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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 2006-07 in the Farming System Research and Development (FSRD) and Multilocation Testing (MLT) sites all over 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 and location specific soil test based fertilizer recommendation to maintain and improve soil fertility. Research report on socio-economic studies, integrated farming system, family nutrition and homestead gardening and on-farm verification of advanced lines and technologies were also included in this report.

On-farm trials on wheat, maize, triticale, tuber crops, pulses. oil seeds and horticultural crops conducted at different MLT and FSRD sites throughout the country through collaboration with development partners. Results of these activities also incorporated in this report. Different training activities and field days for farmers, DAE personal, SSA/SA as well as for the scientists of OFRD was organized during 2006-07 through ICM, CIMMYT, FAO, SDC/IC-SAAKTI and ATT project funded by BARC.

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

I expressed my sincere thanks and gratitude to DANIDA, BARC, JIBC, FAO, IC-SAAKTI and CIMMYT for providing financial assistance to conduct different research, training and Research-Extension linkage activities. I sincerely admire and appreciate my colleagues and field staff who look after the experiments at different locations during study period. Special thanks to the cooperator farmers for their valuable cooperation. I gratefully acknowledge the contribution of Dr. M A Quayyum, CSO (LPR), OFRD, BARI, Gazipur for his valuable comments and suggestions for preparation of the manuscript. Last of all, I acknowledged those who worked very hard to accomplish this voluminous work.

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INTEGRATED FARMING

RESEARCH ISSUE: CROPPING PATTERN BASED FERTILIZER MANAGEMENT

Development of Fertilizer Recommendation for Different Cropping Patterns and Environments

Abstract

The experiment was initiated in 1998-99 and continued up to 2005-06 at different locations of the country to develop cropping pattern based fertilizer recommendation with the emphasis on IPNS. A total of 6 dominant cropping patterns were tested at 7 different locations covering 6 different AEZs of the country during 2005-06. Three nutrient management approaches- soil test based nutrient management (STB), IPNS and verification of FRG '97 was studied along with existing farmers' practice and no fertilizer (control). In STB the fertilizer dose for MYG and HYG were also included. Results revealed that in general, higher yield was recorded from STB for HYG and IPNS based fertilizer recommendation. Higher gross return as well as gross margin was also obtained with the same treatments. But due to addition of organic manure cost in IPNS the MBCR was slightly lower than other nutrient management options. Apparent nutrient balance showed that the balance was negative for N and K in all cases.

Introduction

Soil fertility is a dynamic property which varies with crops, cropping intensity and input use. More than 50% of our cultivated soil contains low organic matter (1.0-1.5%). Annual depletion of plant nutrients in the intensively cropped area ranges from 180 to more than 250 kg ha^{-1} (Karim and Iqbal, 2001). High and medium highland comprising 60% of total cultivated lands which in most cases are deficient in nitrogen, phosphorus, potassium and sulphur. The low organic matter content, higher cropping intensity, improper cropping sequence and faulty management practices are the major causes of depletion of soil fertility. Imbalance use of fertilizers is another serious problem for the country. Previous survey revealed that farmers in many areas in Bangladesh applied nitrogenous fertilizer higher than the recommended dose for some crops. They usually use low amount of organic fertilizers. Scarcity of fuel led them to use cowdung and crop residues as domestic fuel. To maintain and improve soil fertility and organic matter content of the soil it felt necessary to use organic manures along with inorganic fertilizers as an integrated approach Nutrients present in soil, added as inorganic and organic sources and the nutrient harvested by crops should be considered to develop a cropping pattern based fertilizer recommendation. BARC developed a national fertilizer recommendation guide that needs to be further updated and verified for different dominant cropping patterns at different environments. Therefore, it is very important to develop a cropping pattern based fertilizer recommendation for different agro-ecological zones considering the above mentioned issues.

Objectives

- To verify different nutrient management approaches
- To find out a cropping pattern based suitable fertilizer management option for dominant cropping patterns in different AEZ
- To determine the economic option of fertilizer management for pre-dominant cropping patterns

Materials and Methods

The experiment was conducted at different locations under major AEZs with different cropping patterns to find out a cropping pattern based fertilizer recommendation for dominant cropping patterns. It was initiated in 1998-99 and continued till 2005-06. During 2005-06 a total 6 dominant cropping patterns were tested at 7 different FSRD and MLT sites covering 6 AEZs. The experiment was laid out in RCB design with six dispersed replications. The following six fertilizer management options were verified-

T_1 (ED_1)	=	Estimated inorganic fertilizer dose for moderate yield goal
T_2 (ED_2)	=	Estimated inorganic fertilizer dose for high yield goal
T_3 (IPNS)	=	Nutrient management following integrated plant nutrient system approach for high yield goal
T_4 (FRG'97)	=	AEZ basis fertilizer dose following Fertilizer Recommendation Guide '97
T_5 (FP)	=	Farmers' practice
T_6	=	Control

The treatment concept was to compare the soil test based (STB) mineral fertilizer dose for Moderate Yield Goal (MYG), High Yield Goal (HYG), the high yield goal integrated with organic manure and inorganic fertilizers, Fertilizer Recommendation Guide (FRG '97) as well as the farmers prevailing fertilizer management practices. Details of the site characteristics and crop management practices are given in Appendix Table 1 & 2. The different cropping patterns studied at different locations are as follows-

Different cropping patterns tested in different locations

Sl #	Cropping pattern	AEZ	Location
1.	Mustard - Boro - T.Aman	25	Nandigram (Bogra)
2.	Potato-Boro-T.Aman	9	Kushumhati (Sherpur)
3.	Wheat-Jute-T.Aman	12	Ishan Gopalpur (Faridpur)
4.	Wheat-Mungbean-T.Aman	11	Jhenaidah and Natore
5.	Sesame-T.Aman	13	Dumuria (Khulna)
6.	Chickpea-T.aman	26	Chabbisnagar (Rajshahi)

Nutrient dose (kg ha^{-1}) of different cropping patterns tested in different locations

Treatment	Site: Nandigram, Bogra		
	Mustard (N-P-K-S-Zn-B + CD t ha^{-1})	Boro (N-P-K-S-Zn)	T.Aman (N-P-K-S-Zn)
T_1	60-19-45-19-0-1 + 0	87-17-79-13-0	60-12-55-8-0
T_2	84-25-66-24-0-1.5 + 0	122-25-111-19-0	82-15-70-11-0
T_3	69-25-66-24-0-1.5 + 5	122-25-111-19-0	82-15-70-11-0
T_4	70-20-35-20-1-0.5 + 0	100-15-60-8-0	75-12-40-5-0
T_5	69-15-38-14-0-0 + 0	90-25-40-15-1	51-15-34-10-0.5
T_6	0-0-0-0-0-0 + 0	0-0-0-0-0	0-0-0-0-0

Treat.	Site: Sherpur			Site: Ishan Gopalpur, Faridpur		
	Potato (N-P-K-S-Zn+ MOC t ha^{-1})	Boro (N-P-K-S)	T.Aman (N-P-K-S)	Wheat (N-P-K-S-Zn + CD t ha^{-1})	Jute (N-P-K-S)	T.Aman (N-P-K-S)
T_1	104-22-84-12-3 + 0	104-11-42-8	72-8-32-5	73-25-35-7-2 + 0	65-9-35-3	57-8-25-1.5
T_2	147-32-120-19-4 + 0	147-15-59-12	98-10-41-6	100-35-50-10-2 + 0	85-12-50-5	78-10-33-2
T_3	132-27-105-19-4 + 0. 5	147-15-59-12	98-10-41-6	70-25-20-10-2 + 10	85-12-50-5	78-10-33-2
T_4	90-15-50-10-1 + 0	100-12-40-7	60-8-30-4	75-20-25-10-2 + 0	65-7-20-3	60-6-16-4
T_5	120-20-80-0-0 + 0	112-25-45-18	60-10-0-0	105-21-26-14-0 + 0	31-11-44-0	90-20-25-15
T_6	0-0-0-0-0 + 0	0-0-0-0	0-0-0-0	0-0-0-0-0 + 0	0-0-0-0	0-0-0-0

Treat.	Site: Jhenaidah			Site: Natore		
	Wheat (N-P-K-S-Zn + CD t ha^{-1})	Mungbean (N-P-K-S)	T.Aman (N-P-K-S-Zn)	Wheat (N-P-K-S-Zn-B + CD t ha^{-1})	Mungbean (N-P-K-S)	T.Aman (N-P-K-S)
T_1	77-25-38-3-2 + 0	16-6-8-1	60-7-18-2-0	87-25-42-8-0.5-0.5 + 0	17-12-9-0*	64-13-19-3
T_2	110-34-54-5-3 + 0	22-9-11-2	82-9-23-2-0	124-32-60-10-1.0-1.0 + 0	17-12-9-0*	87-16-24-4
T_3	95-29-39-5-3 + 5	22-9-11-2	82-9-23-2-0	109-27-45-10-1.0-1.0 + 5	17-12-9-0*	87-16-24-4
T_4	90-20-35-10-2 + 0	20-10-10-6	70-6-20-4-0	90-20-35-10-2.0-0.5 + 0	20-10-10-0	70-6-20-4
T_5	74-21-26-19-2 + 0	20-5-8-0	87-21-26-14-4	95-21-30-14-0-0 + 0	0-0-0-0-0	98-21-24-10
T_6	0-0-0-0-0 + 0	0-0-0-0	0-0-0-0-0	0-0-0-0-0-0 + 0	0-0-0-0-0	0-0-0-0

*for average yield

Treat.	Site: Dumuria, Khulna		Site : Chabbisnagar, Rajshahi	
	Sesame (N-P-K-S + CD t ha^{-1})	T.Aman (N-P-K-S)	Chickpea (N-P-K-S-Zn-B + CD t ha^{-1})	T.Aman (N-P-K-S)
T_1	44-12-0-0 + 0	51-4-0-0	13-14-30-15-0.50- 0.05 + 0	73-10-39-6
T_2	61-15-0-0 + 0	70-6-0-0	20-20-20-45-0.50- 0.50 + 0	100-13-50-6
T_3	46-10-0-0 + 2.5	70-5-0-0	5-15-15- 30-0-0 + 5	100 -13-50- 6
T_4	50-20-14-15 + 0	35-4-15-2	20-20-40-15-0.5-0 + 0	75-12- 40-5
T_5	0-0-0-0 + 0	0-0-0-0	0-20-0- 0- 0-0 + 0	62-13-16- 8
T_6			0-0-0-0-0-0 + 0	0-0-0-0

Results and Discussion

CP : Mustard-Boro-T.Aman
AEZ : Level Barind Tract (AEZ 25)
Location : MLT site, Nandigram, Bogra
Year : 2003-04 to 2005-06

Seed/grain and stover/straw yield of mustard, Boro and T.aman rice in different years are presented in the Table 1. Higher seed yield of mustard was found in the treatment of STB fertilizer for HYG (T_2) followed by IPNS (T_3). The trend over the years is more or less same but yield was drastically reduced in 2003-04 due to cold injury of BARI sarisha-9 and local mustard variety Shati was used in 2004-05. In Boro rice, grain yield did not vary appreciably in 2003-04, however the higher grain was recorded from T_2 followed by T_3 in 2004-05 and the highest yield was obtained from T_2 in 2005-06. The yield from farmers dose (T_5) did not vary with the treatment of STB fertilizer for MYG (T_1), IPNS (T_3) and FRG'97 (T_4) in 2003-04 and with T_4 in 2005-06. Similarly in T. aman rice, higher yield was obtained from T_2 followed by T_3 over the years.

The average of three years data showed that the higher seed yield (1.44 t/ha) of mustard was obtained with STB for HYG (T_2) followed by IPNS (T_3) which were 58 and 52% higher than the farmers' practice, respectively (Table 2). Although higher grain yield of Boro was found from T_2 but it was varied only 8-14% comparing the treatments of T_3, T_1 and T_4. Higher grain yield of T.aman was found from T_2 followed by T_3. The IPNS practice failed to show yield advantages over inorganic fertilizer of same level. Stover/srtraw yield of mustard, Boro and T.aman followed the trend of grain yield of the crops.

Cost and return analysis (average of three years) showed that the highest gross return as well as gross margin was obtained from T_2 followed by T_3 (Table 2).But the fertilizer cost was higher in T_2 and T_3 and therefore, the marginal benefit cost ratio was less in compared to T_4 . MBCR was found higher in T_4 due to less fertilization cost.

Total uptake of N, P and K in different treatments varied from 218-282, 37-48 and 214-279 kg ha^{-1}, respectively (Table 3). Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was higher in T_2 and IPNS treatment (T_3). The partial net balance of N and K was negative in all cases and ranged from -134 to -167 and -17 to -105 kg ha^{-1}, respectively. Potassium balance was found more negative in FP (T_5) and FRG' 97 (T_4) due to less application of K in the soil. However, P balance was found positive in all the cases and ranged from 5 to 19 kg ha^{-1}.

Considering the agro-economic performance as well as sustaining soil fertility, STB fertilizer dose for HYG was found better and application of organic manure (3-5 t/ha) once in a year i.e. 85-25-55-20-0-1 NPKSZnB kg ha^{-1} + OM @ 3-5 t/ha for Mustard, 120-20-80-10-1-0 NPKSZnB kg ha^{-1} for Boro and 80-15-60-5-1-0 NPKSZnB kg ha^{-1} for T.aman could be suggested for Mustard–Boro–T.aman cropping pattern under AEZ 25.

Table 1. Yield of crops as influenced by fertilizer levels in the cropping pattern Mustard-Boro-T.Aman at Nandigram, Bogra during 2003-04 to 2005-06

Treatment	2003-04			2004-05			2005-06		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
Seed/grain yield (t/ha)									
T_1	0.57b	7.07ab	6.02ab	1.15b	5.17b	3.78ab	1.23c	3.73b	4.50ab
T_2	0.78a	7.79a	6.68a	1.76a	5.59a	4.38a	1.77a	4.52a	4.93a
T_3	0.71a	7.30ab	6.17a	1.71a	5.55a	4.21a	1.71a	3.71b	4.80a
T_4	0.59b	7.27ab	5.95ab	1.45ab	5.09bc	3.65b	1.51b	3.43b	4.35ab
T_5	0.51b	6.77b	5.62ab	1.11b	4.74c	3.64b	1.11c	3.28b	3.98b
T_6	0.29c	3.19c	3.16c	0.25c	2.86d	2.25c	0.26d	2.24c	2.78c
Stover/ Straw yield (t/ha)									
T_1	2.76b	7.52a	6.34a	2.83b	5.30b	4.64a	2.90a	3.73b	6.25ab
T_2	3.02a	7.85a	6.88a	3.37a	5.85a	5.40a	3.29a	4.51a	6.70a
T_3	3.20a	7.52a	6.52a	3.15a	5.75a	4.88a	3.19a	3.71b	6.00ab
T_4	2.70b	7.54a	6.12ab	3.36a	5.12bc	5.00a	3.17a	3.43b	5.50ab
T_5	2.59b	6.75ab	5.75b	3.31a	4.87c	4.50a	3.02a	3.28b	5.08b
T_6	1.52c	3.88c	3.51c	1.16c	2.90d	3.50b	1.24b	2.24c	3.70c

Figure in the column having similar letter(s) do not differ significantly

Table 2. Average yield and cost and return analysis of Mustard -Boro-T.Aman cropping pattern as influenced by fertilizer levels at Nandigram, Bogra during 2003-04 to 2005-06 (Average)

Treat	Seed/grainyield ($t\ ha^{-1}$)			Stover/ straw yield ($t\ ha^{-1}$)			GR ($Tk.\ ha^{-1}$)	VC ($Tk.\ ha^{-1}$)	GM ($Tk.\ ha^{-1}$)	MBCR (over control)
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman				
T_1	0.98	5.32	4.77	2.83	5.52	5.74	127545	11534	116011	5.49
T_2	1.44	5.97	5.33	3.23	6.07	6.33	149615	16068	133547	5.31
T_3	1.38	5.52	5.06	3.18	5.66	5.80	140720	15552	125168	4.91
T_4	1.18	5.26	4.65	3.08	5.36	5.54	129690	10732	118958	6.10
T_5	0.91	4.93	4.41	2.97	4.97	5.11	118125	10669	107456	5.05
T_6	0.27	2.76	2.73	1.31	3.01	3.57	64245	0	64245	-

GR = Gross return, VC = variable cost (fertilizer cost), GM = gross margin, MBCR = Marginal benefit cost ratio

Output price (Tk./kg): Mustard seed=20, Mustard stover=0.50, Boro rice=10, T.aman rice=10, Rice straw= 0.50

Input price (Tk./kg): Urea= 6, TSP= 15, MP= 12, Gypsum= 3, Zinc sulphate= 65, Boric acid= 60 & CD= 0.15

Table 3. Effect of different fertilizer management packages on the soil nutrient balance in Mustard-Boro-T.Aman rice cropping pattern at Nandigram, Bogra during 2003-04 to 2005-06 (Avg.of 3 years)

Treatment	Nutrient uptake (kg ha-1)			Nutrient (Inorg.+Org.) added (kg ha-1)			Apparent nutrient balance (kg ha-1)		
	N	P	K	N*	P	K	N	P	K
ED_1	235	40	231	207	48	179	-152	8	-52
ED_2	282	48	279	288	65	247	-167	17	-32
IPNS	266	46	264	288	65	247	-151	19	-17
FRG'97	243	42	240	245	47	135	-145	5	-105
FP	218	37	214	210	55	112	-134	18	-102

*Considering 40% available

Appendix 1. Initial soil status of the experimental site

Land type	R/I	pH	O.C (%)	Total N (%)	K (m.eq./100g soil)	P	S	Zn	B
						ppm			
MHL	I	4.93	1.165	0.1165 (L)	0.08 (VL)	9.306 (L)	11.81 (O)	1.60 (O)	-

MHL =Medium high land, R/I = Rainfed/irrigated, L = Low, M = Medium, O= Opimum, V= Very, H= High

Appendix 2. Crop management practices

Cropping pattern	Variety	Seed rate (kg ha-1)	Planting time	Harvesting time
Mustard	Local	08	4th week of Nov.	1st week of Feb.
Boro	BRRI dhan-29	50	3rd week of Feb.	2nd week of May
T.Aman	BRRI dhan-32	50	3rd week of July	3rd week of Nov.

CP : Potato-Boro-T.Aman
AEZ : Old Barahmputa Floodplain (AEZ 9)
Location : FSRD site, Kushumhati, Sherpur
Year : 2004-05 to 2005-06

Tuber yield of Potato influenced significantly due to different fertilizer options (Table 1). The highest tuber yield was obtained from IPNS based fertilizer dose (T_3) in 2004-05 and the yield was statistically similar to STB fertilizer dose for HYG (T_2) in 2005-06. Tuber yield was lower in FP compared with other nutrient management options. Higher and identical grain yield of Boro rice was recorded from T_2 and T_3 in both the years. Similar yield was also found in T_1 and T_4 which was higher than FP (T_5) in both the years. Similarly, in T.Aman rice, higher grain yield were recorded from STB fertilizer dose for HYG (T_2) followed by IPNS basis fetilizer (T_3). Although higher straw yield was found in T_2 but it was identical to T_3 in Boro and T.Aman rice.

Two years average results showed that the yield of potato tuber (28.49 t/ha) was 10% higher in IPNS (T_3) than the STB fertilizer dose for HYG (T_2) though both possess same dose of nutrients (Table 2). Effect of cowdung applied in T_3 was observed on the yield of Potato.But in case of grain and straw yield of Boro and T.aman, higher yield was found from STB fertilizer dose for HYG (T_2)

From the cost and return analysis it was found that the highest gross return and gross margin were obtained from T_3 followed by T_2 treatment (Table 2). Treatment FRG '97 (T_4) also gave satisfactory gross margin. Marginal benefit cost ratio (MBCR) over control was higher in T_4 due to lower fertilization cost. In spite of additional cost of cowdung applied in IPNS treatment the MBCR was close to STB fertilizer dose for HYG T_2 and farmers practice (T_5).

For further confirmation the experiment may be repeated in the next year.

Table 1.Yield of crops as influenced by different fertilizer packages in Potato-Boro-T.Aman rice cropping pattern at Sherpur during 2004-05 to 2005-06

Treat	Tuber/grain yield ($t\ ha^{-1}$) 2004-05			Tuber/grain yield ($t\ ha^{-1}$) 2005-06			Straw yield ($t\ ha^{-1}$) 2004-05		Straw yield ($t\ ha^{-1}$) 2005-06	
	Potato	Boro	T.Aman	Potato	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman
T_1	25.27 b	5.39 b	4.08 b	22.08 b	4.90 b	4.25 b	5.98a	5.19b	5.10 b	5.10 b
T_2	28.98 b	6.50 a	5.54 a	22.84 ab	6.05 a	5.65 a	6.91a	6.61a	6.50 a	6.13 a
T_3	32.31 a	6.01 a	5.32 a	24.66 a	5.53 a	5.44 a	6.57a	6.24a	6.35 a	6.04 a
T_4	26.72 b	5.68 b	4.25 b	21.88 b	4.95 b	4.90 ab	6.41a	5.69ab	5.35 b	5.19 ab
T_5	17.92 c	4.95 c	3.16 c	18.38 c	4.15 c	3.74 c	5..30b	3.68c	5.25 b	4.11 c
T_6	8.17 d	1.21 d	1.09 d	9.68 d	1.15 d	1.23 d	2.05c	1.43d	2.35 c	1.43 d

Table 2. Average yield, cost and return of Potato-Boro-T.Aman cropping pattern as influenced by different fertilizer options at Sherpur during 2004-05 to 2005-06 (average)

Treat.	Tuber/ grain yield ($t\ ha^{-1}$)			Straw yield ($t\ ha^{-1}$)		GR ($Tk.\ ha^{-1}$)	VC ($Tk.\ ha^{-1}$)	GM ($Tk.\ ha^{-1}$)	MBCR (over control)
	Potato	Boro	T.Aman	Boro	T.Aman				
T_1	23.68	5.15	4.17	5.54	5.15	42780	13351	414449	19.24
T_2	25.91	6.28	5.60	6.71	6.37	455915	18660	437255	15.27
T_3	28.49	5.77	5.38	6.46	6.14	485795	20262	455533	15.54
T_4	24.30	5.32	4.58	5.88	5.44	431970	11777	420193	22.17
T_5	18.15	4.55	3.45	5.28	3.90	359280	12068	347212	15.61
T_6	8.93	1.18	1.16	2.20	1.43	170890	0	170890	

Price of output (Tk/kg):Potato= 4.00, T.Aman rice = 7.00, Jute (fibre)= 8.00, Jute stick = 1.00, Rice straw = 0.50
Price of inputs (Tk/kg):Urea= 6.00, TSP= 14.00, MP= 10.00, Gypsum= 3.00, Zinc sulphate= 25.00, Mustard oil cake=10.00

Appendix 1. Initial soil status of the experimental site

Land type	R/I	pH	O.C (%)	Total N (%)	K (m.eq./100g soil)	P (ppm)	S (ppm)	Zn (ppm)	B (ppm)
MHL	I	5.6	1.40	0.07 (VL)	0.09 (VL)	5.96 (L)	6.64 (L)	0.39 (VL)	0.20 (VH)

Appendix 2. Crop management practices

Cropping pattern	Variety	Seed rate (kg ha-1)	Planting time	Harvesting time
Potato	Diamant	1500	1st week of Dec.	2nd week of Feb.
Boro	BRRI dhan 28	40	3rd week of Feb.	2nd week of May
T.Aman	BRRI dhan 33	40	3rd week of July	3rd week of Nov.

CP : Wheat-Jute-T.Aman
AEZ : Low Ganges River Flood Plain (AEZ 12)
Location : Ishan Gopalpur, Faridpur
Year : 2003-04 to 2005-06

Average of three years data showed that higher grain/fibre yield of Wheat, Jute and T.Aman were obtained from T_3 (IPNS) (Table 1). The nutrient dose of STB for HYG (T_2) was 40% higher than that of T_1, but the yield was only 6-14% higher in T_2 comparing the yield of STB for MYG T_1. Despite of having same nutrient dose, the yield of T_3 was slightly higher than the treatment of T_2. It might be due to addition of cowdung in the treatment T_3 which increased the organic matter content of the soil (Appendix 2). The trend of the yield of straw/stick was more or less similar to the yield of grain/fibre yield of Wheat, Jute and T.Aman rice. The control treatment produced least amount of grain and straw yield in all crops.

The cost and return analysis of crops grown in Wheat-Jute-T.Aman cropping pattern showed that the highest gross return and gross margin was obtained from treatment T_3 followed by T_2 and T_4(Table 1). The highest MBCR (6.27) was obtained from the treatment T_4. It might be due o lower variable cost.

Higher MBCR was also found in T_3 and T_1. Additional cost for organic manure in T_3 reduces the MBCR.

The amount of N, P, K and S absorbed by Wheat, Jute and T.Aman rice at the farmers' field are presented in Table 2. The amounts varied widely with the treatments. Nutrient uptake by crop was mainly influenced by biomass production. Nitrogen replenishment through inorganic fertilizer and cowdung addition was not enough to balance N removal by crops since much of the applied N was lost from the soil. The N balance thus, was negative; 72-137 kg N/ha respectively, appeared to have been removal in excess of the amounts added in soil. The P balances were almost favorable as expected. The positive effect of these elements was reflected in the subsequent crop. But in case of K and S, it was evident that this element was removed in large excess of the amount added as fertilizer. This may lead to K depletion in the long run.

From three years study, it is apparent that the treatment IPNS (T_3) is superior to other fertilizer management practices in respect of crop yield in Wheat–Jute–T.Aman rice cropping system. Gross return and gross margin are also higher with IPNS. However, MBCR was little bit less compared to AEZ based fertilizer recommendation (FRG'97). Consider over all yield and soil fertility for sustaining crop production, IPNS (80-30-30-5-0-1 NPKSZnB kg ha-1 + 5 t/ha CD for wheat, 85-12-40-5 NPKS kg ha-1 for jute and 80-10-30-2 NPKS kg ha-1 for T.aman) practice could be recommended for Wheat–Jute–T.Aman rice cropping pattern of Low Ganges River Floodplain area (AEZ 12).

Table 1. Yield and cost and return of Wheat-Jute-T.Aman cropping pattern as influenced by different fertilizer levels at Ishan gopalpur, Faridpur (Avg. of 3 years)

Treatment	Grain/fibre yield ($t\ ha^{-1}$)			Straw yield ($t\ ha^{-1}$)			GR ($Tk\ ha^{-1}$)	VC ($Tk\ ha^{-1}$)	GM ($Tk\ ha^{-1}$)	MBCR (over control)
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman				
T_1	2.58	3.49	2.37	4.16	3.04	3.46	109880	8707	109880	5.09
T_2	2.89	3.78	2.56	4.68	3.22	3.66	129518	11804	117714	4.68
T_3	3.04	3.98	2.76	4.62	3.46	4.19	137911	12436	125475	5.12
T_4	2.62	3.48	2.51	4.23	2.92	3.45	121029	7452	113577	6.27
T_5	2.63	3.40	2.44	4.27	2.92	3.16	119621	9953	109668	4.55
T_6	1.57	2.87	1.61	2.71	1.63	2.28	74267	0	74267	-

Table 2. Effect of different fertilizer options on the soil nutrient balance in Wheat-Jute-T.Aman rice cropping pattern at Ishan Gopalpur, Faridpur during 2003-04 to 2005-06 (Avg. of 3 years)

Treatment	Nutrient uptake ($kg\ ha^{-1}$)				Nutrient added (inorg.+org.) ($kg\ ha^{-1}$)				Apparent nutrient balance ($kg\ ha^{-1}$)			
	N	P	K	S	N	P	K	S	N	P	K	S
T_1	208	39	274	45	78	42	85	12	-130	4	-189	-33
T_2	227	43	297	48	105	57	133	17	-122	14	-164	-31
T_3	242	45	318	51	105	57	133	17	-137	12	-185	-34
T_4	152	40	282	45	80	33	61	17	-72	-7	-221	-28
T_5	211	39	278	44	90	52	95	29	-121	13	183	-15
T_6	128	25	174	29	0	0	0	0	-128	-25	-174	-29

Appendix 1. Yield of crops influenced by different fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at Ishan Gopalpur, Faridpur during 2003-04 to 2004-05

Treatment	2003-04			2004-05			2005-06		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
	Grain/fibre yield (t ha^{-1})								
T_1	2.56	2.21	2.84	2.48	2.28	3.12	2.69	2.62	3.15
T_2	2.97	2.36	2.99	2.77	2.52	3.35	2.94	2.79	3.33
T_3	3.10	2.69	3.30	2.93	2.62	3.67	3.09	2.98	3.42
T_4	2.51	2.04	2.60	2.63	2.38	3.10	2.71	2.64	3.06
T_5	2.74	2.18	2.80	2.60	2.31	2.97	2.54	2.26	2.98
T_6	1.58	1.68	1.60	1.47	1.67	1.69	1.65	1.57	1.59
	Straw/Stick yield (Tk. ha^{-1})								
T_1	3.49	4.08	3.19	3.74	4.15	3.55	3.24	4.26	3.65
T_2	3.77	4.62	3.25	3.85	4.68	3.85	3.72	4.76	3.88
T_3	4.12	4.71	3.68	3.97	4.31	3.96	3.86	4.84	4.93
T_4	3.42	4.12	3.21	3.55	4.37	3.65	3.48	4.20	3.50
T_5	3.44	4.24	3.23	3.50	4.49	3.14	3.26	4.08	3.13
T_6	2.82	2.78	1.93	2.88	2.86	2.30	2.91	2.74	2.62

Appendix 2. Initial and post harvest soil status of the experimental site

soil status	Land type	R/I	pH	O.M (%)	Total N (%)	K (m.eq./100g soil)	P	S
	MHL	I					ppm	
Initial			7.58	2.55 (M)	0.128 (L)	0.197 (M)	6.30 (L)	21.87(M)
Post harvest			8.24	2.63 (M)	0.11 (L)	0.190 (M)	9.50 (L)	20.63(M)

Appendix 2. Crop management practices

Cropping pattern	Variety	Seed rate (kg ha-1)	Planting time	Harvesting time
Wheat	Protiva	120	1st week of Dec.	1st week of April
Jute	O-9897	08	4th week of April	Last week of July
T.Aman	BRRI dhan-32	50	2nd week of Aug	Last week of Nov

CP : Wheat-Mungbean-T.Aman
AEZ : High Ganges River Flood Plain (AEZ 11)
Location : MLT site, Jhenaidah
Year : 2003-04 to 2005-06

Fertilizer applied for STB high yield goal both inorganic (T_2) and IPNS (T_3) failed to show higher grain yield of wheat than the treatment of fertlizer applied for medium yield goal (T_1) in 2003-04 (Table 1). In 2004-05, different nutrient management options did not influence on the grain yield of wheat, however the highest grain yield was obtained from STB for HYG (T_2) in 2005-06. The highest seed yield of mungbean was obtained from STB for HYG (T_2) in the three consecutive years. The higher grain yield of T.aman was found from STB for HYG (T_2) in 2003-04 but it was also identical to farmesr' practice (T_5) in 2004-05. Among the different treatments, siginificant variation of the grain yield of T.aman rice was not found in 2005-06. Straw yield of wheat did not show significant response to the different nutrient management options over the years. The straw yield of T.aman was varied in 2003-04 and 2004-05 but not in 2005-06, however higher yield was found from STB for HYG (T_2) over the years

On an average of three years, higher grain yield of wheat was obtained from IPNS (T_3) followed by HYG (T_2) which were 17 and 13% higher than the farmers' dose (T_5), repectively (Table 2).Higher seed yield of mungbeean, grain yield of T.aman and straw yield of wheat and T. aman were found in HYG (T_2) followed by IPNS (T_3).

The cost and return analysis of crops grown in Wheat-Mungbean-T.Aman cropping pattern showed that the highest gross return as well as gross margin was obtained from treatment T_2 where STB fertilizer dose for HYG was applied. Fertilizer cost was the highest in IPNS practice (T_3) due to additional cost of cowdung. Higher MBCR was found with T_1 followed by T_2 and T_4 due to less fertilizer cost.

Total uptake of N, P and K in different treatments varied from 289-333, 54-63 and 210-239 kg ha^{-1}, respectively (Table 3). Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was highest in STB for HYG treatment (T_2) followed by IPNS (T_3). The partial net balance of N, P and K were negative in all cases and ranged from -226 to -258, -6 to -21 and -134 to -153 kg ha^{-1}, respectively. Initially the P status of the soil was medium and less amount of P was applied in STB fertilizer doses. But P uptake of Mungbean is much higher, therefore P balance was found negative.

After three years of experimentation, considering yield, profit as well as long term soil fertility, STB fertilizer dose for HYG (110-30-50-5 NPKS kg ha^{-1} for wheat, 25-10-20 NPK kg ha^{-1} for mungbean and 85-9-25-10-2 NPKSZn kg ha^{-1} and crop residue 2-3 t/ha for T.aman) could be suggested for recommendation for the cropping pattern. Crop residues of mungbean could be incorporated in the soil for sustaining soil fertility.

Table 1. Yield of crops as influenced by different fertilizer levels in the cropping pattern Wheat-Mungbean-T.Aman at Jhenaidah during 2003-04 to 2004-05

Treatment	2003-2004			2004-05			2005-06		
	Wheat	M.bean*	T.Aman	Wheat	M.bean	T.Aman	Wheat	M.bean	T.Aman
Grain/seed yield (t ha^{-1})									
T_1	2.85a	1558b	4.11c	3.03a	1.47c	3.33bc	2.68b	1.41b	3.50ab
T_2	2.96a	1705a	4.73a	3.27a	1.69a	3.68a	3.08a	1.50a	3.81a
T_3	3.07a	1582b	4.09c	3.14a	1.57b	3.39b	2.81b	1.39bc	3.45ab
T_4	2.55b	1555b	4.10c	3.09a	1.53bc	3.19c	2.62b	1.46b	3.23ab
T_5	2.52b	1511b	4.47b	2.96a	1.54bc	3.56a	2.74b	1.29bc	3.62ab
T_6	1.22c	965c	2.33d	1.47b	0.95d	2.67d	1.41c	1.03c	2.86b
Straw/Stover yield (t ha^{-1})									
T_1	5.94a		5.97abc	5.39a		2.75c	5.06a		5.23
T_2	6.08a		6.45a	5.64a		3.50a	5.99a		5.59
T_3	6.13a		5.59c	5.38a		3.26ab	5.50a		5.49
T_4	5.36ab		5.87bc	5.37a		2.98bc	5.39a		5.39
T_5	5.27ab		6.17ab	5.22a		3.43a	5.67a		6.73
T_6	2.51c		4.61d	2.10b		2.06d	4.11b		4.37

*kg ha^{-1}

Table 2. Average yield, cost and return of Wheat-Mungbean-T.Aman rice cropping pattern at Jhenaidah during 2003-04 to 2005-06 (Avg. of 3 years)

Treat	Grain/seed yield (t ha^{-1})			Straw yield (t ha^{-1})		GR (Tk ha^{-1})	VC (Tk ha^{-1})	GM (Tk ha^{-1})	MBCR (over control)
	Wheat	Mungbean	T.Aman	Wheat	T.Aman				
T_1	2.85	1.47	3.65	5.46	4.65	146230	7397	138833	7.19
T_2	3.10	1.63	4.17	5.90	5.18	162600	10167	152433	6.84
T_3	3.20	1.52	3.64	5.67	4.78	153255	12267	140988	4.91
T_4	2.75	1.51	3.51	5.38	4.75	144950	7920	137030	6.56
T_5	2.74	1.45	3.88	5.39	5.44	147175	9751	137424	5.55
T_6	1.37	0.98	2.62	2.91	4.36	93015	0	93015	

Output (Tk./kg**)** : Wheat grain= 14, Wheat straw= 0.5, Mungbean grain= 40, T.Aman grain= 11, T.Aman straw= 1
Input (Tk./kg**):** Urea= 6.25, TSP= 17, MP= 16.50, Gypsum= 4.50, Zn $S0_4.7H_20$= 90 and Cowdung= 0.75

Table 3. Effect of different fertilizer options on the soil nutrient balance in Wheat-Mungbean-T.Aman rice cropping pattern at Jhenaidah during 2003-04 to 2005-06 (Avg. of 3 years)

Treatment	Nutrient uptake (kg ha^{-1})			Nutrient (inorg. + org.) added (kg ha^{-1})			Apparent nutrient balance (kg ha^{-1})		
	N	P	K	N	P	K	N	P	K
T_1	304	57	217	153	38	64	-251	-19	-153
T_2	333	63	239	214	52	88	-258	-11	-151
T_3	310	58	222	214	52	88	-235	-6	-134
T_4	302	57	215	180	36	65	-239	-21	-150
T_5	289	54	210	181	47	60	-226	-7	-150

Appendix 1. Initial soil status of the experimental site

Land type	R/I	pH	O.C (%)	Total N (%)	K (m.eq./100g soil)	P	S	Zn	B
						ppm			
MHL	I	-	-	0.11 (L)	0.18 (L)	7.04 (VL)	26.1 (O)	0.69 (L)	-

Appendix 2. Crop management practices

Cropping pattern	Variety	Seed rate (kg ha^{-1})	Planting time	Harvesting time
Wheat	Shatabdi	120	Last week of Nov	3rd week of March
Mungbean	BARI mung-5	40	1st week of April	3rd week of June
T.Aman	BRRI dhan -9	50	Last week of July	Last week of Oct.

CP : Wheat-Mungbean-T.Aman
AEZ : High Ganges River Flood Plain (AEZ 11)
Location : MLT site, Natore
Year : 2004-05 to 2005-06

Grain yield of wheat, mungbean and T.aman were influenced significantly due to different fertilizer options (Table 1). Higher and identical grain yield of wheat and T.aman were obtained both the treatments of STB for HYG (T_2) and IPNS (T_3) in both years.The highest Grain yield of mungbean also showed significant variations accross the nutrient management packages and the highest grain yield was obtained from STB for HYG (T_2) in 2004-05. But in the next year yield did not vary due to the nutrient management packages. Higher straw yield of wheat was recorded in T_3 and T_2 in 2005-06, but yield did not vary in 2004-05 due to different nutrient options. Higher straw yield of T.aman was also obtained from IPNS (T_3).

On an average, the yield improvement of wheat with estimated inorganic fertilizer dose (T_2) and integrated nutrient management for high yield goal (T_3) were 18 and 19% compared to farmers' practice (T_5), respectively (Table 2). The variation of yield of mungbean from T_3 to T_2 was 6%. Plants grown without fertilizer had the lowest grain yield of mungbean (T_6). Higher grain yield of T.aman was recorded with IPNS (T_3) which was close to in T_2,

Cost and return analysis results showed that the higher gross return, gross margin and fertilizer cost were recorded from T_2 and T_3. Among the treatments, highest MBCR was recorded from farmers' practice (5.25) due to lower fertilizer cost.

Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was highest in STB for HYG treatment (T_2) followed by IPNS (T_3). The partial net balance of N and K were negative in all cases and ranged from -192 to -211 and -128 to -150 kg ha^{-1}, respectively. P balance was positive in T_1, T_2 and T_3. Sulphur balance was positive in farmers' practice only.

The experiment may be continued for the next year for concretre recommendation.

Table 1. Yield of crops as influenced by different fertilizer levels in the cropping pattern Wheat-Mungbean-T.Aman at Natore during 2004-05 to 2005-06

Treat.	2004-2005			2005-06			2004-2005		2005-06	
	Wheat	M.bean	T.Aman	Wheat	M.bean	T.Aman	Wheat	T.Aman	Wheat	T.Aman
	Grain/seed yield (t ha^{-1})						Straw yield (t ha^{-1})			
T_1	3.17b	0.70b	3.66b	2.99 c	1.32 a	3.77 b	3.85a	4.82d	3.72 c	4.44 b
T_2	3.69a	0.89a	4.46a	3.56 a	1.27 a	4.44 a	4.39a	5.92ab	4.34 ab	4.84 ab
T_3	3.58ab	0.68b	4.50a	3.72 a	1.37 a	4.43 a	4.08a	6.49a	4.57a	5.11 a
T_4	3.23b	0.73b	4.05ab	3.32 b	1.23 ab	3.97 b	3.84a	5.64bc	4.14 b	5.10 a
T_5	3.14b	0.59bc	4.38a	2.99 c	1.37 a	3.87 b	3.97a	5.21cd	3.74 c	4.06 ab
T_6	1.43c	0.54c	1.92c	1.90 d	1.08 b	2.12 c	2.04b	3.37e	3.09 d	3.11 c

Table 2. Average yield, cost and return of Wheat-Mungbean-T.Aman rice cropping pattern at Natore during 2004-05 to 2005-06 (Avg. of 2 years)

[Treat	Grain/seed yield (t ha^{-1})			Stover/straw yield (t ha^{-1})		GR (Tk. ha^{-1})	VC (Tk. ha^{-1})	GM (Tk. ha^{-1})	MBCR (over control)
	Wheat	Mungbean	T.Aman	Wheat	T.Aman				
T_1	3.08	1.01	3.71	3.79	4.63	134415	9846	124569	4.21
T_2	3.63	1.08	4.45	4.37	5.38	155205	12903	142302	4.59
T_3	3.65	1.02	4.47	4.32	5.80	154060	13020	141040	4.45
T_4	3.27	0.98	4.01	3.99	5.37	140625	9672	130953	4.94
T_5	3.07	0.98	4.13	3.85	5.04	137825	8748	129077	5.25
T_6	1.67	0.81	2.02	2.56	3.24	83130	0	83130	-

Price (Tk kg^{-1}): Wheat grain 18.00, Wheat straw 0.50, Mungbean35.00, T.Aman grain 10.00,T.Aman Straw 1.00, Urea 6.00 TSP 18.00 MP16.00 Gypsum 5.00 Boric acid 120.00, Zn $S0_4$. $7H_20$ 70.00 Cowdung 0.25.

Table 3. Effect of different fertilizer options on the soil nutrient balance in Wheat-Mungbean-T.Aman rice cropping pattern at Natore during 2004-05 to 2005-06 (Avg. of 2 years)

Treatment	Nutrient uptake (kg ha^{-1})				Nutrient (inorg. + org.) added (kg ha^{-1})				Apparent nutrient balance (kg ha^{-1})			
	N	P	K	S	N	P	K	S	N	P	K	S
T_1	265	49	198	20	168	50	70	11	-198	1	-128	-9
T_2	302	56	229	24	228	60	93	14	-211	4	-136	-10
T_3	296	55	226	24	228	60	93	14	-205	5	-133	-10
T_4	273	51	206	21	180	36	65	14	-201	-15	-141	-7
T_5	269	50	204	21	193	42	54	24	-192	-8	-150	3

Appendix 1. Initial soil status of the experimental site

Land type	R/I	pH	O.C (%)	Total N (%)	K (m.eq./100g soil)	P	S	Zn	B
						ppm			
MHL	I	8.26	-	0.10 (L)	0.18 (L)	8.43 (L)	26.71 (O)	0.61 (L)	-

Appendix 2. Crop management practices

Cropping pattern	Variety	Seed rate (kg ha-1)	Planting time	Harvesting time
Wheat	Shatabdi	120	Last week of Nov	3rd week of March
Mungbean	BARI mung-5	40	1st week of April	3rd week of June
T.Aman	BR-11	50	Last week of July	Last week of Oct.

CP : Sesame-T.Aman
AEZ : Gangesw Tidal Flood Plain (AEZ 13)
Location : MLT site, Dumuria, Khulna
Year : 2001-02, 2003-04 & 2005-06

Although, this pattern was initiated in 2001-02 but it was damaged in 2002-03 and 2004-05 due to heavy shower. The yield of sesame and T.aman in different years is presented in the Table 1 Statistically similar and higher grain yield of sesame was found from STB for HYG (T_2) and IPNS (T_3) in 2001-02 and 2005-06. But in 2003-04, different nutrient management options did not influence on the grain yield of sesame. Although the highest grain yield of T.Aman was recorded from STB for HYG (T_2) in 2001-02, but it was not consistent in the later two seasons. Yield did not vary due to different nutrient manament options in T.aman rice in 2003-04 and 2005-06. Higher stover yield of sesame was obtained from IPNS (T_3) and STB for HYG (T_2) in different years.Higher straw yield was obtained from IPNS (T_3) followed by STB for HYG (T_2) in 2001-02, but it was not varied in the 2003-04 and 2005-06 due to application of different nutrient doses.

The average of three years result revealed that seed yield of sesame did not vary appreciably among the treatment except with control (FP). However, higher yield was recorded from IPNS (T_3) and STB for HYG (T_2) and almost similar tend was found in the grain yield of T.aman, straw yield of sesame and straw yield of T.aman (Table 2). No considerable yield advantage was found in IPNS over inorganic fertilizers.

Cost and return analysis results showed that the highest gross return recorded from IPNS (T_3) and gross margin from STB for HYG (T_2) (Table 2). MBCR was higher in STB for HYG (T_2) followed by STB for MYG (T_1).

After three years of experimentation it was evident that STB fertilizer dose for HYG or MYG (45-60, 12-15 NP kg ha^{-1} for sesame and 50-70, 4-6 NP kg ha^{-1} for T.aman) could be recommended for Sesame-T.Aman cropping pattern at Khulna region.

Table 1. Effect of different ntrient management options on the yield and mean yield of crops in Sesame-T.Aman cropping pattern at Dumuria, Khulna during 2001-02, 2003-04 and 2005-06

Treatment	2001-02		2003-04		2005-06	
	Sesame (kg ha^{-1})	T.Aman (t/ha)	Sesame (kg ha^{-1}.)	T.Aman (t ha^{-1})	Sesame (kg ha^{-1}.)	T.Aman (t ha^{-1})
Grain/seed yield						
T_1	1112 b	4.15 b	1070 ab	4.20 a	1087 b	4.34
T_2	1239 a	4.46 a	1173 a	4.24 a	1152 a	4.37
T_3	1218 a	4.22 b	1165 a	4.30 a	1182a	4.74
T_4	1113 b	4.03 b	1058 ab	4.17 a	1073 b	4.21
T_5	956 c	3.65 c	984 b	3.77 b	963 c	3.84
Stover/ straw yield						
T_1	3250 b	5.34 b	3270 b	5.12 a	3132 b	5.53
T_2	3612 a	6.05 a	3319 b	5.25 a	3242 ab	5.47
T_3	3675a	6.23 a	3616 a	5.05 a	3470 a	5.44
T_4	3200 b	5.31 b	3114 b	5.05 a	3150 b	5.20
T_5	2525 c	4.45 c	2685 c	4.31 b	2672 c	4.57

Table 2. Average yield, cost and return of Sesame-T.Aman rice cropping pattern as influenced by different fertilizer doses at Dumuria, Khulna during 2001-02 & 2003-04 (average)

Treatment	Grain yield ($t\ ha^{-1}$)		Stover/ Straw yield ($t\ ha^{-1}$)		GR ($Tk.\ ha^{-1}$)	VC ($Tk.\ ha^{-1}$)	GM ($Tk.\ ha^{-1}$)	MBCR (over control)
	Sesame	T.Aman	Sesame	T.Aman				
T_1	1091	4.23	3217	5.33	59415	3405	56010	2.16
T_2	1187	4.36	3391	5.59	62069	4502	57567	2.19
T_3	1191	4.42	3587	5.57	63143	7989	55154	1.35
T_4	1080	4.14	3155	5.19	58210	4557	53653	1.30
T_5	970	3.75	2627	4.44	52324	--	52324	--

Price of output (Tk./kg) : Sesame: 14.83, Sesame Stick : 1.00, Rice grain: 8.50, Rice straw: 0.75,
Price of input (Tk./kg) : Urea: 6.30, TSP: 15.04, Gypsum: 4.60, MP: 13.50, $ZnSO_4$: 80.00, Cow dung: 0.83

Appendix 1. Initial soil status of the experimental site

Location with AEZ	Land type	R/I	pH	O.C (%)	Total N (%)	K (m.eq./100g soil)	P	S	Zn	B
							ppm			
Dumuria (13)	MHL	R	6.8	2.65	0.16 (L)	0.60 (VH)	14.02 (M)	371 (VH)	0.34 (VL)	-

Appendix 2. Crop management practices

Cropping pattern	Variety	Seed rate ($kg\ ha^{-1}$)	Planting time	Harvesting time
Sesame	Local	8	Last week of Feb.	Last week of May
T.Aman	BR-23	40	3rd week of Aug.	3rd week of Dec.

CP : Chickpea-T.Aman
AEZ : High Barind Tract (AEZ 26)
Location : FSRD site, Cabbishnagar, Rajshahi
Year : 2004-05 & 2005-06

Seed yield of chickpea did not vary due to different nutrient management options in 2004-05 (Table 1). The highest yield was recorded from IPNS (T_3) in 2005-06. The overall performance of chickpea was poor in 2005-06 compared to 2004-05 due to lack of soil moisture that resulted the less germination as well as delayed germination of chickpea. In case of T.aman, response of grain yield to different nutrient managmnt options was not found in both the years. Although the highest stover yield of chickpea was found from IPNS in 2004-05, but it did not vary in 2005-06 due to different treatments (Table 1). Among the different nutrient doses, lower straw yield of T.aman was obtaind from MYG (T_1) in 2004-05 but it did not vary in 2005-06 due to application of different nutrient management options.

On an average of two years, higher seed yield of chickpea was recorded from IPNS (T_3) which was 19% higher than the farmers' practice (Table 2). In T.aman rice, higher grain yield was found in INPS (T_3) and was very close (< 1% difference) yield was found between the treatment of T_1 & T_5 and T_2 and T_4.

Cost and return analysis results showed that the highest gross return and gross margin was recorded from IPNS (T_3). Fertilization cost was higher in STB for HYG (T_2). Marginal benefit cost ratio (MBCR) was highest in IPNS (T_3).

After two years of experimentation, considering yield and profit, IPNS fertilizer dose for HYG could be suggested for the cropping pattern. For further confirmation the experiment may be repeated in the next year.

Table 1. Effect of different Nutrient management options on the yield and mean yield of crops in Chickpea-T.Aman cropping pattern at the FSRD site, Chabbishangar during 2004-05 & 2005-06

Treatment	2004-05		2005-06		2004-05		2005-06	
	Chickpea	T.Aman	Chickpea	T.Aman	Chickpea	T.Aman	Chickpea	T.Aman
	Seed/grain yield (t ha^{-1})				Stover/Straw yield (t ha^{-1})			
T_1	1.36 a	2.83a	1.16b	3.53a	1.83d	4.83b	1.30a	4.21a
T_2	1.42 a	3.20 a	1.18b	3.87a	1.83d	5.26a	1.27a	4.64a
T_3	1.29a	3.39 a	1.37a	4.00a	2.10a	6.09a	1.42a	4.49a
T_4	1.34a	3.23 a	1.17b	3.83a	1.98b	5.28a	1.34a	4.50a
T_5	1.33a	2.84 a	1.22a	3.36a	1.88c	5.66a	1.38a	4.44a
T_6	1.06b	2.23b	0.99c	2.04b	1.70e	4.48b	1.12b	3.16b

Table 2. Average yield and cost and return of Chickpea-T.Aman rice cropping pattern as influenced by different fertilizer doses at the FSRD site, Cabbishangar during 2004-05 & 2005-06 (average)

Treatment	Grain yield (t ha^{-1})		Stover/ Straw yield (t ha^{-1})		GR (Tk. ha^{-1})	VC (Tk. ha^{-1})	GM (Tk. ha^{-1})	MBCR (over control)
	Sesame	T.Aman	Sesame	T.Aman				
T_1	1.26	3.09	1.57	4.52	97180	6157	91023	4.03
T_2	1.30	3.54	1.55	4.95	102580	8119	94461	3.72
T_3	1.33	3.70	1.76	5.29	111145	7011	104134	5.53
T_4	1.26	3.53	1.66	4.89	100815	7137	93678	3.98
T_5	1.28	3.10	1.63	5.05	96645	4482	91763	4.97
T_6	1.03	2.14	1.41	3.82	72355	0	72355	0

Input price (Tk./kg): Urea= 6, TSP= 18, MP=15, Gypsum=4, Zinc sulphate= 60,Boric acid= 60 Cowdung=0.15
Output price (Tk./kg): Chickpea= 45, T.aman=12 & Rice straw= 1

Appendix 1. Initial soil status of the experimental site

Land type	R/I	pH	O.M (%)	Total N (%)	K (m.eq./100g soil)	P	S	Zn	B
						ppm			
MHL	R	6.27	1.13(L)	0.06 (VL)	0.11(L)	13.74 (L)	14.51 (L)	1.05 (M)	0.33 (M)

Appendix 2. Crop management practices

Cropping pattern	Variety	Spacing (cm)	Planting time	Harvesting time
Chickpea	BARI chola-5	30 x 10 cm	Last week of Nov.	Last week of March
T.Aman	BRRI dhan-39	25 x20 cm	Last week of July	Last week of Oct.

Improvement of Soil Fertility through Integrated Fertilizer Management in Maize-T.Aman Rice and Cauliflower-Stem Amaranth-Jute Cropping Patterns

Abstract

The experiment was conducted at the Farming Systems Research and Development (FSRD) site, Pushpapara, and MLT site, Pakshi during 2003-04 to 2005-06 to determine a suitable ratio of inorganic and organic fertilizer for improvement of soil fertility and crop productivity. The cropping pattern Maize-T.aman rice and Cauliflower-Stem amaranth-Jute were tested at Madhupur and Dashuria, Pabna, respectively. Four different ratios of organic and inorganic fertilizers were verified along with full dose of inorganic fertilizers (T_1) and no fertilizer (T_6) in the study. Different combinations were 75% inorganic + 25% PM (T_2), 50% inorganic + 50% PM (T_3), 25% inorganic+ 75% PM (T_4) and 100% PM (T_5). The result indicated that the highest yield in maize was obtained from 75% inorganic + 25% poultry manure (PM) treatment but 50% inorganic. + 50% poultry manure exhibited the highest grain yield in T.aman. Regarding the whole cropping pattern, the highest economic return in terms of MBCR was achieved with 100% inorganic fertilizer followed by 75% inorganic + 25% PM treatment. All crops of Cauliflower - Stem amaranth – Jute cropping pattern showed better performance in respect of yield with 50% inorganic + 50% poultry manure (PM) followed by 75% inorganic+25%PM treatment. From the economic view, the highest marginal benefit cost ratio (MBCR) was attained in 100% inorganic fertilizer followed by 75% inorganic + 25%PM treatment but gross margin was higher in 50% inorganic + 50% PM treatment

Introduction

The farmers at FSRD site, Goyeshpur and in the Pabna district as a whole are recently producing more high value crops including vegetables, papaya, banana and hybrid maize. Among those, hybrid maize and cauliflower are introduced to large areas by FSRD team and Maize-T.aman rice and Cauliflower-Stem amaranth-Jute cropping patterns are widely practiced by the farmers. Nutrient demand of hybrid maize and cauliflower is very high. The farmers' are using a very high dose of inorganic fertilizers to meet the demand. Continuous use of inorganic fertilizers at a high rate makes sense of a possible threat on soil health. On the other hand, the FSRD team introduced small scale poultry farm in the district where a huge amount of droppings are being produced, which have seldom use in crop fields. At ARS Pabna, poultry based compost used at active stage of composting produced better/equal rice and stem amaranths yield against 100% inorganic fertilizer. Further more, poultry droppings has become an environment polluting agent in spite its high value as organic material. Therefore, there has developed a concern on using PM for sustaining soil fertility and crop productivity. Keeping this view in mind the experiment was designed to find out the best combination of organic and inorganic fertilizers through integrated nutrient management for the high value crop based cropping pattern for improving soil fertility and productivity.

