SP 9	2.45 c	424.5 a	19.75 b
Local	3.45 a	201.0 b	14.82 c
CV(%)	3.43	1.69	1.69

Table 4. Yield and yield components of sweet potato varieties at Hossainpur MLT site, Kishoreganj during *rabi* 2008-09.

Variety	Vine length $plant^{-1}$ (cm)	Root $plant^{-1}$ (no.)	Root wt. $plant^{-1}$ (g)	Root yield (t ha^{-1})
BARI SP-8	192	5.61	639	31.51
BARI SP-9	212	5.82	674	33.47
Local (check)	104	4.10	219	18.40
LSD (5%)	10.20	1.37	42.43	5.72
CV (%)	12.58	11.56	13.08	10.15

Table 5. Yield and yield contributing characters of some sweet potato varieties in 2008-09 at Razakhali, Patuakhali.

Variety	No. of tuber $plant^{-1}$	Tuber wt. $plant^{-1}$ (g)	Yield (t ha^{-1})
BARI SP-8	4.3 a	526 a	28.5 a
BARI SP-9	4.0 a	469 b	25.5 b
Local	2.8 b	298 c	16.2 c
CV (%)	3.8	7.2	11.34

Adaptive Trial of Improved Stolon Producing Panikachu Varieties

Abstract

A field experiment was conducted at FSRD site, Noakhali, Kishoreganj and Comilla to see the comparative performance of three panikachu varieties during kharif season of 2008. Out of the three varieties Latiraj gave the highest average stolon yield (27 t ha^{-1}) and the Local variety gave the lowest stolon yield (19.46 t ha^{-1}).

Introduction

Panikachu is a very popular aroid crop across the country. Farmers are using the traditional local varieties for long time. Tuber crop research centre of BARI has developed one variety and some advance lines are waiting for release. There is one popular variety of Panikachu in Joypurhat area, which may also perform better in other areas. It is therefore, necessary to study the adaptability of the improved varieties under farmers conditions.

Materials and Methods

The experiment was conducted at farmer's field of Noakhali, Kishoreganj and Comilla. during Kharif season of 2008. The experiment was conducted following randomized complete block design with four replications. There were three varieties of panikachu i.e. Latiraj, Local and BARI panikachu-2. The unit plot size was 6m x 3m. The suckers were transplanted during 11 March to 14 March 2008 at Noakhali, 27 February 2008 at Kishoreganj and 17 January 2008 at Comilla with a spacing of 60 cm x 45 cm. Fertilizers were applied @150-125-175 kg as Urea, TSP and MP. Fertilizers except Urea were applied as basal during final land preparation. One third of Urea was applied as 1^{st} top dress at 35 DAPS and rest two third was also applied as top dress in two equal splits at 15-days interval after 1^{st} top dress. Other intercultural operations were done as and when necessary. Harvesting of stolon was started from 3^{rd} week of March and continued up to 4^{th} week of September depending on planting time with an interval of 7-8 days.. The rhizome (curd) was harvested during September, 2008. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C.

Results and Discussion

Noakhali: All the yield-contributing characters of Panikachu varieties varied significantly except plant height and stolon $plant^{-1}$ (Table 2). Length of stolon (71.1 cm), weight of stolon $plant^{-1}$ (478.9 g) and stolon yield (17.90 t ha^{-1}) were significantly highest in Latiraj variety but rhizome yield (26.15 t ha^{-1}) was highest in local (Daudpuri) variety. Stolon yield of local (Daudpuri) variety was the lowest (8.90 t ha^{-1}) and the lowest rhizome yield (16.45 t ha^{-1}) was found in BARI panikachu-2. However, the Latiraj gave significantly the highest (17.90 t ha^{-1}) stolon yield but highest rhizome yield (26.15 t ha^{-1}) was obtained from local (Daudpuri) variety. The result clearly indicated that Latiraj is better for stolon followed by BARI panikacu-2 but local variety is better for rhizome production.

Kishoreganj: All the yield and yield contributing characters of panikachu varieties varied significantly (Table 3). Number of stolon $plant^{-1}$, weight of stolon $plant^{-1}$ and stolon yield, weight of rhizome $plant^{-1}$, rhizome yield were significantly highest in BARI Panikachu-2. Stolon yield and rhizome yield of local variety was the lowest (13.61 t ha^{-1}) and (13.89 t ha^{-1}). However, the variety BARI Panikachu-2 gave significantly the highest 25.78 (t ha^{-1}) stolon yield and rhizome yield (19.45 t ha^{-1}), which was statistically identical to latiraj variety. The result clearly indicated that BARI Panikachu is better for stolon and rhizome production.

Comilla: Stolon yield was higher in latiraj (33.39 t ha^{-1}) because number of stolon (24.4), length of stolon (70.43 cm) and weight of stolon (32.61 g) was higher in latiraj (Table 4). Plant height (129.453 cm) was higher in local than latiraj (128.20 cm). After the completion of harvest of stolon, the plant was uprooted and cut into the upper portion of rhizome and lower portion of leaves and it has been preserve for next year used as a seedling because that type of seedling give earlier stolon when market price of stolon will high.

Farmers' reaction

Noakhali

1. Latiraj is highly accepted by the farmers.
2. Latiraj boils early, tastes good and non itchy in character.
3. Planting materials/suckers of latiraj should be available in local market.

Kishoreganj: Farmers' are satisfied with the yield and quality of stolon and rhizome of BARI Panikachu-2. Already 11 farmers' collected BARI Panikachu-2 rhizome from our cooperator farmers and they cultivate it next season. Farmers' also opined that there was no incidence of insect and diseases in the new variety.

Comilla: Farmers are interested to grow latiraj due to its stolon yield and quality of stolon.

Table 1. Stolon yields (t ha^{-1}) of Panikachu across locations,2008-09

Variety/Lines	Noakhali	Kishoreganj	Comilla	Mean
Latiraj	23.97	24.44	32.61	27.00
BARI Panikachu-2	15.94	25.78	-	20.86
Local	12.97	13.61	31.81	19.46

Table 2. Yield and yield contributing characteristics of stolon producing panikachu varieties during Kharif season of 2008 in Noakhali

Variety	Plant height (cm)	Stolon plant^{-1} (no.)	Length of stolon (cm)	Weight of stolon plant^{-1} (g)	Yield of stolon (t ha^{-1})	Yield of rhizome (t ha^{-1})
Latiraj	134.6	16.7	71.1	648.0	23.97	18.58
Local (Daudpuri)	142.7	11.5	45.8	350.8	12.97	23.56
PK-176	148.0	12.5	55.3	430.9	15.94	12.51
LSD (0.05)	NS	NS	22.44	140.2	5.50	4.37
CV (%)	11.88	12.50	20.29	16.47	25.80	12.01

Table 3. Yield and yield contributing characters of panikachu varieties , Comilla, 2008-09

Variety	Plant height (cm)	Stolon plant^{-1}	Length of stolon (cm)	Weight of stolon (g)	Yield of stolon (t ha^{-1})
Latiraj	128.20	24.4	70.43	32.61	33.39
Local	129.45	23.5	67.60	31.81	32.14

Adaptive Trial with Improved Mukhikachu Varieties/Lines

Abstract

Performance of four varieties/lines of mukhikachu viz. MK 029, MK 140, Bilashi and local were evaluated in the farmers' field at Bandarban, Jessore and Melandah, Jamalpur during Kharif season of 2008. The highest average cormel yield was obtained from MK-140 (24.19 t ha^{-1}) followed by Bilasi and line, MK-029.The local variety gave the lowest yield across the locations.

Introduction

Mukhikachu (*Colocasia esculenta*) is an important edible aroid in Bangladesh and it contributes to the total supply of bulky vegetables during the late summer when the vegetable becomes scarce in the market. It also plays an important role in the daily diet in other countries of the world. It also compares favorably in terms of nutritional value with other root crops such as cassava, yam, sweet potato and other edible aroids. Such important vegetable needs improvement in variety aspects. Literature revealed that the farmers got very poor yield by using local varieties. Recently, Bangladesh Agricultural Research Institute (BARI) has developed high yield potential mukhikachu varieties/lines viz. Bilashi, MK 029 and MK 140 etc. Therefore, it is necessary to test the adaptability of these mukhikachu varieties/lines under farmers' condition. Hence, a study was undertaken to evaluate those lines in comparison to local variety.

Materials and Methods

The experiment was conducted in the farmers' field of Bandarban, Jessore and Jamalpur during Kharif season of 2008. The trial was conducted in randomized complete block design with three replications. The unit plot site was 3.6 m x 3.6 m. The planting materials were viz. MK 029, MK 140, Bilashi and local. The recommended fertilizer dose 60-40-80 kg ha^{-1} of NPK with 2000 kg of cowdung was applied. All fertilizers and 1/3 of urea were applied as basal. The rest urea was applied in two equal splits at 30 and 60 days after seeding. Seeds were following a spacing of 60 cm x 45 cm.. The seeds were planted on March 25, 2008 at Bandarban, April 3, 2008 at Jessore and April 3, 2008 at Jamalpur and it was harvested during October 4 to 22, 2008. Data were collected on plant height, number of cormels plant^{-1}, weight of cormels plant^{-1} and yield per hectare for statistical analysis.

Results and Discussion

Bandarban: The result showed that the highest plant height (75.33cm) produced by the variety Bilashi which was statistically similar to the line MK-140 (73.56cm). The local variety produced lowest plant height (58.33 cm). The highest number of cormel plant^{-1} (56.00) and weight of cormel plant^{-1} (620.70 g) was produced by the line MK-140 (Table 2) which statistically identical with the line MK- 029. Local variety produced lowest number corms plant^{-1} (30.00) and weight of cormel plant^{-1} (340.30). The highest yield (26.84 t ha^{-1}) was obtained from MK-140 which was statistically similar with the line MK – 029. The lowest yield (14.46 t ha^{-1}) was obtained from the local variety.

Jessore: The highest yield (25.66 t ha^{-1}) was obtained from MK-029 and the lowest (21.26 t ha^{-1}) from farmers own at Jhikargacha, Jessore (Table 3).

Jamalpur: The result showed that the longest plant was recorded from MK 140 was statistically identical to MK 029 and Bilashi (Table 4). The local variety produced significantly the shortest plant. The highest number of cormels plant^{-1} was noted from Bilashi and was statistically different from MK 029 and MK 140. These two lines produced identical cormels plant^{-1}. The lowest number of cormels plant^{-1} was found in the local variety. The similar pattern of behaviour was also noted in case of cormel weight plant^{-1}. The highest cormel yield was recorded from Bilashi (25.55 t ha^{-1}). It was statistically different from MK 140 which produced the second highest cormel yield (20.81 t ha^{-1}).

The line MK 029 produced 17.98 t ha^{-1} of cormel yield while the local variety produced the lowest cormel yield (12.66 t ha^{-1}). Bilashi produced 101% higher yield than the local variety.

Farmers' reaction

Bandarban: Farmers' are very much interested to grow the lines MK -140 and MK -029 for higher yield and economic return. They also opined that BARI varieties/lines are tasty due to its softness after cooking.

Jessore: Farmers of this area were impressed with the mukhikachu lines MK-029 & MK-140 for its high yield. They are interested to grow this line because higher yield other than existing variety (farmers own). This lines may be recommended for released as a variety.

Jamalpur: Farmers were satisfied with the higher yield of Bilashi. They already preserved the seeds for next year cultivation. It is expected that sustainable yield could be obtained with this variety at MLT site of Jamalpur.

Table 1. Mean yield (t ha^{-1}) of Mukhikechu across locations,2008-09

Variety/Lines	Bandarban	Jessore	Jamalpur	Mean
MK-029	25.54	25.66	17.98	23.06
MK-140	26.84	24.93	20.81	24.19
Bilashi	19.83	24.20	25.55	23.19
Local	14.46	21.26	12.66	16.13

Table 2. Performance of yield and yield contributing characters of mukhikachu at Balaghata, Bandarban during 2008.

Variety/lines	Plant height (cm)	Cormel $plant^{-1}$	Wt. of cormel $plant^{-1}$ (g)	Yield (t ha^{-1})
MK-029	65.00 b	52.00 ab	585.00 ab	23.54 a
MK-140	73.56 a	56.00 a	620.70 a	26.84 a
Bilashi	75.33 a	41.00 c	412.30 c	19.83 b
Local	58.33 c	30.00 d	340.30 d	14.46 c
CV (%)	10.67	9.98	11.23	12.11

Table 3. Performance of yield and yield contributing characters of mukhikachu at MLT site, Jhikargacha, Jessore during 2007-08

Variety/ lines	Plant height (cm)	Cormel $plant^{-1}$ (no.)	Weight of cormel $plant^{-1}$ (g)	Yield (t ha^{-1})
MK-140	70.3	33.6	680	24.93
MK-029	69.8	29.4	700	25.66
Bilashi	68.4	30.4	660	24.20
Farmer's own	58.6	29.4	580	21.26

Table 4. Yield and yield contributing characters of mukhikachu at MLT site, Malancha, Jamalpur during Kharif-I, 2008

Treatment	Plant ht (cm)	Cormels $plant^{-1}$ (no.)	Cormel wt $plant^{-1}$ (g)	Yield (t ha^{-1})
MK 029	58.3 a	22.47 b	480.3 b	17.98 c
MK 140	61.6 a	25.13 b	560.3 b	20.81 b
Bilashi	50.0 a	29.20 a	656.7 a	25.55 a
	47.7 b	16.90 c	348.8 c	12.66 d
F	**	**	**	**
CV (Local %)	8.98	9.51	7.08	8.67

On-Farm Adaptive Trial of Advanced Lines of Groundnut

Abstract

A field trial was conducted at Mymensingh Sadar Upazila, Kishoreganj and Cox's Bazar during the rabi season of 2008-09 to evaluate the performance of some advanced lines of groundnut along with other released varieties. Among the tested lines/varieties highest average pod yield (2.45 t ha^{-1}) was obtained from BARI Chinabadam 6, which was closely followed by line ICGV-96342 (2.38 t ha^{-1}) and ICGV-96346. At Cox's Bazar highest pod yield was obtained from ICGV-97262 and ICGV-96346 (3.63 t ha^{-1}).

Introduction

Groundnut is one of the important oilseed crops of Bangladesh. The varieties grown by the farmers are low yielder. Oilseed Research Center of BARI has developed some high yielding varieties of groundnut which are being popularized among the farmers. Some advanced lines are also selected by Oilseed Research Center of BARI. Before releasing as variety, these lines should be tested in the farmer's field in comparison to other released varieties. So, an On-farm trial was conducted at farmer's field of Laxmipur, Shambhuganj of Mymensingh Sadar, Kishoreganj and Cox's Bazar to evaluate the performance of the selected advanced lines of groundnut.

Materials and Methods

The experiment was conducted at Laxmipur, Shambhuganj under MLT site, Mymensingh Sadar, Hossainpur MLT site, Kishoreganj and Cox's Bazar MLT site during the rabi season *of* 2008-09. The design of the experiment was RCB with three replications, however, the trial of Mymensingh was non replicated. Seven groundnut advanced lines/varieties (ICGV-96346, ICGV-96342, ICGV-97262, Dhaka-1, BARI Chinabadam 6, BARI Chinabadam 8 and Pk-1) were tested in farmer's field. Unit plot size was 4m x 5m. Fertilizers were applied at the rate of 12-18-60-55-1.7 kg ha^{-1} of NPKS and B, respectively. Seeds were sown on 6 December 2008 at Mymensingh, 25 December 2008 at Kishoreganj and 12 December, 2008 with a spacing of 30 cm x 10 cm. But at Mymensingh spacing was 30 cm X 15 cm. Intercultural operations were done as and when necessary. The crop was harvested during 4-29 May 2009. Data on yield and yield contributing characters were recorded and analyzed statistically.

Results and discussion

Kishoreganj

The higher pods plant^{-1} and kernel pod^{-1} was recorded from BARI chinabadam-6 and BARI chinabadam-8 respectively (Table 2). Higher 100-kernel weight was recorded from the variety BARI chinabadam-6 which was statistically different to other varieties/lines of groundnut. Significantly the highest pod yield (2.21 t ha^{-1}) was obtained from BARI Badam-6 followed by BARI chinabadam-8. BARI chinabadam-6 gave the highest pod yield due to higher number of pods plant^{-1} and 100-kernel weight. The variety Dhaka-1 gave the lowest nut yield due to less pods plant^{-1} and less 100-kernel weight.

Mymensingh

The varieties BARI Chinabadam-6 and BARI Chinabadam-8 required 153 days to mature (Table 3). The advanced lines matured within 149 days. The check variety DA-1 took 147 days for its maturity. Number of pods plant^{-1} was minimum (16.8) in the check variety. Number of kernels pod^{-1} ranged from 1.5 to 1.8 in both lines and varieties. Weight of 100 kernel was highest in BARI -6 (55.3 g) followed by the advanced line No. 96342 (51.5 g). Kernel weight was lowest in the check variety DA -1 (33.1 g 100-kernel^{-1}). Shelling percent of the varieties/lines ranged from 68.3 to 75.1, the highest being in both PK-1 and No. 96342 and lowest (68.3%) in No. 96346. Pod yield was highest (2.23 t ha^{-1}) in the advanced line No. 96342 followed by BARI-6 (2.02 t ha^{-1}). The check variety gave the lowest pod yield of 1.28 t ha^{-1}. The advanced lines No. 96342 and No. 96346 gave higher yield (74 and 21%, respectively) than the check variety DA-1 (1.28 t ha^{-1}). The varieties BARI -6 and BARI C-8 also gave better yield (58 and 51% higher, respectively) than the check.

Cox's Bazar

The highest pods plant^{-1} was recorded in the variety ICGV-96346 (39) which was significantly different from other varieties (Table 4). Lowest pods plant^{-1} was recorded in the varieties Dhaka-1 and BARI Cheenabadam-8. But in case of pod weight plant^{-1} highest was observed in ICGV-96342, ICGV-97262 which was statistically similar with ICGV-96346. The highest pod yield (3.63 t ha^{-1}) was obtained from ICGV-96346 and ICGV-97262 followed by ICGV-96342. The variety Dhaka-1 produced the lowest nut yield.

Farmers' reaction

Mymensingh

Farmers are interested to grow the groundnut variety BARI-6 and advanced line ICGV-96342 for their higher yields, good colour and seed size. They wanted seeds of those variety/line for the next year sowing.

Kishoreganj

Farmer's of MLT site, Hossainpur opined that there was incidence of insect and diseases in the new varieties. They also opined that the yield of BARI chinabadam-6 was higher than other variety/lines. They preferred BARI chinabadam-6 due to its higher yield, taste, pod size and color.

Cox's Bazar

1. Needs more time than local variety
2. Farmers' local variety is more tasty than those varieties
3. Farmers' preferred advance line ICGV-96346 because of its yield

Conclusions

The experiment should be conducted over the years to reach to conclusion.

Table 1. Average Seed yield (t ha^{-1}) of different groundnut varieties/lines across location, 2008-09.

Varieties/lines	Kishoreganj	Mymensingh	Cox's Bazar	Mean
ICGV-97262	1.96	1.33	3.63	2.31
ICGV-96346	1.80	1.55	3.63	2.33
ICGV-96342	1.80	2.23	3.13	2.38
PK-1	1.93	1.42	-	1.67
Dhaka-1	1.75	1.28	1.88	1.63
BARI Badam-8	2.04	1.43	2.38	2.12
BARI Badam-6	2.21	2.02	3.13	2.45

Table 2. Yield and yield contributing characters of groundnut varieties/lines, at Mymensingh, 2008-09

Variety/ line	Days to maturity (days)	plant height (cm)	No. of pods plant^{-1}	No. of kernels pod^{-1}	wt. of 100 kernel (g)	Shelling (%)	Pod yield (t ha^{-1})	Relative position
BARI-6	153	43.2	21.2	1.5	55.3	71.3	2.02	158
BARI C-8	153	45.8	23.6	1.5	48.9	72.1	1.93	151
PK-1	149	45.8	18.8	1.7	40.1	75.1	1.42	111
No. 96342	149	40.8	28.2	1.8	51.5	75.1	2.23	174
No. 96346	149	41.8	17.4	1.7	40.8	68.3	1.55	121
No. 97262	149	43.2	22.0	1.8	45.0	74.3	1.33	104
DA-1 (Check)	147	41.4	16.8	1.8	33.1	74.8	1.28	100

Table 3. Performance of yield and yield contributing characters of groundnut varieties/lines at Hossainpur MLT site, Kishoreganj, 2008-2009

Variety	No. of plants m^{-2} (at harvest)	Days to maturity	Shelling %	Plant height (cm	No. of pods $plant^{-1}$	No. of kernel pod^{-1}	100-kernel wt. (g)	Nut yield (t ha^{-1})
ICGV-97262	21	148	73	57.6	16	1.83	40.67	1.96
ICGV-96346	22	147	69	67.93	14	1.77	37.33	1.80
ICGV-96342	23	147	69	58.37	14	1.77	40.00	1.80
PK-1	20	143	72	58.67	16	1.70	36.33	1.93
Dhaka-1	19	139	69	57.53	13	1.70	31.00	1.75
BARI Badam-8	21	143	69	56.27	17	1.80	46.33	2.04
BARI Badam-6	19	149	58	57.07	20	1.73	50.00	2.21
LSD (0.05)	22.31	ns	ns	ns	5.76	0.15	3.51	0.64
CV (%)	10.15	6.95	9.31	6.53	10.29	5.31	4.19	11.27

Table 4. Performance of groundnut varieties at Cox's bazar MLT site during rabi (2008-09)

Treatment/Variety	Pods $plant^{-1}$	Pod wt. $plant^{-1}$	Nut yield (t ha^{-1})
ICGV-96346	39.00 a	58.10 a	3.63 a
ICGV-96342	30.25 b	58.50 a	3.13 b
ICGV-97262	29.05 c	58.50 a	3.63 a
Dhaka-1	24.15 d	26.75 c	1.88 d
BARI Chinabadam 6	29.10 c	57.50 a	3.13 b
BARI Chinabadam 8	23.55 d	38.80 b	2.38 c
CV (%)	1.90	6.70	4.63

On-Farm Adaptive Trial of Advanced Lines of Soybean

Abstract

An experiment was conducted at Mymensingh, Kishoreganj and Patuakhali during *rabi*' 2008-09 to test the performance of three advanced lines and three released varieties of soybean with a local as check. The advanced lines/varieties were: BARI Soybean 5, Amber, Shohag, BGM-02026, BGM-02093, GC-84051, AGS-95, ASSET-95, BC-84051, and GMOT-17. Among the tested line and varieties highest average yield (2.47 t ha^{-1}) was obtained from GC-84051.

Introduction

Soybean (*Glycine max* L.) is an important oil seed crop in the world although it is considered as minor oil crop in Bangladesh. However, in the recent years, it is gaining popularity in Bangladesh as a crop for poultry feed ingredient. On the other hand soybean oil is used extensively for cooking. It is also used for making nutritious food items like soyadal, soyakhechuri, soyamisty, soyapolao, soyamilk, soyacake, soyabiscuits, soyabread etc. Extraction of oil from Soybean seed is not practiced in the country due to its small scale production and non-availability of extraction machine. Its seed contain 42-45% protein and 20-22% edible oil. Oil Seed Research Centre, BARI has developed some varieties/advanced lines of soybean which need to be tested in the farmer's field. So, the experiment was designed to evaluate the performance of advanced lines and varieties of soybean across locations.

Materials and Methods

The experiment was conducted at farmers field of Multilocation Testing Site, Trishal, Mymensingh, Kishoreganj and Patuakhali during *rabi*' 2008-09. The design of the experiment was randomized complete block with four replications. Unit plot size was 3m x 5m. The treatments of the experiment were BARI Soybean 5, Amber, Shohag, BGM-02026, BGM-02093, GC-84051, AGS-95, ASSET-95, BC-84051, and GMOT-17. The crop was fertilized by following STB method, NPKS @ 23-40-40-20 kg ha^{-1}, respectively. Half of N and all other fertilizers were applied as basal. Rest half of N was applied in two equal splits at 30 and 60 days of sowing following first and second weeding. The seeds were sown on 4-5 January 2009 at Mymensingh, 27 December, 2008 at Kishoreganj and 12-13 January, 2009 Patuakhali with a spacing of 30 cm apart rows with continuous seeding maintaining a distance of about 5-10 cm seed to seed. Before sowing, the seeds were treated with Forastin 50% WP @ 3 g kg^{-1} seed. Other intercultural operations were done as and when necessary. At maturity, the crop was harvested during 18- 26 April, 2009. Data on yield and yield contributing characters were recorded and analyzed statistically following computer package program MSTAT-C.

Results and discussion

Mymensingh

Plant population varied from 35.2-46.8 plants m-2 where the maximum (46.8) was in BGM-02026 and minimum (35.2) was in the variety Amber (Table 2). Significantly higher plant height (66.95 cm) and number of pods $plant^{-1}$ (59.70), number seeds pod^{-1} (2.05) were observed in the advanced line BGM-02026 . Plant height, number of pods $plant^{-1}$ and number seeds pod^{-1} of the advanced lines were identical. Number of pods $plant^{-1}$ varied from 36.95-59.70, number seeds pod^{-1} varied from 1.65-2.05 and 1000 seed weight varied from 81.3-133.8 g. The advanced lines BGM-02026 and GC-84051 gave significantly the highest seed yield of 2.48 t ha^{-1} and 2.45 t ha^{-1}. These two advanced lines also gave the highest stover yield of 2.73 t ha^{-1} and 2.71 t ha^{-1}. Higher seed yield and stover yield in the advanced lines were attributed due to better performance of the yield contributing characters. The lowest seed yield (2.04 t ha^{-1}) was observed in the variety BARI Soy-5 which was identical to Shohag, local and Amber. Higher stover yield (2.73 t ha^{-1}) was observed in GC-84051 which was identically followed by BGM-02026 (2.71 t ha^{-1}).

Kishoreganj

The lines BGM-02026 gave higher pods $plant^{-1}$, seeds pod^{-1} that was statistically similar to BGM-02093. BARI soybean-5 gave higher yield (2.12 t ha^{-1}) followed by shohag (2.06 t ha^{-1}). It might be due to optimum plant stand, pods $plant^{-1}$, seeds pod^{-1} and higher 1000 seed weight (Table 3). The line GC-84051gave the lowest seed yield (1.70 t ha^{-1}) and it was statistically identical to BGM-02026 and BGM-020293. It might be due to less plant stand, pods $plant^{-1}$, seeds pod^{-1} and 1000 seed weight. The maturity days were close to each other by variety/line. There was some incidence of hairy caterpillar, leaf roller in the varieties but comparatively less infestation observed in new lines.

Patuakhali

Among the tested lines and varieties, highest yield was observed from Shohag (1783 kg ha^{-1}) followed by BARI soybean-5 (1666 kg ha^{-1}) and GMOT-17 (1630 kg ha^{-1}) and lowest yield observed from BGM-02026 (yield 1200 kg ha^{-1}). All the eight varieties perform satisfactorily (Table 4)

Farmer's reaction

Mymensingh The farmers preferred the tested advanced lines due to their higher yields and economic return.

Kishoreganj It is a new crop to the farmers. Farmers' of Hossainpur area interested to cultivate soybean. But seed availability and marketing of soybean is a problem.

Patuakhali It is a new crop to the farmers. Farmers are interested to cultivate soybean. But seed availability and marketing of soybean is a problem.

Conclusion

Farmers have been taken soybean as a new crop. For creating local demand and to popularize it, motivational work would be fruitful for sustaining this new crop at farmer's field. Besides these, attention should be given on marketing facility, uses of soybean and availability of seeds in proper time in the local market.

Table 1. Mean seed yield (t ha^{-1}) of Soybean over locations, 2008-09

Variety/Lines	Mymensingh	Kishoreganj	Patuakhali (Seeds yield^{-1})	Mean
BARI Soyben-5	2.04	2.12	1.66	1.94
Amber	2.09	2.01	-	2.05
Shohag	2.05	2.06	1.78	1.96
BGM-02026	2.45	1.76	1.20	1.80
BCM-02093	2.30	1.79	1.28	2.47
GC-84051	2.48	1.70	-	2.09
AGS-95	-	-	1.58	-
ASSET-95	-	-	1.40	-
BC-84051	-	-	1.55	-
GMOT-17	-	-	1.63	-

Table 2. Yield and yield contributing characters of soybean at MLT site, Trishal, Mymensingh during rabi' 2008-09

Varieties/ lines	Plant population m^{-2}	Plant height (cm)	No. of branches plant^{-1}	No. of pods plant^{-1}	No. of seeds pod^{-1}	1000 seed weight (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
BARI Soy-5	44.3 ab	47.80 b	2.15 bc	36.95 c	1.90 b	133.8 a	2.04 c	2.30bc
Amber	35.2 c	35.25 d	1.30 d	44.45 b	1.65 c	133.8 a	2.09 c	1.89 d
Shohag	39.0 c	46.95 bc	1.95 c	44.75 b	2.05 a	132.5 ab	2.05 c	2.13 c
BGM-02026	46.8 a	66.95 a	2.45 b	59.70 a	2.05 a	81.3 d	2.45 a	2.71a
BGM-02093	43.3 abc	64.70 a	1.80 c	58.95 a	2.00 ab	81.3 d	2.30 b	2.44 b
GC-84051	41.0 bc	65.65 a	3.05 a	58.85 a	2.00 ab	111.3 c	2.48 a	2.73 a
Local	42.0 abc	43.45 c	1.90 c	37.25 c	1.90 b	127.5 b	2.06 c	2.13 c
LSD (0.05)	4.82	3.55	0.41	4.87	0.12	5.75	0.11	0.23
CV (%)	8.03	4.51	13.21	6.73	4.22	3.38	5.82	6.96

Table 3**.** Yield and yield contributing characters of soybean varieties/line at Hossainpur MLT site, Kishoreganj during rabi, 2008-09

Variety/ Line	No. of plants m^{-2}	Days to maturity (Days)	Plant height (cm)	No. of pods plant^{-1}	No. of seeds pod^{-1}	1000-seed wt.(g)	Yield (t ha^{-1})
BGM-02026	45	113	50	19	2.15	85	1.76
BGM-02093	41	113	47	17	2.14	86	1.79
GC-84051	45	114	49	18	2.05	93	1.70
Shohag	56	111	53	13	2.00	108	2.06
BARI soybean-5	59	111	56	16	2.02	101	2.12
Amber	55	112	58	13	2.08	100	2.01
LSD (0.05)	NS	NS	NS	2.25	0.06	5.76	218
CV (%)	13.21	8.61	6.56	7.86	17.73	3.32	6.31

Table 4. Yield and yield attributes of soybean varieties at MLT site Kuakata, Patuakhali, 2008-09

Variety	Plant height (cm)	No. of pods plant^{-1}	No. of seeds pod^{-1}	100-seed weight (g)	Seed yield (kg ha^{-1})
AGS-95	35.6	28.9	2.1	9.0	1580 c
BARI Soybean-5	36.1	26.9	2.1	8.5	1666 b
BGM-02026	50.6	32.0	2.1	5.7	1200 e
ASSET-95	48.6	29.1	2.0	7.1	1400 d
BC-84051g1	42.5	27.2	2.2	7.8	1550 c
GMOT-17	50.8	34.2	1.8	8.2	1630 bc
Shohag	42.7	28.6	2.2	8.7	1783 a
BGM-02093	46.6	33.7	1.9	6.2	1280 e
CV (%)	-	-	-	-	9.25

On-Farm Adaptive Trial of Advanced Lines of Rapeseed

Abstract

The study was carried out at Faridpur, Pabna, Satkhira, Narail, Patuakhali during the rabi season of 2008-09 to evaluate the performance of advanced lines of rapeseed at different locations. The highest average seed yield was obtained from BJDH-1(1366 kg ha^{-1}) and it was closely followed by BJDH-11 (1313 kg ha^{-1}).

Introduction

Rape seed is one of the most important oil seed crop in Bangladesh. Bangladesh is deficit in edible oil, which cost valuable foreign currency for importing seeds and oils every year. In Bangladesh, yield of this crop is lower compared to other mustard growing countries. The reason behind this lower yield is attributed to the genetically low yield potential of local varieties and poor management practices. Thus, there was need for varieties with high yield potential of oil seed crop. Some advanced lines of rape seed showed better performance during the previous years. But before releasing these lines as varieties, performance should be tested in the farmers' field. So, this trial has been under taken to evaluate the performance of advanced lines of rape seed in farmer's field at different locations.

Materials and Methods

The experiment was conducted at Faridpur, Pabna, Satkhira, Kushtia, Narail and Patuakhali during the rabi season of 2008-09. Three advanced lines BJDH 11, BJDH 18, BJDH-1 and one mustard variety BARI sarisha-11 (as check) were used in the study. The experiment was laid out in randomized complete block design with four dispersed replications. The unit plot size was 5 m x 3 m. The crop was fertilized at the rate of 138, 36, 50, 33, 1.6 and 1 kg ha^{-1} of N, P, K, S, Zn and B respectively. Half of N and all other fertilizers were applied during final land preparation. Rest half of N was used as top dress at 30 days after sowing. The seeds were sown on 6 November, 2008 at Faridpur, 11-12, November 2008 at Pabna, 31 October, 2008 at Satkhira, 27 October, 2008 at Kushtia, 6-8 November, 2008 at Narail and 2-7 December, 2008 at Patuakhali with 30 cm x 5 cm spacing. Two irrigation was applied at December 2 and 31, 2008. The crops received continuous 15 days foggy weather and was affected by aphid. To control aphid, Malathion was sprayed along with fungicide Rovral (two times) against fungal disease. One weeding and thinning was done at 15 days after sowing. The crop was harvested during February 10 to 8 March 2009. Plant protection measures were taken as and when required. Necessary data were collected and analyzed statistically.

Results and Discussion

Faridpur: Plant height, number of siliqua plant^{-1}, number of seeds per siliqua, 1000 seed weight and seed yield were significantly influenced by the effect of varieties/lines (Table 2). The advanced line BJDH-11 produced significantly highest yield (1801 kg ha^{-1}) followed by BJDH-18 (1733 kg ha^{-1}) which were statistically identical. It may be due to higher number of seeds siliqua^{-1} as well as bolder seed size (4.00g). The check variety of BARI Sarisha 11 gave the lowest yield (1564 kg ha^{-1}) which are at par to BJDH-01 (1603 kg ha^{-1}) and BJDH 18 (1733 kg ha^{-1}). The significantly lowest TSW was found in BARI Sarisha 11.

Pabna: Line BJDH-01 took the maximum days to flowering followed by BJDH-18 (Table 3).The lowest days to flowering was observed in BJDH-11. The advanced lines took the maximum days to maturity while the variety attained maturity with the minimum days. The highest plant height was observed in BJDH-01 while the lowest was recorded in the variety BARI Sarisha-11. Plant population per unit area was more or less similar in the tested variety and lines. The highest number of siliqua plant^{-1} was recorded from BJDH-01 & BJDH-18 and the lowest was in BARI Sarisha- 11. Maximum number of seeds siliqua^{-1} was observed in BJDH-11. The line BJDH -01 attributed to minimum number of seeds siliqua^{-1}. The maximum weight of 1000 seeds was recorded in BJDH 11 which was statically identical to BARI sarisha-11. The highest seed yield was obtained from BJDH-01 and it was significantly identical with other lines.

Satkhira: The advanced line DJDH-18 took the maximum days to flowering followed by BJDH-1 (Table 4). The lowest days taken to flowering was observed in BARI sarisha-11. At the same time, the lowest field duration (88 days) was also taken by BARI sarisha-11 among the varieties. The highest seed yield was found in BARI sarisha-11 which was followed by line BJDH-01. The highest yield of BARI shrisha-11 was probably due to highest number of siliqua plant^{-1} and seeds pod^{-1}. The lowest seed yield was obtained from the line BJDH-18 due to the lowest number of plant population and seeds pod^{-1}. However, the line BJDH-18 produced the highest straw yield (5.78 t ha^{-1}).

The results revealed that the highest seed yield (1850 kg ha^{-1}) was obtained from BJDH-01 which was statistically at par to those of BJDH-11(1078 kg ha^{-1}) and BJDH-1 (1073 kg ha^{-1}). The maximum no. of pods plant^{-1} and seeds pod^{-1} were recorded from BJDH-01.

Narail: The yield and yield contributing characters viz. Plant population per square miter, Number of pods per plant and straw yield have shown statistical differences (Table 6). The highest seed yield (1069 kg ha^{-1}) was recorded from BJDH-1 and the lowest in BJDH-18 (1017 kg ha^{-1}).

Patuakhali: The highest yield was obtained from BJDH-18 (1122 kg ha^{-1}) followed by BARI sarisha - 11 (1025 kg ha^{-1}) (Table 7). Comparatively lowest yield was observed in BJDH-11 (772 kg ha^{-1}). In 2007-08 BARI sarisha-11 gave the highest yield followed by BJDH-18 and BJDH-11.

Farmer's reaction

Faridpur: Farmers are happy for high yield of mustard. The advanced lines gave more fuel than normal variety but the lines have lodging tendency.

Pabna: Farmers opined that they need short duration crop but the new lines are long duration, they were not fully satisfied though the yield is relatively higher.

Satkhira: Farmers preferred BARI sarisha-11 in comparison to the lines for its good yield and shorter crop duration.

Kushtia: The performance of BJDH-1 is good. Farmers reacted very positively and were satisfied with that variety for its high yield and bold size seed.

Patuakhali: Farmers are satisfied to get this yield. If it is possible to sow early they expected to get higher yield.

Conclusion

This is the first year results of the experiment. It needs further trial for making final conclusion. However, most of the farmers want short duration variety to facilitate timely boro rice planting. In non-boro rice area those long duration cultivars might be promoted.

Table 1. Seed yield (kg ha^{-1}) different rape seed and Mustard across locations, 2008-09

Variety/Lines	Faridpur	Pabna	Khulna	Kushtia	Narail	Patuakhali	Mean
BJDH-1	1603	1502	725	1850	1690	827	1366
BJDH-11	1801	1306	700	1780	1520	772	1313
BJDH-18	1733	1369	412	1730	1170	1122	1256
BARI Sarisha-11	1564	1004	887	1720	1360	1025	1260

Table 2. Yield and yield contributing characters of mustard lines/varieties at FSRD site, Faridpur during rabi 2008-09

Lines/varieties	Days to maturity	Pl.pop m^{-2}	Pl. height (cm)	Siliqua plant^{-1}	Seed siliqua^{-1}	TSW (g)	Seed yield (kg ha^{-1})
BJDH – 11	104	50.0	174.2ab	137.1ab	11.37ab	4.00a	1801a
BJDH – 18	100	49.6	174.7a	124.5b	12.52a	3.85a	1733ab
BJDH- 01	100	49.3	161.5b	135.8b	11.57ab	3.50b	1603b
BARI Sarisa 11	95	50.6	114.5c	161.2a	11.35b	2.80c	1564b
CV (%)		5.63	4.8	10.4	6.25	4.24	6.98

Table 3. Yield and yield contributing characters of different advanced lines/variety of rape seed during the rabi season of 2008-09 at MLT site, Khaloibhara, Kashinathpur, Pabna.

Treatments	Days to flower (50%)	Days to maturity (no.)	Plant population m^{-2} (no.)	1st branch ht.(cm)	Plant height (cm)	Branch $plant^{-1}$ (no.)	Siliqua $plant^{-1}$ (no.)	Seeds $siliqua^{-1}$ (no.)	1000-Seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
BJDH-11	40.25b	98.25ab	48.25a	73	162.4b	4.38	62.8b	14.15a	3.1a	1306a	4557a
BJDH-18	43.0a	99.00a	43.15a	59	135.215c	4.20	113.12a	12.33b	2.12c	1369a	4354a
BJDH-01	44.25a	97.00b	42.15a	101	181.6a	4.45	114.15a	12.05b	2.6b	1502a	4616a
BARI sarisha-11	40.75b	93.00c	44.15a	108	134.1c	4.25	61.1b	12.13b	2.93ab	1004b	3987a
CV (%)	4.94	5.81	6.14	-	4.62	-	5.52	11.15	9.76	11.15	8.98
LSD	1.306	1.257	4.405	-	6.741	-	7.779	231.0	0.420	231.0	629.1

Table 4. Yield and yield attributing characters of rapeseeds and mustard at Satkhira MLT site during Rabi season, 2008-09

.Variety	Days to flower (50%)	Days to maturity	Plant pop^n m^{-2}	Plant height (cm)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	Weight of 1000 seeds (g)	Seed yield (kg ha^{-1}.)	Straw yield (t ha^{-1})
BJDH-01	44	98	124.75	155.88	74.38	10.93	4.74	725.00	4.43
BJDH-11	42	98	123.25	156.08	62.60	11.17	5.38	700.00	5.15
BJDH-18	47	98	102.25	174.10	74.23	9.48	5.10	412.50	5.78
BARI Sarisha-11	39	88	115.75	117.48	93.20	11.88	4.13	887.50	4.06
LSD(0.05)	-	-	22.95	24.38	11.42	1.079	0.2949	232.80	0.485
CV(%)	-	-	12.32	10.10	9.38	6.21	3.81	21.36	6.23

Table 5. Effect of different varieties on yield and yield components of Mustard at Kushtia, 2008-09

Treatment	Plant height (cm.)	Plants m^{-2} (no.)	No. of branches $plant^{-1}$	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	1000 grain Wt.(g)	Seed yield (kg ha^{-1})	Straw yield (t ha^{-1})
BJDH-01	175.5	46	5.0	149	14.0	2.86	1.85	3.86
BJDH-11	182.5	45	5.0	145	13.0	3.03	1.78	3.90
BJDH-18	207.5	45	6.0	135	13.0	3.0	1.73	4.36
B.S-11	168.5	45	5.0	143	12.0	3.13	1.72	3.96
CV(%)	1.71	2.66	9.0	3.98	4.38	3.93	2.87	6.96
LSD	5.0	NS	NS	9.12	0.89	0.9	8.13	4.47

Table 6. Yield and yield attributes of mustard (*Brassica juncia*) at MLT site, Tularampur, Narail during rabi 2008-09

Entries	Plant Pop. m^{-2} (no.)	Plant height (cm)	Branches $plant^{-1}$ (no.)	Siliqua $plant^{-1}$ (no.)	Seeds $siliqua^{-1}$ (no.)	1000-grain wt. (g)	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})
BJDH-01	94.25	169.50	6.75	129.05	11.25	3.12	1.69	5.00
BJDH-11	73.50	172.65	4.80	113.85	10.35	3.20	1.52	4.60
BJDH-18	71.75	188.75	4.75	97.80	11.50	3.18	1.17	5.65
BARI Sarisha-11	96.25	167.85	6.10	139.00	10.90	2.95	1.36	3.75
CV (%)	8.64	6.26	19.99	11.69	7.50	5.32	12.79	8.49
LSD (0.05)	11.60	NS	NS	22.42	NS	NS	0.30	0.65

Table 7. Yield and yield contributing characters of four mustard and rapeseed varieties at FSRD site, Patuakhali 2008-09

Variety	Plant height(cm)	Siliqua $plant^{-1}$ (no.)	Seeds $siliqua^{-1}$ (no.)	1000-seed wt (g)	Seed yield (kg ha^{-1})
BJDH-11	143b	105c	10b	3.0a	772c
BJDH-18	153a	100c	11b	2.5ab	1122a
BJDH-01	145b	133a	11b	2.5ab	827c
BARI sarisha-11	135 c	120b	13a	2.0b	1025b
CV%	6.52	8.31	2.5	2.10	9.32

On-Farm Adaptive Trial of Advanced Lines of Rapeseed Mustard

Abstract

Five lines/varieties viz. NAP 205, NAP 0422, NAP 0447, Tori 7 and BARI Sarisha 8 were evaluated at Comilla, Jamalpur and Pabna during the rabi season of 2008-09 in farmer' field. The highest average seed yield was recorded from BARI Sarisha 8 (1620 kg ha^{-1}) followed by NAP 205 (1550 kg ha^{-1}). As NAP lines were harvested within 80-82 days it may be grown in between T.Aman-Boro rice cropping pattern. Among NAP cultivars, NAP-205 was the earliest.

Introduction

Mustard is the main Oil crop in the country covering about 70% of the total area and production. An acute shortage of edible Oil has been prevailing in our country. It produces only 33% of its requirement and the remaining 67% is met up by importing at the cost of huge amount of foreign currency. Farmers are cultivating mustard mostly the local varieties. A number of advanced rapeseed lines/varieties have been developed by BARI and these need to test in the farmers' field for familiarize among the farmers' and also to evaluate their performance as well.

Materials and Methods

The experiment was conducted at Comilla, Jamalpur and Pabna during the rabi season of 2008-09. The treatment included in the study were i) NAP 205, ii) NAP 0422, iii) NAP 0447, iv) Tori 7 and v) BARI Sarisha 8. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 3m x 4m. The land was fertilized with 120-34-45-30-1.8-1.7 kg ha^{-1} of NPKSZnB, respectively. The entire amount of fertilizer except half of N was applied at the time of final land preparation. The seed were sown continuously with 30 cm apart row on 11 Novembver, 2008 at Comilla, 5 November 2008 at Jamalpur and 15 November 2008 at Pabna. The crops were harvested depending on the maturity of the individual crop ranging from 28 January, 2009 to13 February 2009.The data on the yield attributes were collected from 10 randomly selected plants collected prior to harvest from each plots. The grain yield was recorded plot wise. The collected data were averaged, analyzed and means were separated as per DMRT.

Results and Discussion

Comilla: The highest seeds pod^{-1} (25.75) was found in NAP 205 and the lowest result was found in Tori-7 (Table 2). The highest plant height (112.25 cm) were observed in NAP 0447 and the second highest were recorded in BARI Sarisa-8. The highest pods $plant^{-1}$ was also found in NAP 0447 which was statistically similar to NAP 0422 (113.25) and NAP 205(110.75). The maximum days need to maturity (84.5), the highest number of branches $plant^{-1}$ (4.5) and highest weight of 1000 seed were found in BARI Sarisa-8. The highest seed yield was recorded in BARI Sarisa-8 (1744 kg ha^{-1}) which was statistically similar to NAP 205 (1683025), NAP 0422 (1638.75), and NAP 0447 (1623.25) and the lowest was found in Tori-7.

Jamalpur: The longest plant was recorded form NAP 0442 which was statistically identical to Tori 7, NAP 0447 and BARI sarisha 8 (Table 3). The shortest plant was recorded from NAP 205. The number of plants m-2 was found insignificant due to varieties variation. The highest number of siliqua $plant^{-1}$ were noted from NAP 0447 was identical to NAP 205. The other three varieties produced identical siliqua $plant^{-1}$. The highest number of seeds $siliqua^{-1}$ was found in NAP 0447 and was statistically identical to NAP 205 and NAP 0442. BARI Sarisha 8 produced the second highest number of seeds $siliqua^{-1}$ while Tori 7 produced the lowest. The weight of 1000 seed was found insignificant. However, the highest seed yield was recorded from NAP 0447 (1701 kg ha^{-1}) was identical to NAP 205 (1581 kg ha^{-1}). The lowest yield was recorded from Tori 7 (1207 kg ha^{-1}). NAP 205 and Tori 7 took the shortest time to mature the plant.

Pabna: From the results it was found that BARI Sarisha-8 took the maximum days to flowering and maturity followed by line NAP-0422 and NAP-0447 (Table 4). The lowest days to flowering and maturity was observed in Tori-7. The line NAP-205 is more. or less same as Tori-7 incase of flowering and maturity duration. The highest plant height was observed in BARI Sarisha-8 while the lowest was recorded in the line NAP-205. Plant population per unit area was higher in BARI Sarisha-8 and Tori-7 and lowest in NAP-0447. The highest number of siliqua plant^{-1} was recorded from NAP-0447 and the lowest was in Tori-7. Maximum number of seeds siliqua^{-1} was observed in BARI sarisha-8. Tori-7 attributed to minimum number of seeds siliqua^{-1}. The maximum weight of 1000 seeds was recorded in NAP-205 which was statistically identical to other line and variety except Tori-7. The highest seed yield was obtained from BARI sarisha-8 and it was significantly differed from other variety/lines. Probably the cumulative effect of maximum plant stand, and other yield attributes contributed the highest seed yield of BARI sarisha-8. The lowest seed yield was attained in Tori-7. The line NAP-0447 might be a promising variety due to its higher performance in yield attributes but yield became less mainly due to less plant establishment. Stover yield was also highest in BARI sarisha-8 and lowest in Tori-7. From the general observation, it was found that during the flowering to grain filling stage there were about two weeks heavy foggy weather which hampered pollination and caused relatively poor seed yield in all lines/varieties.

Farmers' reaction

Jamalpur: Farmers were satisfied with the higher yield of NAP varieties.

Pabna: Farmers opined that NAP-205 is a short duration crop with higher yield than Tori-7. So, they like to cultivate it in future in their field where they will cultivate Boro rice provided if the seeds are available.

Conclusion

The experiment should be continued for the next year for making conclusion.

Table 1 Average seed yield (kg ha^{-1}) of rapeseed mustard across locations, 2008-09

Variety/Lines	Comilla	Jamalpur	Pabna	Mean
Nap 0422	1639	1530	1002	1390
Nap 205	1683	1581	1386	1550
Nap 0447	1623	1701	948	1424
Tori-7	1185	1207	770	1054
BARI Sarisha-8	1744	1535	1582	1620

Table 2. Yield and yield components of different lines/varieties of rapeseed and mustard at Agricultural Research Station, Comilla during rabi 2008-09

Lines/ varieties	Flowering days	Maturity days	No. of plants $^{-1}$	Plant height (cm)	No. of branches plant^{-1}	No. of pods plant^{-1}	No. of seed pod^{-1}	1000 Seed weight	Yield (kg ha^{-1})
Nap 0422	29.2	80.5b	71	103.2b	3.75ab	113.2ab	21.00b	3.36a	1638.7ab
Nap 205	28.0	81.0b	72	98.2bc	3.25b	110.7b	25.75a	3.12ab	1683.2ab
Nap 0447	28.7	81.5b	71	112.2a	3.00b	127.7a	22.00b	3.35a	1623.2b
Tori 7	26.0	77.2c	71	94.5c	4.25a	84.2c	17.25c	2.28b	1185.0c
BARI sarisha-8	30.0	84.5a	72	104.2b	4.5a	90.7c	22.25b	3.50a	1744.0a
LSD (0.05)	4.71	1.226	2.68	6.088	0.8325	15.72	2.731	0.3678	106.8
CV (%)	4.71	0.98	2.45	3.86	14.4	10.1	8.19	7.37	4.40

Table 3. Yield and yield contributing characters of rape seed mustard at MLT, Malancha, Melandah, Jamalpur during rabi, 2008-09

Treat	Plant ht. (cm)	Plants m^{-2} (no.)	Siliqua plant^{-1} (no.)	Seeds siliqua^{-1} (no.)	1000 seed wt (g)	Seed yield (kg ha^{-1})	Maturity (days)
NAP 205	72.6 b	62.5	80.8 a	20.6 ab	3.30	1581 ab	80 b
NAP 0422	85.6 a	59.7	61.0 b	20.5 ab	3.38	1530 bc	83 a
NAP 0447	74.9 b	63.3	62.5 b	22.8 a	3.33	1701 a	83 a
Tori 7	83.1 a	63.0	62.0 b	14.1 c	3.13	1207 d	80 b
BARI Sarisha 8	76.6 ab	61.5	68.3 b	20.0 b	3.23	1535 bc	83 a
CV (%)	5.96	7.15	6.06	5.71	6.75	6.13	5.72

Table 4. Yield and yield contributing characters of different advanced lines /variety of mustard during the rabi season of 2008-09 at MLT site, Atghoria, Pabna.

Treatments	Plant population m^{-2} (no.)	Days to 50% flowering	Days to maturity	Plant height (cm)	Siliqua $plant^{-1}$ (no.)	Seeds $siliqua^{-1}$ (no.)	1000-Seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1= NAP-205	62.23b	31	72	53.55c	38.65c	18.1b	3.33a	1167.5b	1386.25b
T_2= NAP-0422	66.02ab	37	80	62.9b	44.75b	15.1c	2.98a	845c	1002.25c
T_3= NAP-0447	61.9b	37	80	60.17b	58.51a	14.97c	3.15a	858.75c	948d
T_4= Tori-7	67.35a	30	70	54.62c	35.27d	12.15d	2.50b	741.25d	770.5e
T_5 = BARI Sharisa-8	67.8a	40	88	65.75a	42.57b	19.07a	3.13a	1225.00a	1582a
CV (%)	4.85	-	-	5.91	5.03	3.56	4.58	7.61	8.6
$LSD_{0.05}$	4.767	-	-	5.429	3.316	0.8486	0.3502	39.54	31.80

On-farm Adaptive Trial of Advanced Lines of Sesame

Abstract

The trial was conducted at FSRD site, Hatgobindpur, Faridpur during kharif season of 2009 to evaluate the performance of advanced lines of sesame in the farmers' field. Four advanced lines namely Ses-0265, Ses-0570, Ses-05115, Ses-0801 and one variety BARI Til-3 were tested in this trial. The highest seed yield (1745 kg) was recorded from the line Ses-0265 followed by Ses-0801 (1705 kg) which were statistically identical. BARI Til 3 gave the lowest yield.

Introduction

The demand of edible oil is increasing day by day in Bangladesh. Mustard is the major oilseed crop in this country. But the area of this crop is decreasing gradually due to pressure of other rabi crops. Sesame is the crop that can be cultivated after the harvest of different rabi crops and the yield performance of sesame is more or less good in medium to high land. So, sesame can meet the demand of edible oil to some extent. Good varieties of sesame are needed to increase the yield of this crop through advanced line trial.

Materials and Methods

The trial was conducted at FSRD Site, Hatgobindpur, Faridpur during kharif I season, 2008-09. The advanced lines and varieties of Til namely, Ses-0265, Ses-0570, Ses-05115, Ses-0801 and BARI Til-3 were used in this trial to evaluate the performance of advanced lines of Til. The experiment was laid out in RCB design with four replications. The unit plot size was 5 m x 3 m with 30 cm wide rows. The crop was sown on 10 March, 2009. Fertilizers were used @ 120-140-45-105-5-10 kg urea, TSP, MP, gypsum, ZnSO4 and Boric acid ha^{-1}. All fertilizers were applied before final land preparation except urea. Urea was applied half as basal and half as top dress. Intercultural operations were done as and when necessary. The crop was harvested on 2-8 June, 2009. The yield and yield contributing characters was collected and analyzed statistically.

Result and Discussion

The seed yield and yield contributing characters like number of plants per square metre, number of pods per plant and number of seeds pod^{-1} differed significantly among the different varieties/lines (Table 1). The plant height and 1000 seed weight showed insignificant difference. The advance line Ses - 0265 gave significantly highest yield (1745 kg ha^{-1}) followed by Ses – 0801 (1705 kg ha^{-1}) due to higher yield-contributing characters like number of pods $plant^{-1}$ and number of seeds pod^{-1} and the lines are statistically identical. Again Ses-0570 and Ses-05115 are identical and produced significantly higher yield than check variety BARI Til-3.

Farmers' reaction

Farmers were encouraged to observe the performance of new lines/varieties of Til. They preferred the 8 chambered Til line/variety. The area of Til cultivation is increasing every year in this area.

Table 1. Yield and yield attributes of different sesame lines/variety at FSRD site, Hatgobindpur, Faridpur during kharif, 2008-09

Line/variety	Pl. pop m^{-2}	Plant height (cm)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	TSW (g)	Seed yield ($kgha^{-1}$)	
						2008	2007
Ses- 0265	34.7b	128.4	72.8a	103.6a	2.95	1745a	-
Ses- 0570	36.1b	126.0	61.0b	87.9c	2.88	1685b	1545
Ses- 05115	34.2b	139.7	72.1a	94.8b	2.90	1660b	-
Ses- 0801	45.3a	135.2	71.5a	102.1a	2.78	1705a	-
BARI Til 3	32.8b	134.7	61.3b	72.9d	2.90	1560c	1448
CV (%)	8.35	6.58	9.13	6.14	3.41	10.25	5.42

Regional Yield Trial of Chickpea in the High Barind Tract

Abstract

A field experiment was conducted in the farmer's field of FSRD site, Kadamshahar, Rajshahi during rabi 2008-09 to develop variety through regional yield trial under Barind environments. Five advanced lines of chickpea namely, BCX-0007-1, BCX-007-10, BCX-008-1, BCX-008-2, SL-02-23 and one check varieties BARI chola-5 was tested. Among the tested entries BCX-0008-2 and BARI chola-5 took the highest and lowest days for flowering respectively and on the other hand, SL-02-23 and BCX-0008-2 took the highest and lowest days for maturity respectively. BCX-0007-10 gave the highest seed yield (1.13 t ha^{-1}) that was followed by BCX-0007-1 (1.00 t ha^{-1}), BCX-0008-1 (0.99 t ha^{-1}) and BARI chola-5 (0.98 t ha^{-1}). The lowest yield (0.75 t ha^{-1}) was obtained from SL-02-23 though it produced heaviest seed (20.23 g).