Materials and Methods

The experiment was conducted at Madhupur, expanded area of Goyeshpur FSRD site and Dashuria MLT site, Pabna during 2003-04 to 2005-06 in Gopalpur soil series under High Ganges River Flood Plain Soil (AEZ-11). Before starting the experiment soil samples were collected from farmers' field and analyzed in the laboratory. The details of soil analytical results are given in Appendix 1 and 2. The experiment was laid out in randomized complete block (RCB) design with six replications (dispersed) and unit plot size was 6m × 5m. Five different organic and inorganic fertilizer doses were tested with Maize- T.Aman rice and Cauliflower-Stem amaranth-Jute cropping patterns. The treatments were; T_1= 100% inorganic fertilizer, T_2=75% inorganic + 25% PM, T_3= 50% inorganic + 50% PM, T_4= 25% inorganic+ 75% PM, T_5= 100% PM & T_6= Control. Nutrient rates used for the two cropping patterns are given below-

CP: Maize (hybrid)-T.Aman rice

Treatment	Nutrient rate (kg ha^{-1})													
	Hybrid Maize							T.Aman rice						
	N	P	K	S	Zn	B	PM*	N	P	K	S	Z	B	PM*
T_1	200	66	88	21	3	0.74	-	92	15	30	5	-	-	-
T_2	150	50	66	16	2.25	0.56	3.75	69	12	22	4	-	-	1.75
T_3	100	33	44	11	1.5	0.37	7.50	46	8	15	3	-	-	3.50
T_4	50	17	22	5	0.75	0.19	11.25	23	4	8	2	-	-	5.25
T_5	-	-	-	-	-	-	15.00	-	-	-	-	-	-	7.00
T_6	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*PM = Poultry manure (t ha^{-1})

CP: Cauliflower-Stem amaranth-Jute

Treatment	Nutrient rate (kg ha^{-1})																				
	Cauliflower							Stem amaranth							Jute						
	N	P	K	S	Zn	B	PM*	N	P	K	S	Zn	B	PM	N	P	K	S	Z	B	PM
T_1	173	30	42	30	3	1	-	156	15	53	3	-	-	-	124	6	14	11	-	-	-
T_2	130	23	32	22	2.25	.75	3.25	117	12	40	2.25			3	93	5	10	8			2.25
T_3	87	15	21	15	1.25	.50	6.50	78	8	27	1.5			6	62	3	7	5			4.50
T_4	44	8	11	8	.75	.25	9.75	39	4	13	.75			9	31	2	4	3			6.75
T_5	-	-	-	-	-	-	13.00	-	-	-	-			12	-	-	-	-			9.00
T_6	0	0	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0			0

*PM = Poultry manure (t ha^{-1})

Poultry manure (Active compost) was the organic source which was made by fresh poultry dropping 50%, chopped crop residues 50%, with Urea 1%, TSP 0.5%, Gypsum 1% of total organic manure and effective microorganism (EM) solution as needed. Poultry manure (PM) contains 1.32% N (Appendix-3) which was the base for calculation of required PM for different treatments. Here, N percent of PM was considered only because N has no residual effect and other nutrient is present in sufficient amount in the PM. Fertilizer application and crop management practices are given in Appendix Table 4 & 5. Different intercultural operations such as weeding, irrigation and plant protection measures were taken as and when required. At maturity different data were collected accordingly and subjected to statistical analysis.

Results and Discussion

CP : Maize-T.Aman rice
Year : 2003-04 to 2005-06

Maize

Yield and yield contributing characters of maize were influenced significantly due to different treatments in 2005-06 (Appendix 6). The highest grain yield was obtained from T_2 (75% inorganic +25% PM) followed by T_1 (100% inorganic) treatment (Table 1). The contribution of maximum grains per cob and 100 grain weight might be resulted in the highest grain yield. The second highest grain yield was recorded in T_1 which was statistically similar with T_3 treatment. The response in straw yield was similar with all the treatments except 100% PM and control. The lowest yield and yield attributes were obtained from control (T_6) treatment.

The result from three consecutive years indicated that the grain yield obtained from 75% inorganic+25% PM treatment was more pronounced than other treatments which followed by 100% inorganic (Table 1). The increased yield in T_2 treatment has an indication that inorganic fertilizer along with organic matter to some extent had positive contribution to optimum plant growth and development. The result also indicated that successive addition of poultry manure after 25%, yield gradually declined. The causes behind this yield reduction may be due to slow release of nutrients and lack of optimum nutrient supply from organic matter for quick growing and vigorous plant like maize.

T.Aman

In 2006, yield and yield contributing characters of T.aman differed significantly due to different treatments. The highest grain yield was obtained from 50% inorganic + 50% PM inorganic was similar to 75% inorganic+25% PM (Table 1). The maximum number of effective tiller and fill grain might be contributed to higher grain yield. The grain yield obtained from other treatments was statistically similar except control. From three years average the highest grain yield was recorded in 50% inorganic+50% PM (T_3) which was followed by T_1, T_2 and T_4 treatments, respectively. The results indicate that T. aman rice was more responsive to PM in the pattern.

The integrated function of organic and inorganic fertilizer may lead to improve the balance uptake of nutrients by T. aman rice which attributed to increased yield in 50% inorganic + 50% PM treatment. Similar response was found in straw yield. The lowest performance in yield and yield attributes were observed in control.

Cost and return analysis

Regarding economic return of different fertilizer management packages, the highest marginal benefit cost ratio (MBCR) was obtained from 100% inorganic treatment (T_1) and the second highest MBCR was found in 75% inorganic+25% PM treatment (Table 2). The lowest MBCR was found in 100% PM (T_5) treatment due to more cost involvement in poultry manure.

Table 1. Effect of different treatment on the yield of Maize and T.aman under Maize-T.aman cropping pattern at FSRD site,Pushpapara, Pabna during 2003-2004 to 2005-2006.

Treatments	2003-04		2004-05		2005-06		Mean	
	Maize	T.aman	Maize	T.aman	Maize	T.aman	Maize	T.aman
Grain yield (t ha^{-1})								
100% Inorganic	7.10	5.44	7.53	4.64	7.74	4.36	7.46	4.81
75% Inorg.+ 25% PM	7.31	5.49	8.35	4.21	8.28	4.53	7.98	4.74
50%Inorg.+ 50% PM	7.14	5.68	7.21	4.78	7.34	4.86	7.23	5.10
25%Inorg.+ 75% PM	6.64	5.66	7.07	4.14	6.62	4.47	6.78	4.76
100% PM	5.99	5.46	6.13	4.22	6.01	4.20	6.04	4.63
Control	3.76	2.94	4.28	3.19	4.18	2.55	4.07	2.89
LSD (0.05)	0.34	0.25	0.67	0.42	0.50	0.34	-	-
CV (%)	4.41	4.00	8.35	8.39	6.25	5.38	-	-
Straw yield (t ha^{-1})								
100% Inorganic	7.27	6.44	8.76	6.01	8.04	5.00	8.00	5.82
75% Inorg.+ 25% PM	9.02	6.11	9.92	5.43	9.59	4.95	9.51	5.50
50%Inorg.+ 50% PM	8.23	7.17	8.61	6.45	7.82	4.74	8.22	6.12
25%Inorg.+ 75% PM	7.71	6.79	8.61	4.91	6.72	4.36	7.68	5.35
100% PM	6.89	6.61	8.15	5.28	6.37	4.40	7.14	5.43
Control	3.89	2.22	5.53	4.00	5.56	3.43	4.99	3.77
LSD (0.05)	1.55	0.24	0.94	0.63	0.53	0.58	-	-
CV (%)	17.80	3.25	9.57	9.90	6.81	8.58	-	-

Inorg. = Inorganic, PM = poultry manure

Table 2. Cost and return analysis of Maize-T.aman cropping pattern as affected by different treatment at FSRD site, Pushpapara, Pabna during 2003-04 to 2005-06 (average).

Treatments	Gross return (Tk ha^{-1})	Variable cost (fertilizer cost onl (Tk ha^{-1})	Gross margin (Tk ha^{-1})	MBCR (Over control)
100% Inorg.	116918	14662	102256	4.01
75% Inorg.+ 25% PM	121138	17556	103582	3.59
50%Inorg.+ 50% PM	119342	20735	98607	2.95
25%Inorg.+ 75% PM	113668	23954	89725	2.32
100% PM	102801	27133	75668	1.65
Control	58073	-	58073	-

Price of Output (Tk/kg): Maize grain =8.75, T.aman rice =11.00, Stover /straw = 0.50
Price of Inputs (Tk/kg):Urea= 6, TSP= 16.50, MP= Tk. 15, Gypsum= 5.00 Borax= 40, Zinc sulphate= 60, PM= 1.40

CP : Cauliflower-Stem amaranth-Jute
Year : 2003-04 to 2005-06

Yield and yield contributing characters as influenced by different combination of organic and inorganic fertilizers were significantly different (Appendix 8). Higher curd yield was attained in 50% inorganic + 50% PM which was statistically identical with 75% inorganic + 25% PM and 100% inorganic treatment. The cumulative positive effect of yield attributes might be resulted in increased curd yield of cauliflower in 50% inorganic + 50% PM treatment (Appendix 8). The lowest performance of yield and yield attributes was observed in control. It revealed that treatments T_1, T_2 and T_3 exerted very close results in view of yield and yield attributes and it might be due to retain almost same nutrient level (mainly N) in each treatment. But little higher yield was obtained from 50% inorganic + 50% PM combination might be due to slow and long term releasing of nutrient from PM and early stage of crop can get required nutrient from inorganic source easily i.e. balanced uptake of nutrients from both the sources.

From the three years result, it was found that yield of cauliflower increased in 2nd year but 3rd year it was decreased in all treatments (Table 3). It is mainly due to over aged (45 days) seedling transplanting and changes of variety (White contessa instead of Lucky due to unavailability) in the last year. But the trends of mean yield are also same as last year i.e. 50% inorganic + 50% PM treatment gave higher yield followed by 75% inorganic+25%PM treatment.

Stem amaranth

The result of 2005-06 showed significant variation among yield and yield attributes of stem amaranth due to different treatments (Appendix 9). Higher yield was obtained from 50% Inorganic + 50% PM treatment which was statistically similar to 75% inorganic+25% PM and 100% PM treatment. The cumulative effect of identical higher number of plant population, higher plant height and higher base circle might be resulted the higher yield. The balanced uptake of nutrients from organic source might be accelerating optimum plant growth which ultimately produced increased yield. The lowest performance of yield and yield contributing characters were found in control.

From the three years mean result, it was found that higher yield also attained in 50% inorganic+50% PM treatment followed by 75% inorganic+25% PM treatment (Table 1). It was also observed that over the years yield increased significantly especially in PM treatments and it was clearly positive effect of PM for increasing soil fertility.

Jute

Different treatments exerted significant variation among yield and yield attributes of jute in last year (Appendix 10). The highest fiber and stalk yield was recorded in 50% Inorganic + 50% PM treatment which was followed by 25% inorganic + 75% PM was statistically identical with this treatment in case of stalk yield. The cumulative effect of higher plant population and longer size of plant might be contributed to higher yield of jute in 50% inorganic+50% PM treatment. The lowest fiber and stalk yield was observed in control. The succeeding effect of previous used PM increased the soil health and water holding capacity (maintain zoe condition). On the other hand, jute seed size is small which can germinate easily on that soil and it tends to higher plant population which showed positive effect on yield. The lowest yield and inferior performance of yield attributes were achieved in the control treatment.

Average of 3 years result showed that 50% inorganic + 50% PM and 75% inorganic + 25% PM were promising combination for jute production (Appendix 10). It is also observed that over the years yields were increasing and it was mainly due to improvement of soil health by adding PM as organic matter.

Economic analysis

From cost and return analysis of three years, it was found that higher marginal benefit cost ratio (MBCR) was obtained from 100% inorganic treatment followed by 75% inorganic+25%PM treatment and the decreasing trend was found with the increasing of PM treatment and the lowest from 100% PM treatment and it is mainly due to higher amount and value of PM (Table 4). But the highest gross return and gross margin was obtained from 50% inorganic + 50% PM treatment. Though lower cost of fertilizer was shown in 100% inorganic treatment but failed to show higher gross margin due to lower total yield. Due to higher variable cost, the lower gross margin was found in the treatment where 100% PM was used. The highest MBCR was obtained from 100% inorganic treatment followed by 75% inorganic+25% PM and lowest from 100% PM treatment and it was mainly due to its higher variable cost. Though MBCR was higher in 100% inorganic treatment due to its lower variable cost but 75%inorganic+25 % PM treatment could help to sustain soil health and crop productivity.

Table 3. Effect of different treatment on the yield of Cauliflower, Stem amaranth, Jute under Cauliflower-Stem amaranth- Jute cropping pattern at MLT site,Pakshi, Pabna during 2003-2004 to 2005-2006.

Treatments	2003-04			2004-05			2005-06			Mean		
	Cauli flower	Stem amaranth	Jute	Cauli flower	Stem amaranth	Jute	Cauli flower	Stem amaranth	Jute	Cauli flower	Stem amaranth	Jute
						Yield (t ha^{-1})						
100% Inorg.	47.25a	27.96b	2.45ab	50.81a	49.00a	3.98b	31.96ab	50.04b	4.03b	43.34	42.33	3.49
75% Inorg.+ 25% PM	49.53a	30.25ab	2.58ab	52.30a	49.00a	4.13ab	32.86ab	56.83ab	4.28b	44.90	45.36	3.66
50%Inorg.+ 50% PM	49.64a	31.41a	2.90a	52.99a	50.00a	4.68a	33.88a	62.42a	4.84a	45.50	47.94	4.14
25%Inorg.+ 75% PM	47.38a	28.71ab	2.48ab	51.41a	47.00a	4.18ab	28.83bc	53.67b	4.23b	42.54	43.13	3.63
100% PM	46.90a	27.36b	2.85a	52.36a	47.00a	4.28ab	25.73c	56.84ab	4.10b	41.66	43.73	3.74
Control	27.46b	14.64c	2.35b	29.39b	22.00b	2.92c	17.01d	27.08c	2.88c	24.62	21.24	2.72
CV (%)	11.5	5.6	9.0	11.04	15.70	9.82	10.19	8.35	5.62	-	-	-
						Stalk yield (t ha^{-1})						
100% Inorg.	-	-	4.00c	-	-	7.45b	-	-	7.00bc	-	-	6.17
75% Inorg.+ 25% PM	-	-	4.67b	-	-	8.30ab	-	-	6.80bc	-	-	6.59
50%Inorg.+ 50% PM	-	-	5.50ab	-	-	9.15a	-	-	8.30a	-	-	7.65
25%Inorg.+ 75% PM	-	-	4.79abc	-	-	8.30ab	-	-	7.70ab	-	-	6.93
100% PM	-	-	5.80a	-	-	9.05a	-	-	6.65c	-	-	7.17
Control	-	-	3.00d	-	-	6.04c	-	-	5.03b	-	-	4.69
CV (%)	-	-	11.7	-	-	10.06	-	-	9.20	-	-	-

Table 4. Cost and return analysis of Cauliflower-Stem amaranth- Jute cropping patterns as affected by different treatment at MLT site, Pakshi, Pabna during 2003-04 to 2005-06 (average)

Treatments	Gross return (Tk ha^{-1})	Variable cost (fertilizer cost only) (Tk ha^{-1})	Gross margin (Tk ha^{-1})	MBCR (Over control)
100% Inorg.	430254	16443	413811	11.03
75% Inorg.+ 25% PM	450756	22894	427862	8.82
50%Inorg.+ 50% PM	470908	30205	440703	7.35
25%Inorg.+ 75% PM	430801	38229	392572	4.76
100% PM	429160	46517	382643	3.87
Control	248922	-	248922	-

Price of Output (Tk/kg): Cauliflower =6.00, Stem amaranth = 3.00, Jute fibre = 18.75, Jute stick =1.50,
Price of Inputs (Tk/kg): Urea = 6.50, TSP = 16.50, MP = Tk. 15.00, Gypsum = 5.00 Borax = 60.00 Zinc sulphate = 60.00, Poultry Manure =1.40

Conclusion

Higher yield of maize was obtained from 75% inorganic fertilizer with 25% PM (T_2) it is probably due to nutrient availability and proper uptake resulting in optimum plant growth and development. In case of T.aman the highest yield was attained in 50% inorganic + 50% PM might be due to improved soil health and balanced accumulation of nutrients from both the sources. The yield response of T.aman to PM was more responsive than maize. For the concern of and yield sustainability soil fertility inorganic fertilizer in combination with suitable quantity of organic matter is needed to be replenished nutrients in Maize-T.aman cropping pattern.

Yeld did not vary markedly among the different combination of organic and inorganic fertilizer in Cauliflower –Stem amaranth –Jute cropping pattern. The treatments with both organic and inorganic fertilizer showed better performance in case of gross return and gross margin though higher MBCR was obtained from 100% inorganic treatment. It might be the availability of nutrient from both inorganic and organic source (PM) and long term slow realizing nutrient from PM. It was also observed that in the succeeding year, all crops yield except last year cauliflower were increasing and it might be due to improvement of soil fertility. Though PM treatment is not more economical but it tends to high yielding, more hygienic crop production which is good for health. From the study, a good response to organic manure was noticed in all the crops tested.

Farmers' reaction

Farmers' of that location opined that combined application of organic and inorganic fertilizer application is very good for their crop and soil.

Recommendation

Based on three years experimentation and considering yield, economic return as well as soil fertility aspect application of 75% inorganic fertilizers along with 25% PM could be recommended for Maize-T.Aman and Cauliflower-Stem amaranth-Jute cropping pattern at Pabna and similar soils of AEZ 11.

Crop	Nutrient dose (kg ha^{-1})						PM (t ha^{-1})
	N	P	K	S	Zn	B	
Maize (Hybrid)	150	50	66	16	2	1	4
T.Aman	46	8	14	3	-	-	3
Cauliflower	130	22	31	22	2	1	3
Stem amaranth	117	12	40	2	-	-	3
Jute	93	5	11	8	-	-	2

PM = Poultry manure

Appendix 1. Nutrient status of the initial soil sample (0-15 cm depth) at Goyeshpur (Madhupur)

Farmers' plot	pH	OC (%)	Total N (%)	Available (PPM)				K (m.eq./100g soil)
				P	S	Zn	B	
Farmer 1	7.5	0.60	0.086	2.63	14.53	1.00	-	0.12
Farmer 2	7.5	0.56	0.081	2.75	18.25	0.64	-	0.13
Farmer 3	7.3	0.60	0.086	2.63	17.91	0.90	-	0.16
Mean of nutrient status	7.43	0.59	0.085	2.67	16.90	0.85	-	0.14
Interpretation	Slightly alkaline		VL	VL	M	L		L

Appendix 2. Nutrient status of the initial soil sample (0-15cm depth) at MLT site, Dashuria

Farmers' plot	pH	OM (%)	Total N (%)	Available (PPM)			K (m.eq./100g soil)
				P	S	Zn	
Farmer 1	7.4	0.92	0.051	26.73	3.63	0.55	0.48
Farmer 2	7.6	0.99	0.048	24.57	5.45	0.26	0.28
Farmer 3	7.6	0.71	0.046	9.99	3.63	0.35	0.34
Farmer 4	7.7	0.64	0.032	9.72	7.27	0.31	0.51
Farmer 5	7.7	0.64	0.032	9.72	11.82	0.67	0.31
Farmer 6	7.7	0.42	0.030	20.52	12.27	0.60	0.30
Mean of Nutrient status	7.6	0.72	0.042	16.88	7.35	0.46	0.37
Interpretation	Slight alkaline		VL	M	VL	L	H

Appendix 3. Nutrient status of the poultry manure (Active compost) made by ARS, Pabna during 2003-04

N (%)	Available (ppm)		K (meq//100g PM)	Ca (%)	Mg (%)
	P	S			
1.32	1.59	0.27	1.79	2.93	0.67

Appendix 4. Crop management practices

Location	Cropping pattern	Variety	Seed rate (kg ha^{-1})/spacing	Planting time	Harvesting time
Madhupur, Pabna	Maize (hybrid) T.Aman	Pacific 11 BR 11	15-20 (75 cm x 25 cm) 40 (25 cm x 15 cm)	1st week of Dec. 1st week of Aug.	1st week of May Last week of Nov.
Dashuria, Pabna	Cauliflower Stem amaranth Jute	Lucky Laboni O-9897	60 cm x 45 cm 2.25 (30 cm cont. line) 8 (30 cm x 5 cm)	2nd week of Nov. 3rd week of Feb. Last week of April	Mid. Jan. 2nd week of April Last week of July

Appendix 5**.** Fertilization method

Crop	Application Method
Maize	One third N, half PM and other fertilizers applied as basal. Rest 2/3 rd N and ½ PM applied in two equal splits as side dress at 8-10 leaf stage and at tasselling stage.
T.Aman	All PKSZn applied as basal. Nitrogen applied in three equal splits at 7-10, 30-35 and 50-55 DAT
Cauliflower	Full dose of cowdung, P and 1/2 K applied as basal. Urea and rest ½ of K applied in three equal splits at 8-10, 30 and 50 DAP as top dress.
Stem amaranth	All fertilizers applies as basal
Jute	One half of N and all PKS applied as basal. Rest of N applied as top dress at 25-30 DAP

Appendix 6: Effect of different combination of inorganic and organic fertilizers on yield and yield attributes of Maize under Maize-T.aman cropping pattern at FSRD site, Puspapara, Pabna during 2005-06

Treatments	Plant height (cm)	Ear height (cm)	Grains cob^{-1} (no.)	100-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
100% Inorg.	169.7	87.85	456.3	31.78	7.74	7.04
75% Inorg.+ 25% PM	165.0	83.28	493.0	31.55	8.28	6.59
50%Inorg.+ 50% PM	160.6	81.67	437.3	30.05	7.34	6.82
25%Inorg.+ 75% PM	160.2	75.20	436.3	28.92	6.62	6.72
100% PM	152.6	80.40	391.7	29.08	6.01	6.37
Control	133.3	62.13	334.2	28.42	4.18	5.56
LSD (0.05)	17.44	12.54	13.12	2.018	0.497	0.527
CV (%)	9.35	13.45	2.60	5.66	6.25	6.81

Appendix 7: Effect of different combination of inorganic and organic fertilizers on yield and yield attributes of T.aman under Maize-T.aman cropping pattern at FSRD site, Puspapara. Pabna during 2006

Treatments	Plant height (cm)	Tiller hill^{-1} (no.)	Panicle length (cm)	Fill grain panicle^{-1} (no.)	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
100% Inorg.	100.81	9.20	23.10	100.94	25.25	4.36	5.00
75% Inorg.+ 25% PM	101.83	9.55	22.50	102.83	25.27	4.53	4.95
50%Inorg.+ 50% PM	99.97	9.63	22.42	107.91	24.60	4.86	4.74
25%Inorg.+ 75% PM	99.75	9.50	22.48	98.35	24.40	4.47	4.36
100% PM	95.78	8.80	22.02	98.25	23.80	4.20	4.40
Control	88.07	7.48	19.65	73.43	22.65	2.55	3.43
LSD (0.05)	6.007	0.977	1.430	14.54	0.758	0.337	0.579
CV (%)	4.08	7.19	4.31	9.95	2.07	5.38	8.58

Appendix 8: Effect of different combination of organic and inorganic fertilizers on the performance of Cauliflower under Cauliflower-Stem amaranth-Jute cropping pattern during 2005-06 at MLT site, Pakshi, Pabna.

Treatments	Plant height (cm)	Leaf plant^{-1} (no.)	Length of curd (cm)	Breath of curd (cm)	Marketable wt. curd^{-1} (g)	Curd yield (t ha^{-1})
100% Inorg.	47.66	18.65	8.65	15.32	728.5	31.96
75% Inorg.+ 25% PM	50.58	18.75	8.83	15.40	734.0	32.86
50%Inorg.+ 50% PM	49.55	18.95	8.83	15.60	736.0	33.88
25%Inorg.+ 75% PM	46.97	19.00	8.50	15.52	638.5	28.83
100% PM	45.63	17.95	8.33	15.00	596.5	25.73
Control	34.75	17.70	6.43	12.50	484.0	17.01
LSD (0.05)	4.414	1.066	1.310	1.813	91.08	4.36
CV (%)	6.39	3.82	10.53	8.12	9.18	10.19

Appendix 9: Effect of different combination of organic and inorganic fertilizers on the performance of Stem amaranth under Cauliflower-Stem amaranth-Jute cropping pattern during 2006 at MLT site, Pakshi, Pabna.

Treatments	Plant height (cm)	Plant diameter (cm)	Plant population m^{-2} (no.)	Yield (t ha^{-1})
100% Inorg.	69.83	4.46	60.08	50.04
75% Inorg.+ 25% PM	76.57	4.78	63.83	56.83
50%Inorg.+ 50% PM	79.31	4.91	64.59	62.42
25%Inorg.+ 75% PM	75.94	4.76	59.67	53.67
100% PM	78.41	5.16	65.17	56.84
Control	33.13	3.45	60.27	27.08
LSD (0.05)	8.584	0.479	NS	6.439
CV (%)	8.27	6.95	16.12	8.35

Appendix 10: Effect of different combination of organic and inorganic fertilizers on the performance of Jute under Cauliflower-Stem amaranth-Jute cropping pattern during 2006at MLT site, Pakshi, Pabna.

Treatments	Plant height (cm)	Plant population m^{-2} (no.)	Fibre yield (t ha^{-1})	Stalk yield (t ha^{-1})
100% Inorg.	3.15	39.25	4.03	7.00
75% Inorg.+ 25% PM	3.16	41.25	4.28	6.80
50%Inorg.+ 50% PM	3.25	43.25	4.84	8.30
25%Inorg.+ 75% PM	3.01	43.08	4.23	7.70
100% PM	3.14	40.92	4.10	6.65
Control	2.64	33.00	2.88	5.03
LSD (0.05)	0.243	6.954	0.343	0.958
CV (%)	5.27	11.50	5.62	9.20

Verification Trial on Nutrient Management Options for Wheat-Mungbean-T.Aman Cropping Pattern

Abstract

The experiment was carried out at Multilocation Testing (MLT) site, Sujanagar, Pabna during two consecutive years (2004-05 to 2005-06) to determine the productivity and profitability of the newly proposed fertilizer recommendation for wider adaptation and to create awareness among the farmers and extension personnel about the new technology. Six different nutrient options were employed for the study. From two years result, it was revealed that the highest grain yield of wheat and T.aman were obtained from IPNS based fertilizer along with mungbean (brown manuring treatment) whereas the maximum yield of mungbean was found in high yield goal fertilizer plus brown manuring. Regarding whole cropping pattern the highest gross margin and benefit cost ratio (BCR) were obtained from IPNS based fertilizer along with brown manuring treatment.

Introduction

Wheat-Mungbean- T.Aman rice cropping pattern is very popular to the farmers of Rajshahi and Jessore region. The turn around time between wheat and rice provide a good chance to grow mungbean. The grain of mungbean is a very good source of human protein and its stover may be a good source of soil organic matter. Farmers also prefer to grow mungbean instead of other green manure crop for its higher market value of grain. Inclusion of mungbean in rice-wheat cropping system contributes to improve and maintain soil fertility. Bangladesh Rice Research Institute (BRRI) has developed a suitable combination of organic and inorganic fertilizers for sustaining soil fertility and higher yield and return for the cropping pattern under AEZ 11. The fertilizer recommendation should be verified in different multilocation testing sites under AEZ 11 for wider adaptation.

Objectives

i. To verify the productivity and profitability of the newly proposed fertilizer recommendation for wider adaptation

ii. To create awareness among the farmers and extension personnel about the new technology

Materials and Methods

The experiment was carried out at MLT site, Sujanagar, Pabna during the year 2004-05 to 2005-06 under High Ganges River Flood Plain Soil (AEZ 11). After selection of the cooperator farmers a composite soil sample was collected and analyzed.

The analytical results indicated that soil was slightly alkaline, its organic matter, N and P contents are low, K medium and P and Zn are very low. The experiment was laid out in randomized complete block (RCB) design with six replications and unit plot size was 8m × 5m. Six different fertilizer doses were tested and applied on the basis of total cropping pattern. The fertilizer treatments for Wheat-Mungbean-T.aman cropping pattern are as follows-

Treatments	Nutrients (kg ha^{-1})											
	Wheat							Mungbean stover	T.aman			
	N	P	K	S	Zn	B	CD (t ha^{-1})		N	P	K	S
T_1=HYG+N_OBM	116	34	30	24	2	1	-	Remove	87	11	15	5
T_2=HYG+BM	116	34	30	24	2	1	-	Retain	77	11	15	5
T_3=IPNS+ N_OBM	101	29	15	24	2	1	5	Remove	87	11	15	5
T_4=IPNS+BM	101	29	15	24	2	1	5	Retain	77	11	15	5
T_5=FP+N_OBM	41	15	20	10	-	-	-	Remove	69	23	27	14
T_6=FP+BM	41	15	20	10	-	-	-	Retain	69	23	27	14

* BM= Brown manuring with mungbean NoBM = Without Brown manuring

Fertilizer doses were calculated for wheat and T. aman using soil test value on the basis of high yield goal (HYG). Fertilizer doses for farmers practice was formulated by interviewing 20 different farmers of the site area. Wheat seed (var.Sourav) was sown on December 12 and 7 in the respective years. One irrigation was provided at crown root initiation stage both the years. The crop was harvested on March 24 and 25 in the respective years. After harvesting of wheat mungbean seed (var. BARI mung-5) was sown on March 27 and April 2 in the respective years without any fertilizer as per specification of the treatment. Mungbean was harvested on May 25 and 30 June 8 and 16 in the respective years. At the beginning of the experiment, each plot of the treatment was divided into two subplots. But in wheat and mungbean the two subplots were imposed with same treatment. Before transplanting of T.aman, one subplot was incorporated with mungbean biomass after harvest of grain, other one subplot was not incorporated with mungbean of each main plot. For IPNS treatment, 5 ton cowdung ha^{-1} was applied and it was rationalized with inorganic fertilizer. The seedling of T. aman was transplanted on 1^{st} week of August in 2005 and 2006. Fertilizer application and other intercultural operations were done when required. The crop was harvested on November 10 and 5 in the respective years. Data on different parameters were collected and analyzed statistically.

Results and Discussion

Wheat

Yield and yield contributing characters of wheat in 2005-06 were affected significantly due to different treatments (Appendix 2 and Table 1). Higher grain and straw yields were obtained from IPNS coupled with mungbean stover incorporation treatment (IPNS+BM). The lowest grain and straw yields were attained in farmer's fertilizer package without mungbean inclusion treatment (FP+N_0BM). The cumulative effect of higher grains $spike^{-1}$ and higher1000 grain weight might have significant contribution to increased yield in (IPNS+BM) treatment. It is mainly due to the succeeding effect of mungbean stover incorporation in the previous year and organic matter (cowdung) application in wheat crop which cummulatively lead to the soil good fertility and productivity. Imbalanced fertilizer and improper management might be resulted in lower yield in farmer's fertilizer package. From two years mean result, it was also revealed that IPNS+ BM treatment gave higher grain and straw yield of wheat followed by HYG+BM treatment where FP+N_0BM gave lower yield (Table 1).

Mungbean

The highest grain yield and biomass were obtained from IPNS+BM and the lowest was observed in FP+N_0BM treatment which was identical to FP+BM treatment (Table 1). The cumulative effect of pods $plant^{-1}$ and l000-seed weight have significant contribution to increased yield in IPNS+BM treatment in 2006 but previous year higher yield was from HYG+NoBMand HYG+BM year and decreased yield in FP+ NOBM treatment (Appendix 3). The residual effect of IPNS treatments cowdung and brown manuring applied for the preceding crop might be attributed to higher grain and biomass yield in IPNS+BM treatment and the imbalance fertilization in the preceding wheat crop under farmer's fertilizer package and no addition of brown manuring might causes lower grain and biomass yield of mungbean.

From the two years mean results, it was found that grain yield of mungbean did not differ markedly among the fertilizer packages. But biomass yield differ which was highest in IPNS+BM treatment. It might be due to succeeding effect of cowdung and preceding years brown manuring of this treatment.

T. aman

From the last year results, it was found that significant variation was observed among the treatments (Table 1). The highest grain yield was obtained from IPNS based fertilizer along with the residual effect of brown manuring. Integrated nutrient management from both organic and ch sources along with residual effect of brown manuring may lead to proper growth of rice plant and succeeding effect on yield. The cumulative effect of effective tiller $hill^{-1}$, grains $panicle^{-1}$ and 1000-grain weight might be contributed to increased grain yield of T.aman crop (Appendix 4). Grain yield was also identical with IPNS+N_0BM and HYG+BM treatments. The lowest grain yield was recorded in farmer's fertilizer package. From the two years mean result it was observed that the highest grain and straw yields were obtained from IPNS+BM treatment but the lowest was obtained from farmers fertilizer packages. So, it is clear that cowdung of IPNS treatment and brown manuring had positive effect on T.aman yield.

Table 1: Effect of different treatment on the yield of Wheat, Mungbean and T.aman under Wheat-Mungbean T.aman cropping pattern at MLT site, Bhabanipur, Sujanagar, Pabna during 2004-2005 to 2005-2006.

Treatments	2004-05			2005-06			Mean		
	Wheat	Mungbean	T.aman	Wheat	Mungbean	T.aman	Wheat	Mungbean	T.aman
Grain yield (t ha^{-1})									
HYG+NoBM	3.40	0.90	4.10	2.35	0.95	3.78	2.88	0.93	3.94
HYG+BM	3.33	0.92	3.90	2.52	0.96	3.82	2.93	0.94	3.86
IPNS+ NoBM	3.15	0.87	4.35	2.43	0.96	3.85	2.79	0.92	4.10
IPNS+ BM	3.45	0.87	4.60	2.69	0.99	3.96	3.07	0.93	4.28
FP+NoBM	2.03	0.85	3.88	1.92	0.92	3.53	1.98	0.89	3.71
FP+ BM	2.20	0.86	3.77	2.14	0.93	3.62	2.17	0.90	3.70
LSD (0.05)	9.97	0.022	0.1768	0.172	0.016	0.156	-	-	-
CV (%)	0.3871	2.11	3.65	5.53	4.34	5.12	-	-	-
Straw yield (t ha^{-1})									
HYG+NoBM	3.62	2.0	4.6	2.96	1.94	5.53	3.29	1.97	5.07
HYG+BM	3.50	2.0	4.1	3.17	1.97	5.70	3.34	1.99	4.90
IPNS+ NoBM	3.35	1.9	5.2	2.99	1.99	5.65	3.17	1.95	5.43
IPNS+ BM	3.60	2.6	5.6	3.38	2.09	5.76	3.49	2.35	5.68
FP+NoBM	3.47	2.3	4.1	2.71	1.80	5.65	3.09	2.05	4.88
FP+ BM	3.23	1.8	4.0	2.91	1.86	5.51	3.07	1.83	4.76
LSD (0.05)	7.18	0.30	0.396	0.186	0.134	0.208	-	-	-
CV (%)	0.2961	3.14	4.37	7.03	5.26	5.79	-	-	-

BM = Brown manuring

Cost and return analysis

Cost and return analysis of different nutrient management packages for the whole cropping pattern showed that the highest benefit cost ratio (BCR), gross return and gross margin were obtained from integrated plant nutrient system (IPNS) fertilizer with brown manuring (T_4) treatment. The lowest BCR was recorded in farmer fertilizer package (T_5) treatment. BCR is always lower in all packages where brown manuring did not incorporated compared to the brown manuring treated plots. It was mainly due to higher variable cost and lower yield.

Table 2: Cost and return analysis of Wheat-Mungbean-T.aman cropping patterns as affected by different treatment at MLT site, Bhabanipur, Sujanagar, Pabna during 2004-05 to 2005-06 (average).

Treatments	Gross return (Tk ha^{-1})	Total Variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
T_1 =HYG+NoBM	116830	53439	63391	2.19
T_2 =HYG+BM	121970	52595	69375	2.32
T_3 =IPNS+ NoBM	121580	55035	66545	2.21
T_4 =IPNS+ BM	128138	54202	73936	2.36
T_5 =FP+NoBM	105656	51181	54475	2.06
T_6 =FP+ BM	108480	50731	57749	2.14

Price of Output (Tk/kg): Wheat grain =15.00, Wheat straw = 0.50, Mung seed = 40.00, T.aman rice =11.00, Rice straw = 0.50
Price of Inputs (Tk/kg): Urea = 6.00, TSP = 16.50, MP = Tk. 15.00, Gypsum = 5.00 Borax = 60.00 Zinc sulphate = 60.00

Farmers' reaction

Farmers' of that location opined that IPNS packages can be considered for their crop yield and soil fertility. Growing of mungbean benefited them through cash income and soil improvement for increased crop production. They also opined that if there was no rainfall during the flowering stage of mungbean the higher yield could be achieved.

Conclusion

From the two years experiment it was revealed that the highest grain yield of wheat and T. aman were obtained from IPNS based fertilizer along with brown manuring treatment (T_4) and it is mainly due to available source of nutrient. If water source could be available during the whole cropping season then higher ratio of nutrient would be available due to rapid decomposition of incorporated mungbean plant and more yields will be obtained. Incorporated mungbean plants have considerable positive residual effect on soil. So, if the practice is done every year, yield as well as soil health will be improved.

Recommendation

Low organic matter content of our soil is the main constraints for soil fertility and crop productivity. So, considering crop productivity, economic return and soil fertility, integrated plant nutrient system with brown manuring of mungbean (IPNS+BM) could be recommended for Wheat-Mungbean-T.aman cropping pattern at Pabna and similar soils of AEZ-11 for sustainable higher yield.

Crop	Nutrients (kg ha^{-1})						Organic matter
	N	P	K	S	Zn	B	
Wheat	101	29	15	24	2	1	Cowdung 5 t ha^{-1}
Mungbean	0	0	0	0	0	0	Mungbean stover incorporate with soil after pod harvest
T. aman	77	11	15	5	0	0	-

Appendix 1. Nutrient status of the initial soil sample (0-15cm depth) of the experimental field.

MLT site Bhabanipur, Pabna	pH	OM (%)	Total N (%)	P	S	Zn	K (meq/100g)
				(µg/g soil)			
Mean status	7.36	1.75	0.10	6.92	9.73	0.29	0.26
Interpretation	Slightly alkaline	Low	Low	Very low	Low	Very low	Medium

Appendix 2: Yield and yield contributing characters of Wheat under Wheat-Mungbean-T.aman cropping pattern at MLT site, Bhabanipur, Sujanagar during 2005-06.

Treatments	Plant height (cm)	Plant population m^{-2} (no.)	Spike length (cm)	Grains spike $^{-1}$ (no.)	1000 Grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
HYG+ NoBM	81.68	181.4	10.20	44.32	36.12	2.35	1.96
HYG+BM	82.80	183.6	10.16	44.64	36.50	2.52	2.17
IPNS+NoBM	84.04	178.4	10.16	44.08	36.20	2.43	1.99
IPNS+BM	83.52	185.6	10.36	48.76	37.38	2.69	2.38
FP+ NoBM	78.60	176.0	9.36	35.36	36.78	1.92	1.71
FP+BM	80.40	179.4	9.84	35.60	35.96	2.14	1.91
LSD (0.05)	2.671	7.759	0.283	7.933	NS	0.172	0.186
CV (%)	5.47	4.25	3.15	14.27	4.39	5.53	7.03

Appendix 3: Yield and yield contributing characters of Mungbean under Wheat-Mungbean-T.aman cropping pattern at MLT site, Bhabanipur, Sujanagar at 2006.

Treatments	Plant population m^{-2} (no.)	Plant height (cm)	Pods $plant^{-1}$ (no.)	Pod length (cm)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Grain yield (kg ha^{-1})	Fresh biomass (kg ha^{-1})	Dry biomass (kg ha^{-1})
HYG+ NoBM	25.26	62.82	20.44	8.04	9.38	38.22	954.6	9551	1935
HYG+BM	25.73	63.72	20.02	8.67	9.36	38.32	962.2	9750	1970
IPNS+NoBM	27.19	62.04	20.76	8.60	9.62	38.26	964.6	9800	1985
IPNS+BM	25.29	64.20	21.44	8.84	9.48	38.46	987.4	10350	2090
FP+ NoBM	25.26	61.34	19.22	7.92	8.68	37.62	923.4	8900	1800
FP+BM	25.06	60.36	18.84	8.27	8.92	37.66	932.0	9200	1860
LSD (0.05)	1.141	2.898	1.264	0.363	0.393	0.346	16.92	691.7	134.7
CV (%)	3.37	3.52	4.76	3.28	3.22	2.69	4.34	5.47	5.26

Appendix 4: Yield and yield contributing characters of T.aman under Wheat-Mungbean-T.aman cropping pattern at MLT site, Bhabanipur, Sujanagar during 2006.

Treatments	Plant height (cm)	Effective tiller $hill^{-1}$ (no.)	Panicle length (cm)	Grains $panicle^{-1}$ (no.)	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
HYG+ NoBM	93.98	9.00	22.08	93.42	21.28	3.78	5.53
HYG+BM	93.16	9.20	21.58	92.38	21.32	3.82	5.70
IPNS+NoBM	95.26	9.46	22.38	93.02	21.56	3.85	5.65
IPNS+BM	92.40	9.48	22.38	93.46	21.88	3.96	5.76
FP+ NoBM	88.76	8.66	20.40	87.40	21.00	3.53	5.65
FP+BM	89.88	8.74	20.44	89.88	21.04	3.62	5.51
LSD (0.05)	4.097	0.315	0.658	2.172	0.468	0.156	0.208
CV (%)	3.37	5.62	3.32	4.80	2.66	5.12	5.79

Integrated Nutrient Management for Sustaining Soil Fertility and Yield of Mustard - Mungben -T. Aman Cropping Pattern

Abstract

The experiment was carried out at Multilocation Testing (MLT) sites, Pakshi, Pabna and Tularampur, Norail during 2005-2006 to estimate the requirement of individual nutrient for maximizing the yield for year round production plan on AEZ basis. Four different fertilizer doses along with absolute control were tested on Mustard - Mungbean-T.aman cropping pattern in the study.Result revealed that seed yield of mustard and grain yield of T.aman rice did not vary significantly among the treatments except with control but in mungbean, significantly higher yield was obtained in T_1 traetment in Pabna. In case of Norail, seed or grain yield of crops did not influence significantly among the treatments.

Introduction

Soil fertility is a dynamic property, which varies with crops, cropping intensity and input use. More than 50% of our cultivated soil contains organic matter below the critical level. Annual depletion of plant nutrients in the intensively cropped area ranges from 180 to more than 250 kg ha^{-1}. High and medium highland comprising 60 % of total cultivation land which is in most cases deficient in essential nutrients such as nitrogen, phosphorus, potassium and sulfur. The low organic matter content, higher cropping intensity, improper cropping sequence and faulty management practices are the major causes of depletion of soil fertility. Imbalance use of fertilizers is another serious problem for the country. Previous survey revealed that farmers in many areas in Bangladesh applied nitrogenous fertilizer higher than the recommended dose for some crops. They usually did not use any organic manure along with inorganic fertilizers as an integrated approach Nutrients present in soil, added as inorganic and organic sources and the nutrient harvested by crops should be considered to develop a cropping pattern based fertilizer recommendation. Remarkable amount of micronutrient is added in soil system when 15-20 ton ha^{-1} biomass of mungbean is ploughed down after grain harvest. 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 is a practiced cropping pattern. 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 at MLT sites Pakshi, Pabna and Tularampur, Norail during 2005-06 and under High Ganges River Flood Plain Soil (AEZ-11). The experiment was laid out in randomized complete block (RCB) design with four replications. The unit plot size was 6 m × 5 m. The seed of mustard (BARI Sarisha-9) was sown on first week of December 2005 in Pabna and 13th November 2005 in Norail maintaining a spacing of 30cm between rows. Intercultural operations were done as per requirement. The crop was harvested on 19 February 2006 in Pabna and 1st week of February 2006 in Norail. After harvest of mustard, mungbean seed (BARI mung-5) was sown on 9 March 2006 in Pabna and 16-20 March 2006 in Norail and the crop was harvested on 15 May 2006 in Pabna and last week of May in Norail. Seedling of T.aman (BRRI dhan-32) was transplanted on 26 July 2006 and harvested on 22 October 2006 in Pabna. Seedlings of BRRI dhan 39 were transplanted on 29 July 2006 and harvested on 7 November 2006 in Norail.

Treatment combinations:

Treat.	(N-P-K-S-Zn-B kg ha^{-1})					
	Pabna			Norail		
	Mustard	Mungbean	T.Aman	Mustard	Mungbean	T.Aman
T_1	120-36-70-40-3-1	25-10	100-36-70-10	120-36-70-40-3-1	25-10-70-40-3-1	120-36-70-10
T_2	160-36-70-40-3-1	25-10	120-36-70-10	160-36-70-40-3-1	25-10-70-40-3-1	160-36-70-10
T_3	120-54-70-40-3-1	25-10	100-36-70-10	120-54-70-40-3-1	25-10-70-40-3-1	120-54-70-10
T_4	120-36-105-40-3-1	25-10	100-36-105-10	120-36-105-40-3-1	25-10-105-40-3-1	120-36-105-10
T_5	0-0-0-0-0-0	0-0	0-0-0-0-0-0	0-0-0-0-0-0	0-0-0-0-0	0-0-0-0

Results and Discussions

Pabna

Yield and yield contributing characters of mustard were affected significantly due to different treatments except no. of seed pod^{-1} and 1000 seed wt. (Table 1). Statistically similar yield response was observed with different nutrient packages except control. The lowest yield (0.37 t ha^{-1}) was obtained from absolute control.

The highest seed yield of mungbean was attained in T_1 nutrient packages (Tbale 2). The cumulative effect of pods plant^{-1}, pod length and 1000 seed weight might have significant contribution to increased yield in T_1 nutrient package. The second highest yield obtained from T_2, T_3 and T_4 treatments were identical. The maximum fresh biomass and stover yields were recorded in T_2 nutrient packages probably due to plant response to higher nitrogen doses which was followed by other nutrient packages except control. Numerically higher grain yield of T.aman was observed in T_2 nutrient packages which was statistically similar with other treatments except control (Table 3). Optimum nutrient doses applied in T.aman and the residual effect of maximum mungbean biomass might be attributed to maximum grain yield in T.aman rice. Similar trend of response was observed in straw yield. Regarding economic return of the pattern, it revealed that the highest marginal benefit cost ratio (MBCR) was recorded in T_1 nutrient packages followed by T_2 nutrient packages.

Norail

The yield and yield component of mustard influenced by different treatments (Table 5). Significant difference was observed in plant height, pods/plant, grains/pod, seed yield and straw yield and 1000-grain weight. The highest yield (2.18 t/ha) was produced by the treatment T_2, which was identical with T_1, T_3 and T_4. The lowest yield (0.92 t/ha) was obtained from T_5 treatment (control). Higher grain yield than control was due to higher number of pods/plant, grains/pod and 1000-grain weight. There was no significant difference of yield and yield attributes of mungbean among the treatments (Table 6). Treatment T_3 showed higher yield, followed by T_1, T_2 and T_4. The lowest yield was obtained from treatment T_5. Plant height, plant population, filled grain/panicle, 1000-grain weight, yield and straw yield of T.aman did not differ significantly by the treatments (Table 7). Highest yield obtained from treatment T_3 followed by T_2, T_1 and T_4. The lowest yield was obtained from treatment T_5.

Farmers reaction

Farmers were satisfied to get this yield of mustard even with late sowing. They opined that mustard seed should be sown within mid November for more yield. Mungbean sowing should be done immediately after harvesting of mustard encourage better mungbean yield which has high market price.

Conclusion

Among the nutrient packages T_1 (120-36-70-40-3-1 NPKSZnB kg ha^{-1} for mustard, 25-10 NP kg ha^{-1} for mungbean, 100-36-70-10 NPKS kg ha^{-1} for T.aman) in Pabna and T_3 (120-54-70-40-3-1 NPKSZnB kg ha^{-1} for wheat, 25-10-70-40-3-1 NPKSZnB kg ha^{-1} for mungbean, 120-54-70-10 NPKS kg ha^{-1} for T.aman) in Norail were pronounced over other nutrient package. It was also indicated the incorporation of mungbean biomass showed positive influence on yield of T. aman rice.

Table 1. Yield and yield contributing characters of Mustard under Mustard-Mungbean-.Aman cropping pattern as affected by different treatments at MLT site, Pakshi, Pabna during the year 2005-06

Treatments	Plant height (cm)	No. of plants m^{-2}	No. of pods $plant^{-1}$	No. of seeds pod^{-1}	1000 seed wt. (g)	Yield (t ha^{-1})
T_1	90.63	114.00	85.43	14.71	2.50	1.52
T_2	92.00	109.00	89.70	14.42	2.60	1.31
T_3	92.63	118.25	84.58	14.53	2.60	1.38
T_4	86.95	124.00	92.55	14.50	2.70	1.34
T_5	88.33	105.75	16.73	14.46	2.30	0.37
LSD (0.05)	14.50	NS	11.03	NS	NS	0.51
CV (%)	11.19	17.44	9.72	9.81	5.60	28.45

Table 2. Effect fof different nutrient management on yield and yield attributes of Mungbean under Mustard-Mungbean-T.aman cropping pattern during 2006 at MLT site, Pakshi, Pabna

Treatments	Plant height (cm)	Plant population m^{-2} (no.)	Pods $plant^{-1}$ (no.)	Pod length (cm)	Seeds pod^{-1} (no.)	1000 seed wt. (g)	Seed yield (kg ha^{-1})	Fresh biomass (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	29.76	29.25	13.70	9.07	10.88	46.05	1218	4875	1641
T_2	31.24	28.75	12.93	8.71	10.82	43.58	1168	5875	1875
T_3	26.32	30.50	12.83	8.95	10.76	44.47	1143	4125	1381
T_4	29.66	29.00	13.10	8.84	11.02	45.00	1158	4313	1438
T_5	24.49	30.00	11.05	7.97	10.38	41.44	1093	3250	1041
LSD (0.05)	3.579	NS	0.724	0.337	0.545	3.233	43.21	1698.12	564.5
CV (%)	8.21	13.15	3.70	2.52	3.28	4.76	2.43	24.56	24.84

Table 3. Effect of different nutrient management on yield and yield attributes of T.aman underMustard-Mungbean-T.aman cropping pattern during 2006 at MLT site, Pakshi, Pabna

Treatments	Plant height (cm)	Effective tiller m^{-2} (no.)	Effective tiller $hill^{-1}$ (no.)	Panicle length (cm)	Filled grains $panicle^{-1}$ (no.)	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	91.74	178.10	8.93	23.60	75.13	23.90	3.31	3.69
T_2	93.94	200.80	9.65	23.42	77.13	24.05	3.72	4.11
T_3	91.24	199.20	8.85	22.95	71.95	23.90	3.43	3.82
T_4	90.56	185.70	9.18	22.85	76.20	24.00	3.42	3.85
T_5	80.79	131.00	6.55	21.08	51.00	22.50	1.50	1.71
LSD (0.05)	3.816	29.71	0.957	0.778	17.04	0.386	1.055	1.124
CV (%)	5.76	10.78	7.20	5.22	15.74	2.06	12.28	11.24

Table 4. Cost and return analysis of Mustard-Mungbean-T.aman cropping pattern during 2005-06 at MLT site, Pakshi, Pabna

Treatments	Gross return (Tk ha^{-1})	Total Variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	MBCR (Over control)
T_1	137655	18702	118953	3.02
T_2	134125	19548	114577	2.70
T_3	131290	21672	109618	2.31
T_4	130945	20802	110143	2.39
T_5	81255	-	81255	-

Price of input (Tk./kg): Urea= 6.5, TSP= 16.50, MP = 15, Zypsum= 5, Zinc sulphate= 60, Borax = 60
Price of out put (Tk./kg): Mustard seed=:25, Mungbean = 50,T.aman grain = 11 & T.aman straw =0.50

Table 5. Effect of fertilizer on the yield and yield contributing character of mustard at MLT site Tularampur, Narail during 2005-06

Treatments	Plant height (cm)	Plant Pop /m^2 (no)	Pods/plant (no)	Grains/pod (no)	1000 grain weight (g)	Yield (t/ha)	Straw yield (t/ha)
T_1	77.93b	159	74.98b	14.45ab	3.18a	1.93a	2.33a
T_2	87.43a	162	100.55a	14.88ab	3.08a	2.18a	2.57a
T_3	84.23ab	156	78.78b	13.70bc	3.35a	1.95a	2.22a
T_4	86.70a	134	93.10ab	15.45a	3.35a	1.89a	2.37a
T_5	58.58c	144	33.13c	13.10c	2.15b	0.92b	1.39b
F-test	**	NS	**	**	**	**	*
CV (%)	6.06	16.91	15.12	5.37	9.25	15.42	18.35

Table 6. Effect of fertilizer on the yield and yield contributing character of mungbean at MLT site Tularampur, Narail during 2005-06

Treatments	Plant height (cm)	Plant Pop /m^2 (no)	Pods/plant (no)	Grains/pod (no)	1000 grain weight (g)	Yield (kg/ha)	Straw yield (t/ha)
T_1	53.20a	35	48.63	11.85	33.85	1265	2.80
T_2	45.83b	40	42.63	11.80	33.70	1230	2.85
T_3	51.18ab	35	47.65	11.85	33.45	1297	3.00
T_4	56.78a	32	45.96	11.10	33.05	1212	2.43
T_5	50.53ab	32	50.55	11.85	33.00	1205	2.40
F-test	*	NS	NS	NS	NS	NS	NS
CV (%)	7.93	14.88	11.10	8.72	7.98	14.66	12.64

Table 7. Effect of fertilizer on the yield and yield contributing character of T. aman at MLT site Tularampur, Narail during 2005-06

Treatments	Plant height (cm)	Plant Pop. /m^2 (no)	Filled grains/ panicle(no)	Unfilled grains/ panicle(no)	1000 grain weight(g)	Yield (t/ha)	Straw yield (t/ha)
T_1	86.20	269	86.43	19.90ab	23.70	3.70	4.95
T_2	86.68	270	71.18	16.55b	22.95	3.85	4.43
T_3	84.25	265	80.60	20.12ab	23.65	3.95	4.18
T_4	86.55	233	81.20	23.48a	23.60	3.70	3.63
T_5	83.20	277	78.53	15.28b	23.25	2.40	4.90
F-test	NS	NS	NS	**	NS	NS	NS
CV (%)	5.32	12.62	15.31	15.35	6.44	20.11	17.75

RESEARCH ISSUE: CROP RESPONSE TO ADDED NUTRIENTS

Response of Crops Grown in Different Cropping Patterns and Environments to Added Fertilizer Nutrients

Abstract

The experiment was conducted at different locations with dominant cropping patterns during 1999-2000 to 2005-06 to find out an optimum fertilizer dose for the crops grown in different cropping pattern. Different crops grown in 9 cropping patterns at 11 locations were tested during 2005-06. Four levels of N, P, K and S (in some cases) viz. 0, MYG, HYG and HYG × 1.3 were evaluated and tested based on soil analysis and target yield. Results showed that a marked response on the yield of crops to added nitrogen was evident irrespective of locations and crops. A considerable response to phosphorus was also observed in most of the locations. Response to potassium and sulphur was not clearly evident in many locations. From the mean yield data a response curve was drawn and the relationship was quadratic in nature. From the response curve the nutrient dose that maximized yield and profit were found out for different crops grown in different cropping patterns at different locations.

Introduction

Crops grown in different cropping patterns and environment responded differently to mineral fertilizer nutrients. The nature of response may vary over time. Inorganic fertilizers are the key success of the crop production systems of Bangladesh agriculture, being responsible for about 50% of the total production but are not usually applied in balanced proportion. The typical behavior of fertilizer response ensures suggests that a high fertilizer dose beyond certain limit may not only reduce the marginal productivity but it may also reduce the total productivity. Therefore, use of excessive fertilizer may not be justifiable from economic point of view. Therefore, it is needed to find out an optimum level of fertilizer for maximum yield.

Objective

To determine optimum and economic dose of fertilizer nutrients for major crops grown in different cropping patterns in different environments.

Materials and Methods

The experiment was conducted during 2005-06 at different locations throughout the country to determine optimum and economic dose of fertilizer nutrients for major crops grown in different cropping patterns. A total of 9 dominant cropping patterns were tested at 11 locations covering 7 AEZs of the country. Details about site characteristics and crop management are given in Appendix Table 1 & 2, respectively. The experiment was laid out in RCB design with six replications across the field. Four different levels of N, P, K and S (in some cases) for different crops grown in different cropping patterns were tested all over the country. Four levels of the particular nutrient were determined based on soil analysis and target yield of the crops grown in the test location and the levels were made as equal interval.

The treatment concept was as follows-

Levels	N	P	K	S
0	0	0	0	0
1	MYG	MYG	MYG	MYG
2	HYG	HYG	HYG	HYG
3	HYG x 1.3	HYG x 1.3	HYG x 1.3	HYG x 1.3

Different cropping patterns tested in different locations

Cropping pattern	AEZ	Locations
Mustard - Boro - T.Aman	4	Gabtali (Bogra)
Wheat-Jute-Mungbean	11	Gangni (Khustia)
Potato-Boro-T.Aman	25	Joypurhat
Potato-T.Aus-T.Aman	9	KIshoreganj
Potato-Jute-T.Aman	11	Paba (Rajshahi)
Potato-Mungbean-T.Aman	11	Bagherpara (Jessore)
Lentil-Jute-T.Aman	11	Magura, Keshabpur (Jessore)
Lentil-Jute-T.Aman	12	Rajbari
Chickpea-T.Aman	26	Nachole (Rajshahi)
Sesame –T.aman	13	Dumuria (Khulna)

Intercultural operations such as irrigation, weeding and pest control were done properly. From the yield data a response curve was drawn and the relationship was found quadratic in nature in most cases. From the response curve fertilizer dose that maximized yield and profit were calculated.

Fertilizer dose for maximum yield was determined from the regression equation of yield by using the following formula:

Rate (for maximum yield) $= - b/2c$,

where, b and c= regression coefficients

Fertilizer dose that maximized profit was estimated from regression equation by using following formula:

Rate (for maximized profit) $= ½c\ (Pf \div Py - b)$

where, b and c are the estimates of the regression coefficients and Pf and Py are the prices of fertilizer and product, respectively.

Results and Discussion

Cropping pattern : Mustard -Boro - T.Aman
AEZ : Karatoya-Bagali Flood Plain (AEZ 4)
Location : MLT site, Gabtali, Bogra
Year : 2003-04 to 2005-06

Mustard

A considerable response of mustard to nitrogen was observed. Seed yield of Mustard increased markedly with the increase of nitrogen up to 90 kg/ha of N. After that level yield was tended to decline. But the rate of increase was higher up to 45 kg/ha of nitrogen. No significant yield increased was noticed due to application of P, K and S. However, yield increased very slowly up to the application of 26, 64 and 28 kg/ha of P, K and S, respectively.

Boro

Grain yield of Boro rice increased appreciably with the increase of N and the highest yield was recorded from 130 kg/ha and then tended to decrease. Response of crop to P was observed to some extent. Yield increased appreciably up to 14 kg P/ha and then slowly increased up to 28 kg/ha. But response to K and S was not very distinct. However, grain yield increased slowly up to 56 and 14 kg/ha of K and S, respectively.

T.Aman

Grain yield of T.Aman rice increased with the increase of N levels up to 86 kg/ha of N and then tended to decrease. But response to P, K, S was not very sharp. Grain yield increased up to 16, 72 and 12 kg/ha of P, K and S, respectively.

From the response curve a quadratic relationship was found and the nutrient dose that maximizes yield and profit was found out.

Crop	Fertilizer dose for maximized yield ($kg\ ha^{-1}$)				Fertilizer dose for maximized profit ($kg\ ha^{-1}$)			
	N	P	K	S	N	P	K	S
Mustard	98	25	60	28	90	20	55	20
Boro	140	22	60	28	130	15	50	14
T.Aman	86	20	50	12	80	12	40	12

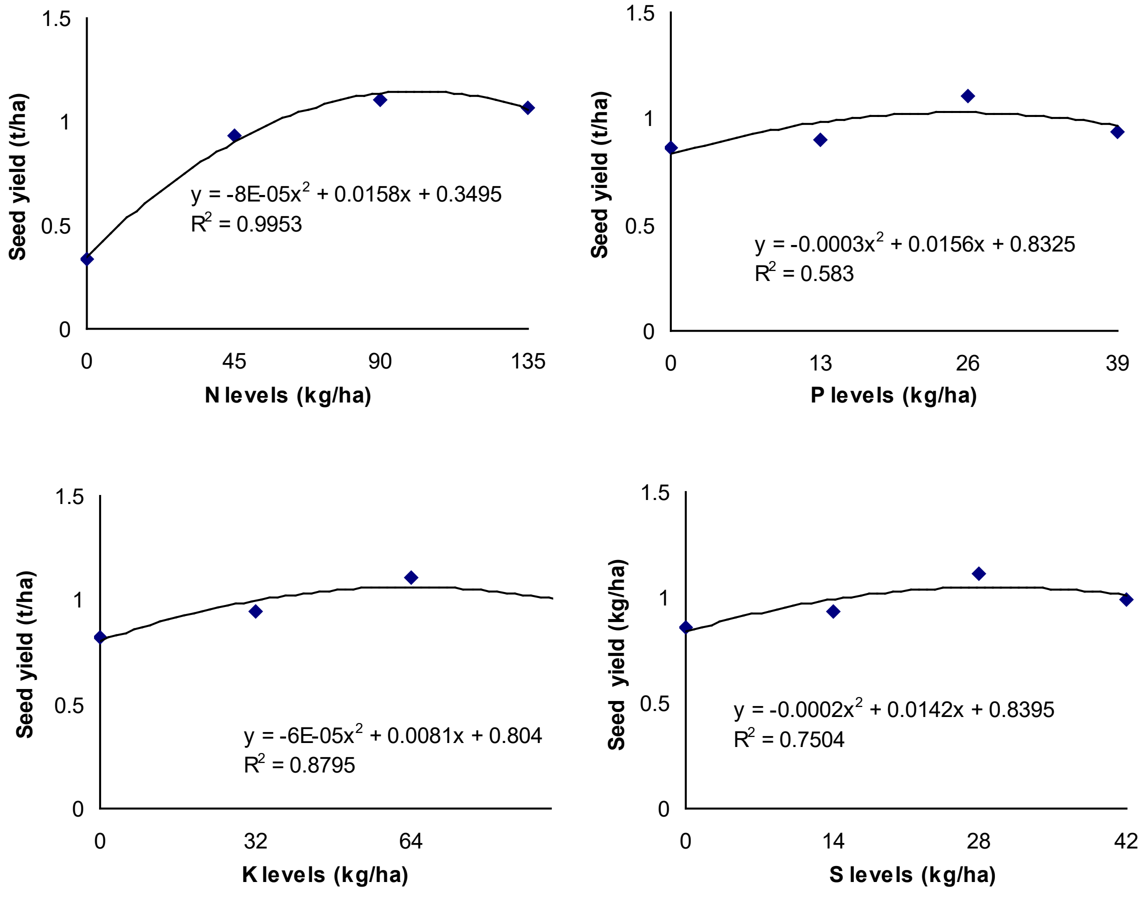


Figure 1. Response of Mustard grown in Mustard-Boro-T.Aman cropping pattern to added N, P, K & S at MLT site, Gabtali, Bogra during 2003-04 to 2005-06 (average)

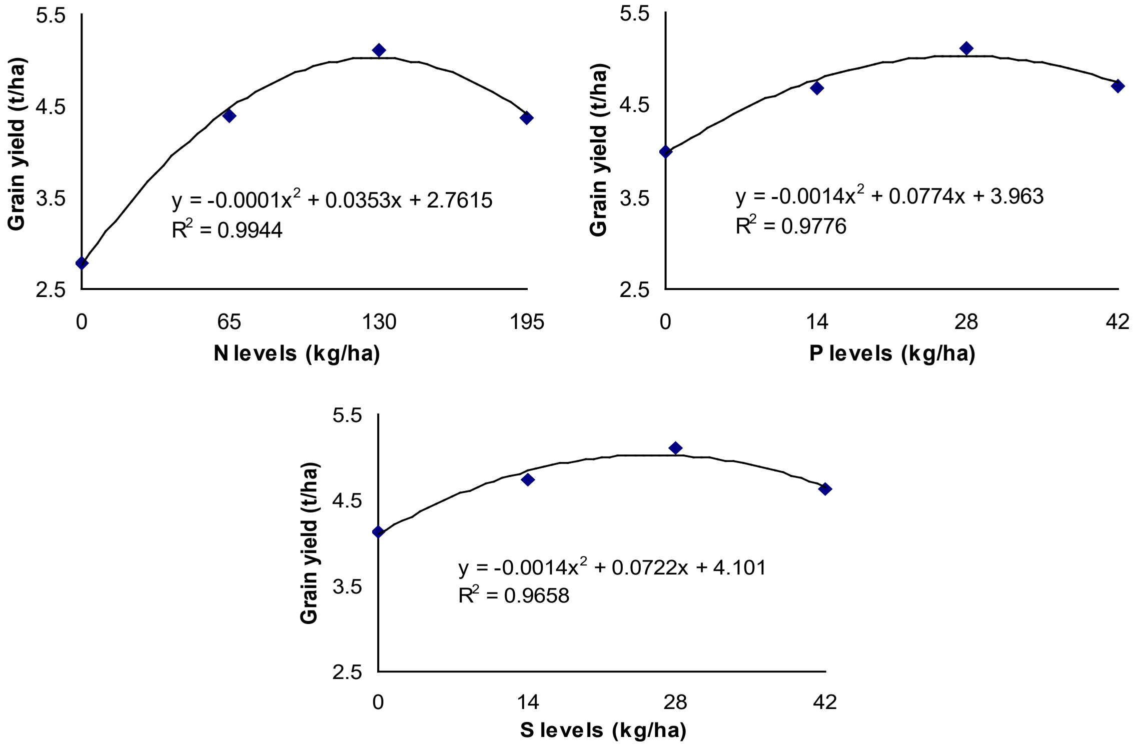


Figure 2. Response of Boro grown in Mustard-Boro-T.Aman cropping pattern to added N, P & K at Gabtali, Bogra during 2003-04 to 2005-06 (average)

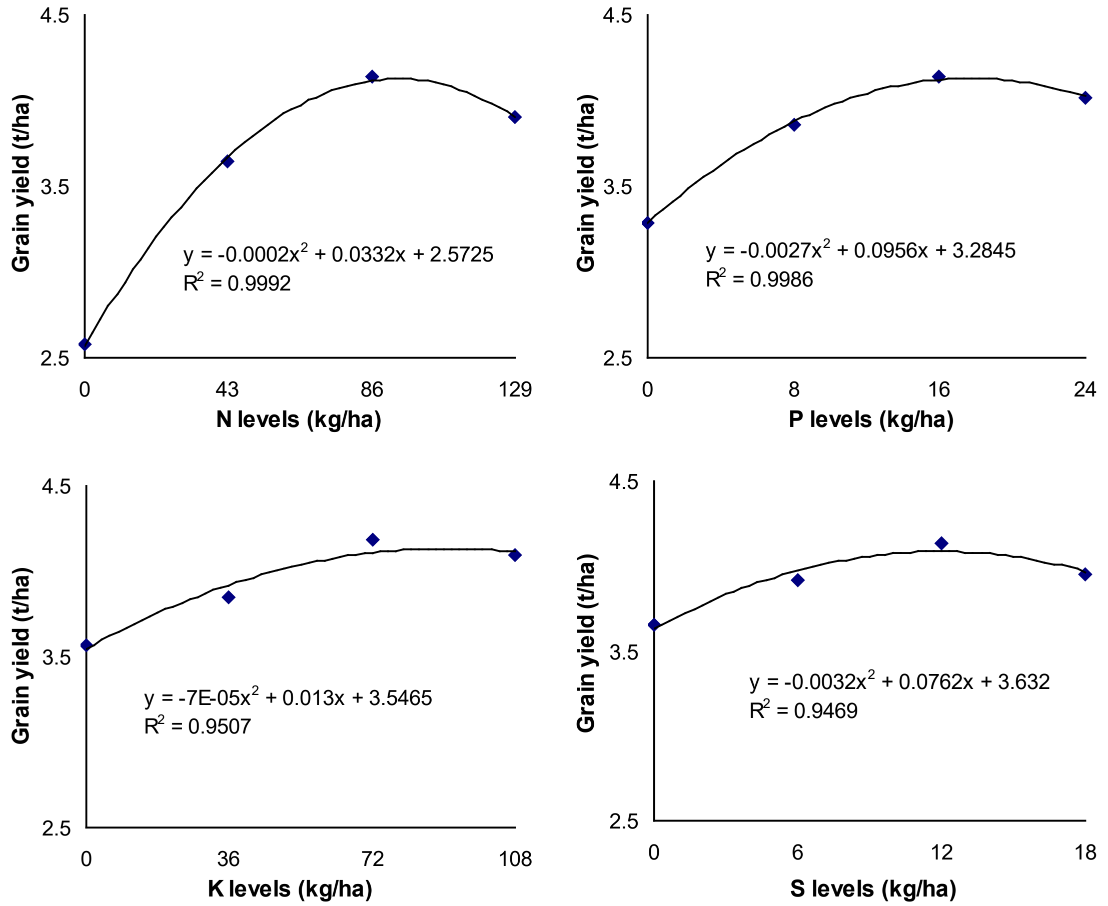


Figure 3. Response of T.Aman grown in Mustard-Boro-T.Aman cropping pattern to added N, P, K & S at Gabtali, Bogra during 2003-04 to 2005-06 (average)

Table 1. Effect of different level of fertilizer nutrients on the yield of crops in Mustard-Boro-T.Aman cropping pattern at MLT site, Gabtali, Bogra during 2003-04 to 2005-06

Mustard						Boro rice						T.Aman rice					
Nutrient level (kg/ha)		Seed yield (t/ha)				Nutrient level (kg/ha)		Grain yield (t ha^{-1})				Nutrient level (kg/ha)		Grain yield (t ha^{-1})			
		2003-04	2004-05	2005-06	Mean			2003-04	2004-05	2005-06	Mean			2003-04	2004-05	2005-06	Mean
N	0	0.39	0.30	0.35	0.35	N	0	2.97	2.61	3.08	2.88	N	0	2.40	2.76	2.69	2.62
	45	0.98	0.88	0.96	0.94		65	4.43	4.36	4.01	4.27		43	3.57	3.74	4.40	3.90
	90	1.10	1.13	1.19	1.14		130	4.94	5.29	4.53	4.92		86	4.02	4.26	5.39	4.56
	135	1.06	1.08	1.04	1.06		195	3.95	4.82	4.35	4.37		129	3.87	3.94	4.86	4.22
P	0	0.83	0.90	0.88	0.87	P	0	3.64	4.34	3.73	3.90	P	0	3.17	3.41	4.37	3.65
	13	0.85	0.95	0.98	0.93		14	4.35	5.03	4.21	4.53		8	3.59	4.14	5.25	4.33
	26	1.10	1.13	1.19	1.14		28	4.94	5.29	4.53	4.92		16	4.02	4.26	5.39	4.56
	39	0.91	0.97	1.03	0.94		42	4.25	5.17	4.32	4.58		24	4.00	4.05	5.26	4.44
K	0	0.85	0.80	0.83	0.83	K	0	4.15	4.27	3.82	4.08	K	0	3.37	3.77	4.51	3.88
	32	0.97	0.93	1.00	0.97		56	4.35	5.08	4.32	4.58		36	3.61	4.10	5.08	4.26
	64	1.10	1.13	1.19	1.14		112	4.94	5.29	4.53	4.92		72	4.02	4.35	5.39	4.56
	96	0.97	0.10	1.00	0.99		168	4.35	5.13	4.42	4.63		108	3.95	4.23	5.32	4.50
S	0	0.93	0.80	0.84	0.86	S	0	3.94	4.32	4.02	4.09	S	0	3.48	3.82	4.75	4.02
	14	0.99	0.87	1.02	0.96		14	4.42	5.09	4.50	4.67		6	3.75	4.10	5.06	4.30
	28	1.10	1.13	1.19	1.14		28	4.94	5.29	4.53	4.92		12	4.02	4.26	5.39	4.56
	42	1.03	0.96	1.03	1.01		42	4.08	5.18	4.43	4.56		18	3.85	4.06	4.98	4.30

Cropping pattern : Wheat - Jute- Mungbean
AEZ : High Ganges River Floodplain (AEZ 11)
Location : MLT site, Gangni, Khustia
Year : 2003-04 to 2005-06

Wheat: A considerable response of wheat to added nitrogen was observed. Grain yield increased appreciably with the increase of nitrogen level up to 100 kg/ha and after that tended to decline. Response to phosphorus was also found and yield increased considerably with the increase of phosphorus level up to 30 kg /ha. Similarly, potassium also showed positive response towards the yield of Wheat. Grain yield increased up to 40 kg/ha of potassium. More or less similar trend was found in both the years.

Jute: Fibre yield of Jute increased sharply up to the application of N @ 90 kg/ha and there after started to decline. Response of Jute to phosphorus was also observed to some extent. Fibre yield increased appreciably up to 10 kg/ha of P and after that level slowly increased up to 20 kg/ha of P.

Mungbean: Nitrogen was not included in the experiment as Mungbean is a legume crop. Response of Mungbean to added P was observed to some extent. Seed yield increased gradually up to 24 kg/ha of phosphorus.

From the response curve a quadratic relationship was found and the nutrient dose that maximizes yield and profit was found out.

Crop	Fertilizer dose for maximized yield (kg ha^{-1})			Fertilizer dose for maximized profit (kg ha^{-1})		
	N	P	K	N	P	K
Wheat	13	36	51	125	30	45
Jute	83	20	43	75	15	35
Mungbean	-	30	-	-	25	-

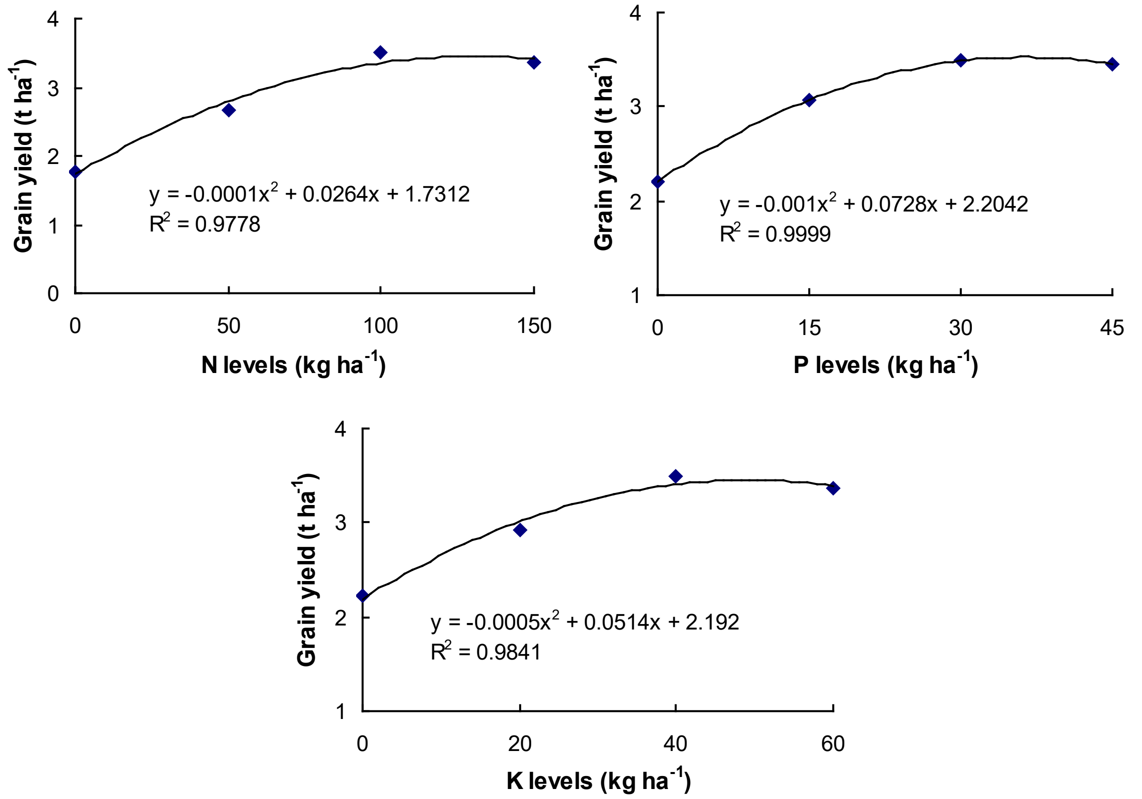


Figure 1. Response of Wheat grown in Wheat-Jute-Mungbean cropping pattern to added N, P & K at MLT site, Gangni, Kushtia during 2003-04 to 2005-06 (Avg. of 3 years)

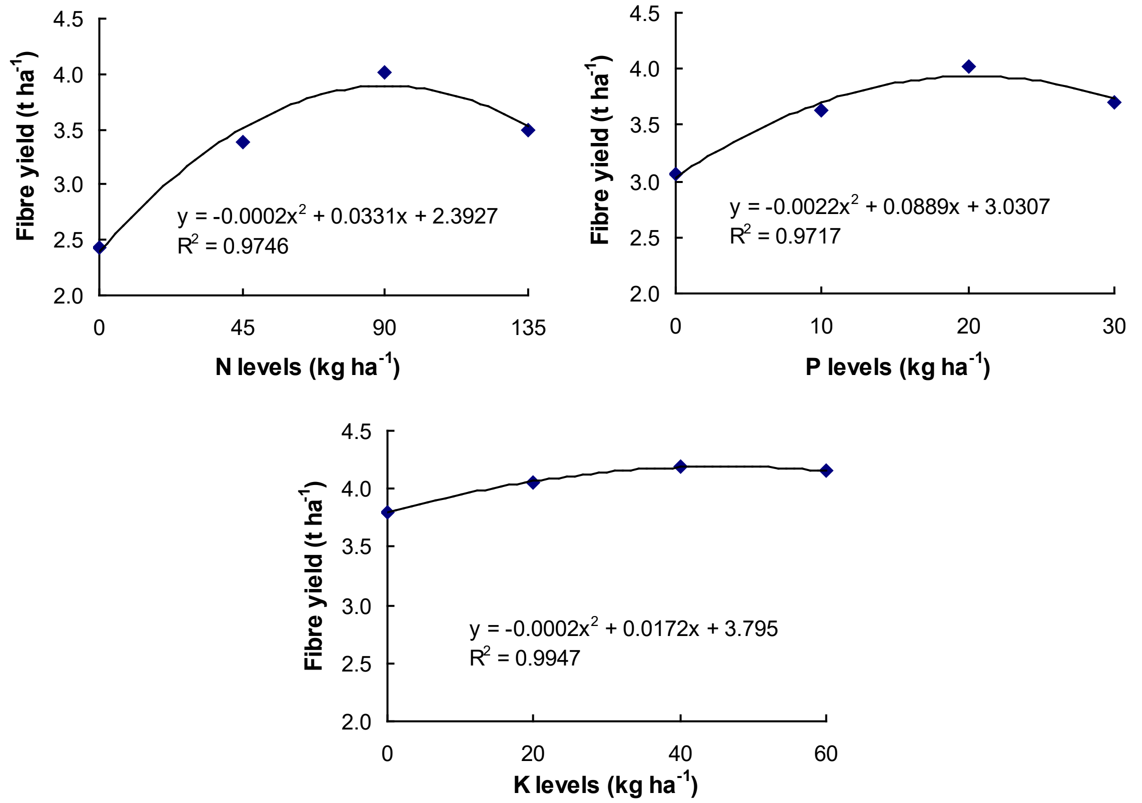


Figure 2. Response of Jute grown in Wheat-Jute-Mungbean cropping pattern to added N, P & K at MLT site, Gangni, Kushtia during 2003-04 to 2005-06 (Avg. of 3 years)

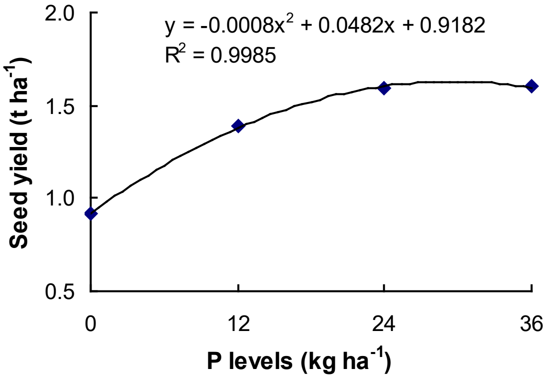


Figure 3. Response of Mungbean grown in Wheat-Jute-Mungbean cropping pattern to added P at MLT site, Gangni, Kushtia during 2003-04 to 2005-06 (Avg. of 3 years)

Table 1. Effect of different level of fertilizer nutrients on the yield of crops in Wheat-Jute-Mungbean cropping pattern at MLT site, Gangni, Kushtia during 2003-04 to 2005-06

Wheat					Jute					Mungbean				
Nutrient level (kg ha^{-1})	Grain yield (t/ha)				Nutrient level (kg ha^{-1})	Fibre yield (t ha^{-1})				Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})			
	2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean
N 0	1.93	1.96	1.44	1.78	N 0	2.08	2.01	3.21	2.43					
50	2.57	2.65	2.76	2.66	45	3.09	3.19	3.89	3.39					
100	3.40	3.45	3.63	3.49	90	3.90	3.94	4.20	4.01					
150	3.25	3.41	3.44	3.37	135	3.35	3.30	3.82	3.49					
P 0	2.09	2.15	2.38	2.20	P 0	2.82	2.77	3.58	3.05	P 0	0.91	0.89	0.94	0.91
15	3.05	3.10	3.04	3.06	10	2.57	3.50	3.80	3.62	12	1.48	1.61	1.09	1.39
30	3.40	3.45	3.63	3.49	20	3.90	3.94	4.20	4.01	24	1.82	1.78	1.17	1.59
45	3.34	3.50	3.50	3.45	30	3.15	3.25	4.10	3.50	36	1.76	1.78	1.20	1.56

Cropping pattern : Potato -Boro - T.Aman
AEZ : Level Barind Tract (AEZ 25)
Location : MLT site, Joypurhat
Year : 2003-04 to 2005-06

Potato: A considerable response of potato to added nitrogen was observed. Tuber yield increased appreciably with the increase of nitrogen up to 134 kg/ha of N. After that level tuber yield tended to decrease. Similarly, P and K showed a positive response towards the yield of potato. Tuber yield increased considerably up to 22 and 24 kg/ha of P and S. Regarding K yield increased appreciably up to 168 kg/ha of K and after that level yield also increased but the rate of increment was slow. The highest yield was found in highest level of K. Initial status of the soil showed that N and P were low, K and S were very low. Therefore, a considerable response of potato to added nutrients was found.

Boro: Grain yield of Boro rice increased appreciably with the increase of N and the rate of increment was higher up to 67 kg/ha of nitrogen. However, grain yield gradually increased up to 134 kg/ha and then tended to decrease. But response to P, K and S was not very evident. Grain yield increased slowly up to 18, 114 and 30 kg/ha of P, K and S, respectively.

T.Aman: Response of T.Aman rice to added nitrogen was observed to some extent. Grain yield increased appreciably up to 44 kg/ha of N and after that slightly increased up to 88 kg/ha. But response to P, K and S was not very sharp. However, grain yield increased up to 16, 72 and 16 kg/ha of P, K and S, respectively, but the rate of increment was very slow. More or less similar trend was found over the years.

From the response curve a quadratic relationship was found and the nutrient dose that maximizes yield and profit was ascertained.

Crop	Fertilizer dose for maximized yield (kg ha^{-1})				Fertilizer dose for maximized profit (kg ha^{-1})			
	N	P	K	S	N	P	K	S
Potato	130	24	172	21	125	22	150	15
Boro	120	18	80	30	115	15	70	20
T.Aman	90	16	70	20	85	12	60	15

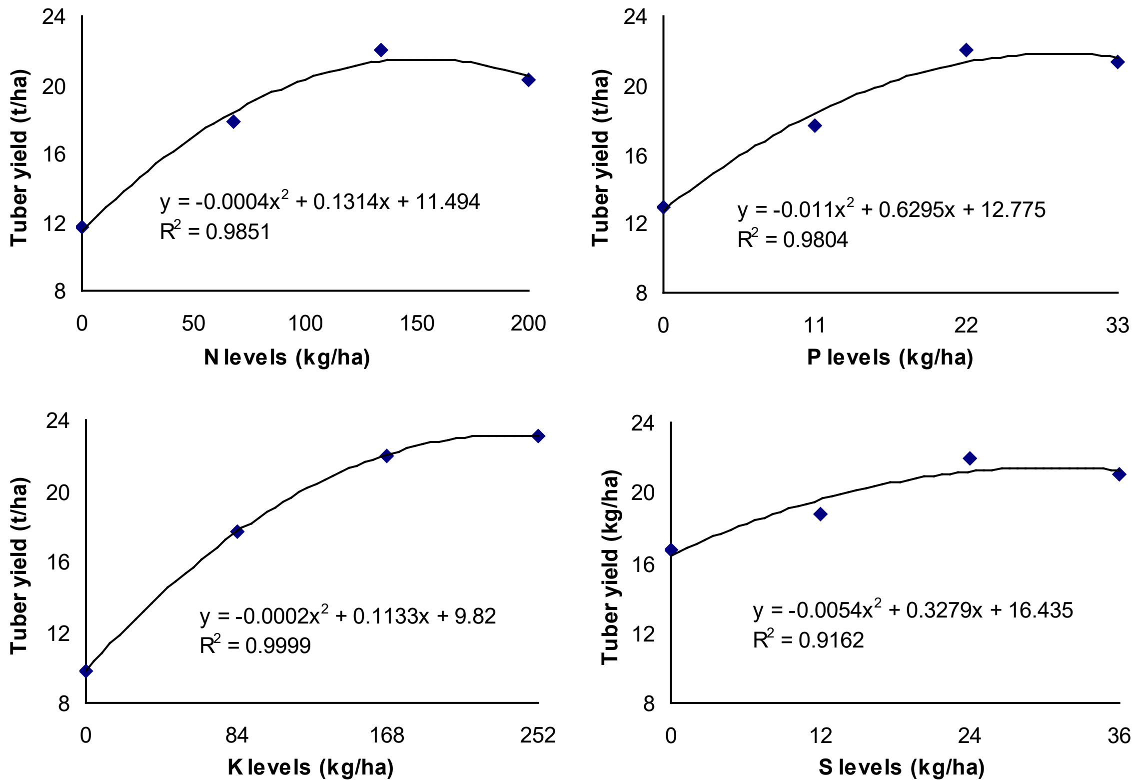


Figure 1. Response of Potato grown in Potato-Boro-T.Aman rice cropping pattern to added N, P, K & S at MLT site, Joypurhat during 2003-04 to 2005-06 (average)

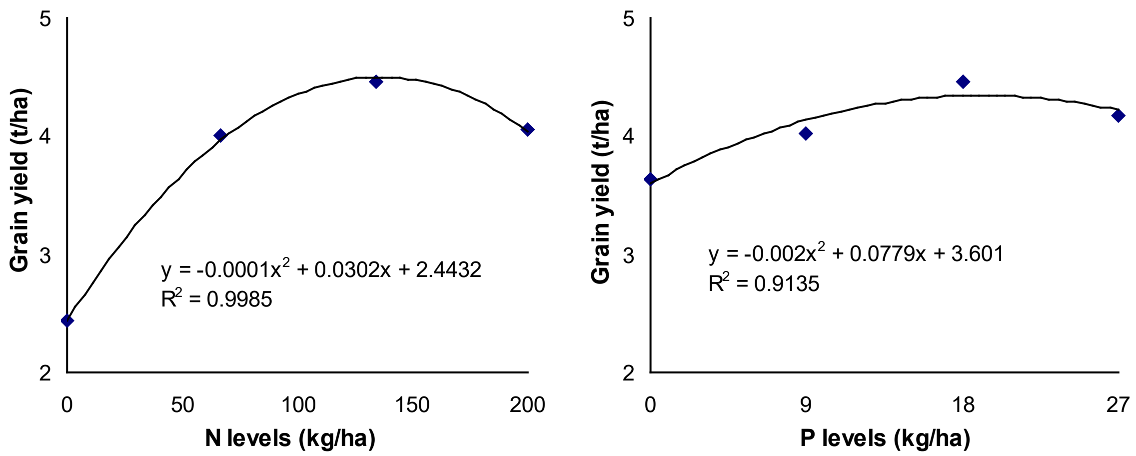


Figure 2. Response of Boro grown in Potato-Boro-T.Aman rice cropping pattern to added N & P at MLT site, Joypurhat during 2003-04 to 2005-06 (average)

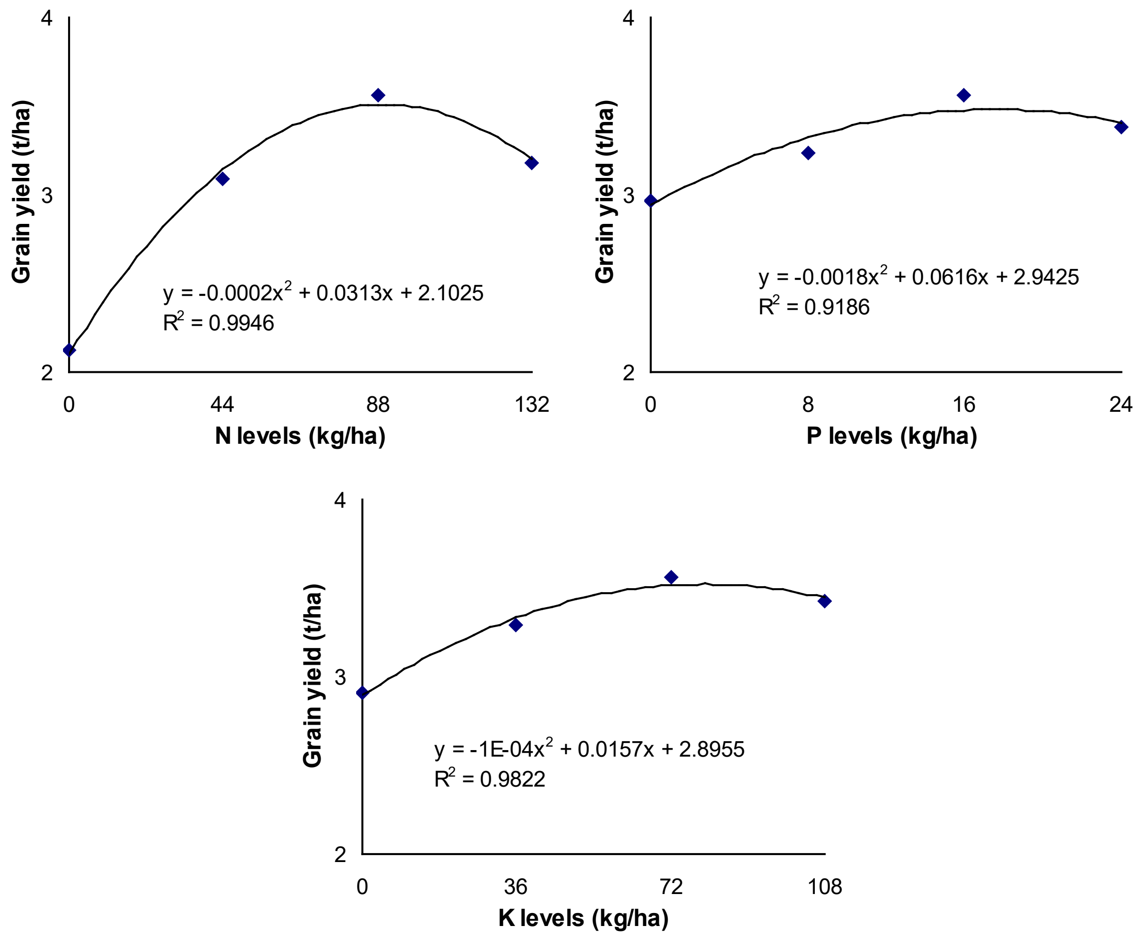


Figure 3. Response of T.Aman grown in Potato-Boro-T.Aman rice cropping pattern to added N, P & K at MLT site, Joypurhat during 2003-04 to 2005-06 (average)

Table 1. Effect of different level of fertilizer nutrients on the yield of crops in Potato-Boro-T.Aman cropping pattern at MLT site, Joypurhat during 2002-03 to 2005-06

Potato					Boro rice					T.Aman rice				
Nutrient level (kg ha^{-1})	Tuber yield (t/ha)				Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})				Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})			
	2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean
N 0	12.2	11.2	11.0	11.5	N 0	2.32	2.55	3.04	2.64	N 0	2.09	2.16	2.64	2.30
68	18.7	17.0	15.9	17.2	67	3.98	4.05	3.40	3.81	44	3.05	3.13	3.10	3.09
134	23.1	21.0	18.2	20.8	134	4.28	4.64	3.81	4.24	88	3.57	3.55	3.36	3.49
200	21.9	18.7	16.7	19.1	200	3.94	4.18	3.57	3.90	132	3.29	3.07	3.03	3.13
P 0	13.8	12.3	11.3	12.5	P 0	3.72	3.56	2.91	3.40	P 0	3.02	2.91	2.80	2.91
11	17.5	18.0	16.8	17.4	9	4.00	4.04	3.52	3.85	8	3.30	3.18	3.20	3.23
22	23.1	21.0	18.2	20.8	18	4.28	4.64	3.81	4.24	16	3.57	3.55	3.36	3.49
33	22.9	19.9	17.6	20.1	27	4.12	4.24	3.62	3.99	24	3.34	3.41	3.34	3.36
K 0	10.4	9.2	8.8	9.5	K 0	3.91	3.74	2.67	3.44	K 0	2.95	2.87	2.81	2.88
84	17.4	18.1	17.2	17.6	57	4.18	4.27	3.70	4.05	36	3.37	3.21	3.18	3.25
168	23.1	21.0	18.2	20.8	114	4.28	4.64	3.81	4.24	72	3.57	3.55	3.36	3.49
252	24.3	22.0	19.7	22.0	170	4.22	4.33	3.47	4.01	108	3.57	3.29	3.23	3.36
S 0	17.0	16.4	16.1	16.5	S 0	4.10	4.02	3.45	3.86	S 0	3.26	3.08	3.15	3.16
12	18.9	18.7	17.1	18.2	15	4.17	4.17	3.74	4.03	8	3.33	3.22	3.19	3.25
24	23.1	21.0	18.2	20.8	30	4.28	4.64	3.81	4.24	16	3.57	3.55	3.36	3.49
36	21.7	20.4	17.8	19.9	45	4.23	4.09	3.60	3.97	24	3.42	3.27	3.17	3.29

Cropping pattern : Potato –T.Aus - T.Aman
AEZ : Old Brahmaputra Flood Plain (AEZ 9)
Location : MLT site, Kishoreganj
Year : 2003-04 to 2005-06

Potato: Response of potato to added nutrients was observed. Tuber yield of potato increased markedly with the increase of nitrogen up to 120 kg ha^{-1} of N and after that yield level tended to decrease. But the response was very sharp up to 60 kg ha^{-1} of nitrogen. As the soil was deficit in N and therefore response to added nitrogen was evident in the tuber yield of potato. Similarly, in case of P, K and S a positive response was also found towards the yield. Tuber yield increased up to the application of 30, 90 and 20 kg ha^{-1} of P, K and S, respectively.

T. Aus: Grain yield increased markedly with the increase of N and the highest yield was obtained from the application of 90 kgha^{-1} of N (Figure 2). Similarly, a positive response to P, K and S was found. Yield increased sharply up to 18, 45 and 14 kgha^{-1} of P, K and S, respectively. After that rate of yield increment was slow.

T.Aman: Grain yield increased up to 90, 18, 45 and 14 kg ha^{-1} of N, P, K and S respectively. After that rate of yield increment was slow. Response of all nutrients was found a quadratic relationship that maximizes the yield up to certain dose.

From the response curve a quadratic relationship was found and the nutrient dose that maximizes yield and profit was found out.

Crop	Fertilizer dose for maximized yield (kg ha-1)				Fertilizer dose for maximized profit (kg ha-1)			
	N	P	K	S	N	P	K	S
Potato	121	33	104	18	98	31	79	17
T. Aus	80	18	35	12	78	16	31	11
T.Aman	81	17	47	12	78	14	35	12

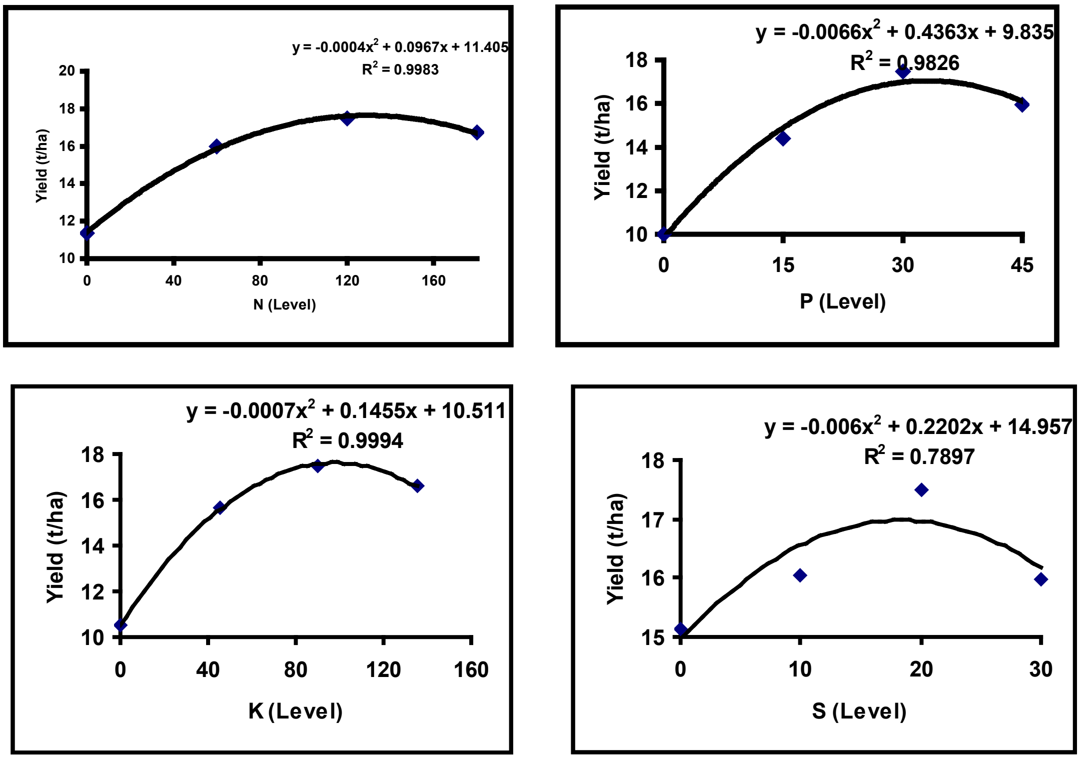


Figure 1. Response of Potato grown in Potato-T.aus-T.aman cropping pattern to added N,P,K and S at MLT site, Kishoregonj Sadar during 2003-04 to 2005-06 (average)

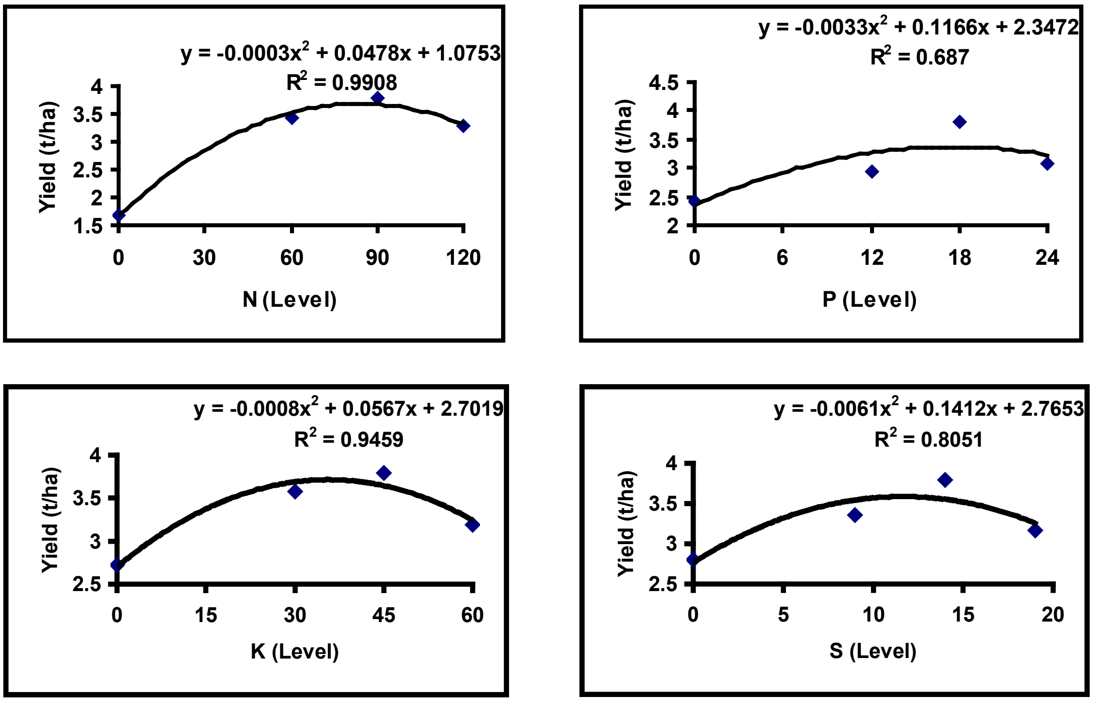


Figure 2. Response of T.aus grown in Potato-T.aus-T.aman cropping pattern to added N,P,K and S at MLT site, Kishoregonj Sadar during 2003-04 to 2005-06 (average)

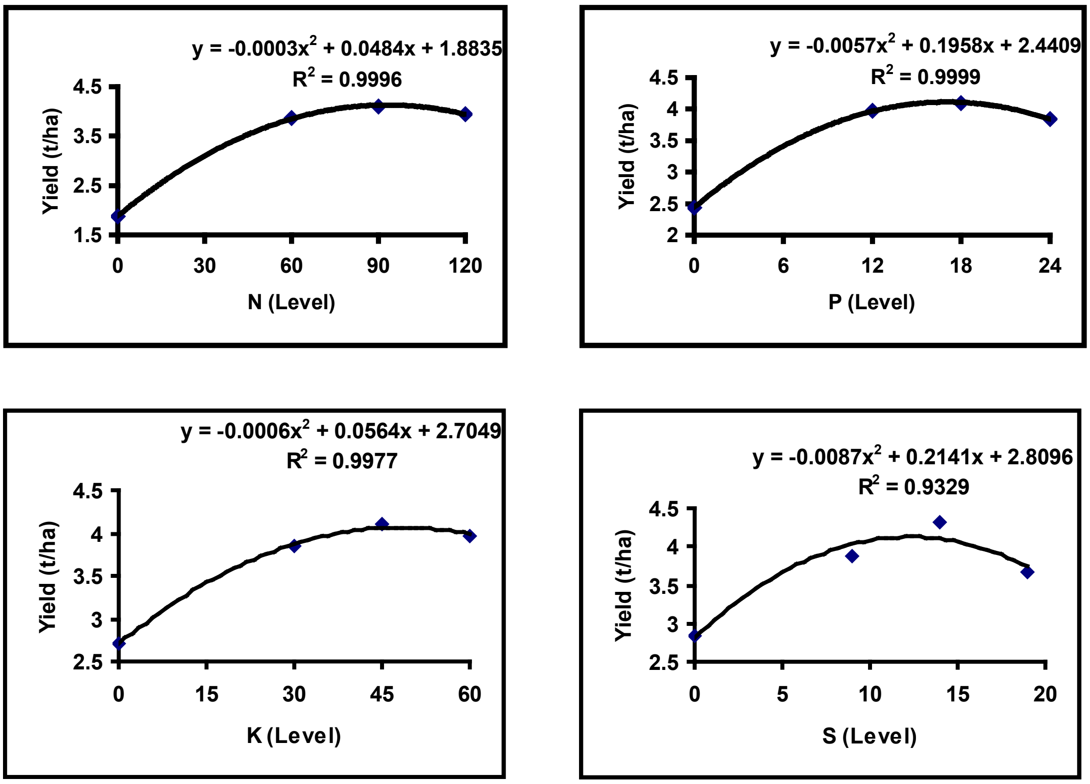


Figure 3. Response of T.aman grown in Potato-T.aus-T.aman cropping pattern to added N, P, K and S at MLT site, Kishoregonj Sadar during 2003-04 to 2005-06 (average)

Table 1. Effect of different levels of nutrients on the yield of crops grown in Potato-T.aus-T.aman rice cropping pattern at MLT site, Kishoregonj sadar, 2003-04 to -2005-06.

Potato					T.Aus rice					T.Aman rice				
Nutrient level (kg ha^{-1})	Tuber yield (t/ha)				Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})				Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})			
	2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean
N 0	10.43	11.66	11.99	11.36	N 0	1.58	1.70	1.78	1.69	N 0	1.84	1.86	1.93	1.88
60	13.40	17.53	17.04	15.99	60	3.39	3.51	3.38	3.43	60	3.97	3.89	3.76	3.87
120	16.21	18.66	17.58	17.48	90	3.68	3.80	3.88	3.79	90	4.18	4.09	4.04	4.10
180	13.54	17.50	16.12	16.72	120	3.17	3.27	3.37	3.27	120	4.05	4.03	3.78	3.95
P 0	8.28	11.68	10.04	10.00	P 0	2.49	2.36	2.36	2.40	P 0	2.41	2.33	2.57	2.44
15	10.54	16.63	16.02	14.40	12	3.20	2.75	2.89	2.95	12	3.87	4.26	3.79	3.97
30	16.21	18.66	17.58	17.48	18	3.68	3.80	3.88	3.79	18	4.18	4.09	4.04	4.10
45	14.61	17.13	16.09	15.94	24	3.25	2.95	2.94	3.07	24	3.67	3.96	3.90	3.84
K 0	9.23	10.88	11.33	10.48	K 0	2.87	2.68	2.61	2.72	K 0	2.80	2.69	2.65	2.71
45	13.67	16.96	16.28	15.64	30	3.39	3.68	3.67	3.58	30	4.06	3.79	3.67	3.84
90	16.21	18.66	17.58	17.48	45	3.68	3.80	3.88	3.79	45	4.18	4.09	4.04	4.10
135	15.50	17.70	16.62	16.61	60	3.14	3.14	3.30	3.19	60	4.00	4.06	3.85	3.97
S 0	14.26	15.86	15.26	15.13	S 0	2.76	2.81	2.84	2.80	S 0	2.97	2.93	2.63	2.84
10	15.21	16.66	16.24	16.04	9	3.33	3.31	3.43	3.36	9	3.81	3.84	3.95	3.87
20	16.21	18.66	17.58	17.48	14	3.68	3.80	3.88	3.79	14	4.81	4.09	4.04	4.31
30	15.96	16.16	15.86	15.99	19	3.16	3.21	3.15	3.17	19	3.70	3.59	3.70	3.66

CP : Potato-Jute-T.Aman rice
AEZ : High Ganges River Floodplain (AEZ 11)
Location : MLT site, Paba, Rajshahi
Year : 2003-04 to 2005-06

Potato: A considerable response of potato to nitrogen was observed. Tuber yield of potato was increased markedly with increase of nitrogen up to 80 kg N/ha and after that level yield also found increasing but at a slower rate up to 160 kg N ha^{-1}. Response of potato to P and K was also observed to some extent. Yield increased up to 20 and 60 kg ha^{-1} of P and K, respectively. But response to S was not evident.