Introduction

The High Barind Tract (AEZ 26) is characterized by undulated land topography and consist of low rainfall, its soil belongs high bulk density, low organic matter, low N and limited available P (Ali, 2000). Moreover continuous puddled rice cultivation without any recycling of organic matter make it difficult for rabi crop cultivation, particularly under rainfed condition. Thus the area needs deep rooting cultivars with high yielding, i.e. cultivars with drought tolerant characteristics. Chickpea (*Cicer arietinum* L) is a potential pulse crop in residual soil moisture condition that can survive well under Barind stress situation due to its deep root system. BARI has already released 8 high yielding chickpea varieties and among them BARI chola-5 is well adopted under Barind environment and so it is widely cultivated in the Barind area. Recently PRC, BARI has collected some promising cultivars of drought tolerant and wilt resistant which may be adopted in Barind area. Therefore, five promising genotypes along with widely cultivated BARI released chickpea variety namely, BARI chola-5 were tested under rainfed optimum management conditions to develop new variety(s).

Materials and Methods

The field trial was conducted at Chabbishnagar under FRSD site, Kadamshahar, Godagari, Rajshahi during *rabi* 2008-09. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 8 rows x 4 m. The seeds were sown in 40 cm row to row distance and seed to seed 10 cm. Five advanced lines of chickpea viz. BCX-0007-1, BCX-007-10, BCX-008-1, BCX-008-2, SL-02-23 and one check variety BARI chola-5 were examined for the regional yield trial under Barind condition. Seeds were sown on 20 November 2008. The seed rate was used 50 kg ha^{-1}. The land was fertilized with 12-19-17-10-1 N-P-K-S-B kg ha^{-1} (FRG, 2005) in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. All fertilizers were applied as basal after final land preparation. The insecticide *Karate* @ 2 ml/L water was applied two times to control pod borer viz. 1st and 2nd spraying was given during flowering and pod setting stage respectively. On the other hand, the fungicide *Bavisteen* @ 2g/L water was used as preventive measures to control BGM for two times and spraying was done before and after flowering of chickpea. One hand weeding was done at 20 DAS. The crop was harvested on 27 March 2009. The seed yield and yield components of chickpea were recorded and analyzed statistically.

Results and Discussion

Crop Duration

Crop duration (days to flowering and maturity) of chickpea genotypes significantly varied (Figure 1). Among the genotypes the highest days were taken for flowering by BCX-0008-2 (84.67 days) followed by BCX-0007-10 (84 days) and these were statistically identical to BCX-0007-1 (83.33 days) and BCX-0008-1 (82.67 days) and significantly the lowest days were taken for flowering by BARI chola-5 (80.67 days). Significantly the highest days were taken for maturity by SL-02-23 (123 days) which was statistically identical to BCX-0007-1 (121 days), BCX-0007-10 (120 days) and BCX-0008-1 (118 days) and significantly the lowest days were taken for maturity by BARI chola-5 and BCX-0008-2 (118 days).

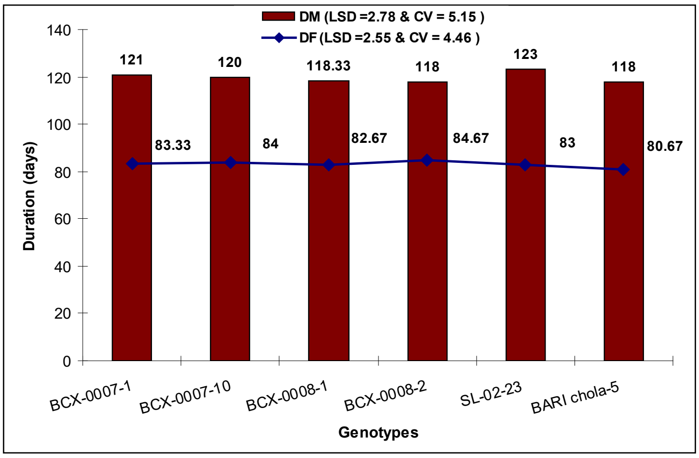

Fig. Days to maturity and Flowering as affected by different genotypes

Yield and yield attributes

Significant variation was observed among the genotypes on the yield and yield parameters of chickpea (Table-1). Among the genotypes significantly the tallest plant was observed in SL-02-23 (45.17 cm) that was identical to BCX-0007-1 (41.33 cm) and significantly the smallest plant was produced by BARI chola-5 (32.40 cm). Significant variation was in plant population m^{-2} and maximum number of plant population was produced by BCX-0007-1 (30.33 m^{-2}) that was statistically identical to BCX-0007-10 (29.77 m^{-2}), BCX-0008-2 (27 m^{-2}) and BARI chola-5 (26.67 m^{-2}) and significantly the lowest number of plant population was recorded in SL-02-23 (17.50 m^{-2}). Significant variation was also observed in pods $plant^{-1}$ and maximum number of pods $plant^{-1}$ was produced by BCX-0008-2 (38.47 $plant^{-1}$) that was statistically identical to BCX-0008-1(37.53 $plant^{-1}$), BCX-0007-1 (35 $plant^{-1}$) BCX-0007-10 (34.20 $plant^{-1}$) and BARI chola-5 (33.13 $plant^{-1}$) and significantly the lowest number of pods $plant^{-1}$ was recorded in SL-02-23 (18.93 $plant^{-1}$). Significantly the heaviest seed was produced by SL-02-23 (20.23 g) and the lightest seed was produced by BARI chola-5 (12.46 g) that was identical to other genotypes. Significant difference was observed in seed yield and stover yield (Table-1). The maximum seed yield (1.13 t ha^{-1}) and stover yield (1.38 t ha^{-1}) were obtained from BCX-0007-10 probably producing maximum number of plant m^{-2} (29.77), maximum number of pods $plant^{-1}$ (34.20) and comparatively heaver seed (13.73 g) among the promising genotypes. Considering the seed yield and stover yield other promising cultivars may be BCX-0008-2 (1.07 t ha^{-1} and 1.15 t ha^{-1}) and BCX-0007-1 (1.00 t ha^{-1} and 1.14 t ha^{-1}). Among the genotypes significantly the lowest seed yield (0.75 t ha^{-1}) obtained from SL-02-23; but this genotypes significantly produced the highest stover yield (1.40 t ha^{-1}) and the check variety BARI Chola-5 gave 0.98 t ha^{-1} and 0.95 t ha^{-1} seed yield and stover yield respectively.

Farmers' reaction

Among the tested genotypes, farmers of the study area find out some genotypes like BCX-0007-10, BCX-0008-2 and BCX-0007-1 for their better performance as well as bolder size seed, higher number of pods $plant^{-1}$ and less pest infestation round whole life cycle.

Conclusion

Farmer selected three promising lines on the basis of performance. So it should be further studied before releasing.

Table 1. Yield and yield attributes of Chickpea genotypes at Chabbishnagar under FSRD site, Kadamshahar, Godagari, Rajshahi during 2008-09

Genotypes	Plant height (cm)	No. of plants m^{-2}	No. of pods plant $^{-1}$	100 seed wt (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
BCX-0007-1	41.33a	30.33a	35.00a	13.23b	1.00a	1.14ab
BCX-0007-10	36.00b	29.77ab	34.20a	13.73b	1.13a	1.38a
BCX-0008-1	32.87b	20.80bc	37.53a	12.27b	0.99a	1.00b
BCX-0008-2	33.57b	27.00ab	38.47a	13.60b	1.07a	1.15ab
SL-02-23	45.17a	17.50c	18.93b	20.23a	0.75b	1.40a
BARI chola-5	32.40b	26.67ab	33.13a	12.46b	0.98a	0.95b
LSD (0.05)	5.01	8.77	6.77	3.54	0.20	0.28
CV (%)	5.25	13.37	7.96	9.60	7.96	9.54

Farmers' Participatory Varietal Selection of Chickpea in the High Barind Tract

Abstract

A field experiment was conducted in the farmer's field of Chabbishnagar under FSRD site, Kadamshahar, Godagari Rajshahi during r*abi* 2008-09 to identify variety through farmers' selection under Barind environments. Six advanced lines of chickpea viz. ICCV-97004 ICCV-96020, ICCV-960254-9, ICCV-960265-6, ICCV-960265-10, ICCV-03203 and one check variety BARI chola-5 were tested in the farmer's field of HBT. Among the tested entries ICCV-960254-9 gave higher seed yield (1.15 t ha^{-1}) that was followed by ICCV-97004 & ICCV-960265-10 (1.03 t ha^{-1}). The lowest yield (0.85 t ha^{-1}) was obtained from the check variety BARI Chola-5.

Materials and Methods

The field trial was conducted at Chabbishnagar under FRSD site, Kadamshahar, Godagari, Rajshahi during rabi 2008-09. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m x 6 rows. The seeds were sown in 40 cm row to row distance and seed to seed 10 cm. Six advanced lines of chickpea viz. ICCV-97004 ICCV-96020, ICCV-960254-9, ICCV-960265-6, ICCV-960265-10, ICCV-03203 and one check variety BARI chola-5 were examined in the trial. Seeds were sown on 20 November 2008. The seed rate was used 50 kg ha^{-1}. The lands were fertilized as PRC, BARI recommendation @ 12-15-17-10-1 N-P-K-S-B kg ha^{-1} in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. All fertilizers were applied as basal after final land preparation. The insecticide *Karate* @ 2 ml/L water was applied two times to control pod borer viz. 1st and 2nd spraying was given during flowering and pod setting stage respectively. On the other hand, the fungicide *Bavisteen* @ 2g/L water was used as preventive measures to control BGM for two times and spraying was done before and after flowering of chickpea. One hand weeding was done at 20 DAS. The crop was harvested on 20 March 2009. The seed yield and yield components of chickpea were recorded and analyzed statistically.

Results and Discussion

I. Crop duration

Significant variation was observed among the genotypes on the crop duration of chickpea (Figure-1). The genotypes ranged from 79.33 - 83.33 days for flower initiation and maximum days (83.33) were taken by ICCV-03203 followed by ICCV-96020 & ICCV-960265-10 (82.33), ICCV-97004 (81.67) and minimum days (79.33) were taken by BARI chola-5. On the other hand, maturity days varied from 117.33 - 124.33 and significantly the highest days (124.33) were taken by ICCV-960265-10 followed by ICCV-960254-9 (122) and ICCV-960254-9 (121.67) and minimum days (117.33) were taken by BARI chola-5.

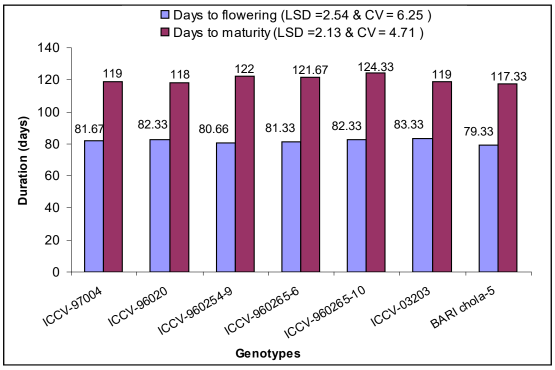

Figure 1. Days to maturity and Flowering as affected different genotypes

II. Yield and yield attributes

Significant difference was observed among the genotypes on the yield and yield parameters of chickpea except plant population m^{-2} and stover yield of chickpea (Table-1). Plant height of different genotypes varied significantly and the tallest plant (37.10 cm) was obtained from ICCV-960265-6 which was statistically identical to other genotypes and the smallest plant was produced by the check variety BARI chola-5. Significant variation was observed in number of pods $plant^{-1}$ and maximum numbers of pods (36.27) were produced by ICCV-97004 followed by other genotypes and minimum numbers of pods (23.53) were obtained from check variety BARI chola-5. Seed size of genotypes differed significantly. Significantly the heaviest seed was obtained from ICCV-03203 (24.33 g) and ICCV-960254-9 (24.10 g) that were statistically similar to ICCV-960265-10 (23.27 g) and ICCV-960265-6 (23 g). Significantly lightest seed (13.93 g) was produced by BARI chola-5.

Seed yield of chickpea varied significantly among the genotypes and all the genotypes showed promising performance rather than BARI chola-5. The maximum seed yield was obtained from ICCV-960254-9 (1.15 t ha^{-1}) that is followed by ICCV-97004 & ICCV-960265-10 (1.03 t ha^{-1}) and ICCV-96020 (0.93 t ha^{-1}). The minimum seed yield (0.85 t ha^{-1}) was recorded in the check variety BARI Chola-5. No significant difference was observed in stover yield of chickpea and the higher stover yield (1.36 t ha^{-1}) was recorded in ICCV-960254-9 followed by ICCV-97004 and ICCV-96020 (1.34 t ha^{-1}) and the lower stover yield (1.09 t ha^{-1}) was obtained from ICCV-960265-10.

Farmers' reaction

Among the tested genotypes, farmers selected some genotypes like ICCV-960254-9, ICCV-97004, ICCV-960265-10 and ICCV-96020 for their better performance as well as bolder size seed, higher number of pods $plant^{-1}$ and less pest infestation round whole life cycle.

Conclusion

Farmer selected five promising lines on the basis of performance. So it should be further study for variety release.

Table 1. Yield and yield attributes of Chickpea genotypes at Chabbishnagar under FSRD site, Kadamshahar, Godagari, Rajshahi during 2008-09

Treatments	Plant height (cm)	No. of plants m^{-2}	No. of pods $plant^{-1}$	100-seed wt (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})
ICCV-97004	34.60ab	20.41	36.27a	21.30b	1.03ab	1.34
ICCV-96020	35.87ab	20.11	28.33bc	16.34c	0.93ab	1.34
ICCV-960254-9	36.53ab	20.07	32.87ab	24.10a	1.15a	1.36
ICCV-960265-6	37.13a	18.51	28.00bc	23.00ab	0.88b	1.16
ICCV-960265-10	36.00ab	19.09	26.20bc	23.27ab	1.03ab	1.09
ICCV-03203	36.80ab	20.07	29.93bc	24.33a	0.90b	1.25
BARI chola-5	32.00b	20.43	23.53abc	13.93d	0.85b	1.35
LSD (0.05)	4.40	NS	7.34	2.10	0.21	NS
CV (%)	6.95	10.86	14.08	4.03	8.40	11.95

Screening of Vegetable Germplasm against Salinity

Abstract

The experiment was conducted at Labsha and Bolarhati under MLT site, Satkhira during the rabi season of 2008-'09 to evaluate the yield potentiality of different vegetable crops against salinity. Mortality and yield of different vegetable crops varied. In both places most of the vegetables viz. pumpkin, BARI Mula-1, BARI Mula-2, BARI French bean-2 (3.5 t ha^{-1}) Spinach, Amaranth, BARI Garden pea-2 and BARI tomato-3 gave the satisfactory yield. But no yield was found from okra due to severe virus infestation. However, in most of the crop growing period salinity level was below 4 dS m^{-1}. Those vegetables are to be tested in more saline soils in the coastal area.

Introduction

In Bangladesh, more then 30% of the cultivable land is in the coastal area. Out of 2.83 million hectares in the 13 districts of coastal area in Bangladesh, about 0.84 million hectares are affected by varying degrees of soil salinity (Karim & Iqbal, 2001). It is a production constraint common to all rainfed coastal agriculture. According to the SRDI soil testing report salinity level vary from 0 to above 20 dS m^{-1} during the Rabi season. In rabi season salinity level increased severely. Southern part of Bangladesh especially greater Khulna district is mono cropped rice based area. Farmers in this locality follow mainly Fallow-T.aman-Fallow cropping pattern. A few numbers of farmers cultivate winter vegetables in some pocket areas which is very small in the context of demand. The major problem to grow vegetable is soil salinity and availability of fresh water. Bangladesh Agricultural Research Institute has developed some vegetable germplasm which needs to be tested in saline/coastal area.

Materials and Methods

The experiment was conducted at Labsha and Bolarhati village under Satkhira MLT site during the rabi season of 2008-'09 in the farmers' field. The plot size was 5 X 1m. The fifteen vegetable crops viz. Pumpkin (Local), Radish (BARI radish-1, BARI raddish-2), Okra (Local), BARI French bean-2, Spinach (Local), Amaranth (Local), BARI Garden Pea-2, BARI cabbage-2, Cauliflower (BARI cauliflower-1, BARI caluiflower-2), Brinjal (BARI brinjal-4, BARI brinjal-6, BARI brinjal-7) and BARI tomato-3 were taken as germplasm to test its tolerance and adaptability against soil salinity. The crops were sown/ transplanted during the month of October and November, 2008. Each crop was harvested at its full maturity stage. All other intercultural operations were done as and when necessary. During the study period, the salinity data were recorded at 15 days interval. Soil salinity was recorded it was mostly below or near 4 dS m^{-1}.

Results and Discussion

Date of sowing, date of harvesting, percent mortality and yield data were recorded for all the crops (Table 1). The yield and its related information for each crop have been briefly described below:

Pumpkin: Pumpkin seedlings those were emerged survived all. Its yield was 43 t ha^{-1} and 35 t ha^{-1} at Labsha and Bolarhati respectively. No adverse effect of salinity was seen during the crop growth period.

Radish: At Labsha, mortality 5.56% and 5.20% mortality recorded was in BARI radish -1 and BARI radish -2 respectively and their yield was 34 t ha^{-1} and 44 t ha^{-1}. At Bolarhati, mortality was higher than Labsha and it was 14.29% and 6.25% and yield was 22 t ha^{-1} and 26 t ha^{-1} for BARI radish 1 and 2 respectively.

Okra: At seedling stage okra was severely infested by virus in both the side. So, no yield was got from okra.

French bean: BARI French bean-2 gave better yield in both places. At Labsha it was 3.50 t ha^{-1} while at Bolarhati it was 9.00 t ha^{-1}. No seedling mortality was observed at Bolarhati but at Labsha it was 4.55%.

Spinach: In both places local spinach was tested and its yield was excellent i.e. 13 t ha^{-1} and 12 t ha^{-1} at Labsha and Bolarhati respectively. Very negligible number of seedling mortality was recorded from both the places.

Amaranth: Local amaranth seeds were sown. Yield of amaranth was satisfactory and it was 6.40 t ha^{-1} and 6.00 t ha^{-1} at Labsha and Bolarhati respectively.

Garden pea: Seeds of BARI Garden pea was sown and its yield was also satisfactory which was 6.40 t ha^{-1} and 7.00 t ha^{-1} respectively.

BARI cabbage-2: BARI cabbage-2 performed better in both the places and it was 31.40 t ha^{-1} and 19.40 t ha^{-1} at Labsha and Bolarhati respectively.

Cauliflower: Yield of BARI cauliflower-1 and BARI cauliflower-2 was not satisfactory and it was only 15 t ha^{-1} and 17 t ha^{-1} respectively at Labsha and at Bolarhati it was 7 t ha^{-1} and 9.40 t ha^{-1} respectively. This lower yield was due to its smaller size head.

Brinjal: Among three BARI Brinjal varieties no one performed satisfactorily. Only BARI Brinjal-6 gave comparatively higher yield among them and it was 9.20 t ha^{-1} and 9.00 t ha^{-1} at Labsa and Bolahati respectively.

Tomato: BARI tomato-3 produced better yield at Labsha (24.80 t ha^{-1}) but at Bolarhati only 4.00 t ha^{-1} yield was found because of severe virus infestation during fruiting stage.

Farmers' reaction

- Farmers of both the locations are interested to grow Pumpkin, BARI cabbage-2, BARI garden pea-2, BARI Brinjal-6 and BARI tomato-3 due to its better yield and reasonable market price.
- Farmers disliked the early flowering habit of BARI radish-1 and BARI radish-2
- Farmers' showed negative attitude to BARI cauliflower-1 and BARI cauliflower-2 because of its small head size and early blossom nature.

Conclusion

This is the first year results of experiment. It needs to further studied in more saline soil.

Table 1. Date of sowing, harvesting, mortality (%) and yield of different vegetable crops at MLT site Satkhira during 2008-'09

Crops	Labsha				Bolarhati			
	Date of Sowing	Date of Harvesting	Mortality (%)	Yield (t ha^{-1}.)	Date of Sowing	Date of Harvesting	Mortality (%)	Yield (t ha^{-1})
Pumpkin	31 Oct.08	12 Jan.'09	--	43.00	08 Nov.08	16 Feb.'09	--	35.00
Radish								
BARI Radish-1	31 Oct.08	06 Jan.'09	5.56	34.00	08 Nov.08	26 Jan.'09	14.29	22.00
BARI Radish-2	31 Oct.08	06 Jan.'09	5.26	44.00	08 Nov.08	26 Jan.'09	6.25	26.00
Okra (Local)	31 Oct.08	--	8.33	--	08 Nov.08	--	33.25	--
BARI French bean-2	31 Oct.08	28 Dec.'08	4.55	3.50	08 Nov.08	02 Jan.'09	--	9.00
Spinach	31 Oct.08	28 Dec.'08	3.16	13.00	08 Nov.08	25 Jan.'09	3.95	12.00
Amaranth	31 Oct.08	28 Dec.'08	--	6.40	08 Nov.08	25 Jan.'09	2.82	6.00
Garden pea	31 Oct.08	04 Jan.'09	3.16	6.40	08 Nov.08	02 Jan.'09	4.00	7.00
BARI cabbage-2	16 Nov.08	08 Feb.'09	--	31.40	25 Nov.08	10 March'09	--	19.40
Cauliflower							--	
BARI cauliflower-1	16 Nov.08	04 Feb.'09	--	15.00	25 Nov.08	28 Feb.09	--	7.00
BARI cauliflower-2	16 Nov.'8	04 Feb.'09	--	17.00	25 Nov.08	28 Feb.09	--	9.40
Brinjal								
BARI Brinjal-4	16 Nov.08	16 March'09	--	6.00	25 Nov.08	15 Mar.09	--	5.00
BARI Brinjal -6	16 Nov.08	18 March'09	--	9.20	25 Nov.08	15 Mar.09	--	9.00
BARI Brinjal-7	16 Nov.08	24 March'09	--	8.00	25 Nov.08	15 Mar.09	--	6.00
Tomato								
BARI tomato-3	16 Nov.08	02 Feb.'09	--	24.80	25 Nov.08	12 Feb.09	--	4.00

Table 2. Salinity levels in the experimental plots at Labsha and Bolarhati MLT site, Satkhira during 2008-09.

Date	Labsha	Date	Bolarhati
27-10-2008	1.56	07-11-2008	1.47
13-11-2008	2.42	22-11-2008	1.52
28-11-2008	2.65	07-12-2008	2.47
13-12-2008	2.99	22-12-2008	2.56
28-12-2008	4.25	06-01-2009	2.96
12-01-2009	5.90	21-01-2009	2.98
27-01-2009	5.50	05-02-2009	4.37
11-02-2009	6.02	20-02-2009	4.18
26-02-2009	5.32	07-03-2009	4.15
13-03-2009	4.73	22-03-2009	4.12
28-03-2009	4.17	06-04-2009	4.27
12-04-2009	4.73	--	--
27-04-2009	4.23	--	--

On-Farm Trial of BARI Chinese Cabbage-1

Abstract

The experiment was carried out at MLT site, Dhirasharm, Gazipur Sadar under AEZ 28 during the rabi season of 2008-09 to evaluate the performance of BARI Chinese cabbage-1 at farmers' field and to popularize and disseminate this variety in the country. BARI Chinese cabbage-1 gave comparatively higher yield (40.7 t ha^{-1}) than hybrid variety (38.3 t ha^{-1}). Gross return, gross margin and benefit cost ratio (BCR) were also higher in BARI variety.

Introduction

Chinese cabbage is one of the most important vegetable in eastern Asia. In China it is most widely grown and commonly cultivated vegetable. In Japan, it ranks third after radish and cabbage. Chinese cabbage is favorable by small farmers in eastern Asia because of its short duration. It is also an efficient food producer, a good cash crop, an appetizing food item and a valuable source of calcium, crude fiber and vitamin C in the human diet (AVRDC, 1991). In the tropics and subtropics, there has been a considerable increased in production in the past decade because of the availability of new, tropically adopted varieties. In our country BARI has developed one Chinese cabbage variety, which needs to be popularized among the farmers. So the present study aims at evaluating the performance of the Chinese cabbage variety under farmers' field and to popularize and disseminate the BARI released high yielding Chinese cabbage variety in the country.

Materials and Methods

The trial was conducted at Dhirasharm, MLT site, Gazipur Sadar during rabi season of 2008-09 under AEZ 28. The design was randomized complete block (RCB) with six dispersed replications. The BARI developed Chinese cabbage-1 was tested along with the hybrid variety. Thirty days old seeding was sown on 21-22 November 2008 with the spacing of 50 cm $\times$ 40 cm. The unit plot size was 1 m $\times$5 m. The crop was fertilized with 240-150-220 kg ha^{-1} of were TSP, MoP and cowdung were used at the rate of 15 t ha^{-1}. Half of quantity of cowdung was applied during land preparation. The rest cowdung and the entire amount of TSP and ⅓rd each of urea and MoP were applied during pit preparation. The rest of urea and MoP were applied in three equal splits as top dressing after 15, 30 and 45 days of transplanting, respectively. Different intercultural operations and irrigation were done where required. The crop was harvested during 5-20 February 2009. Data on yield and contributing characters were recorded and analyzed.

Results and Discussion

Curd length and curd breath were higher in BARI Chinese cabbage-1 than hybrid variety. Numerically the yield of BARI variety was comparatively higher (40.7 t ha^{-1}) over hybrid variety (38.3 t ha^{-1}).

Farmers' reaction

The farmers of Dhirasharm area are not interested to cultivate BARI Chinese cabbage-1 because of its less taste and demand of local market.

Table 1. Yield and yield contributing characters of Chinese cabbage varieties at MLT site, Dhirasharm during the rabi season of 2008-09 under AEZ 28.

Treatment	Plant height (cm)	No. of outer leaves at curd initiation	Plant weight (kg)	curd weight (kg)	curd length (cm)	curd breath (cm)	Yield (t ha^{-1})
BARI Chinese cabbage-1	28.5	12.7	1.33	1.13	27.0	17.5	40.7
Hybrid	29.3	15.2	1.19	1.02	20.7	15.4	38.3
CV(%)	4.51	8.56	13.76	15.15	8.85	5.66	4.76

On-Farm Trial of BARI Lau-2

Abstract

A field trial was conducted at the farmer's field of the MLT site, Gabtali, Bogra and Patuakhali during rabi season of 2008-09 to evaluate the performance of BARI Lau-2 against the local one. BARI Lau-2 gave the highest marketable yield (86.98 t ha^{-1}) with the highest BCR (1.81) at Bogra. At Patuakhali BARI Lau- 2 produced 21 t ha^{-1} marketable yield.

Introduction

Bottle gourd (*Lagenaria siceraria*) is one of the most common popular cucurbits grown in Bangladesh. Its contains 83.1% water, 0.6% minerals, 0.6% frbre, 1.1% protein, 0.1% fat and 15.1% carbohydrate per 100g edible portion The average yield of bottle gourd in Bangladesh is very low. This low yield may be due to the cultivation of the low yielding local varieties, incidence of diseases and insects, lack of technical know–how etc. Recently, BARI has released a bottle gourd variety, BARI Lau-2 which possesses the high yield and attractive color. The present study was undertaken to evaluate the performance of BARI Lau-2 under farmer's field condition and popularize the variety among the farmers to promote their adoption in this area.

Methods and Materials

The experiment was conducted at the MLT site, Gabtali, Bogra and Horticulture Research station, Patuakhali during rabi season of 2008-09. BARI developed bottle gourd variety BARI Lau-2 was tested with the local check. Thirty to thirty-five day old seedlings were planted in pit (60 cm × 60 cm × 60 cm) on 16 October/08 in maintaining the spacing 2 m × 2m at Bogra. While at Patuakhali seeds were plated on 10 August, 2008. Unit plot size was 4 m × 4 m. Manures and fertilizer were applied @ 15 t cowdung ha^{-1}, Urea 175 kg ha^{-1}, TSP 175 kg ha^{-1}, MoP 150 kg ha^{-1} and Gypsum 100 kg ha^{-1}. Half of Cowdung, all of Gypsum and TSP @ 75 kg ha^{-1} were applied during final land preparation. Rest of Cow dung and TSP and each of Urea and MoP @ 50 kg ha^{-1} were applied as basal in pit. Each of Urea and MoP @ 50 kg ha^{-1} were applied after 20 days of transplanting. After that, rest of Urea and MoP were applied in 3 and 2 equal installments respectively, at 20 days interval. Plant protection measures were taken as required. Other intercultural operations were done when necessary. Fruit flies were controlled by using low cost poison baits. At maturity different data were collected accordingly and subjected to statistical analysis. The gross economic return was calculated on the basis of prevailing market price of the commodities.

Results and Discussion

Significant variation was found among the treatments in all characters (Table 1). The variety BARI Lau-2 showed higher yield (86.98 t ha^{-1}) due to higher no and weight of fruit per plant. In case of local variety, fruit yield was found 75.57 t ha^{-1} comprising lower no and weight of fruit per plant (Table 1). Higher gross return (Tk. 434900 ha^{-1}) and net return (Tk. 194019 ha^{-1}) was recorded from BARI Lau-2 (Table 2). Similarly, higher benefit cost ratio (1.81) was obtained from the variety (Table 2).

Farmers' reaction

Bogra: Farmers are interested to grow BARI Lau-2 for its higher yield. They opined that BARI Lau-2 is soft and palatable to eat.

Patuakhali: Yield was low. Seeds are not available. To make the technology sustainable quality seed production should be ensured. Farmers want to judge the variety further

Conclusion

This is the 1st year study, so further trial will be needed for the confirmation of the findings.

Table 1. Yield and yield attributes of Bottle gourd varieties at the MLT site, Gabtali, Bogra during 2008-09.

Treatment	No. of fruit $plant^{-1}$	Wt. of fruit $plant^{-1}$ (kg)	Yield (t ha^{-1})
BARI Lau-2	22.04 a	34.52 a	86.98
Local	12.33 b	30.32 b	75.57
CV (%)	5.26	4.96	6.96

Means is a column having same letter did not differ significantly

Table 2. Cost and return analysis of Bottle gourd varieties at the MLT site, Gabtali during rabi season 2008-09

Treatment	Product yield (kg ha^{-1})	Gross return	Cost of production (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
BARI Lau-2	86980	434900	240781	194019	1.81
Local	75750	377850	240781	137019	1.57

Market price of bottle gourd Tk. 5 kg^{-1}.

Production Program of BARI Lau-1

The development program was carried out at MLT site, Zokigonj during rabi session of 2008-09. Twelve farmers were selected from that area. Every farmer was prepared minimum two pit for BARI lau-1 cultivation, pit was fertilizer with 6kg cow dung, 200-250-150 g pit^{-1} of urea, TSP and MP respectively. Whole amount of cow dung and TSP were applied in pit at there equal splits at vegetative, flowering and fruiting stage. Seeds were sown during October, 2008. Harvesting of fruit started from Dec. 2nd week and if dose continued up to 2.5 to 3 months.

The results showed that at MLT site Zokigonj nine fruits with an individual weight of 1.6kg were produced from each pit.

Farmers' reaction

Farmers were interested to cultivate BARI Lau-1. They opined that it's an early maturing variety. But the market price was not as high as local varieties due to its pale green color. BARI Lau -1 is recommended for large scale extension at farmer's level and it is being collection at later stage to get good taste and heavier fruits.

Table 1. Performance of BARI Lau-1 in farmers plot at MLT site, Zokigonj during 2008-09

Name of site	No of co-operator	Ave. no of pit farm family^{-1}	Yield pit^{-1} (kg)	Yield family^{-1} (kg)	Disposal		
					Consumption (%)	Sale (%)	Distribution (%)
MLT, Zokigonj	12	2	14.46	24.4	64	29	17

On-Farm Trial of BARI Shim-4

Abstract

A trial was conducted in the farmers' field at Sherpur, Bogra, FSRD site Ellenga, Tangail, Lahirirhat, Rangpur, Shibpur, Rajshahi and Faridpur during the rabi season of 2008-09. BARI Shim 4 was tested against one local variety. The highest average pod yield (14.09 t ha^{-1}) was obtained from the variety BARI Shim 4 while the local variety gave 11.38 t ha^{-1}.

Introduction

BARI has developed one new hyacinth bean variety namely, BARI Shim 4 which needs to popularize among the farmers. An on-farm trial may help to popularize the variety among the farmers. Therefore, an on-farm trial was conducted to evaluate the performance of the variety under farmers' field condition and to popularize it in the locality.

Materials and Methods

The trial was conducted in the farmers' field situation at Sherpur, Bogra, FSRD site Ellenga, Tangail, Lahirirhat, Rangpur, Shibpur, Rajshahi and Faridpur during rabi 2008-09. The trial was laid out in RCB design with six dispersed replications. Two varieties viz. BARI Shim 4 and local one were tested. The unit plot size was 4m x 4m and plant spacing was 2m x 2m. The seeds were sown on 22 August to 22 September, 2008. The crop was fertilized with 50-60-120-50-5 kg ha^{-1} urea-TSP-MP-Gypsum-boric acid respectively. Half of urea and MP and all other fertilizers were applied before sowing in pit and rest half urea and MP were applied 15-20 days after emergence in ring method. Weeding, irrigation and pest management practices were done as and when necessary. The harvesting started from 100 days after sowing (DAS) and continued up to 180 DAS. The data were collected variety wise and analyzed statistically.

Results and Discussion

Bogra: The variety BARI Shim-4 gave higher yield (9.99 t ha^{-1}) due to higher no and weight of pod per plant (Table 2).

Tangail: Significantly the highest pod yield (13.77 t ha^{-1}) was obtained from the variety BARI Shim 4 and that of lower in local variety (11.31 t ha^{-1}). The higher yields obtained in BARI Shim 4 as because of larger pod length, number of pods per plant and pod yield per plant was higher (Table 3).

Rangpur: Days of 50 % flowering were earlier (10 days) in BARI Shim-4 compared to local variety. Significantly the higher number of pods per plant (350), pod length (11.45cm) was recorded from BARI Shim-4. Similarly, the highest pod yield (16.20 t ha^{-1}) was also recorded from BARI Shim-4. The lower pod yield (13.58t ha^{-1}) was obtained from local variety (Table 4). The increase in yield by BARI shim -4 was 19 % higher over local variety.

Rajshahi: The results showed that the variety BARI Shim-4 (53 days) was the earliest in flowering and 1st harvesting (80.4 days) than local (Table 5). The highest number of pods plant^{-1} was produced by BARI Shim-4 (326.1) followed by local (276.4). The highest pods plant^{-1} was produced by BARI Shim-4 (2.43 g) followed by local (1.72 kg). The highest pod yield ha^{-1} was produced by BARI Shim-4 (16.24 t ha^{-1}) followed by local (12.62 t ha^{-1}).

Faridpur: BARI Shim-4 produced higher number of pods per plant (249) than the local variety (Table 6). The length of the pod in BARI Shim-4 was higher but the width was lower than the local one. The single pod weight in BARI Shim-4 was 8.44 g but in local it was 7.44 g. BARI Shim-4 gave higher pod yield per plant (2.03 kg) than local variety (1.74 kg). Finally BARI Shim-4 produced 14.25 t ha^{-1} yield against 11.54 t ha^{-1} in local variety. The infestation of aphids and pod borer affected the crop yield. The price of BARI Shim-4 was higher in the market by Tk. 3 to Tk.5 than the local one.

Farmers' opinion

Bogra: Farmers are interested to grow BARI Shim-4 for its higher yield, reasonable economic return and market demand. They are interested to grow BARI Shim-4 in the next year if seeds are available.

Tangail: Farmers like BARI Shim 4 due to its attractive color and consumer's choice. They also chose it for its higher yield performance.

Rangpur: Farmers like this variety for its higher yield and economic return.

Rajshahi: Farmers were interested to grow BARI Shim-4 due to it high yield and earliness. Farmers were collected seeds of BARI Shim-4 next year cultivation .

Faridpur: Farmers are happy with BARI Shim 4 due to its higher yield as well as market price. They have preserved the seed for next season.

Conclusion

BARI Shim 4 may be recommended for large scale production, however large scale production program is need to popularize it.

Table 1. Mean yield (t ha^{-1}) of Country bean varieties across locations, 2008-09

Variety	Bogra	Tangail	Rangpur	Rajshahi	Faridpur	Mean
BARI Shim-4	9.99	13.77	16.20	16.24	14.25	14.09
Local	7.89	11.31	13.58	12.62	11.54	11.38

Table 2. Yield and yield attributes of Country bean varieties at the MLT site, Sherpur, Bogra during 2008-09

Treatment	No. of pod plant^{-1}	Wt. of pod plant^{-1} (kg)	Length of pod (cm)	Width of pod (cm)	Yield (t ha^{-1})
BARI Shim-4	125 a	0.998 a	11.37 b	1.27 b	9.99 a
Local	87 b	0.789 b	11.40 a	2.27 a	7.89 b
CV (%)	6.47	2.08	1.90	3.56	5.67

Means is a column having same letter did not differ significantly

Table 3. Performance of BARI Shim 4 at the FSRD site, Elenga, Tangail during 2008-09

Variety	Pods plant^{-1} (no.)	Pod length (cm)	Pod breadth (cm)	Pod wt plant^{-1} (kg)	Yield (t ha^{-1})
BARI shim-4	313	13.2	1.56	2.00	13.77
Local	255	12.5	1.97	1.66	11.31
LSD (0.05)	32.93	0.88	0.81	0.16	1.31
CV (%)	9.0	5.3	3.6	7.0	8.1

Table 4. Performance of different shim (country bean) varieties at FSRD site, Rangpur, during rabi season, 2008-2009.

Varieties	Days to 50% flowering	No. of pod plant^{-1}	Pod length (cm)	Days to 1st harvest	Days to last harvest	Pod yield (t ha^{-1})
BARI Shim-4	92a	350a	11.45a	110a	158a	16.20a
Local variety	102b	288b	9.11b	122b	170b	13.58b
CV (%)	3.65	6.79	7.12	4.03	6.23	8.79

Table 5. Yield and yield attributes of BARI Shim-4 and local variety at MLTs Shibpur, Rajshahi during 2008-09.

Variety	Days to flowering	Days to 1st harvest	Pods plant^{-1}	Pod yield plant^{-1} (kg)	Yield (t ha^{-1})
BARI Shim-4	53	80.4	326.1	2.43	16.24
Local	56.6	83.6	276.4	1.72	12.62

Table 6. Yield and yield contributing characters of BARI Shim-4 at FSRD site, Faridpur during 2008-09

Variety	Number of pods plant^{-1}	Pod length (cm)	Pod width (cm)	Single pod wt. (g)	Pod yield plant^{-1} (kg)	Pod yield (t ha^{-1})
BARI Shim-4	249	13.10	1.39	8.44	2.03	14.25
Local	237	9.96	2.02	7.44	1.74	11.54

On-Farm Trial of BARI Mistikumra-1

Abstract

A field experiment was conducted at MLT site, Dhirashram. Gazipur and FSRD site, Lahirirhat, Rangpur and MLT site Manikganj during the rabi season 2008-09 to evaluate the performance of sweet gourd variety in the farmer's field. Two Sweet gourd varieties viz., BARI Mistikumra-1 and local (check) were compared. The highest average fruit yield (35.41 t ha^{-1}) was obtained from BARI Mistikumra-1. The lowest yield was obtained from local variety (26.18 t ha^{-1}).

Introduction

Sweet gourd (*Cucurbita moschata*) is the most important vegetable grown in Bangladesh. It is mostly used for making curry in our country. It contains about 1.4 g protein, 48 mg calcium, 0.7 mg iron, 7200 ug carotene, 0.07 mg vitamin B_1, 0.06 mg vitamin B_2 and 26 mg vitamin C per 100 g of edible product. This crop has potentialities to generate higher income compared to many other vegetables. Recently, BARI has developed two high yielding varieties of sweet gourd. The performances of these varieties need to be evaluated under field conditions. Considering the above facts, the trial was undertaken to evaluate the performance of sweet gourd variety in the farmer's field and to popularize and disseminate the BARI developed Sweet gourd variety in the farmer's field.

Materials and Method

The experiment was conducted at MLT site Dhirasharm, Gazipur, FSRD site, Lahirirhat, Rangpur and MLT site Manikganj during the rabi season of 2008-09. Two sweet gourd varieties viz., BARI Mistikumra-1 and local (check) were evaluated. The experiment was laid out in a randomized complete block design with six dispersed replications. The unit plot size was 2.5 m x 10m. The crop was fertilized with 80-35-75-18-4.3-1.7-2000 kg N-P-K-S-Zn-B-CD ha^{-1}. The entire amount of cow dung, P, S, Zn, B and 2/6 of K were applied during pit preparation 7 days before transplantation. The rest of K and N were applied in 4 equal splits at 15, 35, 55 and 75 DAT. One weeding was done on 25 DAS. The crop was irrigated thrice at 20, 35 and 55 DAS. The seeds were sown on 12 November 2008 at Gazipur, 6-10 February 2009 at Rangpur and 25 November, 2008 at Manikganj maintaining 2.5 m x 2 m plant spacing. Infestation of fruit fly was observed. Followed clean cultivation and removed old dead leaves. Finally, it was controlled by applying sex pheromone trap. The crop was harvested during15-30 March, 2009 at Gazipur, 10 June 2009 at Rangpur and 25 March-5 April, 2009 at Manikganj.. Data on yield and yield contributing characters were recorded and analyzed statistically following MSTAT-C software package.

Results and Discussion

Gazipur: The results showed that the BARI developed variety and local variety produced identical fruits $plant^{-1}$, fruit weight, fruit length and diameter (Table 2). Local variety is little bit longer in size than BARI variety. But the fruits yield $plant^{-1}$ was higher in BARI variety. The thickness of the varieties did not significant differed. However, the highest fruit yield was obtained from BARI mistikumra-1 (38.8 t ha^{-1}) whereas local produced 32.2 (t ha^{-1}).

Rangpur: The highest length of fruit was measured from BARI Mistikumra-1 (22.43 cm). The lowest length was recorded from local check (18.51 cm). Similarly, the circumference of fruits was highest with BARI Mistikumra-1 (70.29 cm) which differed significantly from local variety (Table 3). The thickness of flesh was also highest with BARI Mistikumra-1. Different varieties had a significant effect on the number of fruits per plant. The highest number of fruits per plant was recorded from BARI Mistikumra-1 (3.83 $plant^{-1}$). The lower number of fruits per plant was recorded from local variety (2.97 $plant^{-1}$). Similar trend of result was also obtained in case of individual fruit weight. The highest weight of individual fruit was recorded from BARI Mistikumra-1 (4.27 kg $fruit^{-1}$). The highest fruit yield (32.84 t ha^{-1}) was obtained from BARI Mistikumra-1 compared to local variety. The local variety gave the lowest yield (18.05 t ha^{-1}). The color of BARI Mistikumra-1 was light yellow and the color of local variety was yellow. The sweetness of BARI Mistikumra-1 was more compared to local variety

Manikganj: The results showed that the BARI mistikumra-1 produced higher in fruits $plant^{-1}$, fruit weight, fruit length and diameter, fruit yield $plant^{-1}$ compared to local variety. The thickness of the local variety was little bit high. However, the highest yield produced from BARI mistikumra-1 (34.6 t ha^{-1}) where as local produced 28.3 t ha^{-1}.

Farmer's reaction

Gazipur: Farmers preferred that variety BARI Mistikumra-1 for its higher yield, thickness and flesh color. They are interested to grow BARI variety in the next year if seeds are available.

Rangpur: Because of its higher yield, more or less round shape and yellow flesh color farmers preferred BARI Mistikumra-1

Manikganj: Farmers preferred BARI Mistikumra-1 for its higher yield, size, flesh color and taste.

Conclusion

It was the first year trial and it needs to be continued for the next year.

Table 1. Fruit yield (t ha^{-1}) of Sweet gourd across locations, 2008-09

Variety/Lines	Gazipur	Rangpur	Manikganj	Mean
BARI Mistikumra-1	38.8	32.84	34.6	35.41
Local	32.2	18.05	28.3	26.18

Table 2. Yield contributing characters and yield of BARI mistikumra-1 at MLT site, Dhirashram Gazipur Sadar during the rabi season of 2008-09

Treatments	Fruits plants^{-1} (no)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield plant^{-1} (kg)	Flesh thickness (cm)	Yield (t ha^{-1})
BARI Mistikumra-1	5.3	3.6	23.2	22.2	22.4 a	4.9	38.8 a
Local	4.4	3.4	24.7	20.03	18.6 b	4.9	32.2b
CV(%)	6.09	3.46	10.62	12.57	3.65	6.0	3.65

Table 3. Performance of BARI Mistikumra -1 at FSRD site, OFRD, Rangpur during late rabi season 2008-09

Variety	Days to anthesis of 1st female flower	Length of fruit (cm)	Circumference of fruit (cm)	Thickness of flesh (cm)	No. of fruit plant^{-1}	Weight of Indv. fruit (kg)	Yield plant^{-1} (kg)	Fruit yield (t ha^{-1})
BARI Mistikumra -1	38	22.43 a	70.29a	3.50a	3.83a	4.27a	16.42a	32.84a
Local	42	18.51 b	65.32b	2.72b	2.97b	2.98b	9.02b	18.05b
CV (%)	-	2.08	0.98	1.99	1.59	1.03	5.15	5.16

Table 4. Yield contributing characters and yield of BARI mistikumra-1 at MLT site, Manikganj during the rabi season of 2008-09

Treatments	Fruits plants^{-1} (no)	Fruit weight (kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield plant^{-1} (kg)	Flesh thickness (cm)	Yield (t ha^{-1})
BARI Mistikumra-1	3.8	4.76	28.4	24.2	20.2	3.79	34.6
Local	2.6	4.15	22.2	21.2	16.6	4.22	28.3
CV (%)	8.96	13.09	15.59	10.56	5.93	7.89	10.31

On-Farm Trial of Ash Gourd Variety

Abstract

The experiment was conducted in farmers' field of Narail, Kushumhati, Sherpur and Manikganj during the Kharif season, 2008 to evaluate the performance BARI developed ash gourd variety, BARI Chalkumra 1 with the existing local hybrid variety. On the average highest yield was obtained from local variety (13.72 t ha^{-1}) while BARI Chalkumra 1 produced a fruit yield of 12.23 t ha^{-1}.

Introduction

Ash gourd is one of the popular cucurbitaceous vegetable cultivated throughout the country. Ash gourd is considered as a nutritious vegetable. In recent years, BARI has developed a ash gourd variety viz. BARI Chalkumra 1 and released it for farmers' use. The present study aims at evaluating the performance of BARI Chalkumra 1 in farmers' field and to popularize and disseminate it.

Materials and Methods

The experiment was conducted in farmers' field of Narail, Sherpur and Manikganj during the Kharif season of 2008. The experiment was replicated six times (dispersed). BARI developed ash gourd variety BARI Chalkumra 1 was tested with the local hybrid one "Lalteer". Seeds were sown on 25-28 March 2008 at Narail, March 09-20, 2008 at Sherpur and 29 March 2009 at Manikganj, maintaining a spacing 2.0 m x 2.0 m. The unit plot size was 4.0 m x 4.0 m. The crop was fertilized with 80-35-75-18 kg ha^{-1} NPKS, respectively. Cowdung were used at the rate of 10 t ha^{-1}. Half of cowdung and all S and $^{1}/_{3}$ P were applied during the final land preparation. Rest cowdung, P and $^{1}/_{3}$ N and $^{1}/_{3}$ K were applied as basal in the pit. The $^{1}/_{3}$ N and $^{1}/_{3}$ K were applied after 20 days of transplanting. The rest $^{1}/_{3}$ N and $^{1}/_{3}$ K were applied at 20 days interval in 3 and 2 equal installment, respectively. Different intercultural operations such as irrigation, weeding and plant protection measures were taken as per crop requirement. The crop was harvested during May 20 to July 20, 2008 at Narail, May 31-July 22, 2008 at Jamalpur and 30 May to 29 June, 2009 at Manikganj.

Result and Discussion

Narail: The yield of local ashgourd variety was higher than BARI Chalkumra-1 variety (Table 2). The individual fruit weight was also higher in local variety but number of fruit was higher in BARI-Chalkumra-1.

Jamalpur: From the result it was evident that the local hybrid variety, Lalteer was agronomically and economically viable(Table 3). The individual fruit weight, fruit length, fruit diameter and fruit yield plant^{-1} was higher in Lalteer than BARI Chalkumra 1. However, the yield of local was 31.22 t ha^{-1} while BARI Chalkumra 1 gave 27.48 t ha^{-1}.

Manikganj: From the results it was observed that the BARI Chalkumra 1 performed better (Table 4 and Table 5). The individual fruit weight, fruit diameter, fruit plant^{-1} and fruit yield plant^{-1} were higher in BARI Chalkumra 1 than the local variety. However, the yield of BARI Chalkumra 1 was 15.1 t ha^{-1}) while the local variety gave 14.3 (t ha^{-1}). The higher gross return (Tk. 98150 ha^{-1}), the higher net return (Tk. 43160 ha^{-1}) and higher benefit cost ratio (1.78) was obtained form BARI Chalkumra 1. On the other hand, the gross return, net return and benefit cost ratio for the local were Tk. 92950 ha^{-1}, Tk. 37960 ha^{-1} and 1.69, respectively.

Farmers' reaction

Narail: Farmers did not show interest to grow BARI Chalkumra-1 in future.

Jamalpur: Local variety was preferred over BARI-chalkumra-1.

Manikganj: BARI Chalkumra 1is little bit shorter in size than the local, it is tasty and easily boiled. It has good market value in Manikganj sadar.

Table 1. Average yield (t ha^{-1}) of ash gourd in Three locations, 2008-09.

Variety/Lines	Narail	Jamalpur	Manikganj	Mean
BARI Chalkumra-1	10.60	10.99	12.5	11.36
Local	14.37	12.49	13.3	13.39

Table 2. Yield and yield contributing characters of ashgourd variety in Tularampur, Narail during rabi 2008-09.

Variety/ lines	No. of fruit plant^{-1} (no.)	Fruit wt. (g)	Yield (t ha^{-1})
BARI Chalkumra-1	2.33	1898	10.60
Local	2.00	1913	14.37
CV (%)	28.30	6.71	18.29
LSD (0.05)	NS	NS	NS

Table 3. Yield of ash gourd at FSRD site, Sherpur during Kharif 1, 2008.

Treatment	Fruits plant^{-1} (no.)	Fruit wt. (kg)	Fruit length (cm)	Fruit dia (cm)	Fruit yield plant^{-1} (kg)	BCR
BARI C. Kumra 1	6.64	1.65	18.32	9.40	10.99	27.48
Local (Lalteer)	7.37	1.68	18.83	9.62	12.49	31.22

Table 4. Yield and yield contributing characters of ash gourd at MLT Site Manikganj during Kharif-1, 2009.

Treatment	Fruits plant^{-1} (no.)	Fruit wt. (kg)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield plant^{-1} (kg)	Yield (t ha^{-1})
BARI Chalkumra 1	10.5	1.41	17.0	22.5	11.83	15.1
Local	9.9	1.25	18.14	20.2	11.2	14.3

Table 5. Economics of ash gourd production at MLT site, Manikganj during Kharif-1, 2009.

Treatment	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	BCR
BARI Chalkumra 1	98150	54990	43160	1.78
Local	92950	54990	37960	1.69

Price (Tk. kg^{-1}): Bitter gourd= 6.50, Urea=12, TSP=80, MP= 35, Gypsum= 8, and cowdung=2.

On-Farm Trial of BARI Begun-6

Abstract

An experiment was conducted in the farmer's field of Sherpur, Gabtali, Bogra and Jessore during the rabi season of 2008-09 to evaluate the performance of BARI Begun-6. Out of the tested thee varieties, BARI Begun-6 gave the highest average marketable yield (42.11 t ha^{-1}) followed by BAR begun 5, while local variety gave the lowest yield (29.89 t ha^{-1}).

Introduction

Brinjal (*Solanum melongena*) is widely cultivated in Bangladesh and is considered as the second most important vegetable crop after potato in relation to its total production. The average yield of brinjal is 5.91 t ha^{-1} in kharif and 7.02 t ha^{-1} in rabi (Handbook of Agricultural Statistics 2007) which is low compared to other brinjal growing countries of the world. This low yield may be due to the cultivation of the low yielding local varieties, incidence of diseases and insects, lack of technical know –how etc. During the recent years BARI has developed some high yielding varieties of brinjal. Among the varieties, BARI Begun-6 not only high yielder but also resistance to bacterial wilt, brinjal shoot & fruit borer (BSFB) and root–knot nematode (RKN). The present study was undertaken to evaluate the performance of BARI Begun-6 and BARI begun 5 under farmer's field condition and popularize the variety among the farmers to promote their adoption in this area.

Materials and Methods

The experiment was conducted in the farmers' field of Sherpur, Bogra and Jessore during the rabi season of 2008-09. Two varieties viz. BARI Begun-6 and Local were tested in the farmer's field of Bogra and Jessore while at Sherpur BARI begun 5 and Local were evaluated.. The experiment was laid out in RCB design with six replications. The unit plot size was 6 m × 1 m with spacing of 70 cm × 70 cm. Twenty five days old seedling were transplanted on November 20, 2008 at Sherpur, 20 November, 2008 at Bogra and 5 October, 2008 at Jessore, . Manures and fertilizer were applied @10 t cowdung ha^{-1}, Urea 375 kg ha^{-1}, TSP 150 kg ha^{-1} and MoP 250 kg ha^{-1}. Half of cowdung was applied during land preparation. Remaining Cow dung, entire amount of TSP and $^{1}/_{3}$ each of Urea and MoP were applied during pit preparation. The rest of Urea and MoP were applied in 2 equal installments at 21 and 35 days after transplanting. Plant protection measures were taken as required. Other intercultural operations were done when necessary. The fruits of BARI Begun-6 were harvested during January 22 to March 14, 2009 and the fruits of local variety were harvested from January 10 to March 14, 2009 at Bogra, while at Jessore harvesting started from January 20, 2009.At Sherpur BARI begun 5 harvesting started from 14 December, 2008 and continued up to 3 March, 2009. At maturity different data were collected accordingly and subjected to statistical analysis. The gross economic return was calculated on the basis of prevailing market price of the commodities.

Results and Discussion

Sherpur: The plant height was higher in the local variety while the BARI Begun 5 was shorter than the local (Table 2). But the number of fruits plant^{-1} was higher in BARI Begun 5 compared to the local variety. The local variety was more than double in length than the BARI variety, but the fruit diameter was higher in BARI Begun 5 than the local variety. The fruit weight plant^{-1} was higher in the local variety than the BARI Begun 5 variety. The highest yield (38.02 t ha^{-1}) was obtained by local variety. BARI Bagun 5 produced lower yield (35.18 t ha^{-1}). The higher yield in the local variety might be for the higher fruit length which consequently reflected on the weight of fruits plant^{-1} thereby increasing the higher yield.

Bogra: Significant variation was found among the treatments in all characters except brinjal shoot and fruit borer (BSFB) infestation (Table 3). Results revealed that maximum number of fruits per plant (32.90) was obtained from the local variety than that of the tested variety (BARI Begun-6). But BARI Begun-6 produced larger fruit; as a result weight of fruit per plant was higher than local (Table 3). About 5% plants were found infested by brinjal shoot & fruit borer in both varieties. No bacterial wilt and root nematode infestation was observed. The highest fruit yield (55.83 t ha^{-1}) was also obtained from BARI Begun-6 and it was about 31% higher than that of local.

Jessore: The higher yield (28.4 t ha^{-1}) was obtained from BARI begun where as local variety performance lower yield (9.10 t ha^{-1}) in both location in Jessore (Table 4).

Farmers' reaction:

Bogra: Farmers are interested to grow BARI Begun-6 for its green color, attractive large round shape and higher yield. Farmers opined that BARI Begun-6 is soft and palatable to eat.

Jessore: Farmers of this area were so much impressed with the BARI begun-6 for its high yield. They are interested to grow this variety because of higher yield other over existing variety (farmers own).

Sherpur: The yield of BARI Begun 5 is lower than the local. The farmers did not accept it because of irregular shape as well as low market demand. On the other hand, the local variety is long and preferred by the farmers.

This is the 1st year study, so further trial will be needed for the confirmation of the findings.

Table 1. Mean yield (t ha^{-1}) of different brinjal varieties 2008-09.

Variety	Sherpur	Bogra	Jessore	
BARI Begun-5	35.18	-	-	-
BARI Begun-6	-	55.83	28.4	42.11
Local	38.02	42.57	9.10	29.89

Table 2. Yield of brinjal varieties in the farmer's field at FSRD site, Kushumhati, Sherpur.

Treatment	Plant ht (cm)	Fruits plant^{-1} (no.)	Fruit length (cm)	Fruit diameter (cm)	Fruit wt. plant^{-1} (kg)	Yield (t ha^{-1})
BARI Begun 5	76.46	12.40	8.90	7.96	2.29	35.18
Local	84.01	11.73	19.97	5.47	2.48	38.02

Table 3. Yield and yield attributes of Brinjal varieties at the MLT site, Gabtali, Bogra during 2008-09.

Treatment	No. of fruit plant^{-1}	Wt. of fruit plant^{-1} (kg)	% BSFB infested fruit plant^{-1}	Yield (t ha^{-1})
BARI Begun-6	12.62 b	2.17 a	4.78 a	55.83 a
Local	32.90 a	1.68 b	4.90 a	42.57 b
CV (%)	6.83	4.78	11.63	8.42

Table 4. Performance of yield and yield contributing characters of BARI begun-6 at Jessore region during 2008-09.

Variety/ lines	Plant height (cm)	No. of fruit plant^{-1}	Individual fruit wt. (g)	Wt. of fruit plant^{-1}	Yield (t ha^{-1})
BARI begun-6	48.5	13.0	244.5	1953.33	28.4
Local	37.8	3.3	68.33	136.66	9.10

On-Farm Trial of BARI Danta-1

Abstract

An experiment was conducted at FSRD site Hazirhat, Noakhali and Jamalpur during kharif–1 season of 2009 to see the performance of BARI developed stem amaranth variety-Laboni (BARI danta-1) against the local one. On the average Laboni gave the highest yield (46.08 t ha^{-1}).

Introduction

Danta (stem amaranth) is a very popular summer vegetable grown throughout the country. In recent years BARI has developed a high yielding good quality variety Laboni, released for farmers use. The present study aims at evaluating the performance of BARI developed variety Laboni in farmer's field condition and to promote its adoption by the farmers.

Materials and Methods

The experiment was conducted at Hazirhat under FSRD site, Noakhali and Jamalpur during kharif–1 season, 2009. The design of the experiment was RCB with three dispersed replications. BARI developed danta (stem amaranth) variety Laboni was tested with the local check. The unit plot size was 3m × 1.8m with plant spacing of 30 cm × 15 cm. The seeds were sown on 15 April 2009 at Noakhali and 15-17 April at Jamalpur. Manures and fertilizer were applied @ 10 t ha^{-1} CD, Urea 200 kg ha^{-1}, TSP 100 kg ha^{-1} and Mp 150 kg ha^{-1}. The whole quantity of CD, TSP and ½ of Urea were applied during final land preparation and rest of the amount of Urea and Mp were applied at top dressing in 2 equal installments. Others intercultural operations like weeding and irrigation were done as and when necessary. The crop was harvested during April 20 to May 12, 2009 at Noakhali and 15 June, 2009 at Jamalpur. Data on yield contributing characters were recorded.

Results and Discussion

Noakhali: Plant height, no-of branches, no of leaves $plant^{-1}$, total plant wt, stem wt, fibreness, days to 50 % flowering as well as the yield was higher in the variety Laboni compared to the local check 9Table 2). Laboni gave higher yield of 64.47 t ha^{-1} compared to 53.8 t ha^{-1} in local variety Botanking.

Jamalpur: From the result it was evident that the BARI developed stem amaranth variety, Laboni was better (Table 3). Total plant weight, stem weight and stem diameter and also the yield was higher in Laboni compared to the local check. The Laboni variety gave the higher yield (27.71 t ha^{-1}) in comparison to local (23.33 t ha^{-1}).

Farmers' reaction

Noakhali: Farmers are very much interested to grow BARI developed high yielding Laboni danta. The color, taste and market demand of Laboni is better than of the local one. Farmers also opined that the Laboni variety is soft and palatable to eat.

Jamalpur: Farmers are interested to grow BARI developed high yielding variety Laboni. The color, taste and market demand of Laboni is better than the local. They also opined that Laboni is soft, palatable and can be eaten even up to flowering because of less fiber in the stem.

Conclusion

Variety Laboni may be recommended for large-scale production in the locality.

Table 1. Mean yield (t ha^{-1}) of Stem amaranth across locations, 2009

Variety/Lines	Noakhali	Jamalpur	Mean
Laboni	64.46	27.71	46.08
Botanking	32.22	-	
Local	-	23.33	-

Table 2. Yield and attributes of two varieties of Danta at Noakhali, 2009

Varieties	Plant height (cm)	No. of leaves plant^{-1}	Plant wt (g)	Stem wt (g)	Fibreness (cm)	Yield (t ha^{-1})
Labani	126.42	81.56	388.6	287.8	9.79	64.46
Botanking	115.96	83.36	333.0`	233.6	8.3	32.22

Table 3. Yield of stem amaranth varieties at MLT site, Malancha, Melandah, Jamalpur during Kharif 1, 2009

Treatment	Plant ht. (cm.)	Total plant wt. (g)	Stem wt. (g)	Stem diameter (cm.)	Yield (t ha^{-1})
Laboni	70.7	232	195	1.37	27.71
Local	67.5	218	176	1.27	23.33

On-Farm Trial of BARI Bitter Gourd Variety

Abstract

A field trial was conducted at Mymensingh , Sherpur and Manikganj during Kharif-1 season of 2008 to evaluate the performance of BARI developed bitter gourd variety; BARI Karola-1 along with a local. BARI korola-1 gave the highest average yield (17.48 t ha^{-1}) while local variety produced 15.32 t ha^{-1} yield.

Introduction

Bitter gourd is one of the popular cucurbitaceous vegetable cultivated throughout the country. Among the cucurbits, bitter gourd is considered as a nutritious vegetable containing 83-92% water, 4.0-10.5% carbohydrate, 1.5-2.0% protein, 0.2-1.0% oil, 0.8-1.7% fibre, 20-23 mg Ca, 1.8-2.0 mg Fe and 88-96 mg vitamin C. In recent years, BARI has developed a high yielding bitter gourd variety namely BARI karola-1 and released for farmer's use. The present study aims at evaluating the performance of BARI developed variety, BARI karola-1 in farmers' field and also to popularize and disseminate it over locations.

Materials and Methods

The experiment was conducted at Sabjipara, Shambhuganj under Multilocation Testing Site, Mymensingh sadar, FSRD site Kusumhati, Sherpur and MLT site, Manikganj during Kharif-1 season, 2008. The design of the experiment was Randomized Complete Block with six dispersed replications. The BARI developed bitter gourd variety, BARI Karola-1 was tested with the local check (Namdhari)/local. Seeds were sown on 26 February 2008 at Mymensingh, 17 April 2008 at Sherpur 9 March, 2009 at Manikganj maintaining 1.0 m x 1.0 m spacing in the unit plot size of 12.0 m x 1.0 m. The crop was fertilized following STB fertilizer dose for high yield goal (FRG 2005). The STB fertilizer dose was 276-100-250- 54-6000 kg ha-1 of N, P, K, S and cowdung. Half of cowdung, P and all of S, Zn and B were applied during final land preparation. Rest of cowdung and P and $^1/_3$ N and $^1/_3$ K were applied as basal in pit. Other $^1/_3$ N and $^1/_3$ K were applied after 20 days of transplanting. After that, rest of N and K were applied in 3 and 2 equal installments, respectively at 20 days interval. Different intercultural operations, irrigation and plant protection measures were done as and when necessary. The crop was harvested during 30 April-20 August 2008 at Mymensingh, 17 June- 18 July, 2008 at Sherpur and 19-30 May, 2009 at Manikganj. Data on yield and yield contributing characters were recorded and analyzed.

Results and discussion

Mymensingh: Fruit length, fruit diameter, fruit weight and yield of BARI Karola-1(Table 2) were higher compared to the local check (Namdhari). The variety BARI Karola-1 gave slightly higher yield (17.69 t ha^{-1}) compared to the local (Namdhari) one (17.03 t ha^{-1}).

Sherpur: The number of friuts plant^{-1}, individual fruit weight, even fruit length and fruit diameter was higher in BARI Karola 1 than the local hybrid (Table 3). BARI Karola 1 gave a yield of 20.12 t ha^{-1} while the local variety gave 18.64 t ha^{-1}.

Manikganj: From the Tables (4 and 5) it is observed that the BARI developed bitter gourd variety BARI Karola-1 was agronomically and economically viable. No. of fruits plant^{-1}, fruit diameter, fruit weight, fruit weight plant^{-1} and yield of BARI Karola-1 were higher compared to the local check. The variety BARI Karola-1 gave higher yield (14.38 t ha^{-1}) than the local one (12.0 t ha^{-1}). Higher gross return (Tk. 287538 ha^{-1}), Net return (Tk. 190048 ha^{-1}) and higher benefit cost ratio (2.95) were also obtained from BARI Karola-1 compared to local with gross return, Net return and benefit cost ratio of Tk. 239860 ha^{-1}, Tk.142370 ha^{-1} and 2.46, respectively.

Farmer's reaction

Mymensingh: Farmers are very much interested to grow the BARI developed high yielding variety of bitter gourd as BARI Korola-1 due to its higher yield and economic return. However, they are also interested to grow the Namdhari variety as a next variety. The farmers also opined that the variety BARI karola-1 is palatable as smash rather than fry.

Sherpur: Farmers were interested to grow BARI Karola 1 due to its good shape, size, taste and high market value. The hybrid one was less tasty, do not boil uniformly, sour and comparatively low market demand.

Manikganj: Farmers are very much interested to grow the BARI developed high yielding variety of bitter gourd due to its higher yield and economic return. According to them, the size, weight and market demand of BARI Karola-1 is better than that of the local. The farmers also opined that the variety BARI Karola-1 is palatable as smash rather than fry.

Table 1. Average yield (t ha^{-1}) of bitter gourd over location, 2008-09.

Variety/Lines	Mymensingh	Shepur	Manikganj	Mean
BARI Korola-1	17.96	20.12	14.38	17.48
Namdhari	17.03	-	-	-
Local (Hybrid)	-	18.64	12.0	15.32

Table 2. Yield and yield contributing characters of bitter gourd varieties during Kharif-1, 2008 at MLT Site Mymensingh Sadar

Varieties	No. of fruits plant^{-1}	Fruit size (cm)		Fruit wt. (g)	Yield (t ha^{-1})
		Length	Diameter		
BARI Karola-1	27	14.2	4.92	98.33	17.69
Namdhari	28	13.2	4.72	91.67	17.03

Table 3. Yield of bitter gourd at FSRD site, Kushumhati, Sherpur during Kharif 1, 2008

Treatment	Fruit harvest		Fruits plant^{-1} (no.)	Fruit wt. (g)	Fruit len. (cm)	Fruit dia (cm)	Yield (t ha^{-1})
	1st	2nd					
BARI Karola	62	92	10.8	237.5	26.2	4.72	20.12
Local (Hybrid)	62	92	10.1	232.2	24.8	4.35	18.64

Table 4. Yield and yield contributing characters of bitter gourd varieties at MLT Site Manikganj during Kharif-1, 2009.

Varieties	No. of fruits/plant	Fruit size (cm)		Fruit wt.(g)	Yield (t/ha)
		Length	Diameter		
BARI Karola-1	15.44	14.83	4.19	137.33	14.38
Local	13.13	15.85	4.14	132.17	12.0

Table 5. Economics of bitter gourd production at MLT site, Manikganj during Kharif-1, 2009.

Varieties	Gross return (Tk. ha^{-1})	Total cost (Tk. ha^{-1})	Net return (Tk. ha^{-1})	B/C ratio
BARI Karola-1	287538	97490	190048	2.95
Local	239860	97490	142370	2.46

Price (Tk. kg^{-1}): Urea= 12, TSP= 80, MP= 35, Gypsum= 8 and Cowdung= 2, Bitter gourd= 20

On-Farm Trial of Yard Long Bean

Abstract

The experiment was conducted in the farmers' field of Sherpur and Noakhali during the Kharif I season of 2008 to evaluate the performance of BARI developed yard long bean variety, BARI Barbati 1 with the existing local variety. BARI Barbati 1 was better as compared to the local variety. Across locations BARI Barbati-1 yielded 16.34 t ha^{-1}.

Introduction

Yard long bean is a popular vegetable cultivated throughout the country. BARI has developed a yard long variety viz. BARI Barbati 1 and released it for farmers' use. The present study aims at evaluating the performance of BARI Barbati 1 in farmers' field and to popularize and disseminate across locations.

Materials and Methods

The experiment was conducted in farmers' field of Farming Systems Research and Development site, Kushumhati, Sherpur and Noakhali during the Kharif I season, 2008. The experiment was replicated at six dispersed farmers' field. The BARI developed yard long bean variety viz. BARI Barbati 1 was tested with the local one. Seeds were sown on March 30- April 7, 2009 at Sherpur and 7 March, 2009 at Noakhali maintaining a spacing of 60 cm × 50 cm. The unit plot size was 3.0 m x 1.0 m. The crop was fertilized with 20-30-35-10-4-1 kg ha^{-1} of NPKSZnB. Cowdung were used at the rate of 10 t ha^{-1}. Half of the cowdung and entire quantity of S were applied during land preparation. The remaining ½ of the cowdung, entire amount of P and ½ of N and K were applied during pit formation. The rest N and K were top dressed at 30 days after sowing. Different intercultural operations, irrigation and plant protection measures such as Marshal was sprayed against pod borer. The crop was harvested from May 18, 2009 and continued up to July 17, 2009 at Sherpur and 20 April to 13 may, 2009 at Noakhali. Data on yield and yield contributing characters were recorded.

Result and Discussion

Sherpur: The individual fruit weight, fruit length, fruit diameter and fruit yield $plant^{-1}$ was higher in BARI Barbati 1(Table 2) than the local variety. Yield of BARI Barbati 1 produced 14.8 t ha^{-1} while the local variety gave 12.8 t ha^{-1}.

Noakhali: Days to 50% flowering of BARI Barbati – 1 was 43 days whereas in kegornatoki it was 46 days. BARI barbati gave higher no pods $plant^{-1}$ (23.2) and higher pod weight $plant^{-1}$ (475) than kegornatoki. Green pod yield was higher in BARI Barbati -1 (17.89 t ha^{-1}).

Farmers' reaction

Sherpur: BARI Barbati 1 gave higher yield than local and if planted timely would give more yield.

Noakhali: Farmers are satisfied with heavy bearing and good demand in the market of BARI Barbati-1. Farmers expressed their satisfaction for softness and taste.

Conclusion

BARI Barbati is better performer between the tested variety in respect of yield, bearing, market demand, softness and taste both at Sherpur and Noakhali.

Table 1. Mean yield (t ha^{-1}) of yield year long bean across locations, 2008-09

Variety/Lines	Jamalpur	Noakhali	Mean
BARI Barbati-1	14.08	17.89	16.34
Local	12.8		-
Kegorhatki	-	6.92	-

Table 2. Yield of yard long bean at FSRD stie, Sherpur during Kharif 1, 2008

Treatment	Pods plant^{-1} (no.)	Pod weight plant^{-1} (g)	Pod length (cm)	Pod diameter (cm)	Yield (t ha^{-1})
BARI Barbati 1	20.3	221	42.7	0.65	14.8
Local	20.3	193	40.9	0.58	12.8

Table3. Yield and contributing characters of BARI Barbati at FSRD site, Noakhali

Varieties	Days to 50 % flowering	No. of pods plant	wt. of pods plant^{-1} (g)	Yield (t ha^{-1})
BARI Barbati -1	45.5	23.2	475.00	17.89
Kegornatoki	45.7	13.1	181.25	6.92

On-Farm Trial of BARI Tomato Varieties

Abstract

An experiment was conducted at 10 locations namely, Manikganj, Rangpur, Bogra, Munshiganj, Sylhet, Tangail, Shibpur, Narsingdi, Mymensingh, Jamalpur and Patuakhali during the rabi season of 2008-09 to test the comparative performance of different BARI released tomatoes in comparison to local. BARI Tomato-3 gave the highest average fruit yield (69.20 t ha^{-1}) which was closely followed by BARI tomato 14 (68.95 t ha^{-1}), while BARI tomato 6 produced 64.08 t ha^{-1}.

Introduction

Tomato is a high value cash crop grown throughout the country. BARI has developed a good number of high yielding tomato varieties with several high quality characteristics. These varieties have potential to help generate farmer's income in a very short period of time. The present study aim at evaluating the performance of some BARI developed tomato varieties in farmer's field condition and popularize them among the farmers to promote their adoption across the country.

Materials and Methods

The experiment was conducted at Manikganj, Rangpur, Bogra, Munshiganj, Sylhet, Tangail, Shibpur, Narsingdi, Mymensingh, Jamalpur and Patuakhali during the rabi season of 2008-09. The varieties tested were BARI Tomato-3, BARI Tomato 6, BARI Tomato 14 and local. The design of the experiment was randomized complete block with four replications. The unit plot size was 4 m × 3 m. Thirty days old seedlings were transplanted on 4 October to12 December 2008 with a spacing of 60 cm × 40 cm. The crop was fertilized with STB fertilizer dose for high yield goal following FRG' 05. The STB fertilizer dose was 116-35-47-5000 kg ha^{-1} of N, P, K and cowdung. Half of cowdung was applied during final land preparation. The remaining cowdung, the entire amount P and $^{1}/_{3}$ each of N and K were applied during pit preparation. The rest of N and K was applied in 2 equal installments at 21 and 35 DAT. First time tomato harvesting was done during 25 February to 25 March 2009 depending on planting time. Intercultural operations were done as and when necessary. To control the disease Redomil 2 g litre^{-1} of water was sprayed 3 times in all the plots.

Results and Discussions

Manikganj: The highest fruit yield per plant was obtained from BARI Tomato-14 (1.67 kg) followed by BARI Tomato-3 (1.50 kg) and BARI Tomato-6 (1.15 kg) (Table 2). Individual fruit weight was found the highest in BARI Tomato-6 (93.7 g). The significant highest fruit yield (69.7 t ha^{-1}) was recorded in BARI Tomato-3, while BARI Tomato-6 produced the lowest fruit yield (61.20 t ha^{-1}).

Rangpur: The highest fruit yield (60.13 t ha^{-1}) was obtained from BARI Tomato-14 (Table 3) which differed significantly from local check (41.58 t ha^{-1}). The increase in yield with BARI Tomato-14 was 44% higher over local check. Both BARI Tomato-14 and local check was infested by bacterial wilt. The infestation was 9.83 % plant in BARI Tomato-14 and 3 % plant in local check. The crop was also infested by leaf curl viruses. The infestation was about 3% plant in BARI Tomato-14 and 2 % plant in local check at the early stage of growth which was uprooted. During first harvest about 3 % plant in BARI Tomato-14 and 8 % plant in local check (data not recorded) were infested by leaf curl viruses.

Bogra: The highest fruit yield (64.49 t ha^{-1}) was also obtained from BARI Tomato-14(Table 4) and it was 34% higher than that of local.

Munshiganj: Highest individual fruit weight was found in BARI Tomato-3 (96.03 g) followed by BARI Tomato-6 (76.17 g). The lowest individual fruit weight was obtained from farmers cultivated variety (65.13 g). The yield varied from 67.58 to 82.15 t ha^{-1} but the variation was not varied significantly among the different varieties (Table 5).

Sylhet: The results showed that BARI Tomato-3 produce the yield 74 t ha^{-1}. It had good keeping quality, skins were thick and comparatively hard.

Tangail: The highest fruit yield (51.67 t ha^{-1}) was obtained from the variety BARI Tomato 3, while the control variety, BARI Tomato 2 yielded 39.82 t ha^{-1}. BARI Tomato 3 produced higher yield as because of number of fruits per plant and individual fruit weight were higher in BARI Tomato 3 (Table 7).

Shibpur, Narsingdi: The highest fruit yield was obtained in BARI tomato-3 (110.96 t ha^{-1}) and the lowest in local variety (47.94 t ha^{-1}).

Mymensingh: BARI Tomato-3 were superior to the local variety (Table 9). Higher fruit yield obtained from variety BARI Tomato-3 was 27.49 t ha^{-1}. The local variety gave lower fruit yield of 12.29 t ha^{-1}. BARI Tomato-3 showed higher yield due to higher number of fruits $plant^{-1}$ and higher weight of fruits $plant^{-1}$. Due to attack of early blight at seedling/growing stage nearly one third population was damaged and for this reason the yield was lower.

Jamalpur: The result obtained from the study indicated that BARI tomato 3 produced higher yield (72.1 t ha^{-1}) and the local produced lower (58.08 t ha^{-1}) yield (Table 10).

Patuakhali: Plant growth was vigorous. No. of branches per plant was 6.4 and No. of fruits cluster per plant was 4.3. Yield of BARI Tomato-3 was 70.5-62.8 t ha^{-1}- 42.6 t ha^{-1} (Average 65.7 t ha^{-1}) and performed satisfactory.

Farmers' reaction

BARI Tomato 3 and BARI Tomato 14 were preferred by the farmers for its attractive color, fruit shape and higher yield. Less damage in carrying was observed in BARI tomato 3. They were interested to grow the variety as those have good price and demand in the market. But farmers have a fear of wilt infestation.

Conclusion

Need large scale production program to popularize BARI tomato 3 and BARI tomato 14.

Table 1. Fruit yield (t ha^{-1}) of different tomato verities across 10 locations 2008-09

Variety	Manikganj	Rangpur	Bogra	Munshiganj	Sylhet	Tangail	Shibpur	Mymensingh	Jamalpur	Patuakhali	Mean
BARI Tomato-3	69.73	-	-	82	74	51.67	110.96	27.49	72.01	65.7	69.20
BARI Tomato-6	61.217	-	-	67.00	-	-	-	-	-		64.08
BARI Tomato-14	64.17	60.13	64.49	76.00	80	-	-	-	-		68.95
Local	41.58	48.09	-	-	-	47.9	12.29	58.08	41.58		

Table 2. Yield contributing parameter and yield of BARI Tomato varieties at MLT site, Manikganj during the rabi season of 2008-09.

Treatments	Days to flowering	Plant height (cm)	Fruits plant^{-1} (no)	Fruits yield plant^{-1} (kg)	Individual fruit wt. (g)	Yield (t ha^{-1})
BARI Tomato- 3	52	107.7a	26.33a	1.50ab	89.76ab	69.73 a
BARI Tomato- 6	48	104.4a	21.33b	1.15b	93.74a	61.17 c
BARI Tomato-14	42	107.0a	20.33b	1.67a	83.18b	64.17 b
CV (%)		1.98	5.97	11.05	4.01	1.76

Table 3. Performance of BARI Tomato -14 at Lahirirhat FSRD site, Rangpur during rabi season 2008-09

Varieties	Plant height (cm)	No. of branches plant^{-1}	No. of fruit plant^{-1}	Indv. fruit wt (g)	Fruit wt. plant^{-1} (kg)	Yield (t ha^{-1})	% Plant infested by Bact. Wilt *	% Plant infested by virus **
BARI Tomato 14	93.35b	4.51b	28.10a	60.83a	1.70a	60.13a	9.83a	3.16a
Local	102.30a	4.96a	19.70b	56.67a	1.09b	41.58b	3.00b	2.17b
CV (%)	5.57	4.60	9.57	11.73	8.96	9.03	12.88	16.77

*Bacterial Wilt, ** Leaf curl virus

Table 4. Yield and yield attributes of BARI Tomato-14 at the MLT site, Gabtali, Bogra during 2008-09

Treatment	No. of fruit plant^{-1}	Wt. of fruit plant^{-1}	Days of 50% flowering	Yield (t ha^{-1})
BARI Tomato-14	25.20 b	2.35 a	36.6 b	64.49 a
Local	37.90 a	1.64 b	49.2 a	48.09 b
CV (%)	3.86	3.58	2.50	11.75

Table 5. Yield and yield attributes of Tomato varieties at MLT site, Munshiganj during the rabi season of 2008-09

Variety	Days of 50% flowering	Fruits plant^{-1} (no.)	Individual fruit weight (g)	Yield (t ha^{-1})
BARI Tomato-3	41	35	96.03	82
BARI Tomato-6	40	31	76.17	67
Local	33	48	65.13	76
LSD (0.05)	3.29	19.69	29.15	15.50
CV (%)	3.81	22.99	16.25	9.08

Table 6. Performance of BARI Tomato-3 in farmers fields at MLT Site, Zokigonj.

Variety	Marketable fruits plant^{-1} (no.)	Marketable weight fruits^{-1} (g)	Marketable yield plant^{-1} (kg)	Marketable Yield (t ha^{-1})
BARI Tomato-3	27	99	2.50	74

Table 7. Performance of BARI Tomato 3 at FSRD site, Elenga, Tangail during 2008-09

Variety	Plant height (cm)	Fruits plant^{-1} (no.)	Individual fruit wt (g)	Frtuit wt plant^{-1} (kg)	Fruit yield (t ha^{-1})
BARI tomato-3	96.8	21	70	1.44	51.67
BARI tomato-2 (Control)	84.6	19	51	1.09	39.82
LSD (0.05)	5.05	3.45	10.81	0.24	8.16
CV (%)	3.8	11.6	12.0	12.9	12.0

Table 8. Yield and yield contributing characters of BARI Tomato variety at Shibpur, Narsingdi during 2008-09

Variety	Plant height (cm)	Branches plant^{-1}	No. of fruits plant^{-1}	Weight of individual fruit (g)	Weight of fruit plant^{-1} (kg)	Yield (t ha^{-1})
V_1 = BARI tomato-3	103.25	2.6	46.5	81.42	3.69	110.96
V_2 = Local	109.25	2.7	35.75	44.75	1.59	47.94
CV (%)	7.49	3.08	5.8	16.34	15.09	14.81

Table 9. Yield and Yield contributing characters of BARI developed high yielding Tomato variety: BARI Tomato-3 , Mymensingh, 2008-09

Varieties	Plant height (cm)	No. of branches plant^{-1}	No. of fruits plant^{-1}	Wt. of fruits plant^{-1} (kg)	Marketable yield (t ha^{-1})
BARI Tomato-3	101.7	3.85	27..3	1.40	27.49
Local	71.5	3.55	25..3	0.98	12.29

Table 10. Agronomic performance of different tomato varieties at FSRD site, Kushumhati, Sherpur during rabi, 2008-09.

Treatment	Plant ht(cm)	Fruit wt (g)	Fruits plant $^{-1}$ (no.)	Fruit length	Fruit diameter	Fruit wt. plant^{-1} (kg)	Yield (t ha^{-1})
BARI tomato 3	135.2	68.92	29.77	4.55	5.55	2.04	72..01
Local (Alachi)	94.2	38.25	40.47	5.31	4.34	1.55	58.08

On-Farm Trial of BARI Summer Hybrid Lines of Tomato

Abstract

An experiment was conducted in Farming Systems Research and Development site, Kushumhati, Sherpur during Kharif II season, 2008 to investigate the performance of BARI summer hybrid tomato lines. There were two varieties viz. BARI Hybrid tomato 3 and BARI Hybrid tomato 4. BARI hybrid tomato 4 produced higher yield than BARI hybrid tomato 3.

Introduction

Tomato is a high value cash crop gown throughout the country. It contains various types of vitamins and minerals. In Bangladesh, tomato is mainly grown in the winter season. For optimum fruit setting tomato requires night temperature 15 to 20^0 C which does not prevail any where in Bangladesh during May to September. So, year round tomato production is a constraint. Seasonality and multiple diseases problem are the two main barriers of year round tomato production. Considering these factors recently BARI has developed some modern heat tolerant hybrid tomato varieties. Keeping the views in mind, the experiment was under taken at Farming Systems Research and Development site, Kushumhati, Sherpur during Kharif II season, 2008.

Materials and Methods

An experiment was conducted at Farming Systems Research and Development site, Kushumhati, Sherpur during Kharif II season, 2008. The objective was to observe the on-farm performance of BARI summer hybrid tomato lines. There were two varieties viz. BARI Hybrid tomato 3 and BARI Hybrid tomato 4. The unit plot size was 10 m x 1 m. The experiment was replicated in four dispersed farmers' field. The crop was fertilized with 200-50-75 and 10000 Kg ha^{-1} of NPK and cowdung, respectively. Half of cowdung and K and full amount of P were applied during final land preparation. The remaining cowdung was applied during pit preparation. The entire amount of N and remaining k was applied in 3 equal splits at 10, 25 and 40 DAP. The seedlings were transplanted on July 23, 2008 maintaining the spacing 60 cm x 40 cm. Weeding and other intercultural operations were done as per requirement of the crop. The crop harvesting was started from September 11, 2008 and continued up to October 08, 2008. Data were collected in the plant height, fruit no, fruit weight, fruit diameter, fruit length, fruit yield.

Result and discussion

The result obtained from the study indicated that BARI Hybrid tomato 4 produced higher yield (24.32 t ha^{-1}) than BARI Hybrid tomato 3 (22.94 t ha^{-1}). From the Table 2, it was revealed that BARI Hybrid tomato 4 gave the highest gross return, gross margin and BCR.

Farmers' reaction

The farmers were impressed with the off-season fruit yield. They opined that if they were assured of enough seedlings they would go for field cultivation.

Table 1. Yield and yield contributing character of summer hybrid tomato varieties at FSRD Site, Kushumhati, Sherpur during Kharif II, 2008

Treatment	Plant ht.(cm)	Fruit plant^{-1} (no.)	Fruit wt. (g)	Fruit diameter (cm)	Fruit length (cm)	Yield (t ha^{-1})
BARI H. Tomato 3	108.03	17.87	31.33	6.21	6.26	22.94
BARI H. Tomato 4	117.93	16.74	40.33	6.12	7.65	24.32

Table 2. Cost and return analysis of summer hybrid tomato at FSRD Site, Kushumhati, Sherpur during Kharif II, 2008.

Treatment	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})	BCR
BARI H. Tomato 3	11,47,000	5,53,330	5,93670	2.07
BARI H. Tomato 4	12,16,000	5,53,330	6,62,670	2.27

Price: Fresh summer tomato: Tk. 50.00 kg^{-1}

Cost of cultivation of summer tomato (Tk. ha^{-1})

Sl.No.	Item/operation	Price (Tk.)
1.	Land preparation	52,200.00
2.	**Fertilizer**	
	Urea	3,730.00
	TSP	19,130.00
	MP	4,250.00
	Cowdung	8,369.00
3.	Polythene	1,50,000.00
4.	Nylon rope	17,826.00
5.	Jute rope	21,739.00
6.	Bamboo	1,80,000.00
7.	Labour	37,500.00
8.	Weeding	27,500.00
9.	Insecticide	26,086.00
10	Crying and Market toll	5,000.00
Total		5,53,330.00

Late Sowing Potential of Tomato Varieties in Patuakhali Region

Abstract

The experiment was conducted at FSRD site, Razakhali, Patuakhali and MLT site, Amtali, Barguna during rabi season of 2008-2009 to evaluate for late sowing potential of BARI tomato-14 in Patuakhali region. It was observed that fruit yield was highest on December 20, 2008 transplanting (62.9 t ha^{-1}) followed by 1st January, 2009 transplanting (52.4 t ha^{-1}) and the lowest yield (32.6 t ha^{-1}) was obtained from 20 January planting. From the economic study it was revealed that the highest gross margin was obtained from first transplanting and it decreases gradually with delaying of planting time. Considering gross margin planting up to 20 January tomato cultivation was observed profitable.

Introduction

Tomato is an important winter vegetables in Bangladesh. Vitamin-C contents are 31 mg per 100g of tomato. (Matin *et. al.* 1996). Tomato is a photo neutral but thermo sensitive crop and is grown during the winter months of Bangladesh. (Bhuyan and Haque, 1983). Ideal planting time of tomato is rabi season that is cool season of Bangladesh has been recommended from mid September to mid October. Location specific research may be more useful for making any recommendation for a particular region. In rice based cropping system in Patuakhali region sowing time of tomato ranges from 2nd week of November to 1st week of December, though delay sowing reduced yield. AEZ-13 characterized by tidal flooding of field, high rainfall during monsoon and short winter. After T. aman harvest land mainly remains fallow in this region. Delay harvest of transplanted aman rice and excess or less soil moisture are the main reasons for remaining the land fallow. Land become free and soil comes to working condition at the end of December to 1st week of January which is not optimum time for growing many rabi crops including vegetables. Therefore the study has been taken to identify the suitable planting time of tomato for late planting potential for the Patuakhali region of Bangladesh.

Materials and Methods

The experiment was conducted at MLT site, Amtali, Barguna and FSRD site, Razakhali, Patuakhali during rabi season of 2008-2009. Four sowing time S_1: 20 December, S_2: 01 January, S_3: 10 January and S_4: 20 January were tested. In this regard fertilizer application was followed FRG 2005. The experiment was laid out in RCB design with six dispersed replications having unit plot size 8 m × 5 m. In each location 3 replications were set up. Spacing was 60cm x 40cm and var. BARI Tomato-14 was used in the experiment. Application method of fertilizer was followed as recommended. Irrigation and other intercultural operation were done as and when necessary. Yield and yield attributes were recorded and analyzed statistically.

Results and Discussion

At Amtali transplanting was done at 20.12.2008 and 01.01.2009. Harvesting was done three times. Fruits $plant^{-1}$, fruit weight $plant^{-1}$ and individual fruit weight were observed higher in early planting and decreased gradually over time of transplanting. Fruit yield was observed highest in 20.12.08 transplanting (62.9 t ha^{-1}) followed by 01.01.09 transplanting (52.4 t ha^{-1}) due to low temperature in early planting. Lowest yield (32.6 t ha^{-1}) was obtained from 20 January planting due to high temperature during flowering and thus setting of less number of fruits. It might be due to drying up of stigma specially its receptive part and/or pollen.

Farmers' reaction

1. Farmers are highly satisfied to get this yield as well as economic benefit
2. Farmers preferred BARI tomato- 14 fruit size and flesh

Conclusion

However, it was 1st year experiment, it should be continued for the next year for more confirmation. This trial may be continued including more varieties.

Table 1. Effect of sowing time potentiality on tomato yield and yield attributes during rabi, 2008-09 at MLT site Amtali, Barguna.

Treatments	Fruits plant^{-1} (No.)	Fruits weight plant^{-1} (kg)	Individual fruit weight (g)	Fruit yield (t ha^{-1})	Yield reduction (%)
T_1 (20 December)	19	1.52	87.86	62.9a	-
T_2 (January 1)	19	1.28	68.58	52.4b	16.69
T_3 (January, 10)	16	1.13	64.90	45.9c	27.02
T_4 (January 20)	15	0.95	58.80	32.6d	48.17
CV (%)	-	-		10.65	-

Table 2. Cost and return analysis of tomato as affected by sowing time potentiality during rabi, 2008-09 at MLT site Amtali, Barguna

Treatments	Gross return (Tk. ha^{-1})	Total variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1	377400	111445	265955
T_2	340600	110945	229655
T_3	321300	110445	210855
T_4	260800	109945	150855

Tomato @ 6-8 Tk kg^{-1} in local market.

Performance of Ginger Varieties

Abstract

An experiment on Ginger was carried out at ARS Comilla, during 2008-09 to evaluate the potentiality of local variety in comparison to collected improved variety. The results showed that collected variety produced high yield (18.52 t ha^{-1}) than that of the local variety (12.97 t ha^{-1}).

Introduction

Ginger is an aromatic perennial herb belongs to the family Zingiberaceae. It is used more as a condiment than as a spice. The medicinal value of ginger is high. Fresh Ginger contains protein 2.3 %, carbohydrate 12.3 %, volatile oil 1%, fiber 2.4%, mineral 1.2%, water 80.8% and few resin substances. In Bangladesh 49,405 metric tons of ginger produced from about 7,715 hectares of land in 2006 (FAO, 2008). Total requirement of ginger 96,000 metric tons and yield deficit 46,595 metric tons per year in Bangladesh. Farmer's average yield of ginger is 5.54 t ha^{-1} which is very low than the yield of other countries. It is due to unavailability of high yielding varieties and new production technologies. So the present study aims to evaluate the performance of improved collected variety and local variety of Ginger.

Materials and Methods

The trial was carried out at Agricultural Research Station, BARI, Comilla, during 2008-09. The soil of the experimental field was sandy. The experimental field was well prepared ploughing followed by laddering using power tiller. The field was fertilized with Urea, TSP, MoP, Gypsum and Zinc at the rate of 304, 267, 233, 111 and 3 kg per hectare, respectively. Cow dung @ 5 tons per hectare was also applied during final land preparation. Half of the MoP, TSP, Gypsum, and Zinc were applied during final land preparation. Half of urea and one fourth of MoP were applied at 50 DAP; rest urea and MoP applied at 80-110 DAP. The seeds of Ginger were sown on April 23, 2008 maintain with spacing of 60cm x 30cm, before sowing, the seeds of Ginger were treated with fungicide Acrovat MZ @ 0.2% and soil was treated with Curater 5 G at the rate of 10kg ha^{-1} to prevent soil borne insects. Three weeding were done on 28, 50 and 106 days after transplanting. Earthing up were done for proper development of rhizome and remove excess water. Data were recorded likely clump weight, mother rhizome number, mother rhizome weight, primary finger number, primary finger weight, primary finger length, primary finger breadth and yield. The crop was harvested on 26-February/2009 and data were analyzed by using MSTAT.

Results and Discussion

The result suggested that the collected variety had better performance in respect of clump weight, mother rhizome number, mother rhizome weight, primary finger length and primary finger breadth and yield compared to the local variety (Table 1). On the other hand local variety showed better performance in respect of primary finger number and weight (Table-1). The collected variety gave significantly higher yield of 18.52 t ha^{-1} than the local variety (12.97 t ha^{-1}) it might be due to genetic variation and superior morphological characters and also long field duration, clump weight, number of mother rhizome, weight of mother rhizome, primary finger length and breadth.

Conclusion

The collected improved line gave significantly higher yield (18.5 t ha^{-1}) than that of the local variety (12.9 t ha^{-1}). The experiment should be repeated in next year with a view to set RYT.

Table 1. Yield and yield attributes of Ginger lines in ARS, Comilla during 2008-09.

Variety	Clump weight (gm)	Mother rhizome (No.)	Mother rhizome wt. (gm)	Primary finger (No.)	Primary finger wt.(gm)	Primary finger length (cm)	Primary finger breadth (cm)	Yield (t ha^{-1})
Improved line	375.3	1.8	67	5.3	154.7	6.5	2.9	18.5
Local	367.3	1.6	57	5.5	170.3	5.6	2.5	12.9
LSD $_{(0.05)}$	175.8	NS	10.8	NS	10.0	0.8	0.4	4.4
CV %	13.5	8.3	4.9	5.2	1.8	3.6	4.6	8.0

Performance of Turmeric Varieties

Abstract

An experiment was conducted at ARS, Comilla during 2008-09 to evaluate the performance of different turmeric lines along with a check variety BARI holud-3. Among the five varieties Moisa holud gave the highest yield (14.25t ha^{-1}) and Khagrachari holud (8.67t ha^{-1}) produced the lowest yield. Bogura holud (9.52 t ha^{-1}) and BARI holud-3 were statistically similar to Khagrachari holud.

Introduction

Turmeric (*Curcuma longa*) is a popular spice crop in Bangladesh. It is one of the most ancient spices of Indian Sub-continent. It has multiple uses in dying industries, medicines, culinary preparations and cosmetics. It is used in the preparation of tasty curries for its lucrative color and flavors. It is also useful for blood purification and human digestion system. Turmeric contains 69.40 % carbohydrate, 6.30 % protein, Oil 5.10 % and mineral 3.5% in dry basis. Turmeric is cultivated widely in the different parts of Bangladesh. But its yield is low (2.26 t ha^{-1} dry wt basis) in comparison with other turmeric producing countries. It is a long duration crop about 10 months, can also be cultivated in shady places. Soil erosion can easily be checked by cultivating turmeric in sloppy areas. In Bangladesh per annum 16.06 thousand hectares of land produces 41.50 thousand tons of turmeric which is not enough to fulfill the requirement of the country. It is due to shortage of high yielding varieties and appropriate production technologies. So the new varieties and technologies are needed, in view with this, ARS Comilla collected some lines, hence the experiment was undertaken to observe the performance of different collected turmeric lines.

Materials and Methods

The trial was carried out at Agricultural Research Station, BARI, Comilla, during 2008-09. Soil of the experimental field was sandy. The experimental field was well prepared by 3 ploughing followed by laddering using power tiller. The land was fertilized with cow dung, urea, TSP, MP, Gypsum and Zinc at the rate of 5 ton, 220,180,170,110 and 03 kg ha^{-1}, respectively. Half Urea, full amount of TSP, MP, Gypsum, Zinc and cow dung were applied during land preparation, remaining urea was top dressed six weeks after planting. The seeds of turmeric were transplanted on May29, 2008 maintaining a spacing of 60cm x 30cm. Before sowing, the rhizomes were treated with fungicide Acrovat MZ @ 0.2 % and soil was treated with Curater 5 G at the rate of 10kg ha^{-1} to control the insects. Weeding was done on 28, 52 and 108 days after sowing. Earthing up were done three times for proper development of rhizome and remove excess water. Data were recorded likely tillers number, leaf number, clump weight, mother rhizome number and weight, primary finger number and weight and yield per ton per hectare. The crop was harvested on 29th February 2009 and data were analyzed by using MSTAT.

Results and Discussion

Highest tiller number was recorded in the line Anondopur holud (3.2) which was identical with all other lines except BARI holud-3 (1.93).Similar trend was noticed in case of mother rhizome number. Incase of leaf number line collected from Khagrachari produced highest leaf (16.20) which was at par with Bogura holud (16.00) and Anondopur holud (15.80). The lowest leaf number were found in BARI holud -3 (11.80) and which was statistically similar to Moisa holud (12.40). Clump weight was highest in BARI holed -3 (267g) and which was statistically similar to Moisa holud (256g) and Khagrachari holud (251.33g) and the lowest weight were found in Anondopur holud (233g) which was statistically similar to Bogura holud (235.33). Highest mother rhizome weight was found in Khagrachari holud (84.67g), which was statistically similar to Bogura holud (78.33g), Moisa holud(67.68g) and the lowest mother rhizome weight was found in BARI holed-3 (57.33g) resulting lower yield. No significant different was observed in primary finger number but primary finger weight differed significantly. Primary finger weight was found highest in BARI holud-3 (128.67g) and lowest in Bogura holud (94.67g) and which as statistically similar to Moisa holud (102.33g), Khagrachari holud (102.33g) and Anondopur holud(108g). The highest yield was found in Moisa holud (14.25 t ha^{-1}) which was followed by Anondopur holud (11.67 t ha^{-1}). The lowest yield was found in Khagrachari holud (8.67 t ha^{-1}) and which was statistically similar to Bogura holud (9.52 t ha^{-1}) and BARI holud -3 (9.28 t ha^{-1}).

Conclusion

Moisa holud (14.3t ha^{-1}) gave significantly higher yield among the varieties. It is needed to repeat the study for the next year for conducting Regional Yield Trial.

Table 1. Yield and yield attributes of Turmeric line in ARS, Comilla during 2008-09.

Variety	Tillers (no.)	Leaf (no.)	Clump wt. (gm)	Mother rhizome (no.)	Mother rhizome wt. (g)	Primary finger (no.)	Primary finger wt. (gm)	Yield (t ha^{-1})
Moisa	3.0 a	12.4 b	256.0 a	2.5 a	67.7 ab	5.5 a	103.3 b	14.3 a
Anondopur	3.2a	15.8 a	233.0 c	2.5 a	58.7 b	4.9 a	108.0 b	11.7 b
Bogura	2.9 a	16.0 a	235.3 bc	2.6 a	78.3 a	5.7 a	94.7 b	9.5 c
Khagrachari	3.2 a	16.2 a	251.3 ab	2.6 a	84.7 a	5.3a	102.3 b	8.7 c
BARIholud-3	1.9 b	11.8 b	267.0 a	1.9 b	57.3 b	5.4 a	128.7 a	9.3 c
LSD (0.05)	0.6	2.5	17.3	0.5	16.5	NS	15.8	1.7
CV (%)	10.7	9.2	3.7	11.2	12.7	7.9	7.8	8.7

Adaptive Trial of Improved Varieties of Turmeric

Abstract

The trial was conducted at the farmer's field of Melandah, Jamalpur during Kharif-1, 2008 to evaluate the performance of BARI released turmeric varieties. The highest turmeric yield was obtained form BARI Halud 2 (36.63 t ha^{-1}) and differed from other two BARI Halud varieties. These two varieties were BARI Halud 1 and BARI Halud 3 which produced 30.77 t ha^{-1} and 27.80 t ha^{-1} yields respectively. The local variety produced the lowest yield (15.27 t ha^{-1}). The highest BCR (3.29) was obtained from BARI Halud 2. Farmers preferred BARI Halud 2 for its disease resistance, attractive color and higher yield than the local variety.

Introduction

Turmeric is a very important crop in the vast areas of Sherpur district. The farmers are still using the traditional varieties of the crop throughout the area. During the recent years, BARI has developed some high yielding varieties of the crop. These varieties, if adopted by the farmers, will help to increase the production of the crops and farmers' income. To evaluate the location specific performance and to recommend improved verities viz. BARI Halud 1, BARI 2, BARI Halud 3 and local, the trial was conducted at farm level at Multilocation Test Site, Malancha, Melandah, Jamalpur during Kharif-I, 2008.

Materials and Methods

The trial was conducted at farmers' field at Multilocation Testing Site, Malancha, Melandah, Jamalpur during Kharif-I, 2008. Four turmeric varieties: i) BARI Halud 1, ii) BARI Halud 2, iii) BARI Halud 3 and iv) Local were planted from March 20 - 30, 2008 at different farmer's field across the locations. The plot size was 3m x 4m. The seeds were planted in 50 cm x 25 cm apart rows. The trial was set at randomized complete block design with four dispersed replications. Fertilizer was used at the rate of 110-35-90-20-1 NPKSZn kg ha^{-1}, respectively with 6000 kg ha^{-1} cowdung, Half of the amount of N and the entire amount of cowdung, PKSZn were applied at final land preparation. The rest N were top dressed at 80 and 110 days after planting. Harvesting of the crops was started from January 07, 2009. The recorded data were analyzed statistically and means were separated as per DMRT.

Result and Discussion

The number of fingers $plant^{-1}$ was found highest in BARI Halud 2 and was different from BARI Halud 1 and BARI Halud 3. The local variety produced statistically the lowest number of fingers $plant^{-1}$. The number of corms $plant^{-1}$ was found highest in BARI Halud 2 and statistically different form BARI Halud 1 and BARI Halud 3. The local produced the lowest number of corms $plant^{-1}$. The highest number of fingers $plant^{-1}$ was recorded from BARI Halud 2 and was statistically different from BARI Halud 1 and BARI Halud 3. The local produced the lowest number of fingers $plant^{-1}$. However, the highest turmeric yield was obtained form BARI Halud 2 (36.63 t ha^{-1}) and was statistically different from BARI Halud 1 (30.77 t ha^{-1}) and BARI Halud 3 (27.80 t ha^{-1}). The local variety produced significantly lowest yield (15.27 t ha^{-1}). The highest BCR (3.29) was obtained from BARI Halud 2.

Farmers' reaction

Farmers preferred BARI Halud 2 for its diseases resistance, attractive colour and higher yield than the local variety.

Table 1. Yield and yield contributing characters of turmeric varieties at MLT, Malancha, Jamalpur during Kharif-I, 2008

Treatment	Plant height (cm)	Fingers plant^{-1} (no)	Corms plant^{-1} (no)	Finger wt plant^{-1} (g)	Yield (t ha^{-1})
BARI Halud 1	117.8 b	11.8 b	2.23 b	407.0 b	30.77 b
BARI Halud 2	117.0 b	16.3 a	2.64 a	469.1 a	36.63 a
BARI Halud 3	144.5 a	13.6 b	2.13 b	363.1 b	27.80 b
Local	106.5 b	9.1 c	1.23 c	207.0 c	15.27 c
F	*	**	**	**	**
CV (%)	7.84	5.83	6.27	5.65	7.25

Table 2. Cost and return analysis of different turmeric varieties at MLT, Malancha, Melandah, Jamalpur during Kharif-I, 2008

Treatment	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})	BCR
BARI Halud 1	1,53,850.00	55,606.00	98,244.00	2.77
BARI Halud 2	1,83,150.00	55,606.00	1,27,544.00	3.29
BARI Halud 3	1,39,000.00	55,606.00	83,394.00	2.50
Local	76,350.00	55,606.00	20,744.00	1.37

Price: Fresh turmeric Tk.5.00/kg

Farmers Participatory Research on Integrated Farming for Improved Livelihood of Resource Poor Farm Households

Introduction

The subsistence farms of Bangladesh are highly diversified with complex relationships among the various sub-system and the enterprises within a subsystem. While there are different production alternatives, farmers have a limited set of resources. These resources must be utilized in such a manner that maximize farm productivity, farmers benefit and resource-use efficiency in an environmentally sound and sustainable way. A holistic approach to technology generation and packaging is essential to achieve this result through maximizing the complementary interactions among the different farming enterprises/production system and the biophysical and socio-economic environment. In this regard an integrated effort was made for livelihood improvement of the resource poor farm households with the following objectives

i. To utilize available farm resources in a better way
ii. To maximize income and
iii. To improve livelihood of the resource poor farm households

Methodology

Before initiating the program several steps were followed such as i) identification of proven/ recommended technologies, ii) selection of farmer cooperator, iii) accounting of pre-intervention status, iv) analysis of existing system and selection of technologies for intervention, v) implementation of intervention and performance evaluation. Potentials that lead to improve livelihood were identified through participatory discussion with the clientele groups. Based on the potentials suitable technological options were addressed to the farmers and accordingly farmers selected suitable technologies adjusting with their need for livelihood improvement. Year round vegetable production following Goyeshpur model in homestead, Cattle fattening, Vaccination, Poultry rearing, improved fish cultivation, fruit tree management was identified as their major potential area. Five cooperator farmers were selected for the program. On-Farm Research Division (OFRD) team facilitated the cooperators for technological intervention for maximizing the productivity of the components. Farmers were formed groups for planning, implementation, monitoring and evaluation of their activities with competitive behavior. The data on production, farm level utilization, economic return and other socio-economic parameters were recorded and tabulated accordingly.

Results and Discussion

Vegetable production and income

More or less nine production niches of the homestead were brought under cultivation with the suggested vegetables of Goyeshpur model under the selected homestead at FSRD site Pushpapara during the *rabi* season of 2008 to kharif season 2009. It was observed that the production of vegetables was higher at open sunny space. Among the seasons, more crops and production units were covered in rabi season. The total production was recorded 590.92 kg from all production units per farm (Table 1). The average net income from homestead vegetable per farm was achieved Tk.7306 which contributed to the total income of the resource poor farm households (Table 2).

Apparent Nutrient intake and supplementation from vegetables

Apparent nutrient intake especially protein, iron, carotene, vit.B_1 and vit.C by the family member of integrated farming was estimated. Apparent nutrient intake was varied with different vegetable growing months. Intake of nutrient was positively correlated with vegetable consumption. Regarding the daily nutritional requirement of an adult, nutrients such as protein, iron, carotene, vit.B_1 and vit. C was supplemented 4.49, 13.19, 121.87, 13.24 and 93.68%, respectively from the homestead vegetable production (Table 3).

Vaccination to poultry

Poultry birds reared by poor households were vaccinated. The result indicated that due to provide vaccine to poultry the mortality rate was significantly reduced by 91.25% (Table 4). Poultry mortality is a common aspect for poultry rearing in the rural farm households and sometimes they face a great loss from this component. Proper vaccination in time can reduce mortality to great extent and additional income can be achieved.

Cattle fattening

The body weights of the treated cattle's were increased due to feeding with UMS diet, deworming and proper vaccination. Five cattle's were reared with UMS diet for more than eight months while two cattle's were reared for about three months. After feeding, the average body weight increased by 61% over initial weight probably due to long term feeding. The average body weight gained per day was around 515 g. which was encouraging for the cattle growers. The average cell price was increased by 64.92% over initial price. The average profit obtained from each cattle was Tk. 12660 (Table 5).

Improved fish cultivation

Improve management practices were provided for fish cultivation in integrated farming. It was observed that the growth of different fish species were satisfactory probably due to better pond preparation, maintaining proper stocking ratio with area and layer of water bodies and optimum feed management. The average fish production per decimal was 7.12 kg. The average net return per decimal was achieved Tk. 4116 (Table 6).

Improvement of fruit tree management

Effort was made with regard to varietal improvement, fertilizer management and pest and disease control of the fruit trees in integrated farming. Introducing BARI developed variety replacing low yielding traditional variety and some cases improvement of existing trees through grafting with high yielding variety made a positive impact on quality fruit production and income generation. In some cases farmers being taken initiative to raise sapling of different quality fruit trees for dissemination and income generation. The production plant^{-1} was 75, 18, 50, 35, 5, 4 and 3.5 kg from mango, guava, jackfruit, jujube, pomelo, pomegranate and lemon, respectively. Net return plant^{-1} was Tk. 1720, 155, 680, 1490, 50, 580 and 115, respectively from the said fruit trees. Coconut and litchi plants are at good vegetative stage (Table 7).

Farmers' reaction

The resource poor farmers are interested to adopt those technologies which can provide quick return in terms of cash income. They are mostly vulnerable to their decision and shift to other activities. Due to adoption of integrated farming they are hopeful to maintain their family with farm income. The increased productivity and nutrition from the homestead source made them confident for livelihood improvement.

Limitations of the study

1. Tedious, laborious and continuous work, needing skills in production techniques of different components.
2. Lack of strong multidisciplinary scientific team to implement the program
3. Lack in easy analytical tool to interpret data comfortably. (Needs a computer programming on Analysis of results)
4. Skill of site level staff and the farm family members were not as effective as required for optimum production and accurate information

Conclusion

Multidisciplinary well experienced strong scientific team needed for successful integration of technologies. The integrated farming through livelihood approach is seemed to be difficult with traditional office management. It needs intensive care, proper guidance and accountability. Also need incentive packages for the level working staff.

Table 1. Round the year vegetables production from different niches of homestead under integrated farming at FSRD site, Pushpapara, Pabna during April 2008 to March 2009.

Space		Rabi	Kharif-1	Kharif-2	Total
		Aasheen-Falgun	Chaitra-Jaistha	Aashar-Bhadra	
Open sunny space	Bed 1	28.50	30.00	37.38	95.88
	Bed 2	48.75	9.81	18.00	76.56
	Bed 3	18.00	4.88	14.81	37.69
Roof top		24.00	-	-	24.00
Trellis		48.38	7.5	20.00	75.88
Shady place		23.06	0.50	17.13	40.69
Marshy land		18.17	-	18.50	36.67
Unproductive tree		3.38	-	-	3.38
Fence		-	5.50	2.75	8.25
Back yard		11.50	13.00	18.50	43.00
Boundary		37.39	30.94	80.59	148.92
Total		261.13	102.13	227.66	590.92

Table 2. Cost and return from year round vegetable production at FSRD site, Pushpopara, Pabna during April 2008 to March 2009.

Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income (Tk.)
3438.00	7838.00	532.00	7306.00

Table 3. Apparent nutrient intake by a family and nutrient supplementation per head per day under integrated farming at FSRD site, Pushpapara, Pabna during April 2008 to March 2009.