Jute: Fibre yield of Jute increase markedly with the increase of N up to 50 kg/ha and after that yield slowly increased up to 100 kg N ha^{-1}. But response of Jute to P, K & S was not very evident.

T.Aman: Grain yield of T.Aman rice increased sharply with the increase of N levels up to 65 kg N ha^{-1} and than the rate of increment was slow but yield increased up to 130 kg N ha^{-1}. But response of T.Aman to P, K & S was not very evident. The soil of the experimental field was rich with nutrients. Except nitrogen other nutrients status were medium to high, Therefore, response of crops to added P, K and S was not found.

From the response curve, the following doses of the nutrients were found as optimum for different crops.

Crop	Fertilizer dose that maximized yield (kg ha^{-1})				Fertilizer dose that maximized profit (kg ha^{-1})			
	N	P	K	S	N	P	K	S
Potato	133	21	57	19	120	18	50	13
Jute	109	25	67	18	95	20	55	12
T.Aman	135	15	37	21	120	12	30	15

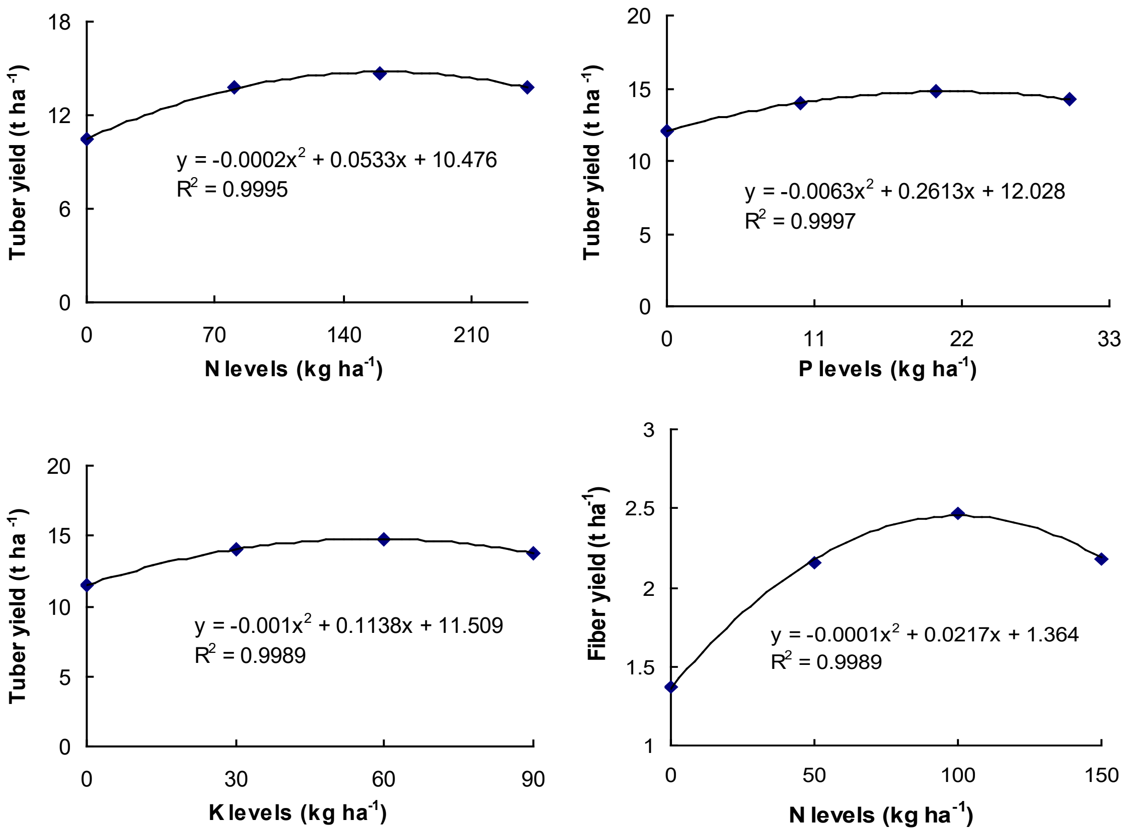


Figure 1. Response of Potato and Jute grown in Potato-Jute-T.Aman cropping pattern to added N (Jute to N only), P & K at MLT site, Paba, Rajshahi during 2003-04 to 2005-06 (average).

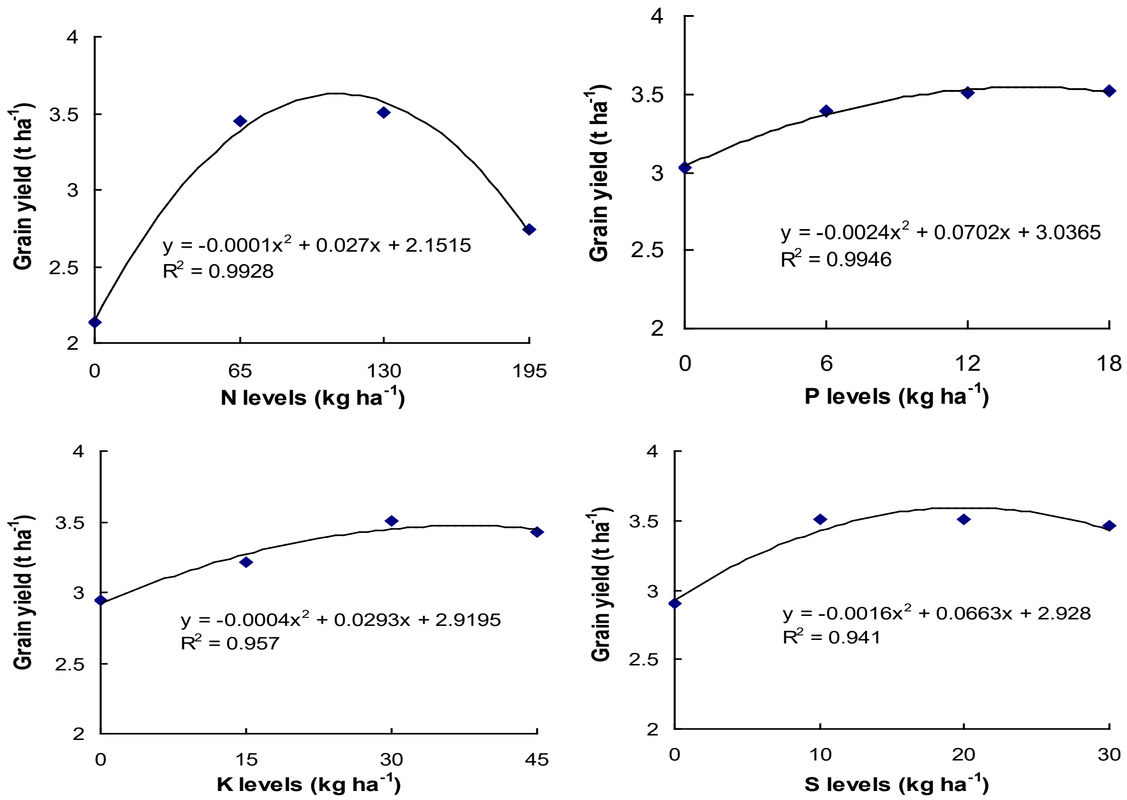


Figure 2. Response of T.aman grown in Potato-Jute-T.Aman cropping pattern to added N, P, K & S at MLT site, Paba, Rajshahi during 2003-04 to 2005-06 (average).

Table 1. Effect of different levels of fertilizer nutrients on the yield of crops in Potato-Jute-T.Aman cropping pattern at MLT site, Paba, Rajshahi during 2003-04 to 2004-05 (average)

Potato		Jute		T.Aman	
Nutrient level (kg ha^{-1})	Tuber yield (t ha^{-1})	Nutrient level (kg ha^{-1})	Fibre yield (t ha^{-1})	Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})
N 0	10.46	N 0	1.37	N 0	2.13
80	13.73	50	2.16	65	3.45
160	14.73	100	2.47	130	3.51
240	13.77	150	2.18	195	2.74
P 0	12.02	P 0	2.09	P 0	3.03
10	14.04	6	2.37	6	3.39
20	14.73	12	2.47	12	3.51
30	14.25	18	2.41	18	3.52
K 0	11.49	K 0	2.15	K 0	2.94
30	14.09	22	2.36	15	3.21
60	14.73	44	2.47	30	3.51
90	13.78	66	2.41	45	3.43
S 0	13.38	S 0	2.11	S 0	2.9
10	13.87	10	2.33	10	3.51
20	14.73	20	2.47	20	3.51
30	13.92	30	2.30	30	3.46

CP : Potato-Mungbean-T.Aman rice
AEZ : High Ganges River Floodplain (AEZ 11)
Location : FSRD site, Bagherpara, Jessore
Year : 2005-06

Potato: Response of Potato to nitrogen was observed to some extent. Tuber yield increased appreciably with the increase of nitrogen up to140 kg/ha and then trended to decline. Response to P and S was not observed. Response to K was observed markedly. Yield increased up to the application of 75 kg/ha of K.

Mungbean: No considerable response of Mungbean to added P and K was found. However, seed yield increased slowly up to 16, and 12 and 8 kg/ha of P, K and S, respectively. But a marked response was observed in N level. Yield increased up to the application of 28 kg/ha of N.

T.Aman: Response of T.Aman rice to nitrogen was observed to some extent. Grain yield increased appreciably with the increase of N up to 50 kg/ha of N and after that level yield increased slowly up to 100 kg/ha. But response to added phosphorus was observed. Response to K and S was not observed at all.

From the response curve, the following doses of the nutrients were found as optimum for different crops.

Crop	Fertilizer dose that maximized yield (kg ha^{-1})				Fertilizer dose that maximized profit (kg ha^{-1})			
	N	P	K	S	N	P	K	S
Potato	151	32	66	7	146	29	61	5
Mungbean	27	14	10	6	21	12	8	4
T.aman	115	15	25	8	100	13	22	6

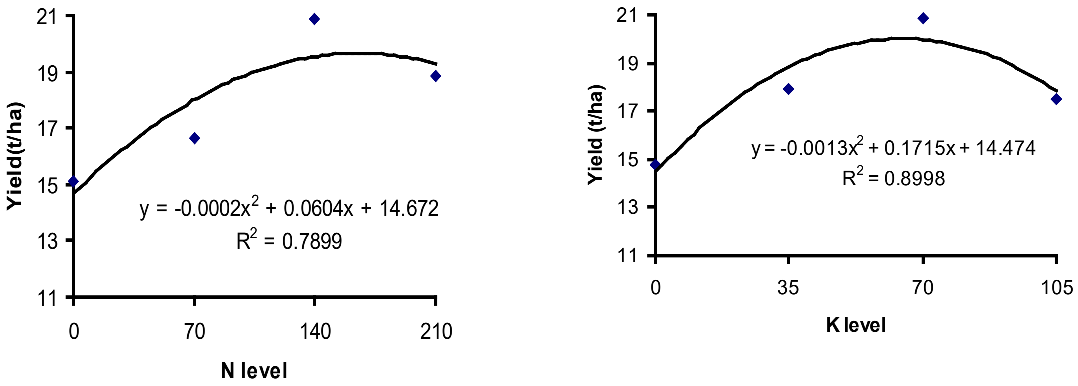


Figure 1. Response of Potato grown in Potato-Mungbean-T.Aman rice cropping pattern to N and P at FSRD site, Bagherpara, Jessore during 2005-06

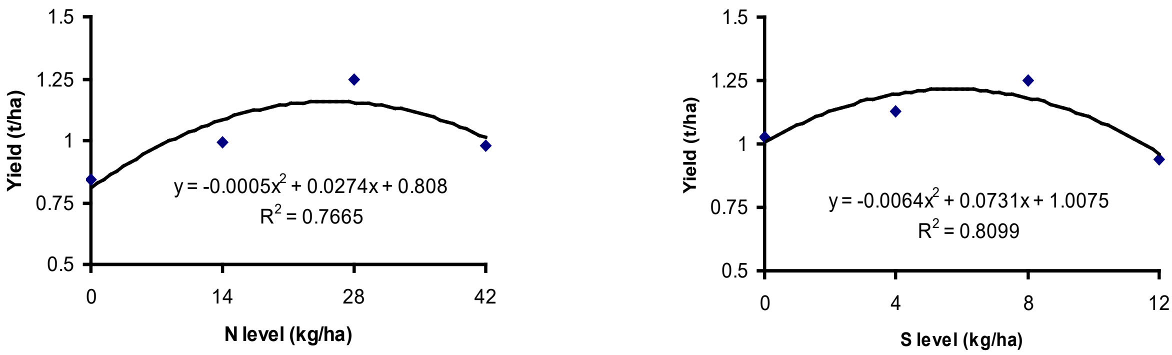


Figure 2. Response of Mungbean grown in Potato-Mungbean-T.Aman rice cropping pattern to N and S at FSRD site, Bagherpara, Jessore during 2005-06

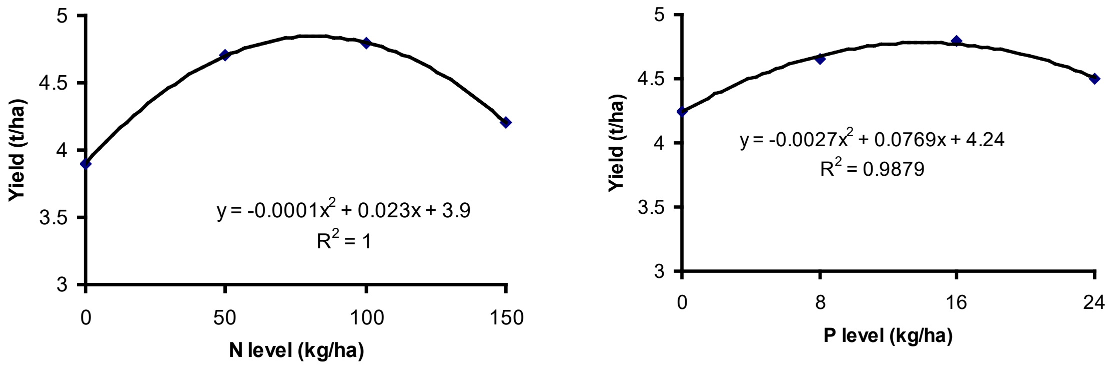


Figure 3. Response of T.Aman grown in Potato-Mungbean-T.Aman rice cropping pattern to N and P at FSRD site, Bagherpara, Jessore during 2005-06

Table 1. Effect of different levels of fertilizer nutrients on the yield of crops in Potato-Mungbean-T.Aman cropping pattern at FSRD site, Bagherpar, Jessore during 200-06

Potato			Mungbean			T.Aman		
Nutrient level ($kg\ ha^{-1}$)		Tuber yield ($t\ ha^{-1}$)	Nutrient level ($kg\ ha^{-1}$)		Grain yield ($t\ ha^{-1}$)	Nutrient level ($kg\ ha^{-1}$)		Grain yield ($t\ ha^{-1}$)
N	0	15.12	N	0	0.84	N	0	3.90
	70	16.66		14	0.99		50	4.70
	140	20.89		28	1.25		100	4.80
	210	18.89		42	0.98		150	4.20
P	0	17.79	P	0	0.90	P	0	4.25
	15	17.85		8	0.91		8	4.65
	30	20.89		16	1.25		16	4.80
	45	18.86		24	0.94		24	4.50
K	0	14.78	K	0	1.11	K	0	4.61
	35	17.93		6	1.12		12	4.35
	75	20.89		12	1.25		24	4.80
	105	17.53		18	1.10		36	4.64
S	0	18.48	S	0	1.03	S	0	4.20
	5	18.27		4	1.13		4	4.30
	10	20.89		8	1.25		8	4.80
	15	16.89		12	0.94		12	4.40

Cropping pattern : Lentil-Jute - T.Aman rice
AEZ : High Ganges River Floodplain (AEZ 11)
Location : MLT site, Magura
Year : 2005-06

Lentil: Though lentil is legume crop but response of lentil to nitrogen was observed to some extent. Seed yield increased appreciably up to16 kg/ha of N and then tended to decline. Similarly, response to phosphorus and sulphur was found to some extent. Seed yield increased gradually up to 28 and 6 kg/ha of P and S, respectively and after that started to decline slowly.

Jute: A considerable response of jute to N, P and S was found. Fibre yield increased with the increase of nutrients levels. Fiber yield of jute increased sharply up to 90 kg/ha of N. Similarly, yield increased appreciably up to 24 and 30 kg/ha of P and K, respectively. Response to S was not found.

T.Aman: Response of T.Aman rice to nitrogen and phosphorus was also observed to some extent. Grain yield increased with the increase of N and P level up to 80 and 20 kg/ha of N and P. Initially the soil was deficit in nitrogen and phosphorus and a considerable response was found towards the yield. From the response curve, the following doses of the nutrients were found as optimum for different crops

Crop	Fertilizer dose that maximized yield ($kg\ ha^{-1}$)				Fertilizer dose that maximized profit ($kg\ ha^{-1}$)			
	N	P	K	S	N	P	K	S
Lentil	14	29	10	6	12	25	8	5
Jute	72	20	25	7	65	18	22	6
T.Aman	100	18	10	5	92	16	8	4

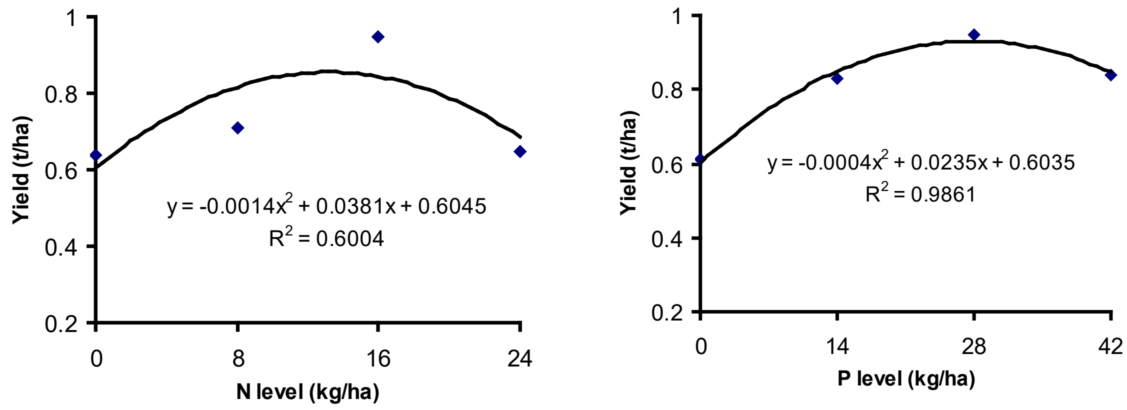


Figure 1. Response of Lentil grown in Lentil-Jute-T.Aman rice cropping pattern to N and P at MLT site, Magura during 2005-06

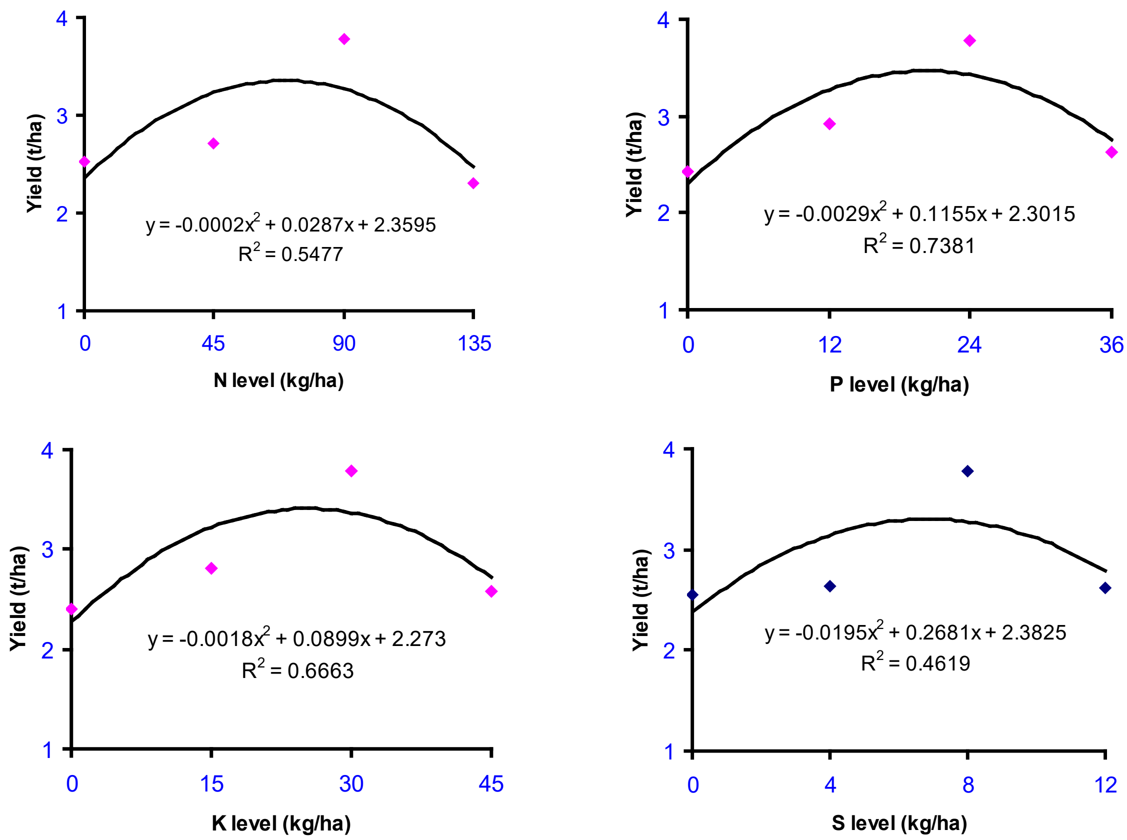
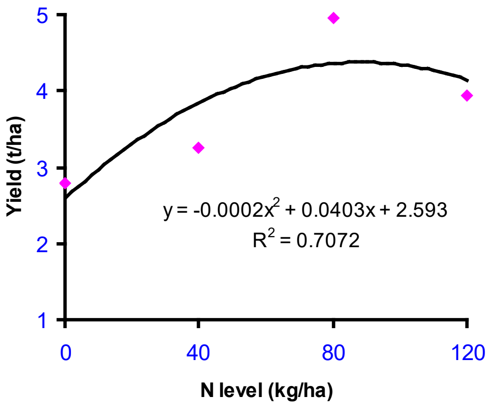


Figure 2. Response of Jute grown in Lentil-Jute-T.Aman rice cropping pattern to N, P, K and S at MLT site, Magura during 2005-06



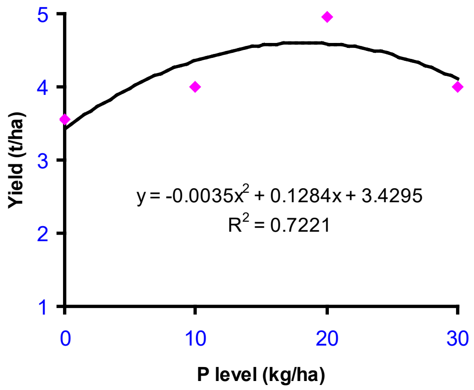


Figure 3. Response of T.Aman grown in Lentil-Jute-T.Aman rice cropping pattern to N and P at MLT site, Magura during 2005-06

Table 1. Effect of different levels of fertilizer nutrients on the yield of crops in Lentil-Jute-T.Aman cropping pattern at MLT site, Magura during 2005-06

Lentil			Jute			T.Aman		
Nutrient level ($kg\ ha^{-1}$)		Grain yield ($t\ ha^{-1}$)	Nutrient level ($kg\ ha^{-1}$)		Fibre yield ($t\ ha^{-1}$)	Nutrient level ($kg\ ha^{-1}$)		Grain yield ($t\ ha^{-1}$)
N	0	0.64	N	0	2.53	N	0	2.79
	8	0.71		45	2.72		40	3.25
	16	0.95		90	3.78		80	4.95
	24	0.65		135	2.30		120	3.95
P	0	0.61	P	0	2.42	P	0	3.55
	14	0.83		12	2.92		10	4.00
	28	0.95		24	3.78		20	4.95
	42	0.84		36	2.63		30	3.99
K	0	0.73	K	0	2.41	K	0	3.62
	6	0.74		15	2.81		5	3.73
	12	0.95		30	3.78		10	4.95
	18	0.73		45	2.58		15	4.05
S	0	0.75	S	0	2.55	S	0	3.55
	3	0.79		4	2.64		3	3.75
	6	0.95		8	3.78		6	4.95
	9	0.85		12	2.62		9	3.65

Cropping pattern : Lentil-Jute - T.Aman rice
AEZ : High Ganges River Floodplain (AEZ 11)
Location : MLT site, Keshabpur, Jessore
Year : 2005-06

Lentil: Response of Lentil to nitrogen and potassium was found some extent. Similarly response to P was not observed at all. Sulphur was not included lentil.

Jute: Although response of Jute to nitrogen, phosphorus and potassium was found to some extent but fibre yield of Jute increased with the increase of 80, 20 and 60 kg/ha of N, P and K, respectively. Sulphur was not included jute.

T.Aman: Grain yield increased appreciably with the increase of N, P, K and S level up to 70, 14, 32 and 2 kg/ha of K and S, respectively. But response to K and S was not prominent.

From the response curve, the following doses of the nutrients were found as optimum for different crops

Crop	Fertilizer dose that maximized yield (kg ha^{-1})				Fertilizer dose that maximized profit (kg ha^{-1})			
	N	P	K	S	N	P	K	S
Lentil	18	21	25	-	16	19	22	-
Jute	69	18	72	-	65	16	68	-
T.Aman	67	13	34	2	63	11	30	1

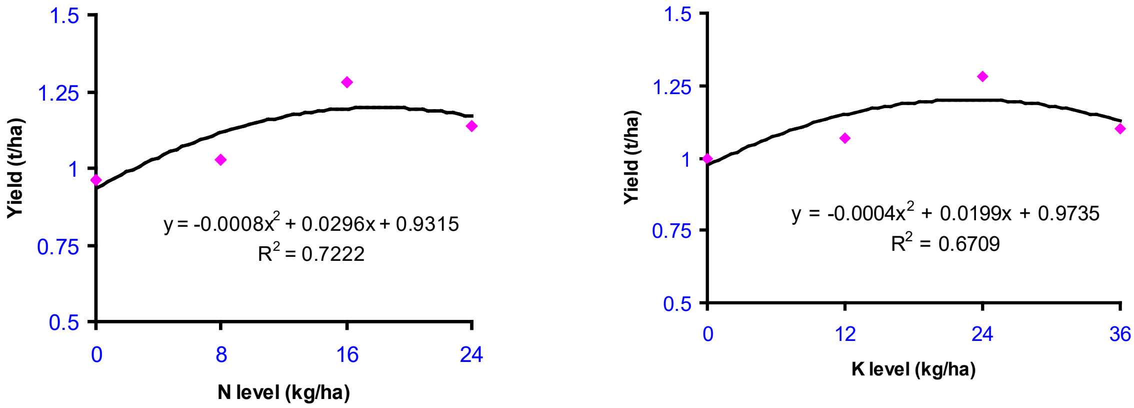


Figure 1. Response of Lentil grown in Lentil-Jute-T.Aman rice cropping pattern to N and K at MLT site, Keshabpur, Jessore during 2005-06

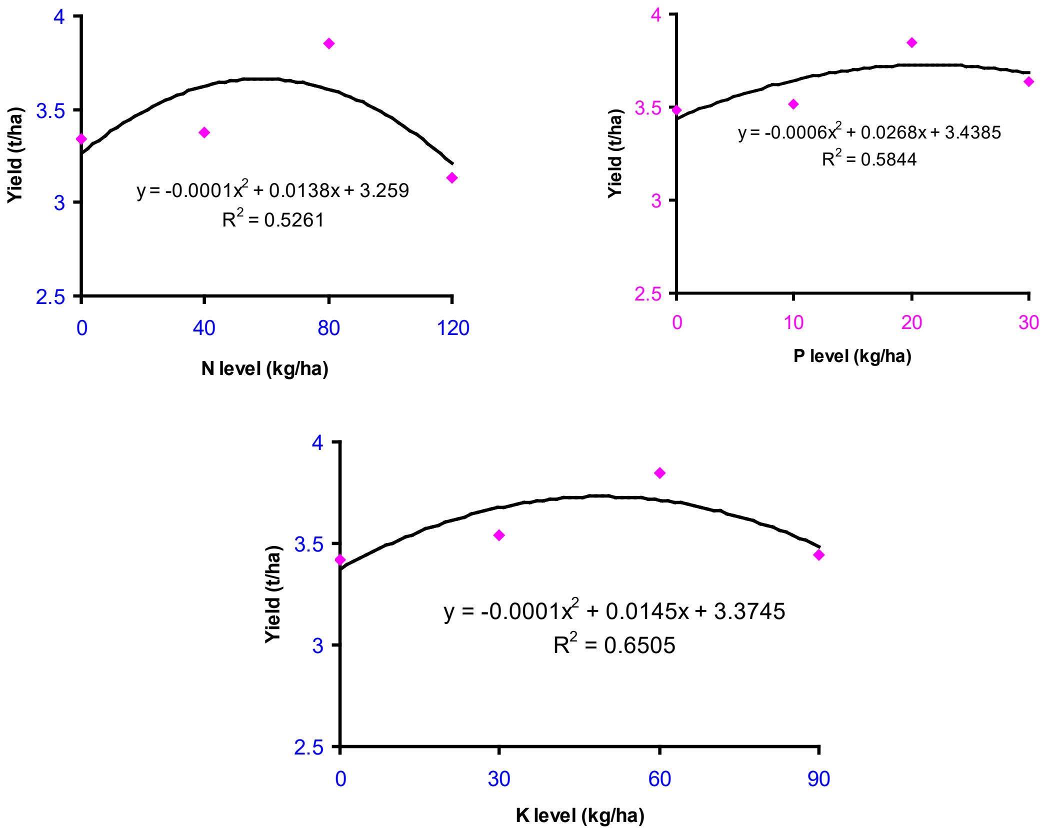


Figure 2. Response of Jute grown in Lentil-Jute-T.Aman rice cropping pattern to N, P, and K at MLT site, Keshabpur, Jessore during 2005-06

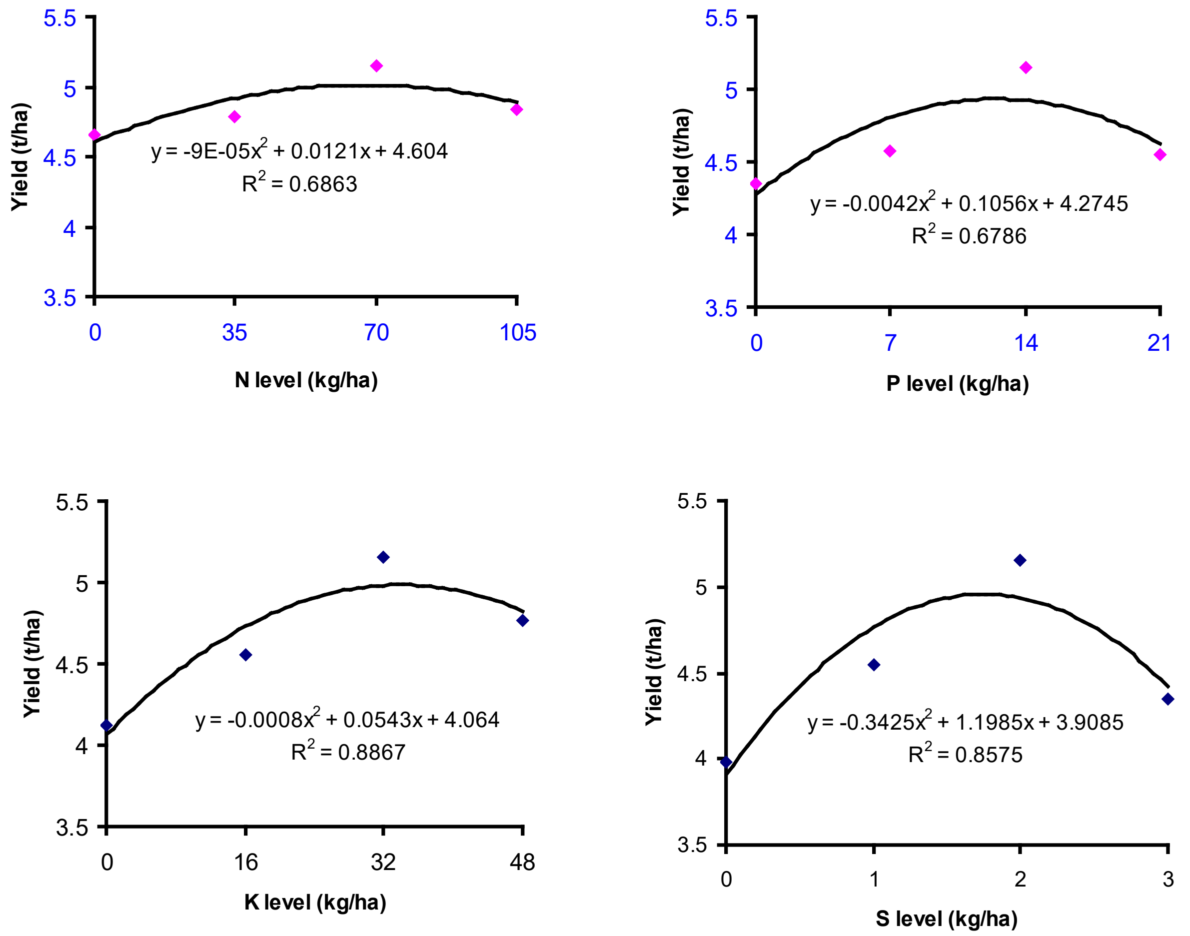


Figure 3. Response of T.aman grown in Lentil-Jute-T.Aman rice cropping pattern to N, P, K and S at MLT site, Keshabpur, Jessore during 2005-06

Table 1. Effect of different levels of fertilizer nutrients on the yield of crops in Lentil-Jute-T.Aman cropping pattern at MLT site, Keshabpur, Jessore during 2005-06

Lentil		Jute		T.Aman	
Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})	Nutrient level (kg ha^{-1})	Fibre yield (t ha^{-1})	Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})
N 0	0.96	N 0	3.34	N 0	4.65
8	1.03	40	3.38	35	4.78
16	1.28	80	3.85	70	5.15
24	1.14	120	3.13	105	4.84
P 0	1.12	P 0	3.48	P 0	4.35
14	1.10	10	3.52	7	4.58
28	1.28	20	3.85	14	5.15
42	1.07	30	3.64	21	4.55
K 0	1.00	K 0	3.42	K 0	4.12
12	1.07	30	3.54	16	4.56
24	1.28	60	3.85	32	5.15
36	1.10	90	3.44	48	4.77
				S 0	4.55
				1	3.98
				2	5.15
				3	3.75

Cropping pattern : Lentil-Jute - T.Aman rice
AEZ : Low Ganges River Floodplain (AEZ 12)
Location : MLT site, Rajbari
Year : 2003-04 to 2005-06

Lentil: Average of three years results showed that grain yield of lentil increased with the increase of N levels and the highest yield was obtained from 17 kg/ha of N and then trended to decline. Similarly P, K and S showed a positive response to some extent towards the yield of lentil. Grain yield increased up to 19, 20 and 9 kg/ha of P, K and S, respectively.

Jute: Average of three years results showed that fibre yield of Jute increased with the increase of nitrogen and the highest yield was recorded from 80 kg/ha and then trended to decrease. Almost similar trend was found in case of P, K and S. Fibre yield increased appreciably up to 19, 63 & 10 kg/ha, respectively.

T.Aman: Average of three years results showed that grain yield of T.aman rice increased with the increase of N level up to 100 kg/ha of N and then trended to decrease. Similarly P, K and S showed a positive response towards the yield of T.aman rice. Grain yield increased up to 18, 27 and 5 kg/ha of P, K and S, respectively.

From the response curve, the following doses of the nutrients were found as optimum for different crops

Crop	Fertilizer dose that maximized yield ($kg\ ha^{-1}$)				Fertilizer dose that maximized profit ($kg\ ha^{-1}$)			
	N	P	K	S	N	P	K	S
Lentil	17	19	20	9	16	18	19	9
Jute	80	19	63	10	78	19	59	10
T.Aman	100	18	27	5	97	17	25	5

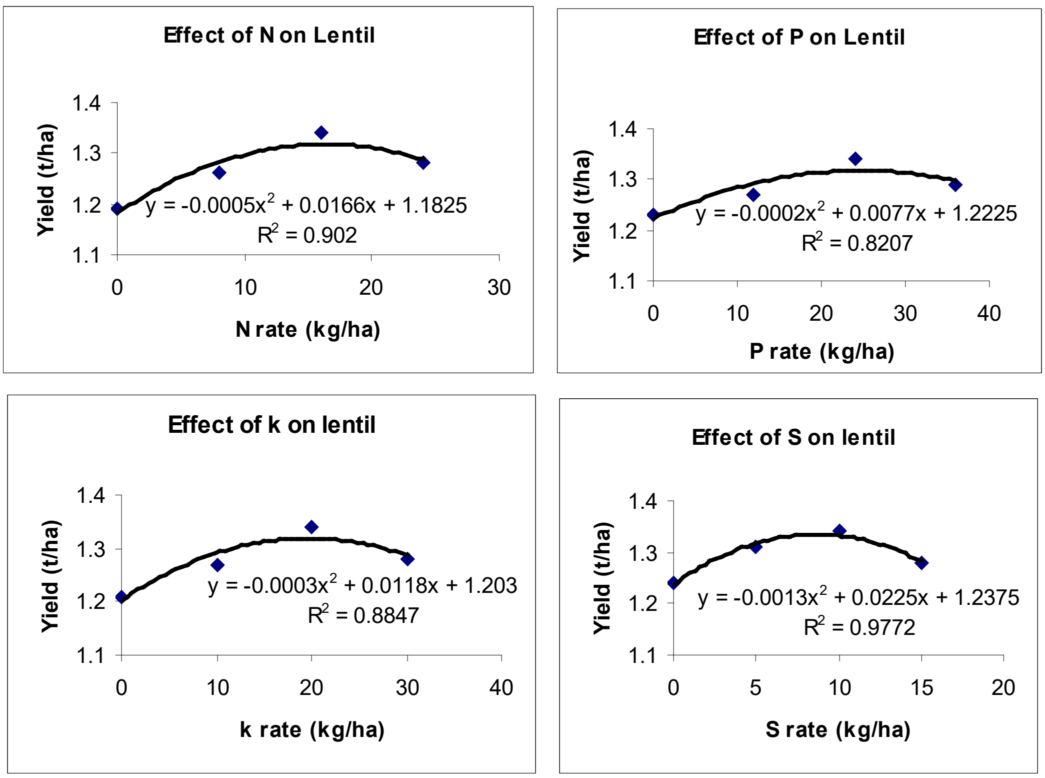


Figure 1. Response of Lentil grown in Lentil-Jute-T.Aman cropping pattern to added N, P, K & S at MIL site, Rajbari during 2003-04 to 2005-06 (average).

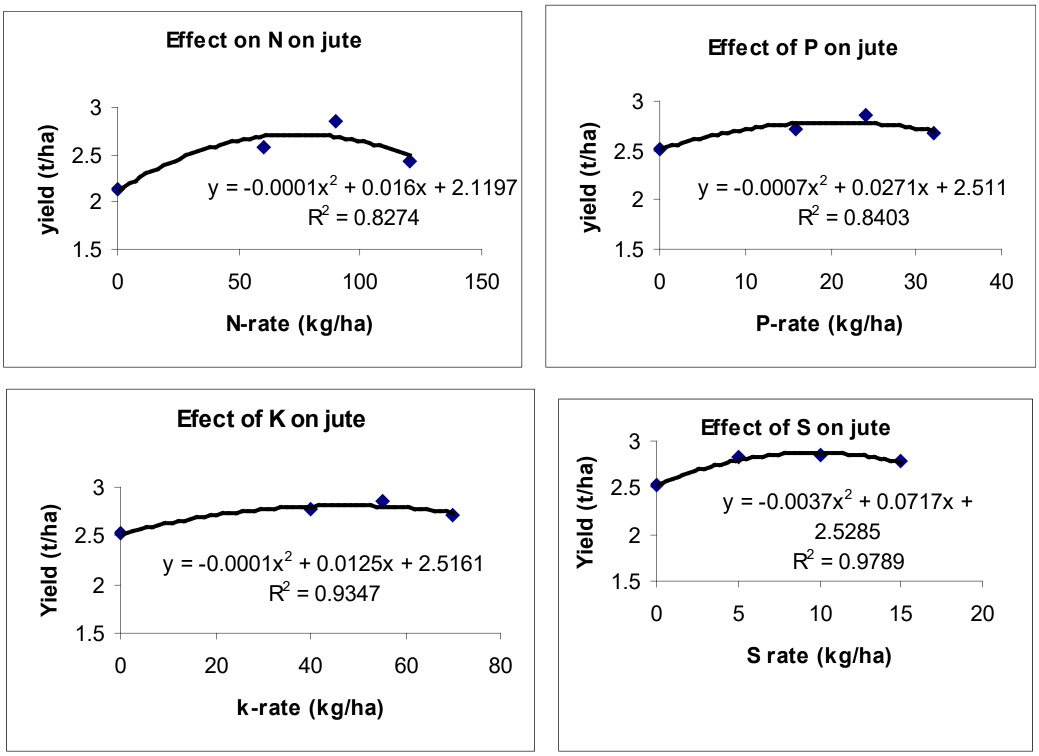


Figure 2. Response of Jute grown in Lentil-Jute-T.Aman cropping pattern to added N, P, K & S at MLT site, Rajbari during 2003-04 to 2005-06(average).

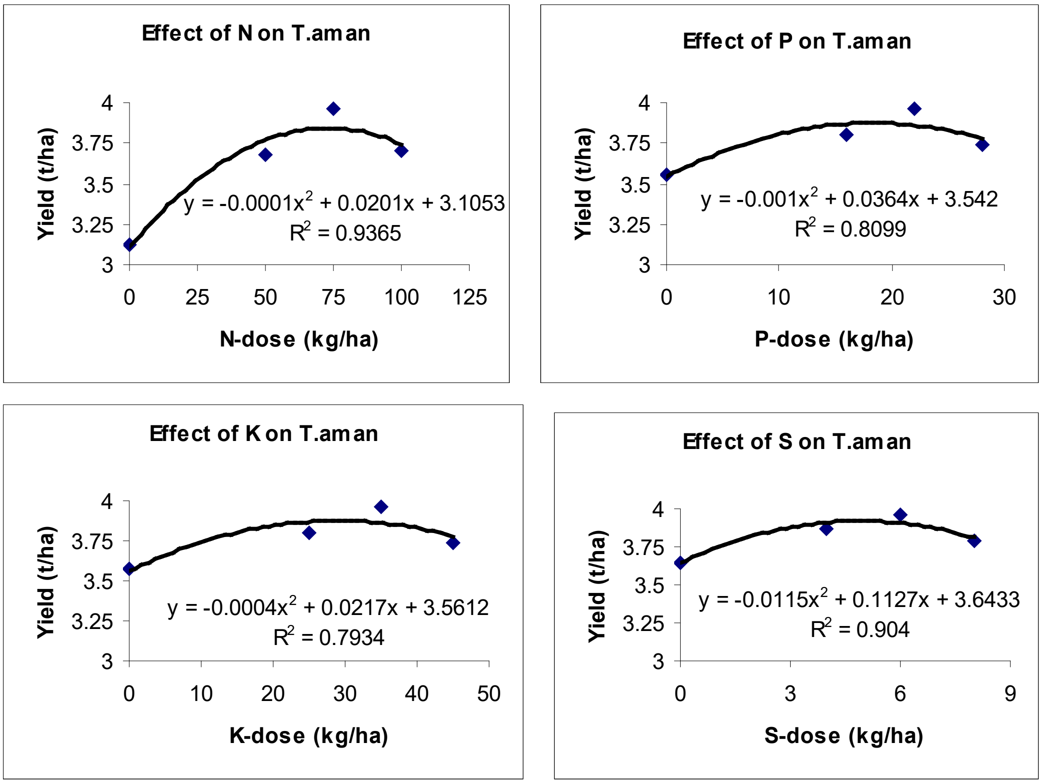


Figure 3. Response of T.Aman grown in Lentil-Jute-T.Aman cropping pattern to added N, P, K & S at MLT site, Rajbari during 2003-04 to 2005-06(average).

Table 1. Effect of different level of fertilizer nutrients on the yield of Lentil-Jute-T.Aman cropping pattern at MLT site, Rajbari during 2003-04 to 2005 -06

Lentil					Jute					T.Aman rice				
Nutrient level (kg ha^{-1})	Seed yield (t/ha)				Nutrient level (kg ha^{-1})	Fibre yield (t ha^{-1})				Nutrient level (kg ha^{-1})	Grain yield (t ha^{-1})			
	2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean		2003-04	2004-05	2005-06	Mean
N 0	1.18	1.13	1.25	1.19	N 0	2.05	2.19	2.17	2.14	N 0	3.13	3.25	2.98	3.12
8	1.24	1.23	1.31	1.26	60	2.81	2.71	2.70	2.70	50	3.81	3.71	3.51	3.68
16	1.36	1.31	1.35	1.34	90	2.88	2.84	2.83	2.85	75	4.24	3.92	3.73	3.96
24	1.33	1.21	1.29	1.28	120	2.82	2.71	2.69	2.74	100	3.81	3.61	3.56	3.70
P 0	1.22	1.19	1.27	1.23	P 0	2.38	2.59	2.60	2.52	P 0	3.46	3.67	3.53	3.55
12	1.29	1.23	1.29	1.27	16	2.78	2.69	2.68	2.72	16	3.94	3.83	3.64	3.80
24	1.36	1.31	1.35	1.34	24	2.88	2.84	2.83	2.85	22	4.24	3.92	3.73	3.96
36	1.34	1.24	1.29	1.29	32	2.70	2.66	2.67	2.67	28	3.80	3.81	3.61	3.74
K 0	1.25	1.14	1.25	1.21	K 0	2.46	2.55	2.55	2.52	K 0	3.56	3.65	3.50	3.57
10	1.30	1.22	1.29	1.27	40	2.88	2.71	2.72	2.77	25	3.96	3.82	3.63	3.80
20	1.36	1.31	1.35	1.34	55	2.88	2.84	2.83	2.85	35	4.24	3.92	3.73	3.96
30	1.34	1.23	1.26	1.28	70	2.80	2.66	2.69	2.72	45	3.87	3.79	3.57	3.74
S 0	1.25	1.21	1.27	1.24	S 0	2.44	2.55	2.57	2.52	S 0	3.59	3.79	3.56	3.65
5	1.32	1.27	1.33	1.31	5	2.88	2.80	2.78	2.82	4	4.04	3.89	3.69	3.87
10	1.36	1.31	1.35	1.34	10	2.88	2.84	2.83	2.85	6	4.24	3.92	3.73	3.96
15	1.30	1.28	1.25	1.28	15	2.85	2.81	2.69	2.78	8	4.06	3.61	3.71	3.79

Cropping pattern : Chickpea -T.Aman rice
AEZ : High Barind Tract (AEZ 26)
Location : MLT site, Nachole, Chapinawabganj
Year : 2002-03 to 2005-06

Chickpea

Nitrogen was not included in Chickpea for response study. Average of three years data revealed that response of chickpea to added P, K and S was observed to some extent. Grain yield increased gradually up to 30 kg ha^{-1} of P, K and S. Almost similar trend was found in the 3 years.

T.Aman

Response of T.Aman to nitrogen was observed. Grain yield increased markedly with the increase of N level up to 80 kg N ha^{-1}. Then yield tended to decline. But response to P was not evident. Response to K and S was evident.

From the response curve, the following doses of the nutrients were found as optimum for different crops

Crop	Fertilizer dose that maximized yield (kg ha^{-1})				Fertilizer dose that maximized profit (kg ha^{-1})			
	N	P	K	S	N	P	K	S
Chickpea	-	32	28	36	-	27	26	34
T.Aman	82	17	23	10	78	15	22	10

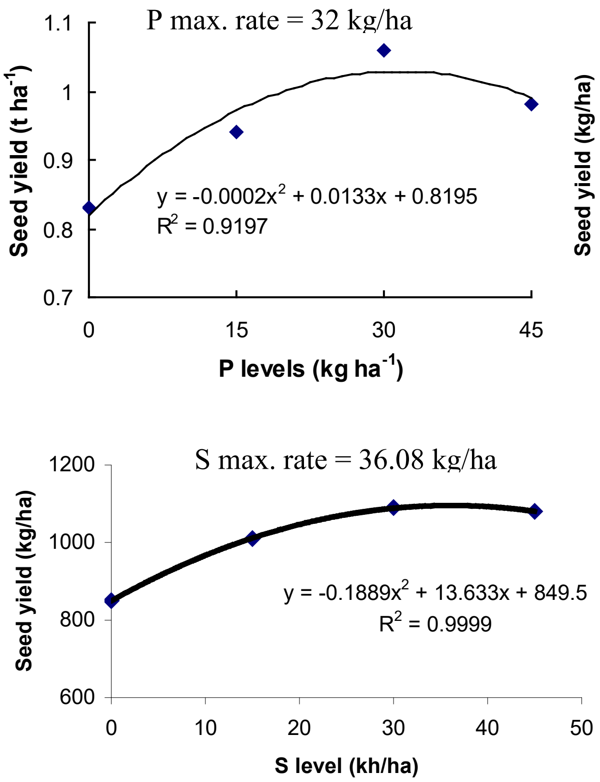


Figure 1. Response of Chickpea grown in Chickpea-T.Aman cropping pattern to added P, K & S at MLT site, Nachole, Chapainawabganj during 2003-04 to 2005-06 (average)

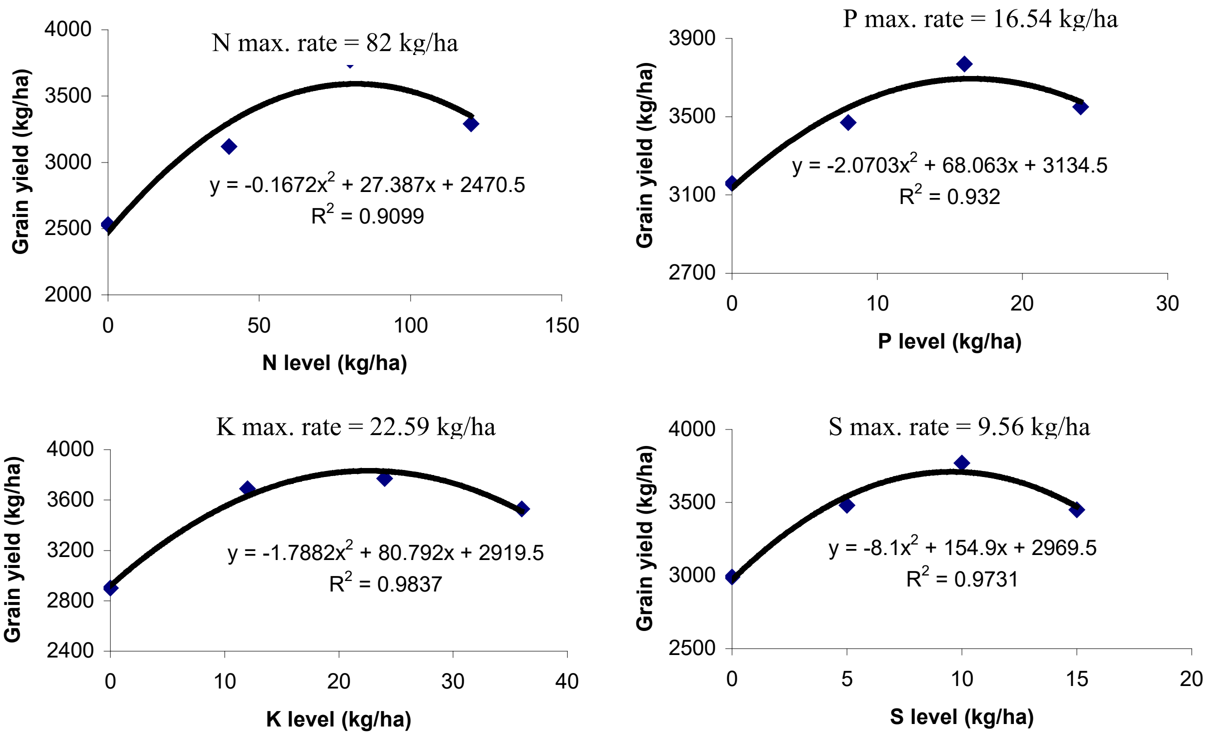


Figure 2. Response of T.Aman grown in Chickpea-T.Aman cropping pattern to added N, P, K & S at MLT site, Nachole, Chapainawabganj during 2003-04 to 2005-06 (average)

Table 1. Effect of different level of fertilizer nutrients on the yield of Chickpea-T.Aman cropping pattern at MLT site, Nachole, Rajshahi during 2003-04 to 2005-06

Chickpea						T.Aman rice					
Nutrient level (kg ha^{-1})		Seed yield (t ha^{-1})				Nutrient level (kg ha^{-1})		Grain yield (t ha^{-1})			
		2003-04	2004-05	2005-06	Mean			2003-04	2004-05	2005-06	Mean
						N	0	2.55	2.35	2.69	2.53
							40	3.37	3.02	2.98	3.12
							80	4.01	3.35	3.96	3.77
							120	3.61	2.58	3.68	3.29
P	0	0.98	0.82	0.97	0.92	P	0	3.68	2.25	3.56	3.16
	20	1.10	0.96	1.16	1.07		8	3.85	2.93	3.65	3.47
	30	1.13	0.92	1.24	1.09		16	4.01	3.35	3.96	3.77
	40	1.08	0.97	1.10	1.05		24	4.00	2.78	3.88	3.55
K	0	0.85	0.75	0.95	0.85	K	0	3.35	2.43	2.94	2.90
	15	1.02	0.95	1.08	1.01		12	4.20	2.95	3.92	3.69
	30	1.13	0.92	1.24	1.09		24	4.01	3.35	3.96	3.77
	45	1.14	0.97	1.14	1.08		36	3.81	2.99	3.79	3.53
S	0	0.89	0.77	0.89	0.85	S	0	3.75	2.21	3.02	2.99
	15	0.98	0.91	1.06	0.98		5	3.91	2.75	3.79	3.48
	30	1.13	0.92	1.24	1.09		10	4.01	3.35	3.96	3.77
	45	1.07	0.89	1.12	1.02		15	3.85	2.76	3.75	3.45

Cropping pattern : Sesame -T.Aman rice
AEZ : Ganges Tidal Floodplain (AEZ 13)
Location : MLT site, Dumuria
Year : 2003-04 and 2005-06

Sesame

Yields of Sesame increased with increasing level of the fertilizer nutrients to a certain limit and then decreased. But the yield increase was prominent incase of nitrogen and highest yield (1140kg/ha) was obtained from 60kg/ha. P has distinct effect on the yield and highest grain yield (1140kg/ha) was obtained from 24kg/ha of P.