Benglali month	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B_1 (mg)	Vit-C (mg)
Baishakh	151.12	247.38	246532.5	8.86	4186.75
Jaistha	491.87	574.38	1592766.2	30.30	10855.62
Aashar	752.32	1344.56	3091051.2	38.35	12879.88
Sraban	397.2	1031.00	1157542.5	17.20	11107.5
Bhadra	341.38	342.13	131958.75	26.80	7678.5
Aasheen	204.25	249.75	184997.5	26.46	2257.5
Kartik	291.63	1040.00	312422.5	31.76	1231
Agrahaon	461.19	461.64	367586.25	27.70	2598.13
Poush	504.19	751.88	681921.25	37.91	7629.38
Magh	591.75	369.25	145736.25	32.30	5543.13
Falgun	302.38	289.52	90165.00	11.94	2210.00
Chaitra	19.5	37.00	4250.00	0.27	206.67
Total	4508.78	6738.50	8006929.80	289.85	68384.06
Nutrient supplementation (%)	4.49	13.19	121.87	13.24	93.68

Table 4. Number of birds vaccinated and mortality rate before and after vaccination under integrated farming at FSRD site, Pushpapara, Pabna during April 2008 to March 2009.

Date of vaccination	Name of vaccine	Number of birds vaccinated	Mortality rate before vaccination (%)	Mortality rate after vaccination (%)	Mortality rate reduced (%)
14.06.08	BCRDV	440	80	10	91.25
15.06.08	RDV	830	75	5	
28.08.08	BCRDV	460	80	10	
29.08.08	RDV	790	75	5	
04.12.08	BCRDV	390	85	12	
05.12.08	RDV	915	82	8	
30.03.09	BCRDV	460	85	12	
31.03.09	RDV	690	82	8	

Table 5. Cattle fattening with Urea Molasses Straw diet, Vaccination and Deworming program at FSRD site, Pushpapara, Pabna during the year of 2008-09.

Name of farmers	No. of Cattle	Age (months)	Initial body wt. (Kg)	Duration of feeding with UMS diet (days)	Body wt. gained (Kg)	Av. body wt. gain/ day (g)	Purchasing cost (Tk.) + variable cost cattle	Sell price (Tk.) estd.	Profit (Tk.)	Remarks
Abbas Ali	1	26	200	255	350	588	23500	42500	19000	Before starting the program all cattles were dewormed and vaccinated
Md. Zinnah	1	28	210	255	355	569	24250	45000	20750	
Amin uddin	1	21	140	82	165	305	13200	15500	2300	
Omar Ali	1	18	120	90	160	445	11750	14300	2550	
Bazlur Rahman	1	26	205	255	375	667	24800	43500	18700	
Average			175	187.4	281	514.8	19500	32160 (64.92%)	12660	

Table 6. Polyculture of fish with improved management at FSRD site, Pushpapara, Pabna during the year of 2008-09.

Farmers name	Pond area (dec.)	Releasing of fingerlings			Production (kg)	Cost (Tk.)	Net return (Tk.)
		Species	Weight (kg)	Price (Tk.)			
Abdul Baki	06	Ruhu	1.00	120	47.00	1100	2190
		Katla	0.60	60			
		Mrigal	1.00	100			
		Rajpunti	1.00	120			
		Silvercarp	1.00	70			
		Mirrorcarp	0.50	40			
Bilal Hossain	04	Ruhu	0.150	24	36.00	626	2254
		Katla	0.100	16			
		Rajpunti	0.400	60			
		Silvercarp	0.250	36			
Abul Hossain	12	Jap. Ruhu	0.420	63	85.00	1852	4948
		Katla	0.480	72			
		Rajpunti	0.840	126			
		Silvercarp	0.720	108			
		Nilotica	0.420	63			
		Ruhu	0.480	72			
Azim Uddin	16	Jap. Ruhu	0.800	120	105.00	2150	6250
		Katla	0.560	84			
		Rajpunti	1.600	240			
		Silvercarp	0.960	144			
		Ruhu	0.560	84			

Table 7. Improvement of fruit tree management in integrated farming at FSRD site, Pushpapara, Pabna during the year of 2008-09.

Name of fruit	Number	Management	Production plant^{-1} (kg)	Total return plant^{-1} (Tk.)	Cost plant^{-1} (Tk.)	Net return (Tk.)
Mango	355	Fertilizer and irrigation management, removing of pest and disease infested plant parts, top working, pest and disease control with bio pesticides	75	1875	155	1720
Guava	8	Fertilizer management and removing of pest and disease infested plant parts, pest and disease control with bio pesticides	18	180	25	155
Jackfruit	4	Fertilizer management, pest and disease control with bio pesticides	50	750	70	680
Jujubee	7	Fertilizer management, grafting, Pest and disease control with bio pesticides	35	1575	85	1490
Litchi	4	Fertilizer management, removing infested plant parts	Still the plants are at veg. stage	-	-	-
Coconut	22	Removing dead leaves, fertilizer management	Still the plants are at veg. stage	-	-	-
Pamelo	6	Fertilizer management, removing infested plant parts	5	75	25	50
Pomegranate	2	Fertilizer management, removing infested plant parts	4	600	20	580
Lemon	5	Fertilizer management, removing infested plant parts	3.5	140	25	115

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Farmers Participatory Research on Integrated Farming for Improved Livelihood of Resource Poor Farm Households

Abstract

The integrated farming for resource poor farm household activities was conducted at FSRD site Hatgobindopur, Faridpur during 2008-09. The ultimate purposes of the activities were to disseminate the proven technologies from livelihood perspective to resource poor farmers. Ten resource poor farmers were selected on the basis of their own land in the study area. Out of which 5 were marginal and 5 small households. Interventions were made in pilot production program on cropping pattern, block demonstration, homestead area, poultry, livestock and fruit trees management. In homestead, "Ishangopalpur model" was followed with maximum utilization of all possible production units aiming increases the number of vegetables and productivity after the intervention. Intervention in replacement of local low yielding poor quality vegetables by improved high yielding vegetables rich in protein and vitamins has increased income and nutrition level of the farm household members. The most popular four cropping patterns were practice involving modern crop production technologies against existing practices. Besides block demonstration of different crops were also implemented to increase yield per unit area. In livestock sub system, vaccination, vitamin feeding, deworming, layer rearing for egg production were adopted. BARI developed different fruit tree saplings were supplied with recommended management packages. The vegetable production was increased by 225 and 160% in marginal farm family during the rabi and kharif seasons, respectively. While in small farm family the vegetables production was increased by 111 and 53% during the rabi and kharif seasons, respectively. The vegetable consumption also increased than before intervention. The yield of crop has increased substantially. In livestock, mortality rate was less after intervention of different program. In fruit tree management, fruit bearing was also increased than before. After all, the income, family nutrition, employment opportunities, social status has increased than any earlier time of all household categories.

Introduction

Bangladesh an overwhelmingly agricultural economy is one of the most densely populated countries in the world. About half of the populations live in hard-core poverty. The majority of the populations in Bangladesh are small holders of rice farmers and more than 60 percent farmers of this country is resource poor.

Farmers limited source of resources should be utilized in such a manner that maximizes farmers' benefit as well as improve their existing livelihood but traditional commodity oriented agricultural research does not consider the interactions between different components, production system and the environment which are very much essential but the farmer dose not consider actively. Most of the farmers have not adopted many of the technologies developed by different research institutes. Their major constraints are lack of technical know how, inputs and money. Their risks are market and natural calamities.

Objectives

1. Utilization of homestead resources and make availability of vegetables round the year to met up the farmers' family nutrition.
2. Adoption of suitable high yielding varieties of different crops to fit into the existing cropping pattern for higher yield and economic return.
3. Improvement of farmer's social status through intervention of new and profitable technologies (livestock, fruit tree management program etc.) as Income Generating Activities (IGA).

Methodology

The activities were carried out at FSRD site, Hatgobindapur, Faridpur since April 2008. On the basis of farmer's traditional practices, their needs and choices, the site team considered several alternatives of technologies of crops, livestock, fisheries and other components as per available resources of the farm with active participation of the farmers. Two categories of farmer i.e. marginal and small were targeted for homestead vegetable production. Before going to implement the project activities a case study of individual households was carried out and detail information in respect of livelihoods maintained by the selected households were documented. Total resources inventory, liabilities, technology used, level of input used, output obtained income and expenditure status, labor availability of the farms of previous year was accounted by detail households case study with intensive visit. After analysis of existing system, the technologies were selected for intervention in priority basis. Then the farmers were motivated through all possible ways to utilize their own resources to adopt the technologies. Under this project different farming component i.e. crop, homestead, fruit tree management were integrated and a holistic approach was taken for improvement of households.

Activities

On the basis of farming component, different types of program were designed during the year of 2008-09, which are as below:

Program I: Gender utilization and family nutrition

A. **Homestead -** Year round vegetable and creeper production following **"Ishan Gopalpur Model".**

Program II: Pilot production program of different field crops under cropping pattern based and single crop based

A. **Cropping pattern based activities**

1. Wheat- Jute-T.aman rice
2. Mustard-Jute-T.aman rice
3. Potato-Jute-T.aman rice
4. Maize-T.aus-T.aman rice

B. Varietal performance of different field crops under single crop based through block demonstration

Program III: Tree plantation and management

Program IV: Livestocks activities

Program V: Technology transfer

ACHIEVEMENTS

Program I: Gender utilization and family nutrition program

Year round homestead vegetable and creeper production following **“Ishan Gopalpur Model”.**

The vegetables cultivation program at homestead area was carried out at FSRD site, Hatgobindapur, Faridpur following “ Ishan gopalpur Model”. Ten households of marginal and small group were selected for this program. The vegetables crops were selected according to the preference of the farmers through participatory method. Before conducting the activities a comprehensive training was provided to the selected farmers on vegetables cultivation. The FSRD team provided regular technical assistance of vegetables cultivation to the co-operators.

Objectives

1. Optimization of homestead resources for making availability of vegetables round the year.
2. Utilization of family labour specially women and children.

Vegetable production

The performances of vegetables crops grown in homestead area from **marginal group** are presented in Table 1. After intervention of “Ishan Gopalpur Model” the total vegetable production was 153 kg, of which 111 and 42.0 kg were from open space and creeper vegetables, respectively during the rabi season of 2008-09. Before intervention the vegetable production was only 47 kg. Therefore the production was increased by 225 %. In Kharif season, after intervention, the production was 133 kg and before intervention it was 51 kg and thus the production was increased by 160 %.

Table 1. Year round average vegetable production of a marginal farmer in homestead area at FSRD site, Hatgobindapur, Faridpur during the year of 2008-09.

Season	Before Intervention			After Intervention			% Increased
	Open space vegetables (kg)	Creeper vegetables (kg)	Total	Open space vegetables (kg)	Creeper vegetables (kg)	Total	
Rabi	22	25	47	111	42	153	225
Kharif	18	33	51	70	63	133	160
Total =	40	58	98	181	105	286	193

From **small farmer group** after intervention of Ishan Gopalpur Model the total vegetable production was 184 kg of which open space and creeper vegetables contributed 112 and 72 kg, respectively during the year of 2008-09. On the other hand, before intervention, the production was only 87 kg in rabi season. Therefore the production was increased by 111%. In kharif-I season, the production was 141 and 92 kg, after and before intervention, respectively. The production was increased about 53% in kharif season (Table 2).

Table 2. Year round average vegetable production of a small farmer in homestead at FSRD site, Hatgobindapur, Faridpur during the year of 2008-09.

Season	Before Intervention			After Intervention			% Increased
	Open Space vegetables (kg)	Creeper vegetables (kg)	Total	Open Space vegetables (kg)	Creeper vegetables (kg)	Total	
Rabi	32	55	87	112	72	184	111
Kharif	29	63	92	75	66	141	53
Total	61	118	179	187	138	325	82

Disposal pattern of vegetables

From marginal group, the total vegetables production was 98 kg of which 77, 6 and 15 kg were consumption, distribution and sold, respectively. On the basis of the disposal pattern the consumption per person per day was 49 g before intervention of the model. On the other hand, after intervention the total production was 286 kg of which the consumption, distribution and sold amount were 246, 10 and 30 kg, respectively and the consumption per person per day was 156 g (Table 3).

Table 3. Disposal pattern of vegetables of marginal farmer during the kharif & rabi season of 2008-09.

Vegetables	Total harvest (kg)	Consumption		Distribution (kg)	Sold (kg)
		Amount (kg)	Per person/day (g)		
Before intervention					
a. Open space	40	35	49	2.00	3.00
b. Creeper	58	42		4.0	12.0
Total =	98	77		6.00	15.0
After intervention					
a. Open space	181	152	156	5	20
b. Creeper	105	94		5	10
Total =	286	246		10	30

* Average household size: 4.33

In small group farmer, before intervention the total homestead vegetables production was 179 kg. The disposal pattern of the vegetables like consumption, distribution and sold were 159, 5.0 and 15 kg, respectively and consumption per person per day was 73 g. On the other hand, after intervention of the vegetables model the total production was 325 kg of which 300, 10 and 15 kg were used as consumption, distribution and sold, respectively and the consumption was 149 g per person per day (Table 4).

Table 4. Disposal pattern of vegetables of a small farmer during the kharif & rabi seasson of 2008-09.

Vegetables	Total harvest (kg)	Consumption		Distribution (kg)	Sold (kg)
		Amount (kg)	Per person/day (g)		
Before					
a. Open space	87	77	73	3.0	7.0
b. Creeper	92	82		2.0	8.0
Total	179	159		5.0	15.0
After					
a. Open space	187	153	142	6.0	10.0
b. Creeper	138	147		4.0	5.0
Total	325	300		10.0	15

* Average household size: 6.0

Farmers' reaction

Farmers were very much interested to involve themselves in homestead gardening due to earn some cash money and harvest fresh vegetables daily to meet up their daily requirement.

Program II: Pilot production program of different cropping patterns

A. Cropping pattern based activities

The production program was conducted at FSRD site, Hatgobindapur, Faridpur from kharif I, 2008. Three rice base cropping patterns viz., i) Wheat-Jute-T.aman, ii) Potato-Jute-T.aman and iii) Mustard-Jute--T.aman were included in this program. The crop varieties namely BRRI Dhan 32, BARI sharisa-11, Shatabdi (Wheat) and Cardinal (Potato) were used. The fertilizer dose, sowing and harvesting date used in these trails are presented in Table 5. The area of 50 to 60 decimal cropping land of two-category farmers (small and marginal) were included under this program.

The overall performance of all the crops under each pattern was good and satisfactory. The yield of wheat, jute, T.aman, mustard and potato were 3.60, 2.58-2.72, 3.60-3.75, 1.96 and 26 t ha^{-1}, respectively. The highest gross return (Tk. 457750 ha^{-1}) and gross margin (Tk. 292750 ha^{-1}) were found from Potato-Jute-T.aman cropping pattern. This pattern also gave the highest BCR (Table 6).

Table 5. Name of the crops and their management practices during the year of 2008-09.

Name of crops	Variety	Fertilizer dose (kg ha^{-1}) (N-P-K-S-Zn-CD)	Sowing time	Harvesting time
1. Wheat	Shatabdi	70-25-20-10-2+10 ton	17-22 Nov. 08	12-15 March 09
2. Jute	0-9897	85-12-50-5	10-12 April 08	02-12 August, 08
3. T.aman	BRRI Dhan 32	78-10-33-2	10 – 15 August, 08	10 -15 Nov 08
4. Mustard	BARI Sarisha-11	84-18-22-14-1	12 – 17 Nov 08	27-29 Feb 09
5. Potato	Cardinal	96-16-32-8-1.5	02 -05 Dec 08	10 -15 March 09

Table 6. Area and performance of crops under different cropping patterns during the year of 2008-09.

Cropping pattern	Area covered (dec)	No. & category of co-operator	Mean yield (t ha^{-1})	GR (Tk. ha^{-1})	TVC (Tk. ha^{-1})	GM (Tk. ha^{-1})	BCR
1. Wheat-Jute-T.aman	50	2 (1 small & 1 marginal)	Wheat = 3.60 Jute = 2.58 T.aman = 3.60	226500	97500	129000	2.32
2. Potato-Jute-T.aman	60	2 (1 small & 1 marginal)	Potato= 26.0 Jute = 2.72 T.aman= 3.70	457750	165000	292750	2.77
3. Mustard-Jute-T.aman	50	2 (1 small & 1 marginal)	Mustard= 1.56 Jute = 2.64 T.aman= 3.75	225225	93500	131725	2.41

Note: GR= Gross return, GM= Gross margin, TVC= total variable cost and BCR= Benefit cost ratio

Farmers' reaction

Farmers opined very much positively with high yield of different crop varieties and high cash return.

B. Varietal performance of different field crop under single crop based through block demonstration

A large number of diversified crops in the rabi season are grown in this area. Most of crop varieties are local and management practices are also not scientific specially fertilizer. There are eleven varieties of seven crops were selected to observe the varietal performance using modern technology through block demonstration at farmers filed during rabi season of 2008-09. The activities were conducted in two locations. One of them was at FSRD site, Hatgobindapur, Faridpur and another at MLT site, Rajbari. The results are shown in following Table 7. The performance of the crops under block demonstration was good and satisfactory except BARI Peaj 1. Farmers got good return and preserved the crop seeds for the next year use.

Farmers' reaction

Farmers were happy to get good yield and return and also improved their technical knowledge on different crops production.

Table 7. Performance of different field crops under block demonstration.

Crops	Variety	Numbers of farmers	Date of sowing	Area (dec)	Yield (kg/ha)	Remarks
Mustard	BARI sarisha 11	8	26-29.10.08	300	1100-1800	Farmers preserved seed for next year use
Lentil (MLT Site, Rajbari)	BARI mashur 4	07	7-27.11.08	250	880-1436	Early sowing seedling damaged due to SIDR
Lentil (FSRD site,Faridpur)	BARI mashur 4	10	2-8.11.08	350	870-1120	Seedling damaged by SIDR and mycoplasma
Onion MLT Site,Rajbari	BARI piaz 2 (Summer)	01	15.10.08	10	15000	Highly seed demand & low keeping quality
Onion FSRD site,Faridpur	BARI piaz 1	02	24.1.08	45	6400	Late planting due
Cabbage	Autumn queen	03	11-26.11.08	33	52500	Late planting due
Radish	BARI mula 1 & 2	02	29-30.10.08	45	56000 & 52000	Farmers were happy for good yield of radish
Wheat through seeder	Prodip & Bijoy	04	26-30.11.08	45	3550 & 3650	Bijoy infested by bipolaris
Potato	Cardinal & Diamant	02	11-15.12.08	40	23500 & 22000	Farmers preserved seed for next year use

Program III: Plantation of fruit tree and management of existing fruit tree

Existing fruit trees are also a resource to the farmers. Different types of management practices like proper fertilization, irrigation, pest and disease control, etc were employed in the existing fruit trees. As a result these trees produced more yield and farmer earned cash and improved family nutrition. Mango hopper is common cause for low yield of mango. Therefore, standard management practices along with mango hopper control were included under this program. The activities carried out as a development work with BARI recommended technologies that are given below.

Activities and findings

1. Mango hopper control

- No. of Co-operator : 12 (6 Small & 6 Marginal)
- No. of tree : 20
- Date of spraying :
  - 1st Spraying : 12-18 Dec 2008
  - 2nd Spraying : 12- 15 Janu 2008
- Name of Insecticide : Cythrin @ 1ml/L and Dithene M-45 2 g/L
- Present condition : A good number of fruit bearing has present in the sprayed trees.

2. Plantation of different fruit sapling

- No. of Co-operator : 45
- No. of tree : 72
- Date of distribution : July - August 2008
- Name of fruit tree : Mango (25) & Litchi (10). Guava (20), Neem (10), Grass (7)
- Present condition : All of mango sapling has alive but others sapling more or less good condition

Program IV: Livestock program (Vaccination, deworming and poultry rearing)

Table 8. Livestock activities

Activities	Household (no.)	Breed	No. of bird/cattle	Present condition
Vaccination of poultry	100	Local	300	Mortality decreased
Dewarming of cattle	50	Local	100	Good
Vitamin feeding	40	Local	85	Good

The results of the vaccination program were presented in Table 8. The results showed that after vaccination program mortality percentage become very low compare to before vaccination in ease of all livestock population. This program has created awareness and interest among the co-operator farmers.

Farmers' reaction

- Farmers positively opined due to low mortality rate of their livestock.
- Farmers are highly interested of layer rearing

Utilization of Fisheries Gher Boundaries through Vegetable Production in Coastal Area

Abstract

The experiment was conducted to find out suitable vegetable and fruit species for planting in the *bund* around fisheries gher at Bagerhat MLT site. Five vegetable patterns were designed and tested for the study. The experiment was carried out at Rabi and kharif season during the year of 2008-09. Among the tested vegetables in the patterns, tomato and bottle gourd gave the highest yield while highest BCR was found from cabbage and bottle gourd in Rabi and kharif seasons, respectively.

Introduction

The medium low land and lower portion of medium high land occupies a considerable available area of the district. The dominant cropping pattern in such land types is Fallow–T.Aman–Fallow. Because of low productivity from the land, farmers of the area are shifting over to fish production. A number of fisheries gher has cropped up around the district of Khulna, Bagerhat and Satkhira. The *bunds* around the ghers occupy a reasonable area and are underutilized. The area is deficit in vegetables and there is acute shortage of fuel and fruit. Attempt was made to utilize the bunds through crop cultivation and tree plantation to increase the local production by utilizing the gher bunds. The present study was undertaken to find out suitable vegetable and fruit species for planting in the *bund* around fisheries gher and to increase production and consumption of vegetables and fruits round the year.

Materials and Methods

Different vegetables and fruits were grown on fisheries gher boundaries during the rabi and kharif season of 2008-09 at MLT site Bagerhat. Five different vegetables patterns were studied. The patterns were as follows

Vegetable pattern		Planting date	
Rabi	Kharif	Rabi	Kharif
Knolkhol	Okra	7 November 2008	6 June 2008
Tomato	Indian Spinach	7 November 2008	6 June 2008
Cabbage	Chilli	7 November 2008	6 June 2008
Brinjal	Bottle gourd	4 December 2008	5 June 2008
Chilli	Bitter gourd	7 November 2008	8 June 2008

The experiment was conducted with six farmer's gher boundaries. The plot size was 6m×1m. Standard crop production technologies were used. Data on yield, cost, return and disposal of vegetables were recorded and analyzed.

Results and Discussion

Performance of rabi and kharif vegetables in pattern during the year of 2008-09 have been presented in Table 1, 2, 3 and 4. At Rabi season tomato gave the highest yield (58.33 t ha^{-1}) while bottle gourd produced 50 t ha^{-1} in kharif season. The higher yield (57.77 t ha^{-1}) was obtained from cabbage. Although, the yield of tomato is higher than that of cabbage, but cabbage shows the highest BCR (1.41). It was due to lower production cost of cabbage (Tk. 163538 ha^{-1}). Bottle gourd yielded the highest production (50 t ha^{-1}) and the highest BCR was also found from the same.

Farmers' reaction

Farmers are interested to grow cabbage and tomato for its better yield and market price. Besides, they showed their negative attitude to cultivate brinjal and bitter gourd due to brinjal fruit and shoot borer and virus infestation, respectively.

Conclusion

This is the 1st year results. It requires further study to draw final conclusion.

Table 1. Field duration and yield of different vegetable crops in rabi and kharif season during the year of 2008-09.

Vegetable pattern		Field duration (days)		Yield (t ha^{-1})	
Rabi	Kharif	Crop 1	Crop 2	Crop 1	Crop 2
Knolkhol	Okra	84	144	20.27	16.66
Tomato	Indian Spinach	116	135	58.33	40.27
Cabbage	Chilli	90	137	57.77	04.16
Brinjal	Bottle gourd	150	133	06.11	50.00
Chilli	Bitter gourd	130	120	07.22	10.00

Table 2. Economic performance of different vegetables patterns at MLT site, Bagerhat.

Vegetable pattern		Gross return (Tk. ha^{-1})		Total cost (Tk. ha^{-1})		Net return (Tk. ha^{-1})		BCR	
Rabi	Kharif	Crop 1	Crop 2	Crop 1	Crop 2	Crop 1	Crop 2	Crop 1	Crop 2
Knolkhol	Okra	202777	150000	161388	130394	41389	19606	1.26	1.15
Tomato	Indian Spinach	291666	120833	220216	107291	71450	13542	1.32	1.13
Cabbage	Chilli	231111	83333	163538	77416	67573	5917	1.41	1.08
Brinjal	Bottle gourd	97777	225000	95755	175602	2022	49398	1.02	1.28
Chilli	Bitter gourd	130000	150000	98805	122950	31195	27050	1.32	1.22

Price (Tk. kg^{-1}) **:** Knolkhol= 10.00, Okra= 9.00, Tomato= 5.00, Indian Spinach= 3.00, Cabbage= 4.00, Chilli= 20.00, Brinjal= 16.00, Bottle gourd= 4.50, Chilli= 18.00, Bitter gourd= 15.00

Table 3. Disposal pattern of vegetable in gher boundary (Avr. 6 families) during the year of 2008-09.

Vegetables		Qty. harvested kg/ 30 m^2/ family		Consumption kg/family		Amount distribution kg/ family/30 m^2		Amount sold kg/family		Value (Tk.)	
Rabi	Kharif	Crop 1	Crop 2	Crop 1	Crop 2	Crop 1	Crop 2	Crop 1	Crop 2	Crop 1	Crop 2
Knolkhol	Okra	1200	10.00	4	4	2	3	6	3	120	90
Tomato	Indian Spinach	35.00	24.00	15	8	8	6	12	10	175	72
Cabbage	Chilli	35.00	3.00	12	2	8	0	15	1	140	60
Brinjal	Bottle gourd	04.00	30.00	3	13	0	7	01	10	64	135
Chilli	Bitter gourd	04.00	6.00	2	2	0.50	1	1.5	3	72	90

No. of farm family : 06

Table 4. Performance of utilization of 'gher' boundary vegetables in different sectors.

Name of vegetables	Quantity harvested (kg/40m^2/Family)	Consumption (kg/Family)	Amount distribution (kg/Family)	Amount sold (kg/Family)	Value (Tk.)
Gimakolmi	150	30	20	100	600
Tomato	26	05	03	18	156
Bitter gourd	30	08	05	17	450
Sweet gourd	135	25	11	99	1080

Price (Tk. kg^{-1}): Gimakolmi= 4, Tomato= 6, Bitter gourd= 15 and Sweet gourd= 8.

Livelihood Adaptation to Climate Change in Coastal Area of Khulna and Drought Prone High Barind Tract Area of Bangladesh

Program Summary

Adaptation research under LACC-II project started at coastal/saline area of Laudove, Dakope Upzila of Khulna and at Nachole and Shapahar Upzila under drought-prone High Barind Tract (HBT) through three separate focus group discussions (FGD) during the month of May-June, 2008. After selection of adaptation options homestead vegetable production started immediately with saline/excess soil moisture tolerant vegetables for coastal area. While drought tolerant and water efficient vegetables were selected for HBT area following Barind model. In coastal area several homestead vegetables were successfully produced through scientific management like making ridge and furrowing of bed. There was large participation of women in all the activities of home gardening– from land preparation to marketing at Laudove. Through utilization of different niches of homestead farm family succeeded to increase their vegetable consumption three to five folds more from the bench mark, though intake was below recommended level. Both women and male farmers reported improvement of their health related problems like eye-sight problem, constipation, skin diseases through intake of increased amount of fresh and nutritious vegetables. Economically homestead vegetable production was quite lucrative. Also social relationship of the farm family was improved with neighbors and relatives through free distribution of vegetables. However, farmers need more training and motivation on nutritional aspect associated with scientific management of homestead area. Kharif-I homestead vegetable production was hampered due to long and severe drought.

Short duration T.aman rice variety (cv.BINA dhan 4) was tested at Laudove for facilitating timely planting of rabi crops. It gave better yield and one month shortening of field duration was possible. Farmers kept most of the produced seed for next year cultivation. In post-rainy season (Rabi) different field crops were tested, such as relaying (for timely planting and avoiding of increased soil salinity) of mustard, wheat, cowpea and later on creeping crops like watermelon and sweet gourd. Among them cowpea, water melon and sweet gourd proved to be promising. In droughty area sole chickpea, mixed cropping of chickpea + barley and chickpea + linseed performed better under rainless non-irrigated conditions. Some problems of chickpea production were identified for optimizing yield. Yield of all the rabi dry land crops were low due to acute drought. Chickpea, barley and linseed could sequestrate more carbon deep into the soil because of their deep and prolific root systems.

For improving the adaptive capacity of farmer's different other programs were undertaken in HBT area like, vaccination of cattle, *Moringa* tree and bamboo bush management.

Alongside its own action program, BARI scientists actively helped Department of Agriculture Extension (DAE) for selecting adaptation options under LACC-II project across locations. Scientists of BARI also provided all types of technological back-up for BARI mandated crops/technologies.

Introduction

About 30 % area of Bangladesh belongs to coastal area, which is regularly and recurrently battered by calamities like, cyclone, tidal bore/surge, inundation, intrusion of saline water etc costing thousand of lives and huge amount of properties (Amin et al. 2008). On the other hand main land like Barind area is affected by rabi, and kharif season drought resulting in crop failure/ low yield and loss of other livelihood factors (Brammer, 1999). It is assumed that global warming or climate change has a definite role on adverse climatic situations like increased cyclone, flood and drought. Both in coastal and Barind area large number of people depends on agriculture sector. Therefore, adaptation is important to cope with this changing climate.

Methodology

An array of adaptation measures were formulated in consultation with farmers, concerned researchers, extension personnel and other stakeholders along with careful review of available secondary information and previous experimental results. The adaptation options were experimented in a participatory manner in the farmer's field of Laudove, Dakope, Khulna (south-western area near

Sunderban) representing coastal/saline area. While for droughty area options were tested at Nachole and Shapahar of High Barind Tract area under north-western Rajshahi region. On the basis of three focus group discussion (FGD) with the participation of different stakeholders several key problems and issues were identified and action research programs were chalked out.

Adaptation to climate change in coastal/saline area of Khulna region

The tidal surge like SIDR has badly affected Sunderban and its adjoining areas. Over the years, (1973-2000) salinity of cultivable land of Khulna increased by 21 % (Islam et. 2008) mainly due to three reasons, viz. i) drastic reduction of sweet water flow from upstream in dry season, i.e. from the Padma (Ganges) and its tributaries, because of water diversion by India through Farakka barrage, ii) breaching of embankment by recurrent tidal surge/cyclone, iii) in some area artificial intrusion of saline water for shrimp cultivation by big fish businessmen in the cultivable land, popularly called "Gher". This is also called secondary salinity. This situation is changing the biodiversity of the vast area including crops and cropping patterns, trees, grasses etc., rendering a devastating impacts on health, livelihoods, and income of the farmers. The resource poor farmers and fishermen are affected most. Thus coping with the changing climate is important through modern technology, crops/trees/ varieties/cropping systems/farming systems for the overall livelihoods improvements of farm community, particularly the resource poor.

Adaptation in Homestead of coastal area

On the basis of crop suitability against salinity in Rabi and Kharif-I seasons and excess soil moisture in Kharif-II season and farmer's preference, the following year round homestead vegetable model was tested and recommended. Women farmer's choice was also considered, such as Tankuni (*Centella asiatica,* a medicinal plant cum vegetable)/Helencha (*Enhydra factuans*) was accommodated in the model for partially shady area cum excess moisture conditions. For open sunny space those rabi vegetables were selected which are tolerant at 4-6 dS/m salinity such as Knolkhol/Kholrabi(*Brassica oleracea*), Beet (*Beta vulgaris*), Spinach(*Beta bengalensis*) and Tomato ((Tisdale et al. 1997). In general salinity in homestead is low because of raised and modified soils. Commonly eight niches were observed in homestead area of Laudove, though some small homestead has less number of niches. Farmers were largely successful in producing both kharif and rabi vegetables (Table 1). Production per homestead was three times more (120 kg) in rabi season than kharif (40 kg), because kharif-II production started late. Moreover kharif production was affected by excessive rainfall. Among the produced vegetables, farmers consumed 52 %, free distributed 18 % among relative and neighbor and sold 30 % for cash income, which they need for purchasing small items including children's book, pencil and other items. Most of the earned money was hold by women. There was significant improvement in kharif season vegetable intake (Table 2), more than five times (46 g/head/day) from the bench mark (8 g/head/day). Because of excessive soil moisture farmers produced only some creepers like ash gourd on roof top. But now through making ridged bed, drainage of water has improved, and farmers were able to produce vegetables like amaranth, kangkong and Indian spinach. In rabi season also consumption of vegetable increased almost three times (92 g/head/day) from the base (32 g/head/day). On the average of 240 days, vegetable intake has increased more than three times(69 g/head/day) from the bench mark (20 g/head/day) through vegetable gardening, though it was far less than recommended requirement of 200 g/head/day for an adult. However, it is also a marked improvement for this remotely situated calamity affected island's poor people along side Sunderban (mangrove forest) where this type of endeavor is probably rare. In this island female has contributed more in homestead vegetable production (Table 3) from land preparation to intercultural managements except marketing. Because most of male partners are out of home for their livelihoods like fishing, Sunderban forest related business and other off/non farm activities. Economic analysis (Table 4) clearly showed that vegetable gardening is quite profitable bringing a gross margin of Tk. 1135/homestead costing only Tk 250/homestead (without family labor) with 4.54 benefit cost ratio (BCR). The amount of profit might be small but homestead vegetable gardening has a profound impact on family members' food habit, nutrition, consuming balanced diet in a carbohydrate (rice) dominated society (Table 5). Vegetable purchasing cost was reduced. It paved the path of obtaining safe vegetable at own homestead, as most of the commercially produced vegetable is sprayed with excessive systemic (long lasting effect) insecticides. Actually the program opened the path of major women participation in all activities including meeting, training, field day and home gardening and field works (Table 11). However, there are some limitations such as acute crisis of sweet water for vegetable cultivation in kharif-I season (February to May) and unavailability of quality seeds/seedlings.

Laudove Homestead Vegetable Model (for saline area of Khulna)

Niche 1: Sunny land (open space)

Bed 1: Knolkhol-Kangkong-Kangkong
Bed 2: Beet-Ladysfinger+ Red amaranth-Ladysfinger
Bed 3: Spinach-Indian spinach- Indian spinach
Bed 4: Tomato-Stem amaranth-Stem amaranth

Niche 2: On-roof

Roof-1: Bottle gourd-White gourd- White gourd
Roof-2: Sweet gourd-White gourd- White gourd

Niche 3: Trellis

Trellis-1: Bottle gourd-White gourd-Sponge gourd
Trellis-2: Country bean-Bitter gourd- Snake gourd

Niche 4: Partially shady area

CP-1: Moulavi Kaclu(aroid)- Moulavi Kaclu(aroid)- Moulavi Kaclu(aroid)
CP-2: Thankuni/Helencha- Thankuni/Helencha- Thankuni/Helencha

Niche 5: Marshy area

Panikachu (aroid)- Panikachu (aroid)- Panikachu (aroid)

Niche 6: On-tree support

Potato yam/Choi jhal- Potato yam/Choi jhal- Potato yam/Choi jhal

Niche 7: Home boundary/backyard

Local banana/Moringa- Local banana/Moringa- Local banana/Moringa

Niche 8: Home boundary fence

Country bean-Yard long bean- Sponge gourd

Table 1. Average production and disposal pattern of rabi and kharif season (240 days) vegetable per homestead at Laudove MLT site,Dakope, Khulna during Jul.2008- Feb.09.

Season	Total production in240 days (kg)	Total own consumption (kg)	Own* consumption (g/head/day)	Free distribution (kg)	Sold (kg)	Total cash income (Tk)
Kharif	40.17	27.4	45.66	6.77	6.0	37.22
Rabi	120.1	55.20	92.00	22.30	42.6	405.4
All season total	160.27	82.6(52)	68.83	29.07(18)	48.6(30)	442.62

Figure in parenthesis indicates percentage. * Five members in family were considered

Table 2. Average intake of homestead vegetables of 10 farmers in kharif and rabi seasons at Laudove, Dakope, Khulna, Bangladesh during July 2008- February 2009.

Season	Before intervention (g/head/day)	After intervention (g/head/day)
Kharif	8	45.66
Rabi	32	92
Total	20	68.83

*Considering only own production from homestead

Table 3. Average work distribution among the family members for the homestead vegetable production at Laudove MLT site,Dakope, Khulna during rabi and kharif season Jun.2008-Mar.09.

Name of practice	Male (%)	Female and children (%)
Land preparation	49	51
Sowing/planting	40	60
Irrigation	19	81
Intercultural operation	25	75
Harvesting	21	79
Marketing	70	30

Table 4.Economic return per homestead (240 days) at Laudove, Dakope, Khulna, 2008-09.

Vegetable name	Average total production/ bed (kg)	Vegetable price (Tk/kg)	Gross return (Tk/bed)	Average production cost in Tk./ homestead (Without family labor)	Gross margin/ homestead (Tk)	Benefit cost ratio (BCR)
Knolkhol	26.8	10	268	250	1135	4.54
Beet	25	11	275			
Spinach	19	6	114			
Tomato	49.3	9.50	468			
Kangkong	12.55	7	88			
Okra	4.7	10	47			
Indian spinach	11.22	6	67			
Stem amaranth	11.7	5	58			
Total	160.27	-	1385			

Table 5. Visual impact of the vegetable gardening (not quantified for qualitative data) on the cooperating household members, Laudove, Dakope, Khulna, 2008-09.

Sl. No.	Area of consideration	Impacts created
01.	Income and cost reduction	- Cash income increased though small amount but cost of vegetable purchasing was reduced significantly
02.	Family nutrition and health	- Consumption of vegetables increased - Positive change of consumption habit - Reduced disease infestation - No problem in eye-sight due to intake of more vegetable - No or less constipation - Visually health improved due to higher consumption of pest-free vegetable
03.	Resource use pattern	- Successful adaptation of new crops in saline environment - Homestead area utilized properly both kharif and rabi season - Farmers utilized all the available niches for vegetable production - Use of farm yard wastage
04.	Education and knowledge	- Increased knowledge of family members regarding vegetable cultivation and nutrition - Cultivation of vegetable in bed helped to reduce salinity and drainage in kharif season
05.	Social status	- Social status increased - Improved mental strength - Increased acceptability to people due to free distribution of vegetable among neighbor/relative
06.	Micro environment	- Household waste used for composting - New plantation improved environment
07.	Others	- Increased utilization of family labor
08	Women empowerment	- Active participation by women. In general women kept the sell proceeds of vegetable selling

Limitations

1. Lack of non-saline fresh water during dry season (January to May).
2. Soil salinity accompanied with drought, hot and humid weather due to recent climatic change make the situation more vulnerable.
3. Quality seed/seedling is not available in this island
4. Lack of awareness regarding modern vegetable production and nutrition

Adaptation in crop field of coastal area

Within the polder T.aman rice variety BR23 is the major crop. Is it is a photosensitive long duration variety , it took around 160 days, harvested in early December, thus timely planting/sowing of following rabi crops like mustard, wheat are delayed. Moreover yield level of BR23 is also comparatively low (400 kg/Bigha or 3 t/ha). To facilitate the timely planting of succeeding rabi crops T.aman rice variety BINA dha n4 was introduced for the first time. It was harvested on 5 November and grain yield (468 kg/Bigha or 3.5 t/ha) was 500 kg/ha higher than BR23 (Table 6). But after the harvest of T.aman planting/ relaying of mustard / cowpea /maize/wheat was not possible due to excessive water in the field. As there was enough rainfall in October, 2008 (Table 13), so relaying was possible in late November. But mustard was seriously affected by fog and aphid attack, producing zero yields. While maize growth was hampered by growing salinity during February –April (Table 12), it gave very small cobs and some plants also died. Cowpea had a very good germination and later stage growth was stunted due to excessive soil moisture. Observing this situation soil was opened with a spade to reduce soil moisture content. This operation works, and cowpea gave a reasonable yield (134 kg/Bigha, or 1t/ha) also it fetched good economic return (Table 9). Wheat germination was good, but growth was less due to excessive soil moisture, however it gave a reasonable yield (267 kg/Bigha or 2 t/ha) under zero tillage condition(Table 8), but its economic return (Table 9) was not so encouraging(only 605 Taka gross margin/Bigha with 1.17 benefit cost ratio). Crops such as sesame and mungbean were also tested but serious drought along with increase of soil salinity reduced its population below threshold level. It was also not possible to irrigate as sweet water source within polder was dried (pond/canal) due to long winter drought, on the other hand outside polder pond and river water was critically salty. Two creepers, water melon and sweet gourd were also planted in January. It survived well, also produced fruit though yield was not high (Table 10). Water melon gave 685 kg/Bigha (5.12 t/ha) fruit while sweet gourd yielded 557 kg/Bigha fruit (4.15 t/ha). Both water melon and sweet gourd has market in the locality. Water melon is exported to main land and brings cash income. Along with selling, sweet gourd is used as rainy season vegetable security, because it could be stored in house easily. Market price of both water melon and sweet gourd was a bit low due to late harvest, but it could be advanced by planting one month poly bag raised seedling. Both water melon and sweet gourd creeping vines and leaves worked as soil mulch which could effectively reduce soil evaporation and prevent rising of soil salinity. It needs small amount of water only in its base, which could be possible to supply from mini pond/Kuni or small canal within the polder. Thus making small pond at one side of a big plot is important to produce commercially viable crop like water melon. But it needs some investment. The experimentation suggests that cowpea, water melon and sweet gourd could be a viable adaptation options in post rainy season. However, testing of other field crops would continue with saline tolerant varieties along with appropriate management options for reducing soil salinity and drought.

Different adaptation options were evaluated by a good number of women farmers and other stakeholders. They opined that homestead gardening could be regarded as a successful avenue through scientific management and selection of appropriate vegetables. However, for success field crops more attention would be given to small scale water harvest. They were optimistic about short duration T.aman rice BINA dhan 4.

Table 6. Yield and yield attributing characters of T.aman rice at Laudove, Dakope, Khulna, a coastal saline area of Bangladesh during kharif season 2008.

Crop	Field duration (days)	Plant ht. (cm)	Tillers/ hill (No.)	Panicle length (cm)	Grains/ panicle (No.)	1000-grain weight (gm)	Grain yield (kg/bigha)	Straw yield (kg/ bigha)
T.aman (BINA dhan-4)	130	115	18	24	120	26	468	428
Traditional T.aman BR 23	162	-	-	-	-	-	401	-

BINA dhan-4-harvested on 5 November, 2008, BR23 –harvested on 7 December, 2008

Table 7. Yield and yield attributing characters of zero-tillage cowpea after T.aman rice at Laudove, Dakope, Khulna, a coastal saline area of Bangladesh during rabi season 2008-09

Crop	Plant population/ m^2	Plant ht. (cm)	Pod/plant	Seed/pod	1000-grain weight (g)	Seed yield (kg/bigha)
Cowpea (BARI Falon-1)	16	70	9.00	9.00	80.	134

Date of sowing: 27 Nov, 2008

Table 8. Yield and yield attributing characters of zero-tillage wheat ater T.aman rice at Laudove, Dakope, Khulna, a coastal saline area of Bangladesh during rabi season 2008-09.

Crop	Days to heading	Days to maturity	Spike /m^2	Plant ht (cm)	Spike length (cm)	Grains/ spike (No.)	1000-grain weight (g)	Grain yield (kg/ bigha)	Straw yield (kg/ bigha)
Wheat (var. Sourov)	66	105	207	69	9.38	31	36	267	309

Date of sowing-27 Nov, 2008

Table 9. Economic return from different rabi field crops after T.aman rice at Laudove, Dakope, Khulna during rabi 2008-09.

Crops	Production cost (Tk/Bigha)	Gross return (Tk/bigha)	Gross margin (Tk/bigha)	BCR
Cowpea	1200	3350	2150	2.79
Wheat	3400	4005	605	1.17

Product price: Cowpea-Tk 25/kg, Wheat-Tk 15/kg

Table10. Yield and economic return from watermelon and sweet gourd after T.aman rice at Laudove, Dakope, Khulna, 2009.

Crop	Area (Bigha)	Fruit yield (kg/Bigha)	Production cost (Tk/Bigha)	Gross return (Tk/Bigha	Gross margin(Tk/Bigha	BCR
Watermelon	0.5	685	2672	4112	1440	1.54
Sweet gourd	0.5	557	2405	3343	938	1.39

Seeding date: water melon- 8 March, 2009, Sweet gourd-8 March, 2009
Price: Watermelon-Tk. 6/kg, Sweet gourd-Tk. 6/kg, 1 Bigha = 33 Decimal or 1320 m^2 1 US$ = Tk. 69/-

Table 12. Salinity level of crop field at Laudove MLT site, Dacope, Khulna during rabi and kharif season Jun.2008- Mar.09.

Month	Salinity (dS/m)			
	10th	20th	30th	Average
Jun.08	5.50	4.30	4.45	4.75
Jul.08	3.30	3.85	2.08	3.08
Aug.08	4.40	4.80	5.00	4.73
Sep.08	3.00	2.85	2.08	2.64
Oct.08	3.95	4.05	4.25	4.08
Nov.08	3.60	3.75	6.02	4.46
Dec.08	5.50	6.20	7.01	6.24
Jan.09	7.00	6.99	8.20	7.40
Feb.09	7.91	8.00	8.50	8.14
Mar.09	8.22	9.00	7.99	8.40

Table13. Weekly and monthly rainfall (mm), monthly average maximum and minimum temperature (^{0}C) and monthly average maximum and minimum humidity (% recorded at Khulna (January 2008-March2009).

Month	Rainfall (mm)					Temperature (°C)		Humidity (%)	
	1st week	2nd week	3rd week	4th week	Total	Max.	Min.	Max.	Min.
Jan. 08	00	00	00	67	67	25.1	13.8	-	-
Feb.08	00	03	33	0	36	26.8	15.3	-	-
Mar.08	02	00	15	31	48	32.3	22.4	-	-
Apr.08	23	13	00	0	36	35.0	24.5	-	-
May.08	19	47	27	58	151	35.9	25.3	97	44
Jun.08	13	90	60	24	187	32.7	26.2	81	60
Jul.08	83	43	116	59	301	31.5	26.3	99	69
Aug.08	44	62	36	61	203	32.4	26.6	98	64
Sep.08	00	53	34	292	379	32.8	26.2	99	61
Oct.08	11	00	00	176	187	31.8	23.8	100	51
Nov.08	00	00	00	00	00	29.6	19.6	100	42
Dec.08	00	00	00	00	00	26.1	16.4	99	47
Jan. 09	01	00	00	00	00	26.2	15.2	100	40
Feb.09	00	06	00	00	00	29.4	16.9	100	31
Mar.09	00	02	00	08	10	32.2	21.1	98	31

Adaptation in homestead of droughty High Barind Tract (HBT) area

Following Barind model (Ali et al., 2007), homestead vegetable was cultivated at Nachole and Shapahar. However, production was less compared to other areas due to late start in kharif-II season and subsequent six months acute rabi and kharif-I drought. Despite the effect of drought it succeeded to provide better vegetable and nutrition security to family members with a very minimal production cost. Among the two sites of HBT area, Shapahar farmers produced markedly more (137 kg/homestead) than Nachole farmers (83 kg/homestead). On the average (Table 14) 77 % was consumed, 15 % was free distributed among relative and neighbor and rest 15 % was sold for cash income. Before intervention per head/day vegetable intake was only 24 gram. Through homestead gardening it was elevated to 64 g/head/day (Table 15), though it was far less than requirement. However, farmers got some vegetable from locally grown drought tolerant *Moringa* tree. Finding its important management options on Moringa tree has undertaken along with planting of new Moringa garden (Appendix 4). For managing drought importance must be given on water harvest and water shed management along with selection of more water efficient and drought tolerant vegetables like creepers. Because water could be a more scarce resource in this area, as underground water table is going down in Barind area due to over exploitation for boro rice production (Sevaraju et al. 2006). For home gardening women have the major role in intercultural operations, harvesting and cooking, while male has a major role in land preparation and sowing (Table 16). Economically homestead vegetable production is quite profitable in both locations of HBT (Table 17 and 18) with a marginal production cost having 2.89 to 3.28 benefit cost ratio. As family labor is utilized for its production, cost is only seed and manure/fertilizer. Women and children gave time with high enthusiasm. Malnutrition is widespread among the poverty gripped children in Barind area. As vegetable production is far less than other floodplain areas, thus it cost is also higher, which the poor farmers cannot afford. As a consequence, symptoms like lip side and tongue rupture, eye sight problem, constipation and other skin diseases are quite visible among children even among elders, particularly in winter. Many farmers and housewives have reported to us that increased consumption of vegetable from home garden has relieved them form these types of symptoms and diseases (Table 19). Thus homestead gardening though a small enterprise, yet it has role for all the family members including women, men and children. Particularly supply of safe vegetable is ensured by themselves from own homestead.

Table14. Average production and disposal pattern of homestead vegetable of 10 farmers at two different Upazila of Barind area, Rajshahi, Bangladesh, July 2008- February 2009.

Location	Total production in 240 days (kg)	Total own consumption (kg)	Own consumption (g/head/day)	Free distribution (kg)	Sold (kg)	Total cash income (Taka)
Nachole	83.00	66.00	55.00	14.73	2.27	23/-
Shapahar	137.00	87.26	72.71	18.74	31.00	310/-
Mean	110.00	76.63(70)	63.85	16.73(15)	16.63(15)	166.50/-

Figure in parenthesis indicates percentage. * Five members in family were considered

Table 15. Average intake of homestead vegetables of 10 farmers at two different Upazila of Barind area, Rajshahi, Bangladesh, July 2008- February 2009.

Location	Before intervention (g/head/day)	After intervention (g/head/day)
Nachole	25.00	55.00
Sapahar	22.50	72.71
Mean	23.75	63.85

Table 16. Average work distribution (%) among the family members for the homestead vegetables production, High Barind Tract(Nachole and Shapahar), Bangladesh 2008-09.

Operations	Men	Women and children
Land preparation	94	6
Seed/seedling sowing	62.50	37.50
Intercultural operation	22.50	77.50
Harvesting	6.50	93.50
Cooking	0	100
Marketing	82.50	17.50

Table 17. Economic return per homestead at Naclole, Nawabganj during 2008-09.

Vegetables name	Average total vegetable production (kg/bed)	Vegetable price (Tk./kg)	Gross return (Tk.)	Average production cost in Tk./homestead (Without family labor)	Gross return /homestead (Tk.)	Benefit cost ratio (BCR)
Red amaranth	6.5	8	52	255.00	737.35	2.89
I. Spinach	9.2	8	73.6			
Kangkong	6.4	7	44.8			
Katoa	4.95	6	29.7			
Spinach	5.23	11	58			
Radish	9.95	9	89.55			
Brinjal	4.53	21	95.13			
Bush bean	3.16	17	53.72			
Bottle gourd	15.05	9	135.45			
Country bean	18.02	20	360.4			
Total	83	-	992.35	-	-	-

Table 18. Economic return per homestead at Shapahar, Naogaon, during 2008-09.

Vegetables name	Total vegetable production (kg/bed)	Vegetable price (Tk./kg)	Gross return (Tk.)	Average production cost in Tk./ homestead (Without family labor)	Gross return /homestead (Tk.)	Benefit cost ratio (BCR)
Red amaranth	12	10	120	305.00	1002.50	3.28
I. Spinach	8.85	10	88.50			
Kangkong	14.30	8	114.40			
Katoa	13.30	8	106.40			
Okra	4.30	15	64.50			
Spinach	10.90	8	87.20			
Radish	13.50	10	135.00			
Bush bean	3.80	12	45.60			
Batishak	11.30	8	90.40			
Bottle gourd	25.60	10	256.00			
Country bean	19.30	15	199.50			
Total	137	-	1307.5	-	-	-

Table 19. Visual impact of the vegetable gardening (not quantified for qualitative data) on the cooperating household members, High Barind Tract (Nachole and Shapahar) 2008-09.

Sl. No.	Area of consideration	Impacts created
01.	Income and cost reduction	- Cash income increased though small amount but cost of vegetable purchasing was reduced significantly
02.	Family nutrition and health	- Consumption of vegetables increased - Positive change of consumption habit - Reduced disease infestation - No problem in eye-sight due to intake of more vegetable - No or less constipation - No rupture of lip side and tongue due to increased intake of vegetable - Visually health improved due to higher consumption of pest-free vegetable
03.	Resource use pattern	- Introduction of new water efficient crops - Homestead area utilized properly including use of all niches - Use of farm yard wastage
04.	Education and knowledge	- Increased knowledge of family members regarding modern vegetable cultivation and nutrition
05.	Social status	- Social status increased - Improved mental strength - Increased acceptability to people due to free distribution of vegetable
06.	Micro environment	- Household waste used for composting - New plantation improved environment
07.	Others	- Utilization of family labor increased
08.	Women empowerment	- Active participation from women. Mostly women kept the sell proceeds of vegetable selling

Adaptation in crop field of High Barind Tract

On the basis of secondary information and FGD field crops were selected. The drought tolerant, deep rooting, low water requiring crops like chickpea, barley and linseed (Ali et al, 2007) were selected for growing under rainfed conditions. Wheat was selected because it requires minimal (two) supplementary irrigation which could be supplied from big pond. It may be mentioned that for production of one kg wheat 1000 liter water is needed whereas boro rice requires 3000 liter water for production of one kg rice (Ali et al, 2008). Chickpea was grown as sole crop or as mixed cropping with barley or linseed to facilitate better utilization of soil nutrients, moisture, sunlight and space.

However, yield of all the dry land crops were comparatively less because of serious drought during November to April. Moreover in 2008 there was low rainfall (Table 26) , thus amount of residual soil moisture was also low. Hence, chickpea, linseed and barley crop growth was below optimum level resulting in lower yield (Table 20, 21 and 22). However, mixed cropping of chickpea with barley produced better yield at Nachole, might be due to complimentary combination along with deep and prolific root systems of barley (Ali et al. 2007). However, other possible reasons of low yield of chickpea were identified by close observation of chickpea field and subsequent soil chemical analysis. Low pH (below 5.5) of some field rendered molybdenum deficiency along with very low soil organic matter (around 0.8%) caused poor growth and yield of chickpea. Generally legume crop like chickpea needs >5.5 soil pH. Small amount of molybdenum application could increase chickpea yield significantly (Johansen et al, 2008). Long foggy weather during day time for more than one month could have hampered normal photosynthesis resulting in yield reduction. This is also applicable for wheat and other winter crops.

Wheat yield was moderate at Nachole (347 kg/Bigha or 2.6 t/ha) and at Shapahar it produced only 267 kg/Bigha or 2.2 t/ha (Table 23). Economic analysis (Table 24 and 25) suggests that chickpea and its mixed cultivation with barley and linseed was quite profitable compared to wheat, because of lower production cost and higher market price of chickpea. Across locations wheat gave 1.18-1.37 benefit cost ratio (BCR), whereas sole chickpea had 2.45-2.68 BCR, chickpea+barley fetched 3.43 BCR and chickpea +linseed gave 2.38 BCR. Thus as a dry land crop chickpea, linseed and barley has more prospect for coping with drought and climatic change because of their low water requirement (except germination) and deep and prolific root systems. Also above three crops could sequestrate more carbon deep into the soil through their deep and prolific root systems.

Table 20.Pilot production program of chickpea under Chickpea-T.aman cropping pattern, High Barind Tract, Rajshahi, 2008-09.

Parameter	Nachole	Shapahar	Effect of drought
Date of sowing	24-26 Nov., 2008	25-30 Nov., 2008	During chickpea growing period (November-March) almost there was no rainfall; moreover often deep fog hampers photosynthesis of the crop. Additionally there was small rainfall in October, that is residual soil moisture storage was low, resulting in poor growth of chickpea crop
Date of harvest	24-26 Mar., 2009	30 Mar., 2009	
Field duration (days)	119	120	
Plant population/m2	17	37	
Plant height (cm)	30	36.7	
No. of pod/plant	24	30.5	
No. of seed/pod	1.3	2.0	
Grain yield (kg/Bigha)	73	82	
Biomass yield (kg/Bigha)	77	80	

20 Bigha in each location

Table 21. Pilot production program of mixed cropping of chickpea with barley (20 %) under Chickpea + barley-T.aman cropping pattern, High Barind Tract, Nachole, Nawabganj, 2008-09.

Parameter	Chickpea	Barley	Effect of drought
Date of sowing	18 Nov.2008	18 Nov., 2008	During crop growing period (November-March) almost there was no rainfall; moreover often deep fog hampers photosynthesis of the crop. Additionally there was small rainfall in October, that is residual soil moisture storage was low, resulting in poor growth of chickpea crop
Date of harvest	26 Mar., 2009	26 Mar., 2009	
Field duration (days)	128	128	
Plant population/m2	13	04	
Plant height (cm)	47	67	
No. of pod/plant	42	18	
No. spikelet/panicle			
No. of seed/pod	1.2	54	
No. of grains/panicle			
Grain yield (kg/Bigha)	107	40	
Biomass yield (kg/Bigha)	93	60	

3 Bigha block

Table 22. Pilot production program of mixed cropping of chickpea with linseed under Chickpea + linseed -T.aman cropping pattern, High Barind Tract, Shapahar, Naogaon, 2008-09.

Parameter	Chickpea	Linseed	Effect of drought
Date of sowing	27 Nov.2008	27 Nov., 2008	During crop growing period (November-March) almost there was no rainfall; moreover often deep fog hampers photosynthesis of the crop. Additionally there was small rainfall in October, that is residual soil moisture storage was low, resulting in poor growth of chickpea crop
Date of harvest	30 Mar., 2009	30 Mar., 2009	
Field duration (days)	123	123	
Plant population/m2	32	60	
Plant height (cm)	34.2	66	
No. of pod/plant No. spikelet/panicle	29	23.6	
No. of seed/pod No. of grains/panicle	2	8.2	
Grain yield (kg/Bigha)	80	10	
Biomass yield (kg/Bigha)	72	14	

3 bigha block

Table 23. Pilot production program of Wheat under Wheat-T.aman cropping pattern, High Barind Tract, Rajshahi, 2008-09

Parameter	Nachole	Shapahar	Effect of drought
Date of sowing	24 Nov.2008	18 Nov., 2008	During crop growing period (November-March) almost there was no rainfall; moreover often deep fog hampers photosynthesis of the crop. Additionally there was small rainfall in October, that is residual soil moisture storage was low, resulting in poor growth of chickpea crop
Date of harvest	25 Mar., 2009	22 Mar., 2009	
Field duration (days)	120	123	
No. of effective tiller/m2	241	251	
Plant height (cm)	92	95.2	
No. spikelet/panicle	18	14.1	
No. of grains/panicle	33	34.8	
Grain yield (kg/bigha)	347	296	
Biomass yield (kg/bigha)	681	-	

3 bigha block

Table 24. Economic return from different rabi crops after T.aman rice at Nachole, High Barind Tract during rabi 2008-09.

Crops	Production cost (Tk/Bigha)	Gross return (Tk/bigha)	Gross margin (Tk/bigha)	BCR
Sole chickpea	1100	2695	1595	2.45
Chickpea+Barley	1250	4285	3035	3.43
Wheat	4008	5505	1497	1.37

Table 25. Economic return from different rabi crops after T.aman rice at Shapahar, High Barind Tract during rabi 2008-09.

Crops	Production cost (Tk/Bigha)	Gross return (Tk/bigha)	Gross margin (Tk/bigha)	BCR
Sole chickpea	1100	2950	1850	2.68
Chickpea+Linseed	1270	3029	1759	2.38
Wheat	4008	4740	732	1.18

Biomass return included in both Nachole and Shapahar. Product price in both location: Chickpea-Tk 35/kg, Barley-Tk 10/kg, Wheat-Tk 15/kg, Linseed-Tk 15/kg

Table 26. Twelve years (1998- May 2009) monthly rainfall (mm) of Rajshahi, Bangladesh.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1998	12	5	51	33	129	92	436	276	280	208	33	0	1555
1999	5	8	25	9	144	348	347	310	502	155	108	0	1961
2000	4	7	27	136	200	244	117	191	642	85	0	0	1653
2001	0	4	9	13	214	324	337	211	97	185	1	0	1395
2002	11	1	21	111	195	223	316	240	281	49	11	0	1459
2003	2	19	64	44	84	280	238	131	262	293	0	8	1425
2004	10	0	0	63	85	503	305	217	361	152	0	0	1696
2005	13	1	101	34	106	92	493	147	115	268	0	0	1370
2006	0	0	7.4	37.2	191.2	189	120.4	217.8	304	35.2	10.4	0	1112.6*
2007	0	26.6	59.4	54	125.6	309.6	325	235.7	306.9	75.4	0.6	0	1518.8
2008	25	0.6	0.4	22.4	131.6	256.9	221.5	245.5	127.5	127	0	0	1158.4*
2009	1	7	27.9	0	-	-	-	-	-	-	-	-	-
Mean	6.92	6.60	32.76	46.38	145.95	260.14	295.99	220.18	298.04	148.42	14.91	0.73	1482.16
SD (±)	7.57	8.26	30.54	40.68	46.97	116.99	116.53	51.69	163.98	85.24	32.46	2.41	240.05

*Exceptionally high rainfall year. ** Exceptionally low rainfall year , i.e. drought.

- High standard deviation (SD) indicates uncertainty of monthly rainfall

Table 27. Five years (2005 - May 2009) average temperature (^{0}C) of Rajshahi, Bangladesh

Month	2005		2006		2007		2008		2009	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
January	9.4	26.4	6.5	29	6.2	18.3	11.09	23.74	12.35	24.49
February	8.9	33.2	12.8	35.4	10.6	30.5	11.96	25.59	12.56	29.45
March	15.2	36	13.7	39.6	11.9	37.5	20.12	33.03	17.96	33.39
April	18.9	38.6	20	38.8	18.5	39	23.07	36.33	23.89	37.44
May	19.4	39.8	21	39	20.9	39.2	24.25	35.43	-	-
June	24	42.4	22.5	36.8	25.59	33.77	25.71	32.64	-	-
July	24	34	25.2	36.4	26.05	32.45	25.98	31.95	-	-
August	24.2	35.5	25.2	35.8	26.56	33.17	26.37	32.77	-	-
September	23.4	36.2	24	35.5	26.06	32.85	25.84	32.24	-	-
October	19	33	21.7	34.6	23.29	31.9	22.56	31.79	-	-
November	14	31.4	10.4	31.5	18.45	29.75	16.55	29.59	-	-
December	10.2	27.8	9.7	27.4	11.54	25.42	15.04	25.01	-	-
Mean	17.55	34.53	17.73	34.98	18.80	31.98	20.71	30.84	-	-

Improved livestock management for livelihood adaptation in High Barind Tract

Livestock (poultry, goose, goat. sheep, cow and buffalo) is an integral part of farm family's livelihoods. It does not only provide draft power, meat, and milk or cash income by selling, but its dung is used as manure for fertilizing crop field/homestead and also largely used as fuel (dung cake). Moreover, many landless and marginal farmers major income source is grazing of cattle, goat and sheep in the Barind area. However, village area livestock is generally out of modern veterinary care, which makes it vulnerable to deadly diseases. Thus loss of birds and animal has a tremendous negative impact on the poor farmer's livelihood. Therefore, to create farmers awareness vaccination program was arranged with the help of local veterinary doctor against major diseases. Both in Nachole and Shapahar 411different birds and animal were vaccinated Table 26 & 27).

Table 26. Livestock improvement program under LACC-II, Nachole, Nawabjang, 2008.

Activities	Number of Cooperators	Date of vaccination	No. of animal vaccinated	Name of vaccine
Vaccination of Poultry	35	03.09.2008	285	RDV & Duck Plague
Vaccination of Goose	25	do	63	do
Vaccination of Goat	10	do	15	PPR
Vaccination of Cattle	25	do	13	FMD & Anthrax
De-worming of cattle	10	do	35	-
	Total =		411	-

Table 27. Livestock improvement program under LACC-II, Shapahar, Noagaon, 2008.

Activities	Number of Cooperators	Date of vaccination	No. of animal vaccinated	Name of vaccine
Vaccination of Poultry	25	06.08.2008	156	RDV & Duck Plague
Vaccination of Goose	10	do	55	do
Vaccination of Goat	15	do	20	PPR
Vaccination of Cattle	32	do	160	FMD & Anthrax
De-worming of cattle	12	do	50	-
	Total =		441	-

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Adoption and Impact of Homestead Vegetables Production Model in Goyeshpur, Pabna

Abstract

The study was conducted at the FSRD site, Goyeshpur, Pabna to assess the adoption and impact of homestead vegetables production module of Goyeshpur during April-May 2009. A total of twelve farmers as well as homestead vegetables production models were selected purposively as sample to collect necessary information for the present study. The study showed that the level of adoption of the technologies was medium to low. The vegetables production rate was 47 percent lower compared to project period (2000). The over all impact on socio-economic parameters of the farmers increased by 71 percent for practicing the homestead vegetables production model.

Introduction

Homestead land has been defined as the land owned by the dwelling units of the households surrounding the dwelling units including kitchen, cowshed, court yard, pond, roads, space around homestead, space used for cultivation of trees and vegetables. The government of Bangladesh has placed great emphasis on vegetables, especially, homestead vegetables production round the year to meet the nutritional and caloric need of the growing population and for increasing employment opportunities and income of the farmers. The land area available for crop production is decreasing rapidly due to construction of roads, building and industries, but at the same time the demand for all agricultural products is increasing. Thus it is needed to open new avenues for increasing production. Though the homestead of Bangladesh are already in use, renewed intervention for their intensive utilization system for their potentials in employment and income generation, poverty alleviation and improvement of nutritional food security and other benefits. Vegetables are rich in vitamin and mineral. Regular intake of vegetables can effectively protect people of all ages against mal nutrition and under nutrition, an in ability to see normally in dim light (night blindness), which is caused by vitamin A deficiency in the body (Sabur, 1990). Per capita consumption of vegetable is only 80 g/day (HRC, BARI, 2007), in comparison to daily requirement of 220 g/day/head (FAO, 1999). Intensive vegetables production can provide not only nutritional security but also be helpful for employment generation and higher farm income. Female labor can also be used in the homestead vegetables production unit. On-Farm Research Division has developed some location specific homestead vegetables model over the country under different AEZs. These models are practicing by the farmer during the last ten years and supplying fresh vegetables round the year. By using the model many unutilized/under utilized area has come to under vegetables growing unit with planned and productive way. Considering this context the impact status of these vegetables model should be assessed in the farmer's level. Therefore, the present study is under taken to meet up the following objectives.

Objectives

i) To see the adoption status of homestead vegetable model.
ii) To assess the impact of homestead vegetables production model.
iii) To know the vegetable utilization pattern.
iv) To identify the constraints of vegetables production model.

Methodology

The study was conducted at the FSRD site, Gayeshpur, Pabna during April-May 2009 to assess the adoption and impact of homestead vegetables production module of Gayeshpur. Twelve farmers as well as homestead vegetables production models were brought under consideration who were produced vegetable with the Goyeshpur model during the project year 2000. All these model 12 homestead vegetables production models were selected as sample to collect necessary information for the present study. The selected farmers were under marginal (0.1-0.50 ha) farm category. Data were collected by pre tested survey schedule, face to face interview method and participatory approach from all the farmers who were practicing vegetable model. The impact and adoption level were tested with the result during project period (2000) and nine years later of the project period i.e. present situation (2009). The problems were identified with Focus Group Discussion (FGD) approach. Purposive sampling technique was followed for selecting sample farmers. The collected data were then tabulated, summarized, analyzed and presented in tabular formula.

Calculation of Gross Return and Gross Margin

Gross return of each technology was calculated by multiplying the yield with their unit price. Gross margin is the difference between gross return (GR) and total variable cost (TVC). Gross return and gross margin can be calculated with the following formula.

Gross return = Product yield $\times$ Unit price

Gross margin = Gross return-Total variable cost.

Calculation of PIS

Perceived Impact Score (PIS) technique was used to highlight overall impact of technologies PIS was computed for each changed item by summing the weights for responses of all the sample farmers against that change item (Khatun, 1999). The weights assigned were 3, 2, 1 and 0 for excellent change, moderate change, average change and no change, respectively. In order to make a meaningful comparison of data, the PIS for a particular change item was standardized by using the following formula;

$$SPIS = \frac{\text{Observed perceived impact score}}{\text{Possible perceived impact score}} \times 100$$

Level of Adoption

The level of adoption was measured by computing adoption scores for recommended technologies. Score was given to each technology that varied from 1 to 4 according to the adoption of the suggested technology. A respondent farmer could get a score of 4 for adopting cent percent of technologies. On the other hand farmers could receive a score of 3 for 75% adopting, 2 for 50% adopting and 1 for 25% adopting (Hossain, 1997). The mean score became the index of level of adoption of the recommended technologies. On the basis of the score that earned by the farmers were categorized as high=≥ 3, medium=≥ 2, low = ≥ 1 and very low= ≤ 1 level of adopters respectively.

Results and Discussion

Socio-economic characteristics of the sample farmers

Socio-economic characteristics affect the production, management practice and other activities of homestead vegetables production. The characteristics were considered as age, education, family size occupation etc. Age itself is an influencing factor for the acceptance of improved technology and in taking risk. It was showed that 17 percent farmers were under 30-40 age group, 50 percent under 41-50 and 33 percent were under 51-60 age group. About 8 percent farmers were able to sign their name. Another 17 percent belonged to the education level of class I-V and 33 percent under VI-X. The rest 42 percent were under XI-XII class. The average family size (5.5) was 17 percent higher than that of national average (4.8) of Bangladesh (BBS, 2001). The percentage of male was 55 and female was 45 in the study area. About 50 percent of the sample farmers were engaged with agriculture and 42 percent with agriculture+ business. The rest 8 percent were engaged with agriculture + service in the study area. On an average the sample farmers had 0.13 ha homestead area of which 0.06 ha was for vegetable growing purpose, 0.09 ha was occupied by houses, roads, trees, ponds etc. and 0.03 ha was unutilized area. The average cultivated area was found to be 0.18 ha.

Technology intervened in homestead vegetables production model

Farmers produced different types of vegetables in homestead area primarily for family consumption and surplus to sell. Farmers were producing vegetables into 10 resources/production units during both the project period (2000) and present situation (2009).The resources were open space, roof, trellis, tree support, fence, partial shady area, marshy land, homestead boundary, back yard and pond back etc. Farmers produced vegetables from each and every possible production units efficiently for own consumption and surplus to sell for more cash income during the project period (2000). It was found that farmers got 1037 kg/farm vegetables. Gross return was Tk.10735, Total variable cost was Tk.1133 and gross margin was Tk. 9602 during project period (2000) (Table 1). On the other hand, after nine years of the project (at present situation) they could produce 630 kg/farm vegetables which was 39 percent lower than project period that may be due to assigning lower priority in homestead gardening. Gross return (Tk. 8515) and gross margin (Tk. 5810) also found lower in the present situation (2009) (Table 3). The result indicated that higher yield as well as gross margin was possible to the project period for adopting of more new technologies and optimized use of resources may be due to regular supervision and monitoring as well as ensured technical support to the farmers.

Disposal pattern of vegetables grown in Goyeshpur Model

Farmers in the study area produced vegetables in homestead for home consumption and good economic return also. It was found that 35% of the total production was consumed by farmers. About 56 percent vegetable were sold and rest 9 percent with distributed among the neighbours during project period (2000) (Table 2). It was also observed that 48 percent of the total production of vegetables was sold by the farmers. About 38 percent vegetables were consumed and rest 14 percent was distributed to the neighbor and relatives at present situation (Table 4). It was also noticed that per family member consumed 116 g vegetables per day which was lower than recommendation (220 g/day/person: FAO, 1999).

Adoption level of intervened technologies

For adoption level, the sample farmers were classified into 4 categories based on the mean scores of the farmers in respect of technologies given in each production unit. The mean score and adoption categories were shown in Table 5. The highest score (3.0) was found in trellis which indicated high level of adoption. The adoption level of the rest technologies were in medium to low level.

Socio-economic impact of homestead vegetables production model

Seven socio-economic parameters were considered for describing the impact of homestead vegetables production model such as social status, health condition, resource use, savings, technical knowledge, food habit and household micro environment etc. It was observed that minimum of 60 percent to maximum of 80 percent for average change of these social parameters. Minimum of 8 percent to maximum of 20 percent for no chance and minimum of 10 percent to maximum of 32 percent for moderate change had been occurred in socio parameters (Table 6). The overall SPIS of seven social parameters was found to be 71 percent indicating that over all change in social parameter of the farmers increased by 71 percent for involving himself in the homestead vegetable production model. The highest observed SPIS was 83 percent for food habit changes and the lowest 56 percent for house hold micro environment (Table 7).

Problems faced by the sample farmers

Problems were identified through focus group discussion with the sample farmers. Most of the farmers (76%) reported that high price of input for vegetable production. About 71 percent farmers opined that motivation work and extension programme is poor at present may be due to sifting of the FSRD site. About 68 percent farmers reported that they did not get quality seed and guide line for the improved technology. About 40-65 percent sample farmers also opined that they did not get training on vegetables cultivation so their level of technical knowledge is getting low, family members are scattered for education, business and service oriented activities so they did not get interest for home gardening as well as proper utilization of land. The sample farmers also identified some constraints of the vegetable production model as i) approach of the model was top down ii) farmer's choice was not considered for variety/seed selection iii) participatory approach did not work efficiently and iv) land less and marginal farmers were considered mainly as cooperator farmers for implementing the program.

Conclusion

Homestead vegetables production model is a model for natural fridge of vegetables which able to supply fresh vegetables as well as nutrition round the year and source of good economic benefit for the marginal farmers. The result of project period (2000) showed the model was profitable but present study showed in sufficient use of unused resources as well as low vegetables production due to above mentioned constrains which caused low yield and benefit. The study also revealed that the technology adoption level was medium to low in the study area. Presently, vegetables consumption rate was found low compared to project period due to low vegetables production.

Recommendations

On the basis of the findings of the study the following recommendations were made with a view to improve the vegetables production model

- Training program should be arranged to improve the technical knowledge of the farmers.
- Linkage should be increased and strengthened between extension, NGOs and farmers.
- Motivational program should be arranged to encourage the farmers towards vegetables production model.

So, by minimizing the constraints of vegetables production model, research-extension and non government organizations could give more attention for better living style of the farmers.

Table 1. No. of technologies intervened, yield, return and gross margin in homestead during Project period (2000) at the FSRD site, Goyeshpur,Pabna

Resource area	Technology used			Area (dec.)	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)
Open space Bed-1	Radish	Stem amaranth	Indian spinach	2	132	1160	150	1010
Bed-2	Cabbage	Brinjal	Red amaranth		80			
Bed-3	Tomato	Spinach	Okra		31			
Roof	Bottle gourd	Wax gourd		3	195	1783	210	1520
Trellis	Bottle gourd	Sweet gourd		1	193	2090	240	1850
Tree support	Bitter gourd Country bean Snake gourd	Yard long bean Ribbed gourd Potato yam	Sponge gourd	8 No.	83	812	70	742
Fence	Bitter gourd	Yard long bean	Bitter gourd	200m	56	640	90	550
Partial shady area	Elephant foot yam, Ginger	Leaf aroid, Chilli		1	70	665	65	600
Marshy land	Panikachu	Pani kachu	Panikachu	1	85	590	50	540
Homestead boundary	Papaya, Guava, Lemon			1	125	1313	78	1235
Back yard	Plantain banana, Drumstick			2	40	560	30	530
Pond bank	Country beam, bottle gourd	Sweet gourd/bitter gourd		8	95	1175	150	1025
					1185	10735	1133	9602

Source: Annual Research Report 2000 OFRD, Pabna

Table 2. Vegetable consumption pattern by the sample farmers during project period (2000) at the FSRD site, Goyeshpur, Pabna

Production unit/resource area	Total production(kg)	Consumed (kg)	Distributed (kg)	Sold (kg)
Open space	243	90	21	132
Roof	195	68	18	109
Trellis	193	70	17	106
Tree support	83	30	9	44
Fence	56	21	5	30
Partial shady area	70	25	6	39
Marshy land	85	26	7	52
Homestead boundary	125	43	10	72
Back yard	40	15	3	22
Pond bank	95	32	8	55
	1185	420 (35 %)	104 (9%)	661 (56%)

Table 3. No. of technologies intervened, yield, return and gross margin in homestead during Present situation (2009) at the FSRD site, Goyeshpur,Pabna.

Resource area	Technology used			Area (dec.)	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)
Open space								
Bed-1	Radish	Stem amaranth	Indian spinach	No bed	60	240	200	40
Bed-2	Cabbage	Brinjal	Red amaranth	5 decimal	55	875	500	375
Bed-3	Tomato	Spinach	Okra		40	400	50	350
Roof	Bottle gourd	Wax gourd			80	1600	250	1350
Trellis	Bottle gourd	Sweet gourd		4 decimal	150	1150	650	500
Tree support	Bitter gourd	Yard long bean	Sponge gourd	1 decimal	5	50	25	25
	Country bean	Ribbed gourd			20	200	20	180
	Snake gourd	Potato yam						
Fence	Bitter gourd	Yard long bean	Bitter gourd	$120m^2$	5	100	50	50
Partial shady area	Elephant foot yam, Ginger	Leaf aroid, Chilli		$20m^2$	10	750	250	0
Marshy land	Panikachu	Pani kachu	Panikachu	3 decimal	30	200	80	120
Homestead boundary	Papaya, Guava, Lemon			$60m^2$	75	750	300	450
Back yard	Plantain banana, Drumstick			$20m^2$	40	400	300	100
Pond bank	Country beam, bottle gourd	Sweet gourd/ bitter gourd			60	1800	30	1770
					630	8515	2705	5810

Table 4. Vegetables utilization pattern by the sample farmers at the FSRD site, Goyeshpur, Pabna during 2009.

Production unit/resource area	Total production (kg)	Consumed (kg)	Distributed (kg)	Sold (kg)
Open space	155	105	20	30
Roof	80	20	10	50
Trellis	150	30	20	100
Tree support	25	10	5	10
Fence	5	5	-	-
Partial shady area	10	3	-	7
Marshy land	30	10	5	15
Homestead boundary	75	25	15	35
Back yard	40	15	5	20
Pond bank	60	15	10	35
	630	238 (38%)	90 (14%)	302 (48%)

Table 5. Adoption level of intervened technologies used by the sample farmers at the FSRD site, Goyeshpur, Pabna during 2009

Resource area	Weighted Score (N = 12)	Mean Score	*Adoption level	Reasons
Open place	31	2.1	Medium	Reluctant for making bed to grow vegetables
House roof	16	1.3	Low	For decreasing the longevity of the roof
Trellis	36	3.0	High	Adopting from the beginning
Shady area	30	2.5	Medium	Lack of motivation and low income
Marshy land	17	1.4	Low	Lack of motivation and low income
Tree support	22	1.8	Low	Unavailability of non fruit trees
Pond Bank	14	1.2	Low	High cost involved for trellis
Back yard	34	2.8	Medium	Lack of inspiration or consciousness
Fence	20	1.6	Low	Lack of motivation
House Boundary	35	2.9	Medium	Adopting from the beginning

*Adoption level: $\geq$3= high, $\geq$2 = Medium, $\geq$1=Low and $\leq$1= very low

Table 6. Socioeconomic impact of homestead vegetable production model at the FSRD site, Goyeshpur, Pabna during 2009

Parameters	No change	Average change	Moderate change	Excellent change	Total
Social status	10	70	20	-	100
Health condition	8	60	32	-	100
Resource use	10	75	15	-	100
Saving	20	80	-	-	100
Technical knowledge	15	75	10	-	100
Food habit	20	80	-	-	100
Household micro environment	20	60	20	-	100

Table 7. Impact of homestead vegetable production model on the basis of PIS at the FSRD site, Goyeshpur, Pabna during 2009.

Parameters	Perceived impact score (PIS)	Standardized perceived impact core (SPIS)	Percentage (%)	Rank
Social status	26	72	14	4
Health condition	28	77	15	3
Resource use	23	64	13	5
Saving	25	69	14	4
Technical knowledge	28	78	16	2
Food habit	30	83	17	1
Household micro environment	20	56	11	6
Over all SPIS		71		

Table 8. Problems faced by the sample farmers at the FSRD site, Goyeshpur, Pabna during 2009

Sl. No	Nature of problems	% farmers responded	Ranks of problem
1.	High price of input	76	1
2.	Lack of extension service and motivation	71	2
3.	Non-availability of quality seed and production technology	68	3
4.	Withdraw of FSRD site office	64	4
5.	Lack of training program	61	5
6.	Lack of technical knowledge	61	5
7.	Family members are scattered	46	6
8.	Lack of interest on vegetable model	40	7
9.	Lack of interest on proper utilization of land	40	7

Input Use and Profitability of Different Crops under Major Cropping Patterns in Some Selected Areas of Bangladesh

Abstract

The study was conducted at the FSRD site, Kadamshahar, Barind of Rajshahi and FSRD site, Lahirirhat of Rangpur during April-May, 2009 to document the input use level and to estimate the profitability of crops in major cropping patterns. A total of 80 sample farmers (40 farmers from each location) were selected to collect necessary primary data with the help of pre-designed survey schedule by group discussion, participatory approach and face to face interview method. Purposive sampling technique was followed for selecting the sample farmers. Data were collected from total 6 major cropping patterns of both the locations. The three major cropping patterns in FSRD Site, Barind were Tomato-Boro-T.aus, Mustard-Boro-T.aman and wheat-T.aman and the rest 3 major cropping patterns in FSRD Site, Rangpur were Potato-Boro-T.aman, Boro-T.aman and Potato-Maize-T.aman. The study revealed from Kadamshahar, Barind of Rajshahi that considering the Tomato-Boro-T.aus cropping pattern, the total production cost, gross return, net return and BCR were Tk.318960, Tk.448275, Tk.129315 and 1.25, respectively. In Mustard-Boro-T.aman cropping pattern, the total production cost, gross return, net return and BCR were Tk.156801, Tk.198300, Tk.41498 and 1.31 respectively. In Wheat-T.aman cropping pattern, the total production cost, gross return, net return and BCR were Tk.93158, Tk.104070, Tk.10912 and 1.12, respectively in the study area. On the other hand, it was observed from Lahirirhat, Rangpur that considering Potato- Boro-T.aman cropping pattern, the total production cost, gross return, net return and BCR were Tk.232842, Tk.316654, Tk.83812 and 1.31, respectively. In Boro-T.aman cropping pattern, the total production cost, gross return, net return and BCR were Tk.107781, Tk.132096, Tk.24315 and 1.27, respectively. In Potato-Maize-T.aman cropping pattern, the total production cost, gross return, net return and BCR were Tk.210297, Tk.335969, Tk.125673 and 1.63, respectively in the study area.

Introduction

The crop sector of Bangladesh agriculture is trying to produce more food to meet the requirements of ever growing population. The need of the hour is to achieve substantially higher crop yield than the present yield levels from our limited land resources on a sustainable basis. A crop production system with high yield targets cannot be sustainable unless proper nutrient inputs are applied in crop field. Although per unit cost and returns in the agricultural field is important for farm management. The basic understanding of cost and return is the understanding and knowledge concerning with the relationship between products/outputs and the cost incurred for input factors. This relationship depends on time, price and variable and fixed factors of production. Cost and return related information is important to assess the profitability of crop cultivation. Profitability of a crop depends on yield, price of the product and cost of inputs. Any variation in any of the above factors will change the profitability. Yield, price and cost are also changed over time, place and different management practices.

Information about input use level, yield cost and return of different crops in major cropping pattern play a significant role in agriculture sector of Bangladesh. It is also important and demand full to researchers, extension workers, policy makers and NGOs to plan new enterprises for future agriculture production. The wage rate, price of different inputs and output are changing over the time. So, current and updated information is needed to calculate the cost and return of different major crops. No effort was given yet before to consolidate the relevant information on cost and return of different crops in major cropping patterns. Therefore, the present study is under taken to meet up the following objectives.

Objectives

- To document the input use level of different crops under major cropping patterns.
- To estimate the profitability of the crops in major cropping pattern.

Methodology

The study was conducted at the FSRD site, Kadamshahar, Barind of Rajshahi and FSRD site, Lahirirhat of Rangpur, during April-May, 2009 to document the input use level and to estimate the profitability of crops in 3 major cropping pattern, A total of 80 sample farmers (40 farmers from each location) were selected to collect necessary primary data with the help of pre-designed survey schedule by group discussion, participatory approach and face to face interview method. Purposive sampling technique was followed for selecting the sample farmers. Data were collected from 6 major cropping patterns of both the locations of which 3 major cropping patterns (Tomato-Boro-T.aus, Mustard- Boro-T.aman and Wheat-T.aman) from Kadamshahar, Barind of Rajshahi and the rest 3 major cropping patterns (Potato-Boro-T.aman, Boro-T.aman, and Potato-Maize-T.aman) from Lahirirhat, Rangpur. Cost and return were calculated based on the prevailing market price of each input and output for all crops in major cropping pattern in each location. Interest on operating capital was calculated at the rate of ten percent interest rate with four months duration of the crops. Farmers provided the primary information from their memories during interview. The collected data were tabulated, summarized, analyzed and presented in tabular form. Farmers were interviewed by the researcher himself and Scientific Assistants or Senior Scientific Assistants who were employed in the mentioned FSRD sites. Enterprise costing technique was followed in calculating cost and return. Profitability was done based on net return analysis according to Dillion and Hardaker (1980). Per hectare cost and return was calculated in single crop as well as whole pattern basis.

Results and Discussion

Location : FSRD site Kadamshahar, Barind, Rajshahi

Tomato-Boro-T.aus: It was the first major cropping pattern in the study area. Farmers used Sabal/Surakkha as a variety of Tomato, BRRI dhan 28 as the variety for Boro and BR26/Parija for T.aus. They applied 375-150-75 kg Urea-TSP-MOP ha^{-1} in Tomato, 188-75-38-38 kg Urea-TSP-MOP-Gypsum ha^{-1} in Boro and 225-75-38 kg Urea-TSP-MOP ha^{-1} in T.aus rice. The average yields were found 3394 kg ha,$^{-1}$ 5100 kg ha^{-1} and 3150 kg ha^{-1} from Tomato, Boro and T.aus, respectively. It was observed that MOP applied in lower rate in tomato and Boro but high in T.aus under Tomato-Boro-T.aus cropping pattern compared to recommendation (185-150-90-56-6 kg Urea-TSP-MP-Gypsum-Boric acid for Tomato, 210-75-90-45 kg urea-TSP-MOP-Gypsum ha^{-1} for Boro and 108-30-24-22 kg Urea-TSP-MOP-Gypsum ha^{-1} for T.aus according to FRG 2005).

It was observed that the total production cost of Tomato was Tk.220350 and total cost of Boro was Tk.62108 while it was Tk.36562 per hectare for T.aus rice. The gross return was Tk.339375, Tk.67200 and Tk.41700 per hectare for Tomato, Boro and T.aus, respectively. The net return received by the farmers was Tk.119025, Tk.5092 and Tk.5198 ha^{-1} from Tomato, Boro and T.aus rice, respectively. The benefit cost ratio was 1.54 for tomato, 1.08 for Boro and 1.14 for T.aus, respectively. The study revealed that per kg Tomato production cost was Tk.6.49, Tk.12.18 for Boro while it was Tk.11.59 for T.aus rice (Table 1). Considering the Tomato-Boro-T.aus cropping pattern, the total production cost, gross return, net return and BCR were Tk.318960, Tk.448275, Tk.129315 and 1.25, respectively in the study area.

Mustard-Boro-T.aman: Farmers cultivated the crops under Mustard-Boro-T.aman cropping pattern in medium high land in the study area. Farmers used Tori-7 as a variety of mustard, BRRI dhan 28 as the variety of Boro and BR11/ Sarna as T.aman. They did not use manure in this pattern. Urea was applied as top dress once in Mustard and twice in Boro and T.aman. They applied 38-113-75 kg Urea-TSP-MOP ha^{-1} in Mustard, 225-113-75 kg Urea-TSP-MOP ha^{-1} in Boro and 150-75-75-37 kg Urea-TSP-MOP-Gypsum ha^{-1} in T.aman. Yield was estimated 1470 kg ha^{-1} for Mustard 5325 kg ha^{-1} for Boro and 4350 kg ha^{-1} for T.aman. Yield was satisfactory for all crops in the cropping pattern. Farmers applied higher amount of Urea, TSP and MOP in Boro and T.aman crop under this pattern compared to recommendation (185-140-110-95-6 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for Mustard, 206-75-90-45 kg Urea-TSP-MOP-Gypsum ha^{-1} for Boro and 140-35-56-45-2.5 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for T.aman according to FRG 2005).

It was observed that per hectare total production cost of mustard was Tk.41269 while it was Tk.66482 for Boro and Tk.49050 per hectare for T.aman rice. The gross return was Tk.67500, Tk.70125 and Tk.60675 per hectare for mustard, Boro and T.aman, respectively. The net return received by the farmers was Tk.26230 from mustard, Tk.3643 from Boro and Tk.11625 per hectare from T.aman rice. The benefit cost ratio was 1.64, 1.05 and 1.24 for mustard, Boro and T.aman, respectively. The study revealed that per kg mustard production cost was Tk.28.07 while it was Tk.12.48 for Boro and Tk.11.28 for T.aman rice (Table 2). Considering the whole cropping pattern the total production cost, gross return, net return and BCR were Tk.156801, Tk.198300, Tk.41498 and 1.31, respectively in the study area.

Wheat-T.aman: It was the third major cropping pattern in the study area. Farmers used Shatabdi as a variety of Wheat and BR11/ Sarna as T.aman. No organic fertilizer was found to use in this cropping pattern. They used Urea twice in T.aman as top-dress and once in Wheat. They applied 188-75-38-8-4 kg Urea-TSP-MOP-Gypsum-ZnO-Boric acid ha^{-1} in Wheat and 188-113-75-75 kg Urea-TSP-MOP-Gypsum ha^{-1} in T.aman. The average yield was 3300 kg and 3923 kg ha^{-1} from Wheat and T.aman rice, respectively. It was observed that all the fertilizer used by the farmers were higher in T.aman and low in Wheat than the recommendation (195-125-120-55-6 kg Urea-TSP-MOP-Gypsum-Boric acid ha^{-1} for Wheat and 140-35-56-45-2.5 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for T.aman according to FRG 2005).

It was observed that per hectare total production cost of Wheat was Tk.48632 while it was Tk.44526 per hectare for T.aman rice. The gross return was Tk.52500 and Tk.51570 per hectare for Wheat and T.aman, respectively. The net return received by the farmers was Tk.3868 from Wheat and Tk.7044 per hectare from T.aman rice. The benefit cost ratio was 1.08 and 1.16 for Wheat and T.aman, respectively. The study revealed that per kg Wheat production cost was Tk.14.74 while it was Tk.11.35 for T.aman rice (Table 3). Considering the whole pattern the total production cost, gross return, net return and BCR were Tk.93158, Tk.104070, Tk.10912 and 1.12, respectively.

Location: FSRD site, Lahirirhat, Rangpur

Potato-Boro-T.aman: It was the first major cropping pattern in the study area Lahirirhat, Rangpur. Farmers used Granola, BRRI dhan-28 and BRRI dhan 32/BRRI dhan 33 as the varieties of Potato, Boro and T.aman rice, respectively. They applied manure @ 2964 kg ha^{-1} in potato. Fertilizer application rate was 296-198-247-99-10-10 kg Urea-TSP-MOP-Gypsum-ZnO-Boric acid ha^{-1} for Potato, 198-30-20 kg Urea-TSP-MOP ha^{-1} for Boro and 148-49-49 kg Urea-TSP-MOP ha^{-1} for T.aman. Urea was applied in three splits in Potato and two for Boro and T.aman crops. Average yield was 18871 kg, 5138 kg and 3754 kg per hectare for Potato, Boro and T.aman, respectively. Farmers used higher dose of all fertilizer in Potato and T.aman but lower dose of urea and MOP in Boro compared to recommended dose (210-80-125-55-4-6 kg Urea-TSP-MOP-Gypsum-ZnO-Boric acid ha^{-1} for Potato, 210-30-45 kg Urea-TSP-MOP ha^{-1} for Boro and 145-20-32-45-2.5 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for T.aman according to FRG 2005).

The total production cost of Potato was Tk.126450 while it was Tk.62611 for Boro and Tk.43781 per hectare for T.aman rice. The gross return was Tk.188708, Tk.67579 and Tk.60367 per hectare for Potato, Boro and T.aman, respectively. The net return received by the farmers was Tk.94467 from Potato, Tk.4968 from Boro and Tk.16586 per hectare from T.aman rice. The benefit cost ratio was 1.49, 1.08 and 1.38 for Potato, Boro and T.aman, respectively. The study revealed that per kg Potato production cost was Tk.6.70 while it was Tk.12.19 for Boro and Tk.11.66 for T.aman rice (Table 4). Considering the whole cropping pattern the total production cost, gross return, net return and BCR were Tk.232842, Tk.316654, Tk.83812 and 1.31, respectively.

Boro-T.aman: It was identified as second major cropping pattern in the study area where farmers used BRRI dhan 28 as the variety of Boro and BRRI dhan 33/ Sarna as T.aman. Fertilizer application rate was observed 237-119-79-49 kg Urea-TSP-MOP-Gypsum ha^{-1} in Boro and 148-49-40-30 kg Urea-TSP-MOP-Gypsum ha^{-1} in T.aman. Urea was applied in two splits in Boro and T.aman. Average yield was 5236 kg ha^{-1} for Boro and 3952 kg ha^{-1} for T.aman. It was noticed that farmers were using lower dose of all fertilizers except TSP in Boro and T.aman compared to recommended dose (260-70-92-55-4 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for Boro and 145-20-44-45-2.5 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for T.aman according to FRG 2005).

It was observed that the total production cost of Boro was Tk.64020 while it was Tk.43761 per hectare for T.aman rice. The gross return was Tk. 69259 and Tk. 62837 per hectare for Boro and T.aman, respectively. The net return received by the farmers was Tk.5239 from Boro and Tk.19076 per hectare from T.aman rice. The benefit cost ratio was 1.08 and 1.44 for Boro and T.aman, respectively. The study revealed that per kg Boro production cost was Tk.12.23 while it was Tk. 11.07 for T.aman rice (Table 5). Considering the whole cropping pattern the total production cost, gross return, net return and BCR were Tk.107781, Tk.132096, Tk.24315 and 1.27, respectively in the study area.

Potato-Maize-T.aman: It was the third major cropping pattern in the FSRD site, Lahirirhat, Rangpur. Farmers used Granola as a variety of Potato, NK-40, PM-11, Pacific-11 as a variety of Maize and BRRI dhan 33 as the varieties T.aman rice. They applied manure @ 4199 kg ha^{-1} in potato and @ 2470 kg ha^{-1} in Maize. Fertilizer application rate was 222-198-148-74-10-10 kg Urea-TSP-MOP-Gypsum-ZnO-Boric acid ha^{-1} for Potato, 247 kg ha^{-1} for Maize and 198-74-40-35 kg Urea-TSP-MOP-Gypsum ha^{-1} for T.aman. Urea was applied in three splits in Potato and two splits in Maize and T.aman crops. Average yield was 19278 kg, 8102 kg and 3952 kg per hectare for Potato, Maize and T.aman, respectively. Farmers used higher dose of all fertilizers in Potato and lower dose of urea in Maize and MOP in T.aman compared to recommended dose (210-80-125-55-4-6 kg Urea-TSP-MOP-Gypsum-ZnO-Boric acid ha^{-1} for Potato, 425-180-150-165-8-6 kg Urea-TSP-MOP-Gypsum-ZnO-Boric acid ha^{-1} for Boro and 145-20-32-45-2.5 kg Urea-TSP-MOP-Gypsum-ZnO ha^{-1} for T.aman according to FRG 2005).

The total production cost of Potato was Tk.119663 while it was Tk.46026 for Maize and Tk.44608 per hectare for T.aman rice. The gross return was Tk.182780, Tk.89908 and Tk. 63281 per hectare for Potato, Maize and T.aman, respectively. The net return received by the farmers was Tk.63117 from Potato, Tk.43882 from Maize and Tk.18674 per hectare from T.aman rice. The benefit cost ratio was 1.53, 1.95 and 1.42 for Potato, Maize and T.aman, respectively. The study revealed that per kg Potato production cost was Tk.6.55 while it was Tk. 5.68 for Maize and Tk.11.29 for T.aman rice (Table 6). Considering the whole cropping pattern the total production cost, gross return, net return and BCR were Tk.210297, Tk.335969, Tk.125673 and 1.63, respectively.

Conclusion

The productivity and the yield of major crops under different cropping patterns had been changed over time due to application of imbalanced fertilizer and traditional management practice. The study revealed that farmers used lower dose of fertilizer in Tomato, Boro, Mustard and Wheat but higher dose in T.aman in Kadamshahar, Barind of Rajshahi. On the other hand, farmers in Lahirirhat, Rangpur applied higher dose of fertilizer in Potato and T.aman but lower dose in Boro and Maize. Most of the farmers did not use manure and recommended dose of fertilizer in their crops for major cropping patterns. Per hectare production cost, gross return and net return were found higher than previous year due to high cost of input and low price of output in the study areas. So, Government should ensure more subsidies on fertilizer and diesel to minimize the production cost of the crops and increase selling price of output for giving inspiration to crop production as well as better living of the farmers.

References

Dillion, J. L and J. B. Hardaker. 1980. Farm Management Research for Small Farmer Development, Agricultural Services, Bulletin 14, FAO, Rome, Italy.

Table 1. Per hectare cost of production and return of Tomato, Boro and T.aus rice under Tomato-Boro-T.aus rice cropping pattern at FSRD site, Kadamshahar, Barind, Rajshahi during the year of 2008-09

Items	Tomato			Boro			T.aus			Tomato-Boro-T.aus
	Quantity	Unit price	Cost & return	Quantity	Unit price	Cost & return	Quantity	Unit price	Cost & return	
Human Labor (Man-days):										
Hired	315	150	47250	113	150	16875	53	150	7875	
Family	45	150	6750	60	150	9000	15	150	2250	
Ploughing by power tiller (No.)	5	200	7500	2-3	200	4500	2	200	3000	
Seed rate (kg)	200 g	800	120000	40	40	1600	35	13	455	
Fertilizer dose (kg):										
Urea	375	12	4500	188	12	2250	225	12	2700	
TSP	150	45	6750	75	45	3375	75	45	3375	
MOP	75	40	3000	38	40	1500	38	40	1500	
Gypsum				38	7	263				
Irrigation cost (Tk.)	5-6 times	100	4500	16-20 times	45	6750	2 times	100	1500	
Insecticides/pesticides cost (Tk.)			900			450			450	
Interest on operating capital (Tk.)	4 month @10%		6638	4 month @10%		1583	4 month @10%		765	
Rental value of land (Tk.)		-	12563		-	12563		-	12563	
Total production cost (Tk.)			220350			62108			36502	318960
Yield (t/ha):										
Main product	33.938	10	339375	5.100	12	61200	3150	12	37800	
By-product	-			6.000	1	6000	3900	1	3900	
Gross return (Tk.)			339375			67200			41700	448275
Net return (Tk.)			119025			5092			5198	129315
BCR			1.54			1.08			1.14	1.25
Per kg production cost (Tk.)			6.49			12.18			11.59	

Table 2. Per hectare cost of production and return of Mustard, Boro and T.aman rice under Mustard-Boro-T.aman rice cropping pattern at FSRD site, Kadamshahar, Barind, Rajshahi during 2008-09

Items	Mustard			Boro			T.aman			Mustard-Boro-T.aman
	Quantity	Unit price	Cost &return	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost & return	
Human Labor (Man-days):										
Hired	52.5	150	7875	120	150	18000	105	150	15750	-
Family	22.5	150	3375	38	150	5625	22.5	150	3375	-
Ploughing by power tiller (No.)	2-3	200	3000	2	200	4500	2	200	4500	-
Seed rate (kg)	7.5	95	712	35	20	700	30	15	450	-
Fertilizer dose (kg):										
Urea	38	12	450	225	12	2700	150	12	1800	-
TSP	113	45	5062	113	45	5063	75	45	3375	-
MOP	75	40	3000	75	40	3000	75	40	3000	-
Gypsum	-	-	-	-	-	-	37	7	262	-
Irrigation cost (Tk.)	1 time	100	750	12-16 times	60	7200	-	-	-	-
Insecticides/ pesticides cost (Tk.)	-	-	-	-	-	2250	-	-	-	-
Interest on operating capital (Tk.)	4 month @10%	-	799	4 month @10%	-	1645	4 month @10%	-	1088	-
Rental value of land (Tk.)	-	-	16245	-	-	15000	-	-	15000	-
Total production cost (Tk.)	-	-	41269	-	-	66482	-	-	49050	156801
Yield (t/ha):										
Main product	1.470	45	66150	5325	12	63900	4.350	12.5	54375	-
By-product	1.350	1	1350	6225	1	6225	6.300	1	6300	-
Gross return (Tk.)	-	-	67500	-	-	70125	-	-	60675	198300
Net return (Tk.)	-	-	26230	-	-	3643	-	-	11625	41498
BCR	-	-	1.64	-	-	1.05	-	-	1.24	1.31
Per kg production cost (Tk.)	-	-	28.07	-	-	12.48	-	-	11.28	-

Table 3. Per hectare cost of production and return of Wheat and T.aman rice under Wheat-T.aman rice cropping pattern at FSRD site, Kadamshahar, Barind, Rajshahi during 2008-09

Items	Wheat			T.aman			Wheat-T.aman
	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost and return	
Human Labor (Man-days):							
Hired	75	150	11250	75	150	11250	-
Family	38	150	5625	30	150	4500	-
Ploughing by power tiller (No.)	2-3	200	4500	2-3	200	4500	-
Seed rate (kg)	120	35	4200	35	15	525	-
Fertilizer dose (kg):							
Urea	188	12	2250	188	12	2250	-
TSP	75	45	3375	113	45	5063	-
MOP	38	40	1500	75	40	3000	-
Gypsum	38	7	263	75	7	525	-
Zinc Oxide	8	120	900	-	-	-	-
Boric Acid	4	140	525	-	-	-	
Irrigation cost (Tk.)	1 times	100	750	-	-	-	-
Insecticides/ pesticides cost (Tk.)	-	-	-	-	-	-	-
Interest on operating capital (Tk.)	4 month@10%	-	1194	4 month@10%	-	1063	-
Rental value of land (Tk.)	-	-	11250	-	-	11250	-
Total production cost (Tk.)	-	-	48632	-	-	44526	93158
Yield (t/ha):							
Main product	3.300	15	49500	3.923	12	47070	-
By-product	3.000	1	3000	4.500	1	4500	-
Gross return (Tk.)	-	-	52500	-	-	51570	104070
Net return (Tk.)	-	-	3868	-	-	7044	10912
BCR	-	-	1.08	-	-	1.16	1.12
Per kg production cost (Tk.)	-	-	14.74	-	-	11.35	-

Table 4. Per hectare cost of production and return of Potato, Boro and T.aman rice under Potato-Boro-T.aman rice cropping pattern at FSRD site, Lahirirhat, Rangpur during 2008-09

Items	Potato			Boro			T.aman			Potato-Boro-T.aman
	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost and return	
Human Labor (Man-days):										
Hired	109	120	13042	49	120	5928	69	120	8299	-
Family	49	120	5928	79	120	9485	49	120	5928	-
Ploughing by power tiller (No.)	2-3	200	3952	20	200	3952	20	120	2371	-
Seed rate (kg)	1976	20	39520	35	20	700	30	20	600	-
Manure (Kg)	2964	1	2964	-	-	-	-	-	-	
Fertilizer dose (kg):										
Urea	296	12	3557	198	12	2371	148	12	1778	-
TSP	198	80	15808	30	80	2371	49	80	3952	-
MOP	247	60	14820	20	60	1186	49	60	2964	-
Gypsum	99	6	593	-	-	-	--	-	-	-
Zinc Oxide	10	140	1383	-	-		-	-	-	-
Boric Acid	10	140	1383	-	-	-	-	-	-	-
Irrigation cost (Tk.)	2-3 times	100	1976	20-24 times	70	17982	-	-	-	-
Insecticides/ pesticides cost (Tk.)	-		2964	-	-	1235	-	-	988	-
Interest on operating capital (Tk.)	4 month @10%	-	3560	4 month @10%	-	1521	4 month @10%	-	919	-
Rental value of land (Tk.)	-	-	15000			15000	-	-	15000	-
Total production cost (Tk.)	-	-	126450	-	-	62611	-	-	43781	232842
Yield (t/ha):										
Main product	18.871	10	188708	5.138	12	61651	3.754	15	56316	-
By-product	-	-	-	5.928	1	5928	4.051	1	4051	-
Gross return (Tk.)	-	-	188708	-	-	67579	-	-	60367	316654
Net return (Tk.)	-	-	62258	-	-	4968	-	-	16586	83812
BCR	-	-	1.49	-	-	1.08	-	-	1.38	1.31
Per kg production cost (Tk.)	-	-	6.70	-	-	12.19		-	11.66	-

Table 5. Per hectare cost of production and return of Boro and T.aman rice under Boro-T.aman rice cropping pattern at FSRD site, Lahirirhat, Rangpur during 2008-09

Items	Boro			T.aman			Boro-T.aman
	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost and return	
Human Labor (Man-days):							
Hired	79	120	9485	79	120	9485	-
Family	30	120	3557	40	120	4742	-
Ploughing by power tiller (No.)	2-3	100	1976	2-3	200	3952	-
Seed rate (kg)	35	20	700	30	20	600	-
Fertilizer dose (kg):							
Urea	237	12	2845	148	12	1778	-
TSP	119	80	9485	49	80	3952	-
MOP	79	60	4742	40	60	2371	-
Gypsum	49	6	296	30	6	178	-
Irrigation cost (Tk.)	16-20 times	60	12449	-	-	-	-
Insecticides/ pesticides cost (Tk.)	-	-	1037	-	-	-	-
Interest on operating capital (Tk.)	4 month @10%	-	1566	4 month @10%	-	919	
Rental value of land (Tk.)	-	-	15000	-	-	15000	-
Total production cost (Tk.)	-	-	64020	-	-	43761	107781
Yield (t/ha):							
Main product	5.236	12	62837	3.952	15	59280	-
By-product	6.422	1	6422	3.557	1	3557	-
Gross return (Tk.)	-	-	69259	-	-	62837	132096
Net return (Tk.)	-	-	5239	-	-	19076	24315
BCR	-	-	1.08	-	-	1.44	1.27
Per kg production cost (Tk.)	-	-	12.23	-	-	11.07	-

Table 6. Per hectare cost of production and return of Potato, Maize and T.aman rice under Potato-Maize-T.aman rice cropping pattern at FSRD site, Lahirirhat, Rangpur during 2008-09

Items	Potato			Maize			T.aman			Potato-Maize-T.aman
	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost and return	Quantity	Unit price	Cost and return	
Human Labor (Man-days):										
Hired	119	120	14227	99	120	11856	94	120	11263	-
Family	49	120	5928	44	120	5335	25	120	2964	-
Ploughing by power tiller (No.)	2-3	200	2964	2-3	100	988	10	200	1976	-
Seed rate (kg)	2025	20	40508	12	200	2470	30	20	600	-
Manure (kg)	4199	1	4199	2470	1	2470	-	-	-	-
Fertilizer dose (kg):										
Urea	222	12	2668	247	12	2964	198	12	2371	-
TSP	198	80	15808	-	-	-	74	80	5928	-
MOP	148	60	8892	-	-	-	40	60	2371	-
Gypsum	74	6	445	-	-	-	35	6	207	-
Zinc Oxide	10	150	1482	-	-	-	-	-	-	-
Boric Acid	10	150	1482	-	-	-	-	-	-	-
Irrigation cost (Tk.)	2 times	150	1482	2-3 times	-	2223	-	-	-	-
Insecticides/ pesticides cost (Tk.)	-	-	1235	-	-	1729	-	-	-	-
Interest on operating capital (Tk.)	4 month @10%	-	3344	4 month @10%	-	991	4 month @10%	-	946	-
Rental value of land (Tk.)	-	-	15000	-	-	15000	-	-	15000	-
Total production cost (Tk.)	-	-	119663	-	-	46026	-	-	44608	210297
Yield (t/ha):										
Main product	18.278	10	18.278	8.102	10	81016	3.952	15	59280	-
By-product	-	-	-	8.892	1	8892	4.001	1	4001	-
Gross return (Tk.)	-	-	182780	-	-	89908	-	-	63281	335969
Net return (Tk.)	-	-	63117	-	-	43882	-	-	18674	125673
BCR	-	-	1.53	-	-	1.95	-	-	1.42	1.63
Per kg production cost (Tk.)	-	-	6.55	-	-	5.68	-	-	11.29	-

Yield Gap Analysis of Mustard in the Farmers' Field

Abstract

The study was carried out at MLT site, Atghuria, Pabna to estimate the yield and benefit gap under different management practices of mustard cultivation. The study revealed that research managed plots (RMP) gave higher yield (1366 kg ha^{-1}) than farmers practice (894 kg ha^{-1}). The yield gap between RMP and FP was found 472 kg ha^{-1} and that of benefit gap (Net return) was found Tk.3903.ha^{-1}. The study suggests that the difference in yield and benefit could be minimized by practicing the recommended package of mustard production at farm level in the study area.

Introduction

There exists a wide gap between farm level potential yield and actual farm yield of mustard. There are some factors behind lower yield of mustard at farm level. Research conducted at experimental stations may not be adequate to suggest about the potential yields on farmers fields. Environmental condition may also not be similar between experimental station and farmers fields. To overcome the above-mentioned problems and to have an accurate estimation of different aspects of technology, experiments on farmer's fields are essential. The deference between the experimental station yield and actual farm yield is termed as the yield gap and the factors responsible for this yield gap is yield constraint. The difference between the experimental station yield and the potential farm yield is referred to as yield gap-I and the difference between the potential farm yield and the actual farm yield as yield gap-II. This study is aimed to study on yield gap-II.

It is therefore, urgently needed to know the yield gap between research managed plot and farmers plot and to analyze the contribution of production factor to the yield gap. The study is therefore, designed to estimate the yield gap of mustard under farmers plots and research managed plots, to identify the probable reasons for yield gap and to estimate the economic implications of yield gap.

Materials and Methods

The study was carried out at MLT site, Atghuria, Pabna during April-May 2009 Purposive sampling technique was applied in selecting the sample farmers of research managed plot (RMP) and farmers plots (FP). A total of 40 farmers, 20 from farmers plot and 20 from research managed plot were interviewed by using pre designed survey schedule. The collected data were then edited, summarized and analyzed in order to achieve the objectives of the study. Cobb-Douglas production function analysis was used to identify the individual effects of inputs of mustard under different management practices.

A Cobb- Douglas production function was selected to quantify the relative contribution of different production factors to the yield gap between research managed plot (RMP) and farmers plot (FP) for being easy on logarithmic transformation. The function becomes a simple linear one and the co-efficient of the production factors are the elasticity of production.

The Cobb- Douglas functional form of the multiple regression is as followers:

$$Y = a\ Xi\ Ui$$

$$\text{or, } \ln Y = \ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+ b_5\ln X_5+b_6\ln X_6+b_7\ln X_7+ Ui$$

Where: Y = Yield gap between research managed plot (RMP) and farmers plot (FP) (kg ha^{-1})

X_1 = Seed rate (kg ha^{-1})
X_2 = Difference in Urea (kg ha^{-1})
X_3= Difference in TSP (kg ha^{-1})
X_4= Difference in MP (kg ha^{-1})
X_5= Difference in Gypsum (kg ha^{-1})
X_6 = Difference in Human labor (Tk ha^{-1})
X_7 = Difference in Irrigation (Tk ha^{-1})
a = Constant or intercept, b_1, b_2, b_3, ----,b_7 = Co efficient of respective variables and
Ui= Disturbance term

Results and Discussion

Agronomic practices and technology employed: It is revealed from the study that there were differences in agronomic practices as well as input use levels between RMP and FP. Farmer Plot received less amount of chemical fertilizer (189-94-50-94-4 kg Urea-TSP- MP-Gypsum-ZnO ha^{-1}) than research managed plot (250-170-85-150-5-5 kg Urea-TSP-MP-Gypsum-ZnO-Boric acid ha^{-1}). Planting and harvesting period also differed. Farmers did not use fertilizer rationally and it might be due to lack of proper knowledge and cash. RMP were found to recommended amount of chemical fertilizers in mustard and this might be caused higher yield. BARI Sarisha-13 was used as seed in both RMP and FP in the study area. Farmers did not apply boric acid is their crop and they use little amount of fungicides in cloudy weather during mustard cultivation.

Cost of cultivation: It was found that the total cost was Tk.49172 ha^{-1} for the RMP. In case of FP per hectare total cost was Tk. 34195 ha^{-1}. The higher cost incurred in mustard cultivation under research managed plots compared to farmers' practices was mainly due to higher use of material inputs and improved management practices (Table 2). The grain yield of research managed plots was found higher (1366 kg ha^{-1}) than that of farmers' practices (894 kg ha^{-1}). The higher yield in research managed plots was observed may be due to recommended fertilizer dose as well as improved production package of mustard.