T.Aman

Yield of T.Aman rice increased with increasing level of the fertilizer nutrients to a certain limit and then decreased. But the yield increase was prominent incase of nitrogen and the highest yield (4.38t/ha) was obtained from 80kg/ha (Fig.-2) . Similar trend was observed with P.

From the response curve, the following doses of the nutrients were found as optimum for different crops

Crop	Fertilizer dose that maximized yield (kg ha^{-1})		Fertilizer dose that maximized profit (kg ha^{-1})	
	N	P	N	P
Sesame	56	20	44	12
T.Aman	80	22	69	17

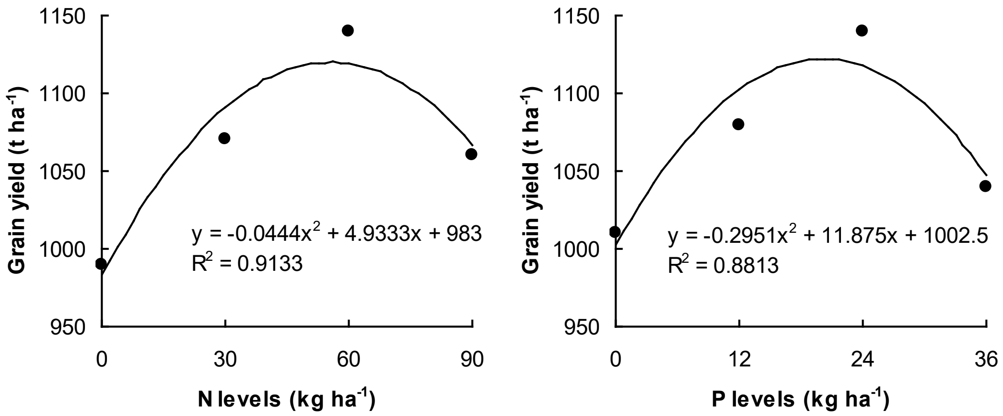


Figure 1. Response of sesame grown in Sesame -T.Aman cropping pattern to added N and P at MLT site, Dumuria, Khulna 2003-04 and 2005-06 (average).

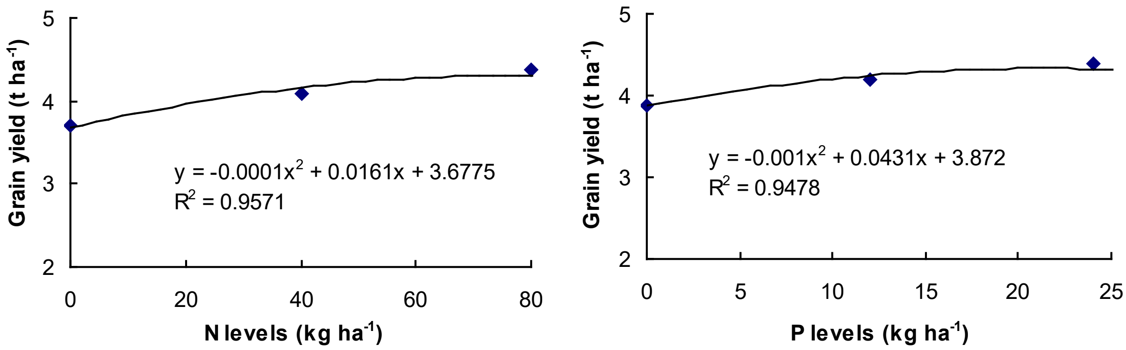
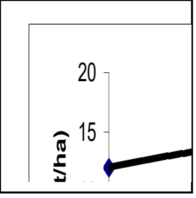


Figure 2. Response of T.Aman grown in Sesame -T.Aman cropping pattern to added N and P at MLT site, Dumuria, Khulna 2003-04 and 2005-06 (average).

Table 1. Effect of different level of fertilizer nutrients on the yield of Sesame-T.Aman cropping pattern at MLT site, Dumuria, Khulna during 2003-04 to 2005-06

Sesame					T.Aman rice				
Nutrient level (kg ha^{-1})		Seed yield (t ha^{-1})			Nutrient level (kg ha^{-1})		Grain yield (t ha^{-1})		
		2003-04	2004-05	Mean			2003-04	2004-05	Mean
N	0	1040	940	990	N	0	3.80	3.60	3.70
	30	1090	1050	1070		40	4.29	3.89	4.09
	60	1163	1117	1140		80	4.34	4.42	4.38
	90	1100	1020	1060		120	4.16	4.08	4.12
P	0	1062	958	1010	P	0	3.90	3.88	3.89
	12	1142	1018	1080		12	4.25	4.13	4.19
	24	1163	1117	1140		24	4.34	4.42	4.38
	36	1081	999	1040		36	4.10	4.10	4.10



Appendix table 1. Initial soil status of the experimental site

Location with AEZ	Land type	R/I	pH	O.C (%)	Total N (%)	K (m.eq./100g soil)	P	S	Zn	B
							ppm			
Gabtali	MHL	I	5.9	-	0.10 (L)	0.07 (VL)	8.49 (L)	8.93 (L)	-	-
Kushtia	MHL	I	8.1	2.54	0.15 (L)	0.69 (VH)	3.98 (VL)	30.0 (O)	0.82 (L)	0.36 (M)
Joypurhat	MHL	I	4.9	-	0.06 (VL)	0.07 (VL)	13.4 (L)	7.15 (VL)	1.66 (O)	-
Kishoreganj	MHL	I		0.99	0.11 (L)	0.14 (L)	8.52 (L)	9.56 (L)	-	-
Paba	MHL	I	8.4	3.83	0.09 (VL)	0.21 (M)	16.0 (M)	6.63 (VL)	2.29 (O)	0.46 (O)
Bagherpara	MHL	I	-	-	0.06 (VL)	0.20 (M)	6.96 (VL)	19.3 (M)	0.95 (M)	-
Magura	MHL	R	-	-	0.12 (L)	0.26 (M)	5.79 (VL)	24.0 (O)	0.48 (L)	-
Keshobpur	MHL	R	-	-	0.14 (L)	0.15 (L)	7.64 (L)	31.1 (O)	0.81 (M)	-
Rajbari	MHL	R	7.4	2.85	0.14 (L)	0.19 (M)	6.09 (VL)	19.2 (M)	-	-
Nachole	MHL	I	5.8	-	0.07 (VL)	0.20 (M)	16.0 (M)	6.62 (VL)	2.24 (H)	0.46 (O)
Dumuria	MHL	R	6.8	2.65	0.16 (L)	0.60 (VH)	14.02 (M)	371 (VH)	0.34 (VL)	-

Appendix table 2. Crop management practices

Site	Cropping pattern	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Gabtali	Mustard	Tori-7	8	4 th week of Nov	1st week of Feb
	Boro	BRRI dhan-28	50	2nd week of Feb	2nd week of May
	T.Aman	BRRI dhan-32	50	2nd week of Jly	4th week of Oct
Gangni	Wheat	Protiva	100	1st week of Dec.	3rd week of March
	Jute	O-9897	10	1st week of April	2nd week of Aug
	Mungbean	BARI mung-5	40	Last week of Aug	3rd week of Nov
Kishoreganj	Potato	Diamant	1500	1st week of Dec.	2nd week of March
	T.Aus	BR-26	40	2nd week of May	1st week of Aug
	T.Aman	BRRI dhan-32	50	2nd week of Aug	4th week of Nov
Paba	Potato	Cardinal	1800	1st week of Dec	2nd week of Feb
	Jute	Falgunitosha	8	2nd week of April	Last week of July
	T.Aman	BRRI dhan-39	50	1st week of Aug	Last week of Nov.
Magura	Lentil	Local	30	3rd week of Nov	1st week of March
	Jute	O-9897	10	2nd week of April	3rd week of July
	T.Aman	BRRI dhan-32	50	1st week of Aug	2nd week of Nov
Bagherpara	Potato	Heera	1500	Last week of Nov	2nd week of Feb
	Mungbean	BARI mung-5	40	3rd week of March	1st week of June
	T.Aman	BRRI dhan-32	40	3rd week of July	4th week of Nov
Keshobpur	Lentil	Local	30	3rd week of Nov	1st week of March
	Jute	O-9897	10	2nd week of April	3rd week of July
	T.Aman	BRRI dhan-32	50	1st week of Aug	2nd week of Nov
Rajbari	Lentil	BARI mashur-4	30	3rd week of Nov	1st week of March
	Jute	O-9897	10	Last week of Mar.	3rd week of July
	T.Aman	BRRI dhan-32	50	1st week of Aug	2nd week of Nov
Chabbishnagar	Chickpea	BARI chola-5	40	3rd week of Nov	4th week of March
	T.Aman	BRRI dhan-39	40	3rd week of July	Last week of Oct.
Nachole	Chickpea	BARI chola-5	40	2nd week of Nov	3rd week of March
	T.Aman	BRRI dhan-39	40	3rd week of July	Last week of Oct.
Dumuria	Sesame	Local	20	Last week of Feb.	Last week of May
	T.Aman	BR-23	40	3rd week of Aug.	3rd week of Dec.

RESEARCH ISSUE: VERIFICATION OF FERTILIZER MANAGEMENT PRACTICES

Effect of Urea Super Granule (USG) as a Source of Nitrogen on Hybrid Maize

Abstract

An experiment was conducted at farmers field of the FSRD site, Ellenga, Tangail during 2006-07 in medium high land situation under AEZ-8 to observe the efficiency of USG application in hybrid maize production in comparison to prilled urea Recommended dose of N as prilled Urea, recommended dose of N as USG, 10% less of recommended dose of N as USG, 20% less of recommended dose of N as USG and the farmer's practice were the five treatments. Higher grain yield was obtained from recommended dose of N as USG (9.84 t/ha) which was followed by 10% less N as USG (9.82 t/ha). Maximum gross margin and BCR were found from 10% less of recommended dose of N as USG

Introduction

In our country different types of fertilizer materials are becoming available in the market. Urea Super Granule (USG) is one of the most nitrogenous fertilizers which is now available in the market and the farmer's are using it in Boro rice and also using it in different vegetable and fruit crops such as brinjal cabbage cauliflower, banana etc. Maize now has become one of the profitable field crops at Tangail. The land area of this crop is increasing day by day. But the efficiency of USG to this crop is yet to be tested. Keeping this view in mind, the experiment was undertaken to find out the optimum and economic dose of USG for maize in the locality.

Materials and Methods

The experiment was carried out at the FSRD site, Ellenga, Tangail during rabi 2006-07 in the medium high land situation under AEZ-8. The experiment was laid out in RCB design with six dispersed replications. The unit plot size was 6m x 5m using plant spacing 75cm x 25 cm. The variety BHM-3 was used. Five fertilizer levels, viz, T_1: Recommended dose of N as prilled Urea, T_2: Recommended dose of N as USG, T_3: 10% less than recommended dose of N as USG, T_4: 20% less than recommended dose of N as USG and T_5-Farmer's practice were considered as the treatments. Prilled rea was prilled applied as basal but USG was applied as ring method 10-15cm apart from plant stalk, and 7.5 – 10 cm depth in soil. Weeding and irrigation were done twice in a cropping season before fertilizer application in soil. Other management practices were done as and when necessary. Data on grain yield and other yield contributing parameters were recorded considering 20 plants randomly selected from each plot. Data on cost and return were also recorded. Collected data were analyzed statically using computer package MSTATC.

Result and Discussion

Yield and yield contributing parameters of maize varied due to N levals and source (Table 1). Higher plant height (220.2cm) was obtained from plot treated with recommended dose of N as USG, which was at par with that of 10% less N as USG (217.7cm) and recommended dose of prilled urea (215.2cm). Higher number of grain per cob (455) was obtained from recommended N as USG and it was at par with 10% less of N as USG (448) followed by recommended N as prilled urea (430). The lowest grain number (368) was obtained from farmer's practice. The weight of 1000 grain was the highest (455.3g) with N as recommended USG and it was statistically similar with that of plants treated with 10% less N as USG (452.5g) and recommended dose of N as prilled urea (445.2g). The lowest grain weight was obtained from farmer's practice (390.5g). Grain yield was also higher in 100% USG (9.84 t/ha) and it was at par with 10% less N as USG (9.82 t/ha). The lowest yield (7.29 t/ha) was obtained from farmer's practice. As USG is comparatively a larger and compact form of N and placed near to the root zone, the plants could receive it slowly for a long period which might be help in better growth and development of plants leading to higher grain yield and yield attributes.

In cost and return analysis, higher gross return was obtained from recommended N as USG (Tk. 115720/ha) but higher gross margin and BCR and benefit cost ratio were found from with 10% less N as USG (gross margin Tk 75782/ha and BCR 2.90). The lower gross return and BCR was found in farmers practice.

Farmers' reaction

The farmers opined that apparently the USG treated plants were superior in terms of yield but additional cost and labour is required.

Conclusion

Application of N as USG was found more effective than that of N as prilled form. The trial should be repeated for another one year for confirmation.

Table 1. Yield and other yield parameters of hybrid maize as influenced by different source and level of nitrogen at char land situation of Bhuyapur, Tangail during 2006-07

Treatment	Plant height (cm)	Cob length (cm)	Cob breath (cm)	Grain/ cob (no)	Grain wt/ cob (g)	1000-grain wt. of (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	215.20a	18.66b	15.15b	430b	182.3a	445.2a	8.85b	9.83b
T_2	220.23a	19.73a	16.40a	455a	185.6a	455.3a	9.84a	10.24a
T_3	217.70a	20.13a	16.43a	448a	184.3a	452.5a	9.82a	10.40a
T_4	208.70b	18.45b	15.00b	408b	165.7b	420.4b	8.80b	9.25b
T_5	190.00c	16.35c	14.90c	368c	146.5c	390.5c	7.29c	7.44c
CV (%)	9.85	8.99	5.99	6.15	8.26	6.44	9.29	12.37

Table 2. Cost and return analysis of hybrid maize production as influenced by different source and level of nitrogen at char land situation of Bhuyapur, Tangail during 2006-07

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	104232	37852	66380	2.75
T_2	115720	40115	75605	2.88
T_3	115530	39747	75782	2.90
T_4	103512	39380	64132	2.62
T_5	92940	36910	56030	2.51

Fixed cost : 9140 Tk/ha (Plough + Irrigation + Seed + Pesticide)
Price : Urea @ 6.50 Tk/kg, USG @ 7.00 Tk/kg, Labour in : T_1 = 25300 Tk/ha, T_2 = 27300 Tk/ha, T_3 = 27300 Tk/ha, T_4 = 27300 Tk/ha, T_5 = 25300 Tk/ha

Effect of Urea Super (USG) as a Source of Nitrogen on Tomato

Abstract

The experiment was conducted in Sylhet during 2005-06 and 2006-07 and in Khustia during 2006-07 to find out the effect of Urea Super Granule (USG) on tomato. Recommended dose of USG, 10 and 20% less than recommended USG were tested along with recommended dose of prilled urea and farmers practice. Higher yield of tomato increased due to application of USG over prilled urea. Higher fruit yield of tomato was obtained with 10% less N as USG in Sythet and with recommended dose of USG in Khustia. Yield was also higher with recommended dose of USG in Sylhet in 2005-06.

Introduction

Tomato is grown in different regions with prilled urea with other fertilizers. This is why volatilization loss of prilled urea is very high and farmers loss a huge amount of money for nitrogenous fertilizer. To minimize this loss USG application may be a good technology to increase yield as well as reduction of production cost. This is why, the trial was undertaken with fulfill the objectives to find out the efficiency of USG and compare the yield performance of Tomato with USG and prilled urea and to find out the optimum and economic dose of USG for Tomato.

Materials and Methods

The experiment was conducted at the FSRD site, Jalapur, Sylhet under AEZ-20 during 2005-06 and 2006-07 and MLT site, Gangni, Kushtia during rabi of 2006-07. The land type was medium highland with pH 4.97, N (0.09%) as low, P (10.92 ppm) as optimum, K (0.16 meq./100g soil) as high, S (21.78 ppm) as high and B (0.33 ppm) were as medium, and Zn (1.31 ppm) am medium, respectively in Sylhet and pH 8.0, organic matter (1.80 %) as low, N (0.120%) as low, Zn (o.96 ppm) as low, P (4.481 ppm) as low, S (25.86 ppm) was as medium in Khustia, respectively. Thirty days seedling of tomato (var. Epock) was transplanted from 18 December 2005 to 6 January 2006 at Sylhet and. Tomato variety 'Sathi' was transplanted from 15 to 18 September, 2006 with spacing 80cm x 60cm at Kushtia. There were five treatments i.e. i) Recommended dose of Nitrogen as Prilled urea, ii) Recommended dose of Nitrogen as USG iii) 10% less recommended dose of Nitrogen as USG iv) 20% less recommended dose of Nitrogen as USG and v) Farmers dose. All fertilizers and 50% of MP were applied on the basis of soil test values as per recommendation (FRG, BARC, 2005) during the final land preparation except urea and USG. Urea super granule (USG) was applied at 15 DAT as ring method, 10 cm apart from plant stalk and 8cm depth covering with soil. But prilled urea was applied in 3 equal splits at 15, 30 and 45 DAT. The rest 50% of MP fertilizer was also applied at 15 DAT for all the treatment. Before conducting the field experiment soil samples were collected from each plot and its chemical analysis was done. The crop was harvested from March 24 to April 17, 2006 in Sylhet and November 20, 2006 to January 30, 2007 in Khustia The data on yield and different yield contributing characters were recorded from 10 randomly selected plants in each plot and plot-yield was also estimated. Data were analyzed statistically using MSTATC package.

Results and Discussion

Sylhet

Significant variation of yield attributes were found due to application of different fertilizer management packages (Table 1).Yield of tomato was increased significantly due to application of USG over prilled urea and higher yield was obtained from the USG 10% less recommended dose (97.81 t/ha) followed by USG recommended dose (92.10 t/ha) in 2006-07. But in previous year higher yield was obtained from USG recommended dose. Regarding cost and benefit, higher gross return, gross margin and BCR were obtained from the treatment of USG 10% less recommended dose followed by USG recommended dose (Table 2).

Khustia

Yield of Tomato increased due to application of USG over prilled Urea (Table 3). The highest yield was obtained from treatment of recommended dose of N as USG (115.50 t/ha) as compared to other treatments. The second highest yield was obtained from the treatment of USG 10% less recommended dose (103.75 t/ha). Higher gross return, gross margin and BCR were obtained from the treatment of recommended dose of N as USG followed by USG 10% less recommended dose (Table 3).

Farmers' reactions

Sylhet: Farmers opined that USG was more effective and profitable than that of normal prilled urea. It would be less labour intensive if placed only once. Weed infestation was also less. The growth was uniform and quality was better than that of normal prilled urea. Farmers are interested to apply USG if it is available in the market.

Khustia: Farmers opined that USG was more effective and less weed infestation but unavailability of USG in the local market is a problem.

Conclusion

Application of N as USG was found more effective in yield and economic return than that of N as prilled form. The trial should be repeated for another one year for confirmation.

Table 1. Effect of urea super granule (USG) on the yield and yield attributes of Tomato (Epok) at FSRD site, Jalalpur, Sylhet

Treatment	Plant ht.(cm)	Branches/ plant	Cluster/ plant	Fruits/ plant	Fruit/ kg	Yield (t/ha)	
						2006-07	2005-06
Prilled urea (Rec)	88.00	4.53	11.07	24.13	12.78	77.29	85.39
USG (Rec)	94.87	4.93	11.87	31.93	12.05	92.10	101.36
USG(10%<Rec)	97.80	6.07	12.47	36.13	11.75	97.85	88.12
USG(20%<Rec)	97.40	5.27	11.73	30.53	12.45	90.71	75.14
Farmers practice	89.27	4.80	11.87	26.87	13.38	75.98	47.14
LSD(0.05	3.906	NS	NS	7.290	0.776	9.145	
CV%	2.22	12.74	6.23	12.94	3.31	5.60	

Table 2. Effect of USG on cost and return of Tomato at Jalalpur, Sylhet during 2006-07

Treatment	Gross return (Tk./ha)	TVC (TK/ha)	Gross margin (Tk/ha)	BCR
Prilled urea (Rec)	618280	105205	513083	5.88
USG (Rec)	736808	105770	631038	6.97
USG(10%<Rec)	782528	105499	677029	7.41
USG(20%<Rec)	725712	105228	620484	6.89
Farmers practice	607872	105838	502034	5.74

Market price (Tk./kg): Tomato= 8.00, Urea= 6.00, USG= 6.30, TSP= 16.00, MP= 16.00, Gypsum= 6.00, $ZnSO_4$=45.00

Table 3: Yield and yield components and cost and return of Tomato as influenced by USG at Gangni, Kushtia during 2006-07

Treatment	Fruit wt. /m^2 (kg)	Fruit wt. /plant kg)	Yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR
Prilledurea (Rec)	9.32	3.80	93.25	746000	75920	670080	9.82
USG (Rec)	11.55	4.71	115.5	924000	77170	846830	11.97
USG(10%<Rec)	10.37	4.28	103.75	830000	76720	753280	10.81
USG(20%<Rec)	9.82	4.06	98.25	786000	76270	709730	10.30
Farmers practice	8.62	3.56	86.25	690000	73540	61460	9.38
LSD (5%)			4.46				
CV (%)			2.38				

Note: Tomato 8 Tk/kg

Effect of Urea Super Granule (USG) as a Source of Nitrogen on Cabbage

Abstract

The experiment was conducted at Sylhet and Bharamara and Gangni of Khustia during 2006-2007 to find out the effect of urea super granule (USG) on cabbage. Recommended dose of USG, 10 and 20% less than recommended USG were tested along with recommended dose of prilled urea and farmers practice. Higher yield of cabbage was found from 10% less than recommended USG in Gangni, Khutsia and in Sylhet. But in Bharamara, Khustia, higher yield was found in the framers' practice followed by recommended N as USG. BCR was found higher from recommended N as USG in all the locations.

Introduction

The importance of cabbage (*Brassica oleracea*) as vegetable due to supply of adequate vitamins, carbohydrates and minerals is well known. It is the most important winter vegetable and is grown throughout Bangladesh. In Kushtia district, Cabbage is grown with prilled urea with other fertilizers. This is why volatiliztion loss of prilled Urea is very high and farmers loss a huge amount of money for nitrogen fertilizer. To minimize this loss USG application may be a good technology to increase yield as well as reduction of production cost. This is why, the trial was undertaken with fulfill the objectives to find out the efficiency of USG and compare the yield performance of cabbage with USG and prilled Urea and to find out the optimum and economic dose of USG for cabbage.

Materials and Methods

The experiment was carried out at the FSRD site, Jalalpur, Sylhet and MLT sites of Bharamara and Gangni of Khustia during 2006-2007 in the highland. The land type was medium highland with pH 5.31, N (0.09%) as low, P (11.71 ppm) as optimum, K (0.11 meq/100g soil) as high , S (9.25 ppm) as high and B (0.29 ppm) as medium and Zn (1.59 ppm) were am medium, respectively in Sylhet and pH 8.0, organic matter (1.80 %) as low, N (0.120%) as low, Zn (o.96 ppm) as low, P (4.481 ppm) as low, S (25.86 ppm) was as medium in Gangni, Khustia,, respectively. There were five treatment viz. i) Recommended dose of USG, ii) 10% less than recommended USG iii) 20% less than recommended USG and v) Farmers practice were tested followed by RCB design with 6 replications. Twenty five to thirty days seedlings of cabbage (var. Atlas-70) were transplanted on 24.11.2006 in Sylhet, from 12.09.06 to 14.09.06 at Gangni and 09.11.2006 at Bharamara with 60 x 45 cm spacing. All fertilizers and 50% of MP were applied on the basis of soil test values as per recommendation (FRG, BARC, 2005) during the final land preparation except urea and USG. Urea super granule (USG) was applied 10 days after transplanting as ring method, 10 cm apart from plant stalk and 8 cm depth covering with soil. But prilled urea was applied in 3 equal splits at 10, 25 and 35 DAT. The rest 50% of MP fertilizer was applied at 10 DAT for all the treatment. Before conducting the field experiment soil samples were collected from each experimental plot and its chemical analysis was done. The crops were harvested from 04.12.06 to 16.12.06 at Gangni and 29.01.2007 at Bharamara. The data on yield and different yield components were recorded from 10 randomly selected plants in each plot and plot-yield was also measured. Data were analyzed statistically using MSTATC package.

Results and Discussion

Sylhet

Yield of cabbage increased significantly with the application of USG over prilled urea (Table 1). Higher yield was obtained from the USG recommended dose (95.26 t/ha) followed by USG 10% less recommended dose (90.22 t/ha) and USG 20% less recommended dose (88.44 t/ha). It might be due to uniform N_2 supply of USG on head weight. Regarding cost and benefit, higher gross return, gross margin and BCR were obtained from the treatment of recommended dose of N as USG followed by USG 10% less recommended dose.

Khustia

Head yield of cabbage increased significantly with the application of USG over prilled urea at Gangni but significantly higher yield of cabbage was not found in the treatment of N as USG over over prilled urea at Bharamara. Higher head yield was found in farmers' practice followed by recommended dose of N as USG. Higher gross return, gross margin and BCR were obtained from the treatment of recommended dose of N as USG in both locations.

Farmers' reactions

Sylhet: Farmers opined that USG was more effective, less weed infestation than normal prilled urea. The growth of cabbage was uniform, compactness and quality was better than that of normal prilled urea. It would be less labour intensive, if USG could be placed only one time. Farmers were interested to apply USG, if it is available in the market.

Khustia: Farmers were satisfied with the USG application. They found that they could be benefited from this technology. Besides this, they preferred this system for long longevity of crops. They also opined that rapid growth of the plant, more yield within short time, less weed infestation and one application was enough.

Conclusion

USG performed better than that of normal prilled urea in case of yield and economic return. As the experiment was studied only one year the experiment should be repeated for further verification.

Table 1. Effect of different form of urea on the yield and yield attributes of Cabbage at FSRD site, Sylhet 2006-07

Treatment	Plant ht.(cm)	Head pericycle (cm)	Head diameter (cm)	No. Outer leaves	Wt.+outer leaves (kg)	Wt.-outer leaves (kg)	Head yield (t/ha)
Prilled urea (Rec)	13.84	66.16	17.36	14.52	2.65	2.08	77.19
USG (Rec)	13.68	68.08	18.88	18.72	3.09	2.57	95.26
USG(10%<Rec)	12.88	65.40	17.96	14.56	3.00	2.44	90.22
USG(20%<Rec)	12.68	64.04	18.48	15.44	2.98	2.39	88.44
Farmers practice	12.28	61.16	18.72	16.52	2.55	2.02	74.82
LSD (0.05)	NS	3.536	NS	NS	0.25	0.27	10.22
CV (%)	9.33	4.06	6.94	8.58	6.47	8.95	8.95

Wt.+ outer leaves = Weight of head with outer leaves, Wt.-outer leaves = Weight of head without leaves

Table 2. Effect of different form of urea cost and return of cabbage at Jalalpur, Sylhet during 2006-07

Treatment	Gross return (Tk./ha)	TVC (TK/ha)	Gross margin (Tk/ha)	BCR
Prilledurea (Rec)	385925	45480	340445	8.48
USG (Rec)	476295	45350	430945	10.50
USG(10%<Rec)	451110	45050	406060	10.01
USG(20%<Rec)	442220	44775	397445	9.88
Farmers practice	374075	44950	329125	8.32

Market price (Tk./kg): Cabbage= 5.00, Urea= 6.00, USG= 6.30, TSP= 16.00, MP= 16.00, Gypsum= 6.00, $ZnSO_4$=45.00

Table 3.Yield and yield components of Cabbage as affected by USG at Gangni, Kushtia during 2006-07

Treatment	Wt. of head /m^2 (kg)	Wt. of head (kg)	Head yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR
Prilledurea (Rec)	5.72	1.14	57.22	57221	81893	490317	6.98
USG (Rec)	7.84	1.56	78.42	784200	82508	701692	9.50
USG(10%<Rec)	6.83	1.36	68.33	683300	82253	601047	8.30
USG(20%<Rec)	5.95	1.18	59.48	594760	81998	512762	7.25
Farmers practice	5.60	1.12	56.01	560100	76688	483412	7.30
LSD (0.05)		0.10	3.84				
CV (%)		2.19	3.19				

Note: Cabbage 10 Tk /kg

Table 4. Yield and yield components of Cabbage as affected by USG at Bharamara, Kushtia during 2006-07

Treatment	Wt. of head /m^2 (kg)	Wt. of head (kg)	Head yield (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Prilledurea (Rec)	11.88	2.97	107.99	323955	41392	282563	7.85
USG (Rec)	12.42	3.105	112.89	338670	42007	296663	8.01
USG(10%<Rec)	10.70	2.67	100.1	300285	41752	258533	7.19
USG(20%<Rec)	9.73	2.703	88.47	265410	41497	223913	6.39
Farmers practice	12.99	3.43	118.14	354420	46350	308070	7.65
LSD (0.50)		0.34	11.02				
CV (%)		5.70	5.55				

Note: Cabbage 3 Tk/kg

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Effect of Urea Super Granule (USG) as a Source of Nitrogen on Cauliflower

Abstract

The experiment was conducted at Bharamara and Gangni during 2006-2007 to find out the effect of Urea Super Granule (USG) on cauliflower. USG 10% and 20% less of recommended USG were tested along with recommended dose of prilled Urea, USG and farmers practice. Results revealed that yield of cauliflower increased due to application of USG over prilled Urea. In case of Gangni, the highest yield was obtained from treatment T_2 (46.45 ton/ha) and in case of Bharamara, yield was highest in treatment T_5 (34.74 ton/ha). But BCR was highest in treatment T_1 (at Bharamara), and T_4 (at Gangni) with BCR 6.8 and 9.88, respectively.

Introduction

The importance of cauliflower as vegetable due to supply of adequate vitamins, carbohydrates and minerals is well known. It is the most important winter vegetable and is grown throughout Bangladesh. In Kushtia district, cauliflower is grown with prilled Urea with other fertilizers. This is why volatiliztion loss of prilled Urea is very high and farmers loss a huge amount of money for nitrogen fertilizer. To minimize this loss USG application may be a good technology to increase yield as well as reduction of production cost. This is why, the trial was undertaken with fulfill the objectives to find out the efficiency of USG and compare the yield performance of cauliflower with USG and prilled Urea and to find out the optimum and economic dose of USG for cauliflower.

Materials and methods

The experiment was conducted at Gangni and Bharamara in Kushtia during rabi season of 2006-2007. The variety was Autumn Queen (in Gangni) and Kandichar (in Bharamara). The area was $300m^2$. There were five treatment viz. i) Recommended dose of N as USG, ii) 10% less than recommended N as USG iii) 20% less than recommended N as USG and v) Farmers practice (200-45-75-14 NPKS kg/ha) were tested followed by RCB design with 6 replications. Thirty days old seedlings cauliflower was transplanted from 12.09.06 to 02.10.06 with spacing 50 cm × 35 cm at Gangni and 9.11.06 with 60 cm × 35 cm spacing at Bharamara. Irrigation, pesticide application, plant protection measures and other intercultural operations were done as and when required. The crops were harvested from 07.11.06 to 16.11.06 at Gangni and 04.01.2007 at Bharamara. Cauliflower was transplanted on with 30 days old seedlings. Spacing was 60 × 25 cm. The crops were harvested at maturity.

Results and Discussions

It was revealed that yield of cauliflower increased due to application of USG over prilled Urea. Higher yield was obtained from the T_2 where USG (Rec. dose) was followed at Gangni but at Bharamara, the highest yield was found in treatment T_5 (34.74 ton/ha), where farmers practice was followed. Higher gross return and net return was obtained from treatment T_4 (Tk.866700/ha & Tk. 779895/ha) at Gangni and treatment T_5 (Tk. 312660/ha and Tk. 266310/ha) at Bharamara. So, from one year result showed that USG could be used instead of prilled Urea for higher benefit.

Farmers' reaction

Farmers were very satisfied with the USG application. They found that they could be benefited from this technology.

Conclusion

This was the first year trial. Farmers' were very satisfied and it will be continued for the next year. USG should be available to the farmers.

Table 1. Yield and yield components of Cauliflower as affected by USG at Gangni, Kushtia during 2006-07

Treatment	Average wt. of cauliflower /m^2 (kg)	Average wt. of each cauliflower (kg)	Yield (t/ha)	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	3.19	0.64	31.88	557987	86722	471265	6.43
T_2	4.66	0.93	46.45	812875	87225	725650	9.31
T_3	4.16	0.83	41.63	728525	87015	641510	8.36
T_4	3.92	0.78	39.24	866700	86805	779895	9.98
T_5	3.32	0.66	33.19	580825	82200	498625	7.06
LSD (0.05)	-	0.12	6.92	-	-	-	-
CV (%)	-	8.98	9.55	-	-	-	-

Price (Tk./kg): Cauliflower 17.50

Table 2. Yield and yield components of Cauliflower as affected by USG at Bharamara, Kushtia during 2006-07.

Treatment	Average wt. of cauliflower /m^2 (kg)	Average wt. of each cauliflower (kg)	Yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk./ha)	BCR
T_1	3.34	0.83	30.40	274252	40222	234030	6.80
T_2	3.35	0.84	30.41	273712	40725	232987	6.72
T_3	3.09	0.77	27.86	250762	40515	210247	6.19
T_4	2.71	0.68	24.37	219307	40305	179002	5.44
T_5	3.90	0.97	34.74	312660	46350	266310	6.74
LSD (0.05)	-	0.10	2.19	-	-	-	-
CV (%)	-	3.73	3.94	-	-	-	-

Price (Tk./kg): Cauliflower= 9

Effect of Integrated Nutrient Management Options on the Yield of Cabbage and Cauliflower

Abstract

The experiment was conducted at MLT site Dhirashram, Gazipur sadar (AEZ-28) during the rabi seasons of 2005-06 and 2006-07 to evaluate the proper nutrient management options and to determine the economic dose of fertilizer for cabbage and cauliflower. The cabbage variety Autumn Queen and cauliflower variety Shirajiku F_1 were tested. Soil test based (STB) inorganic fertilizer does for HYG and two IPNS treatment with poultry manure (PM) and cowdung (CD) along with farmers practice and no fertilizer treatment were verified. Average of two years data showed that higher head yield of cabbage (110.6 t/ha) was obtained from IPNS based fertilizer for HYG with PM but higher curd yield of cauliflower was obtained from STB inorganic fertilizer dose for HYG (57.17 t/ha). Regarding cost and return analysis higher gross margin and MBCR were calculated from STB inorganic fertilizer in both crops. Cost for organic fertilizer reduced the MBCR in IPNS treatment.

Introduction

Cabbage and cauliflower are very popular winter vegetable crops in Bangladesh. Farmers recently grow the hybrid varieties due to available seed in the market and higher yield. Hybrids become very popular to the farmers and the area for vegetable cultivation is increasing day by day. But information regrinding fertilizer recommendation for hybrid varieties of vegetable are particularly P and K fertilizers in vegetable crops very scanty in Bangladesh. Cabbage and cauliflower is also very popular winter vegetable crop in Gazipur and the farmers are using hybrid varieties of vegetable for the last couple of years. In Gazipur sadar, the farmers applied high dose of chemical fertilizers and a recent field survey reveals that the yield of cabbage and cauliflower is lower than expected yield which might be due to imbalance use of inorganic fertilizer and organic manure. An integrated use of inorganic and organic fertilizer are may help to improve soil fertility and also increase crop productivity. Therefore, keeping all these views the present study was taken to find out the proper nutrient management packages for hybrid varieties of cabbage and cauliflower in medium highland soil at Gazipur Sadar under AEZ 28.

Materials and Methods

The experiment was conducted under irrigated condition during the rabi season of 2005-06 and 2006-07, at MLT site Dhirashram, Gazipur under AEZ 28 (Madhupur Tract). The design of the experiment was RCBD with five dispersed replications. The plot size was 4m x 5m (20 m^2). The crop varieties Autumn Queen (cabbage) and Shiragiku F_1 (cauliflower) were transplanting on 7 November, 2006. Fertilizers were applied as per treatment based on soil analysis and BARC fertilizer recommendation guide 1997. Five different fertilizer packages were tested and the treatments were T_1= IPNS basis fertilizer management for high yield goal (HYG) with PM, T_2= IPNS with CD for HYG, T_3= Soil Test basis inorganic for HYG, T_4= Farmers' dose and T_5= Control.

Treatments	Crops	
	Cabbage	Cauliflower
	Nutrient rate (kg/ha)	
	N- P- K- S- B- CD- PM	N-P-K-S-B-CD-PM
T_1	186-12-116-31-1-0-3000	133-12-81-24-1-0-3000
T_2	201-12-122-31-1-5000-0	148-12-87-24-1-5000-0
T_3	216- 12- 137- 31- 1- 0- 0	163- 12- 102- 24- 1- 0- 0
T_4	98-62-47-19-0-8000-0	98-62-47-19-0-8000-0
T_5	0- 0 - 0 - 0 -0 - 0 - 0	0 - 0 - 0 - 0 - 0 - 0 - 0

The entire amount of CD, PM, 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 at 7-10, 25-30 DAT to heading and curd formation stage for cabbage and cauliflower, respectively. Thirty five days old seedlings of cabbage and cauliflower were transplanted at a spacing of 60cm x 60cm. Intercultural operations such as weeding, irrigation and pest control measures were done in order to maintain the normal crop growth. Irrigations were given six times. The crops were harvested on 11-18 January, 2007. Data on yield and yield attributes along with other parameters were collected properly and subjected to statistical analysis.

Nutrient status of the initial soil sample at MLT site, Dhirashram, Gazipur

Parameters	pH	OM (%)	K (meq/ 100 ml)	Total N (%)	P	S	Zn	B
					Ug/ml			
Soil test value	5.7	1.162	0.132	0.0614	51.8	12.2	3.04	0.194
Interpretation	Acidic	L	L	VL	VH	L	VH	L

Results and Discussion

Yield

A. Cabbage

Plant height, yield attributes and head yield were significantly influenced by the treatments (Table 1) in 2006-07. There was no significant difference in plant height among the treatments except control plot. The whole plant weight also showed lower weight in farmer and control plot. Similar trend was followed in case of marketable head weight and head yield. The result of the both the years were almost similar. On an average, higher head yield was recorded from T_1 but closely followed by T_3 and T_2 and higher than farmers' dose.

B. Cauliflower

Significant variation was found in plant height, whole plant weight, marketable curd weight and curd yield of cauliflower. Higher plant height was recorded from treatment T_3 followed by T_4 and the lowest height from control. Farmers' dose and control plot showed the lowest whole plant weight as compared to other treatments. Similar trend was followed in case of marketable curd weight. But the highest curd yield was obtained from treatment T_2 where IPNS with cowdung for HYG was used. Farmers' dose failed to show higher curd yield than any of organic or inorganic fertilizer used in the treatment.

Cost and return analysis

The cost and return analysis of two years of cabbage and cauliflower have been presented in Table 2 and 4. In cabbage the highest gross return was calculated from T_1 followed by T_3, but gross margin was highest in T_3 due to low variable cost. In both the crops the variable cost was highest in T_4 followed by IPNS due to cost of PM and cowdung applied. The low variable cost and high MBCR was observed in T_3 due to inorganic fertilizer cost only. Higher cost for organic manure reduced the MBCR. Considering the yield, cost and return as well as soil fertility concern the fertilizer dose based on IPNS (T_1 and T_2) and estimated dose (T_3) of fertilizer for HYG were found superior for cabbage and cauliflower at Gazipur sadar under AEZ 28.

Farmers' reaction

Farmers of that location are highly pleased with the higher yield and positive effect of IPNS and STB dose of fertilizer for HYG. They opined that in future they will use IPNS dose for cabbage and cauliflower production.

Conclusion

Higher yield and return was obtained from soil test based inorganic fertilizer followed by IPNS with poultry manure for HYG in both the crops. The experiment needs to be repeated next year for final recommendation.

Table 1. Effect of different nutrient management packages on yield and yield attributes of cabbage at MLT site Dhirashram, Gazipur during 2006-07

Treatments	Plant height (cm)	Whole plant wt. (kg)	Marketable head wt. (kg)	Marketable head yield (t/ha)
T_1	32.98a	4.30a	3.91a	117.1a
T_2	33.22a	4.22a	3.88a	116.5a
T_3	33.22a	4.12a	3.80a	114.1a
T_4	33.10a	3.54b	3.23b	96.9b
T_5	30.50b	1.58c	1.14c	34.3c
CV (%)	3.11	4.08	3.30	3.33

Table 2. Cost and return analysis of different nutrient management packages in cabbage at MLT site, Dhirashram Gazipur during 2005-06 and 2006-07

Treatments	Yield (t/ha)			Gross return (Tk./ha)	Variable cost* (Tk./ha)	Gross margin (Tk./ha)	MBCR (over control)
	2005-06	2006-07	Mean				
T_1	104.1	117.1	110.6	306053	17687	288366	12.2
T_2	101.3	116.5	108.9	301156	23131	278025	9.1
T_3	104.5	114.1	109.3	302869	11399	291470	18.6
T_4	89.7	96.9	93.3	258687	29590	229097	5.7
T_5	31.3	34.3	32.8	90985	0	90985	-

* Fertilizer cost only.

Table 3. Effect of different nutrient management packages on yield of cauliflower at MLT site, Dhirashram, Gazipur during 2006-07

Treatments	Plant height (cm)	Whole plant wt. (kg)	Marketable curd wt. (kg)	Marketable curd yield (t/ha)
T_1	64.04b	2.50a	2.00a	55.38c
T_2	64.08b	2.50a	2.04a	58.34a
T_3	67.08a	2.30a	1.98a	56.74b
T_4	65.96ab	2.04b	1.86b	52.02d
T_5	43.44c	1.15c	0.73c	20.96e
CV (%)	3.63	8.51	3.45	2.07

Table 4. Cost and return analysis of different nutrient management packages in cauliflower at MLT site, Dhirashram Gazipur during 2005-06 and 2006-07

Treatments	Yield (t/ha)			Gross return (Tk./ha)	Variable cost* (Tk./ha)	Gross margin (Tk./ha)	MBCR (over control)
	2005-06	2006-07	Mean				
T_1	56.9	55.38	56.14	337740	15349	322391	14.2
T_2	55.6	58.34	56.97	340555	20793	319762	10.6
T_3	57.6	56.74	57.17	343555	9061	334494	24.7
T_4	50.0	52.02	51.01	305050	29590	275460	6.3
T_5	19.3	20.96	20.13	119810	0	119810	-

*Fertilizer cost only

Integrated Nutrient Management for Potato Production in the High Barind Tract

Abstract

A study was undertaken at the Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during 2006-2007 to find out an optimum and economic fertilizer dose for potato production in High Barind Tract. The treatments combinations were: (i) T_1 (Based on soil test): $N_{145}P_{22}K_{51}S_{11}Zn_3B_1$ kg/ha (ii) T_2 (IPNS): $N_{110}P_{10}K_{30}S_{11}Zn_{13}B_1$ kg/ha + Poultry manure 3 t ha^{-1} iii) T_3 (Farmers practice): N_{100} P_{30} K_{80} S_{15} Zn_3 kg ha^{-1} + 8 t/ha (iv) T_4 (Without fertilizers): $N_0P_0K_0S_0Zn_0B_0$ kg/ha. The yield and yield components of potato were significantly influenced by the different nutrient management packages. Treatment T_3 (Farmers practice) produced the maximum tuber yield of potato 17.43 t/ha (115% increased over control) which was identical with tuber yield 16.32 t/ha obtained from based on soil test value for high yield goal (T_1). The highest gross margin of Tk.146920/ha was obtained in T_3 treatment followed by Tk.138930/ha in T_1 treatment. The highest MBCR over control (9.28) and MRR (1739%) were obtained in T_1 treatment. So, the fertilizer dose $N_{145}P_{22}K_{51}S_{11}Zn_3B_1$ kg/ha was optimum for maximizing the yield as well as economically profitable and viable for potato production in High Barind Tract soil.

Introduction

High Barind Tract (AEZ 26) comprises part of Rajshahi, Chapinawabganj and Naogoan district, characterized by grey terrace soil, low organic matter, low rainfall and high temperature. Potato is one of the major food crops in Bangladesh. It is mainly used as vegetable in our country. The increase of area and production of potato in High Barind tract is comparatively less than other area of Bangladesh. But the acceptance and area coverage of potato in High Barind Tract are increasing day by day. The average yield of potato in HBT is comparatively low. The factors responsible for this gap are variety, seed quality, soil climate and nutrient management (Elias *et al.*, 1991). The basic concept underlying the integrated plant nutrition system (IPNS) is to provide an ideal nutrition for a crop through a proper combination of various nutrient resources and their optimum utilization along with maintenance of soil productivity. The sustainable crop production might be possible through the integrated use of organic manure and chemical fertilizer. Sustainable production of crops can not be maintained by using the chemical fertilizers alone and similarly it is not possible to obtain higher crop yield by using only organic manure (Bair, 1990). The intensive cropping with modern varieties and nutrient leaching with monsoon rains caused a marked depletion of nutrients from Bangladesh soil. Soil test and judicious application of fertilizers target yield of crops is one of the approaches to overcome the problem of nutrient mining from soils. Being a high biomass yield, potato absorbs large quantities of different nutrients from the soil. In Bangladesh, Potato is grown intensive-cropped soil and thus heavy dose of fertilizers are needed to obtain satisfactory yields. Farmers of Barind area used different fertilizer dose for potato production. Therefore, it is necessary to develop a fertilizer recommendation for potato production in HBT soil. The present research work has been undertaken to verify and find out the optimum dose for potato production in High Barind Tract.

Materials and Method

A Field experiment was conducted at the Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during 2006-2007 to find out an optimum and economic fertilizer dose for potato production in High Barind Tract. Before conducting the experiment, the soil of the experimental field was chemically analyzed in the SRDI laboratory, Rajshahi. The soil of the experimental plots belongs to Amnura series under AEZ 26 and composed of grey terrace soils of silty clay loam in texture with a pH value of 5.6. The soil contained 0.88% organic matter, 0.07% total N, 5.89 ppm available P, 0.27 me% exchangeable K, 18 ppm available S, 0.1 ppm available B and 0.88 ppm available Zn. The levels of the fertilizers were selected on the basis of target yields as per

Fertilizer Recommendation Guide' 2005. The experiment was design is a randomized complete block design with three replications. The description of the treatments is stated Table 1.

Table 1. Description of the treatments and nutrient rates for potato

Treatment code	Description of the treatments	Nutrient rate (kg/ha)						PM (t/ha)	CD (t/ha)
		N	P	K	S	Zn	B		
T_1	HYG (Based on soil test according to FRG"2005)	145	22	51	11	3	1	0	0
T_2	IPNS for HYG	110	10	30	11	3	1	3	0
T_3	Farmer's practice	120	30	80	15	3	0	0	5
T_4	Control	0	0	0	0	0	0	0	0

Note: HYG: High yield goal, IPNS: Integrated plant nutrition system

Fertilizer recommendations for high yield goal (HYG) were determined from soil test values according to Fertilizer Recommendation Guide'2005. The fertilizer levels used by the farmers were considered as farmers practice (FP). Poultry manure had 1.5% N, 0.55% P, 0.75% K. Full doses of poultry manure, one third of 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 25 and 35 DAS. The unit plot size was 3 m x 3 m. Potato (Variety: Cardinal) tubers were planted on 30 November 2006. The tubers were planted at the spacing of 60 cm × 25 cm. The crop was harvested at maturity on 05 March 2007. Intercultural operations viz. earthling up, weeding, irrigation, fungicide and insecticide spray were done in order to support normal plant growth. Data on yield and yield contributing characters of potato were recorded. Observations were made on yield components from 10 randomly selected plants per plot. All the data were statistically analyzed and the mean comparisons were made by DMRT at 5% level of significance. The economic analysis was done for gross return, marginal benefit cost ratio and marginal rate of return (MRR) for different nutrient management packages following the method suggested by Perrin *et al*. (1979).

Results and Discussion

Yield components

Yield components of potato responded significantly to different fertilizer treatments (Table-2). The height of potato plant increased from 26.9 cm in the control treatment to 50.5 cm in treatment T_1. The maximum plant height (50.5 cm) was found in the treatment T_1 due to higher doses of nitrogen. The highest number of stems (4.06) and leaves (15) per plant were found in treatment T_3 (Farmers practice) due to higher doses of inorganic fertilizer with organic fertilizer. The highest foliage coverage at 60 DAP, 83.66 and 83% were found in the treatment T_3 and T_1 due to higher doses of nitrogen. The fertilizer dose used by the farmers (T_3) produced maximum number of tuber per plant (8.16) and average weight of tuber (69.66 g). This might be due to higher doses of potassium and cowdung. This results support the findings of Sarker *et al.* (1996) who reported that application of organic manure with chemical fertilizer produced the higher number of tuber per plant and tuber weight. The minimum tuber per plant (4.6) and average tuber weight (27.67 g) were found in control (T_4) due to lower fertility. There was a linear relationship between number of tuber plant^{-1} and tuber yield (Fig.1) and average tuber weight and tuber yield (Fig. 2). The maximum days (92) for maturity of potato were found in IPNS treatments (T_2), which were at per with T_3 treatment (91). This might be due to presence of organic mature.

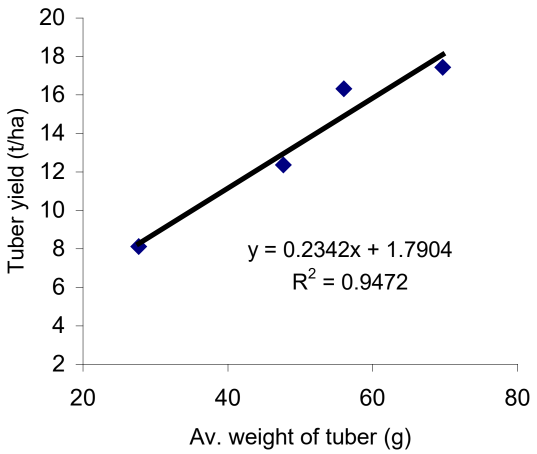

Fig. 1. Regression between average weights of tuber and tuber yield of potato

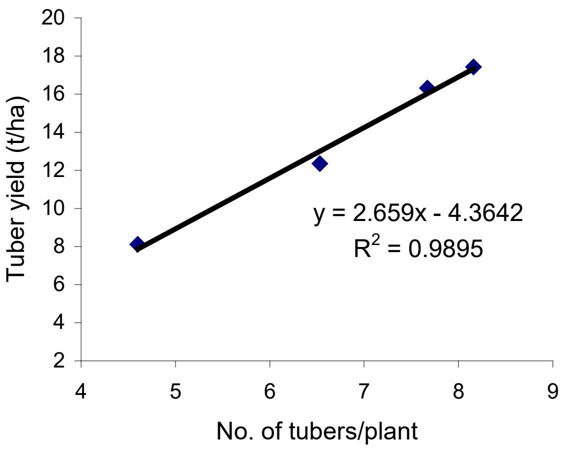

Fig. 2. Regression between number of tubers/ plant and tuber yield of potato

The straight line plotted in the figure indicates that there is a linear relationship between number of tuber/plant & tuber yield and average weight of tuber & tuber yield of potato. It is observed that with the increase of number of tuber/plant and weight of tuber, the tuber yield is to be found increased.

Tuber yield

Fertilizer treatments significantly influenced on the tuber yield of potato (Table 3). The fertilizer dose used by the farmers (T_3) produced the higher tuber yield of potato compared to the other treatments. The tuber yield ranged from 8.12 to 17.43 t/ha. The highest tuber yield (17.4 t ha^{-1}) was obtained from T_3 (Farmers practice) showing an increase of 115% over control and was significantly different from all other treatments. The result is in agreement with the findings of Upadhayay and Grewal (1987) was obtained height tuber yield by the application of organic manure and chemical fertilizer. The next highest tuber yield (16.32 t ha^{-1}) was observed in treatment T_1 (HYG). Treatment T_3 (Farmers practice) and T_1 (HYG) produced higher tuber yield due to higher number of tuber $plant^{-1}$ and average tuber weight. This result is in also agreement with the findings of Sharma (2003) who reported that tuber yield of potato increased with the increase of fertilizer rate.

Cost and return analysis

The highest gross margin (Tk. 146920/ha) was found in treatment T_3 followed by T_1 (Tk. 138930/ha) and the lowest (Tk.73080/ha) in T_4 (Table 3). This variation occurred due to the variation of tuber yield of potato. On the other hand, the highest MBCR over control (9.28) was found in treatment T_1 that was closely followed by treatment T_3 (8.42). Karim *et al.* (1994) reported that farmers always try to maximize their returns up to the point where returns to investment are the highest as the capital is scarce. The performance of undominated treatments has been done through marginal analysis (Table 4). The highest marginal rate of return (MRR) 1739% was found in treatment T_1 indicating that if the farmers spend additional one hundred taka, they can expect a benefit of Tk. 1739/ha. Thus farmers of the area may be advised to go for treatment T_1 that supplies sufficient balanced nutrients. The marginal farmers who are unable to afford necessary cost may choose T_2. Considering MBCR and MRR, treatment T_1 (Nutrients for HYG based on soil test value) was found economically profitable and viable among the nutrient management treatments for the cultivation of potato in the High Barind Tract soil.

Conclusion

From the results of this investigation, it may be concluded that the treatment T_1 (Nutrients for HYG based on soil test value) was found economically profitable and viable for the production of potato in the High Barind Tract soil. So, the fertilizer dose $N_{145}P_{22}K_{51}S_{11}Zn_3B_1$ kg/ha was optimum for growing as well as economic benefit of potato. This was first year result. So, a concrete conclusion is not possible to draw. It needs further investigation with proper care in the next year.