Yield difference between RMP and FP: The yield difference was found 472 kg ha^{-1} between RMP and FP, which was significant at 1% level of confidence (Table 3). The main causes of yield gap were that the farmers did not apply recommended dose of fertilizer and did not maintain the cultural management in mustard. It was noticed that 70 percent difference in total cost caused 34 percent difference in grain yield and 71 percent difference in net return implying that the cost incurred for different inputs under farmers plots was not rational and gave relatively less benefit to the investment.

Economics of Mustard cultivation: The highest gross return (Tk 54640 ha^{-1})was found in research managed plot than that of farmers plot (Tk 35760ha^{-1}). The total cost was calculated Tk 49172 ha^{-1} in RMP and Tk 34195 in FP. On the other hand, the highest net return (Tk 5468 ha^{-1}) was found in RMP and it was Tk 1565 ha^{-1} in farmers plot for mustard cultivation.

Contribution of key factors to the yield gap of Mustad: The Cobb-Douglas production function estimated the relative contribution of key factors in yield gap, which is presented in table 3. The relative contribution of specified factors influencing yield gap can be explained from the estimates of regression equation.

The coefficient of gap in use of urea was found 0.215 implying that one percent increase in urea by farmers plot, keeping other factors constant, would decrease the yield gap by 0.215 percent. Similarly the coefficient of gap in use of TSP and Gypsum was found 0.232 and 0.133 respectively, implying that one percent increase in use of TSP by FP, keeping other factors constant, would decrease the yield gap by 0.232 percent and one percent increase in Gypsum by FP, keeping other factors constant, would decrease the yield gap by 0.133 percent. These variables showed significant contribution to the yield gap of mustard.

The above-mentioned results and discussions reveal that the production of mustard can be increased by following recommended practices and yield gap can also be minimized. It was found that urea, TSP and Gypsum played significant role in yield gap of mustard production. As a result the yield level of FP can be increased by increasing use of urea, TSP and Gypsum. The yield of farmers plots can be increased by increasing use of these inputs.

Conclusion

The yield gap of mustard could be minimized if recommended practices can be ensured at farmers' level. Especially, farmers do not apply recommended level of fertilizer and this might be the cause of such yield differences.

Table 1. Yield and input use gap of mustard between research managed plot and farmers plot at MLT site, Atghuria, Pabna during 2009.

Explanatory variable	RMP	FP	Gap between RMP and FP
Variety	BARI Sarisha-13	BARI Sarisha-13	-
Sowing time	2-7 Nov.	12-20	10-13 days
Product yields (kg ha^{-1})	1366	894	472
Mechanical power (No. ha^{-1})	2-3	2-3	-
Human labour (Man-days.ha^{-1})	110	92	18
Seed Rate(kg ha^{-1})	6	7	1
Fertilizer : Urea (kg ha^{-1})	250	189	61
TSP(kg ha^{-1})	170	94	76
MP (kg ha^{-1})	85	50	35
Gypsum (kg ha^{-1})	150	94	55
ZnO (kg ha^{-1})	5	4	1
Boric acid (kg ha^{-1})	5	-	5
Harvesting time	2-5 Feb.	15-20 Feb.	13-15 days
Pesticide/Insecticide (Tk. ha^{-1})	1667	1712	45
Irrigation (No. ha^{-1})	2	1	1

Table 2. Per hectare cost and return of mustard in research managed plot and farmers plot at MLT site, Atghuria, Pabna during 2009.

(Tk.ha^{-1})

Variables	RMP	Farmers Plot (FP)	Gap between DP and FP
Mechanical power	4500	4500	-
Human labor	12300	11040	2160
Seed	480	560	- 80
Urea	3000	2268	732
TSP	13600	7520	6080
MP	5525	3250	2275
Gypsum	1500	940	560
ZnO	600	480	120
Boric acid	600	-	600
Irrigation Cost	4500	2625	1875
Incticides	1667	1012	655
Total Cost	49172	34195	14977 (70%)
Gross Return	54640	35760	1880 (34%)
Gross return	5468	1565	3903 (71%)

Table 3. Cobb-Douglas production function model estimate of determinants of yield gap in mustard cultivation at MLT site Atghuria, Pabna during 2009.

Variable	Co-efficient of determination
Intercept	6.43
X_1= Seed (kg)	-0.152
X_2 = Urea (kg)	0.215*
X_3 = TSP (kg)	0.232*
X_4 = MP (kg)	- 0.121
X_5 = Gypsum (kg)	0.133**

Variable	Co-efficient of determination
X_6 = Human labour (Man-days)	0.211
X_7 = Irrigation (Tk)	0.214
R^2	0.71
F-statistics	3.73
Return to scale (Σbi)	0.73
No. of observation	20

** Significant at 1% level, * Significant at 5% level.

Existing Marketing Systems of Vegetables and Its Development in Rangpur and Rajshahi

Introduction

The economy of Bangladesh is primarily dependent on agriculture. Crops constitute the largest and most important seeds of agriculture. Most of the people are living in rural areas and are directly or indirectly engaged in a wide range of agricultural activities of them 63% employed in agriculture with about 57% being employed in the crops sector. More than 50% of our farmers are under small and marginal category in crops sector.

In our country, land is limited and degraded day by day for various reasons. We are improving in food grain production and various steps have already been taken to produce more high valued crops. Virtually all of the production comes from the small farmers sector. Aggregating output from small farmers significantly increases of costs associated with marketing, transport and transaction and add considerably to the variability of quality leading to reduce price. As seasonal in nature the farmers are not getting fair prices of their produces.

Agriculture marketing is essential for maximizing the income of farmers and ensuring sustainable supply of farm produces to consumers at reasonable price. To scale up agricultural production in the country it is also important to develop a sustainable mechanism that links agriculture production with marketing system which can ensure timely supply of produce in a desirable form with required quantities. This can be achieved by crops diversification and expansion of market opportunities and association of the farmers with a common goal and interest. NCDP has established some growers and wholesale markets in 61 upazila under 16 districts of North-West region in Bangladesh with the financial assistance of ADB and GOB project from 2001.High value crop production, group formation and empowerment of the farmers and improve marketing system is being practicing in that area.

Therefore, an attempt has been made to visit some primary and secondary markets for getting an overall idea on how products are marketed at farm level as well as intermediaries' level.

Objectives

1) To examine the supply chain of the existing vegetable marketing system in the study area
2) To identify the constraints of the marketing systems of vegetables

Methodology

A field visit was done in Rangpur and Rajshahi district. An open discussion was held at Matherhat, Pirganj, Rangpur and Noahata, Paba, Rajshahi on 23 and 24 June 2009, respectively to know the primary situation of the marketing system of local and wholesale market. Local and wholesale markets were visited by the ICM club members of Mithapukur of Rangpur and Zagir ICM club members of Rajshahi. A total of 50 ICM club members (25 from each location) were visited the existing NCDP growers' market activities. Farmers have access to market of 33 high values crops in the growers market.

Some observations

Marketing structure in the study area

The farmers in the study area sell their small marketable surplus of their products and buy their daily necessaries and farm inputs like seed, fertilizer, pesticides, farming implements etc. They sell their products in the rural primary markets to farmers, local traders, retailers and local consumers. These markets generally site twice a weak. In the rural assembling markets, the growers and traders of the nearby villages buy from traditional markets assemble products for sale to traders who come from out side for procurement of the local surplus and movement of the same to the wholesale markets in

Rangpur/Rajshahi. The existing marketing channel by which the vegetables or crops are reached to the ultimate consumers through Producers, Faria, Bepari, Wholesalers, Arathders (commission agents) and retailers.

Supply chain of vegetables found in Rajshahi and Rangpur

Each and every vegetables has some supply chain in a market and it depends on the distance from the production place to consuming place. Marketing cost will be increased with the increase of participants in the supply chain. There are five categories of market intermediaries as Faria, Bapari, Arathdar, wholesaler and retailer.

Farias are small-scale rural traders who purchase products from the grower either in village or from primary markets and sell them to Beparies or local retailers. Although they are engaged in trading, but their major source of income is derived from agriculture. The Beparies are the rural assemblers who generally purchase products indirectly from the producers through Farias in village and transport them to the terminal or wholesale market and arrange sale of the products from Bepari to wholesalers who further sell products to the retailers. Retailers can also purchase products directly from the Beparies through Arathders. Arathders have permanent staffs, by which they charge commission from both the parties like Beparies and wholesalers. Wholesalers are regular traders who generally purchase products from Beparies through Arathders and sell them directly to consumer. Retailers have permanent shops in the traditional markets or they have markets on open air outside the markets.

The existing supply chain of vegetables in Rangpur

1. Farmers–Consumers
2. Farmers–Wholesaler/Faria/Local consumers in village
3. Farmers–Retailers–Consumers
4. Farmers–Faria–Wholesaler–Retailer- Consumers (Fig.1)
5. Farmers–Faria–Wholesaler–Market in Dhaka/Mymensingh/ Chittagong (Fig.1)

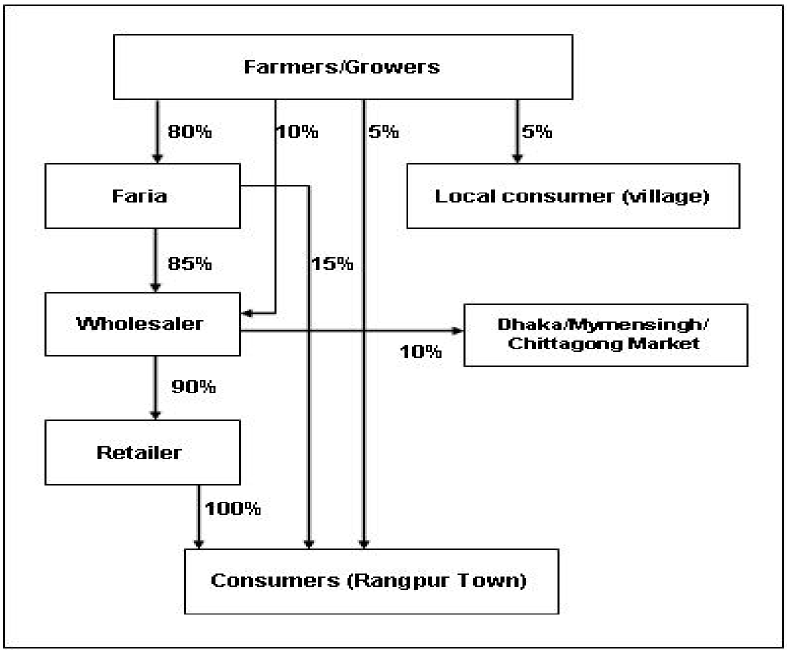

Figure 1. Flow diagram of existing supply chain of vegetables in Rangpur

The market participants involved in existing marketing were farmers, Faria, wholesalers and retailers. The farmers sell 80% of their produces at their farm gate to the Faria and 5% to the local consumers in village. Sometimes they also send it to town (5%). Faria sell the products generally to the wholesalers (85%) and sometimes in town (15%). The retailers purchase products from wholesalers (40%) and sell to the consumers in town and local market (100%) (Figure 1).

The existing supply chain of vegetables in Rajshahi

1. Farmers–Arathder–Retailers–Consumers
2. Farmers–Mobile van retailers –Consumers
3. Farmers–Consumers
4. Farmers–Arathder–Mobile van retailers–Consumers(Rajshahi town) (Fig.2)
5. Farmers–Bepari–Arathder–Wholesaler-Retailers–Consumers(Fig.2)

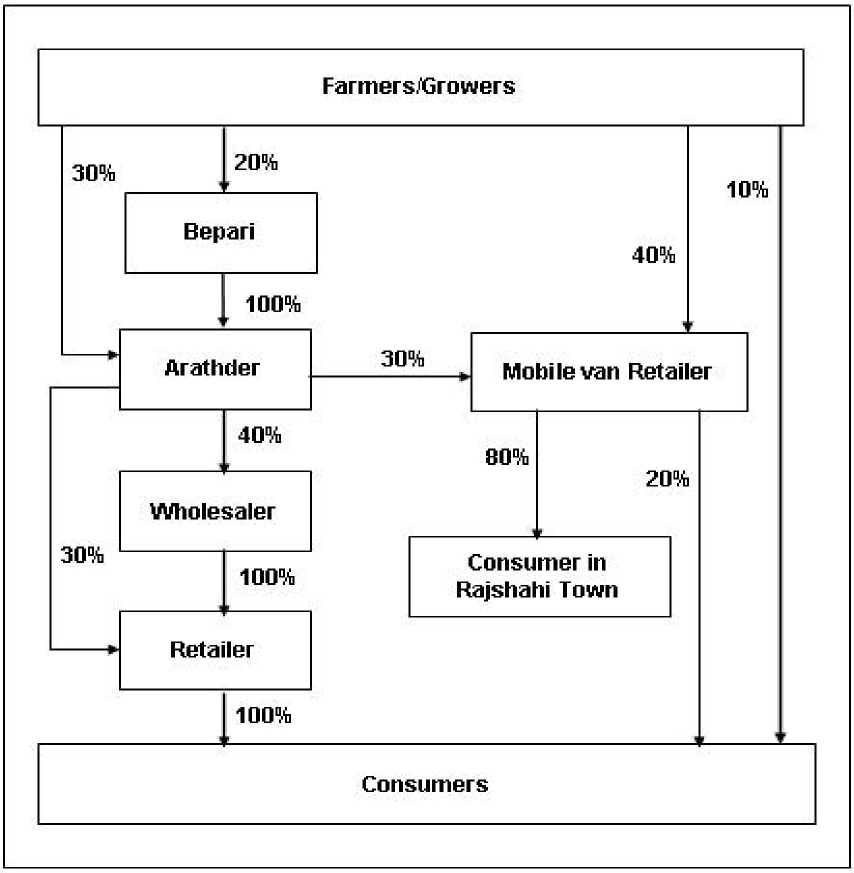

Figure 2. Flow diagram of existing supply chain of vegetables in Rajshahi

In Rajshahi, the vegetables marketing intermediaries were Farmers/ growers, bepari, arathder wholesaler and retailer. The vegetables growers sell 40% of their vegetables to the mobile van retailer, 20% to Bepari, 30% to Arathder and 10% to consumers. Arathder sell 30% to retailer 40 % to wholesaler and 30% to mobile van retailer. The mobile van retailers sell 80% vegetables to the consumers by door to door in Rajshahi town and 20% to the consumer at local market. Wholesaler received 40% vegetables from Arathder and sell to retailers. According to the farmers of the FGD identified that Farmers–Arathder–Mobile van retailer–Consumers supply chain is viable in the study area of city vegetables market, Rajshahi.

Problems identified in the vegetables marketing systems

The problems of the vegetables marketing systems can be explored from the following points of view and observations in the study areas.

i) Lack of good and efficient leadership of the farmers

ii) Pressure on farmers to sell at low price of their products through syndicating

iii) Farmers are not united/associated in a group in traditional market

iv) Price fluctuation existed in the existing market

v) Farmers are not up-to-date about selling price of their product

vi) High rate of spoilage and blemish of vegetables during marketing

vii) Inadequate transport facilities

viii) Lack of proper maintenance of the wholesale market

ix) Lack of gradation and standardization of the vegetable.

Conclusion and Recommendation

Supply chain of vegetables can be considered as a coordinated and integrated process which origin lies on production and ends on its ultimate consumption. The study revealed that the existing supply chain of vegetables is stronger. For developing the supply chain of the vegetables, the following steps can be considered:

1. Contact growing system should be developed for the vegetables/vegetables production.
2. Farmers can be organized in informal groups for vegetables/vegetables production and marketing their products to the primary and wholesale market by themselves.
3. Crop based association should be developed with the selected vegetables growers.
4. More intermediaries should make available in the market for better price fixing.
5. Market should be established in right place for easy access of the product
6. Road communication, storage facilities and network information regarding marketing aspects should be developed at grass-root level for the over all development of the marketing system.

Mature Technologies

1.	**Name of Technology**	:	**Planting date and bulb size on the seed yield and seed quality of summer onion in the High Barind Tract**
2.	Year of conduction		2007-08 and 2008-09
3.	Name of Organization	:	Bangladesh Agricultural Research Institute (BARI)
4.	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
5.	Location of application	:	Area of High Barind Tract with similar soils of AEZ 26
6.	Key characteristics of technology	:	Large bulb (15±2 g) sowing on first week to third week of November produced good quality higher seed yield
7.	Production guideline	:	
	Crop	:	Onion
	Variety	:	BARI Peaj-2
	Spacing	:	25 cm × 20 cm
	Planting time	:	First week to 3rd week of November
	Fertilizer dose		125-55-75-20-1 kg, N-P-K-S-B ha^{-1} + 5 t ha^{-1} CD
	Fertilizer application	:	Whole quantity of phosphorus, sulphur, zinc, cowdung (CD), half of potassium and one third of nitrogen should be applied as basal. Rest of potassium at 30 days after emergence (DAE) and the remaining nitrogen should be applied as side dressing at 30 and 45 DAE.
	Crop protection measure	:	Rovral (2 g/L water) and Bavistin (1 g/L water) should be sprayed simultaneously 8-10 days intervals during vegetative stage as a preventive measure of *Purple blotch* disease.
	Yield	:	600 kg seed ha^{-1}
8.	Risk involvement in adopting the technology	:	No risk involvement
9.	Impact on environment	:	No harmful effects on environment
10.	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/ leaflet, Radio talk etc.
11.	Expected outcome	:	Quality seed will be increased for summer onion cultivation
12.	Socio-economic aspect	:	

Gross return (Tk.ha^{-1})	Total cost (Tk.ha^{-1})	Net return (Tk.ha^{-1})	BCR
120000	40000	80000	3.0

13.	Recommendation	:	For quality seed production of summer onion, the optimum bulb size is 15±2 g and sowing time is first week to third week of November under Barind condition

1.	**Name of Technology**	**:**	**Intercropping Soybean with kaon varying plant population**
2.	Year of conduction		2007- 08 and 2008 - 09
3.	Name of Organization	:	Bangladesh Agricultural Research Institute (BARI)
4.	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
5.	Location of application	:	Medium highland areas of Laxipur with similar soils of AEZ 18
6.	Key characteristics of technology	:	One row kaon (40%) after two rows of soybean (100%) as intercropped found suitable and profitable than that of sole soybean
7.	Production guideline	:	
	Crop	:	Soybean and Kaon
	Variety	:	BARI soybean 5 and BARI kaon 3
	Spacing	:	Soybean: 30cm × 10cm Kaon: 30cm × 5cm
	Sowing time	:	Third week of January
	Fertilizer dose	:	80-60-30 kg N-P-K ha^{-1}
	Fertilizer application	:	Phosphorus, potassium and 1/3rd of nitrogen should be applied as basal and rest of nitrogen should be applied as top dress in two equal splits at 25 and 50 DAS, respectively.
	Yield (t ha^{-1})	:	Soybean: 1.92 Kaon: 0.94
8.	Risk involvement in adopting the technology	:	No risk involvement
9.	Impact on environment	:	No harmful effects on environment
10.	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/ leaflet, Radio talk etc.
11.	Expected outcome	:	Total productivity and profitability could be increased
12.	Socio-economic aspect	:	

Crop	Total variable cost (Tk.ha^{-1})	Gross margin (Tk.ha^{-1})	BCR
Sole soybean	20850	61300	3.46
Soybean (100%) with kaon (40%)	31500	64150	3.98

13.	Recommendation	:	The plant population of 100% soybean intercropped with 40% kaon is suitable and profitable than that of sole soybean. So, this technology should be widely disseminated in the soybean growing areas.

1. **Name of Technology**	:	**Replacement of existing B.Aus rice variety by BRRI dhan 42 or BRRI dhan 43 to escape early flood in Char areas of Tangail**
2. Year of conduction		2007-08 and 2008-09
3. Name of Organization	:	Bangladesh Agricultural Research Institute (BARI)
4. Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
5. Location of application	:	Charland area of Tangail with similar soils of AEZ 8
6. Key characteristics of technology	:	• BRRI dhan 42 or BRRI dhan 43 could harvest 10-15 days earlier than that of existing variety to escape early flood • BRRI dhan 42 or BRRI dhan 43 produced numerical higher yield than existing variety
7. Production guideline	:	
Crop	:	B.Aus rice
Variety	:	BRRI dhan 42 or BRRI dhan 43
Spacing	:	25cm × continuous sowing
Sowing time	:	Last week of April
Fertilizer dose	:	67-10-37-6 kg, N-P-K-S ha^{-1}
Fertilizer application	:	Entire quantity of phosphorus, potassium, sulphur and half of nitrogen should be applied during final land preparation and rest of nitrogen should be applied at 30-35 DAS
Yield (t ha^{-1})	:	BRRI dhan 42: 3.17 BRRI dhan 43: 3.05
8. Risk involvement in adopting the technology	:	No risk involvement
9. Impact on environment	:	No harmful effects on environment
10. Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/ leaflet, Radio talk etc.
11. Expected outcome	:	Total productivity and profitability could be increased
12. Socio-economic aspect	:	

Variety	Gross return (Tk.ha^{-1})	Total cost (Tk.ha^{-1})	Net return (Tk.ha^{-1})	BCR
BRRI dhan 42	47550	16620	30930	2.86
BRRI dhan 43	45750	16620	29130	2.75

13. Recommendation	:	BRRI dhan 42 or BRRI dhan 43 may be recommended for large scale production in char areas of Tangail.

Farmers Participatory Research on Integrated Farming for Improved Livelihood for Resource Poor Farm Households

Background

Bangladesh Agricultural Research Institute (BARI) has been developed a huge number of good technologies which is beneficial for different categories of farmers. Department of Agricultural Extension (DAE) is trying to disseminate these technologies among the farmers. On the other had On-Farm Research Division, BARI is also trying to disseminate technologies among the farmers in their FSRD & MLT sites. OFRD is working directly with the farmers and there is a good scope to transfer technologies under direct supervision of the Scientists. With this point of view, different FSRD sites of OFRD are engaged in technology transfer through of Technology Village, Crop Museum, block demonstration, adaptive trial, training and field days. Considering the above circumstances the present study was implemented at the five (05) existing FSRD site viz. Rangpur, Barind, Rajshahi, Faridpur, Patuakhali and Noakhali, respectively.

The project activities were carried out at four site viz. Rangpur, Barind (Rajshahi) Patuakhali and Noakhali since June 2006. On the basis of farmer's traditional practices, their needs and choices, the site team considered several alternatives of technologies of crops, livestock and other components as per available resource of the farm with active participation of the farmers. According to the aim of the project, three categories of farmer i.e. Landless, marginal and small were selected. Before going to implement the project activities a case study of individual households was carried out and detail information in respect of livelihoods maintained by the selected households were documented. Total resources inventory, liabilities, technology used, level of input used, output obtained income and expenditure status, labor availability of the farms of previous year was accounted by detail households case study with intensive visit & cross examinations for authentication of the data before intervention. After analysis of existing system, the technologies were selected for intervention in priority basis. Then the farmers were motivated through all possible ways to utilize their own resources to adopt the technologies. Under this project different program i.e. year round vegetable and creeper production in homestead, plantation and management of existing fruit trees, livestock program and production of different cropping pattern were undertaken for improvement of livelihood of farmers.

A. GENDER UTILIZATION AND FAMILY NUTRITION PROGRAM

1. Year Round Vegetable and Creeper Production in Homestead

Introduction

Vegetables play an important role in human diet. But per day per head vegetable consumption is very low (about 30 g/day/head) compare to that of in the neighboring countries like Nepal (42 g), Pakistan (91 g), India (135 g) and Sri Lanka (120 g). For proper nutrition of human body a person should take about 200 g vegetables per day. Intensive vegetable production could provide not only nutritional security but also higher total farm income and lower dependency on cereal foods. Farmers in rural areas especially low-income groups are seriously suffering from malnutrition such as iron deficiency, anemia and exophthalmia etc. These problems can be reduced by regular intake of green and yellow leafy vegetables. It is a great opportunity to employ the female labour in the homestead vegetable production system. In Bangladesh, female labours are not interested to work with male in the crop fields. The school going children can also help in home gardening. With the ever increasing problems of malnutrition and limited land holding particularly for the small holders, a good option to grow vegetables intensively in the homestead. So, increased production of vegetable is urgently needed. Hence, a year round homestead vegetable production programme was undertaken with the following objectives:

i) To supply fresh vegetables for family consumption
ii) To ensure vegetables round the year from homestead and improve family nutrition as well as income of the family
iii) To utilize women labour in income generating activities

Methodology

The programmes were conducted at the FSRD sites of Rangpur, Barind (Rajshahi), Patuakhali and Noakhali during kharif II (2008) and Rabi season of 2008-09 to popularize different vegetable model at different location through use of homestead area.

FSRD site, Kadamshahar, Rajshahi (Barind Model)

The vegetables cultivation program at homestead area was carried out at FSRD site, Kadamshahr, Rajshahi by "Barind Model". Before initiation of activities an individual case study of each household was conducted to identify the resource base and potentials of different farm category. Finally 10 households of marginal and small group were selected for this program. The vegetables crops were selected according to the choice of the farmers through participatory method. Before conducting the activities a comprehensive training was provided to the selected farmers on fruit and vegetables cultivation following Barind Model. The FSRD team provided technical assistance to the cooperators regularly to cultivate vegetables successfully.

Space utilization by year round vegetable cultivation of farmers homestead area under Barind during the year of 2008-09

Niche/space		Year round homestead vegetable pattern		
		Rabi	Kharif I	Kharif II
Open sunny place	Bed-1	Red amaranth + Brinjal	Kangkong	Kangkong
	Bed-2	Spinach	Indian spinach	Red amaranth
	Bed-3	Radish	Stem amaranth	Jute leaf (*Pat Shak*)
	Bed-4	Batishak	Okra + Red amaranth	Onion + Red amaranth
	Bed-5	Bushbean	Chili + Red amaranth	Chili
Roof top		Country bean, bottle gourd	Sweet gourd, White gourd	-
Trellis		Country bean, bottle gourd	Sweet gourd, yard long bean, bitter gourd	-
Muddy wall		Country bean	Ribbed gourd, Indian spinach	-
Homestead areas		Brinjal, onion, garlic	Plantain banana, papaya, drumstick	-
Pond/ditch banks and slope		Bottle gourd, country bean	Sweet gourd, bitter gourd	-

FSRD site, Lahirirhat, Rangpur

The vegetables cultivation at homestead area was conducted at FSRD site, Lahirirhat, Rangpur by Syedpur Model. Twelve (12) homesteads were selected for vegetable gardening. The participatory farmers utilized the open space, partially shady places and boundary (ail) of the homestead, which were previously remained either unutilized or underutilized. There were five beds and the unit bed size was 5m x 1m in each homestead. Vegetables like lalshak, data, okra, gimakalmi, indian spinach, snake gourd, sponge gourd, ribbed gourd, ash gourd and cucumber grown in summer. Cabbage, cauliflower, tomato, radish, garlic, spinach, napa shak, brinjal, carrot, pepper, coriander shak and country bean were grown in winter at their homestead. They also produced bitter gourd, ribbed gourd as fenced crop and papaya (Shahi) as boundry crop (homestead boundary) successfully. The farmers utilized partial shady place for ginger and turmeric production with proper management.

Year round vegetables cultivation at farmers homestead areas under Syedpur Model, Rangpur during the year of 2008-09.

Niche/space			Year round homestead vegetable pattern		
			Rabi	Kharif-1	Kharif-2
Open sunny space	Bed 1	:	Radish	Lalshak	Kangkong
	Bed 2	:	Cabbage	Data	Coriander shak
	Bed 3	:	Brinjal + Lalshak	Spinach	Indian spinach
	Bed 4	:	Tomato + Napashak	Okra	Lalshak
	Bed 5	:	Garlic	Patshak	Okra
2. Roof top		:	Bottle gourd	Ash gourd	
		:	BARI Shim 1	Sweet gourd	
3. Trellis/fence		:	Bitter gourd	Ribbed gourd	
4. Boundary/Ail		:	5-15 papaya plantation		
5. Slightly Marshy land		:	Kachu		
6. Partially shady place		:	Ginger and Turmeric		

FSRD site, Hazirhat, Noakhali (Atkapalia Model)

Homestead gardening was introduced among the 15 landless and marginal farmers for year round vegetable production in 25-35 m^2 homestead area. There were five beds which unit bed size was 5m x 1m. Vegetable likes red amaranth, batishak, radish, spinach, tomato, danta, Indian spinash and brinjal were cultivated in the homestead area. Vegetables were cultivated round the year one after another. The vegetables were produced in the FSRD site, Hazirhat, Noakhali on different types of space following Atkapalia model.

Year round vegetable production of farmers homestead area under Atkapalia Model, Noakhali druing the year of 2008-09

Niche/space		Year round homestead vegetable pattern		
		Rabi	Kharif I	Kharif II
Open sunny space	Bed 1	Lalshak-Radish-Tomato	Amaranths	Indian spinach
	Bed 2	Batishak-Tomato	Okra	Danta
	Bed 3	Cauliflower-Lalshak + Brinjal	Gimakalmi	Gimakalmi
	Bed 4	Cabbage-Spinach	Okra	Lalshak
	Bed 5	Radish-Batishak	Indian spinach	Amaranths
Roof top		Country bean/Bottle gourd	Ash gourd	
Trellis		Bottle Gourd	Ribbed gourd/Cucumber/Bittergourd	

FSRD site, Razakhali, Patuakhali (Lebukhali Model)

Five beds of each 8 m × 1.5 m were taken for year round homestead gardening programme under Lebukhali model. Vegetables were cultivated round the year one after another. Fiften (15) homesteads were used for this purpose situated at FSRD site, Razakhali, Patuakhali. For vegetable production the open sunny place and other spaces of homestead were utilized in a systematic way following Lebukhali Model.

Year round vegetables production of farmers homestead area Lebukhali Model, Patuakhali druing the year of 2008-09.

Niche/space		Year round homestead vegetable pattern		
		Rabi	Kharif I	Kharif II
Open sunny space	Bed-1	Red amaranth + Radish	Brinjal	Summer onion
	Bed-2	Bush bean	Okra	Indian spinach
	Bed-3	Coriander leaf + cabbage	Stem amaranth	Kangkong
	Bed-4	Red amaranth – Potato	Stem amaranth	Kangkong
	Bed-5	Red amaranth + Tomato	Indian spinach	Indian spinach
Roof		-	Wax gourd	-
Fence		Bitter gourd	Yard long bean	-
Trellis		Country bean	Ribbed gourd	-
Non-fruit trees		-	Sponge gourd	Sponge gourd
Pond/ditch slope		Bottle gourd	Bitter gourd	-

Sorjan method of vegetable cultivation round the year

Barisal-Patuakhali region is a vegetable deficit area. Considerable portion of the land inundate twice a day by tidal water from May to 1st week of December. On the other hand T.aman rice harvesting becomes late even up to 1st week of January in few fields. As a result vegetable becomes late and it would not be profitable. Therefore, OFRD, BARI, Patuakhali has developed Sorjan method of cropping system for vegetable and fruit cultivation round the year to solve this problems. Under the program, eight farmers were selected for year round vegetables production in Sorjan method at Razakhali, Patuakhali.

For Sorjan method, five raised beds each measuring 23m × 2m was considered 1m above the ground level. Four furrows each measuring 23 m × 1.5 m were excavated in between the beds. Total land area was 23 m × 26 m. In summer season, okra, yard long bean, bitter gourd, ribbed gourd, snake gourd, cucumber, kangkong, Indian spinach was grown using the following patterns. In 2008-2008 five new Sorjan are being established.

Sorjan Method

Niche	Year round vegetable production in sorgan		
	Rabi	Kharif-I	Kharif-II
Bed-1	Red amaranth + Radish	Yard long bean	Sponge gourd
Bed-2	Bush bean	Okra	Indian spinach
Bed-3	Coriander leaf + cabbage	Summer onion	Summer onion
Bed-4	Red amaranth – Potato	Stem amaranth	Kangkong
Bed-5	Red amaranth + Tomato	Indian spinach	Indian spinach
Bed edge (Traille between two beds)	Bitter gourd	Bitter gourd	-
	Bitter gourd	Ribbed gourd	-
	Bitter gourd	cucumber	-

RESULTS AND DISCUSSION

A. Gender utilization and family nutrition program

FSRD stie, Kadamshahar, Rajshahi (Barind Model)

The performances of vegetables crops grown in homestead area from marginal group are presented in Table 2. After intervention of "Barind Model" the total vegetable production was 219.15 kg, of which 155.85 and 63.30 kg were from open space and creeper vegetables, respectively. Before intervention the vegetable production was only 51.23 kg. Therefore the production was increased by 327% after intervention of Barind model against traditional practice (Table-1). In small farmer group, after intervention of Barind Model, the total vegetable production was 212.92 kg of which open space and creeper vegetables contributed 162.90 and 50.02 kg, respectively. On the other hand, the production was only 58.39 kg before intervention. Considering all season, the production was increased about 264% after introduction of Barind model against traditional practice (Table 2).

Table 1.Year round average vegetable production of a marginal farmer in homestead area at MLT site, Sapahar, Noagoan during the year of 2008-09.

Season	Before Intervention			After Intervention			% Increased
	Open space vegetables (kg)	Creeper vegetables (kg)	Total	Open space vegetables (kg)	Creeper vegetables (kg)	Total	
Rabi	5.93	15.85	21.82	75.30	38.25	113.55	
Kharif-I	10.25	10.45	20.70	-	-	-	327
Kharif-II		8.75	8.75	80.55	25.05	105.60	
Total	16.18	35.05	51.23	155.85	63.30	219.15	

Table 2. Year round average vegetable production of a small farmer in homestead area at MLT site, Sapahar, Noagoan during the year of 2008-09.

Season	Before Intervention			After Intervention			% Increased
	Open Space vegetables (kg)	Creeper vegetables (kg)	Total	Open Space vegetables (kg)	Creeper vegetables (kg)	Total	
Rabi	8.35	15.32	23.67	80.55	30.02	110.57	
Kharif-I	12.37	12.12	24.49				264
Kharif-II		10.21	10.21	82.35	20.00	102.35	
Total	20.72	37.67	**58.39**	162.9	50.02	**212.92**	

Disposal pattern of vegetables

In marginal group, the total production homestead vegetables were 51.23 kg, which was divided among the consumption, distribution and sold as 41.23, 6.00 and 4.00 kg respectively and consumption per person per day was 23 g during before intervention. On the other hand, after intervention of model vegetables production was 211.15 kg of which 156.35, 16.50 and 38.30 kg were used as consumption, distribution and sold respectively and the consumption was 114g per person per day (Table 3). So the consumption was increased 91 g/person/day after introduction of Barind model against traditional practice.

From small group, the total vegetables production was 58.15 kg of which 47.69, 5.46 and 5.00 kg were consumption, distribution and sold respectively and on the basis of the disposal pattern the consumption per person per day was 27 g before intervention of the model. On the other hand, after intervention the production was 212.92 kg of that the consumption, distribution and sold amount were 158.30, 11.70 and 42.92 kg, respectively and the consumption per person per day was 138 g (Table 5). So the consumption was increased 111 g/person/day after intervention of Barind model against traditional practice.

Table 3. Disposal pattern of vegetables of marginal farmer during the year of 2008-09.

Vegetables	Total harvest (kg)	Consumption		Distribution (kg)	Sold (kg)
		Amount (kg)	Per person/day (g)		
Before					
a. Open space	16.18	12.18		4.00	0
b. Creeper	35.05	29.05	23	2.00	4.00
Total	51.23	41.23		6.00	4.00
After					
a. Open space	155.85	120.85		10.00	25.00
b. Creeper	55.30	35.50	114	6.50	13.30
Total	211.15	156.35		16.50	38.30

Table 4. Disposal pattern of vegetables of a small farmer during the year of 2008-09.

Vegetables	Total harvest (kg)	Consumption		Distribution (kg)	Sold (kg)
		Amount (kg)	Per person/day (g)		
Before					
a. Open space	20.71	17.25		3.46	0
b. Creeper	37.44	30.44	27	2.00	5.00
Total	58.15	47.69		5.46	5.00
After					
a. Open space	162.90	122.50		7.50	32.90
b. Creeper	50.02	35.8	138	4.20	10.02
Total	212.92	158.30		11.70	42.92

Intake of vitamins and energy

After intervention, the consumption of food energy as well as vitamins were increased remarkably because of increasing vegetable production at homestead area in both farm category (Table 5 & 6). Before intervention the consumption of food energy, Vit-C, Vit-A, Vit-B_1 and Vit-B_2 of marginal farmer for per person per day were 30 kcal, 15 mg, 3277 µg, 0.03 mg and 0.06 mg, respectively and after intervention these were increased as 272 kcal, 231 mg, 41742 µg, 0.88 mg and 1.23 mg, respectively (Table-6). After intervention of "Barind Model" the consumption of food value as well as vitamins simultaneously increased in a small farmer group. Before intervention consumption of food energy, Vit-C, Vit-A, Vit-B_1 and Vit-B_2 for a person per day were 37 kcal, 18 mg, 3823 µg, 0.04 mg and 0.08 mg, respectively and after intervention that were increased to 329 kcal, 280 mg, 50530 µg, 1.06 mg and 1.49 mg, respectively (Table-6)

Table 5. Nutrient uptake by a family member of marginal farmer during the year of 2008-09.

Nutrient category	Before Intervention		After Intervention	
	Total	Per person day^{-1}	Total	Per person day^{-1}
Food energy (kcal)	11107	30	65423	272
Vit-C (mg)	5559	15	55622	231
Vit-A/Carotene (µg)	1196083	3277	10240558	41742
Vit-B_1 (mg)	14	0.03	211	0.88
Vit-B_2 (mg)	25	0.06	296	1.23

Table 6. Nutrient uptake by a family member of small farmer during the year of 2008-09.

Nutrient category	Before Intervention		After Intervention	
	Total	Per person/day	Total	Per person/day
Food energy (kcal)	13316	37	79197	329
Vit-C (mg)	6664	18	67332	280
Vit- A/Carotene (μg)	1395430	3823	12396465	50530
Vit-B_1 (mg)	16	0.04	255	1.06
Vit-B_2 (mg)	30	0.08	359	1.49

Farmer's reaction

Farmers were very much interested to involve themselves in homestead gardening due to earn some cash money and harvest fresh vegetables daily to meet up their daily demand.

FSRD site, Lahirirhat, Rangpur (Syedpur Model)

Vegetable production

Irrespective of farm categories it was observed that season wise vegetable production was highest in rabi season (225.30 kg farm^{-1} in landless, 269.45 kg farm^{-1} in marginal and 271.60 kg farm^{-1} in small) followed by kharif II (121.20 kg farm^{-1} in landless, 135.93 kg farm^{-1} in marginal and 141.60 kg farm^{-1} in small farm) season (Table 7, 9 & 11). The lowest amount of vegetable production was recorded from kharif-1 season. The result also evident that, irrespective of season higher quantity of vegetable was produced by small farm categories (511.15 kg year^{-1}) followed by marginal (498.70 kg year^{-1}) and landless (421.70 kg year^{-1}) (Table 12, 10 & 8). This suggests that vegetable production declined towards poor farmer this was probably because of involvement in other income generating activities.

Table 7. Round the year vegetable production from different niches by landless group of farmers at the FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Niches	Rabi	Kharif-1	Kharif-II	Total (kg)
	Mid. Oct.-Mid March (Kg)	Mid March-Mid June (Kg)	Mid June-Mid Oct. (Kg)	
Open sunny place				
Bed-1	25.30	16.00	19.20	60.5
Bed-2	14.00	15.00	24.50	53.5
Bed-3	24.00	11.00	10.00	45.00
Bed-4	27.00	6.00	3.50	37.00
Bed-5	4.00	3.50	20.25	27.75
Roof Top	45.00	5.00	2.00	52.00
Trellis	21.50	9.50	2.25	33.25
Shady place	24.50	-	12.00	36.50
Marshy land	7.30	-	-	7.30
Fence	6.00	5.20	6.00	17.20
Boundary	26.00	4.00	21.50	51.50
Total	**225.30**	**75.2**	**121.2**	**421.70**

Table 8. Year round vegetable production and utilization pattern of landless farmers at FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Month	Name of vegetable	Total Production (kg)	Vegetable utilization			Cash income (Tk)	Total income (Tk)
			Consumption (kg)	Distribution (kg)	Sale (kg)		
June/08	Indian spinach, Okra, Sweet gourd, Ribbed gourd	17.30	5.30	3.0	9.0	81.0	155.7
July/08	Indian spinach, Okra, Kangkong Sweet gourd, kalakachu, Ribbed gourd	16.50	1.50	2.0	13.0	117.0	148.0
August/08	Indian spinach, Okra, Kangkong Sweet gourd, kalakachu	33.20	16.20	4.0	13.0	169.0	431.6
Sept./08	Okra, lalsak, Indian spinach, kalakachu, Kangkong	16.00	3.00	2.0	11.0	143.0	208.0
Oct./08	Papaya	38.70	20.70	5.0	13.0	182.0	541.8
Nov./08	Papaya, Radish Sak, lalsak Potato yam	15.00	6.50	2.5	6.0	48.0	120.0
Dec./08	Spinach, Bottle gourd, Bean, Potato Yam, Papaya, Napasak, Radish	51.00	29.00	6.0	16.0	128.0	408.0
Jan./09	Radish, Cabbage, Spinach, Bottle gourd, Yam, Papaya	54.00	28.00	7.0	19.0	209.0	594.0
Feb./09	Radish, Cabbage, Bottle gourd, Papaya, Tomato, Bitter gourd, Turmeric, Ginger	50.50	30.50	4.0	16.0	144.0	454.5
Mar./09	Tomato, Data, Bottle gourd, Papaya, , Brinjal, Garlic, Turmeric, Ginger	47.20	30.20	5.0	12.0	108.0	424.8
Aprl./09	Data, Patsak, Indian spinach , lalsak	48.30	32.30	3.0	13.0	91.0	338.1
May/09	Data, , Okra, kalakachu, Indian spinach, lalsak	34.00	15.00	5.0	14.0	140.0	340.0
	Total	421.70	218.20	48.5	155.0	1560.0	4165.0

Table 9.Year round vegetable production from different niches by marginal group of farmer at FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Niches	Rabi	Kharif-1	Kharif-2	Total (kg)
	Mid. Oct.-Mid March (Kg)	Mid March-Mid June (Kg)	Mid June-Mid Oct. (Kg)	
Open sunny place				
Bed-1	27.25	24.10	21.25	72.60
Bed-2	27.60	17.22	26.15	70.97
Bed-3	26.00	12.00	11.65	49.65
Bed-4	19.25	9.00	4.00	32.25
Bed-5	6.50	3.00	12.50	22.00
Roof Top	47.00	6.25	2.23	55.48
Trellis	23.50	11.20	3.20	37.90
Shady place	26.25	-	22.15	48.40
Marshy land	19.00	-	-	19.00
Fence	5.50	6.25	7.00	18.75
Boundary	41.60	4.30	25.80	71.70
Total	269.45	93.32	135.93	498.70

Table 10.Year round vegetable production and utilization pattern of marginal farmers at FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Month	Name of vegetables	Total Production (kg)	Vegetable utilization			Cash income (kg)	Total income (kg)
			Consumption (kg)	Distribution (kg)	Sale (kg)		
June/08	Indian spinach, Okra, Ribbed gourd, Sweet gourd,	27.50	12.00	2.50	13.00	117.0	247.50
July/08	Indian spinach, Okra, Sweet gourd, kalakachu Ribbed gourd, Kangkong	20.70	5.00	3.70	12.00	108.0	186.30
August/08	Indian spinach, Okra, kalakachu, Kangkong	36.00	19.00	4.00	13.00	169.0	468.00
Sept./08	kalakachu, Kangkong, Okra, Indian spinach , Lalsak	18.50	7.500	2.00	9.00	117.0	240.50
Oct./08	Papaya	32.25	17.25	3.00	12.00	168.0	448.0
Nov./08	Papaya, Potato yam, Radish Sak, lalsak	22.30	11.30	2.00	9.00	72.0	178.40
Dec./08	Spinach, Bottle gourd, Bean, Potato Yam, Papaya, Napasak, Radish sak	58.60	35.400	8.20	15.00	120.0	468.80
Jan./09	Radish, Cabbage, Bottle gourd, Papaya, Tomato	67.25	42.75	6.50	18.00	198.0	739.75
Feb./09	Radish, Cabbage, Bottle gourd, bitter gourd, Papaya, Turmeric, Ginger	63.500	46.200	3.30	14.00	126.0	571.50
Mar./09	Cabbage, Tomato, Data, Bottle gourd, Papaya, Garlic, lalsak , Turmeric, Ginger	53.50	34.50	7.00	12.00	108.0	481.50
Aprl./09	Data, Patsak, Indian spinach, lalsak	57.400	42.400	4.00	11.00	77.0	401.80
May/09	Data, , Okra, kalakachu, Indian spinach, lalsak	41.20	23.200	5.00	13.00	130.0	412.00
	Total	498.700	296.50	51.20	151.00	1510.0	4843.65

Table 11. Year round vegetable production from different niches by small group of farmer at FSRD site Lahirirhat Rangpur during June 2008 to May 2009.

Niches	Rabi Mid. Oct.-Mid March (kg)	Kharif-1 Mid March-Mid June (kg)	Kharif-2 Mid June-Mid Oct . (kg)	Total (kg)
Open sunny place				
Bed-1	29.20	31.20	23.50	83.90
Bed-2	29.50	9.50	27.20	66.20
Bed-3	29.30	15.00	13.60	57.90
Bed-4	31.20	7.00	5.50	43.70
Bed-5	9.00	4.00	21.20	34.20
Roof Top	44.00	7.15	3.10	54.25
Trellis	25.00	12.40	4.30	41.70
Shady place	29.20	-	17.40	46.60
Marshy land	12.00	-	-	12.00
Fence	7.70	5.30	8.70	21.70
Boundary	25.50	6.40	17.10	49.00
Total	271.60	97.95	141.6	511.15

Table 12. Year round vegetable production and utilization pattern of small farmers at FSRD site, Lahirirhat, Rangpur during June 2008 to May 2009.

Month	Name of vegetable	Total Production (kg)	Vegetable utilization			Cash income (kg)	Total income (TK)
			Consumption (kg)	Distribution (kg)	Sale (kg)		
June/08	Indian spinach, Okra, Sweet gourd, Ash gourd	23.25	11.25	3.00	9.0	81.0	207.0
July/08	Indian spinach, Okra, Sweet gourd , lalsak, kalakachu, Kangkong	27.50	10.5	4.00	13.0	117.0	247.50
August/08	Indian spinach, Okra, kalakachu, Kangkong, lalsak	38.00	21.00	5.00	12.0	156.0	494.0
Sept./08	Kalkachu, Kangkong, Indian spinach, okra, lalsak	19.20	5.20	3.00	11.00	143.0	249.6
Oct./08	Papaya	43.50	24.50	4.00	15.00	210.0	609.0
Nov./08	Papaya, potato yam, Radish sak, lalsak	14.70	4.70	3.00	7.00	56.0	117.6
Dec./08	Spinach, Bottle gourd, napasak, radish, Bean, Potato Yam, Papaya,	52.50	33.5	7.00	12.00	96.00	420.00
Jan./09	Radish, Cabbage, Bottle gourd, Papaya, bean, Tomato	64.30	43.03	5.00	16.00	176.00	707.30
Feb./09	Cabbage, Bottle gourd, bean ,tomato, Papaya, Turmeric, Ginger	65.40	50.40	4.00	11.00	99.00	588.6
Mar./09	Tomato, Brinjal, lalsak, Datasak, Bottle gourd, Turmeric, Ginger bean, Papaya, Bitter gourd	61.20	43.2	6.00	12.00	108.0	550.8
Aprl./09	Data, Patsak, Indian spinach , lalsak, Tomato, brinjal	59.00	42.0	5.00	12.00	84.0	413.0
May/09	Data, Okra, snake gourd kalakachu, patsak, lalsak, Indian spinach	42.60	26.6	4.00	12.00	120.0	426.0
	Total	511.15	316.15	53.00	142.00	1446.00	5030.40

Disposal pattern

Consumption: The consumption of vegetable varied among the farm categories. The total consumption was highest in small (316.15 kg year^{-1}) followed by marginal (296.50 kg year^{-1}) and landless (218.20 kg year^{-1}) farm (Table 12, 10 & 8). The average vegetable intake per head per day was higher in small farm (216.54 g) followed by marginal (162.46 g) and landless (149.45 g) farm (Table 13). The results revealed that intake was lower towards poor farms. This was probably because of more selling of vegetables in the market to meet up their instant need.

Distribution: The distribution pattern of vegetable was presented in Table 12, 10 & 8. The highest amount of vegetable was distributed by small farm (53 kg year^{-1}) followed by marginal (51.20 kg year^{-1}) and landless farm (48.50 kg year^{-1}).

Selling: Each farm family sold some amount of vegetables to the market to meet up their instant need. The highest amount of vegetables sold by landless farm (155 kg year^{-1}) followed by marginal (151.0 kg year^{-1}) and small farm (142 kg year^{-1}) (Table 8, 10 & 12). The pattern of selling indicated that selling increased towards poor farmer. Resource poor farmers in some cases might have no alternative than selling vegetables to meet up their instant need compared to resource rich farmers. The over all results indicated that production, intake and distribution of vegetables increased from landless towards small farmer while selling increased towards poor farmers.

Table 13. Disposal pattern and intake of vegetables by different farm categories at FSRD site, Lahirirhat, OFRD, Rangpur

Farm Category	No. of average family member	Before Intervention (2007-2008)**					After Intervention(2008-2009)				
		Total Production (Kg)	Disposal			Intake/ head/ day (g)	Total produc -tion (kg)	Disposal			Intake/ head/ day(g)
			Consumption (kg)	Distribution (kg)	Sale (kg)			Consumption (kg)	Distribution (kg)	Sale (kg)	
Landless	04	134.2	85.0	10.0	39.2	58.22	421.70	218.20	48.5	155.0	149.45
Marginal	05	157.1	118.1	14.0	25.0	64.71	498.70	296.50	51.20	151.0	162.46
Small	04	172.2	120.0	23.0	29.2	82.19	511.15	316.15	53.00	142.0	216.54

**Before intervention data was collected by interview of the concerned farmer at the FSRD site, Lahirirhat, Rangpur

Economic return

Each farm family sold a portion of their produce to the local market to meet up their daily necessities. However, economic return was also calculated on the basis of total production. The highest cash income by selling vegetables was recorded from landless farm (Tk 1560 year^{-1}) followed by marginal (Tk 1510 year^{-1}) and small farm (Tk 1446 year^{-1}) (Table 13).The highest total income (Tk 5030.40 year^{-1}) and net income (Tk 4290.40 year^{-1}) was earned by small farmer followed by marginal and landless (Table 14). This trend was probably influenced by their total vegetable production.

Table 14. Year round total vegetable production and utilization pattern and net income of different group of farmers June 2008 to May 2009.

Farmers group	Total production (kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income (Tk)
		Own consumption	Distribution	Sale				
Landless	421.70	218.2	48.50	155.00	1560.0	4165.00	475.0	3690.00
Marginal	498.700	296.50	51.20	151.00	1510.0	4843.65	623.0	4220.65
Small	511.15	316.15	53.00	142.00	1446.0	5030.40	740.0	4290.40
Total	1431.55	830.85	152.70	448.00	4516.0	14039.05	1838.000	12201.05
Mean	477.18	276.95	50.90	149.33	1505.33	4679.68	612.66	4067.01

FSRD site, Hazirhat, Noakhali (Atkapalia Model)

Homestead gardening was introduced among the 15 Resources Poor Farmers (RPF). In respect of different agro-ecological situation "Atkapalia Model" was followed here within 25-35 m^2 homestead yard area for year round vegetable production. In the homestead 10 numbers of vegetables (red amaranth, batishak, radish, indian spinach, tomato, okra, kangkong, amaranth, gimakolmi and brinjal) were introduced for cultivation. Each homestead harvested vegetable on an average of 245 kg. The area of homestead is very small but from nutritional point of view, its importance is higher. However, the amount is small but it helped very positively in mitigating daily need of nutrient. Particularly marginal and landless farmers have increased their food security. They had to purchase the daily requirements of vegetables from the market. But, now with the increased production of vegetables in homestead, they almost don't have to go to market for purchasing vegetables. Among the participated resources poor farmers (RPF), it was observed that dietary habit has been changed which was found more pronounced among landless and marginal farmers. They have developed their tendency to take vegetables that are more nutritious. In addition, it created a very positive impact on family member, neighbors and visitors due to good performance and yield, which helped in family nutrition and proper utilization of homestead area.

Table 15a: Production, intake, sell and distribution to neighbors and income of one family (Average from 15 farm families) during the Kharif year of 2008 at FSRD site, Noakhali

Sl. No.	Name of the Vegetables	Total Production (kg)	Intake (kg)	Sell (kg)	Distribution (kg)	Total (Tk)	Cash (Tk)
1	Red amaranth	11	7	2	2	132	24
2.	Indian spinach	29	15	10	4	232	80
3.	Gimakalmi	35	18	12	5	210	72
4.	Okra	27	13	12	2	270	120
5.	Amaranths	25	13	8	4	175	56
	Total	127	66	44	17	1019	352
	%	-	52	35	13	-	34

Table 15b: Production, Intake, Sell, Distribution to neighbors and income of one family (Average from 15 farm families) during the rabi season of 2008-09 at FSRD site, Noakhali

Sl. No.	Name of the Vegetables	Total Production (kg)	Intake (kg)	Sell (kg)	Distribution (kg)	Total (Tk)	Cash (Tk)
1.	Red amaranth	25	10	10	5	300	120
2.	Kangkong	17	10	5	2	204	60
3.	Radish	19	9	7	3	109	70
4.	Batishak	20	12	5	3	140	35
5.	Tamato	18	9	7	2	216	84
6.	Brinjal	19	8	8	3	190	152
Total		118	58	42	18	1159	521
%		-	50	35	15	-	44

Note: Vegetable price/kg: 1. Red Amaranth = 12 Tk, 2. Indian Spinach = 8 Tk, 3. Gimakalmi = 6 Tk, 4. Okra = 10 Tk, 5. Amaranth = 7 Tk, 6. Kangkong = 12 Tk , 7. Red Amaranth = 10Tk, 8. Batishak = 7 Tk, 9. Tamato = 12 Tk, 10. Brinjal = 10 Tk

Table 16a: Nutrient Intake by a family during the Kharif season of 2008 (from beds) at FSRD site, Noakhali

Sl. No.	Name of Vegetable	Intake (kg)	Energy (kcal)	Protein (g)	Iron (mg)	Carotene (mg)	Vit B_1 (mg)	Vit B_2 (mg)	Vit C (g)
1.	Red Amaranth	7	3010	371	-	8358	7	9.1	30.1
2.	Indian Spinach	15	4050	330	1500	1923	3	54	9.6
3.	Gimakalmi	18	8200	324	702	19332	2.5	4.6	7.6
4.	Okra	13	5590	234	195	21710	5.2	20.8	13.0
5.	Amaranths	13	247	11.7	234	34	1.3	23.4	0.13
	Total	66	21097	972.2	2631	51367	19	111.9	60.4

Table 16 b : Nutrient Intake by a family during the Rabi season of 2008-09 at FSRD site, Noakhali

Sl. No.	Name of Vegetable	Intake (kg)	Energy (kcal)	Protein (g)	Iron (mg)	Carotene (mg)	Vit B_1 (mg)	Vit B_2 (mg)	Vit C (g)
1.	Red Amaranth	10	4300	530	-	11940	10	13	43
2.	Kangkong	10	3000	330	1000	8470	3	9	15
3.	Radish	9	2520	117	450	-	3.8	-	30.6
4.	Batishale	12	-	-	-	-	-	-	-
5.	Tamato	19	4140	342	324	3420	12.6	1.8	55.8
6.	Brinjal	19	7980	324	171	1615	22.8	15.2	95.0
	Total	50	21940	1643	1945	25445	30.2	39	239.4

Note: Nutrient conversion source: Krishi Diary, 2009

Table 21: Works distribution among family members

Sl. No.	Works done	Female	Male	Children
1.	Seed storing	1		
2.	Bed preparation		1	1
3.	Sowing of seed	1	1	1
4.	Intercultural Operations	1		1
5.	Harvesting of vegetables	1		
6.	Marketing		1	
7.	Seed purchase		1	
8.	Distribution	1	1	
9.	Fence and Macha Making		1	
10.	Communication and training	1	1	
		60 %	70%	30%

Extension Message

Vegetable production throughout the year in homestead garden following 'Atkapalia Model' was highly accepted by the resource poor and marginal farmers, extension and NGO personnel in the char areas of Noakhali because of its potentiality to meet up vegetables demand, supplying nutrition and providing extra income for the farm families throughout the year. If this technology is disseminated to each and every farm family of this area, the farmers will be benefited in future in respect of nutrition, economic return and poverty and malnutrition may be alleviated.

FSRD site, Razakhali, Patuakhali (Lebukhali Model)

The average vegetable production in every homestead was given in Table 17. In each homestead, the total vegetables production from July 2008 to May 2009 was 499 kg. Farmers consumed, distributed and sold 258 kg, 58 kg and 183 kg of vegetables, respectively. From the study it was observed that each family member consumed vegetables of 155 g/day (considering 5 member families). They also earned Tk. 2119 cash from each homestead. Total cost of production was Tk. 1540. The area of homestead is very small but from nutritional point of view its importance is more. Though the amount of vegetables is small but it created positive impact to meet up the daily requirement of the family nutrient. Among the farmers, it was observed that dietary habit has been changed which was found more pronounced among the landless and marginal farmers. In addition, it is created a very positive impact on family member, neighbors and visitors due to good performance and yield, which helped, in family nutrition and proper utilization of homestead area.

Table 17. Round the year vegetables production and utilization pattern of homestead (average of ten homesteads) at FSRD site, Razakhali, Patuakhali from July 2008 to April 2009**.**

Month	Name of vegetables	Total production(kg)	Vegetables utilization (kg)			Cash income(Tk)	Total income(Tk)
			Intake	Distribution	sell		
July	Spinach, Sponge gourd, Ribbed gourd, Kangkong, Wax gourd	30	17	2	11	112/-	295/-
Aug.	Sponge gourd, Bitter gourd, Wax gourd	27	17	2	8	90/-	293/-
Sept.	Bitter gourd, Summer onion, Sponge gourd	16	11	1	4	60/-	260/-
Oct.	Summer onion, Bitter gourd	12	10	2	-	-	175/-
Nov.	Bottle gourd, Bean, Bitter gourd, Red amaranth	39	22	3	14	142/-	416/-
Dec.	Bottle gourd, Bean, Bitter gourd, Red amaranth, Radish	55	28	8	19	197/-	567/-
Jan.	Radish, Bottle gourd, Bean, Bitter gourd, Red amaranth, Cabbage, Cor. leaf	78	37	14	27	480/-	885/-
Feb.	Tomato, Bush bean, Bitter gourd, Cabbage,	72	32	7	33	210/-	683/-
March	Tomato, Potato, Bitter gourd, Brinjal	84	35	10	39	478/-	1008/-
April	Yard long bean, Stem amaranth, Bitter gourd, Brinjal	45	24	4	17	220/-	580/-
May	Yard long bean, Stem amaranth, Bitter gourd, Brinjal, Kangkong, Indian spinach	41	25	5	11	130/-	485/-
Total		499	258	58	183	2119/-	5467

Composting with kitchen, Farm yard waste and poultry droppings at FSRD site, Lahirirhat, Rangpur

Soil fertility is declining day by day in different agro ecological zones of Bangladesh. This is caused by imbalance use of fertilizer and loss of nutrients from the soil. This situation is further aggravated by low organic matter content of the soil. A good soil should have more than 3.5 percent organic matter. However, the soil of Rangpur region is deficient in organic matter content. In FSRD site, the amount is 1.27 percent even in many areas it is less than one percent. The organic matter content of the soil is declining day by day. This is caused by crop removal, burning of plant residues and cow dung, improper management and preservation of compost or manure and less addition of organic manure to the soil. It was reported that proper management of household waste, cow dung, farm yard waste, poultry droppings etc. in a proper and scientific way improves the quality of the organic manure.

At FSRD site, Lahirirhat, Rangpur, scientific process of composting was demonstrated in three poor farmers homestead. Each farmer had 2 pits each of $3 \times 1.5 \times 1.0$ m^3 size. Average production in 6 month varied from 1050-1200 kg per household (Table 18). The prepared compost was utilized in home gardening, rice field, plantation of fruit trees and vegetables pits.

Table 18. Compositing with kitchen, farm yard waste and poultry droppings at FSRD site, Lahirirhat, Rangpur during the year of 2008-09.

SL. No.	Name of farmers	No. of pit & area	Date of initiation	No. of composting/ pit	Total amount prod. (kg)	Uses
01.	Hafez Delwar	2 pits $3\times1.5\times1$ m^3	28.11.08	2 times	1200	Home garden, boro rice field, plantation tress & vegetable pits
02.	Mizanur Rahman	2 pits $3\times1.5\times1$ m^3	25.11.08	2 times	1050	Home garden, boro rice field, plantation tress & vegetable pits
03.	Fazlul Haque	2 pits $3\times1.5\times1$ m^3	30.11.08	2 times	1130	Home garden, boro rice field, plantation tress & vegetable pits

Sorjan method of vegetable cultivation round the year at Razakhali, Patuakhali

Barisal-Patuakhali region is a vegetable deficit area. Considerable portion of the land inundate twice a day by tidal water from May to 1st week of December. On the other hand, T.aman rice harvesting becomes late even up to 1st week of January in few fields. As a result vegetable becomes late and it would not be profitable. Therefore, OFRD, BARI, Patuakhali has developed Sorjan method of cropping system for vegetable and fruit cultivation round the year to solve this problems. Under the program, eight farmers were selected for year round vegetables production in Sorjan method at Razakhali, Patuakhali.

For Sorjan method, five raised beds each measuring 23m × 2m was considered 1m above the ground level. Four furrows each measuring 23 m × 1.5 m were excavated in between the beds. Total land area was 23 m × 26 m. Initial cost for raising beds was Tk. 12000 and bamboo, net, rope etc. cost was Tk. 3150 In first summer season, okra, yard long bean, bitter gourd, ribbed gourd, snake gourd, cucumber, kangkong, Indian spinach were grown using the following patterns. All the crops are being harvested. In 2008-09 four new Sorjans has been established.

Table 19. Utilization of Sorjan round the year

Niche	Year round vegetable production in sorgan		
	Rabi	Kharif-I	Kharif-II
Bed-1	Red amaranth + Radish	Yard long bean	Sponge gourd
Bed-2	Bush bean	Okra	Indian spinach
Bed-3	Coriander leaf + abbage	Summer onion	Summer onion
Bed-4	Red amaranth – Potato	Stem amaranth	Kangkong
Bed-5	Red amaranth + Tomato	Indian spinach	Indian spinach
Bed edge (Trellis	Bitter gourd	Bitter gourd	-
between two beds)	Bitter gourd	Ribbed gourd	-
	Bitter gourd	cucumber	-

As the new sorjan established in 2008-09 come into production for first season and crops are being harvested the data presented below was from sorjans established in the previous year. A total of 1094 kg different vegetables were produced in ten months of which 237 kg was consumed, 61 kg was gifted to relatives and neighbours and 796 kg was sold in the market and Tk.10157 was cash income. Total value of produced vegetables was Tk. 13986. It produces much higher income than from traditional crop cultivation in the same area of land (Table 20).

Table 20. Round the year vegetables production and utilization pattern in Sorjan (average of 5 Sorjan) at FSRD site, Razakhali, Patuakhali in 2008-09 (data from the sorjan established in the last year).

Month	Name of vegetables	Total production (kg)	Vegetables utilization (kg)			Cash income (Tk)	Total income (Tk)
			Intake	Distribution	sell		
July	Spinach, Sponge gourd, Ribbed gourd, Kangkong, Wax gourd	77	22	5	50	613/-	944/-
Aug.	Sponge gourd, Bitter gourd, Wax gourd	75	20	4	51	622/-	914/-
Sept.	Bitter gourd, Summer onion, Sponge gourd	70	18	4	48	648/-	945/-
Oct.	Summer onion, Bitter gourd	85	12	2	71	980/-	1173/-
Nov.	Bottle gourd, Bean, Bitter gourd, Red amaranth	104	26	5	73	883/-	1257/-
Dec.	Bottle gourd, Bean, Bitter gourd, Red amaranth, Radish	180	27	7	146	1706/-	2103/-
Jan.	Radish, Bottle gourd, Bean, Bitter gourd, Red amaranth, Cabbage, Cauliflower	182	32	13	137	1680/-	2231/-
Feb.	Tomato, Bush bean, Bitter gourd, Cabbage, Cauliflower	123	30	10	83	1166/-	1727/-
March	Tomato, Potato, Bitter gourd, Brinjal, Cucumber	112	26	8	78	995/-	1428/-
April	Yard long bean, Okra, Stem amaranth, Cucumber	86	24	3	59	864/-	1259/-
	Total	1094	237	61	796	10157/-	13986/-

Farmers' reaction

1. Farmers are highly pleased to see the performance of crops in the sorjan.
2. Bearing initial cost is difficult for poor farmers.

Programme : Management of different plantation trees

FSRD site, Lahirirhat, Rangpur

Each farmer has some sorts of fruits, fuel and timber trees in their homestead area. The trees owned by the farmers can play a vital role in income generation. However, the existing fruit trees have low yield potential. Moreover, the quality of the fruits was inferior. This was because of either lack of scientific knowledge or use of poor management in the production system. Application of balanced fertilizer in proper time, timely pruning, irrigation and best use of pest control measures of 83 plants were done to increase production (Table 21). Poor health and mango hopper was the main cause of low production of mangoes. Similarly, *Rhizopus* foot rot of jackfruit reduced number of bearing. Mango hopper and other fungal disease was properly controlled by spraying Rilothrin @ 2 ml/litre of water followed by Thiovit @ 4.5 g/litre of water alternatively during 20-30 December, 2008 and 15-20 January, 2009. These problems were reduced after spraying and bearing of mangoes and jackfruits were increased. The qualities of fruits were also improved. A total of 36 high yielding varieties of Guava (BARI peyara -2) and jujube (Apple Kul and Thai Kul) were planted in the homestead for future income generation (Table 22).

Table 21. Management of existing fruit tress at FSRD site, Lahirirhat, Rangpur, during the year of 2008-09.

Farm category	No. of farm	Number of trees						Date of fertilization
		Mango	Jack fruit	Litchi	Betel nut	Guava	Total	
Landless	5	7	6	-	7	5	25	August -2008
Marginal	4	8	6	1	6	4	25	August -2008
Small	3	12	6	-	10	5	33	August -2008
Total	10	27	18	1	23	14	83	-

Table 22. Management of existing fruit tress at FSRD site, Lahirirhat, Rangpur, during the year of 2008-09.

-	Control of mango hopper	Control of anthracnose of mango	Control of *Rhizopus* Fruit rot of Jackfruit
Land less	1st spray 20-30 Dec/08 2nd spray 15-20 January/09	1st spray 30 Jan./09 2nd spray 15 April/ 09	1st spray 10-12 Feb./09
Marginal by	1st spray 20-30 Dec/08 2nd spray 15-20 January/09	1st spray 30 Jan./09 2nd spray 15 April/ 09	1st spray 10-12 Feb./09
Small	1st spray 20-30 Dec/08 2nd spray 15-20 January/09	1st spray 30 Jan./09 2nd spray 15 April/ 09	1st spray 10-12 Feb./09

Mango hopper and other fungal disease was properly controlled by spraying Rilothrin @ 2 ml/litre of water followed by Thiovit @ 4.5 g/litre of water alternatively. Anthracnose was controlled by spraying Contaf @ 1 ml/liter of water. *Rhizopus* fruit rot of Jackfruit was controlled by spraying Folicur @ 0.5 ml/liter of water.

Table 23. Plantation of fruit trees at FSRD site, Lahirirhat, Rangpur, during the year of 2008-09.

Farm categories	No. of farm	Date of distribution	No. of trees			Present condition
			Guava	Jujube	Total	
Land less	5	11.8.2008	5 (1)	10 (2)	15 (3)	Good
Marginal	4	11.8.2008	4	8 (1)	12 (1)	Good
Small	3	11.8.2008	3 (1)	6 (1)	9 (2)	Good
Total	12	-	12	24	36	-

The figures is the parenthesis indicates damage plant

FSRD site, Razakhali, Patuakhali

Most of the farmers grow fruit trees for their fruit consumption and forest tree for fuel and timber at their homestead. Existing fruit trees are also resources to the farmers. But the existing fruit trees in the homestead are local varieties with low quality and poor yield potential. By performing different types of management practices these turned into fruit bearing condition and earn cash money as well as meet up the demand of family nutrition. Therefore, the program was undertaken to create awareness among the farmers for growing fruit tree in their homestead and to disseminate BARI fruit variety among the farmers.

Every household has more or less fruit trees. Few of them are poor quality and few of them are better in quality. It is a resource of a farmer. An extra production as well as income can be brought from these existing fruit trees through proper management. Moreover OFRD, Patuakhali gave different fruit saplings in the previous years (Table 24).

Table 24. Management of existing fruit trees in the homestead at Razakhali during the year of 2008-09.

Activity	Fruit tree	No. of farmers	No. of trees
Manure & fertilizer application	Mango	32	145
	Guava	21	67
Pruning	Guava	40	98

Program: Livestock

Livestock is an important and useful resource of the households in our rural Bangladesh. It contributes about 2.93% of GDP (BER 2006). It plays a vital role for improvement of livelihood of the household of providing proteins and calories. In spite of its important in our economy this sector has been suffering from different types of problems. Among them disease and quality feed are major problems that were faced by the farmers for their livestock rearing. From different research findings it was revealed that proper vaccination can reduce the mortality rate and quality feed can ensure proper growth and development of cattle and poultry birds. Considering the above circumstances vaccination and poultry birds rearing program were included with the following objectives.

(i) To reduce mortality rate of livestock population.
(ii) To improve family nutrition.
(iii) To increase farmer’s income as well as create employment.

FSRD site, Lahirirhat, Rangpur

Livestock are the part and parcel of our Agriculture. The largely contribute in cultivation process by providing draft power and adding organic manure to the soil. It improves our livelihood by providing proteins and calories. Disease and quality feed problems hindering improvement of this sector. However, the existing livestock and poultry were seriously suffered from different kinds of worm and Ranikhet disease, respectively. It was reported that proper vaccination can reduce mortality rate and quality feed can improve proper growth and development of livestock and poultry. A total of 225 birds were vaccinated to reduce Ranikhet and a total of 63 cattle’s were de-wormed to improve their health (Table 25). The vaccination of chicken was done by BCRDV @ 1 drop at one eye and for adult it was done by RDV @ 1 cc injection per bird in muscle. The de-worming of cattle was done by ‘Triben-L 1500 mg’ @1 tablet per 75 kg body weight. The mortality percentage of poultry was significantly reduced by vaccination. Similarly, the health of the cattle’s was also improved to a great extent after de-worming.

Table 25. Live stock activities at FSRD site, Lahirirhat, Rangpur during the year of 2008-09.

Activities	No. of household	Breed	No. of birds/cattle	Present condition
Vaccination				
11.8.2008	30	Local	70	Good
30.10.2008	30	Local	90	Good
16.01.2009	30	Local	65	Good
De-worming of cattle				
30.10.2008	20	Local	35	Good
20.1.2009	20	Local	28	Good

FSRD stie, Kadamshahar, Rajshahi

There were 225 poultry birds and cattle were vaccinated of which, 135, 56, 9 and 25 was poultry, goose, goat and cattle, respectively (Table 26). The results showed that after vaccination program mortality percentage become very low compare to before vaccination in case of all livestock population. Before vaccination the mortality rate of poultry, goose, goat and cattle were 23%, 10%, 15% and 5% and after vaccination those percentage reduces as 5%, 0%, 3% and 0%. This program has created awareness and interest among the co-operator farmers. Twenty five local breed of cattle were feed deworming tablet where 45 goat of black bengal and local breed were feed vitamins for proper growth and development of cattle and goats (Table-27).

Farmers' reaction

- Farmers expressed satisfaction about the positive effect of vaccination on low mortality rate of their livestock.
- Farmers are highly interested of pigeon and goose rearing to generate income at household level and alleviate poverty of the rural poor people.

Table 26: Name and performance of vaccine to livestock's population FSRD stie, Kadamshahar, Rajshahi during the year of 2008-09.

Name of animal	Date of vaccination	Vaccinated birds/cattle	Name of vaccine	Mortality rate (%)	
				Before vaccination	After vaccination
Poultry	23.06.2006	135	RDV & Duck Plague	23	5
Goose	do	56	do	10	0
Goat	do	9	PPR	15	3
Cattle	do	25	FMD & Anthrax	5	0
	Total	225			

Table 27. Deworming of cattle and vitamin feeding of goats FSRD stie, Kadamshahar, Rajshahi during the year of 2008-09.

Name of activities	Breed	No. of goat/cattle	Present condition
Deworming of cattle	Local	25	Good condition. Proper growth and development of the animals was observed.
Vitamin feeding of goat	Black bengal goat & local	45	
	Total	70	

FSRD site, Razkhali, Ptuakhali

The results of the vaccination program and other activities are presented in Table 28. The results showed that after vaccination program mortality percentage become very low compare to before vaccination in ease of all livestock population. This program has created awareness and interest among the co-operator farmers. The deworming of cattle and vaccination of cattle and buff^{-1} doen.

Table 28 Livestock activities at FSRD site, Razakhali, Patuakhali, during the year of 2008-09.

Activities	No. of household	Breed	No. of bird/ cattle	Present condition
Dewarming of cattle	18	Local	50	health improved
Vaccination of cattle and buffalo	18		50	health improved
Cattle fattening with urea molasses straw (UMS) diets	10	Local	10	on going
Vaccination of poultry	28	Local	350	mortality rate decreased

Program : Fisheries

FSRD stie, Kadamshahar, Rajshahi

Fisheries program-Monoculture of *Nilotica* in seasonal ponds

The growth performance of *Nilontica* was satisfactory. It attained as marketable size within five months. The initial weight of *Nilotica* was 8 g and final weight was 95 g. The average fish yield was 4.66 kg/ per decimal pond area (Table 29).

Table 29. Performance of *Nilotica* in seasonal ponds during the year of 2008-09.

Sl. no.	Pond size (decimal)	Amount harvested (kg)	Harvest rate (kg/decimal)
1.	5.0	21.50	3.7
2.	3.5	20.50	5.86
3.	7.5	23.50	4.47
4.	3.0	13.00	5.33
5.	8.0	25.78	3.22
Total	27.0	104.28	3.86

Farmer's reaction

Farmers shown interest to culture Nilotica due to its rapid growth, taste, high market price and good adoption in their seasonal ponds

FSRD site, Lahirirhat Rangpur

Some farm household owned seasonal mini pond. In most cases they have not culture any fishes to this pond. Few of them were cultivating fishes in a traditional way. They did not use any fertilizer or supplemental food to their pond and thus their yield was reduced. They released Silver carp, Tilapia, Rajputi, Rui, Mrigal etc. for poly-culture. They did not maintain actual population of fingerlings per unit area. Average densities of fishes used by them varied from 75-80 per decimal.

Poly-culture of Silver carp, Rajputi, Rui and Mrigal were done on 10 mini seasonal ponds for increasing yield in a scientific way. Fertilization of pond and supplemental food also added for fish culture. The result indicated that the average yield of fishes were 14.32 to 15.76 kg per decimal after intervention while they got only 6.75 to 8.23 kg per decimal before intervention (Table 30).

Table 30. Fisheries activities at FSRD site, Lahirirhat Rangpur during the year of 2008-09.

Farm category	No. of Farm	Av. area of water bodies (dec.)	Date of release of fingerlings	Name of fingerlings	No. of fingerlings per /dec.	Average yield (kg/dec.)	
						Before intervention	After intervention
Marginal	5	5-7	05.05.08	Silver carp	10	-	5.02
				Rajputi	15	-	2.30
				Rui	15	-	5.25
				Mrigal	5	-	1.75
Total	-				45	6.75	14.32
Small	5	5-10	05.05.08	Silver carp	10	-	5.52
				Rajputi	15	-	2.62
				Rui	15	-	5.67
				Mrigal	5	-	1.95
Total					45	8.23	15.76

FSRD site, Razakhali, Ptuakhali

Almost every homestead has a pond either large or small in the southern region of Bangladesh. Pond owners do not use it properly in maximum cases. But this pond could be a production unit for round the year. Different creepers on trellis round the year and pisi-culture can meet up family nutrition requirements as well as a source of extra income. In 2008-09 at FSRD site, Razakhali 3 small ponds were selected for this purpose. Creepers like Bottle gourd, bitter gourd, wax gourd was grown and monosex hybrid tilapia/rajputi was used in the pond. Average production was 560 kg bottle gourd, 195 kg bitter gourd and wax gourd is now vegetative stage. Average fish production was 64 kg per pond.

Program : Pilot production program of different cropping patterns

FSRD site, Lahirirhat, Rangpur

On-Farm Research division, of BARI has generated several cropping pattern, which are biologically and agro-economically viable. These patterns are widely accepted to the farmers. These technologies have created good impacts on farmer’s income and maintained food security at household level at different parts of the country. Among them, some cropping patterns were undertaken under the pilot production program to increase farm productivity as well as cropping intensity.

The pilot production programme of different cropping patterns was done at FSRD site, Lahirirhat, Rangpur during 2007-08 and 2008-09 to compare their performance. The six cropping patterns viz., Potato- Boro- T.aman, Potato/Maize- T.aman, Potato - Mungbean – T aman, Potato-Jute-T.aman, Potato-vegetables-T.aman and Mustard-Boro-T.aman was evaluated. The performance of traditional cropping pattern Fallow-Boro-T.aman was also monitored at 10 farmer’s field. One cropping cycle was completed is 2007-08 and the second cycle was started in 2008-09.The sowing time, harvesting time and fertilizer application are presented in Table 31 and 32.

In 2007-08

The results of the first cycle are shown in Table 33. The highest gross margin (Tk. 204783 ha^{-1}) was obtained from Potato-Maize-T.aman rice cropping pattern which was followed by Potato-Jute-T.aman (Tk.196402 ha^{-1}) and Potato-Boro-T.aman rice cropping pattern (Tk. 179313 ha^{-1}) in 2007-08. While the highest benefit cost ratio (2.16) was obtained from Potato-Maize-T.aman rice cropping pattern which was closely followed by Potato-Boro-T.aman rice (2.14) and Potato-Jute-T.aman rice (2.10) cropping pattern in 2007-08. The lowest gross margin (Tk.36255 ha^{-1}) was obtained from traditional Fallow-Boro-T.aman rice cropping pattern.

In 2008-09

The second cycle was started in 2008-09. None of the cropping pattern completed the cycle in this year. However, the highest gross margin (Tk. 158256 ha^{-1}) was obtained from Potato-Boro rice-T.aman rice cropping pattern (Table 34**.** While the highest benefit cost ratio (2.09) was obtained from Potato-Maize-T.aman rice cropping pattern.

Table 31. Sowing and harvesting time of different crops in the tested cropping pattern at FSRD site, Rangpur during the year of 2007-08.

Cropping pattern	No. of farmers involved	Sowing date			Harvest date		
		Potato/ Mustard	Boro/Maize/ Jute/Vegetable	T.aman	Potato/ Mustard	Boro/ Mungbean/ Maize/ Jute/Okra	T.aman
Potato-Boro-T.aman	6	23-28 Nov.	23-26 Feb.	15-20 July	22-24 Feb	20-25 May	15-18 Nov.
Potato-Maize-T.aman	12	28-30 Nov.	1-5 Jan.(relay)	15-20 July	25-30 Feb	20-26 May	18-25 Nov.
Potato-Jute-T.aman	5	26-30 Nov.	10-14 Mar.	20-25 July	24-28 Feb	15-22 July	20-25 Nov.
Potato-Mungbean-T.aman	3	25-28 Nov.	8-10 Mar.	10-12 July	2-5 Mar.	15-25 May	20-25 Nov.
Potato-Veg(Okra)-T.aman	3	27-30 Nov.	1-3 Mar.	10-13 July	28-30 Feb.	On-going	On-going
Mustard-Boro-T.aman	3	20-22 Nov.	25-28 Feb.	On going	20-22 Feb	18-22 May	On going
Fellow-Boro-T.aman	10	-	5-15 Feb.	10-20 July	-	10-25 May	14-25 Nov.

Potato= Granula, Maize=NK-40, Mustard= BARI Sharisha-9, Boro= BRRI Dhan-28, Jute= O-9897, Okra= BARI Dharosh-1, T.aman= BRRI Dhan-11

Table 32. Fertilizer dose used in different crops in the tested cropping pattern at FSRD site, Lahirirhat Rangpur, during the year of 2007-08 and 2008-09.

Crops	Fertilizer dose
Potato	129-20-132-17-15-3-1.5-5000 kg NPKS MgZnBCD ha^{-1}
Boro	125-20-60-15-1 kg NPKSZn ha^{-1}
T.aman	115-12-40-5-1 kg NPKSZn ha^{-1}
Mungbean	20-16-15-1 kg NPKSZnB ha^{-1}
Mustard	64-22-53-29-6-1.5-1 kg NPKSMgZnB ha^{-1}
Jute	88-18-67-18-5 kg NPKSZn ha^{-1}
Okra	70-20-75-18-2.5-1.5-5000 kg NPKSZnBCD ha^{-1}

CD= Cowdung

Table 33. Yield and economics of different cropping pattern tested at FSRD site, Lahirirhat Rangpur during the year of 2007-08.

Cropping pattern	Average Yield (t ha^{-1})			Average stover yield (t ha^{-1})		
	Potato/ Mustard	Boro/ Maize/ Jute/Vegetable	T.aman	Potato/ Mustard	Boro/ Mung/ Maize/ Jute/Vegetable	T.aman
Potato-Boro-T.aman	23.22	5.25	4.25	-	5.65	4.58
Potato-Maize-T.aman	25.31	8.52	4.11	-	9.63	4.35
Potato-Jute-T.aman	24.83	1.85	4.05	-	3.75(stick)	4.36
Potato-Mungbean-T.aman	23.49	.0893	4.37	-	2.10 (biomass)	4.45
Fellow-Boro-T.aman	-	4.05	3.45	-	4.25	3.76

Table 33 contd.

Cropping pattern	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
Potato-Boro-T.aman	336565	157252	179313	2.14
Potato-Maize-T.aman	381320	176537	204783	2.16
Potato-Jute-T.aman	374530	178128	196402	2.10
Potato-Mungbean-T.aman	320890	155005	165885	2.07
Fellow-Boro-T.aman**	82455	46200	36255	1.78

* Potato=Tk 10/kg, Mungbean= Tk.70/Kg, Jute fibre= Tk. 15/Kg, Mustard= Tk. 32.50/Kg, Maize= Tk.9/Kg, Boro= Tk.10/Kg, T.Aman= Tk.11/Kg, ** Monitoring results at 10 farmers plot

Table 34.Yield and economics of different cropping pattern tested at FSRD site, Lahirirhat Rangpur during the year of 2008-09.

Cropping pattern	No. of farmer involved	Average Yield (t/ha)			Average stover yield (t/ha)		
		Potato/ Mustard	Boro/ Maize/ Jute/Vegetable	T.aman	Potato/ Mustard	Boro/ Jute/ Mungbean	T.aman
Potato-Boro-T.aman(Potato-Boro)	6	25.11	5.27	-	-	5.76	-
Potato/Maize-T.aman(Potato)	12	25.01	-	-	-		-
Potato-Jute-T.aman(Potato)	5	24.89	-	-	-		-
Potato-Mungbean-T.aman(Potato& Mungbean)	3	24.22	0.825	-	-	2.31	-
Mustard-Boro-T.aman(Mustard & Boro)	3	1.13	5.16 (On going)	-	1.35	5.36	-
Potato-Veg.(Okra)-T.aman(Potato)	3	25.07	8.32 (On going)	-	-		-
Fellow-Boro-T.aman(Boro)	10	-	4.10	-	-	4.11	-

Table 34 contd.

Cropping pattern	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
Potato-Boro-T.aman(Potato-Boro)	306680	148424	158256	2.07
Potato/Maize-T.aman(Potato)	250100	119538	130562	2.09
Potato-Jute-T.aman(Potato)	248900	119538	129362	2.08
Potato-Mungbean-T.aman(Potato& Mungbean)	275200	139538	135662	1.97
Mustard-Boro-T.aman(Mustard & Boro)	91167	50586	40581	1.80
Potato-Veg.(Okra)-T.aman(Potato)	-	-	-	-
Fellow-Boro-T.aman(Boro)	41000	28886	12114	1.42

FSRD stie, Kadamshahar, Rajshahi

The performance of three patterns was given in Table 35. The overall performance of both crops under each pattern was good and satisfactory. The yield of chickpea, wheat and mustard was 1.12 t ha^{-1}, 3.01 t ha^{-1} and 1.30 t/ha respectively. Higher gross margin (Tk.60050 ha^{-1}) was obtained from Mustard--T.aman cropping pattern due to higher yield as well as high price of mustard in the local market. The lowest gross margin (Tk.48500 ha^{-1}) found from Chickpea-T.aman cropping pattern. The higher BCR (2.40) was obtained in Mustard-T.aman cropping pattern followed by Chickpea-T.aman (2.23) cropping pattern where lower BCR (1.99) was obtained from Wheat-T.aman cropping pattern (Table 36).

Farmers' reaction

Farmers opined very much positively with high yield of different crop varieties and high cash return.

Table 35: Different types of management practices in different rice based cropping pattern during the year of 2008-09 FSRD stie, Kadamshahar, Rajshahi

Management practices	Chickpea	Wheat	Mustard	T.aman
1. Variety 2. Area (Bigha)	BARI chola 5 20	Shatabdi 8	BARI sharisa-11 2	Sharna 30
3. Sowing/ planting date	20-30 Nov. 08	18-30 Nov. 08	15 Nov. 08	02– 08 Aug 08
4. Spacing	Line to line 30cm with continuous sowing	Line to line 20cm with continuous sowing	Line to line 30cm with continuous sowing	Line transplanting by 20cm X15cm
5.Fertilizer dose (Urea-TSP-MP-Gyp-B.acid-$ZnSo_4$ kg/ha)	40-80-40-0-10	200-160-40-110-5-5 + 10 CD	250-170-85-150-10-5 + 8 t CD	175-51-80-45- 0-5
6. Application procedures	All organic & inorganic fertilizers were applied at final as basal dose	All organic & inorganic fertilizers and 2/3 of urea were applied at final as basal dose and rest 1/3 urea was applied as top dress.	All organic & inorganic fertilizers and 2/3 of urea were applied at final as basal dose and rest 1/3 urea was applied as top dress.	All organic & inorganic fertilizer and 1/3 of urea were applied at final land preparation and rest 2/3 urea was applied into two equal installments during tillering and before panicle initiation stage
8. Weed management	Once, 23-25 DAS	Once 25 DAS	Once, 25 DAS	Twice, 20 & 35 DAT
9. Water management	No need	Three Irrigation at 20, 45 and 70 DAS	Irrigation twice at 20 and 35 DAS	No need
10. Pesticide application	Karate @ 2 ml/L water was used before pod setting to control pod borer	No need	Melataf 57 EC @ 2 ml/L water was used to control aphids	Dimecron @ 0.5 ml/L during heading stage.
11. Date of Harvesting	30 March -10 April 2009	27 March -5 April 2009	28 Feb 2009	01- 10 Nov 2008

Table 36.Area and performance of crops under different cropping patterns during the year of 2008-09 at FSRD stie, Kadamshahar, Rajshahi .

Cropping pattern	Mean yield (t ha^{-1})	GR (Tk ha^{-1})	TCC (Tk ha^{-1})	NR (Tk ha^{-1})	BCR
1. Chickpea-T.aman	C.pea = 1.12, T.aman = 3.35	94050	4100	53050	2.23
2. Wheat-T.aman	Wheat = 3.01, T.aman = 3.49	97500	49000	48500	1.99
3. Mustard--T.aman	Mustard= 1.30, T.aman= 3.39	102850	42800	60050	2.40

*Note: GR= Gross return, NR= Net return, TCC= Total cultivation cost and BCR= Benefit cost ratio

Price: Chickpea Tk.40 kg^{-1}, Wheat Tk.15 kg^{-1}, Mustard Tk.40 kg^{-1} and Rice Tk. 12.50kg^{-1}
Urea Tk.612 kg^{-1} , TSP Tk.45 kg^{-1}, MP Tk.40 kg^{-1} , Gypsum Tk.7 kg^{-1}, Boron Tk.100 kg^{-1}

Noakhali

Performance of difference cropping pattern at FSRD site, Noakhali and MLT site, Laxmipur

Farmers of greater Noakhali usually grow various crops in cropping pattern basis. Because of the wet condition prevailing during monsoon, rice is the only suitable crop. Depending upon the flooding depth or availability of irrigation facilities there is one or two rice and some rabi crops like soybean, ground nut in the pattern. In the present view of Bangladesh the major cropping patterns are rice based (Hoque, 1999). But farmers as well as farmers of greater Noakhali normally use local varieties of rice such as Hayida, Kajalshil, Rajashil; imbalance fertilizer uses, in some cases there is no fertilizer and get lower yield. Application of fertilizers, especially NPK in balanced quantities is often advocated for sustaining high yields of crops (Singh et al., 1973; Bhuiyan et al., 1991; Panaulla et al., 1999).On the other hand soybean and groundnut is the most promising cash crops among the farmers in this area are mostly owners with a few tenant cultivators. The average yield of these crops can be increased by using high yielding varieties. BARI and BRRI developed some varieties may be used as the replacement of the existing low yielding varieties without disturbing the cropping patterns with their recommended production technology such as recommended fertilizer so can be transferred to some parts of greater Noakhali having suitable agro-climatic conditions.

Table 37. Agronomic performance of Soybean-D. Aus- T. Aman cropping pattern at Noakhali and Laxmipur during the year of 2007-08 .

Items	cropping pattern					
	Non-participating farmers			Improved management practices among participating farmers		
	Soybean	D. Aus	T. Aman	Soybean	D. Aus	T. Aman
plot size	10 X 8 sq. m.	10X 8 sq. m		10 X 8 sq. m.	10 X 8 sq. m.	10X8 sq. m.
Variety used	shoag	Hyida	Kajalsail	BARI soybean-5	BRRI Dhan-27	BRRI Dhan-40
Date of seedling/ Sowing	12 to 15 January,2008	22/04/2008	30 June ,2008	16 to 20 January,2008	13 to 22 May,2008	17 August ,2008
Date of transplanting	-	27 to 31 May, 2008	05-07 August,2008	-	-	17 to 23 September,2008
seedling age (days)	-	35-39	36-38	-	-	30-36 days
planting method	random	Random	Random	Line sowing	Dibbling	Line sowing
Spacing	-	-	-	30 X 10 cm	20 cm	25 cm X 15 cm
organic manure cowdung	200 t/ha	-	300 kg	2 t/ha		2 t/ha
Basal fertilizer			-			
N	15			25	34	31
P	05	2 kg/ha	3 kg/ha	33	10	10
K	-	-	-	55	7	34
S	-	-	-	18		4
1st top dress: N (kg/ha)period	-	10-13June2008 38 kg/ha	18 to 20August,2008 45	-	20 to 26 June,2008 34	11 to 14 October,2008 31
2nd top dress N (kg/ha)period	-	30 June to 2 July,2008 38 kg/ha	4 to 7 September,2008 45 kg/ha	-	-	9 to 11 November,2008 31
	06 to 10 May,2008 harvesting period	16-20 July,2008	25 to 29 November,2008	06 to 10 May,2008	30, August to 10, September,2008	27 December,2008 to 5 January,2009
Grain Yield(t/ha)	2.63 t/ha	2.18	2.47	2.54 t/ha	3.15	3.53
Field duration (days)		85-89	149-152		109-111	132 to 140
By product (kg/ha)		2.40	3.		3.10	3.78

Table 38.Agronomic performance of Groundnut -T. Aus- T.Aman cropping pattern at Noakhali and Laxmipur during the year of 2007-08 .

Items	cropping pattern					
	Non-participating farmers			Improved management practices among participating farmers		
	Groundnut	T. Aus	T. Aman	Groundnut	T. Aus	T. Aman
plot size	10X 8 sq. m	10X 8 sq. m		10 X 8 sq. m.	10 X 8 sq. m.	10X8 sq. m.
Variety used	Dhaka -1	Hyida	Kajalsail	Dhaka-1	BRRI Dhan-27	BRRI Dhan-40
Date of seedling/ Sowing	15 to 20 January,2008	22/04/2008	30 June ,2008	16 to 18 January,2008	24 April,2008	25 july ,2008
Date of transplanting	-	27 to 31 May, 2008	05-07 August,2008	-	27 to 30 May, 2008	28-31August,08
seedling age (days)	-	35-39	36-38	-	37-42 days	33-37 days
planting method	Dibbling (random)	Random	Random	Line sowing	line sowing	Line sowing
Spacing	-	-	-	30 X 15cm	20 X 15 cm	25X 15 cm
organic manure Cowdung	500 kg	-	300 kg	2 t/ha	-	2 t/ha
Basal fertilizer			-			
N				25	26	31
P	80 kg	2 kg/ha	3 kg/ha	33	08	10
K	2	-	-	43	30	34
S	-	-	-	18	3	4
1st topdrss:	-	10-13 June2008	18 to 20 August,2008	-	17-22 June,2008	18-23 September,08
N (kg/ha)period		38 kg/ha	45		26 kg/ha	31kg/ha
2nd topdress	-	30 June to 2 July,2008	4 to 7 September,2008	-	2-5 July,2008	13 to 17 October,2008
N (kg/ha)period		38 kg/ha	45 kg/ha			31 kg/ha
harvesting period	10 to 14 May,2008	16-20 July,2008	25 to 29 November,2008	12 to 16 May,2008	11-16 August,2008	15 December,2008
Grain Yield(t/ha)	1.27	2.18	2.47	2.02 t/ha	3.12	3.31
Field duration (days)	115 to 119	85-89	149-152	116-118 days	111-113	139-142
By product (kg/ha)		2.40	3.		3.47	3.52

Table 39.Agronomic performance of Fallow -T. Aus- T.Aman cropping pattern at Noakhali and Laxmipur during the year of 2007-08.

Items	cropping pattern					
	Non-participating farmers			Improved management practices among participating farmers		
	Fallow	T. Aus	T. Aman	Fallow	T. Aus	T. Aman
Plot size		10X 8 sq. m			10 X 8 sq. m.	10X8 sq. m.
Variety used		Hyida	Kajalsail		BRRI Dhan-27	BRRI Dhan-40
Date of seedling/ owing		26/04/2008	01 July ,2008		6May 2008	15 August,2008
Date of transplanting		29 to 31 May, 2008	7-10 August,2008		10 to 17 June,2008	20 to 25 September,2008
seedling age (days)		33-35	36-39		34 - 41 Days	36-41 days
planting method		Random	Random		Line sowing	Line sowing
Spacing		-	-		20 cm X 15 cm	25 cm X 15 cm
organic manure Cowdung		-	300 kg		-	2 t/ha
Basal fertilizer						
N			-		26	31
P		2 kg/ha	3 kg/ha		8	10
K		-	-		30	34
S		-	-		3	4
1st top-dress: N (kg/ha)period		14-17 June2008 38 kg/ha	22 to 25 August,2008 45		09 to 16 July,2008 26	12 to 16 October,2008 31
2nd top-dress N (kg/ha)period		2 to 4 July,2008 38 kg/ha	7 to 10 September,2008 45 kg/ha		26 to 31 July,2008 26	15 to November,2008 31
harvesting period		20-23 July,2008	29 to 31 November,2008		25August to 04 September,2008	13 to 18 December,2008
Grain Yield(t/ha)		2.87	2.47		3.11	3.27
Field duration (days)		85-87	149-152		118-120	138-143
By product (kg/ha)		3.43	3.		3.29	3.53

FSRD site, Rajakhali, Patuakhali

Mungbean-T. aus-T. aman cropping pattern

Mungbean-T. aus-T. aman is the second major cropping pattern regarding acreage next to Khesari-T. aus-T. aman in the Patuakhali region. Farmers are usually growing traditional local varieties in most cases. Only 25-30% mungbean growing are is covered by modern varieties. T. aus and T. aman coverage is very less compared to mungbean. On the other hand yield of local varieties are very less than HYV. With this point of view, a pilot production progaram was undertaken to verify Mungbean-T. aus-T. aman cropping pattern with modern varieties. Modern varieties selected for this pattern was BARI mung-6, BRRI dhan-27 (T.aus) and BRRI dhan-41 (T. aman). The program was conducted at FSRD site, Razakhali, Patuakhali during 2008-09. Mungbean has been harvested and T. aus has been transplanted. Number of cooperator farmers was five. Application of fertilizers and other intercultural operations were done as per recommendation. Performance of the first crop BARI mung-6 of the pattern was good and satisfactory. A total area was 0.5 ha. and yield of BARI mung-6 was 895 to 1180 kg/ha and it was 52% higher than farmers' practice with local varieties.

Chilli-T. aman cropping pattern

Chilli-T. aman is the third major cropping pattern regarding acreage next to Khesari-T. aus-T. aman and Mungbean-T. aus-T. aman in the Patuakhali region. Farmers are usually growing traditional local varieties in most cases. In few cases in OFRD, Patuakhali research sites modern chilli variety is seen. With this point of view, a pilot production progaram was undertaken to verify Chilli-T. aman cropping pattern with modern varieties. Modern varieties selected for this pattern was BARI lanka-1 and BRRI dhan-41 (T. aman). The program was conducted at FSRD site, Razakhali, Patuakhali during 2008-09. Ripen fruits of chilli is being harvested. Number of cooperator farmers was seven and total area was 0.4 ha. Application of fertilizers and other intercultural operations were done as per recommendation. Performance of the first crop BARI lanka-1 of the pattern was good and satisfactory. Number of green fruits (average 71 per plant) is much higher than local cultivars. Fruit borer infestation was observed in some plots and protective measures were taken. The fruits are covered by leaves. As a result birds do not find the ripen fruits. Fruits size and shape are more or less uniform.

FSRD stie, Kadamshahar, Rajshahi

The performance of Onion and garlic was given in Table 40. The overall performance of both crops was good and satisfactory. The yield of onion and garlic was 6.00 t ha^{-1} and 4.50 t/ha respectively. The gross return, gross margin and BCR was Tk.120000 ha^{-1}, Tk.47000 ha^{-1}) and 1.64 in onion respectively. On the other hand, in garlic the gross return, gross margin and BCR was Tk.180000 ha^{-1}, Tk.105000 ha^{-1} and 2.40, respectively (Table 41).

Farmer's reaction

Farmers opined that production technology was good but they need high yielding cultivars to increase the productivity of garlic and onion.

Table 40: Different types of management practices in onion and garlic during the year of 2008-09.

Management practices	Onion	Garlic
1. Variety	Local	Local
2. Area	10 deci	10 deci
3. Sowing/ planting date	2 November 2008	2 November 2008
4. Spacing	Line to line 30cm with continuous sowing	Line to line 20cm with continuous sowing
5.Fertilizer dose (Urea -TSP- MP kg/ha)	250 -200 -160 + 10CD	200 -150 -140 + 10CD
6. Application procedures	All organic, TSP, 1/ 2 of urea and MP were applied as basal dose during final land preparation and rest urea and MP was used as top dress at 25 & 50 DAS.	All organic, TSP, 1/ 2 of urea and MP were applied as basal dose during final land preparation and rest urea and MP was used as top dress at 25 & 50 DAS.
8. Weed management	Twice, 25 & 50 DAS	Twice, 25 & 50 DAS
9. Water management	Three Irrigation at 20, 40 and 60 DAS	Three Irrigation at 20, 40 and 60 DAS
10. Pesticide application	*Rubral plus redomil* @ 2 2g/L water was used 7-10 days interval as preventive measure of purple blotch	No need
11. Date of Harvesting	17 February 2009	17 March 2009

Table 41: Area and performance of crops under different cropping patterns during the year of 2008-09.

Crops	Mean yield (t/ha)	Gross return (Tk ha^{-1})	Total cultivation cost (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
1. Onion	6.00	120000	73000	47000	1.64
2. Garlic	4.50	180000	75000	105000	2.40

*Note: GR= Gross return, NR= Net return, TCC= Total cultivation cost and BCR= Benefit cost ratio

Price: Onion Tk.20 kg^{-1} and Garlic Tk. 30 kg^{-1} Urea Tk.612 kg^{-1} , TSP Tk.45 kg^{-1}, MP Tk.40 kg^{-1} , Gypsum Tk.7 kg^{-1}, Boron Tk.100 kg^{-1}

FSRD site, Razakhali, Patuakhali

The pilot production program was conducted at FSRD site, Razakhali, Patuakhali during the rabi season of 2008-09. Crop varieties were BARI peaj-1, BARI roshun-1 and BARI dhonia-1. Crops were transplanted/ sown on 07.01.2009. Application of fertilizers and other intercultural operations were done as per recommendation. Number of cooperator farmers was three. A total area was 18 decimal. Performance of onion and garlic was moderate and coriander was satisfactory. Yield of BARI peaj was 5.08 t ha^{-1}, BARI roshun-1 was 3.1 t ha^{-1} and BARI dhonia-1 was 1150 kg ha^{-1}. Farmers are interested to grow spices crop in a small scale.

Programme : Screening of different crops and crop varieties in coastal area

Southern coastal region is probably the most vulnerable area of Bangladesh especially in the context of agriculture. Varying degrees of Soil and water salinity, drought, scarcity of suitable irrigation water in dry season and sometimes also in early *kharif-1* season, high rainfall in wet season, cyclone, tidal flood etc. are the most common phenomenon in this area. Out of 2.83 million hectares in the 13 districts of coastal in Bangladesh, about 0.833 million hectares are affected by varying degrees of soil salinity (Karim *et al.*, 1990). It is a production constraint common to all rainfed agriculture in the coastal areas. It is believed to be mainly responsible for low cropping intensity in the area (Rahman *et al.*, 1989). In Patuakhali district 31% land remains fallow during winter period whereas it goes to 53% in kharif-I season (DAE, Patuakhali, 2008). Cultivation of local T. aman rice delay harvesting even up to 15 January, heavy clay soil delay to joe condition delayed most of the winter crops. In the coastal area khesari, cowpea, mungbean, chilli, sweet potato, sesame, groundnut are main rabi crops that sown/ planted as late rabi crop. With this point of view, this program was undertaken to find out suitable crop(s)/ varieties for the coastal area that could bring the fallow land under cultivation and increase national food production. The performance results of the crops area given in table 42.

Table 42. Yield of different crops/ varieties at FSRD site, Razakhali, Patuakhali during the year of 2008-09.

Crop	Variety	Yield	Remarks
Mustard	BARI sarisa-9	855 kg/ha	required high land
	BARI sarisa-11	910 kg/ha	”
	BARI sarisa-14	1124 kg/ha	”
Potato	Asterix	17.51 t/ha	8% scab infection
	Granola	15.34 t/ha	21% scab infection
	Diamont	14.62 t/ha	28% scab infection
Sesame	BARI til-3	being harvested	
Sweet potato	BARI sweet potato-8	22.56 t/ha	
	BARI sweet potato-9	20.98 t/ha	
Onion	BARI peaj-1	5.24 t/ha	
Tomato	BARI tomato-14	54 t/ha	
Maize	BARI hybrid maize-5	7.20 t/ha	
Chickpea	BARI chola-5	760 kg/ha	
Garlic	BARI roshun-1	2.35 t/ha	
Chilli	BARI lanka-1	being harvested	
Mungbean	BARI mung-6	1080 kg/ha	

1.	**Name of Technology**	:	**Planting date and bulb size on the seed yield and seed quality of summer onion in the High Barind Tract**
2.	Year of conduction		2007-08 and 2008-09
3.	Name of Organization	:	Bangladesh Agricultural Research Institute (BARI)
4.	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
5.	Location of application	:	Area of High Barind Tract with similar soils of AEZ 26
6.	Key characteristics of technology	:	Large bulb (15±2 g) sowing on first week to third week of November produced good quality higher seed yield
7.	Production guideline	:	
	Crop	:	Onion
	Variety	:	BARI Peaj-2
	Spacing	:	25 cm × 20 cm
	Planting time	:	First week to 3rd week of November
	Fertilizer dose		125-55-75-20-1 kg, N-P-K-S-B ha^{-1} + 5 t ha^{-1} CD
	Fertilizer application	:	Whole quantity of phosphorus, sulphur, zinc, cowdung (CD), half of potassium and one third of nitrogen should be applied as basal. Rest of potassium at 30 days after emergence (DAE) and the remaining nitrogen should be applied as side dressing at 30 and 45 DAE.
	Crop protection measure	:	Rovral (2 g/L water) and Bavistin (1 g/L water) should be sprayed simultaneously 8-10 days intervals during vegetative stage as a preventive measure of *Purple blotch* disease.
	Yield	:	600 kg seed ha^{-1}
8.	Risk involvement in adopting the technology	:	No risk involvement
9.	Impact on environment	:	No harmful effects on environment
10.	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/ leaflet, Radio talk etc.
11.	Expected outcome	:	Quality seed will be increased for summer onion cultivation
12.	Socio-economic aspect	:	

Gross return ($Tk.ha^{-1}$)	Total cost ($Tk.ha^{-1}$)	Net return ($Tk.ha^{-1}$)	BCR
120000	40000	80000	3.0

13.	Recommendation	:	For quality seed production of summer onion, the optimum bulb size is 15±2 g and sowing time is first week to third week of November under Barind condition

1.	**Name of Technology**	**:**	**Intercropping Soybean with kaon varying plant population**
2.	Year of conduction		2007- 08 and 2008 - 09
3.	Name of Organization	:	Bangladesh Agricultural Research Institute (BARI)
4.	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
5.	Location of application	:	Medium highland areas of Laxipur with similar soils of AEZ 18
6.	Key characteristics of technology	:	One row kaon (40%) after two rows of soybean (100%) as intercropped found suitable and profitable than that of sole soybean
7.	Production guideline	:	
	Crop	:	Soybean and Kaon
	Variety	:	BARI soybean 5 and BARI kaon 3
	Spacing	:	Soybean: 30cm × 10cm Kaon: 30cm × 5cm
	Sowing time	:	Third week of January
	Fertilizer dose	:	80-60-30 kg N-P-K ha^{-1}
	Fertilizer application	:	Phosphorus, potassium and 1/3rd of nitrogen should be applied as basal and rest of nitrogen should be applied as top dress in two equal splits at 25 and 50 DAS, respectively.
	Yield (t ha^{-1})	:	Soybean: 1.92 Kaon: 0.94
8.	Risk involvement in adopting the technology	:	No risk involvement
9.	Impact on environment	:	No harmful effects on environment
10.	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/ leaflet, Radio talk etc.
11.	Expected outcome	:	Total productivity and profitability could be increased
12.	Socio-economic aspect	:	

Crop	Total variable cost (Tk.ha^{-1})	Gross margin (Tk.ha^{-1})	BCR
Sole soybean	20850	61300	3.46
Soybean (100%) with kaon (40%)	31500	64150	3.98

13.	Recommendation	:	The plant population of 100% soybean intercropped with 40% kaon is suitable and profitable than that of sole soybean. So, this technology should be widely disseminated in the soybean growing areas.

1. Name of Technology	**:**	**Replacement of existing B.Aus rice variety by BRRI dhan 42 or BRRI dhan 43 to escape early flood in Char areas of Tangail**
2. Year of conduction		2007-08 and 2008-09
3. Name of Organization	:	Bangladesh Agricultural Research Institute (BARI)
4. Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
5. Location of application	:	Charland area of Tangail with similar soils of AEZ 8
6. Key characteristics of technology	:	• BRRI dhan 42 or BRRI dhan 43 could harvest 10-15 days earlier than that of existing variety to escape early flood • BRRI dhan 42 or BRRI dhan 43 produced numerical higher yield than existing variety
7. Production guideline	:	
Crop	:	B.Aus rice
Variety	:	BRRI dhan 42 or BRRI dhan 43
Spacing	:	25cm × continuous sowing
Sowing time	:	Last week of April
Fertilizer dose	:	67-10-37-6 kg, N-P-K-S ha^{-1}
Fertilizer application	:	Entire quantity of phosphorus, potassium, sulphur and half of nitrogen should be applied during final land preparation and rest of nitrogen should be applied at 30-35 DAS
Yield (t ha^{-1})	:	BRRI dhan 42: 3.17 BRRI dhan 43: 3.05
8. Risk involvement in adopting the technology	:	No risk involvement
9. Impact on environment	:	No harmful effects on environment
10. Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/ leaflet, Radio talk etc.
11. Expected outcome	:	Total productivity and profitability could be increased
12. Socio-economic aspect	:	

Variety	Gross return (Tk.ha^{-1})	Total cost (Tk.ha^{-1})	Net return (Tk.ha^{-1})	BCR
BRRI dhan 42	47550	16620	30930	2.86
BRRI dhan 43	45750	16620	29130	2.75

13. Recommendation	:	BRRI dhan 42 or BRRI dhan 43 may be recommended for large scale production in char areas of Tangail.

Production Program of Mungbean with Boron Fertilizer

Abstract

The production program was conducted at Gobindoganj, Ulipur and Domar MLT sites, OFRD, Rangpur during the Kharif season of 2008-09 to observe the effect of boron on mung bean cultivation in the farmer's field. Two treatments viz., T_1= Recommended fertilizer dose without boron & T_2= Recommended fertilizer dose with boron (1.0 kg ha^{-1}) were compared for this purpose. Irrespective of MLT sites, the grain yield was significantly higher in T_2 (recommended fertilizer dose with boron) and the yield were 1870 kg ha^{-1} at Gobindoganj, 1053 kg ha^{-1} at Ulipur and 1430 kg ha^{-1} at Domar MLT sites. The lower grain yield was obtained from T_1 (recommended dose without boron) and the yield were 819 kg ha^{-1} at Gobindoganj, 547 kg ha^{-1} at Ulipur and 686 kg ha^{-1} at Domar MLT sites. The higher gross return and gross margin was also obtained from T_2. The lower gross return and gross margin was obtained from T_1.

Introduction

Mungbean is the second most popular pulse crop in Bangladesh. With the introduction of newly released photo period insensitive short duration verities like BARI mung-6 the farmers interest in mungbean cultivation. Agro ecological zone- 3 is very much boron deficit area which caused lower yields of mungbean. Boron is essential micronutrient for plant. It is notated that Boron is responsible for pod and seed formation. Therefore application of boron in addition to essential major elements and cowdung has gaining practical significance. The production program was under taken at farmer's field to create awareness about the effect of boron on the yield of mungbean.

Materials and Method

The production program was conducted at Gobindoganj, Ulipur and Domer MLT site, OFRD, Rangpur the during the kharif–I season of 2008-09 to observe the effect of boron on mungbean in the farmer's field. Two treatments viz., T_1= Recommended fertilizer dose without boron & T_2= Recommended fertilizer dose with boron (1.0 kg ha^{-1}) were evaluated. The land type was medium high which belongs to AEZ 3. The experiment was laid out in a randomized complete block design with four dispersed replications. The total land area was 1000m^2 each side The seeds were sown on 25-26 February, 5-8 March and 26 February, 2009 at Gobindoganj, Ulipur and Domer MLT sites, respectively, maintaining 30cm x continuous plant spacing. The crop was fertilized with 25-17-18 kg N-P-K ha^{-1} as blanket dose. All the fertilizers were applied during final land preparation. The crop was harvested on 12 – 13 May, 26-27 May and 14-15 May, 2009 at Gobindoganj, Ulipur and Domar MLT sites, respectively.

Results and Discussion

Grain yield of mungbean varied significantly due to boron fertilizer. The higher grain yield was obtained from T_2 (1870kg ha^{-1} at Gobindoganj, 1053 kg ha^{-1} at Ulipur and 1430 kg ha^{-1} at Domar) and the lower grain yield was recorded from T_1 (without boron fertilizer). The economic performance of mungbean was influenced by boron. The higher gross margin was obtained from recommended fertilizer dose with boron (1 kg ha^{-1}) at Gobindoganj (Tk. 106361 ha^{-1}), Ulipur, (Tk.49174 ha^{-1}) and Domar (Tk.75456 ha^{-1}) MLT site.

Farmer's reaction

Farmers were satisfied with better yield of mungbean from boron applied fields. They realized the benefit of boron application in mungbean production.

Conclusion

Application of boron has positive effect on seed yield of mungbean. For production of mungbean the farmer should use 1kg B/ha in the Rangpur region.

Table 1. Yield of mungbean as influenced by boron fertilizer at different MLT sites in Rangpur during the rabi season of 2008-09.