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Table 2. Yield components of potato as influenced by nutrient management

Treatments	Plant height (cm)	No. of stems/ plant	No. of leaves/ plant	Foliage coverage at 60 DAP	No. of tuber/ plant	Average wt. of tuber (gm)	Days to maturity	Yield (t/ha)
T_1	50.5	3.46	16	83.00	7.63	57.00	88	16.32
T_2	47.0	3.26	15	78.33	6.53	47.67	92	12.36
T_3	42.3	4.06	18	83.66	8.16	69.66	91	17.43
T_4 (Control)	26.9	2.16	12	62.33	4.60	27.67	86	8.12
LSD (0.05)	8.64	0.55	3.31	10.90	1.46	18.14	5.05	1.05
CV (%)	6.85	5.70	7.25	4.69	7.17	11.87	1.87	8.36

Note: Figures in a column having same letter do not differ significantly at 5% level by DMRT

Table 3. Partial budget analysis for fertilizer use in potato production

Treatments	Gross return (Tk/ha)	Variable cost of fertilizers (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	146880	7950	138930	9.28
T_2	111240	6012	105228	6.34
T_3	156870	9950	146920	8.42
T_4	73080	0	73080	-

Price (Tk./kg): Urea= 6, TSP= 18, MP= 17, Gypsum= 5, Zincoxide= 80, Boric acid= 150, Cowdung= 0.20, Poultry manure= 0.60 & Potato tuber= 9

Table 4. Marginal analysis of cost undominated treatments on the yield of potato

Treatments	Gross margin (Tk/ha)	Variable cost (Tk/ha)	Marginal increase in net benefit (Tk/ha)	Marginal increase in variable cost (Tk/ha)	Marginal rate of return (%)
T_3	146920	9950	7990	2000	399
T_1	138930	7950	33702	1938	1739
T_2	105228	6012	32148	6012	534
T_4	73080	0	-	-	-

Integrated Nutrient Management for Tomato Production in the High Barind Tract

Abstract

A study was undertaken at the Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during 2006-2007 to find out an optimum and economic fertilizer dose for tomato production in High Barind Tract. 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 (Based on soil test for HYG): $N_{140}P_{40}K_{90}S_{30}Zn_4$ kg/ha (ii) T_2: T_1 + Cowdung 5 t/ha iii) T_3 (IPNS for high yield goal): N_{124} P_{33} K_{74} S_{30} Zn_4 kg/ha + Cowdung 5 t/ha (iv) T_4 (According to FRG' 2005): $N_{135}P_{37}K_{50}S_8Zn_{1.5}$ kg/ha v) T_5: T_4 + Cowdung 5 t/ha vi) T_6 (Farmers practice): N_{80} P_{30} K_{55} S_{20} kg/ha and vii) T_7 (Control). The yield and yield components of tomato were significantly influenced by the different nutrient management packages. The IPNS treatment (T_3) produced the maximum fruit yield of tomato (43.05 t/ha) which was 155% increased over control. The highest net benefit of 246300 Tk./ha was obtained in T_3 treatment followed by 220780 Tk./ha in T_2 treatment. The highest MBCR over control (13.54) and MRR (2934%) were obtained from T_3 treatment. So, the fertilizer dose $N_{124}P_{33}K_{74}S_{30}Zn_4$ kg/ha + Cowdung 5 t/ha was optimum for maximizing the yield as well as economically profitable.

Introduction

Tomato (*Lycopersicon esculentum*) is one of the most popular and nutritious vegetable crop in Bangladesh. At present, tomato ranks third next to potato and sweet potato in terms of world vegetable production (FAO, 2002). It is the dependable source of vitamin A, B, C and minerals Ca, P and Fe (Islam, 1996). In Bangladesh it is cultivated as winter vegetable, which occupies on area of 14906 ha of land with annual production of about one lakh tons (BBS, 2004). In High Barind Tract, farmers are produced early tomato after harvest of T. aus rice. Early tomato cultivation is increasing day by day in this area. The average yield of tomato in High Barind Tract is low compared to other parts of the country. The factors responsible for this gap are variety, seed quality, soil climate and nutrient management (Elias *et al*. 1991). The basic concept underlying the integrated plant nutrition system (IPNS) is to provide an ideal nutrition for a crop through a proper combination of various nutrient resources and their optimum utilization along with maintenance of soil productivity. The sustainable crop production might be possible through the integrated use of organic manure and chemical fertilizer. A judicious application of nutrients from both organic and inorganic sources might be helpful in obtaining higher yield of tomato in Barind soil. Rahman *et al.* (1998) reported that the highest yield of tomato was obtained by the application of organic and inorganic fertilizer. A suitable combination of organic and inorganic sources of nutrients is necessary for a sustainable agriculture that will provide a good economic return with good soil health. Soil test and judicious application of fertilizers for target yield of crops is one of the approaches to over come the problem of nutrient mining from soils. Bangladesh Agricultural Research Council (BARC) developed a national Fertilizer Recommendation Guide 2005. This will help in judicious application of fertilizers for target yield. Farmers of Barind area used different fertilizer dose for tomato production. It may be possible to increase the yield of tomato by evolving a proper combination of organic and inorganic fertilizer. But no work has been done in respect of nutrient management to improve and sustain production and yield of tomato in the Barind Tract of Bangladesh. Therefore, it is very necessary to develop a fertilizer recommendation for tomato production in HBT soil. Considering the above facts the present research work was undertaken to find out an optimum and economic fertilizer dose for tomato production in the High Barind Tract.

Materials and Methods

A Field experiment was conducted at the Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during 2006-2007 to find out an optimum and economic fertilizer dose for tomato production in High Barind Tract. Before conducting the experiment, soil of the experimental field was chemically analyzed in the SRDI laboratory, Rajshahi. The soil of the experimental plots belongs to Amnura series under AEZ 26 having a pH value of 5.5, 0.92% organic matter, 0.09% total N, 6.45 ppm available P, 0.26 me% exchangeable K, 16 ppm available S and 0.86 ppm available Zn. The levels of the fertilizers were selected on the basis of target yields as per Fertilizer Recommendation Guide' 2005. The experiment was designed with seven treatments; laid out in a randomized complete block design with three replications. The description of the treatments is stated in the following table.

Table 1. Description of the treatments and nutrient rates for tomato

Treatment	Description of the treatments	Nutrient rate (kg/ha)					CD
		N	P	K	S	Zn	(t/ha)
T_1	HYG (Based on soil test)	140	40	90	30	4	-
T_2	T_1 + Cowdung	140	40	90	30	4	5
T_3	IPNS basis	124	33	74	30	4	5
T_4	FRG 2005	135	37	50	8	1.5	-
T_5	T_4 + Cowdung	135	37	50	8	1.5	5
T_6	Farmer's practice	80	30	55	20	-	-
T_7	Control	0	0	0	0	0	0

Note: HYG= High yield goal, IPNS= Integrated plant nutrition system

Fertilizer recommendations for high yield goal (HYG) were determined from soil test values according to Fertilizer Recommendation Guide'2005. The fertilizer levels used by the farmers were considered as farmers practice (FP). This was the average of the fertilizer doses used by the farmers of the village Kadamshahar during 2005-2006. The sources of nutrients were urea for N, TSP for P, MP for K, Gypsum for S and Zinc oxide for Zn. Cowdung had 0.96% N, 0.27% P, 0.82% K. Full doses of cowdung, one fourth of 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 21, 35 and 45 days after transplanting. The unit plot size was 3 m x 2 m. Thirty days old seedlings of tomato (Variety: Surrokha) were transplanted on 16 September 2006 with the spacing of 60cm x 50cm. Tomato was harvested on 1st December 2006 to 15 January 2007. Intercultural operations viz. weeding, irrigation, fungicide and insecticide spray were done in order to support normal plant growth. Data on yield and yield contributing characters were recorded. Observations were made on yield components from 10 randomly selected plants per plot**.** The data were analyzed statistically and the mean differences were adjudged by LSD. The economic analysis was done for gross return, marginal benefit cost ratio and marginal rate of return (MRR) for different nutrient management packages following the method suggested by Perrin *et al.* (1979).

Results and Discussion

Yield components

Yield components of tomato responded significantly to different nutrient management packages (Table 2). The height of tomato plant increased from 66.54 cm in the control treatment to 85.42 cm in treatment T_2. Maximum plant height 85.42 cm was found in the treatment T_2 due to higher doses of nitrogen and cowdung. Kuksal *et al.* (1997) reported that nitrogen application at higher rates increased plant height. Maximum number of plants/m^2 and primary branch/plant were found in treatment T_3 (IPNS). The highest number of fruits/plant (30) was found in integrated plant nutrition system (T_3), which was at par with treatment T_1 and T_2 followed by treatment T_5. The minimum number of fruits/plant (20) was found in control treatment due to lower fertility. The highest fruit length (4.59 cm) and diameter (4.98 cm) were also found in IPNS treatment (T_3). This might be due to proper combination of organic and inorganic fertilizer. Combined application of organic and inorganic fertilizer's improved soil health and made better environmental condition for plant growth and development resulted in increased fruit diameter. The result is in agreement with Islam *et al.* (1997) who reported that the length and breath of individual fruit of tomato was increased with proper combination of organic and inorganic fertilizer. The highest fruit yield/plant (2.02 kg) was found in treatment T_3 that was statistically identical with T_1, T_2 and T_5 and lowest (0.98 kg) in control treatment. There was a linear relationship between number of fruits/plant and fruit yield (Figure 1).

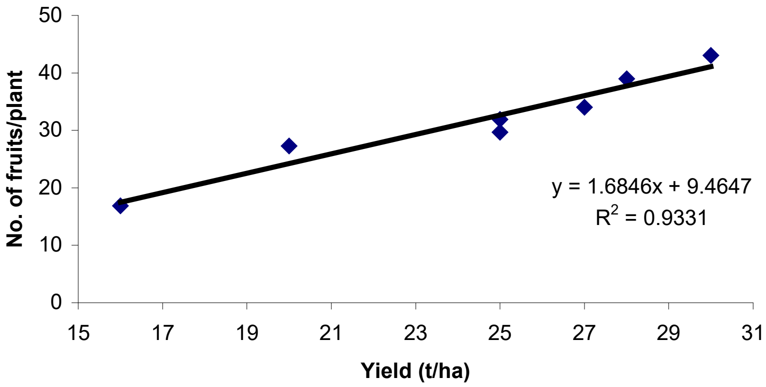

Figure 1. Regression between number of fruits/plant and fruit yield of tomato

The regression equation Y = 1.6846x + 9.46 and the straight line plotted in the figure indicate that there was a linear relationship between number of fruits/plant and fruit yield of tomato. It was observed that with the increase of number of fruits/plant, the fruit yield was found to be increased.

Fruit yield

There was a significant effect of different nutrient management packages on the fruit yield of tomato (Table 3). The application of fertilizer on the basis of integrated plant nutrition system for HYG (T_3) increased the fruit yield of tomato compared to the other nutrient management practices. The fruit yield ranged from 16.86 to 43.05 t/ha. The maximum fruit yield (43.05 t/ha) was obtained from T_3 (IPNS) showing an increase of 155% over control but it was at par to treatment T_2 whereas the lowest yield (16.86) in control plot due to poor fertility. Treatment T_3 (IPNS) and T_2 produced higher fruit yield due to higher number of fruits/plant and fruit yield/plant. This result is in agreement with the findings of Prezotti *et al.* (1988) who stated that combined application of organic and inorganic fertilizer increased total productivity by 48% of tomato.

Cost and return analysis

Gross return, variable cost, gross margin, marginal benefit-cost ratio over control and marginal rate of return of different fertilizer treatment for tomato have been shown in Table 4. The economic analysis of the experiment exhibited that treatment T_3 (IPNS) produced the highest gross margin of Tk.246300/ha, although its variable cost was Tk.11600/ha. The second highest gross margin, Tk.220780/ha was recorded from treatment T_2 and the lowest Tk. 101160/ha in control plot (T_7). This variation occurred due to the variation of fruit yield of tomato. On the other hand, the highest MBCR over control (13.54) was found in treatment T_3 that was closely followed by treatment T_2 (10.04). Karim *et al.* (1994) reported that farmers always try to maximize their returns up to the point where returns to investment are the highest as the capital is scarce. The performance of undominated treatments has been done through marginal analysis. The highest marginal rate of return 2934% was found in treatment T_3 indicating that if the farmers spend additional one hundred taka, they can expect a benefit of Tk. 2934/ha. Thus farmers of the area may be advised to go for treatment T_3 that supplies sufficient balanced nutrients. The marginal farmers who are unable to afford necessary cost may choose T_4. Considering MBCR and MRR, treatment T_3 (IPNS for HYG based on soil test value) was found economically profitable and viable among the nutrient management treatments for the cultivation of tomato in the High Barind Tract soil.

Conclusion

From the results, it may be concluded that the integrated plant nutrition system (IPNS) for high yield goal (T_3) was found economically profitable and viable for growing tomato in High Barind Tract soil. So, the fertilizer dose $N_{124}P_{33}K_{74}S_{30}Zn_{14}$ kg/ha + cowdung 5 t/ha was optimum for growing as well as economic benefit of tomato in High Barind Tract soil. This was first year result, further investigation with proper care in the next year.

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Table 2. Yield components of tomato as influenced by different nutrient management

Treatments	Plant height (cm)	No. of plants/m^2	Primary branch/plant	No. of fruits/ plant	Fruit length (cm)	Fruit diameter (cm)
T_1	80.39	4.24	12	27.00	3.42	4.28
T_2	85.42	3.74	14	28.30	4.00	4.50
T_3	83.36	4.28	15	30.20	4.59	4.98
T_4	79.49	3.60	11	24.80	3.69	4.08
T_5	82.60	3.66	13	25.03	3.90	4.16
T_6	76.23	3.52	9	20.00	3.28	3.88
T_7	66.54	3.12	6	15.94	2.96	3.02
LSD (0.05)	6.07	0.714	12.23	4.48	0.72	1.03
CV (%)	4.08	7.66	3.48	7.35	5.27	12.01

Note: Figures in a column having same letter do not differ significantly at 1% level by DMRT

Table 3. Yield of tomato as influenced by different nutrient management packages

Treatments	Fruit yield (kg/plant)		Fruit yield (t/ha)	
	Yield (kg/plant)	% Yield increase over control	Yield (t/ha)	% Yield increase over control
T_1	1.80	84	34.01	101
T_2	1.94	98	39.00	131
T_3	2.02	106	43.05	155
T_4	1.68	70	29.70	76
T_5	1.74	72	31.88	89
T_6	1.22	25	27.31	62
T_7	0.98	-	16.86	-
LSD (0.05)	0.46	-	5.72	-
CV (%)	11.49	-	6.27	-

Note: Figures in a column having same letter do not differ significantly at 1% level by DMRT

Table 4. Partial budget analysis for fertilizer use in tomato production

Treatments	Gross return (Tk/ha)	Variable cost of fertilizers (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)	MRR (%)
T_1	204060	12100	191960	8.50	D
T_2	234000	13220	220780	10.04	D
T_3	258300	11600	246300	13.54	2934
T_4	178200	9700	167900	7.94	530
T_5	191280	10800	180480	8.34	913
T_6	163860	8560	155300	7.32	695
T_7	101160	0	101160	-	

Price (Tk./kg): Urea= 6, TSP= 18, MP= 17, Gypsum= 5, Zincoxide= 80, Boric acid= 150, Cowdung= 0.02, & Tomato= 6

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Effects of Different Levels of Nitrogen and Sulphur on the Yield and Storability of Summer Onion

Abstract

Nitrogen and sulphur levels on the yield and yield contributing characters of summer onion (Var. BARI Piaj-2) for the High Barind Tract were studied in farmer's field at Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during 2006-2007. Four levels of nitrogen (0, 50, 100 and 150 kg/ha) and four levels of sulphur (0, 20, 40 and 60 kg/ha) were used as treatment variables. The results showed that the highest bulb yield (10.3 t/ha) was recorded from 100 kg N/ha that was 77% increase over control. It was closely followed by 150 kg N/ha (9.32 t/ha) and the lowest bulb yield (5.84 t/ha) from no nitrogen. Sulphur dose (40 kg/ha) gave the highest bulb yield (9.27 t/ha) than other S levels and lowest (6.46 t/ha) from control (S_0). Regarding combined effect, the highest bulb yield (12.05 t/ha) was obtained from 100 kg N/ha with 40 kg S/ha and the lowest (4.33 t/ha) from control (N_0S_0). The higher percent of rotten bulbs (34.21%) after 90 days of storage was found from 150 kg N/ha with no sulphur whereas the lowest percent of rotten bulbs (12.28%) was found for the control treatment (N_0S_0). The maximum gross margin (101800 Tk./ha) and BCR (3.37) were obtained from 100 kg N/ha with 40 kg S/ha. Therefore, summer onion can be produced by the application of 100 kg N/ha with 40 kg S/ha for maximizing yield as well as economic benefit in the High Barind Tract of Bangladesh.

Introduction

Onion (*Allium cepa* L.) is an important spice crop grown in all over Bangladesh. Onion is used in almost all food preparation and is an integral part of Bangladesh. It is grown more or less in all the district of Bangladesh but the average yield being about 4 t/ha (BBS, 2004). There is an acute shortage of onion in relation to its requirement. Due to limitation of land, it is not possible to raise the area and production of the crop horizontally. The high demand of onion can only be meet up by increasing its per hectare yield. This can be done by many ways of which the most important are the judicious application of fertilizer and introduction of high yielding varieties. Many authors (Pathak, 1994) reported a significant response of onion to N and S fertilization. It can be cultivated both in rabi and kharif seasons. Its high demand can only be meet up by growing in summer season. For proper growth and development onion requires sufficient amount of nitrogen and sulphur. Nitrogen increases the vegetative growth, gives a deep green colour to the leaves and produces good quality foliage and promotes carbohydrate synthesis. Nitrogen is essential for building up of protoplasm and protein which induce cell division and initiate meristematic activity when applied in optimum quantity. The soil of high Barind tract contains very low amount nitrogen (<0.006% of total N). It can not provide proper amount of nitrogen to onion plant which resulted in stunted growth and reduce the yield of summer onion. Onion is a sulphur loving crop. In addition to NPK nutrients, sulphur has been found to be very beneficial for onion. It is essential for proper vegetative growth and bulb development in onion. Sulphur has a great influence in increasing the yield of onion and improving the quality especially pungency and flavors. Sehnug (1990) reported that sulphur compounds as the key development of quality of onion. Inadequate supply of sulphur nutrient caused slow crop growth at any stage resulting in yield reduction. Considering the above factors, the present study has been undertaken to observe the effect of nitrogen and sulphur on the yield and storability of summer onion varieties.

Materials and Methods

The experiment was conducted at the Farming System Research and Development (FSRD) site, Kadamshahar, Godagari, Rajshahi during 2006-2007 to find out the economic dose of nitrogen and sulphur and storability capacity of summer onion in the High Barind Tract. The soils of the experimental plots were analyzed in the laboratory of SRDI, Rajshahi before conducting the experiment. 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 soil contained 0.98% organic matter, 0.11% total N, 9.0 ppm available P, 0.25 me% exchangeable K, 14.89 ppm available S and 1.3 ppm available Zn. The treatments comprised three levels each of N (0, 50, 100 and 150 kg/ha as urea) and four levels of S (0, 20, 40 and 60 kg/ha as gypsum). Phosphorus @ 40 kg/ha as triple super phosphate, potassium @ 100 kg/ha as muriate of potash and cowdung 10 t/ha were applied as a blanket dose of all the plots. Full doses of cowdung and all other inorganic fertilizers except urea were applied to individual plot and mixed with soil at the time of final land preparation The urea was top dressed at 15, 35 and 45 DAT. The experiment was laid out in a factorial randomized complete block design with three replications. The unit plot size was 3m x 2m. Forty days old seedlings of onion (Variety BARI Piaj-2) were transplanted on 25 September 2006. The seedlings were transplanted at the spacing of 20cm x 10cm. Intercultural operations viz. mulching, weeding, irrigation, fungicide and insecticide sprays were done in order to support normal plant growth. The onion was harvested at maturity on 18 January 2007. Bulb of onion was stored in bag made by nylon net. Data for percent of rotten loss was collected after 15 days interval. Data on yield and yield contributing characters of onion were recorded. Observations were made on yield components from 10 randomly selected plants per plot. The data were analyzed statistically and the mean differences were adjudged by LSD. The economic analysis was done for gross return, gross margin and marginal benefit cost ratio for different treatments following the method suggested by Perrin *et al*. (1979). The gross return and benefit cost ratio were estimated by using the following formula:

Gross return (Tk./ha) = Yield (t/ha) × Average market price (Tk./kg) × 1000

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

Results and Discussion

Effect of nitrogen

Plant height, number of leaf/plant, number of bulb/m^2, bulb diameter, average bulb weight and bulb yield were significantly influenced by nitrogen except bulb length (Table 1). Among four nitrogen levels, 150 kg N/ha produced maximum plant height (49.36 cm) followed by 100-kg N/ha. The result is in conformity with Kuksal *et al.* (1997) reported that nitrogen application at higher rates increased plant height. The maximum number of leaf/plant was also found from 150 kg N/ha but lowest in control. Nehra *et al.* (1988) reported that application higher rates of N number of leaf significantly increased compared with N_0. The highest average weight of single bulb (58.08 g), bulb diameter (4.75 cm) and maximum number of bulb/m^2 were found from 100 kg N/ha but closely followed by 150 kg N/ha. The highest bulb yield (10.32 t/ha) was obtained from 100 kg N/ha and it was 77% higher yield (5.84 t/ha) over control. The result supports the findings of Gaushal *et al.* (1991) stated that increasing nitrogen levels increased the bulb yield.

Effect of sulphur

Plant height, number of leaf/plant, bulb diameter, average bulb weight and bulb yield were significantly influenced by sulphur except number of bulb/m^2 and bulb length (Table 2). The tallest plant (43.28 cm) was obtained from 40 kg S/ha but at par to 20 and 60 kg/ha. No sulphur (S_0) produced the shortest plant (34.02 cm). The maximum number of leaves/plant was found with 40 kg S/ha and minimum in without sulphur. There was no significant effect of sulphur on the number of bulb/m^2 and bulb length of onion. The highest bulb diameter (51.98 cm) and average single bulb weight (51.98 g) was obtained from 40 kg S/ha that was significantly differed from other levels of sulphur. Bulb yield was significantly influence by the different levels of sulphur. Forty kg S/ha produced maximum bulb yield (9.27 t/ha) due to the highest bulb diameter and average single bulb weight. This result is in agreement with the findings of Singh *et al.* (1996).

Interaction between nitrogen and sulphur levels

The effect of interaction between nitrogen and sulphur levels shows significant variation in respect of plant height, number of leaf/plant, bulb diameter, average bulb weight and bulb yield except number of bulb/m^2 and bulb length (Table 3). The tallest plant (52.12 cm) and maximum number of leaf/plant (11) were produced from 150 kg N/ha with 60 kg S/ha that were statistically identical to 100 kg N/ha with 40 kg S/ha. But the shortest plant (31.91 cm) and minimum number of leaf/plant (5) were produced from zero N and S. This result is in agreement with the findings of Harun-or-Rashid (1998). There was no significant effect of interaction between N and S levels on the number of bulb/m^2 and bulb length of onion. The highest bulb diameter (5.35 cm) and average single bulb weight (62.18 g) was obtained from 100 kg N/ha with 40 kg S/ha that was significantly differed from other levels of N and S. Bulb yield was significantly influence by the interaction of N and S levels. The maximum bulb yield (12.05 t/ha) was produced from 100 kg N with 40 kg S due to the highest bulb diameter and average single bulb weight. This result is in agreement with the findings of Singh *et al.* (1996) who reported that combined addition of N + S significantly increased yield. The minimum bulb yield (4.33 t/ha) was produced without N and S.

Cost and return analysis

Gross return, total variable cost, net return and marginal benefit cost ratio (BCR) of different combination of nitrogen and sulphur levels shown in Table 4. Cost and return analysis of the experiment exhibited that the maximum gross return (Tk. 144600/ha), gross margin (Tk.101800/ha), total variable cost (Tk.42800/ha) and benefit cost ratio (3.37) were obtained from 100 kg N/ha with 40 kg S/ha followed by same N level with 20 kg S/ha. The lowest gross return (51960 Tk./ha), gross margin (Tk.16300/ha), total variable cost (Tk.35660/ha) and BCR (1.45) were found in without N and S. This variation was attributed due to the variation of tuber yield of onion. Considering gross margin and marginal benefit cost ratio, it was found that 100 kg N/ha with 40 kg S/ha were economically profitable and viable for the production of onion in High Barind Tract.

Percent of rotten bulbs of onion at different period of storage was significantly influenced by N and S fertilization (Table 5). The higher percentage of rotten bulbs (34.21%) after 90 days of storage was found for 150 kg N/ha with no sulphur whereas the lowest percentage of rotten bulbs (12.28%) was found for the control treatment (N_0S_0). This might be due to higher dose of nitrogen. The results are in agreement with the findings of Ahmed *et al.* (1988). The lowest rotting percentage for crops harvested at 90 days was perhaps due to the fact that this crop was harvested in optimum matured stage. The lowest rotten loss was obtained from the onion bulbs of the control plots. It may be due to the control plots did not receive any fertilizers that kept the bulbs less succulent and also due to less attack of bacteria and fungi.

Conclusion

Therefore, it may be concluded that summer onion (Var. BARI Piaj-2) can be produced with 100 kg N/ha and 40 kg S/ha for maximizing the yield and economic benefit of summer onion in the High Barind Tract soil. The study should be continued in the next year for further verification.

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Table 1. Effect of different nitrogen levels on the yield and yield attributes of summer onion (Var. BARI Piaj-2)

Nitrogen levels	Plant height (cm)	No. of leaf/plant	No. of bulb/m^2	Bulb length (cm)	Bulb diameter (cm)	Av. bulb weight (g)	Bulb yield (t/ha)
N_0	34.02	6	35	4.89	3.23	35.16	5.84
N_{50}	42.19	7	39	5.06	4.16	38.80	8.17
N_{100}	45.62	9	41	5.23	4.75	58.08	10.34
N_{150}	49.36	10	39	5.20	4.35	44.38	9.32
LSD (0.05)	4.13	0.37	2.48	NS	0.09	0.98	0.56
CV (%)	8.01	7.91	8.47	6.06	3.30	4.08	9.95

Table 2. Effect of different sulphur levels on the yield and yield attributes of summer onion (Var. BARI Piaj 2)

Sulphur levels	Plant height (cm)	No. of leaf/plant	No. of bulb/m^2	Bulb length (cm)	Bulb diameter (cm)	Av bulb weight (g)	Bulb yield (t/ha)
S_0	36.77	6	37	4.99	3.81	43.43	6.46
S_{20}	41.82	8	39	5.08	4.01	46.63	8.62
S_{40}	43.28	9	39	5.11	4.33	51.98	9.27
S_{60}	42.56	8	38	5.10	4.30	48.94	9.00
LSD (0.05)	4.13	0.37	NS	NS	0.94	0.098	0.56
CV (%)	8.01	7.91	8.47	7.04	3.30	4.08	9.95

Figures in a column having same letter do not differ significantly at 5% level by DMRT, NS = Not significant

Table 3. Interaction effect between nitrogen and sulphur levels on the yield and yield attributes of summer onion (Var. BARI Piaj 2)

N x S levels	Plant height (cm)	No. of leaf/plant	No. of bulb/m^2	Bulb length (cm)	Bulb diameter (cm)	Av. bulb weight (g)	Bulb yield (t/ha)
N_0S_0	31.91	5	38	4.82	4.04	30.74	4.33
N_0S_{20}	34.68	6	40	4.95	3.30	34.53	6.20
N_0S_{40}	30.50	6	39	4.89	3.33	40.23	6.98
N_0S_{60}	32.82	8	38	4.98	3.40	40.00	6.95
$N_{50}S_0$	39.84	8	39	4.98	4.08	45.87	7.00
$N_{50}S_{20}$	41.65	8	38	5.04	4.07	49.22	8.19
$N_{50}S_{40}$	45.10	9	40	5.15	4.33	55.33	9.33
$N_{50}S_{60}$	45.00	9	40	5.18	4.51	56.00	9.40
$N_{100}S_0$	38.49	8	40	5.16	4.28	53.70	8.04
$N_{100}S_{20}$	49.12	8	42	5.26	4.64	60.15	11.48
$N_{100}S_{40}$	49.15	9	43	5.28	5.35	62.18	12.05
$N_{100}S_{60}$	50.01	11	41	5.20	5.00	60.22	11.52
$N_{150}S_0$	40.10	7	40	4.92	4.28	50.04	8.14
$N_{150}S_{20}$	48.52	10	41	5.02	4.68	52.12	9.28
$N_{150}S_{40}$	52.10	11	39	5.16	5.00	55.10	9.55
$N_{150}S_{60}$	52.12	11	38	5.18	5.02	55.18	9.60
LSD (0.05)	7.15	0.64	NS	NS	0.16	1.70	0.96
CV (%)	7.01	6.91	6.47	6.04	4.30	4.08	8.95

Figures in a column having same letter do not differ significantly at 5% level by DMRT, NS = Not significant

Table 4. Cost and return analysis of nitrogen and sulphur levels on the yield of summer onion (Var. BARI Piaj-2)

N x S levels	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	Benefit cost ratio (BCR)
N_0S_0	51960	35660	16300	1.45
N_0S_{20}	74400	36200	38200	2.05
N_0S_{40}	83760	36750	47010	2.27
N_0S_{60}	83400	41050	42350	2.03
$N_{50}S_0$	84000	40200	43800	2.08
$N_{50}S_{20}$	98280	40750	57530	2.41
$N_{50}S_{40}$	111960	41300	70660	2.71
$N_{50}S_{60}$	112800	41500	71300	2.72
$N_{100}S_0$	96480	41700	54780	2.31
$N_{100}S_{20}$	137760	42250	95510	3.26
$N_{100}S_{40}$	144600	42800	101800	3.37
$N_{100}S_{60}$	138240	45050	93190	3.06
$N_{150}S_0$	97680	45560	52120	2.14
$N_{150}S_{20}$	111360	45820	65540	2.43
$N_{150}S_{40}$	114600	46000	68600	2.49
$N_{150}S_{60}$	115200	46050	69150	2.50

Note: Input cost: Urea=Tk.6/kg, TSP=Tk. 18/kg, MP=Tk.17 /kg, Gypsum=Tk. 5/kg, Cowdung=Tk 200/ton Onion seed = Tk. 2500/kg, Out put: Onion= Tk. 12/kg

Table 5. Cumulative rotten loss of onion bulbs at different periods of storage as influenced by nitrogen and sulphur levels

N × S levels	Rotten loss at different days during storing (%)					
	15	30	45	60	75	90
N_0S_0	3.36d	8.22d	8.22d	10.55e	12.28e	12.28e
N_0S_{20}	3.00d	8.22d	10.33c	14.59d	16.60c	16.60d
N_0S_{40}	2.98d	6.24e	10.44c	12.44cd	14.55d	18.55c
N_0S_{60}	2.18e	6.20e	9.70d	13.47cd	16.55c	16.55d
$N_{50}S_0$	4.52c	8.22d	14.55b	18.77b	20.80b	22.93b
$N_{50}S_{20}$	4.22c	12.33b	12.44bc	16.66c	18.73bc	20.88b
$N_{50}S_{40}$	4.22c	10.33c	10.33c	14.40d	20.64b	18.77c
$N_{50}S_{60}$	3.22d	8.44d	12.55bc	14.65d	16.77c	18.21c
$N_{100}S_0$	6.33b	14.55a	16.66b	14.79d	21.99b	25.10ab
$N_{100}S_{20}$	4.22c	12.44b	20.77ab	20.88ab	20.88b	22.95b
$N_{100}S_{40}$	4.22c	12.42b	14.56bc	16.68c	18.77bc	21.88b
$N_{100}S_{60}$	3.21d	6.36b	10.12c	14.12d	16.79c	18.32c
$N_{150}S_0$	8.42a	12.36c	22.12a	25.69a	29.32a	34.21a
$N_{150}S_{20}$	5.44ab	9.56b	14.33bc	19.22b	24.10ab	28.20ab
$N_{150}S_{40}$	2.11e	8.22cd	14.50bc	18.77b	20.89b	22.99b
$N_{150}S_{60}$	4.20e	12.38d	12.45c	16.60c	18.74bc	21.00b
LSD (0.05)	**	**	**	*	**	**
CV (%)	4.15	3.39b	5.21	3.49	4.48	3.52

N.B.: Figures in a column having same letter do not differ significantly at 5% level by DMRT
** Significant at 1% level *Significant at 1% level

On-Farm Verification of Boron Fertilizer for Maize Production

Abstract

An experiment was conducted at Serudanga, Mithapukur, Rangpur during 2006-07 to observe the effect of boron on maize in the farmers field. The highest grain yield (10.10 t/ha) was obtained with the application of 2 kg B/ha which was 35 and 94% higher than the farmers' practice and without boron, respectively. BCR (2.52) was also higher in the same treatment.

Introduction

Maize is the third cereal crop in our country. Now-a-days, area under maize production is increasing sharply for poultry industry as well as fodder purposes. Boron deficit is pronounced in the northern region. Most of the farmers do not apply boron fertilizer in maize cultivation. Boron is responsible for proper pollination and seed formation. Therefore, application of boron in addition to essential major elements along with a maintenance dose. Thus, the experiment was undertaken to observe the effect of boron on maize in the farmers field.

Materials and Methods

The experiment was conducted at Serudanga, Mithapukur, Rangpur during 2006-07. The experiment was laid out in a randomized complete block design with three dispersed replications. Unit plot size was 8m X 12m. The treatments were T_1= 2 kg B/ha, T_2= 0.75 kg B/ha (farmer's practice) and T_3= 0 kg B/ha (control). Maize (variety BARI hybrid maize-5) was planted on December 08, 2007. Land type was medium high land belongs to AEZ 3 with irrigation facility. Site-specific other fertilizer doses recommended in fertilizer recommendation guide, 2005 (FRG, 2005) were followed in T_1 and T_3, which were 196-36-75-30-3-3 kg/ha NPKSMgZn. In T_2, farmer's doses were 230-49-125-22-3 kg/ha NPKSZn. One-third of nitrogen and all other fertilizers were applied during final land preparation. Remaining nitrogen was applied in two equal split as topdressing at 8-10 leaf stage and at tasseling stage. Four irrigations were ensured at 3-5 leaves, 8-10 leaves, tasseling and grain filling stage of maize. Weeding and plant protection measures were taken as and when necessary.

Results and Discussion

Grain yield, 100-grain weight, Cob length, cob breadth and grains/cob were significantly differed due to application of different doses of boron. The highest grain yield 10.10 t/ha was obtained from T_1 (2kg B/ha), which was significantly higher than the yields 7.5 t/ha and 5.20 t/ha respectively from T_2 (1 Kg B/ha) and T_2 (0 kgB/ha) (Table-1). T_3 produced the lowest yield, which was significantly lower than the other treatments. Higher yield in T_1 might be due to cumulative favourable effect of 100-grain weight, cob length, cob breadth and number of grains per cob. The highest 100-grain weight 32.2 g was produced by T_1, which was identical to T_2 (29.9) but statistically higher than T_3 (27.5). T_2 and T_3 were identical in producing 100-grain weight. The highest cob length and cob breadth 22.8 cm and 16.35 cm respectively were recorded from T_1, which were statistically similar with T_2 (20.2 cm and 15.30 cm respectively) but higher than T_3 (17.3 cm and 13.50 cm respectively). T_2 and T_3 were identical in producing cob length and cob breadth. The highest number of grains/cob (570.1) was recorded in T_1, which was significantly higher than T_2 (467.6) and T_3 (322.3). T_2 produced significantly higher number of grains/cob than T_3.

The highest gross return Tk.10100/ha, gross margin Tk.60885/ha and benefit cost ratio 2.52 were observed in T_1 i.e. 2 kg B/ha (Table-2).

Farmers reaction

Farmers were impressed by seeing the larger cob size and higher yield in boron treated plot instead of empty and smaller cob with lower yield in boron less or without boron plot.

Conclusion

Two kg boron/ha should be used for higher yield of maize. Framers should be encouraged to use boron in maize through motivation.

Table 1. Yield and yield contributing characters of maize as influenced by boron fertilizer during 2006-07 at Serudanga, Rangpur.

Treatment (B kg/ha)	100 grain weight (g)	Plants/ m^2 (no)	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob breadth (cm)	Grains/ cob (no)	Grain yield (t/ha)	Yield increase over control (%)
2.00	32.2a	5.8	250.2	133.3	22.8a	16.35a	570.1a	10.10a	94.23
0.75	29.9ab	5.6	250.5	132.4	20.2ab	15.30ab	467.6b	7.50b	44.20
0	27.5b	5.8	253	123.67	17.3b	13.50b	322.3c	5.20c	-
F-test	*	NS	NS	NS	*	*	**	**	-
CV (%)	4.57	6.60	6.14	7.18	6.46	5.44	7.19	9.43	-

** Significant at 1 % level * Significant at 1 % level

Means in a column followed by common letter(s) do not differ significantly.

Table 2. Economic performance of mize as influenced boron fertilizer during 2006-07 at Serudanga, Rangpur.

Treatment (B kg/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
2.00	101000	40115	60885	2.52
0.75	75000	42330	32670	1.73
0	52000	42230	9770	1.33

Price: Maize after harvest = Tk.10/kg. Seed maize = Tk. 200/kg, Urea = Tk.6/kg, TSP = Tk.18/kg, MP = Tk.15.5 /kg, Gypsum = Tk.5/kg, Zinc Sulphate = Tk.80/kg and Boric acid = Tk.90/kg.

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Effect of Different Sources of Boron on Mustard

Abstract

An experiment was conducted at Charkalibari, Sambhuganj, Mymensingh during rabi season, 2006-07 to know the effect of Boron from different sources on mustard. At Mymensingh, the treatments of the experiment were: i) Foliar application of Bortrac-150 @ 3 l/ha, ii) Soil application of boric acid @ 1.5 kg/ha of B and iii) Control (without B). The results showed that there were significant difference in some plant characters and yields of mustard due to treatment variation. Application of Bortrac-150 increased the seed and stover yields by 16% and 18%, respectively than the control whereas in the soil application of boric acid these increase were only 9% and 16%, respectively than the control.

Introduction

Boron is an essential micronutrient for crop production. Recently boron deficiency was observed in different parts of the country. Based on initial soil test data it was found that some soils of Old Himalayan Piedmont plain, Tista Meander Floodplain. High Ganges River Floodplain and Old Brahmaputra Floodplain are deficient in boron. Therefore, yield of many crops like mustard, chickpea and papaya is decreasing and typical boron deficiency symptoms are also observed in those crops. Due to boron deficiency in soil the yield of mustard is decreased manifold. Because boron deficiency causes smaller, deformed or irregular shaped pods of mustard with smaller seed size which ultimately cause low yield of mustard. On-Station studies revealed that there was a good response of boron to mustard crop. Different sources of boron are now available in the market and their performance need to be verified in different crops. Bortrac-150 is a liquid boron fertilizer marketed by Setu Corporation Ltd. It's field performance needs to be identified. Therefore, the present study was designed to evaluate the performance of Bortrac-150 on the performance of mustard.

Materials and Methods

The experiment was conducted on Non-Calcareous Dark Grey Floodplain soil at Charkalibari, Mymensingh during rabi season, 2006-07. The experimental field belongs to medium low land of Agro-ecological Zone 9 i.e. Old Brahmaputra Flood Plain soil with silty clay loam in texture. The pH of the soil was 5.8. The soil contained 0.10% total N, 0.18 meq/100g exchangeable K and 2.15, 14.28, 2.64 and 0.18 ppm available P, S, Zn and B, respectively. The soil was low in B. The design of the experiment was randomized complete block with six dispersed replications. The unit plot size was 5m x 8m. The treatments of the experiment were: T_1: Bortrac-150, 3 t/ha at 4-6 leaf stage and again at the onset of stem extension;T_2: 1.5 kg B/ha as Boric acid (soil application) and T_3: Control (without B). Fertilizers were applied at the rate of 100-25-60-20 kg NPKS/ha. Full amount of PKS and half of urea were applied as based. Rest half of urea was top dressed at 20 DAS. The seeds were sown on 31 October 2006 @ 9.00 kg/ha following broadcast method. The variety used was Tori-7. Intercultural operations were done as and when necessary. In the first time Bortrac-150 was sprayed on 13 November and second time spraying was done on 22 November 2006. The crop was harvested on 14 January 2007. Data on yield and yield contributing characters were recorded and analyzed statistically. Mean differences were adjudged by LSD test.

Results and Discussion

The results of the experiment have been shown in Table 1. All the yield contributing characters and yields were statistically significant except plant population and number of siliqua/plant. Table 1 shows that the plant characters and yields in the treatments of Bortrac-150 and soil application of boron through boric acid were identical. However, the performance was a little bit better in Bortrac-150 compared to soil boron application. The control treatment gave the lowest value in all plant characters and yields. The higher plant height, higher number of branches/plant, higher number of seeds/siliqua and higher 1000-seed weight in Bortrac 150 were 73.1 cm, 3.6, 13.8 and 2.30 g, respectively. Seed and stover yields were also higher (1075 kg and 1991 kg) in Bortrac-150 followed by soil application of boron through boric acid. The control treatment gave the lowest seed (925 kg/ha) and stover (1683 kg/ha) yields. Results showed that seed and stover yields of Bortrac-150 were 16 % and 18 %, respectively higher than the control.

Conclusion

The experiment has been conducted for only one year. For more confirmation the trial should be continued in the next year. Though the yield was increased in Bortrac 150 over control, the cost of Bortrac-150 must be economic. Otherwise it will not be accepted by the farmers.

Table 1. Yield and yield contributing characters of mustard (var. Tori-7) as affected by boron fertilizer

Treatment	Plant population/ m^2 (no.)	Plant height (cm)	No. of branches / plant	No. of siliqua /plant	No. of seeds/ siliqua	1000-seed weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
Bortrac-150	99	73	3.6	55.5	13.8	2.30	1075	1991
Boric acid	102	72	3.3	55.2	13.4	2.27	1008	1958
Control	99	66	2.9	50.6	12.9	2.20	925	1683
LSD(0.05)	NS	2.21	0.47	NS	0.48	0.05	110.6	146
CV (%)	3.21	2.44	11.29	8.30	2.83	2.09	8.57	6.05

Effect of Different Sources of Boron on Papaya

Abstract

An experiment was conducted at the Multilocation Testing (MLT) site, Khaloibhara, Kashinathpur, Pabna during 2006-07 in the High Ganges River Floodplain (AEZ-11) to evaluate the performance of different sources of boron on papaya. Three different sources of boron were tested on papaya against control. The highest yield was obtained from the application of fertibor and it was identical to all other sources of boron except control. The economic return in terms of gross margin and BCR was also obtained higher from fertibor treatment.

Introduction

Papaya is a very important fruit crop in Bangladesh and widely grown throughout the country. But yield is very poor particularly in boron deficient area. Smaller and deformed or irregular shaped fruits produced and dropped prematurely due to boron deficiency. About 50-60% yield increased due to application of boron. Different sources of boron are also now available in the market and their performance need to be verified in papaya. Therefore, the present study was undertaken with the following objectives.

Objectives

i. To evaluate the performance of different sources of boron on papaya
ii To determine the optimum dose of boron for papaya

Materials and Methods

An experiment was conducted at the MLT site Khabibhara, Kashinathpur, Pabna during 2006-07 in High Ganges River Floodplain agro ecological zone (AEZ-11). The experiment was laid out in a Randomized Complete Block Design with four replications. The unit plot size was 8m 55m and each pit size was 60cm 560cm. Four different source of boron were T_1= 2 kg B ha^{-1} from Fertibor, T_2= 2 kg B ha^{-1} from Granibor, T_3= B ha^{-1} from Boric acid and T_4= control. Other nutrients were applied at the rate of 253-110-275-45-4.5 g N-P-K-S-Zn per pit. Forty to forty five days old seedlings were transplanted on April 20, 2006 with a spacing of 2m × 2m. Three seedlings were transplanted 30cm apart in each pit in a triangular fashion to ensure one female plant per pit. The full amount of P,S Zn and cowdung were applied in the pit before 10 days of transplantation. Boron of different sources was applied during final pit preparation. The total urea and MP were applied as top dress in four equal installments starting from one month after transplanting with 45 days intervals. Intercultural operations, preventive and curative plant protection measures were done as and when needed. One female plant per pit was retained finally. Fruits showing yellow string were harvested individually. The fruit harvesting was started from September, 2006 continued up to February, 2007. Data on yield (marketable) and other yield contributing characters were recorded and analyzed statistically.

Results and Discussion

Yield and yield contributing characters affected by sources of boron is presented in Table-1. Similar trend of response was observed in case of yield and yield attributes. Numerically the maximum fruits $plant^{-1}$ and fruit breath was obtained from fertibor application which significantly contributed to increased yield over other treatments. Fruit length and weight per fruit was more pronounced in grainbor than fertibor. However, regarding the response on yield, fertibor and granibor was found equally effective for higher yield. Comparatively lowest yield was recorded in boron omission plot.

Regarding economic return, the highest margin and BCR was obtained from Fertibor followed by granibor.

Farmer's reaction

Farmers were happy with satisfactory yield and economic return due to the application of fertibor and granibor. Initially they were reluctant to use boron fertilizer but later on they were motivated to see the performance of boron fertilizer.

Recommendation

Final recommendation would be drawn after completion of the experiment another one year.

Table 1. Yield and yield attributes of Papaya as affected by different sources of boron at MLT site, Khaloibhara, Kashinathpur, Pabna during 2006-07.

Treatments	Fruits/ plant (no.)	Fruit length (cm)	Fruit breath (cm)	Weight/ fruit (kg)	Yield/plant (kg)	Yield (t/ha)	Brix (%)
T_1=Fertibor	31.75	41.28	27.42	1.93	62.13	178.7	8.75
T_2=Granubor	31.41	42.02	27.02	1.95	61.02	175.8	7.42
T_3=Boric acid	31.25	41.46	26.61	1.75	57.11	164.0	7.58
T_4=Control	27.83	38.00	24.33	1.51	45.56	130.8	5.83
CV (%)	3.72	3.92	3.23	11.85	9.22	11.54	15.07
LSD	1.81	2.55	1.36	0.33	8.32	29.97	1.78

Table 2. Cost and return analysis of Papaya as affected by different sources of boron at MLT site Khaloibhara, Kashinathpur, Pabna during 2006-07.

Treatments	Gross return (Tk./ha)	Variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1=Fertibor	893500	59033	834467	15.14
T_2=Granubor	879000	59062	819938	14.88
T_3=Boric acid	820000	58964	761036	13.91
T_4=Control	654000	58376	595624	11.20

Price of input (Tk./kg): Urea= 6.50, TSP= 16.50, MP= 15.00, Gypsum= 5.00, Zinc sulphate= 60.00, Borax= 60.00, Fertibor = 60.00 & Granubor = 60.00

Price of out put (Tk./kg): Green Papaya= 5.00

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Effect of Different Sources of Zinc on Mustard

Introduction

Among the micronutrients Zn deficiency is wide spread in Bangladesh. Zinc is less available for plant uptake in high pH soils e.g. calcareous soils mainly due to its retention by soil and soil constituents. Therefore, crop grown in calcareous soil might be suffered due to zinc deficiency. Mustard is an important oilseed crop grown throughout the country. But effect of zinc on the growth and yield of the crop are not studied comprehensively in different areas of the country. But it is very important to quantify the yield reduction due to zinc deficiency particularly in calcareous soil. Recently, different zinc fertilizer materials are available in the market but their effects on crops are not yet studied also. Therefore, the experiment was designed to determine the effect of different sources of Zn on the yield of mustard.

Objectives

1. To evaluate the performance of different sources of zinc on mustard
2. To determine the optimum dose of zinc for mustard

Materials and Methods

The study was carried out at the MLT site, Khaloibhara, Kashinathpur, Pabna during 2006-2007. Two sources of Zn were compared to control treatment. The experiment was laid out in RCBD with six replications. The unit plot size was 8m × 5m. The seeds were sown on Nov. 22, 2007 with specific plant spacing (30 cm line × continuous sowing). Mustard variety was BARI sharisha-11. The crop was fertilized at the rate of 300-180-100-180-12 kg/ha of Urea, TSP, MP, Gypsum and Borax). Zinc was applied at the rate of 2 litre ha^{-1} as zintrac-700 and 2 kg ha^{-1} as Zn $S0_4$, $7H_20$. Half of urea and entire quantity of TSP, MP, Zypsum, Borax and Zn fertilizers were applied during final land preparation. Remaining urea was applied as top dress at flower initiation stage. Thinning, weeding, irrigation, pest management and other intercultural operations were provided when required. Crop was harvested on March 4, 2007. Yield and yield contribute characters were recorded and analyzed statistically.

Results and Discussion

The yield and yield attributing characters is presented in Table 1. The significant highest yield was obtained from zintrac-700. The lowest yield was attained from Zn omission plot. The yield contributing characters showed significant different among the treatments and supported the highest yield of zintrac-700. But the lowest yield of BARI Sarisha-11 was due to gloomy weather and two times rainfall during flowering stage, which hampered the fertilization and seed setting.

Conclusion

The response of Zintrac-700 as Zinc fertilizer on the yield performance of mustard was encouraging. It needs to be tested at least for another one season with its splitted doses.

Table 1. Yield and yield contributing characters of Mustard as affected by different sources of zinc at MLT site Khaloibhara, Kashinathpur during 2006-07.

Treatments	Plant height (cm)	Plant pop^n/m^2	Pods/plant (no.)	Seeds/pod (no.)	1000-Seed wt. (g)	Seed yield (kg/ha)
T_1 = Zintrac-700 2 L ha^{-1}	121.0	83.83	79.15	9.32	2.78	1122
T_2 = $ZnSo_4.7\ H_2O$ 2 Kg ha^{-1}	118.8	80.17	76.80	9.14	2.49	1058
T_3 = Control (Zn omission)	114.9	78.33	73.53	8.99	2.15	968
LSD (0.05)	2.381	1.783	2.255	0.107	0.107	23.09
CV (%)	4.57	4.72	5.29	9.89	3.36	7.71

On-Farm Verification of Fertilizer Trial for Garden Pea Production

Abstract

The experiment was conducted at the FSRD site, Ellenga, Tangail and Ovirampur village, Rangpur Sadar during rabi season in 2006-2007 to evaluate the performance of different fertilizer treatment on garden pea varieties under farmer's field condition. BARI motorshuti-1 gave the highest pod yield (10.68 t/ha) at Tangail. But yield variation was not found between BARI motorshuti-1 (11.36 t/ha) and BARI motorshuti 2 (11.65 t/ha) at Rangpur. The fertilizer combination of N_{50}, P_{26} K_{42} S_{12} and 1 kg/ha of Mo. B and Zn provided the highest yield in both locations.

Introduction

Garden pea is a protein rich vegetable grown during the winter. It's per hectare yield is very low because the crop is rain fed, exposed to biotic and abiotic stress, lack of high yielding varieties and use of imbalance fertilizers. The yield, however, can be increased by using high yielding variety and adopting judicious nutrient management. Among the different fertilizer nutrients, the importance of N, P and K on garden pea yield have been reported by several researches (Singh *et al.*1992, Yadav *et al.,* 1992). The application of S also has been found effective in increasing yield of garden pea (Shivran *et al* 1996). A significant response of vegetable pea in application of Mo, B and Zn were also reported by singh *et al.* (1992). Therefore, a balanced fertilizer can play a key role in increasing production of garden pea. As such the present study was under taken to verify the combined effect of fertilizer nutrients on the performance of garden pea.

Materials and Method

The trial was conducted at the FSRD site, Ellenga, Tangail and Ovirampur village, Rangpur Sadar during Rabi 2006-07 in the farmer's field condition. The design of the experiment was factorial RCBD having four replications. Two tested variety were BARI Motonshuti-1 and BARI Motonshuti-2 were considered as the first factor. Three fertilizer doses viz; T_1= $N_{50}P_{26}K_{42}S_{12}$ kg/ha, T_2= $N_{50}P_{26}K_{42}$ $S_{12}B_1Mo_1Zn_1$ kg/ha and T_3= farmer practice. The unit plot size was 4.2 m x 5 m. The seeds were sown at 30cm x 15cm spacing. Weeding, pests control and other cultural managements were done as per recommendation of HRC, BARI. The data on different plant characters and yield components were collected from 10 plants randomly selected in each plot and yield was recorded plot wise. Data were analyzed statistically using MSTATC package.

Results and Discussion

Tangail

Effects of variety shows that BARI Motonshuti-1 gave higher plant height (88.4 cm), pod/plant (15), seed/pod (7) 1000 seed wt (57.99 g) and the highest fresh pod yield (10.68 t/ha) over that of BARI Motonshuti-2 (Table 1). The parameters of garden pea significantly varied due to fertilizer levels applied (Table 2). Treatment T_2 (N_{50} P_{26} K_{42} S_{12} & 1 kg/ha of Mo. B and Zn) was showed higher yield than T_1 ($N_{50,}$ $P_{26,}$ $K_{42,}$ S_{12} kg/ha). The highest number of pods/plant (18), seeds/pod (6) and 1000 seed wt. (60.3 g) were obtained in plants treated with T_2 (N_{50} P_{26} K_{42} S_{12} & 1 kg/ha of Mo. B and Zn). The highest fresh pod yield (11.91 t/ha) was also obtained from the same treatments. The lowest fresh pod yield was from farmers practice (8.50 t/ha). The BARI motorshuti-1 along with N_{50} P_{26} K_{42} S_{12} & 1 kg/ha of Mo. B and Zn provided the highest pod yield (12.35 t/ha) and it was at par with that of variety BARI Motonshuti-2 (11.48 t/ha) with the same fertilizer dose (Table 3).

Rangpur

The highest pod yield (11.50 t/ha) was recorded from T_2 treatment which was statistical different from T_1 and T_3 Treatments (Table 4). The highest pod/plant and seeds/pod was obtained from T_2 Treatment. It may be due to micronutrient. There was no significance difference in case of 100-seed weight. The pod yield of BARI Motorshuti-2 was higher than BARI motorshouti -1 in all treatments. The highest BCR was obtained from T_2 (7.55) followed by T_1 & T_3

Farmers' reaction

Tangail: Farmers opined that BARI Motonshuti-1 is better over BARI motorshuti-2 regarding yield and market accessibility because its seed size is longer than BARI motorshuti-2.

Conclusion

Yield of garden pea increased due to use of micronutrient (M_0, B &Zn).But this is the first year experiment, so the experiment should be continue e in 2nd year for confirmation of the result.