	Yield (kg ha^{-1})		
	Gobindagang	Ulipur	Domar
T_1 = Recommended fertilizer dose without boron	819	547	686
T_2 = Recommended fertilizer dose with boron	1870	1053	1430
CV (%)	4.17	5.13	5.12

Table 2. Economic performance of mungbean as influenced by boron

Treatments	Gross return(Tk ha^{-1})			Total cost (Tk ha^{-1})			Net return (Tk ha^{-1})		
	Gobindaganj	Ulipur	Domar	Gobindaganj	Ulipur	Domar	Gobindaganj	Ulipur	Domar
T_1	57330	38290	48024	23481	23201	23386	33849	15089	24638
T_2	130900	73710	100100	24539	24536	24644	106361	49174	75456

$T_{1=}$ Recommended fertilizer dose with out boron, $T_{2=}$ Recommended fertilizer dose with boron (2.0kg/ha)
Price (Tk.kg^{-1}): Price: Maize = Tk 70 , Urea= 11.80, TSP= 74:36, MOP=.55, Gypsum= 7, Zinc sulphate= 140 and Boric acid = 180 Labour : 112 day^{-1}.

Production Program of Mustard with Boron Fertilizer

Abstract

The production program was conducted at the Ulipur MLT site, OFRD, Rangpur during the Rabi season of 2008-09 to observe the effect of boron on mustard in the farmer's field. Two treatments viz., T_1= Recommended fertilizer dose without boron & T_2= Recommended fertilizer dose with boron (1.0 kg ha^{-1}) were compared for this purpose. The experiment was laid out in a randomized complete block design with four dispersed replications. Significantly the higher grain yield (1100 kg ha^{-1}) was obtained from T_2 (Recommended fertilizer dose with boron) compared to T_1 (Recommended fertilizer dose without boron (700 kg ha^{-1}). The higher gross return (Tk. 45154 ha^{-1}) and gross margin (Tk. 20858 ha^{-1}) was obtained from T_2.

Introduction

Mustard is the most popular oilseed crop grown in Bangladesh. With the introduction of newly released varieties like BARI sarisha -9 the farmers are getting more interest in mustard cultivation. Boron is responsible for pod and seed formation. Rangpur is boron deficit area which caused lower yield of mustard. For this reason, the experiment was undertaken to find out the effect of boron fertilizer on BARI sarisha-9 at Ulipur MLT site.

Materials and Method

The production program was conducted at Ulipur MLT site, OFRD, Rangpur during Rabi season, 2008-09 to observe the effect of boron on mustard cultivation in the farmer's field. Two treatments viz., T_1= Recommended fertilizer dose without boron & T_2= Recommended fertilizer dose with boron (1.0 kg/ha) were evaluated. The land type was medium high which belongs to AEZ 3. The experiment was laid out in a randomized complete block design with four dispersed replications. The total land area was 800m^2. The seeds were sown on 11 November, 2008 maintaining 30cm x continuous plant spacing. The crop was fertilized with 92-30-35-20-2-1 kg N-P-K-Zn-Bkg ha^{-1}. Half of urea and all other fertilizers were applied during final land preparation. The remaining urea was applied at 25 DAS. The crop was harvested on 25 January, 2009.

Results and Discussion

The yield and economic return of mustard are presented in Table-1. The yield of mustard varied significantly due to boron fertilizer, the higher yield was recorded from T_2 (1100 kg ha^{-1}). The lower yield was recorded from T_1 (700 kg ha^{-1}). The higher gross return (Tk. 24296 ha^{-1}) and gross margin (Tk. 20858 ha^{-1}) was also obtained from T_2 (Recommended fertilizer dose with boron (1.0 kg ha^{-1}). The lower gross return (Tk.31500 ha^{-1}) and gross margin (Tk. 8027 ha^{-1}) was obtained from T_1 (Recommended fertilizer dose without boron).

Conclusion

Application of boron has positive effect an grain yield of mustard. For production of mustard the farmers should use 1 kg B/ha in the Rangpur region.

Farmer's reaction

Farmers were impressed by getting higher yield in boron treated plot compared to non treated plot. They are interested to grow mustard with boron fertilizer.

Table 1. Effect of boron on yield and economics of mustard at Ulipur MLT site during rabi 2008-09.

Treatments	Yield (kg ha^{-1})	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})
T_1= Recommended fertilizer dose without boron	700	31500	23473	8027
T_2 = Recommended fertilizer dose with boron (1.0 kg/ha)	1100	45154	24296	20858

Mustard= Tk. 45 kg^{-1}, Urea= 11.80 kg^{-1}, TSP=74.36 kg^{-1}, MP=55 kg^{-1}, Zinc sulphate =140 kg^{-1}, Boric acid=180 kg^{-1}, Gypsum=7 kg^{-1}

Demonstration on Seedling Tuber Production Using TPS

Abstract

A production programme of seedling tuber using TPS was carried out at Gangi and Bharamara in Khustia during the rabi season of 2008-09. In Bharamara and Gangni, the average yield of TPS of 30 t ha^{-1}.

Introduction

The production of seedling tuber is higher than any other high yielding variety (HYV) of potato. So far the Tuber crops Research centre (TCRC) of BARI released 34 HYV of potato with recommendation of optimum management practices, optimum date of panting, seed rate, fertilizer dose etc. There is a vast seed crisis of potato in our country. Lacking of quality seed as well as high price makes unable to our farmers for potato production. Seedling tuber production technology helps farmers to increase potato Production. Especially the farmers of kushtia Meharpur District are very much motivative to a adapt any of new technology. Therefore, this study was undertaken to popularize TPS production of farmers level which may helpful to recover the seed crisis.

Materials and methods

The experiment was conduced at farmers field of Bharamara and Gangni in Khustia during rabi season of 2008-09. Four farmers were selected for this trial. Hundred (100g) TPS was given to each of the farmer in every location. The crop was sown on 17 November, 2008, on raised beds 20m x 1m x 3m maintaining the spacing of 20 m x 5 m. Manures and fertilizer were applied at the rate of 4 t ha^{-1} cowdoung and 150-13-150-28-7-17 kg NPKS Zn & B ha^{-1} respectively as recommendation of TCRC. Intercultural operations and plant protection measures were done as and when necessary. The crop was harvested on 04 March, 2009. Data on wt. of tuber let /m^2 and yield (t ha^{-1}) were recorded.

Results and Discussion

The sample of each square meter tuber let yield was taken from one square meter in three places of each location. Crop was harvested in different raised bed of the block. The average tuberlet yield per square meter was 3.0 kg. The total plot yield of the trial was recorded kg in the block with average yield of 30t/ha).

Farmers' reaction

Farmers express their satisfaction with more yields of tuber let and they are interested to cultivate this crop. But there is a problem in storage of the tuber let which may use as seed in next year.

Table 1. Yield and yield contributing character of tuberlet as influence by TPS at Kushtia during the rabi season of 2008-2009.

Place (Sample)	No. of tuber let plant^{-1}	Tuber let (No. kg^{-1})	Tuber let m^{-2} (kg.)	Yield (t ha^{-1})
Bharamara	9	114	3.1	31.0
Gangni	8	118	2.9	29.0
Average	8.5	116	3.0	30.0

Production Programme of BARI Mosur-5

Abstract

A production programme of Lentil was carried out at MLT site in Pabna, Gangni and Bharamara during the rabi season of 2008-09. BARI Masur-5 was used in this programme. The average yield of BARI masur-5 was in Pabna, Bharamara and Gangni of 1.81, 1.4 and 1.25 t/ha.

Introduction

Pulse crops are said to be friend to the human, livestock and soil health as well as highly economic when a crop is successfully harvested. Among the pulses, lentil is most popular for good taste, high market value and high protein content. Farmers are cultivating lentil with local low yielding variety and do not follow the recommended management technology. BARI has developed high yielding variety (BARI Mosur-5) that can easily fit into the cropping pattern. To popularize the variety with recommended technology for wide scale extension a development program on lentil was under taken with the following objectives.

Objectives

i) To popularize new lentil variety BARI Mosur-5
ii) To increase farmers income

Materials and methods

The programme was carried out at MLT sites kashinathpur in Pabna, Bharamara and Gangni in Kushtia during the rabi season of 2008-09. Before implementing the programme a discussion meeting was arranged with local farmers by the site team of the location. As per the principles of the programme all sorts of inputs were bought and procured by the participating farmers and researcher through participatory approach. BARI Mashur-5 was sown on 5-13 November,2008 and the crop was fertilized with Urea, TSP. MoP and Borax @ 45-85-38-1.5 kg ha^{-1} at Pabna and 43-200-40 kg ha^{-1} at Bharamara and Gangni were applied as basal. Last week of December and 1st week of January was heavy foggy weather hampered lentil production. Plant production measures were taken as and when necessary. The crop was harvested on 24-28 February 2009.

Results and Discussion

The results of the production is presented in Table 1. The results indicated that seed yield was no achieved at satisfactory level due to two weeks of foggy weather during flowering stage. The average yield of 1.81, 1.4 and 1.25 t/ha were at three different produced MLT sites.

Farmers' Reaction

They got higher yield than local variety. They opine that its pod number and seed size is attractive, delicious and easily cookable . They stored seed for future cultivation instead of local. They are more interested in broadcast sowing than line sowing due to higher labour cost.

Conclusion

BARI Mosur-5 is a promising variety. Its crop and yield performance is better than BARI mosur-4 or other local varieties. If the supplied seed quality was good and the weather was in favourable condition the potential yield might be achieved.

Table 1. Performance of lentil (BARI Mashur-5) al MLT site kashinathpur in Pabna and Bharamara and Gangni in Kushtia during the rabi season of 2008-09.

Location	Variety	Co-operator (No.)	Area covered (ha)	Grain yield (t ha^{-1})
Pabna	BARI Mashur	17	3.5	1.81
Bharamara		30	30	1.4
Gangni		30	30	1.25

Pilot Production Program of Mustard Varieties

Abstract

Pilot production programme of mustard varieties were conducted at MLT sites of Pabna, Gangi and Bharamara during the rabi season of 2008-09 to introduce the improved varieties of mustard replacing local variety. Among the varieties BARI Sarisha-11 gave highest grain yield (1.8 t ha^{-1}) in Bharamara and BARI Sarisha-13 was obtained higher yield (1.73 t ha^{-1}) in Pabna. In Gangni, BARI Sarisha-14 was produced lower yield (1.2 t ha^{-1})

Introduction

Mustard is one of the most important oil crops in Bangladesh. It occupies the highest acreage and production. The yield of this crop in Bangladesh is found lower compared to that in the other countries. Bangladesh is deficit in edible oil, which cost valuable foreign currency for importing seeds and oil. Recently BARI has been released some mustard varieties, which have high yield potential. But farmers are not getting potential yield at their condition. The reason behind this lower yield is genetically low yield potential of local varieties and poor management practices. Thus, it is needed to increase production of oil seed for increased population of the country. High yielding varieties have a bold seed size, hike oil content and attractive color, which may be sold in market at hike price. So, it is necessary to replace local varieties by HYV and introduce improve management to achieve potential yield. Keeping these views in mind this program was undertaken

Materials and methods

The pilot production programme was conducted at MLT sites Atghoria, Pabna, Gangni and Bharamara during the rabi season of 2008-09. A discussion meeting was arranged for the cooperator farmers to replace local varieties by high yielding varieties BARI sarisha-13 in Pabna, BARI Sarisha-11 and 14 in Gangni and BARI Sarisha-11 in Bharamara respectively. The crop was fertilized with 120-35-50-30-5-10 kg ha^{-1} NPKS Zn and B in kushtia and 138-36-50-32-3-2 kg ha^{-1} NPKS Zn and B in Pabna. Half quantity of N and all others fertilizers were applied as basal during final land preparation. Rest half of N was applied as top dress 20-22 days after seed germination. The crops were sown in 1-13 November 2008 and used recommended seed rate. One irrigation was provided at 20-25 days after sowing. During the whole January and 1st week of February there were heavy foggy weather and that situation two times Rovral and insecticides were used to protect the crops from disease and insect respectively. The crop was harvested during 3-14 March in Bharamara and Pabna, 23 February in Gangni 2009.

Results and Discussion

Among the three varieties BARI Sarisha-11 was obtained highest grain yield (1.8 t ha^{-1}) in Bharamara. The variety was found to be more resistant to alternaria leaf blight disease. In Pabna BARI Sarisha-13 gave 1.5 t ha^{-1} yield and being high yield potential, this variety suitable for growing in the cropping pattern. At Gangni BARI Sarisha 11 gave compartively lower yield than other varieties

Farmers' reaction

Farmers reacted very positively with now high yielding varieties. The farmers of Pabna chose the variety BARI Sarisha-13 and farmers of Gangni and Bharamara chose the variety BARI Sarisha-11, Farmers expressed their satisfaction with high yield and bold size. The farmers preserved large amount of seeds for wide area extension in the next season.

Table : Pilot production programme of mustard varieties under farmers management at the MLT sites Atgoria, Pabna, Gangni in Meherpur, Bharamara during rabi season of 2008-09

Variety	No. of co-operator farmers			Area covered (ha)			Yield (t ha^{-1})		
	Pabna	Gangni	Bharamara	Pabna	Gangni	Bharamara	Pabna	Gangni	Bharamara
BARI sarisha-11	-	5	15	-	1	3	-	1.56	1.80
BARI sarisha-13	3	-	-	1.73	-	-	1.5	-	-
BARI sarisha-14	-	12	-	-	5	-	-	1.20	-

Pilot Production of Mustard under Cropping Pattern Mustard-Mungbean-T.aman Rice

Abstract

The pilot production program of Mustard under cropping pattern Mustard-Mungbean-T.aman was conducted at MLT site Tularampur, Narail from rabi 2007-08 to rabi 2008-09. The seed yield of BARI sharisa-12, Mungbean (BARI mungbean-5) and T.aman (BR-39) were 1.37 t ha^{-1}, 1.47 t ha^{-1} and 4.23 t ha^{-1}, respectively.

Introduction

Mustard-Mungbean-T. aman cropping pattern is going to be a popular pattern in south west region of Bangladesh. In a four year's trial at Jessore and Ishurdi, it was found that inclusion of a pulse crop between two cereal crops in a cropping pattern (Mustard-Mungbean-T.aman) would reduced the requirement of chemical fertilizers maintaining a good health of soils through biological fixation of nitrogen and addition of organic matter to soil. BARI sharisa-12, BARI Mungbean-5 are so promising variety of BARI. To satisfy the demand of the farmer this variety was selected with BR-39 to cultivate under the cropping pattern Mustard-Mungbean-T.aman. This experiment was undertaken to popularize mustard-mungbean-T.aman pattern to the area.

Materials and Methods

The pilot production program of Mustard (BARI sarisha-12) under cropping pattern Mustard-Mungbean-T. aman was conducted at MLT site Tularampur, Narail. Mustard seeds were sown on 22 November, 2007. Fertilizers were applied @ of 120-36-70-40-3-1 kg N-P-K-S-Zn-B ha^{-1} in the form of Urea, TSP, MP, Gypsum, Zinc sulphate and Boric acid respectively. All the fertilizers and half of Urea was applied before flowering. Intercultural operations were done according to necessity. The crops were harvested from 04 March 2008. After harvesting of mustard Mungbean (BARI Mungbean-5) was sown at 10 March 2008. Fertilizer application and intercultural operation was done properly. Picking were done from 24 May to 18 June 2008. BR-39 was sown at 20 July 2008 as T.aman in this cropping pattern. The seed rate was 50 kg/ha and fertilizer were applied @120-54-76-10 kg NPKS ha^{-1}. Intercultural operation and irrigation were done properly. Data on yield and yield attributes were recorded.

Results and Discussion

The seed yield of BARI sharisa-12, Mungbean (BARI mungbean-5) and T.aman rice (BR-39) were 1.37 t ha^{-1}, 1.47 t ha^{-1} and 4.23 t ha^{-1} respectively (Table 1).

Farmers' reaction

Farmers showed their reaction to accept the pattern Mustard-Mungbean-T.aman cropping pattern.

Table 1. Seed yield of mustard under pilot production programme at MLT site, Jhikorgacha during the rabi season of 2007-08

Variety	Seed yield (t ha^{-1})
BARI Sarisha-12	1.37
BARI Mungbean-5	1.47
BR-39	4.23

Pilot Production of Relay Mustard with T.aman

Abstract

Pilot production program of mustard was conducted at MLT site, Satkhira during the rabi season of 2008-'09 to disseminate the technology of mustard production relaying with T.aman. The variety Tori-7 and BARI sarisha-9 were sown in two farmers' field in this pilot program. In between, Tori-7 gave the yield 904.80 kg ha^{-1} while 1055.60 kg ha^{-1} was obtained from BARI sarisha-9.

Introduction

Bangladesh has an acute shortage of oil seeds in respect of its demand. The farmers of Satkhira area generally grow local mustard variety after harvest of T.Aman rice. The productivity of this mustard variety is very low that cannot full fill the demand of oil of a farmer family. In most cases, farmers sow the mustard seed after harvest of long duration local T.Aman rice variety that drastically reduced the mustard yield due to its late planting and high soil salinity. Therefore, the farmers seek a new mustard variety, which can perform well without breaking the existing cropping pattern. Oil Seed Research Centre of BARI has developed some varieties of mustard which posses the high yield potential and shorter field duration. Mustard can be relayed with short duration T.Aman to ensure the right sowing time. Keeping this in mind the program was undertaken.

Materials and Methods

The program was conducted at MLT site Satkhira, Khulna during the rabi season of 2008-09 to disseminate the technology of mustard production relaying with T.aman. Two farmers of one from Katia Godai Bill and other from Daulatpur, Satkhira were selected for this program. The variety Tori-7 and BARI sarisha-9 were used. Seeds were soon on 17 October and 04 November, 2008 at Godai Bill and Daulatpur. The mustard seeds were broadcasted in T.aman rice field before 15 days of T.aman (BINA dhan-4) harvesting. The seed rate of mustard was 10 kg/ha. The fields were fertilized with 250-170-85-150-15-15 kg ha^{-1} of Urea, TSP, MOP, Gypsum, Zinc sulphate and Borax respectively. All the fertilizers were applied as basal except urea. Urea was applied as top dressed on 20 and 35 days after sowing. The crop was harvested according to their maturity. Intercultural operation and plant protection measures were taken as and when necessary. During the crop growing period soil salinity was 3.25-9.50 dS/m.

Results and Discussion

Between two varieties Tori-7 produced lower yield (904.80 kg ha^{-1}) than BARI Sarisha-9 (1055.60 kg ha^{-1}) and took 95 days to mature whereas Tori-7 was required 72 days.

Farmers' reaction

The farmers are interested to cultivate Tori-7 and/or BARI-9 due to their shorter field duration. Because, the crop can suit in the local existing cropping pattern, T.aman-Fallow-Boro rice that help to farmers to get an extra crop.

Table 1. Yield of mustard under pilot production program at MLT site, Satkhira during the Rabi season of 2008-09.

Variety	No. of co-operator farmers	Area (m^2)	Days to maturity	Seed yield (kg ha^{-1})
Tori-7	1	35000	72	905.0
BARI Sarisha-9	1	5000	75	1056.0

Production of Disease Free Seed Potato at Farmers' Level through Seed Plot Technique

Introduction

In Bangladesh potato is an important cash crop which is occupied 3rd position after rice and wheat. Last few years, the farmers are cultivating potato as relay crop with maize. This relay cropping system is increasing day by day due to its higher economic return. But scarcity of good quality potato seed at local area, the average yield of potato is becoming very low. Seed plot technique is a very good technology for quality seed potato production at farmers' level. So, the present program was undertaken to increase the availability of quality seed potato at farm level to promote potato production as intercrop with hybrid maize.

Materials and Methods

The seed potato production program was conducted at Modhupur village under FSRD site, Pushpopara, Pabna and kishoreganj Sadar during rabi season of 2008-09. Ten co-operator farmers were involved with the program and each of them was supplied 50 kg granola and 50 kg cardinal variety in Pabna and 50 kg diamant and 50 kg Raja in Kishoreganj seed through Tuber Crop Research Centre (TCRC) of BARI. But the supplied seed was not homogenous and also not optimum in size. Land area of each farmer was 10 decimal of which 5 decimal was under one variety and 5 for other variety cultivation. Before conducting the program, an intensive training was provided to the related farmers with the help of TCRC scientist. Moreover, the OFRD scientist and scientific staff provided technical support to the farmers, for producing quality seed. Fertilization was done as per recommendation of TCRC, BARI (161-44-130-22-1kg, N-P-K-S-B ha^{-1} with 10 t CD ha^{-1}, 15 kg furadan ha^{-1} and 20 kg staple blitching powder ha^{-1}). All amount of cowdung and blitching powder were applied during final land preparation. Half urea and all other fertilizers and furadan were applied according to individual potato line and covered with soil before seed sowing. The rest half urea was top dressed at 31 DAS. Regular spray was done by Folicur and Ridomil gold at 10 days interval as preventive measure and Semifuran and Malathion were applied against control of cutworm and aphid. Due to continuous foggy weather during the vegetative growth stage two times of Sobicron+Ridomil Gold and Acrobat+Melodidue were sprayed to prevent the late blight disease. Other operations viz. earthing up, weeding, irrigation etc. were done when necessary. Seed potato was sown on 04 and 12-30 December, 2008 at Pabna and Kishoreganj. Two weeks before harvest of seed potato all potato plants were removed from the field to prevent the contamination of fungus disease to the seed potato. Finally, potato tuber was harvested on 20 February at Pabna and 10 March 2009 at Kishoreganj. Farmers were used Diamont variety from their own source and cultivation procedure was also their own practice. After harvesting, grading and processing of potato, the storable seeds were stored in cold storage for own cultivation and sell to other potato growers in the next year.

Results and Discussion

Pabna: Among the cultivated varieties cardinal showed better performance and farmers own cultivated variety Diamont showed poor performance. Gronala might be a potential variety if there was no black scurf disease on leaf. In case of variety cardinal maximum tuber yield (23.89 t ha^{-1}) was produced by Md. Baki Billah and lowest yield (13.33 t ha^{-1}) was by Md Nurul Haque. On the other hand, in case of Granola the maximum tuber yield (17.78 t ha^{-1}) was produced by Md. Abdul Jalil and lowest yield (13.11 t ha^{-1}) was produced by Md. Nurul Haque. Optimum size of seed potato was found relatively higher in granola variety. Diseases infestation were relatively poor in improved cultivation method than farmers practice except black spot on leaf (Foma) and scab. About 90% plant leaves of granola variety were infested with black spot on leaf (Foma) and 5% tuber of the cardinal variety were infested with scab disease. The both diseases were absent in diamont variety but it was more infested with viral disease. Seed potato of cardinal and granola were stored in cold storage by the farmers ranging from 200 to 300 kg per farmer per variety.

Kishoreganj: The results of the experiment are presented in Table 3 & 4. From the table 3, it was observed that Diamant variety produced higher tuber yield through improved practice compared to farmers' practice. The variety Diamant produced the tuber yield ranges from 27.61 to 20.34t ha^{-1} and Raja produced the tuber yield ranges from 22.36 to 18.52 t ha^{-1} through improved practice where as in farmers practice Diamant produced the tuber yield ranges 22.92 to 17.90 t ha^{-1}. In improved practice Diamant tuber yield was about 16% higher over farmers practice. Table 4 showed that in every field scab disease was found on both the varieties. But scab incidence was higher in Diamant than the variety Raja. Virus infection was very low, bacterial wilt was nil and late blight was also very low to nil.

Table 1. Performance of seed potato production under seed plot techniques at FSRD site, Pushpopara, Pabna during the year of 2008-09.

SL. No.	Farmers Name and Address	Variety	Grading			Yield		Seed stored at cold storage (kg)
			<20 gm	20-60gm	>60gm	kg 5 dec^{-1}	t ha^{-1}	
1.	Md.Afser Pra. Modopur, Pabna	Cardinal	13	72	14.33	295	15.000	250
		Granola	19.33	87.66	18.33	320	16.000	200
		Diamant (FP)	14.66	85	12.66	277.778	13.888	-
2.	Md. Abdul Rashid Modopur, Pabna	Cardinal	16	82.33	21.67	332.222	16.610	300
		Granola	11.66	74	17	273.333	13.666	250
		Diamant (FP)	11	75.67	14.67	260	13.000	-
3.	Md. Baki Billah Modopur, Pabna	Cardinal	19.66	73	44	477.778	23.888	300
		Granola	13.66	93	18	307.775	15.388	250
		Diamant (FP)	16.66	78	15	282.220	14.110	-
4.	Md. Rojob Ali Modopur, Pabna	Cardinal	19.33	60	22.66	333.830	16.691	250
		Granola	32.66	80.66	9	291.100	14.555	200
		Diamant (FP)	-	-	-	-	-	-
5.	Md. Abbas Ali Modopur, Pabna	Cardinal	8.33	58	23.66	357.778	17.888	250
		Granola	15	78.67	13.67	297.778	14.888	200
		Diamant (FP)	15.67	78	10	273.333	13.666	-
6.	Md. Abdul Jalil Modopur, Pabna	Cardinal	16	115.33	26.33	456.667	22.8333	300
		Granola	16	98.66	19	355.555	17.777	250
		Diamant (FP)	14	86	16	295.556	14.777	-
7.	Md. Romjan ALi Modopur, Pabna	Cardinal	19	116	27.66	472.222	23.610	300
		Granola	11.33	70.66	18.33	317.778	15.888	250
		Diamant (FP)	14	78.33	15.33	287.778	14.388	-
8.	Md. Norul Haque Modopur, Pabna	Cardinal	13.66	85.33	17.66	277.778	13.333	250
		Granola	14.66	78	17.66	262.222	13.110	200
		Diamant (FP)	-	-	-	-	-	-
9.	Md. Manjan Ali Modopur, Pabna	Cardinal	16.33	98.33	20.33	346.667	17.333	250
		Granola	11.66	41	14	273.333	13.666	200
		Diamant (FP)	-	-	-	-	-	-
10.	Md. Aftaf Uddin Modopur, Pabna	Cardinal	12.33	81.33	19.33	342.222	17.110	250
		Granola	13	77	16	271.111	13.555	200
		Diamant (FP)	13	77	11	255.555	12.777	-

FP = Farmers' practice

Table 2. Diseases recorded from different potato varieties under improved and farmer's management system at FSRD site, Pushpopara, Pabna during the year of 2008-09

Diseases name	Cardinal (Improved management)	Granola (Improved management	Diamant (Farmer management
Late blight	-	-	-
Viral disease	2%	2%	10%
Bacterial wilting	1%	1%	2%
Stem rot	1%	1%	2%
Black scurf	-	90%	-
Scab	5%	-	-
Cutworm affected plant	1%	1%	2%

Table 3. Yield of seed potato by improved and farmers practice of 10 locations

Sl No.	Farmers' name	Improved Practice		Farmers' Practice
		Diamant (t ha^{-1})	Raja (t ha^{-1})	Diamant (t ha^{-1})
1.	Md. Harunur Rashid Vill. pathankandy, Kishoregonj	27.61	19.22	26.92
2.	Md. Alamin Vill. pathankandy, Kishoregonj	26.81	18.52	-
3.	Md. Abdul Mazid Vill. pathankandy, Kishoregonj	20.34	-	17.90
4.	Md. Bassu Miah Vill. pathankandy, Kishoregonj	21.33	18.80	19.80
5.	Md. Hobiz Miah Vill. pathankandy, Kishoregonj	24.14	22.14	20.11
6.	Md. Abdul Kadir Vill. pathankandy, Kishoregonj	25.35	22.36	-
7.	Md. Abdur Rashid Vill. pathankandy, Kishoregonj	24.87	18.80	22.00
8	Md. Azharul Islam Vill. pathankandy, Kishoregonj	20.87	-	18.25
9	Sree Anil Chandra Das Vill. pathankandy, Kishoregonj	27.66	19.26	19.76
10.	Sree Nikhil Chandra Das Vill. pathankandy, Kishoregonj	26.15	20.19	20.58
	Average	24.51	17.66	20.67

Table 4. Disease incidence in the seed plot of 10 farmers' field

Farmers'	Diamant				Raja			
	Scab %	Virus %	LB %	BW %	Scab %	Virus %	LB %	BW %
1.	30	0.2	10	0	20	0.2	10	0
2.	30	0.2	5	0	25	0.2	5	0
3.	25	0.5	3	0	20	0	0	0
4.	30	0.5	5	0	30	0	0	0
5.	28	0.2	2	0	20	0	0	0
6.	25	0.5	2	0	15	0	0	0
7.	24	0.1	1	0	20	0.1	1	0
8.	15	0.1	0	0	12	0.1	0	0
9.	20	0.5	4	0	15	0.2	12	0
10.	18	0.3	3	0	14	0.2	2	0

Farmers' reaction

Pabna: Farmers also opine that seed production technology is very good technology and they will try to follow it in future.

Kishoreganj: Farmers are very much interested to adopt informal seed system, because they can produce good quality potato seed in a minimum cost in their field that could save a lot of money. Farmers' opined that it is very difficult for a farmer to preserve the seed in BADC cold storage.

Conclusion

It is found that seed plot technique is very effective method to produce good quality potato seed at farmer's level but in future the supplied seed should be optimum in size which might be created a positive effect on farmer's interest. On the other hand yield of all varieties might be higher if there were no long time heavy foggy weather and seed could be sown earlier.

Seed Production Program in different Locations under OFRD during the year of 2008-09

Crop	Location	Variety	Area (ha)	Yield (t/ha)
Wheat	Bharamara, Kushtia	Bijoy	0.5	4.8
	Gangni	Prodip	0.5	4.8
		Shatabdi	0.132	2.6
		Sufi	0.132	3.28
		Sourav	0.132	4.6
Mukhikachu	Gangni	Bilashi	0.5	22
		MK-0140	1.5	25
Mustard	Bharamara, Kushtia	BARI Sarisha-11	0.5	1.92
	Gangni	BARI Sarisha-14	05	1.20
Groundnut	Daulatpur	BARI Badam-6	02	1.98
Mashkalai	Gangni	BARI Mashkalai-3	6	1.65
	Bharamara	....	6	1.65
Lentil	Bharamara	BARI Mashur-5	4	1.24
	Gangni	BARI Mashur-5	2	1.30
	Bharamara	BARI Mashur-6	3	1.27
	Gangni	BARI Mashur-6	2	1.35
Sunflower	Bharamara	BARI Sunflower-2	10	1.58

Activities of BARI Technology Village (BTV) under OFRD during the year of 2008-09

a. Crop Museum

Modhupur, Pabna

Name of crop	Name of variety	Date of sowing/ planting	Date of harvest	Yield (t ha^{-1})	Gross return (Tk ha^{-1})	Cost of cultivation (Tk ha^{-1})	Gross margin (Tk ha^{-1})
Garden pea	BARI-3	15-12-08	08-03-08 19-03-09	6.30	157500	24200	133300
Garden pea	BARI-1	,,	19-03-09	5.00	125000	24200	100800
Bush bean	BARI-2	,,	,,	12.5	250000	28775	221225
Potato	Raza	,,	09-03-09	22.33	446600	92112	354488
	Diamont	,,	,,	17.00	340000	,,	247888
	Asterix	,,	,,	17.33	346600	,,	254488
	Granola	,,	,,	18.33	366600	,,	274488
	Multa	,,	,,	16.00	320000	,,	227888
Wheat	Shufy	,,	25-03-09	4.17	57337	38640	18697
	Prodip	,,	26-03-09	4.33	59537	,,	20897
	Gourb	,,	28-03-09	3.30	45375	,,	6735
	Barly	,,	19-03-09	3.67	50462	,,	11822
Gardenpea (Maize + G.pea)	BARI-1	,,	8-03-09 19-03-09	4.83	120750	6545	114205
Maize+ Potato	Asterix	,,	,,	12.33	246600	37500	209100
Maize	BHM-5	,,	18-04-09	8.13	105690	66375	39315
	BHM-7	,,	,,	7.67	99710	,,	33335
Maize (Maize + Garden pea)	BHM-5	,,	,,	7.80	101400	,,	35025
Maize (Maize + Bushbean)	BHM-5	,,	,,	7.87	102310	,,	35935
Maize (Maize + Potato)	BHM-5	,,	,,	7.47	97110	,,	30735

Hatgobindpur, Faridpur

Name of crop	Name of variety	Date of sowing	Date of harvesting	Yield (t/ha)	Cost of cultivation (Tk./ha)	Net return (Tk./ha)
Wheat	Shatabdi Prodip Bijoy Sufi	27.11.08	20.3.09 14.3.09 17.3.09 20.3.09	3.40 3.30 3.52 3.30	27000.00	24000.00 22500.00 25800.00 22500.00
Lentil	BARI masur 4	4.11.08	02.03.09	1.44	15500.00	70900.00
Mustard	BARI sarisha 09 BARI sarisha 11 BARI sarisha 14 BARI sarisha 15	09.11.08	25.1.09 10.2.09 04.2.09 04.2.09	0.98 1.62 1.12 1.55	21500.00	7900.00 27100.00 12100.00 25000.00
Radish	Tasakisun Pinky Druti	14.11.08	29.12.08 to 16.1.09	63.6 60.5 64.7	48525.00	269475.00 253975.00 210275.00
Lalshak	BARI lalshak 1	09.11.08	20.12.08 to 05.1.09	7.8	15800.00	100200.00
Spinach	BARI palangshak 1	09.11.08		14.6	16800.00	100000.00
Potato	Diamant Cardinal	06.12.08	01.3.09	21.70 20.90	80500.00	179900.00 191200.00
Garden pea	BARI motorshuti 1 BARI motorshuti 3	09.11.08	23.2.09 to 28.2.09	10.85 7.54	20500.00	142250.00 92600.00
Bushbean	BARI jharsheem 1 BARI jharsheem 2	09.11.08	30.12.08 to 21.1.09	6.52 5.40	17250.00	67510.00 55650.00
Coriander	BARI dhania 1	27.11.08	28.3.08	1.72	16850.00	34750.00

Prices of products (Tk./kg): Lalshak 15.00, Spinach 8.00, Gardenpea 15.00, Bushbean 13.00, & 13.50

Binnatari, Rangpur

Name of crop	Variety	Area (m^2)	Yield (t/ha)	Consumption (kg)	Distribution (kg)	Sale (kg)
Bagun	BARI Bagun-8	12	76.66	10	2	80
Tomato	BARI Tomato-2	12	81.66	30	10	58
Tomato	BARI Tomato-3	12	85.0	25	5	72
Tomato	BARI Tomato-14	12	80.0	16	10	70
Spinach	BARI Lalsak-1	12	13.33	4	2	10
Spinach	BARI Lalsak-1	12	15.0	5	3	10
Bosh bean	RARI Bosh bean-1	12	13.33	3	1	12
Motorsuti	BARI Motorsuti-1	24	11.66	5	3	20
Radish	BARI Mula-1	24	75.0	20	10	150
Radish	BARI Mula-2	24	56.25	25	10	100
Borboti	BARI Borboti-1	24	16.66	10	-	30
Mustard	BARI sarisha-9	12	1.41	-	-	1.7
Mustard	BARI sarisha-14	12	1.66	-	-	2.0
Mustard	BARI sarisha-15	12	1.83	-	-	2.2
Batisak	BARI Batisak-1	12	45.83	10	5	40
Lau	BARI Lau-1	12	41.66	20	-	30
Sim	BARI sim-1	12	15.0	8	-	10

b. Block Demonstration

Modhupur, Pabna

Crop (Variety)	Land area (dec.)	Date of sowing/ planting	Date of harvest	Yield (t ha^{-1})	Total income (Tk ha^{-1})	Cost of cultivation (Tk ha^{-1})	Gross margin (Tk ha^{-1})
Wheat (Sufi)	116	03-12-08	18-.3-09	4.0	50000	38640	11360
Wheat (Prodip)	66	05-12-08	22-3-09	4.166	52075	38640	13435
Wheat (Gourab)	33	15-12-08	28-3-09	2.6	32500	38640	-6140
BARI Bearly-1	66	18-12-08	22-3-09	4.0	40000	38640	1360
BARI Moshur-4	50	21-11-08	2-3-09	1.17	72913	19560	53353
BARI Moshur-6	99	23-11-08	02-3-09	1.33	83313	19560	63753
BARI Sharisha-9	99	12-11-08	02-02-09	1.43	57332	46665	10667
BARI Sharisha-13	33	12-11-08	10-02-09	1.37	54664	46665	7999
BARI Sharisha-15	33	12-11-08	05-02-09	1.47	58664	46665	11999
Potato (Raja)	12.0	10-12-08	04-3-09	21.67	379225	79055	300170
Potato (Diamant)	12	11-12-08	05-03-09	14.67	256725	79055	177670
potato (Asterix)	12	10-12-08	04-03-09	16.83	294525	79055	215470
Potato (Granula)	12	08-12-08	02-03-09	17.33	303275	79055	224220
Potato (Multa)	12	10-12-08	02-03-09	15.00	262500	79055	183445

Hatgobindpur, Faridpur

Name of crop & variety	Area (ha)	Farmers involved (No.)	Sowing date	Yield (t/ha)	Cost of cultivation (Tk./ha)	Net return (Tk./ha)	Seed preserved (kg)
Wheat							
Shatabdi	1.0	6		3.60		27000.00	200
Prodip	0.50	3	22.11.08 to	3.62	27000.00	27300.00	150
Bijoy	0.50	4	30.11.08	3.50		25500.00	120
Sufi	0.25	2		3.48		25200.00	35
Maize							
BHM 2	0.40	4	7.12.08 to	7.7	43777.00	71723.00	--
BHM 5	0.30	4	10.12.08	7.5		68723.00	--
Lentil							
BARI masur 4	2.0	8	28.10.08 to 07.11.08	1.14	15500.00	52900.00	50
Mustard							
BARI Sarisha-11	1.0	6	27.10.08 to 02.11.08	1.54	21500.00	24700.00	12
Potato							
Diamont	0.40	8	01.12.08 to	23.30		199100.00	800
Cardinal	0.40	7	03.12.08	20.82	80500.00	190160.00	700
Granula	0.10	1		18.62		142940.00	300
Radish							
BARI mula 1	0.20	4	27.11.08	54.25		222725.00	--
Pinky	0.20	5	to 02.11.08	60.70	48525.00	254975.00	--
Druty	0.10	3		56.82		178755.00	--
BARI piaj 1	1.0	8	8.01.09 to 14.1.09	7.54	41250.00	109550.00	--
BARI dhania 1	0.20	3	4.12.08 to 9.12.08	1.58	16850.00	30550.00	2.00
Laboni	0.13	4	22.3.09 to 28.3.09	42.52	23500.00	167850.00	500g
BARI dherosh 1	0.13	3	14.3.09 to 16.3.09	12.85	37600.00	155150.00	500g
BARI til 3	0.50	5	5.3.08 to 8.3.08	1.56	17300.00	37300.00	6.00
BARI mung 5	3.0	6	1.3.08 to 7.3.08	1.65	12500.00	53500.00	30.00

Prices of products (Tk./kg): Wheat-15.00, Maize-15.00, Lentil-60.00, Mustard-30.00, Potato-Cardinal 13.00, Diamant 12.00, Granula 12.00, Radish-5.00, Druty 4.50, Onion-20.00, Coriandar-30.00, Data-4.50, Dharosh-15.00, Lalshak-15.00, Til-35.00 and Mung-40.00

Tangail

SL	Name of Experiment	Experimental site	Variety	Sowing time	Harvesting time	Area ha	Yield (t ha^{-1})
01	Mustard	MLT site, Ghatail	BARI sharisha-9	02.11.08-07.11.08	23.01.09-27.01.09	4.0	0.95-1.25
02	Wheat	MLT site, Ghatail	Shatabdi	24.11.08	15.03.09	0.8	2.90-3.30
			Bijoy	05.12.08	23.03.09	0.4	3.00-3.50
		FSRD site, Elenga	Sufi	30.11.08	21.03.09	0.25	3.10-3.60
			Pradip	04.12.08	24.03.09	0.25	3.30-3.90
			Gourab	14.12.08	30.03.09	0.25	2.25-2.75
		MLT site, Bhuapur	Pradip	7.11.08-10.11.08	12.03.09	1.6	1.80-2.50
03	Seed production of BARI Chinabadam-7&8	MLT site, Ghatail	BARI Chinabadam-7	02.08.09-04.08.09	20.12.08-26.12.08	2.0	1.35-1.75
			BARI Chinabadam-8	09.08.08-13.08.09	20.12.08-26.12.08	2.0	1.55-1.95
04.	Potato	FSRD site, Elenga	Diamont	02.12.08	05.02.09	0.12	18.00-20.00
			Cardinal	02.12.08	05.02.09	0.12	16.00-18.00
			Petronis	29.11.08	03.02.09	0.06	15.00-17.00
			Asterix	28.11.08	03.02.09	0.12	14.00-16.00
			Multa	30.11.08	05.02.09	0.06	15.00-17.00
			Granola	30.12.08	04.12.09	0.06	16.00-17.00
05.	Maize	MLT site, Bhuapur	BMH-5	18.11.08-25.11.08	18.04.09-23.04.09	4.0	6.80-7.50
06.	Sesame	FSRD site, Elenga	BARI till-2	10.04.09-15.04.09		2.0	
		MLT site, Bhuapur	BARI till-3	06.04.09-09.04.09		2.7	
		MLT site, Ghatail	BARI till-2&3	08.04.09-15.04.09		2.0	
		MLT site, Modhupur	BARI till-2&3	11.04.09-15.04.09		1.4	
06	Mungbean	MLT site, Bhauapur	BARI Mug-6	15.03.09-19.03.09		3.4	
		MLT sites, Ghatail,	BARI Mug-6	10.03.09-20.03.09		3.0	
		MLT site, Modhupur	BARI Mug-6	16.03.09-22.03.09		1.0	

c. **Distribution of BARI fruit sapling and establishment organized fruit garden**

Modhupur, Pabna

Sapling supplied	Year wise distribution			Total No.	Present alive plant
	2006	2007	2008		
Mango	27	48 (Garden)	**56** (Garden)	131	103
Litchi	26	21	60	107	38
Coconut	26	25	-	51	42
Lemon	26	10 (Garden)	-	36	28
Batabi lebu	-	35	-	35	29
BARI guava 2 (Farmers own initiative)		200	60	260	250

Hatgobindpur, Faridpur

Name of fruits	Varieties	No of sapling distributed in 2008	No. of cooperators in 2008	Mortality %	Total no. distributed in BTV (in 3 yrs.)
Mango	BARI Aam 1	40	35	10	108
	BARI Aam 2	8			42
	BARI Aam 3	4			36
	BARI Aam 4	8			20
Litchi	BARI litchu 1				40
	BARI litchu 2				30
	BARI litchu 3				30
Guava	Kazi peara	60	36	22	240
Coconut	BARI coconut 1	50	24	20	80
	BARI coconut 2	50			80
Lemon	BARI lebu 1				25
	BARI lebu 2				25
	BARI batabi lebu 1				5
Bettle nut	BARI supari 1				10
	BARI supari 2				10

d. Top working of mango trees

Modhupur, Pabna

Sl. No	Farmers Name	Village	Variety	No. of trees	Present condition	Date of pruning
1.	Md. Moksed Ali	Mothergasi	BARI-2	1	Good	Jan 30 to Feb 28, 2008
2.	Md. Azizul Haque	,,	Langra	1	Fruiting stage	
3.	Md. Abdul Alim	,,	Langra	1	Good	
4.	Md Razab Ali	Modhupur	BARI-2,3	17	Fruiting stage (5)	
5.	Md. Bakibellah	,,	BARI-2	1	Inflorescent pruned	
6.	Md. Rafiqul	,,	Langra	1	Good	
7.	Md. Shadullah dulal	,,	BARI-3,4	5	Fruiting stage	
8.	Md. Karamoth Ali	,,	BARI-2, 3 Langra	1	Inflorescent pruned	
9.	Md. Osman Ali	,,	BARI-2	1	Fruiting stage	
10.	Md. Polash	,,	BARI-2,3	2	Good	

Training, Workshop, Networking meeting, Field days and Publications, 2008-09

Project: Agriculture Sector Programme Support Phase II (AEC-BARI)

Training for scientists

Training programme	Venue	Duration	Participants
Integrated Crop Management	BARI, Joydebpur, Gazipur	5 days	45
Integrated Crop Management	ARS, OFRD, BARI, Rangpur	5 days	25

Orientation Training for field staff

One day orientation training programme was held at the different locations to orient the scientific assistant/senior scientific assistants. In those training programmes, sub assistant agriculture officers of DAE of respective sites were participated.

Venue	No. of participants		
	SA/SSA	SAAO	Total
ARS, BARI, Rangpur	37	4	41
OFRD, BARI, Barind, Rajshahi	35	6	41
BARI, Gazipur	35	6	41
OFRD, BARI, Comilla	34	6	40
RARS, BARI, Jamalpur	29	6	35
	170	28	198

Training programme for co-operator farmers

Five hundred cooperator farmers of 14 locations were oriented on the on-going experiment

Locations	No. of farmers
Rangpur	60
Barind	35
Shyampur	45
Pabna	40
Bogra	40
Tangail	45
Jamalpur	30
Mymensingh	30
Kishoreganj	25
Noakhlai	40
Patuakhali	30
Sylhet	25
Comilla	35
Manikganj	20
Total	**500**

Workshops, Networking Meeting and Field Days:

Altogether 9 regional workshops were organized where 614 participants from DAE, NARS institutes, AEC, NGOs and agricultural organizations attended. There were 13 networking group meetings with 232 participants include DD, DTO, SMS and SAAO of DAE, scientists from OFRD and farmers representatives. There were 55 field days held where 4400 participants attended (80% of them are farmers both male and female).

Regional research review and program planning workshop 2009

Regions	Venue	No. of participants	Category of Participant
Rangpur	WRC, BARI, Nashipur, Dinajpur	96	DAE,BARI, NARS Scientists, BADC, DAE, Khamarbari, Dhaka, SCA, AIS, NGO and ICM Farmer/Farmers Trainers.
Rajshahi	RARS, BARI, Ishurdi	91	
Jamalpur	RARS, BARI, Jamalpur	67	
Comilla-Sylhet	BRRI, Comilla	65	
Dhaka	BARI, Gazipur	78	
Jessore	RARS, BARI, Jessore	80	
Barisal	RARS, BARI, Barisal	80	
Chittagong	RARS, BARI, Hathazari, Chittagong	57	
Chittagong Hill Tracts	Hill Agricultural Research Station, Khagrachhari	41	
	Total	**655**	

Networking group meeting

Locations	No. of participants	Category of Participant
Rangpur	63	Scientists of NARS Institutes, DDAE, DTO, SMS, UAO, Farmer's Trainer, Farmer's representative, BADC, NGO.
Barind and Shyampur, Rajshahi	20	
Pabna	18	
Bogra	16	
Tangail	16	
Jamalpur	13	
Mymensingh/Kishoreganj	14	
Noakhlai	17	
Patuakhali	15	
Sylhet	14	
Comilla	12	
Manikganj	14	
Total	**232**	

Field days

Location	No. of filed days	No. of participants	Category of Participant
Rangpur	8	640	Scientists, DAE personnel, SA/SSA/SAAO, NGO, Media representatives, Local leader and farmers
Barind	3	240	
Shyampur	6	480	
Pabna	5	400	
Bogra	4	320	
Tangail	5	400	
Jamalpur	3	240	
Mymensingh	3	240	
Kishoreganj	1	80	
Noakhali	4	320	
Patuakhali	3	240	
Sylhet	3	240	
Comilla	4	320	
Manikganj	3	240	
Total	55	4400	

Publication

AEC/OFRD published 7 (seven) booklets.

Project: On-Farm technology transfer through farmers' participation

Field day

Subject	Venue	Categories of participants	Number of Participants
Field day on BARI Mung	FSRD site, Faridpur	BARI, DAE, NGO and Farmers	260
Field day on Sorjan vegetable cultivation	FSRD, site, Patuakhali	BARI, DAE, NGO and Farmers	62
Field day on homestead vegetable production round the year (Lebukhali method)	FSRD, site, Patuakhali	BARI, DAE, NGO and Farmers	60
Field day on different cropping patterns	FSRD, site, Rangpur	BARI, DAE, NGO and Farmers	100
Field day on different cropping patterns	FSRD, site, Noakhali	BARI, DAE, NGO and Farmers	100
Field day on different cropping patterns	FSRD, site, Rajshahi	BARI, DAE, NGO and Farmers	100
Field day on T.aman	Dacope, Khulna	BARI, DAE, NGO and Farmers	83
Field day on Vegetables	Dacope, Khulna	BARI, DAE, NGO and Farmers	87

Training

Venue	Title of training	Number of Participants	Categories of participants
FSRD site, Kadamshahar, Rajshahi	Integrated Farming System	20	SA/SSA/SAAO
FSRD site, Kadamshahar, Rajshahi	Integrated Farming System	30	Farmers
FSRD site, Kadamshahar, Rajshahi	Seed Production chickpea, mustard and lentil	90 (3 batch)	SAAO. SSA, SA, NGO representative and Farmers
FSRD site Laharirhat, Rangpur	Orientation training for field staff	20	SA/SSA/SAAO
FSRD site, Laharirhat, Rangpur	Orientation training for field staff	30	Farmers
FSRD site, Hatgobindapur, Faridpur	Orientation training for field staff	30	SA/SSA/SAAO
FSRD site, Hatgobindapur, Faridpur	Orientation training for field staff	30	Farmers
FSRD site, Razakhali, Patuakhali	Orientation training for field staff	30	SA/SSA/SAAO
FSRD site, Razakhali, Patuakhali	Orientation training for field staff	60	Farmers
FSRD site, Noakhali	Orientation training for field staff	30	SA/SSA/SAAO
FSRD site, Noakhali	Orientation training for field staff	30	Farmers

Networking group meeting

Venue	Number of member
FSRD site Laharirhat, Ranrpur,	15
FSRD site, Kadamshahar, Rajshahi	15
FSRD site, Razakhali, Patuakhali	15
FSRD site, Hatgobindapur, Faridpur	15
FSRD site, Noakhali	15
FSRD site, Ghatail, Tangail	16

Project: Management of Utilization of Bio-slurry on Crops production

Training

Name of Training	No. of Bach	No. of participants	Locations
Orientation training for Field staff (Bio-slurry)	4	152 (SA/SSA/SAAO)	Pabna, Jessore, Noakhali and Gazipur
Training for cooperator Farmers on bio-slurry management	14	420 (Farmers)	Rangpur, Pabna, Barind, Rajshahi, Bogra, Kushtia, Jessore, Faridpur, Patuakhali, Comilla, Sylhet, Kishoreganj, Mymensingh and Gazipur

Field day

Location	No. participants	Category of Participant
Tangail	70	Scientists, DAE personnel, SA/SSA/SAAO, NGO, Media representatives, Local leader and farmers
Kushtail	70	
Bogra	70	

Project: Livelihood adaptation to Climate Change (FAO funded)

Training

Name of Training	No. of bach	No. of participants	Locations
Homestead vegetable production in drought prone area	2	60	High Barind Tract
Homestead vegetable production in Saline area	1	30	Khulna

Field day

Subject	Venue	Number of participants	Category of Participant
Field day on Homestead vegetable production in Saline area	Khulna	80	Scientists, DAE personnel, SA/SSA/SAAO, NGO, Local leader and farmers
Adoption of field crops in Saline/Coastal area	Khulna	80	

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Mostak Ahmed, SO
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[1]Higher study, [2]Transfer to other Division/Centre

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Sanjay Kumar Mondal, SA, MLT, Nazirpur
M Ashraful Alam, SSA, Rahmatpur
Zakir Hossain, SA, Sadar
Abdullah Al Mamun, SA
M Saifur Rahman, SA, Sadar
M Yakub Ali, SA, Sadar
M Kabir Hossain, SA, Sadar
Asia Khatun, SA, Sadar
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Aghni Kumar Sikder, SA
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Md. Abdur Rouf, SA
A B S M Sobhan, SA
Sohel Ahmed Sabbir, SA
Md. Shamsul Alam, SA
Md. Nazmul Kabir, SA

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Md. Tabibur Rahman, SSA, MLT, Dumuria
Mr. Amaresh Chandra Sarker, SA, MLT, Satkhira
S.M. Asaduzzaman, SA, Laudove MLT, Dacope
S.M. Motiar Rahman, SA, Laudove MLT, Dacope
Mr. Swapan Ray, SA, Station, Daulatpur, Khulna
Md. Abdus Samad, SA, MLT, Satkhira
Abu Md. Khairul Anam, SA, Daulatpur, Khulna
S.M. Delower Hossain, SA, MLT, Bagerhat
Md. Moniruzzaman, SA, MLT, Dacope
Mr. Gagendra Nath Mondal, SA, Daulatpur, Khulna
Md. Yaqub Ali, SA, MLT, Dacope, Khulna

Kushtia
Md. Atiul Islam, SSA
Md. Sorour Uddin, SA
Sk. Yousuf Harun, SA
Md. Rashel Kabir Tarafder, SA
Dipongkar Biswas, SA

Faridpur
Md. Nurul Islam, SSA
Md. Jamal Uddin, SA
Md. Humayun Kabir, SA
Md. Farid Ahmed, SA
Md. Abu Bakkar Siddique, SA
Md. Golam Mostafa, SA
Md. Alauddin (1), SA
Md. Alauddin (2), SA
Md. Masud Rana, SA
Md. Rezaul Karim, SA

List of Farming Systems Research and Development (FSRD) and Multilocation Testing (MLT) sites

A. FSRD SITES

1. Kushumhati, Sherpur sadar, Sherpur
2. Jalalpur, Sylhet sadar, Sylhet
3. Ellenga, Kalihati, Tangail
4. Lahirirhat, Rangpur
5. Pushpapara, Pabna sadar, Pabna
6. Hatgobindapur, Faridpur sadar, Faridpur
7. Rajakhali, Dumki, Patuakhali
8. Hazirhat, Noakhali sadar, Noakhali
9. Kadamshahar, Godagari, Barind, Rajshahi

B. MLT SITES

Region-1

Pabna	:	Bhabanipur-Sujanagar, Khabihati-Kashinathpur, Atgoria
Shyampur, Rajahahi	:	Noudapara-Paba, Baneshar-charaghat, Rajshahi
Barind, Rajshahi	:	Aamnura-Chapai nawabganj sadar, Sapahar, Naogaon
Rangpur	:	Domar (Nilphamari), Ulipur (Kurigram), Gobindaganj (Gaibandha)
Bogra	:	Sherpur, Shibganj, Joypurhat, Gabtali
Rajbari, Dinajpur	:	Biral, Dinajpur sadar
Thakurgaon	:	Thakurgaon sadar

Region-2

Jamalpur	:	Tatultala-Jhenaigati, Maloncha-Melandah
Tangail	:	Gatail, Madhupur, Gobindadasi-Bhuyapur
Mymensingh	:	Trishal, Netrakona sadar, Mymensingh sadar, Nalitabari, Phulpur
Kishoreganj	:	Karimganj, Pirijpur, Sadar, Hossenpur

Region-3

Jessore	:	Tularampur-Narail, Shalikha-Magura, Kaliganj-Jhenaidah, Jikargacha-Jessore, Kuadabazar-Monirampur
Khulna	:	Satkhira sadar (Gopinampur Magura), Bagherhat sadar (Srighat), Dumuria (Sajiara), Laodop-Daccope (Khulna)
Kushtia	:	Bamondi, Alamdanga, Kazirhat-Bharamara
Faridpur	:	Rajbari sadar, Mostafapur-Madaripur
Patuakhali	:	Aamtali, Alipur/Mohipur
Barisal	:	Goranadi-Barisal, Dakkin Ratanpur-Bhola, Nazirhat-Pirojpur, Bhola sadar
Madaripur	:	Madaripur sadar, Gopalganj sadar

Region-4

Hathazari	:	Rasangiri, Samitirhat-Fatikchari, Kharan, Junglekhail-Patiy, Jilonja-Cox's bazar, Sadaha-Satkanya
Noakhali	:	Dagonbhuiya-Celumia, Turapganj & Laxmipur sadar
Comilla	:	Sadar, Chadpur sadar, B. Baria sadar, Debidder, Borura, Choddagram
Sylhet	:	Sadar, Jahangirnagar-Sunamganj, Islampur-Moulvibazar, Jakiganj
Bandarban	:	Lemujiri-Buhalong

Region-5

Gazipur	:	Manikganj sadar, Munshiganj sadar, Dhirashram-Gazipur sadar
Shibpur, Narsingdi	:	Shibpur, Narsingdi

THE END