Table 1. Effect of variety on yield and yield parameters of garden pea at FSRD site, Ellenga, Tangail during 2006-07

Variety	Plant height (cm)	Pods/plant (no)	Seeds/pod (no)	1000 Seed/wt. (gm)	Fresh pod yield (t/ha)
BARI Motonshuti-1	88.4 a	15 a	8 a	57.90 a	10.68 a
BARI Motonshuti-2	83.1 a	12 a	4 b	51.2 b	9.86 b
CV (%)	5.72	10.45	5.05	4.07	8.75

Table 2. Effect of fertilizer on yield and yield parameters of garden pea at FSRD site, Ellenga, Tangail during 2006-07

Treatment (kg/ha)	Plant height (cm)	Pods/plant (no)	Seeds/pod (no)	1000 seed wt (g)	Fresh pod yield (t/ha)
$T_1 = N_{50}, P_{26}, K_{42}, S_{12}$	90.2 a	13 b	6 b	56.3 b	10.40 b
$T_2 = N_{50}, P_{26}, K_{42}, S_{12}\ Mo_1B_1Zn_1$	94.2 a	18 a	6 a	60.3 a	11.91 a
T_3 = Farmer practice	73.0 b	11 c	5 c	47.0 c	8.50 c
CV (%)	5.72	10.45	5.05	4.07	8.75

Table 3. Interaction effects of variety and fertilizer dose on yield and yield parameters of garden pea at FSRD site, Ellenga, Tangail during 2006-07

Treatment	Plant height (cm)	Pods/plant (no)	Seeds/pod (no)	100 seed wt (g)	Fresh yield (t/ha)
BART motonshuti-1 x T_1	92.3 ab	15 b	7 b	61.3 a	10.53 bc
BART motonshuti-1 x T_2	98.3 a	18 a	8 a	64.0 a	12.35 a
BART motonshuti-1 x T_3	74.7 b	12 b	7 b	48.3 cd	9.16 cd
BART motonshuti-2 x T_1	88.0 b	12 b	4 c	51.3 c	10.26 bc
BART motonshuti-2 x T_2	90.0 ab	17 a	5 c	56.7 b	11.48 ab
BART motonshuti-2 x T_3	71.33 c	9.33 c	4.10 c	45.7 d	7.83 d
CV (%)	5.72	10.45	5.05	4.07	8.75

$T_1 = N_{50}, P_{26}, K_{42}, S_{12}$ (kg/ha), $T_2 = N_{50}, P_{26}, K_{42}, S_{12}$ & 1 kg/ha of Mo, B and Zn, T_3 = Farmers practice.

Table 4. Effect fertilizer on yield and yield attributes of garden pea at the farmer's field, Ovirampur, Rangpur during 2006-07

Variety	Pods/plant (no)	Seeds/pod (no)	100 Seed/wt. (gm)	Fresh pod yield (t/ha)
BARI motonshuti-1	25.22 b	5.23	212.81	10.05
BARI motonshuti-2	26.48 b	5.31	213.32	10.87
CV (%)	4.0	8.3	4.21	6.91

Table 5. Effect of fertilizer on yield and yield parameters of garden pea at the farmer's field, Ovirampur, Rangpur during 2006-07

Treatment	Pods/plant (no)	Seeds/pod (no)	1000 seed wt (g)	Fresh pod yield (t/ha)
$T_1 = N_{50}, P_{26}, K_{42}, S_{12}$ kg/ha	26.69 b	5.18 b	213.06 a	10.36 b
$T_2 = N_{50}, P_{26}, K_{42}, S_{12}$ & 1 kg/ha of Mo B & Zn.	29.99 a	6.13 a	213.18 a	11.50 a
T3 = Farmer practice	25.85 b	4.57 b	212.48 a	9.51 b
CV (%)	4.0	8.3	4.21	6.91

Table 6. Interaction effects of variety and fertilizer dose on yield and yield parameters of garden pea at the farmer's field, Ovirampur, Rangpur during 2006-07

Treatment	Pods/plant (no)	Seeds/pod (no)	100 seed wt (g)	Fresh yield (t/ha)
BART motonshuti-1 x T_1	27.23 b	5.20 a b	212.85 a	9.78 b
BART motonshuti-1 x T_2	30.00 a	6.07 a	213.42 a	11.36a
BART motonshuti-1 x T_3	25.22 b	4.43 b	212.18 a	9.01b
BART motonshuti-2 x T_1	26.15 b	5.03 b	213.27 a	10.94 b
BART motonshuti-2 x T_2	29.99 a	6.20 a	213.92 a	11.65 a
BART motonshuti-2 x T_3	26.48 b	4.7 b	212.78 a	10.01 b
CV (%)	4.0	8.3	4.21	6.91

$T_1 = N_{50}, P_{26}, K_{42}, S_{12}$ (kg/ha), $T_2 = N_{50}, P_{26}, K_{42}, S_{12}$ & 1 kg/ha of Mo. B and Zn, T_3 = Farmers practice

Table 7. Cost and return analysis of BARI garden pea at the farmer's field, Ovirampur, Rangpur during 2006-07

Treatments	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	155400	22074	133326	7.04
T_2	172500	22847	149653	7.55
T_3	142650	20916	121734	6.82

Price (Tk./kg): Urea= 6, TSP =18, MP=15.50, Gypsum=5.00, Zinc sulphate=80 and BARI motorshuti=15

Effect of Inorganic and Organic Fertilizers on the Yield of Summer Onion

Abstracts

An experiment was conducted at the MLT site, Moulvibazar during 2004-05 and 2005-06, at ARS, BARI, Alamnagar, Rangpur Rangpur station during Kharif-2, 2005-06 to determine the optimum dose of inorganic and organic fertilizer on the yield of summer onion. Advanced line OF-5 and BARI Peaj-2 were used as the test crop at Moulvibazar and Rangpur, respectively. Four different combinations of inorganic and organic fertilizers doses along with control (no fertilizer) treatments were tested. Yield variation was observed over the treatments. Higher yield was obtained from the treatment of yield was recorded from the treatment 60-35-54-20 N-P-K-S kg/ha along with 3 tons /ha poultry manure in both locations.

Introduction

Onion (*Allium cepa*) is one of the major important spices in Bangladesh. Bangladesh faces a great crisis of onion during the off period and a large amount of money was lost to import onion from neighboring country and others to meet up the demand of our country people. To meet up this demand onion production should be increased and to develop new varieties of this crop. In Bangladesh, onion is mainly grown in the Rabi season (winter). Usually onion is not cultivated during kharif (summer) season in the country. BARI has already developed two varieties of summer onion and some improved and promising lines of summer onion is under trial. There is a significant response of onion to inorganic and organic fertilizer (Nasreen and Hossain, 2000, Ullah, 2002). Although the weather condition seems to be congenial for the proper growth of summer onion but research work of summer onion is very scarce in Bangladesh. For this reason a trial was under taken to find out the optimum and economic dose of fertilizer for summer onion.

Material and Methods

The experiment was conducted at ARS, BARI, Alamnagar, Rangpur and at MLT site, Moulvibazar during the Kharif season of 2006. The experiment was laid out in RCB design with three replications. Advanced line OF-5 and BARI Peaj-2 were used as the test crop at Moulvibazar and Rangpur, respectively. The unit plot size was 2m x 2m and spacing 20cm x 10cm. The seedlings (OF-5) were transplanted on 25 th November (late Karif-II), 2006 and 12 february 2007 (Karif-I) at Moulvibazar. In Rangpur, Seeds were sown on 16 th May, 2006 in seed bed and transplanted in the experimental plot on 5th July, 2006.The treatments were T_1 =120-45-85-40 kg /ha NPKS +5t/ha cowdung, T_2 = 90-55-75-20 kg/ha NPKS + 5t/ha cowdung (Recommended from SP. Res. center), T_3 = 60-35-54-20 kg/ha NPKS + 3t/ha poultry manure, T_4 = 75-49-60-20 kg/ha NPKS + 5 t/ha cow dung, T_5 = Control (no fertilizer added). Chemical fertilizer i. e N, P, K, S and Zn were applied from Urea, TSP, MP, gypsum, zinc sulphate. Half of urea and all others fertilizers were applied at the time of final land preparation. . The rest of urea was top dressed after 25 DAS. Ruvral @ 2g/litre water and Admire @ 0.5ml/litre water were sprayed at every 10 days interval to control purple blotch and thrips. The crop was irrigated and weeds out as and when necessary. The crop was harvested on 6th March, 2007(Karif-II) and 5th May 2007 (Karif-I) at Moulvibazar and October 2006 at Rangpur.

Result and Discussion

Moulvibazar

Higher yield was obtained from treatment T_3 i.e. 60-35-54-20 kg/ha NPKS + 3t/ha poultry manure (23.169 t/ha) which was followed by T_4 i.e. 75-49-60-20 kg/ha NPKS + 5 t/ha cow dung (21.88 t/ha) during Kharif I.. In Kharif-II, the higher yield (29.58 t/ha) was statistically similar to T_4 and T_1 (120-45-85-40 kg /ha NPKS +5 t/ha cowdung). The lowest yield (14.618 t/ha) was found from T_5 i.e. absolute control plot in both seasons.

Rangpur

Higher bulb yield (18.44 t/ha) was obtained from T_3 (60-35-54-20kg NPKS/ha+3t/ha PM) which was identical to T_2 (90-54-75-20 kg NPKS/ha + 5 t/ha cowdung) and T_4 (75-49-60-20 Kg NPKS/ha +5 t/ha cowdung) treatments (Table 3). The highest plant height was recorded from T_3 treatment which was identical to T_1, T_2 and T_4 treatments. The lowest plant height was recorded from control plot. Weight of 10 bulb was maximum in treatment T_3 and the lowest in control plot. Application of poultry manure along with other essential nutrients helped maintain soil fertility and responded favorably which resulted in yield difference.

The highest marginal rate of return was also obtained by T_3 treatment due to its higher yield followed by T_4. (Table 4). Highest MRR was obtained from high total variable cost it means that high investment will give high return.

Farmers' reaction

Farmers are very much interested to cultivate this crop but hey need seed and seedling in proper time. Farmers also opined that they need more training on the production technology of summer onion. Purple blotch is a problem for this crop.

Conclusion

Treatment T_3 was found promising for increasing yield of summer onion. The application of poultry manure (3t/ha) along with other chemical fertilizers ($N_{60}P_{35}K_{54}S_{20}$ kg/ha) might have positive effect for higher yield of summer onion.

Table 1. Yield performance of summer onion effected by different fertilizer level at Moulvibazar in during Kharif I, 2007

Treatment	Plant population/plot	Number of onion/kg	Yield (kg/plot)	Yield (t/ha)
T_1	204	20.00	7.99	20.52
T_2	204	22.66	7.88	19.71
T_3	204	16.50	9.27	23.17
T_4	204	18.16	8.74	21.89
T_5	204	29.00	5.71	14.62
LSD (0.05)	-	0.691	0.542	1.71
CV (%)	-	2.70	5.68	7.10

T_1 =120-45-85-40 kg /ha NPKS +5t/ha cowdung, T_2 = 90-55-75-20 kg/ha NPKS + 5t/ha cowdung (Recommended from SP. Res. center), T_3 = 60-35-54-20 kg/ha NPKS + 3t/ha poultry manure, T_4 = 75-49-60-20 kg/ha NPKS + 5 t/ha cow dung, T_5 = Control (no fertilizer added).

Table 2. Yield performance of summer onion affected by different fertilizer level at Moulvibazar during Kharif II 2007

Treatment	Plant pop^n/ plot	Number of onion /kg	Yield (kg/plot)	Yield (t/ha)	
				2006-07	2005-06
T_1	204	14.45	12.15	25.44	20.33
T_2	204	18.21	11.41	24.23	19.44
T_3	204	11.17	13.73	29.59	23.82
T_4	204	12.82	12.20	27.90	21.73
T_5	204	24.00	9.41	16.92	17.22
LSD (0.05)	-	1.07	1.16	4.27	0.68
CV (%)	-	3.53	5.22	9.13	-

Table 3. Yield and yield attributes of summer onion (BARI onion –2) as affected by inorganic and organic fertilizer at Rangpur during 2005-06.

Treatments	Plant height (cm)	No. of leaves/plant	Length of bulb(cm)	Breath of bulb(cm)	10-bulb wt(g)	Bulb yield (t/ha)
T_1	32.30a	7.30a	3.49b	3.94b	333.4b	14.88b
T_2	32.20a	6.93a	3.80ab	4.45ab	383.1a	15.60ab
T_3	33.70a	7.70a	4.61a	5.02a	410.2a	18.44a
T_4	32.97a	7.50a	3.45b	3.95b	311.7b	16.90ab
T_5	22.30b	4.16b	2.33c	2.86c	157.7c	4.57c
CV%	7.81	8.22	8.48	7.21	4.02	8.08

Means followed by common letters are not significantly different at 5% level by DMRT.

Table 4. Marginal analysis of inorganic and organic fertilizer application on onion production at Rangpur during 2005-2006

Treatments	TVC (Tk./ha)	Gross margin (Tk./ha)	Marginal gross margin (Tk/ha)	Marginal variable cost (Tk/ha)	Marginal rate of return(%)
T_1	10644.4	227435.6	-12251.6	731.6	-16.75
T_2	9912.8	239687.2	-21910.3	1110.3	-19.73
T_3	12161.2	282878.2	55442.2	1516.8	36.55
T_4	8802.5	261597.5	188477.5	8802.5	21.44
T_5	0	73120	-	-	-

Price (Tk./kg): Urea=6,TSP =18, MP=15.50, Gypsum =5.00, Zinc sulphate=80 and BARI Peaj-2=12

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Response of Chickpea Varieties to Elite Strain of *Rhizobium*

Abstract

A field experiment was conducted at the FSRD site, Kadamshahar, Rajshahi during Rabi season of 2006-07 with the objectives to study the response of inoculation with different plant genotypes. Three varieties of chickpea viz. BARI chola-5, BARI chola-6 and BARI chola-7 and rhizobial inoculum (*Rhizobium* strain RCa-220) were used in this experiment. Each variety was tested with/without *Rhizobium* inoculation. Inoculated plants gave higher nodule number, nodule weight, root weight, shoot weight, stover yield and seed yield compared to non-inoculated plants. Among 3 varieties, BARI chola-6 produced the highest nodule number and nodule weight. Apparently the highest seed yield was observed in BARI chola-6, which was closely followed by BARI chola-5 and 7. There was no significant difference for yield between inoculated and non-inoculated treatments.

Introduction

Chickpea (*Cicer arietinum* L.), commonly known as gram, is the third major pulse crop in Bangladesh but second in consumption priority. In Bangladesh, it stands 5th in respect of area (16650 ha) and production (12245 tons) among the pulse crop (BBS, 1999). The average yield of chickpea is low (600-700 kg/ha) compared to other neighboring countries (ICRISAT, 1990). Bangladesh has been developing a good number of varieties of chickpea. Some of these varieties are waiting for cultivation in the farmers' level but were not screened in respect to nodulation, nitrogen fixation and as well as yield. There is a great possibility to increase its production by exploiting better colonization of the roots and rhizospheres through the application of effective nitrogen fixing bacteria to the seed or to the soil. This can minimize uses of nitrogenous fertilizer, which is very costly in our country. Using high yielding varieties/advanced lines of chickpea in combination with effective rhizobial strains along with management practices including manures and fertilizers can enhance the yield. The present investigation was undertaken to study the response of inoculation with different plant genotypes.

Materials and Methods

Chickpea was sown on 19 November 2006 at the FSRD site, Kadamshahar Rajshahi. The experiment was designed in Randomized Complete Block Design having 4 replications in each treatment. Three varieties of chickpea viz. BARI chola-5, BARI chola-6 and BARI chola-7 were tested. Each variety was treated with or without *Rhizobium* inoculant. Unit plot size was 4m x 3m. There were 6 treatment combinations. Basic doses of phosphorus @ 22 kg P ha^{-1} as TSP, potash @ 42 kg K ha^{-1} as muriate of potash, sulphur @ 20 kg S ha^{-1} and zinc @ 5 kg Zn ha^{-1} as zinc oxide were applied in the field. Urea was applied neither in the inoculated nor in the non-inoculated plots. Peat based rhizobial inoculum (*Rhizobium* strain RCa-220) @ 1.5 kg/ha was used for seed inoculation. During the course of the experiment growth and development of plants in the field were care fully observed. At 50% flowering stage, 10 randomly selected plants were uprooted from each unit plot. Dry weight of roots, shoots and nodules including nodule numbers were recorded. Data on plant height, 1000-seed weight (g), stover yield and seed yield were also taken. The plants were harvested on 26 March 2007. Dry weight of seed and stover from each unit plot was recorded. All data were analyzed statistically.

Results and Discussion

Results on effect of different varieties on nodule number/plant, nodule weight (mg/plant), root weight (g/plant), shoot weight (g/plant), 1000-seed weight (g), stover yield (t/ha) and seed yield (t/ha) have been presented in Table 1.

Among the 3 varieties studied, BARI Chola-6 gave significantly higher nodule number (24.5), nodule weight (65.4 mg/plant), root weight (0.28 g/plant) and shoot weight (2.20 g/plant) but statistically at par to BARI chola-7. Stover yield and seed yield was found to be non-significant but slightly higher seed yield was observed in BARI chola-6.

Results on effects of rhizobial inoculation on nodule number/plant, nodule weight (mg/plant), root weight (g/plant), shoot weight (g/plant), 1000-seed weight (g), stover yield (t/ha), seed yield (t/ha) have been presented in Table 2.

Inoculated plants gave significantly higher nodule number, nodule weight and shoot weight. The root weight, stover yield and seed yield was higher in inoculated plant compared to non-inoculated plants (Table 2). Results on interaction effects of varieties and rhizobial inoculation on nodule number/plant, nodule weight (mg/plant), root weight (g/plant), shoot weight (g/plant), 1000-seed weight (g), stover yield (t/ha), seed yield (t/ha) and percent yield increase over control have been presented in Table 3.

The highest nodule number (28.9/plant), nodule weight (75.9 mg/plant), shoot weight (2.32 g/plant) and seed yield (1.19 t/ha) was recorded in the BARI Chola-6 with inoculation. The results are in agreements with the findings of Eusuf Zai *et al.* (1999a, 1999b), Bhuiyan *et al.* (1996, 2001), Khanam *et al.* (1994) who worked on chickpea in recent years.

Conclusion

Though significant seed yield variation was not found among the variety and inoculation but slightly higher yield was obtained from BARI chola-6 with inoculation. However, availability of quality inoculum is a problem.

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Table 1. Effects of varieties on nodulation, dry matter production and yield of chickpea at FSRD site, Kadamshahar, Rajshahi during 2006-2007

Variety	Nodule no./plant	Nodule weight (mg/plant)	Root weight (g/plant)	Shoot weight (g/plant)	Plant height (cm)	Stover yield (t/ha)	1000-seed wt. (g)	Seed yield (t/ha)
BARI Chola-5	18.0b	50.1b	0.19b	1.69b	38.6	1.63	135c	1.08
BARI Chola-6	24.5a	65.4a	0.28a	2.20a	38.4	1.49	212a	1.15
BARI Chola-7	22.6a	61.2a	0.24a	1.79b	41.4	1.74	145b	1.07
SE (±)	1.34	2.92	0.014	0.107	NS	NS	2.37	NS

Means followed by common letter are not significantly different at 5% level by DMRT, NS=Non-significant

Table 2. Effects of rhizobial inoculum on nodulation, dry matter production and yield of chickpea at FSRD site, Kadamshahar, Rajshahi during 2006-2007

Variety	Nodule no./plant	Nodule weight (mg/plant)	Root weight (g/plant)	Shoot weight (g/plant)	Plant height (cm)	Stover yield (t/ha)	TSW (g)	Seed yield (t/ha)
Uninoculated	17.6b	48.4b	0.22	1.73	38.5	1.56	162.3	1.07
Inoculated	25.8a	69.5a	0.25	2.05	40.4	1.68	165.8	1.13
SE (±)	1.10	2.39	NS	0.87	NS	NS	NS	NS

Means followed by different letter are significantly different at 5% level by DMRT

Table 3. Interaction effects of varieties and rhizobial inoculum on nodulation, dry matter production and yield of chickpea during 2006-2007

Treatment	No. of nodule/ plant	Nodule weight (mg/plant)	Root weight (g/plant)	Shoot weight (g/plant)	Plant height (cm)	Stover yield (t/ha)	1000-seed wt. (g)	Seed yield (t/ha)	Yield increase over control (%)
BARI chola-5 x U	14.3	40.3	0.18	1.54	38.4	1.55	132	1.07	-
BARI chola-5 x I	21.7	59.8	0.21	1.83	38.9	1.72	137	1.09	2.8
BARI chola-6 x U	20.1	54.8	0.26	2.08	36.0	1.44	210	1.12	-
BARI chola-6 x I	28.9	75.9	0.29	2.32	40.8	1.54	214	1.19	6.3
BARI chola-7 x U	18.5	50.0	0.22	1.57	41.3	1.69	145	1.03	-
BARI chola-7 x I	26.8	72.8	0.26	2.01	41.6	1.79	146	1.10	6.8
SE (±)	NS	NS	NS	NS	NS	NS	NS	NS	-
CV (%)	17.5	14.0	17.1	16.0	9.2	15.7	4.1	10.8	-

NS: Not significant, U: Uninoculated, I: Inoculated

Response of Mungbean to Newly Developed Bio-fertilizer in the Farmers' Field

Abstract

Field experiment was carried out the FSRD Site, Hatgavindapur, Faridpur during kharif I season, 2006-07 to find out the response of newly developed Rhizobium strain on Mungbean. Newly isolated strain BARI RVr-404 was tested with BARI Mung-5. Inoculum with other fertilizers produced higher yield (1588 kg/ha) but it was identical with fertilizer treatments.

Introduction

New *Rhizobium* (BARI RPs-402) bio-fertilizer has been developed for mungbean. The strain was found to perform better in the research stations but it needs to verify at the farmer's field. The present investigation was undertaken to observe the response of mungbean to newly developed bio-fertilizer under farmer's condition and to reduce the use of N-fertilizer in mungbean cultivation.

Materials Methods

The trial was conducted at the FSRD Site, Hatgavindapur, Faridpur during kharif I season, 2006-07. The BARI mung-5 and rhizobium BARI RPs-402 were used in this trial. The experiment was laid out in RCB design with four compact replications. The unit plot size was 4 x 4 m^2 with 30 cm wide solid rows. The crop was sown on 08 March 2007. Four treatments were used and they are as follows: T_1 (By SSD): 50-22-42-20-5 kg NPKSZn/ha, T_2:0-22-42-20-5 kg NPKSZn/ha + inoculum, T_3 (FRG'05): 24-22-42-20-5 kg NPKSZn/ha and T_4 (FP)-25-20-30-15 kg NPKS/ha. All fertilizers were applied before final land preparation. Intercultural operations were done when necessary. The crop was harvested on 8 May 2007. The yield and yield contributing characters data of mungbean was collected and analyzed statistically.

Result and discussion

The yield and yield contributing characters of mungbean was presented in Table 1. The yield and yield contributing characters were significantly influenced by different treatments except plant population/m^2, plant height and seed yield. The treatment T_2 showed higher yield (1588 kg/ha) due to higher pods/plant and TSW. The highest number of pods/plant (19.72) and seeds/pod (9.40) was obtained from the treatment T_1 that was statistically similar to T_2 and T_3. The highest thousand seed weight (57g) was obtained from the treatment T_3 that was also identical to T_1. The lowest yield (1368 kg/ha) was obtained from T_4 (Farmers practice) which might be due to the lower performance of yield contributing characters. It may be concluded from the trial that inoculums along with other inorganic fertilizers (PKSZn) could be used instead of urea fertilizer for higher yield in mungbean cultivation.

Farmer's reaction

Farmers were very encouraged to observe the performance of BARI mung-5 with inoculums.

Table 1. Plant height, yield and yield attributes of mungbean (BARI mung-5) at FSRD Site, Hatgavindapur, Faridpur during kharif I season, 2006-07

Treatments	Plant pop./m^2	Plant height (cm)	Pods/ plant (no)	Seed/ pod (no)	1000-seed wt. (g)	Seed yield (kg/ha)
T_1 (50-22-42-20-5 kg NPKSZn /ha)	24.50	39.10	19.72	9.40	56.60	1560
T_2 (0-22-42-20-5 NPKSZn/ha + Inoculum)	23.25	39.45	19.20	9.25	57.0	1588
T_3 (24-22-42-20-5 kg NPKSZn/ha)	24.00	39.97	19.17	8.82	54.28	1537
T_4 (FP) (25-20-30-15 kg NPKS/ha)	24.25	36.47	17.17	8.45	53.55	1368
LSD (0.05)	NS	NS	1.42	0.78	2.51	NS
CV (%)	10.95	7.79	4.71	5.40	2.83	9.44

Response of Lentil to Newly Developed Bio-fertilizer in the Farmers' Field

Abstract

The experiment was conducted at Jessore, Faridpur and Kushtia during 2005-06 to 20067-07 and at Pabna during 2006-07. Three different fertilizer treatments along with farmers' dose were studied to observe the response on lentil. It was evident that using inoculums instead of nitrogen for lentil production in lentil at both the sites.

Introduction

Lentil is the most important pulse crop in Bangladesh and it occupies relatively more lands than other pulse crops. Bio-fertilizer tends to produce nodule at the root of leguminous crops like lentil which minimize the requirements of N fertilizer. New *Rhizobium* bio-fertilizer has been developed for lentil. The strain was found to perform better in the research stations. Seed yield of lentil increased by 10-20% over control at different locations with the use of the bio-fertilizer. Performance of the newly developed strain needs to be verified in the farmer's field. Therefore, the present investigation was undertaken with objectives of i) to observe the response of lentil to newly developed bio-fertilizer under farmers' field condition and ii) to reduce the use of N-fertilizer in lentil cultivation.

Materials and Methods

The experiment was conducted at the MLT site Kuadabazar, Jessore, FSRD Site, Hatgavindapur, Faridpur and MLT site, Bharamara, Khustia during 2005-06 and 2006-07 and MLT site, Atghoria, Pabna during 2006-07. The experiment was laid out in RCBD with six replications. Unit plot size was 4m x 5m. Seeds of BARI musur-4 were sown 16 November at Jessore and Faridpur, 30 October at Khustia and 18 November at pabna with 30cm rows spacing continuous seeding and seed rate was 35 kg $ha^{-1.}$ *Rhizobium* inoculum strain named RLc-640 was used @ 50g kg^{-1} seed for the experiment. All fertilizers were applied as basal and other intercultural operations were done as and when necessary. The crops were harvested during 2-6 March at Jessore, 7 March at Faridpur and 26 February at Kushtia and 20 March at Pabna, 2007. ata on yield and yield attributes were recorded and analyzed statistically.

Treatment combinations at different locations:

Treat.	Jessore	Faridpur	Kushtia	Pabna
	N-P-K-S-Zn kg/ha			
T_1	50-22-42-20-5	24-22-42-20-0	24-22-42-20	50-22-42-20-0
T_2	0-22-42-20-5+Inoculum	50-22-42-20-0	50-22-42-20	0-22-42-20-0 + Inoculum
T_3	24-22-42-20-5	0-22-42-20-0 + inoculum	0-22-42-20	0-0-0-0-0 + Inoculum
T_4 (FP)	20-15-18-8-0	25-18-21-0-0	20-12-17	35-21-14-0-0

Results and Discussion

Jessore

Plant height, plant population, pods/plant, 1000-grain weight, grain yield and straw yield did not differ significantly due to different treatments. Treatment T_2 produced highest yield (935 kg/ha) amongst all treatments but there was no significant difference. So using inoculum instead of nitrogen with other fertilizers is better in lentil production.

Faridpur

The yield and yield contributing characters were significantly influenced by inoculum. The treatment T_3 showed higher yield (1586 kg/ha) due to higher pods/plant, seed/pod and TSW. The lowest yield was obtained from farmers practice (935 kg/ha). Inoculum with inorganic fertilizer (T_3) showed the better performance against only inorganic fertilizer (T_1). The yield was about 95 kg higher than T_2 due to apply of inoculum. So, use of inoculum can be used instead of urea for lentil cultivation.

Kushtia

Treatment T_3 showed higher plant height but pods/plant and 1000-seed yield was insignificant. The highest seed yield (2.22 t/ha) was obtained from treatment T_1 (N-P-K-S 24-22-42-20 kg/ha) but it was statistically at par in 2005-06. On an average higher seed yield was recorded from treatment T_1. Regarding cost and return analysis, higher gross return and net return was obtained from treatment T_1 (Tk.11840/ha and Tk. 7681/ha) which showed also higher BCR (2.84) in treatment T_1.

Pabna

The performance of yield and yield attributes were lower due to occurrence of unexpected rain at flowering stage. There were significant variations regarding plant population m^{-2}. Maximum plant population was observed in T_2 treatment followed by T_3 and T_4 treatment. Plant height was maximum in T_3 treatment where only inoculum was applied. The maximum number of pods plant^{-1} was obtained from T_1 treatment but it was identical with other treatments. Similar trend of response was also observed in seed yield and stover yield. More or less similar trend of response was observed in case of stover yield.

Regarding economic return, the highest gross margin was obtained from T_1 treatment followed by farmers dose (T_4) but the highest benefit cost ratio was recorded in T_3 treatment due to the lowest variable cost because of omission of chemical fertilizer.

Farmers reaction

Faridpur: Farmers were very encouraged to observe the performance of BARI lentil-4 with inorganic fertilizer and inoculum.

Kushtia: Farmers expressed their satisfaction for higher yield potential without use of chemical fertilizer

Pabna: Farmers of that location showed their quite interest on bio-fertilizer because the crops can be grown only with bio-fertilizer. But they opined that it should be available in local level.

Conclusion

Biofertilizer showed higher yield at Kushtia and Faridpur but did not show better performance at Jessore and Pabna during 2006.

Table 1. Yield and yield attributes of lentil at MLT site, Kuadabazar, Jessore during rabi 2006-07

Treatment	Plant height (cm)	Plant Pop./m^2 (no.)	Pods/ plant (no)	1000- gr. wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
T_1	30.10	139	41.38	18.83	0.912	1.53
T_2	30.25	138	41.58	19.53	0.935	1.62
T_3	30.41	128	44.60	19.13	0.903	1.65
T_4	29.20	139	43.95	18.06	0.930	1.65
F-test	NS	NS	NS	NS	NS	NS
CV (%)	5.67	5.74	11.04	5.44	5.21	9.77

Table 2. Yield and yield attributes of lentil at FSRD site, Faridpur during rabi 2006-07

Treatment	Pl.pop/ m^2	Pl. height (cm)	Branches/plant (no)	Pods/plant (no)	Seed /pod (no)	TSW (g)	Seed yield (kg ha^{-1})
T_1	176	33.16	5.30	32.90	1.62	18.20	1538
T_2	171	35.90	4.95	31.87	1.47	18.15	1493
T_3	170	31.27	5.32	33.35	1.65	18.35	1586
T_4 (FP)	172	32.85	4.27	30.24	1.22	17.87	935
LSD (0.05)	4.37	2.67	0.31	3.27	0.41	0.42	108.4
CV (%)	8.50	8.32	6.59	14.29	10.68	5.90	9.27

Table 3. Yield and yield components of lentil as affected by bio-fertilizer at Bharamara MLT site, Kushtia during 2006-2007.

Treatment	Plants/m^2	Plant height (cm)	Pods/ plant	Branch/ plant	100-seed wt. (g)	Seed yield (t/ha)		Stover yield (t/ha)
						2006-07	2005-06	
T_1	62	54.33	241.66	7.13	2.03	2.22	2.05	2.44
T_2	63	47.66	208.33	7.67	2.00	1.76	2.25	2.12
T_3	65	42.33	199.00	6.00	2.06	1.94	1.90	2.34
T_4	63	42.66	209.00	9.00	1.80	1.77	1.85	2.18
LSD (0.05)	2	11.48	NS	1.14	NS	0.22	NS	
CV (%)	2	13.05	15.14	8.15	13.92	6.23		

Table 4. Economic performance of fertilizer doses at Bharamara, Kushtia during 2006-07.

Treatment	Gross return (Tk)	Variable cost (Tk)	Net return (Tk)	BCR
T_1	11840	4159	7681	2.84
T_2	9413	4208	5205	2.23
T_3	10346	4114	6232	2.51
T_4	9477	3821	5656	2.48

Table 5. Effect of bio fertilizer on the yield and yield attributes of Lentil at MLT site, Atghoria, Pabna during 2006-07.

Treatments	Plant population m^{-2} (no.)	Plant height (cm)	Pods $plant^{-1}$ (no)	1000 seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
$T_1 = N_{50}P_{22}K_{42}S_{20}$	228.9	22.22	39.20	19.92	1105	557
$T_2 = N_0P_{22}K_{42}S_{20}$+Inoculum	240.3	25.40	34.87	19.73	1082	544
$T_3 = N_0P_0K_0S_0$+Inoculum	232.0	27.23	33.47	19.83	981	549
T_4 = FD ($N_{35}P_{21}K_{14}$)	232.4	24.63	35.02	19.18	1066	530
LSD (0.05)	9.101	1.570	NS	NS	NS	NS
CV (%)	3.17	5.13	13.76	2.72	9.93	8.32

Table 6. Cost and return analysis of Lentil as affected by bio fertilizer at MLT site, Atghoria, Pabna during 2006-07.

Treatments	Gross return (Tk ha^{-1})	Total Variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	Benefit cost ratio (BCR)
$T_1 = N_{50}P_{22}K_{42}S_{20}$	46847	16955	29892	2.76
$T_2 = N_0P_{22}K_{42}S_{20}$+Inoculum	45862	16373	29489	2.80
$T_3 = N_0P_0K_0S_0$+Inoculum	41846	12748	29098	3.28
T_4 = FD ($N_{35}P_{21}K_{14}$)	45158	15572	29586	2.90

Price (Tk./kg): Inoculum= 70, Urea= 6.50, TSP= 16.50, MP = 15, Gypsum= 5, Zinc sulphate= 60, Borax= 60, Bio-fertilizer = 70, Seed = 40 & Stover= 4.75

Response of Chickpea to Bio-fertilizer in the Farmers' Field

Abstract

A field experiment was conducted at Rajshahi, Pabna, Faridpur, Khustia and Magura during rabi season of 2006-07 to evaluate the response of chickpea to newly developed bio-fertilizer. Four different treatments comprising only iorganic, combination of iorganic and biofertilizer (BARI RCa-203) along with farmers dose were tested on BARI Chola-5. Result revealed yield did not vary significantly in different treatments at Rajshahi and Faridpur, but highest yield was obtained from farmers practice at Pabna, with the application of only organic fertilizer at Khustia and higher yield was found with that application of biofertilizer along with PKS in Magura.

Introduction

Chickpea commonly known as gram, is the third major pulse crop in Bangladesh but second in consumption priority. The average yield of chickpea is low (600-700 kg/ha) compared to other neighboring countries (ICRISAT, 1990). Bangladesh has been developing a good number of varieties of chickpea. Some of these varieties are waiting for cultivation in the farmers' level but were not screened in respect to nodulation, nitrogen fixation and as well as yield. There is a great possibility to increase its production by exploiting better colonization of the roots and rhizospheres through the application of effective nitrogen fixing bacteria to the seed or to the soil. This can minimize uses of nitrogenous fertilizer, which is very costly in our country. Using high yielding varieties/advanced lines of chickpea in combination with effective rhizobial strains along with management practices including manures and fertilizers can enhance the yield. Few indigenous *Rhizobium* strains were collected from different AEZs of Bangladesh and were screened, tested at research stations. Now their efficiency in crop production needs to be tested at farmers' level. The present study was, therefore under taken i) to evaluate the response of chickpea to biofertilizer under farmers' field condition and ii) to reduce the uses of N-fertilizer for lentil cultivation.

Materials and Methods

The experiment was laid out in randomized complete block design having four replications with four treatments. The unit plot size was 4 m × 5 m. The variety BARI Chola-5 of chickpea and peat based rhizobial inocula BARI RCa-203 were used for the experiment. Inoculum used for the experiment was *Rhizobium* strain named BARI ca-203. Inoculum was used @ 50g Kg^{-1} seed. The crop was sown on 21 November at Rajshahi, 20 November at Pabna, 27 November at Faridpur, 26 November at Khustia and 3 December, 2006 at Magura 2006. All fertilizers were applied as basal. Intercultural operations and plant protection measures were taken as and when required. The plants were harvested on 28 March at Rajshahi, 28 April at Pabna, 31 March at Faridpur, 5 April, 2007 at Khustia. Data on plant height, 1000-seed weight, stover yield and seed yield were also taken.

Treatment combinations at different locations:

Treatments	Rajshahi	Pabna	Faridpur	Khustia	Magura
	N-P-K-S kg/ha				
T_1	50-22-42-20	50-22-42-20	24-22-42-20	24-22-42-20	24-22-42-20
T_2	0-22-42-20 + inoculum	0-22-42-20	50-22-42-20	50-22-42-20	50-22-42-20
T_3	0-0-0-0 + inoculum	0-0-0-0 + inoculum	0-22-42-20 + inoculum	0-22-42-20 + inoculum	0-22-42-20 + inoculum
T_4 (FP)	0-8-0-0	0-0-0-0	25-28-30-20	20-12-17	0-0-0-0

Results and Discussion

Rajshahi

The highest nodule number (26.0) and nodule weight (76.1) were recorded in PKS + Inoculum treated plot which was significantly higher over all other treatments. Maximum seed yield was also recorded from $P_{22}K_{42}S_{20}$+ inoculums following same yield in $N_{24}P_{22}K_{42}S_{20}$.

Pabna

The performance of yield and yield attributes were lower due to occurrence of rain at flowering stage. Significant variation was observed in plant population m^{-2}. The highest plant population was observed in farmers dose (T_4) which was similar to T_1 and T_2 treatment. The lowest plant population was observed in T_3. Plant height was maximum in T_2 which was at par with T_3. The maximum number of pods $plant^{-1}$ was obtained from farmers dose and it was significantly differed from other treatments. Similar response was noted in case of 1000 seed weight and seed yield. The number of nodule $plant^{-1}$was maximum in T_3 which was similar to T_2 and T_4. The weight of nodule $plant^{-1}$ was identical. The highest seed yield was obtained from farmer's dose which was significantly varied from other treatments. It was probably due to the cumulative effect of maximum plant population, pods $plant^{-1}$and 100 seed weight. The lowest seed yield was recorded in T_2 treatment might be due to the excess plant growth and less pod setting. The maximum stover yield was attained in T_2 treatment and the minimum in farmer's dose probably due to dwarf plant height.

Regarding economic return, the highest gross margin and BCR was obtained from farmers dose (T_4) followed by T_3. The lowest gross margin and BCR was recorded in T_2 treatment where chemical fertilizer combined with inoculum was applied.

Faridpur

The yield and yield contributing characters were significantly influenced by rhizobium. The treatment T_3 showed higher yield (1561 kg/ha) due to higher contributing characters like as plant populations/m^2, pods/plant and TSW. The lowest yield was obtained from farmers practice (1360 kg/ha). Inoculums with inorganic fertilizer showed the better performance against only inorganic fertilizer. Application of inoculums gave 185 kg higher yield than application of 50 kg N/ha.

Magura

No significant differences were observed in case of plant height, plant population and pods/plant, 1000 seed weight but pods/plant, seeds/pod, yield (t/ha) and straw yield (t/ha) differ significantly. Higher seed yield (1.087 t/ha) was obtained from T_3 which was identical with T_2. The lowest seed yield from T_4 (Farmers dose). The yield of chickpea was hampered due to continuous heavy rainfall in February and pod borer infestation.

Khustia

Nodules/plant, nodule weight/plant, pods/plant and seed yield were significantly affected by different fertilizer treatments. Pods/plant was higher in treatment T_1 followed by T_2. The highest yield (1.63 t/ha) was obtained from treatment T_2.

Framers reaction

Pabna: Farmers did not show their interest on bio-fertilizer because of excess growth and limited pod bearing in chickpea. In farmers general practice dwarf plant with more pod setting encourages yield. For this reason they opined that chickpea can be grown well even without any fertilizer.

Khustia: In the field, Pod borer infestation was high, some plants were dead after yellowing, and flowers were also damaged.

Faridpur: Farmers were very encouraged to observe the performance of BARI chola-5 with inoculums but BGM and pod borer control is difficult.

Conclusion

It was evident that there was a variation on the characteristics of chickpea due to application of different treatments at different locations eg. Chickpea grown without any fertilizer contributed to the higher seed yield followed by only inoculums treatment, the application of nutrients combine with inoculums accelerated excess plant growth which created shading and moist situation in the plant canopy resulted in poor pod setting and the lowest yield but application of biofertilizer instead of applying nitrogenous resulted the higher yield of chickpea at farmers' field etc. From that it is difficult to draw a conclusion on the one year result. The experiment should be continued in next year for confirming the result.

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Table 1. Effect of bio fertilizer (BARI ca-203) on the yield and yield attributes of Chickpea at Rajshahi during 2006-07.

Treatments	Nodule no./plant	Nodule weight (mg/plant)	Root weight (g/plant)	Shoot weight (g/plant)	Plant height (cm)	Stover yield (t/ha)	TSW (g)	Seed yield (t/ha)	Yield increase over FF (%)
$N_{24}P_{22}K_{42}S_{20}$	13.9b	41.0c	0.21	2.02	41.8	1.69	137	1.34	20.7
$N_{50}P_{22}K_{42}S_{20}$	12.0b	43.3c	0.23	2.31	40.9	1.52	137	1.29	16.2
$P_{22}K_{42}S_{20}$ + Inoc	26.0a	76.1a	0.22	2.34	41.1	1.45	138	1.34	20.7
$N_0P_{08}K_0S_0$	17.0b	56.5b	0.19	1.98	39.0	1.65	136	1.11	-
CV (%)	19.5	14.7	15.5	18.7	6.3	10.8	2.2	16.6	-

Table 2. Effect of bio fertilizer (BARI ca-203) on the yield and yield attributes of Chickpea at MLT site Atghoria during 2006-07.

Treatments	Plant population m^{-2} (no.)	Plant height (cm)	Pods $plant^{-1}$ (no.)	Nodule $plant^{-1}$ (no.)	Nodule wt. $plant^{-1}$ (g)	100 seed wt. (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})
$T_1 = N_{50}P_{22}K_{42}S_{20}$	23.08	42.70	24.80	1.67	0.32	13.70	1248	4353
$T_2 = N_0P_{22}K_{42}S_{20}$+Inoculum	23.35	61.33	20.05	3.60	0.46	12.20	1082	6317
$T_3 = N_0P_0K_0S_0$+Inoculum	21.67	60.50	26.07	3.67	0.33	14.52	1382	5425
T_4 = FD ($N_OP_OK_OS_O$)	23.92	42.73	43.83	2.25	0.28	15.35	1772	3850
LSD (0.05)	2.056	3.654	3.188	1.430	0.239	0.551	155.9	396.1
CV (%)	7.26	5.73	9.03	21.56	26.21	3.22	9.24	6.46

Table 3. Cost and return analysis of Chickpea as affected by bio fertilizer at MLT site, Atgharia, Pabna during 2006-07.

Treatments	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
$T_1 = N_{50}P_{22}K_{42}S_{20}$	77346	16955	60391	4.56
$T_2 = N_0P_{22}K_{42}S_{20}$+Inoculum	72144	16373	55771	4.41
$T_3 = N_0P_0K_0S_0$+Inoculum	86860	12748	74112	6.80
T_4 = FD ($N_0P_0K_0S_0$)	105160	12625	92535	8.33

Inoculum = 70.00 Tk kg^{-1}

Table 4. Effect of bio fertilizer (BARI ca-203) on the yield and yield attributes of Chickpea at FSRD site, Faridpur Atgharia during 2006-07

Treatment (NPKS kg/ha)	Plant pop^n/ m^2	Plant height (cm)	Pods/plant (no)	Seeds/pod (no)	TSW (g)	Seed yield (kg/ha)
24-22-42-20	35.20	38.70	39	1.45	118.20	1465
50-22-42-20	33.19	43.65	33	1.39	116.40	1375
0-22-42-20 + inoculum	36.52	40.80	41	1.51	118.90	1561
25-18-20-20 (FP)	34.90	39.15	38	1.47	118.10	1360
LSD (0.05)	2.37	4.67	2.14	NS	1.83	102.2
CV (%)	16.50	10.32	15.17	15.68	3.90	13.27

Table 5. Yield and yield contributing characters of chickpea at Shalikha, Magura during rabi 2006-07

Treatments	Plant height (cm)	Pods/ plant (no.)	Seeds/Pod (no.)	1000- seed weight (g)	Seed yield (t/ha)	Stover yield (t/ha)
T_1	39.75	35.65b	1.45ab	156.1	0.787bc	1.17c
T_2	41.83	37.78ab	1.50ab	137.60	0.950ab	1.58b
T_3	43.58	46.68a	1.57a	143.10	1.087a	1.85a
T_4	39.63	34.02b	1.35b	136.20	0.738c	1.23c
F-test	NS	**	**	NS	**	**
CV (%)	5.93	10.76	6.57	17.51	8.38	7.55

Table 6: Yield and yield components of chickpea as affected by Bio-fertilizer at Bharamara MLT site, Kushtia during 2006-2007.

Treatment	Plant pop^n /m^2	Nodule no./plant	Pods/ plant)	Nodule wt. (mg/plant)	100- seed wt. (g)	Shoot wt. (g/plant)	Seed yield (t/ha)	Stover yield (t/ha)
T_1	38.66	13.5b	27.33	30.2b	15.36	2.39b	1.00	2.39
T_2	39.00	12.8b	26.33	25.6b	15.13	2.50a	1.63	2.50
T_3	38.33	17.4a	18.66	41.2a	15.26	2.52a	1.30	2.30
T_4	38.66	14.0b	23.00	23.3b	14.46	2.42b	1.20	2.40
LSD(0.05)	NS	4.52	6.14	1.14	NS		0.11	0.13
CV (%)	4.88	9.3	13.69	20.3	7.05	1.7	4.79	3.41

Effect of Plant Spacing and Nitrogen Levels on the Growth and Yield of Batishak

Abstract

Three field experiments were conducted in farmers fields at the FSRD site, Hazirhat, Noakhali and MLT site, Laxmipur and Feni during the rabi season of 2006-07 to study the effect of spacing and nitrogen (N) application on the yield of Batishak (*Brassica chinensis*). Three spacing (40 × 15, 40 × 25 and 40 × 35 cm) and four levels of N (0, 40, 80 and 120 kg/ha) were used in the study. The results showed that the closest spacing (40 × 15 cm) coupled with 120 kg N/ha gave the highest yield (28.33, 31.67 and 35.83 t/ha).

Introduction

Batishak (*Brassica chinensis*) is a short duration high yielding leafy vegetable crop. It is quick growing and nutritionally rich crop, which is suitable for growing all the year round. Average yield of Batishak is 44-55 ton/ha (BARI, 2004) while it was found 34.65 ton/ha at farmers field (Anon., 2005). Many factors are related with this yield gap between researcher and farmer's field. Among these factors plant spacing and soil fertility status are two important factors, which influence the yield of batishak. Since, it is a leafy vegetable it requires more nitrogenous fertilizer than the others. Appropriate spacing is also needed to avoid the competition for getting optimum nutrition among the plants. Beside N-status of soil of greater Noakhali is very poor. The present work was undertaken with a view to find out the appropriate plant spacing and optimum N-dose to get maximum production.

Materials and Method

The experiment was conducted at the FSRD site, Hazirhat, Noakhali, MLT sites of Laxmipur and Feni in the growing season of 2006-07. The soils of the experimental plot were sandy loam in texture. The treatments consisted of 3 levels of plant spacing (40 cm x 15cm, 40 cm x 25 cm and 40 cm x 35 cm) and 4 levels of N-doses (0, 40, 80 and 120 kg/ha). The experiment was set in randomized complete block design with three replications. The seeds were sown on the third week of December 2005. The unit plot size was 4 m x 3m. Twenty days old healthy seedlings were transplanted in the main field. Phosphorus and potassium were applied as basal during final land preparation at the rate of 30 kg P and 65 kg K per hectare in the form of triple super phosphate and muriate of potash. As a source of nitrogen urea was applied in two equal splits at 10 days interval after planting. All other intercultural operations were done when and as necessary. There were no pest infestations in the plots. Data on yield and yield contributing characters were recorded and analyzed by computer programme MSTAT-C and means were separated with LSD test. During the experiment period the salinity range of the plots of three locations varied from 2.01 to 9.15 dS/m.

Results and Discussion

Effect of plant spacing

Effect of different plant spacing on various aspects of morphological, yield contributing characters and yield of batishak in the respective three locations are shown in Table 1, 4 and 7. Plant spacing had significant effect on plant height and number of leaves per plant in all the locations except FSRD site, Hazirhat. Higher spread of plant was found in the maximum spacing i.e. 40 cm x 35 cm. Fresh yield/ plant was also higher in the same spacing at all the locations. But higher fresh green yield was obtained from the closer spacing i.e. 40 cm x 15 cm because of the higher number of plant population per unit area.

Effect of N-doses

Effect of different N- doses on various aspects of morphological, yield contributing characters and yield of batishak in the respective three locations are shown in table 2, 5 and 8. The level of nitrogen applications had a marked influence on different yield components and yield of Batishak. There was trend to increase plant height, yield attribute and yield with the increase of N level. Significantly the highest yield was obtained from 120 kg N/ha in all sites

Combination effect

The plant spacing and the level of nitrogen application had an interesting significant on different yield components and yield of Batishak at all the experimental sites (Table 3, 6 and 9). For all the characters, the better performances were obtained with the application of highest level of plant spacing and nitrogen level except yield. The plant height was found increased significantly with the increase of nitrogen and plant spacing. The longest plant (31.70 cm, 32.20 cm and 32.70 cm) were obtained from the highest dose of nitrogen (120 kg/ha) with the spacing 40 x 35 cm respectively. The shortest plants (24.40 cm, 24.90 cm and 25.40 cm) were found in control plots with the spacing of 40 x 15 cm. The number of leaves produced per plant showed the same pattern in response as that of plant height. The highest number of leaves per plant (18.50, 19.50 and 20.50) were obtained when 120 kg N/ha with the spacing 40 x 35 cm. The plants in control plots gave the lowest number of leaves. The level of nitrogen influenced significantly on the length of leaf. A marked increase was found in maximum length of leaf by application of 120 kg /ha. Similarly, the maximum plant spread (34.50, 35.53 and 36.40 cm) was also obtained from application of 120 kg N/ha along with 40 x 35 cm plant spacing. The maximum fresh weight of plant (235, 308 and 292 g) were also produced from 120 kg N/ha with 40 x 35 cm spacing, however, the lowest fresh yield/plant (97.7, 93.0 and 97.0 gm) were obtained from the control plots with 40 x 15 cm. Yields (fresh weight) were increased significantly with an increase in the level of nitrogen and spacing. But application of nitrogen at 120 kg/ha with the spacing 40 x 15 cm produced the highest fresh yield or green biomass (28.33, 31.67 and 35.83 t/ha). Previous reports of a number of workers and the report of last year's experimentation in these locations support the present findings either partially or fully (Miah, 1987; Kraxner *et al*., 1988; Ahmad and Shahjahan, 1991 and Sarder, 1992). The combined effect of spacing and nitrogen application was found to be significant for all the characters studied in this experiment except number of leaves per plant in first two locations (Table 3, 6 and 9). The fresh yield was found to be increased with the increasing level of N irrespective of spacing. The closest spacing (40 x 15 cm) accompanied with maximum dose of N (120 kg/ha) gave the highest yield of Batishak. The combination results of plant spacing and N- doses of the previous year (2005-06) are provided in table 10, 11 and 12.

Farmers' reaction

The batishak were introduced recently by the farmers. The people of the area and farmers were much interested about this crop because of its higher yield and better taste over other leafy vegetables existing. Some farmers also preserved the seeds both for their own use and for selling purpose.

Conclusion

The highest yield was found in the plant spacing 40 x 15 cm with 120 kg N/ha. Similar findings were also obtained from previous year, so this finding may be extended in the more area through the extension personnel, where there is scope for partial irrigation facilities from pond, ditches or canals.

Table 1. Effect of spacing on the yield and yield contributing characters of Batishak at FSRD, Hazirhat, Noakhali during 2006-07

Spacing (cm)	Plant height (cm)	Leaves/plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
40 × 15	28.22	17.21	29.05	28.1	132.2	21.75
40 × 25	29.27	17.40	30.73	29.0	169.3	17.26
40 × 35	29.67	17.65	30.95	29.3	204.0	13.32
LSD(0.05)	0.689	0.109	0.477	0.614	46.09	3.657

Table 2. Effect of N-doses on the yield and yield contributing characters of Batishak at FSRD, Hazirhat, Noakhali during 2006-07

N-doses (kg/ha)	Plant height (cm)	Leaves/plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
0	25.74	16.43	24.37	23.23	101.6	10.89
40	28.97	17.13	31.03	29.40	142.3	15.32
80	30.34	17.87	31.97	30.34	193.0	18.93
120	31.18	18.23	33.60	32.20	237.0	24.63
LSD $_{0.05}$	0.794	0.109	0.551	2.243	53.23	4.223

Table 3. Combined effects of spacing and N-doses on the yield and yield contributing characters of Batishak at FSRD, Hazirhat, Noakhali during 2006-07

Treatment combination		Plant height (cm)	Leaves/ plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
Spacing (cm)	N-doses (kg/ha)						
40 ×15	0	24.40	16.20	23.40	22.30	97.7	15.17
	40	28.60	17.03	29.60	28.50	122.0	20.33
	80	29.53	17.60	30.90	29.90	139.0	23.17
	120	30.33	18.00	32.30	31.70	170.0	28.33
40 × 25	0	25.90	16.40	24.80	23.50	95.0	9.50
	40	29.00	17.10	31.90	30.03	135.0	13.50
	80	30.70	17.90	32.20	30.60	205.0	21.83
	120	31.50	18.20	34.00	32.00	242.0	24.20
40 × 35	0	26.90	16.70	24.90	23.90	112.0	8.00
	40	29.30	17.30	31.60	29.67	170.0	11.79
	80	30.80	18.10	32.80	30.53	299.0	12.14
	120	31.70	18.50	34.50	32.90	235.0	21.36
LSD $_{0.05}$		2.21	NS	1.688	1.414	15.29	2.243

Table 4. Effect of spacing on the yield and yield contributing characters of Batishak at MLT site, Laxmipur, 2006-07

Spacing (cm)	Plant height (cm)	Leaves/ Plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
40 × 15	28.88	18.21	30.05	29.10	153.6	24.21
40 × 25	29.77	18.40	31.73	30.03	179.9	18.00
40 × 35	30.17	18.65	31.96	30.25	219.3	15.50
LSD $_{0.05}$	0.78	0.11	0.47	0.61	47.99	1.68

Table 5. Effect of N-doses on the yield and yield contributing characters of Batishak at MLT site, Laxmipur, 2006-07

N-doses (kg/ha)	Plant height (cm)	Leaves/ Plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./plant (g)	Green biomass (t/ha)
0	26.23	17.43	25.10	24.23	102.9	11.27
40	29.47	18.13	32.03	30.40	176.1	17.82
80	31.07	18.87	32.98	31.34	208.3	21.81
120	31.68	19.23	34.61	33.20	249.7	26.04
$LSD_{0.05}$	0.89	0.11	0.90	0.71	55.42	1.94

Table 6. Combined effects of spacing and N-doses on the yield and yield contributing characters of Batishak at MLT site, Laxmipur, 2006-07

Treatment combination		Plant height (cm)	Leaves /Plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
Spacing (cm)	N-doses (kg/ha)						
40 ×15	0	24.90	17.20	24.40	23.30	93.0	15.50
	40	29.10	18.03	30.60	29.50	176.3	23.83
	80	30.70	18.60	31.90	30.90	155.0	25.84
	120	30.83	19.00	33.30	32.70	190.0	31.67
40 × 25	0	26.40	17.40	25.80	24.50	100.0	10.11
	40	29.50	18.10	32.90	31.03	157.0	15.70
	80	31.20	18.90	33.23	31.60	211.0	21.10
	120	32.00	19.20	35.00	33.00	251.0	25.11
40 × 35	0	27.40	17.70	25.90	24.90	115.0	8.21
	40	29.80	18.30	32.60	30.67	195.0	13.93
	80	31.30	19.10	33.80	31.53	259.0	18.50
	120	32.20	19.50	35.53	33.90	308.0	21.36
$LSD_{0.05}$		2.01	NS	1.71	1.42	28.66	1.53

Table 7. Effect of spacing on the yield and yield contributing characters of Batishak at MLT site, Feni, 2006-07

Spacing (cm)	Plant height (cm)	Leaves/ plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
40 × 15	29.22	19.21	31.08	29.93	156.6	26.08
40 × 25	30.28	20.23	32.82	30.86	182.5	18.20
40 × 35	30.67	20.65	32.92	31.25	218.3	15.58
$LSD_{0.05}$	0.69	NS	1.19	0.70	30.84	2.98

Table 8. Effect of N-doses on the yield and yield contributing characters of Batishak at MLT site, Feni, 2006-07

N-doses (kg/ha)	Plant height (cm)	Leaves/plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
0	26.73	18.43	39.36	26.34	103.7	11.40
40	29.97	19.10	33.01	31.40	169.8	18.02
80	31.35	19.87	33.99	28.68	213.0	22.73
120	32.18	21.33	35.65	33.98	256.7	27.66
$LSD_{0.05}$	0.23	1.88	NS	6.71	35.61	3.44

Table 9. Combined effects of spacing and N-doses on the yield and yield contributing characters of Batishak at MLT site, Feni, 2006-07

Treatment combination		Plant height (cm)	Leaves/ Plant (no.)	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
Spacing (cm)	N-doses (kg/ha)						
40 ×15	0	25.40	18.20	25.40	24.30	97.0	16.17
	40	29.60	19.03	31.67	30.50	137.0	22.83
	80	30.53	19.60	32.80	31.90	177.0	29.50
	120	31.33	20.00	34.33	33.03	215.0	35.83
40 × 25	0	26.90	18.40	26.87	24.83	103.0	10.10
	40	30.00	19.10	33.70	32.03	165.0	16.50
	80	31.73	19.90	34.37	32.60	199.0	19.90
	120	32.50	23.53	36.33	34.00	263.0	26.30
40 × 35	0	27.90	18.70	26.80	25.90	111.0	7.92
	40	30.30	19.23	33.67	31.67	207.0	14.74
	80	31.80	20.10	34.80	32.53	263.0	18.79
	120	32.70	20.50	36.40	34.90	292.0	20.86
$LSD_{0.05}$		1.71	4.79	1.12	0.78	24.08	1.73

Table 10. Combined effect of spacing and N-doses on the yield and yield contributing characters of Batishak at FSRD, Hazirhat, 2005-06

Treatment combination		Plant height (cm)	No. of leaves/plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
Spacing (cm)	N-doses (kg/ha)						
40 ×15	0	23.0	13.20	23.5	23.5	95	15.8
	40	28.6	14.07	28.9	28.9	116	19.3
	80	29.9	14.90	29.5	30.2	135	22.5
	120	31.3	18.07	31.9	31.5	163	27.1
40 × 25	0	25.2	13.17	25.1	24.1	117	11.7
	40	28.5	16.07	29.3	28.6	142	14.2
	80	30.6	17.10	31.2	30.0	198	19.8
	120	30.3	18.73	32.4	30.2	237	23.7
40 × 35	0	27.1	13.63	28.0	26.3	159	11.4
	40	28.9	16.17	30.1	28.0	205	14.6
	80	31.3	16.80	31.6	29.0	247	17.6
	120	30.6	19.13	31.7	29.2	298	21.3
$LSD_{0.05}$		3.135	2.048	2.362	3.345	32.88	3.33

Table 11. Combined effect of spacing and N-doses on the yield and yield Contributing characters of Batishak at MLT site, Laxmipur, 2005-06

Treatment combination		Plant height (cm)	No. of leaves/plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
Spacing (cm)	N-doses (kg/ha)						
40 ×15	0	22.0	14.60	13.3	18.4	122	20.3
	40	23.3	15.63	13.6	20.3	143	23.8
	80	24.4	17.53	13.9	21.2	167	27.8
	120	25.6	18.50	14.1	22.8	203	33.8
40 × 25	0	22.2	15.37	15.9	19.0	139	13.9
	40	23.6	16.17	16.7	21.3	173	17.3
	80	25.3	18.73	19.0	22.0	222	22.2
	120	26.4	19.43	22.5	23.3	254	25.4
40 × 35	0	22.6	15.93	23.2	19.9	169	12.1
	40	23.6	16.83	28.9	22.2	216	15.4
	80	26.0	17.77	30.2	22.5	273	19.5
	120	26.6	19.60	31.6	23.7	336	23.9
$LSD_{0.05}$		0.161	0.401	0.131	0.185	44.57	5.167

Table 12. Combined effect of spacing and N-doses on the yield and yield contributing characters of Batishak at MLT site, Feni, 2005-06

Treatment combination		Plant height (cm)	No. of leaves/ Plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
Spacing (cm)	N-doses (kg/ha)						
40 ×15	0	17.3	12.17	18.1	16.0	114	18.9
	40	22.5	16.67	23.6	19.4	137	22.8
	80	25.8	19.53	30.6	22.4	159	26.5
	120	30.2	21.80	36.2	24.5	191	31.8
40 × 25	0	19.7	12.23	20.4	15.1	132	13.2
	40	26.1	21.53	24.4	20.8	163	16.3
	80	30.3	25.10	29.7	21.9	205	20.5
	120	33.5	25.47	36.1	26.4	241	24.1
40 × 35	0	18.7	11.60	21.9	14.1	154	10.9
	40	23.7	18.97	26.2	19.6	213	15.2
	80	26.8	21.90	34.4	24.6	258	18.3
	120	32.7	23.20	39.2	26.2	303	21.6
$LSD_{0.05}$		3.011	2.244	1.324	1.394	39.21	4.29

Effect of Different Fertilizer Management Options on Chilli

Abstract

The study was conducted at the FSRD site Hazirhat, Noakhali and MLT site, Laxmipur during Rabi season of 2006-07. Chilli was evaluated with five different management practices. Among the five treatments, the highest yield (1.37 and 1.50 t/ha) was observed in the treatment T_1 (150% Recommended fertilizer dose) and the lowest yield (0.58 and 0.60 t/ha) was recorded in the treatment T_5 in both the locations. But economic point of view, the highest BCR was found in the treatment T_2 in both the locations.

Introduction

Chilli is one of the major spices crops of the coastal area of greater Noakhali districts. Most of the lands remain fallow during the Rabi season. It has great potentiality to increase its yield per unit area. But soils of this area are very poor in N and P. Imbalance fertilizer is one of the major factors that causes lower yield of chilli. Research work about balanced fertilization of chilli is very scarce in coastal areas of Noakhali. It is therefore, necessary to explore the possibilities of growing this crop in farmer's field in order to raise its yield through balanced fertilization.

Materials and Methods

The study was conducted at the FSRD site Hazirhat, Noakhali and MLT site Laxmipur during Rabi season of 2006-07. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain (AEZ 18f) and Meghna Estuarine Floodplain (AEZ 18) respectively. The experiment was laid out in RCB design with three replications. Unit plot size was 3 m × 2 m. Seedlings were planted in lines maintaining 40 cm × 30 cm spacing. There were five treatments as follows: T_1= 150% RD, T_2 = 100% RD i.e. 50, 32 and 50 kg/ha N, P and K respectively (FRG'2005), T_3= 50% RD, T_4= Farmers practice (29 and 13 kg/ha N and P respectively) and T_5= control. The whole amount of P, K and $^1/_3$rd of N were applied at the time of final land preparation and remaining N was applied in two installments at 25 and 50 DAT. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 2.33 to 8.87 dS/m.

Results and Discussion

Different fertilizer management packages showed a significant influence on different yield and yield contributing characters of chilli in both the locations (Table 1 and 3). No. of fruit/plant, weight of fruit/plant and fruit yield (t/ha) were increased with the increasing fertilizer dose. The research results of the previous year are provided in Table 2 and 4.

FSRD site, Hazirhat

Treatment T_1 gave the highest number of fruit/plant (56.31) and the lowest was found from T_5 (24.24). The highest weight of fruit /plant was obtained from treatment T_1(16.45 g) that was more than double of T_5 (6.96 g). As the highest number and weight of fruit /plant were found from the treatment T_1 and the highest yield (1.37 t/ha) was also found from the treatment T_1. Control plots gave the lowest yield (0.58 t/ha).

From the economic point of view, the highest gross return (Tk. 68523/ha) was observed in T_1 treatment where 1.5 times fertilizers were used from recommended dose (RD) and the lowest gross return (Tk. 28995/ha) was found in control plots. The highest Benefit Cost Ratio (2.14) was obtained in T_2, i.e. RD of FRG'2005 and the lowest BCR (1.16) was found in control plots.

MLT site, Laxmipur

Treatment T_1 gave the highest number of fruit/plant (53.85) and the lowest was found from T_5 (28.36). The highest weight of fruit /plant was obtained from treatment T_1 (18.01 g) that was more than double of T_5 (7.20 g). As the highest number and weight of fruit /plant were found from the treatment T_1, the highest fruit yield (1.50 t/ha) was also found from the treatment T_1 which was followed by T_2 (1.44 t/ha). Control plots (T_5) gave the lowest fruit yield (0.60 t/ha).

From the economic point of view, the highest gross return (Tk. 75000/ha) was observed in T_1 treatment where 1.5 times fertilizers were used from recommended dose (RD) and the lowest gross return (Tk. 30245/ha) was found in control plots. The highest Benefit Cost Ratio (2.32) was obtained in $T_{2,}$ i.e. RD of FRG'2005 and the lowest BCR (1.21) was found in control plots.

Farmers' reaction

Chilli is a cash crop of the farmers of this area. They want more return and profit by using less capital. Since existing recommended fertilizer dose of chilli by FRG' 2005 gave more yield and economic benefit, the farmers were interested in 100% recommended fertilizer dose provided they have available resources.

Conclusion

From the results of consecutive two years, it may be concluded that, the highest yield was recorded from the 150% recommended dose, which was statistically identical with the result found from the 100% recommended dose. But highest BCR was obtained in treatment T_2 (100% recommended dose). This finding may be conveyed as extension message for the extension personnel.

Table 1. Yield, yield contributing characters and economic analysis of chilli at FSRD site, Hazirhat (2006-07)

Treatment	No. of fruit/plant	Wt. of fruit/ plant (g)	Fruit yield (t/ha)	Gross return (Tk./ha)	Total Cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	56.31	16.45	1.37	68523	34091	34432	2.01
T_2	47.70	15.96	1.33	66590	31059	35531	2.14
T_3	41.94	11.29	0.94	46806	28028	18778	1.67
T_4	31.07	9.72	0.81	40522	26836	13686	1.51
T_5	24.24	6.96	0.58	28995	24996	3999	1.16
$LSD_{0.05}$	6.30	4.24	0.35	-	-	-	-
CV (%)	8.31	18.67	18.78	-	-	-	-

Table 2. Yield, yield contributing characters and economic analysis of chilli at FSRD site, Hazirhat (2005-06)

Treatment	No. of fruit/plant	Wt. of fruit/ plant (g)	Fruit yield (t/ha)	Gross return (Tk./ha)	Total cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	38.86	25.45	1.31	65500	34000	31500	1.92
T_2	35.50	23.78	1.28	64000	31300	32700	2.04
T_3	32.69	20.01	1.12	56000	28600	27400	1.95
T_4	29.88	14.63	0.87	43500	28200	15300	1.54
T_5	25.44	13.84	0.60	30300	25900	4100	1.15
$LSD_{0.05}$	1.832	0.858	0.25	-	-	-	-
CV (%)	3.01	2.33	8.53	-	-	-	-

Table 3. Yield, yield contributing characters and economic analysis of chilli at MLT site, Laxmipur (2006-07)

Treatment	No. of fruit/ plant	Wt. of fruit/ plant (g)	Fruit Yield (t/ha)	Gross return (Tk./ha)	Total Cost (Tk./ha)	Gross Margin (Tk./ha)	BCR
T_1	53.85	18.01	1.50	75000	34091	40909	2.20
T_2	51.63	17.92	1.44	72056	31059	40997	2.32
T_3	35.34	11.17	0.96	45405	28028	17377	1.62
T_4	34.50	9.99	0.83	42152	26836	15316	1.57
T_5	28.36	7.20	0.60	30245	24996	5249	1.21
$LSD_{0.05}$	5.12	4.25	0.37	-	-	-	-
CV (%)	6.68	17.71	17.93	-	-	-	-

Table 4. Yield, yield contributing characters and economic analysis of chilli at MLT site, Laxmipur (2005-06)

Treatment	No. of fruit/plant	Wt. of fruit/ plant (g)	Fruit yield (t/ha)	Gross return (Tk./ha)	Total cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	51.45	29.82	1.51	75500	36250	39250	2.08
T_2	50.65	27.61	1.49	74500	33550	40950	2.22
T_3	42.31	23.45	1.20	60000	30850	29150	1.94
T_4	39.89	19.54	0.89	44500	30450	14050	1.46
T_5	30.05	14.07	0.65	32500	28150	4350	1.15
$LSD_{0.05}$	7.761	3.739	0.220	-	-	-	-
CV (%)	9.62	8.67	10.06	-	-	-	-

Effect of Urea Super Granule (USG) As a Source of Nitrogen on Hybrid Maize

Abstract

The experiment was conducted at the MLT site, Atghoria, Pabna during 2006-07 to evaluate the efficiency of USG on hybrid maize. Positive response of USG on the yield of maize was found. The highest grain yield (7.49 t/ha) and BCR (2.24) were obtained from recommended N as USG. Recommended N as prilled urea and 10% less of recommended N as USG showed identical grain yield and economic return.

Introduction

In Bangladesh different types of fertilizer materials are becoming available in the market. Urea Super Granule (USG) is one of the popular nitrogenous fertilizers which are now available in the market and the farmer's are already using it in boro rice. As a slow releasing urea fertilizer, USG can effectively be used in vegetable crops (Anon, 2003). Some research report on different upland crops revealed that a substantial amount of urea fertilizer can be saved by using USG. Farmers are already started to use it in different upland crops such as brinjal, cabbage, cauliflower, tomato in a limited scale. But the efficiency of USG to hybrid maize is yet to be established. However, the information on the efficiency of USG compared to prilled urea is meager. Therefore, it is very important to evaluate the efficiency of USG on hybrid maize.

Objectives

i. To evaluate the efficiency of USG on hybrid maize
ii. To find out the optimum and economic dose of nitrogen as USG for hybrid maize
iii. To compare prilled urea and USG for the production of hybrid maize.

Materials and Methods

The experiment was conducted at the MLT site, Atghoria, Pabna during 2006-07 in agro-ecological zone of High Ganges River Floodplain (AEZ-11). The experiment was laid out in RCB design with six replications. Unit plot size was 5m x 6m. Treatments were T_1= Recommended dose of nitrogen as prilled urea (195 kg N/ha), T_2= Recommended dose of nitrogen as USG (195 kg N/ha), T_3= 10% less recommended dose of USG (176 kg N/ha), T_4= 20% less recommended dose of USG (156 kg N/ha) and T_5= Farmers practice (104 kg N/ha as prilled urea). Average weight of individual urea super granule was 1 g and 8, 7 and 6 granule of USG were used per plant in T_2, T_3 and T_4 treatment, respectively. Other fertilizers were used as per recommended dose (@ 36-57-24-2-1 kg P-K-S-Zn-B/ha. Entire amount of P, K, S, Zn and B and $^1/_3{}^{rd}$ N as prilled urea (in T_1 and T_5) were applied as basal. Rest $^2/_3{}^{rd}$ N as prilled urea was applied in 2 equal splits at 8 leaves and tasseling stage. USG was applied once at 6 leaves stage. One weeding was done at 5 leaves stage. Two irrigations were provided at 8 leaves and tassling stage. Plant protection measures were taken as required. Maize (var. BARI Hybrid Maize-3) seeds were sown on December 15, 2006. The crop was harvested on April 28, 2007. Data on yield and yield contributing characters were collected and analyzed statistically. Economic analysis was done on the basis of prevailing market price of input and output (Reddy and Reddi, 1992).

Results and Discussion

Yield and yield contributing characters of maize are presented in Table 1. All parameters were found statistically significant. Plant height showed higher in treatment T_2 but it was statistically identical to treatment T_1. Grains/cob was statistically similar to all treatments except T_5 treatment which showed the lowest grains/cob. Similar trend was observed in case of grain weight. The highest grain (7.49 t/ha) and stover yield (10.27 t/ha) of maize were obtained from recommended dose of N as USG (T_2) treatment. It was also found that the yield trends were the cumulative effect on number of grains/cob and individual grain weight. Though the N rate was same in prilled urea (T_1) and USG (T_2) treatment but USG treatment gave higher yield. Moreover 10% less of recommended USG (T_3) gave identical yield with recommended dose of N as prilled urea (T_1) which might be due to slow and long time releasing of N from USG.

From the economic point of view, the highest gross margin (Tk.78488/ha) and benefit cost ratio (2.24) were recorded in recommended dose of N as USG treatment but slightly higher cost was involved. Treatment comprise N as prilled urea and 10% less of recommended N as USG showed close to gross return, gross margin as well as benefit cost ratio.

Farmers reaction

Farmers opined that USG application is laborious but it has very good effect on maize. They agree to cultivate maize with USG next time if it will be available in the market.

Conclusion

For maize cultivation it is better to use USG instead of prilled urea for obtaining higher yield and economic return. Farmers can save 10% urea if they use USG as a source of N. However, the trial should be repeated next season for concrete conclusion.

References

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Table 1. Effect of USG on Maize yield and yield attributes at MLT site, Atghoria during 2006-07

Treatments	Plant height (cm)	No. of grains/ cob	100-grain wt (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1=Rec. N as prilled urea (195 kg N/ha)	178.5	480.0	28.28	7.22	10.17
T_2=Rec. N as USG (195 kg N/ha)	185.5	486.7	28.88	7.49	10.27
T_3=10% less of rec. N as USG (175.5 kg N/ha)	147.8	479.3	28.55	7.20	9.83
T_4=20% less of rec. N as USG (156 kg N/ha)	156.1	478.5	27.68	6.87	9.61
T_5=FP (104 kg N/ha)	152.4	458.8	27.07	4.50	9.11
LSD (0.05)	27.06	11.87	1.46	0.26	0.69
CV (%)	10.7	3.07	4.31	9.07	6.84

Table 2. Cost and return analysis of Maize as affected by USG at MLT site, Atghoria, Pabna during 2006-07

Treatments	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1=Rec. N as prilled urea (195 kg N/ha)	84505	38825	45680	2.18
T_2=Rec. N as USG (195 kg N/ha)	87525	39037	48488	2.24
T_3=10% less of rec. N as USG (175.5 kg N/ha)	84115	38757	45358	2.17
T_4=20% less of rec. N as USG (156 kg N/ha)	80375	38484	41891	2.09
T_5=FP (104 kg N/ha)	54055	35945	8110	1.50

Price of input (Tk. kg^{-1}): Urea= 6.00, USG= 6.50, TSP= 16.50, MP= 15.00, Gypsum= 05.00, Zinc sulphate= 60.00 and Borax = 60.00

Price of out put (Tk. kg^{-1}): Maize grain= 11.00 and Maize stover = 0.50

Effect of Urea Super Granule (USG) As a Source of Nitrogen on Cabbage

Abstract

The experiment was carried out at the FSRD site, Pushpapara, Pabna during 2006-07 to see the efficiency of USG on cabbage and to find out the optimum and economic dose of USG for the crop. No significant variation was observed in different treatments. However, maximum head yield was obtained from recommended dose of N as USG followed by 10% less of recommended N as USG. It indicated the better use efficiency of N from USG. The maximum head yield (129.3 t/ha) and maximum economic return in terms of gross margin (Tk.338830/ha) and BCR (9.94) were recorded in recommended N as USG followed by 10% less of recommended N as USG.

Introduction

Cabbage is an important winter vegetable crop in Bangladesh. It is a high value cash crop for early and late growers in winter season. In Pabna district, it is very popular winter crop to the farmers and they grow it as a commercial crop. But the farmers are not getting satisfactory yield due to lack of awareness about recommended fertilizer dose, method of application and other cultural management.

Recently, some fertilizer manufacturing companies are supplying different types of nitrogenous fertilizer materials in the market. Urea super granule (USG) is one of the popular nitrogenous fertilizers which are now available in the market and the farmers are already using it in some wet land crops. Moreover, they are using it in different upland vegetables and fruit crops such as brinjal, cabbage, cauliflower, tomato, banana, papaya etc and the areas under these crops are increasing day by day. Higher yield and economic returns were obtained from cabbage, brinjal and cauliflower by using USG in farmers' field of Tangail area (Anon. 2003). Anon (2006) reported that by using USG in banana the yield and economic returns were increased considerably as compared to prilled Urea even at 10% less of recommended N as USG. But the efficiency of USG to these upland crops is yet not tested in Pabna region although the farmers already started to use it in different crops in a limited scale. Therefore, it is very important to evaluate the efficiency of USG on cabbage in Pabna region.

Objectives:

i. To evaluate the efficiency of USG on cabbage
ii. To find out the optimum and economic dose of USG for the crop

Materials and Methods

The experiment was carried out at the FSRD site, Pushpapara, Pabna during 2006-07 in High Ganges River Floodplain Soil (AEZ-11). The experiment was laid out in RCB design with four replications. The unit plot size was 3.6m x 3m. There were five treatments viz. T_1 = Recommended dose of N as prilled urea (180 kg N/ha), T_2 = Recommended dose of N as USG (180 kg N/ha), T_3 = 10% less than recommended dose of N as USG (162 kg N/ha), T_4= 20% less than recommended dose of N as USG (144 kg N/ha) and T_5= Farmers practice (121 kg N/ha). Other fertilizers were applied as high yield goal (105-58-30-4-1 kg P-K-S-Zn-B/ha). Average weight of individual urea super granule was 1 g and 11, 10 and 9 granules of USG were used per plant in T_2, T_3 and T_4 treatment, respectively. Thirty five days aged seedlings of cabbage (var. Atlas-70) were planted on November 23, 2006 with 60 cm x 45 cm spacing. Entire amount of TSP, MP, Gypsum Zinc sulphate and Borax were applied as basal. Prilled urea was applied in two installments at 16 and 34 DAP. USG was applied at 20 DAP in 3-4 inches apart from plant and 2-3 inches depth of soil. Pesticide Dursban was applied one time at 40 DAP against Termite. Crops were irrigated three times at 8, 29 and 45 DAP. Other intercultural operations were done when necessary. Plant protection measures were taken as required. Crops were harvested on February 24, 2007. Necessary data were collected and analyzed statistically.

Result and Discussion

The result revealed that the head length of cabbage for all treatments was identical with little increase in recommended N as USG. The similar response was also observed in major yield attributes like cabbage length, breath and marketable head weight. Maximum head yield was obtained from recommended N as USG and it was statistically identical to all other treatments. Probably numerically little higher length, breath and marketable weight attributed to increased yield in recommended N as USG treatment. The result indicated encouraging performance of USG on cabbage yield. It revealed that cabbage yield obtained from 10% less and even 20% less N as USG were statistically identical with recommended USG and recommended prilled urea. It is indicated that the efficiency of USG is better over prilled urea.

Regarding economic return, it was revealed that the highest gross return (Tk.387900/ha), gross margin (Tk.338830/ha) and benefit cost ratio (9.94) were obtained from recommended N as USG. It is also noted that even 10% less of recommended N as USG showed higher BCR than prilled urea and 20% less N as USG reveals similar BCR to recommended prilled urea.

Farmer's reaction

Farmers opined that they can successfully cultivate cabbage with 10% less recommended N as USG. The availability of USG in their locality should be ensured.

Conclusion

From the experiment it was evident that Urea Super Granule had significant positive effect on the growth and yield of cabbage. The farmers can save up to 20% urea by using USG in cabbage cultivation. It should be continued in the next year for confirmation.

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Table 1. Effect of USG on yield and yield attributes of Cabbage at FSRD site, Puspapara, Pabna during 2006-07

Treatments	Head length (cm)	Head breath (cm)	Marketable head weight/kg	Head yield (t/ha)
T_1=Rec. N as prilled urea (180 kg N/ha)	15.27	23.70	3.27	120.8
T_2=Rec. N as USG (180 kg N/ha)	15.40	24.13	3.40	129.3
T_3=10% less of rec. N as USG (162 kg N/ha)	15.25	23.98	3.36	125.8
T_4=20% less of rec. N as USG (144 kg N/ha)	14.85	23.75	3.15	116.3
T_5=FP (121 kg N/ha)	14.77	22.92	3.19	117.9
LSD (0.05)	NS	NS	NS	NS
CV (%)	4.05	3.62	7.78	8.37

Table 2. Cost and return analysis of Cabbage as affected by USG at FSRD site, Pushpapara, Pabna during 2006-07

Treatments	Gross return (Tk/ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1=Rec. N as prilled urea (180 kg N/ha)	362400	48875	313225	7.41
T_2=Rec. N as USG (180 kg N/ha)	387900	49070	338830	9.94
T_3=10% less of rec. N as USG (162 kg N/ha)	377400	48826	328574	7.73
T_4=20% less of rec. N as USG (144 kg N/ha)	348900	47057	301843	7.41
T_5=FP (121 kg N/ha)	306600	41532	265068	7.38

Price of input (Tk./kg): Urea= 6.00, USG= 6.50, TSP= 16.50, MP= 14.00, Gypsum= 5.00, Zinc sulphate= 60.00 and Borax = 40.00

Price of out put (Tk./kg): Cabbage = 2.00

Effect of Urea Super Granule (USG) As a Source of Nitrogen on Tomato

Abstract

The experiment was carried out at the MLT site, Pakshi, Pabna during 2006-07 to see the efficiency of USG on tomato and to find out the optimum and economic dose of USG for the crop. However, the yield of tomato was very low due to severe disease infestation. The maximum yield (31.25 t/ha) was recorded in 10% less of recommended N as USG which was statistically identical to recommended N as USG and 20% less of recommended N as USG, respectively. Similar trend was also observed in case of benefit cost ratio.

Introduction

In Bangladesh, different types of fertilizer materials are available in the market. Urea Super Granule (USG) is one of the popular nitrogenous fertilizers which are now available in the market and the farmers are already using it in boro rice. The efficiency of N utilization can be increased through deep placement in the form of USG. Some research report on different crops revealed that by using of USG a substantial amount of urea fertilizer can be saved. Farmers are also started to use it in different upland crops such as, brinjal, cabbage, cauliflower, tomato in a limited scale. But the efficiency of USG is yet to be established. The information on the efficiency of USG compared to prilled urea is meager. Therefore, the experiment was designed to evaluate the efficiency of USG on tomato crop.

Objectives

i. To evaluate the efficiency of USG on tomato.
ii. To find out the optimum and economic dose of USG for tomato

Materials and Methods

The experiment was carried out at the MLT site, Pakshi, Pabna during 2006-07 in agro-ecological zone of High Ganges River Floodplain (AEZ-11). The experiment was laid out in RCB design with six replications. Unit plot size was 5m × 6m. Treatments were T_1= Recommended dose of prilled urea (230 kg N/ha), T_2= USG as recommended dose of prilled urea (230 kg N/ha), T_3= 10% less of USG (207 kg N/ha), T_4= 20% less of USG (184 kg N/ha) and T_5= Farmers practice (125kg N/ha). Average weight of individual urea super granule was 1 g and 12, 11 and 10 granules of USG were used per plant in T_2, T_3 and T_4 treatment, respectively. Other fertilizer were used as per recommended dose (@. 80-100-18-1-1 kg P-K-S-Zn-B/ha. Entire amount of all fertilizers except N and K were applied as basal. Half of N and half K were applied at 15 DAT. Remaining half of N and half of K were applied at 30 DAT. USG were applied once at 15 DAT. One weeding was done at 23-25 DAT. Plant protection measures were taken as required. Harvesting was started on December 28, 2006 and continues up to February 15, 2007. Necessary data were collected and analyzed statistically.

Results and Discussion

Yield and yield contributing characters of tomato is presented in Table 1. All parameters were found statistically significant. Maximum fruits/plant was recorded from treatment T_3 followed by T_2. Similar trend was followed in case of fruit weight/plant. Individual fruit weight did not differ significantly among the treatments except T_5 treatment. The yield of tomato was very low due to severe disease infestation in the field. However, higher yield of tomato (31.25 t ha^{-1}) was obtained from 10% less of recommended dose of N as a source of USG, which was statistically identical to T_2 and T_3 treatments. It might be due to cumulative effects of number of fruits plant^{-1} and individual fruit weight. The lowest yield of tomato (21.47 t ha^{-1}) was observed in farmers practice due to lower yield attributes and less use of N.

From economic point of view, the highest gross margin (Tk 259720 ha^{-1}) and benefit cost ratio (5.92) was recorded in 10% less of recommended dose of N as USG treatment even 20% less recommended N as USG showed higher BCR (4.92) than recommended N as prilled urea (BCR 4.02).

Farmer's reaction

Farmers of that location are interested to cultivate tomato with 10% less USG in next time. They also opined that the market price of USG should be available with reasonable price.

Conclusion

Positive effect of N as USG over N as prilled urea on tomato was observed. By applying 10-20% less recommended dose of N as a source of USG on tomato, the farmers can obtain more yield and economic return than recommended N as prilled urea. However, the trial should be repeated in the next season for concrete conclusion.

Table 1.Effect of USG on tomato yield and yield attributes at MLT site, Pakshi, Pabna during 2006-07

Treatments	Fruits/plant (no.)	Fruit weight/ plant (kg)	Individual fruit weight (g)	Fruit yield (t/ha)
T_1=Rec. N as prilled urea (230 kg N/ha)	10.52	0.79	75.00	21.25
T_2=Rec. N as USG (230 kg N/ha)	13.48	1.03	76.00	27.44
T_3=10% less of rec. N as USG (207 kg N/ha)	15.37	1.17	76.25	31.25
T_4=20% less of rec. N as USG (184 kg N/ha)	12.90	0.97	74.50	25.83
T_5=FP (125 kg N/ha)	11.46	0.81	69.75	21.47
LSD (0.05)	3.06	0.23	5.67	6.16
CV (%)	15.59	15.77	4.96	15.72

Table 2. Cost and return analysis of tomato as affected by USG at MLT site, Pakshi, Pabna during 2006-07

Treatments	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1=Rec. N as prilled urea (230 kg N/ha)	212500	52855	159645	4.02
T_2=Rec. N as USG (230 kg N/ha)	274400	53104	221296	5.16
T_3=10% less of rec. N as USG (207 kg N/ha)	312500	52780	259720	5.92
T_4=20% less of rec. N as USG (184 kg N/ha)	258300	52455	205845	4.92
T_5=FP (125 kg N/ha)	189700	47560	142140	3.99

Price of input (Tk. kg^{-1}): Urea= 6.00, USG= 6.50, TSP= 16.50, MP= 15.00, Gypsum= 5.00, Zinc sulphate= 60.00 and Borax = 60.00

Price of out put (Tk. kg^{-1}): Tomato = 10.00

Effect of Boron on the Yield and Yield Attributes of Mustard Varieties in Barind Area

Abstract

An experiment was carried out at the FSRD site, Kadamshahar, Godagari, Rajshahi during the rabi season of 2006-07 to find out the effect of boron on the yield and yield attributes of mustard in Barind area. Three varieties of mustard (BARI sarisha-6, BARI sarisha-9 and BARI sarisha-13) and four levels of boron (0, 1.0, 1.5 and 2.0 kg/ha) were tested in the study. The results showed that the highest number of seeds/siliqua (26.74), 1000-seed weight (3.68 g), seed yield (1.73 t/ha) and harvest index (29.67%) were produced by BARI sarisha-13. All the crop characters increased with the increasing rate of boron up to 1.5 kg/ha and thereby slightly declined. The highest seed yield (1.56 t/ha), straw yield (4.81 t/ha) and MBCR (20.15) were found at 1.5 kg B/ha. The response of boron was found to be quadratic in nature. The economically optimum boron dose was 1.38 kg/ha as calculated from the response curves.

Introduction

T.Aman-Mustard-Boro rice is one of the promising cropping patterns in High Barind Tract (AEZ-26). Farmers generally cultivate local mustard variety and sometimes BARI sarisha-9. But yield of the varieties are below 1 t/ha. Mustard (cv. BARI sarisha-13) is 20 days earlier than BARI sarisha-11. It has high yield potentiality (2.0-2.5 t/ha). Boron influences the seed yield of mustard (Mehrotra *et al.,* 1977). Anon (2004) reported that application of boron at the rate of 1.0 kg/ha increased the seed yield of mustard by 34-53% in Old Brahmaputra floodplain (AEZ-9). Sometimes it is called the indicator crop for boron deficiency. Application of boron is not a common practice in Barind area for mustard cultivation. The soil of High Barind Tract contains 0.14-0.33 micro-gram/g soil of B. So, there is a scope to enhance the yield of mustard in this area by applying optimum dose of B. Therefore, the present study was under taken to find out the optimum dose of boron for mustard varieties in High Barind soils.

Materials and Methods

The experiment was conducted at the FSRD site, Kadamshahar, Godagari, Rajshahi during the rabi season, 2006-07. The initial soil samples were collected from the experimental plot for laboratory analysis. The chemical properties of initial soil sample presented in Table 1.

Table 1. Nutrient status of initial soil sample (0-15 cm depth) of the experimental plot

pH	Organic matter (%)	K	Total N (%)	P	S	B	Zn
		meq/100g soil		Micro gram/g soil			
6.00	1.33	0.32	0.07	11.00	13.63	0.18	0.76
	Low	Optimum	Very low	Low	Medium	Low	Low

The experiment was laid out in split-plot design with three replications. Three mustard varieties (BARI Sarisha-6, BARI Sarisha-9 and BARI Sarisha-13) and four boron levels (0, 1.0, 1.5, and 2.0 kg/ha) were tested in the experiment. The varieties were assigned in the main plots and boron levels in the sub-plots. The blanket doses of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate were applied at the rate of 275, 175, 90, 170 and 5.6 kg/ha, respectively. The entire amount of all fertilizers and half of the urea were applied during final land preparation. The rest amount of urea was applied as top dressing at 27 days after sowing (DAS). Boron was applied in the form of boric acid as per treatment as a basal dose. Seeds were sown in 30 cm apart rows with continuous seeding on 5 November 2006. Weeding and thinning were done twice by hand simultaneously at 13 and 23 DAS. Irrigations were applied twice at 26 and 61 DAS. Ripcord and Bavistin were applied once to control aphid and leaf spot, respectively as per dose. The crop was harvested according to their maturity ranging from 31 January to 10 February 2007. Data on different yield components were recorded from randomly selected ten plants from each unit plot. Yield data was taken as plot wise and thereafter converted into tone per hectare. Recorded data were analyzed statistically and means were separated by LSD Test (Gomez and Gomez, 1984). The economic analysis was done for gross return and marginal benefit cost ratio (MBCR) for different boron levels following the method suggested by Perrin *et al.* (1979).

Results and Discussion

Effect of mustard variety

The effect of variety on yield and yield attributes like plant height, length of siliqua, seeds/siliqua and 1000-seed weight were statistically significant (Table 2 and 3). Maximum seed yield (1.73 t/ha) was found in BARI sarisha-13 that was identical to BARI sarisha-6 (1.39 t/ha). The lowest seed yield (1.07 t/ha) was found in BARI sarisha-9. Reduction of seeds/siliqua and 1000 seed weight in BARI sarisha-9 was observed probably due to varietal characters that ultimately resulted in the lowest seed yield. Although the lower number of siliqua/plant was observed in BARI sarisha-13 but the highest number of seeds/siliqua and 1000-seed weight contributed to higher seed yield. The stover yield was found to be highest (4.85 t/ha) in BARI sarisha-6. BARI sarisha-9 matured in 83 days, which was 9 and 11 days earlier than BARI sarisha-6 and BARI sarisha-13, respectively.

Effect of boron

It was observed that boron significantly influenced the yield and yield components of mustard except plant population/m^2, plant height, siliqua length and harvest index (Table 4 and 5). Seed yield increased with the increase in boron rate up to1.5 kg/ha and the yield slightly declined with the next higher dose. The highest seed yield (1.56 t/ha) was obtained from application of 1.5 kg B/ha that was similar to 2.0 kg B/ha (1.50 t/ha) and the lowest (1.13 t/ha) at control. Fertilization with 1.5 kg B/ha showed an increase of yield 38.05% over control. These results are in agreement with the findings reported in BARI (2003). Straw yield (4.81 t/ha) was found the highest at 1.5 kg B/ha treatment.

Interaction effect of variety and boron

There was no significant interaction effect between variety and boron levels.

Response curve performance

For the first year experiment the response curve of boron was drawn from the computation of yield data. The response of boron was found to be quadratic in nature. Finally optimum doses for agronomic and economic yields were calculated from the response curve (Figure 1), those two were almost similar.

Economic performance

After completing the 1st year experiment the maximum gross return (Tk. 43810/ha) was contributed by 1.5 kg B/ha (Table 5) followed by 2.0 kg B/ha (Tk.41960/ha). The maximum marginal benefit cost ratio (20.15) was obtained from 1.5 kg B/ha.

Farmer's reaction

The farmers choose the mustard variety BARI sarisha-13 due to its higher productivity and minimum incidence of diseases. The farmers convinced that application of boron in mustard enhanced the yield.

Conclusion

From the first year results it can be concluded that boron application has a positive effect on rapeseed yield. Among the tested varieties, BARI sarisha-13 performed better in respect of yield and economic return. The economically optimum dose of boron was 1.38 kg/ha. For confirmation the experiment should be continued in the next year.

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Table 2. Yield components of mustard as influenced by different varieties, Godagari, 2006-07

Variety	Plant pop./m^2	Plant height (cm)	Siliqua/ plant	Siliqua length (cm)	Seeds/ siliqua	1000-seed wt.(g)
BARI sarisha-6	59.50	111.53a	92.43	5.11ab	22.58b	3.42ab
BARI sarisha-9	57.08	84.07b	84.54	4.24b	17.24c	2.93b
BARI sarisha-13	61.33	95.08ab	72.90	6.06a	26.74a	3.68a
F-test	NS	*	NS	*	**	*
CV (%)	5.92	5.67	14.56	12.11	11.55	7.41

Table 3. Yield of mustard as influenced by different varieties Godagari, 2006-07

Variety	Seed yield (t/ha)	Stover yield (t/ha)	Days to flowering	Days to maturity
BARI sarisha-6	1.39ab	4.85a	40	92
BARI sarisha-9	1.07b	3.34c	31	83
BARI sarisha-13	1.73a	4.10b	41	94
F-test	**	**	-	-
CV (%)	7.78	11.44	-	-

Table 4. Yield components of mustard as influenced by boron levels Godagari, 2006-07

Boron level (kg/ha)	Plant pop./ m^2	Plant height (cm)	Siliqua/ plant	Siliqua length (cm)	Seeds/ siliqua	1000-seed weight (g)
0	57.22	93.87	71.36b	4.93	21.18b	2.92b
1.0	59.89	96.13	77.56ab	5.05	21.96b	3.42a
1.5	59.67	98.83	93.60a	5.28	24.57a	3.54a
2.0	60.44	98.73	90.66a	5.27	21.06b	3.49a
F-test	NS	NS	**	NS	*	*
CV (%)	5.92	5.67	14.56	12.11	11.55	7.41

Table 5. Yield of mustard and economic return as influenced by boron levels

Boron level (kg/ha)	Seed yield (t/ha)	% yield increase over control	Stover yield (t/ha)	Gross return (Tk./ha)	Variable cost (Tk./ha)	Gross margin (Tk./ha)	MBCR (Over control)
0	1.13c	-	3.13c	31380	-	31380	-
1.0	1.40b	23.89	4.00b	39000	412	38588	18.49
1.5	1.56a	38.05	4.81a	43810	617	43193	20.15
2.0	1.50ab	32.74	4.46ab	41960	823	41137	12.86
F-test	**	-	**	-	-	-	-
CV (%)	7.78	-	11.44	-	-	-	-

Note: Price of boric acid-70 Tk./kg, Mustard-25 Tk./kg and straw-1.00 Tk./kg

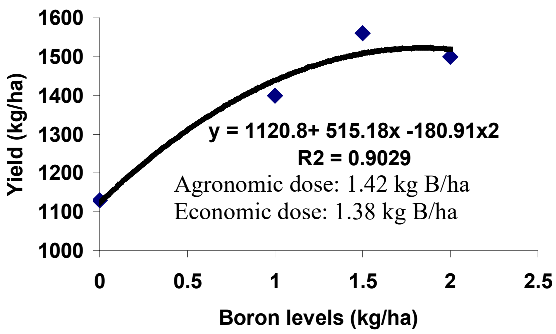

Figure 1. Effect of boron levels on yield of mustard

On-Farm Verification of Boron Fertilization for Maize Production

Abstract

The trial was conducted at the farmer's field of MLT site, Gobindogonj and Ulipur under OFRD, Rangpur during Rabi season of 2006-07 to evaluate the effect of boron on maize. The crop was tested with boron @ 2.0 kg/ha and without boron. Recommended doses of NPKS and Zn were applied as blanket dose. Results revealed that grain yield of maize increased appreciably due to boron application at both the locations. Grain yields 10.33t/ha at Gobindagonj and 10.45t/ha at Ulipur were obtained from boron (2 Kg/ha) treated plots while 4.68 t/ha at Gobindagonj and 6.13 t/ha in Ulipur were recorded from the plots where boron was not applied.

Introduction

Maize is the third cereal crop of Bangladesh. Now-a-days, area under maize production is increasing sharply for poultry industry as well as fodder purposes. Most of the farmers do not apply boron fertilizer in maize cultivation. Boron is responsible for proper pollination and seed formation. Therefore, application of boron in addition to essential major elements along with cowdung has gaining practical significance. The experiment was under taken at farmers' field to create awareness of maize farmers about the effect of boron on the yield of crop.

Materials and Methods

The trial was conducted at the farmer's field in MLT site of Gobindogonj and Ulipur under OFRD, Rangpur in irrigated medium high land during rabi season of 2006-07. The crop was tested with boron @ 2 kg/ha and without boron at six farmers field. A recommended dose of 250-55-138-33-3 kg NPKSZn/ha was applied as blanket dose. The unit plot size was one decimal for each treatment. Seeds were sown with a spacing of 75 cm x 20 cm during first week of December 2007. Irrigation, plant protection measures and other intercultural operations were taken as and when necessary. The crop was harvested at 15-18 may, 2007 at maturity of the crop at both site. Data on yield and yield attributes were recorded.

Results and Discussion

A considerable response of maize to boron was observed at both the locations. The highest grain yield (10.33 t/ha in Gobindogonj and 10.45t/ha in Ulipur) was obtained from boron treated plots. The application of boron might ensure proper pollination resulting in higher number of grains/cob (591) in Gobindogonj and 582 in Ulipur. Similarly, 100-seed weight also influenced appreciably due to boron application. On the other hand, the lowest yield (4.68 t/ha at Gobindogonj and 6.13 t/ha at Ulipur) was obtained from the plots where no boron was used. On an average 92% yield increased due to application of boron against without boron applied plot at Rangpur. Similar results were reported by Sarker *et al*. (1998) who found that yield of maize increased by 11-26% with the application of boron @ 2 kg/ha over no boron at Rangpur.

Farmers' reaction: Farmers were satisfied with reasonable good yield of maize from boron application. They realized the effect of boron on maize production.

Conclusion

Application of boron has positive effect on grain yield of maize. For maize production, the farmers should use 2 kg B/ha. For confirmation of result, the trial should be continued in the next year.

Reference

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Table 1. Effect of boron fertilizer on yield and yield contributing characters of maize at the MLT sites, Gobindogonj and Ulipur, Rangpur during 2006-07

Location	Boron level (kg/ha)	Plant height (cm)	Length of cob (cm)	Diameter of cob (cm)	Grain/cob (no)	Grain wt. / plant (g)	100-grain wt. (g)	Grain yield (t/ha)
Gobindogonj	0	215	17.3	13.3	367.5	96.4	28.1	4.68
	2	217	24.3	16.4	591.0	192.8	32.9	10.33
Ulipur	0	210	15.1	12.2	357.5	132.4	27.4	6.13
	2	212	22.3	15.2	582.0	206.5	33.9	10.45

On-Farm Verification of Boron Fertilization for Mungbean Production

Abstract

The experiment was conducted at the farmer's field of MLT site of Gobindogonj and Ulipur under OFRD, Rangpur during kharif season of 2007 to evaluate the effect of boron on mungbean. The crop was tested with boron @ 1 kg/ha and without boron at farmers field. Recommended doses and NPKS and Zn were applied as blanket dose. The highest seed yield (1212 kg/ha at Gobindogonj and 1189 kg/ha at Ulipur) was obtained from boron applied plot and the lowest seed yield (685 kg/ha at Gobindogonj and 625 kg/ha at Ulipur) was recorded from the plots where no boron was applied. On an average about 83% yield increased due to application of boron @ 1 kg/ha over without boron tested plot at Rangpur.

Introduction

Mungbean (*Vigna mungo* L. wilezek) is the second most popular pulse crop in Bangladesh. The area and production of mungbean during 2005-06 was 0.76 lakh hectares and 0.69 lakh metric tones (AIS, 2007). With the introduction of newly released photo period insensitive short duration varieties like BARI mung-5 and BARI mung-6, the farmers are showing interest in mungbean cultivation. Agro Ecological Zone-3 is very much boron deficient area which caused lower yield of the mungbean crop. It is noted that boron is responsible for pod and grain formation. Application of boron @ 2 kg/ha along with other recommended fertilizers ($N_{40}P_{25}K_{35}S_{20}Zn_2$ kg/ha) gave higher yield of mungbean at Pabna and Faridpur (Anon, 2006). Therefore, application of boron in addition to essential major elements and cowdung has gaining practical significance. The experiment was under taken at farmers' field of Gobindogonj and Ulipur to create awareness about boron effect on mungbean.

Materials and Methods

The experiment was conducted at the farmer's field of MLT sites, Gobindogonj and Ulipur under OFRD, Rangpur to see the effect of boron on mungbean production during kharif season of 2007 under irrigated medium highland condition. The crop was grown with boron @ 1 kg/ha and without boron fertilizer. Recommended doses of 20-20-28-18-2 kg NPKSZn/ha were applied as blanket dose. The trial was conducted with six dispersed replications. The unit plot size was one decimal for each treatment. Seeds were sown during 14-16 March 2007 with a spacing of 30 cm x 20 cm at both the site. Irrigation, plant protection measures and other intercultural operations were followed as and when necessary. The crop was harvested during 18-22 May 2007 at maturity. Data on yield and yield attributes were recorded properly.

Results and Discussion

A considerable response of mungbean to boron was observed. The highest seed yield (1212 kg/ha at Gobindogonj and 1189 kg/ha at Ulipur) was obtained from boron treated plots. Due to boron application, proper pollination and seed formation was higher than without boron treated plots. Yield contributing characters were also positively influenced in boron treated plots which finally increased the seed yield. On an average, about 83% yield increased with the application of boron over without boron applied plot at Rangpur. Islam *et al*. (2006) also reported that seed yield of mungbean increased by about 180% due to application of boron @ 1 kg/ha at Rangpur.

Farmer's reaction

Farmers were satisfied with the better yield of mungbean from boron treated plots. They realized the benefit of boron application in mungbean production.

Conclusion

Application of 1 kg B/ha gave higher yield of mungbean in both Gobindogonj and Ulipur sites. So, 1 kg B/ha may be recommended for mungbean production in Rangpur region. For confirmation of the result, the trial should be continued in the next year.

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Table 1. Effect of boron fertilizer on the yield and yield attributes of mungbean at MLT sites, Gobindogonj and Ulipur, Rangpur during 2006-07

Location	Boron level (kg/ha)	Plant height (cm)	Pods/plant (no.)	Seeds/pod (no.)	100-seed wt. (g)	Seed yield (kg/ha)
Gobindogonj	0	45.50	12.6	6.9	4.4	685
	1	53.75	15.2	11.2	5.3	1212
Ulipur	0	43.4	12.5	6.3	4.6	625
	1	51.5	15.7	11.1	5.4	1189

Development of Fertilizer Recommendation for Potato–Maize–T.Aman Rice Cropping Pattern under AEZ-3

Abstract

The experiment was conducted at the farmer's field in Ulipur and Gobindogonj MLT sites under OFRD, Rangpur during rabi season of 2006-07 to find out the optimum and economic fertilizer dose for Potato-Maize-T.Aman rice cropping pattern. There were five fertilizer doses viz. T_1=STB fertilizer dose for medium yield goal (MYG), T_2=STB fertilizer dose for high yield goal (HYG), T_3=Integrated Plant Nutrient System (IPNS) for high yield goal, T_4=AEZ based fertilizer recommendation (FRG, 2005) and T_5=Farmer practice (FP). Fertilizer doses for different treatments were estimated based on initial soil test data. The highest tuber yield (32.38 t/ha in Ulipur and 32.69 t/ha in Gobindogonj) was obtained from IPNS dose at both the locations. But it was identical with HYG dose at Ulipur location, identical with HYG dose and FRG2005 recommended dose at Gobindogonj.

Introduction

Imbalance use of fertilizers is a serious problem in Bangladesh. Now-a-days the acreage of Potato-Maize- T.Aman rice cropping pattern is increasing sharply day by day. 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. Actually, the farmers don't know what will be the recommended doses in maize crop after potato harvest. For sustainable yield of Potato-Maize-T.Aman rice cropping pattern and maintaining the fertility status of soil, it is needed to develop proper fertilizer dose of the pattern. So, to find out the appropriate fertilizer dose for Potato-Maize-T.Aman rice cropping pattern the experiment was undertaken with the following objectives:

- To verify different nutrient management options
- To recommend fertilizer dose for cropping pattern of Potato-Maize-T.Aman rice
- To determine the economic dose of fertilizer

Materials and Methods

The experiment was conducted at the farmer's field in Ulipur and Gobindogonj MLT sites under OFRD, Rangpur. There were five fertilizer doses viz. T_1= STB fertilizer dose for medium yield goal (MYG), T_2= STB fertilizer dose for high yield goal (HYG), T_3= Integrated plant Nutrient System (IPNS) for high yield goal, T_4= AEZ based fertilizer recommendation (FRG, 2005) and T_5= Farmer practice (FP). The study was initiated with the first crop, potato of the cropping pattern Potato-Maize-T.Aman rice during 2006-07 under irrigated medium highland condition. Soil samples were collected from the selected lands and sent to the laboratory for analysis. After receiving the analytical report of the soil (Table 1) the fertilizer doses of potato, maize and T.Aman were calculated. The treatment details are given in Table 2. The design was RCB with six dispersed replications. The unit plot size was 6m x 9m. The variety of potato was Daimant. Seeds were sown at a spacing of 60 cm x 25 cm during 18-20 December 2006 at both locations. Irrigation, plant protection measures and other intercultural operations were followed as and when necessary. The crop was harvested at maturity during 3-5 March 2007 in both the locations. Data on the yield and yield attributes were recorded and analyzed statistically. The mean separation was done by using LSD test.

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

Soil Characteristic	Ulipur MLT site	Gobindogonj MLT site
Land type and Soil Texture	MHL and Loamy	MHL and Loamy
pH	5.53	6.03
OM (%)	1.60	1.25
Mg (meq/100g soil)	2.49 Very High	3.11 Very High
K (meq/100g soil)	0.68 Very High	0.55 Very High
N (%)	0.08 Very Low	0.06 Very Low
P (Micro gram/g soil)	16.57 Medium	30.66 Very High
S (Micro gram/g soil)	26.53 Optimum	33.30 High
Zn (Micro gram/g soil)	1.06 Medium	0.82 Low
B (Micro gram/g soil)	0.25 Low	0.52 Optimum

Table 2: Details of different treatments of the tested cropping pattern

Treatments	**Ulipur MLT site**	**Gobindogonj MLT site**
	N–P–K–S–Mg–Zn–B–CD (Kg/ha)	
	Potato	
T_1: MYG	101-14-32-2-12-1-0.4-0	107-8-32-4-12-1.7-0-0
T_2: HYG	143-18-45-3-15-1.3-0.5-0	151-10-45-5-15-2.4-0-0
T_3: IPNS	128-15-33-3-15-1.3-0.5-5000	136-7-33-5-15-2.4-1.5-5000
T_4: FRG 2005	96-16-64-10-6-1.5-1-0	96-16-64-10-6-1.5-1-0
T_5: FP	112-14-37-11-0-3-1-3000	104-6-12-0-0-0-3000
	Maize	
T_1: MYG	145-13-26-8-3-0-3.5-0	168-13-26-8-0-1.5-3.5-0
T_2: HYG	205-18-37-12-0-4-5-0	218-18-37-12-02-5-0-0
T_3: IPNS	205-18-37-12-0-4-5-0	218-18-37-12-02-5-0-0
T_4: FRG 2005	196-36-75-30-3-3-1-0	196-36-75-30-3-0-1-3-0-0
T_5: FP		
	T.Aman	
T_1: MYG	70-7-8-20-0.5-0-0-0	92-3-11-3-0-0-0-0
T_2: HYG	101-7-11-3-0-1-0-0	130-4-8-2-0-0-0-0
T_3: IPNS	101-7-11-3-0-1-0-0	130-4-8-2-0-0-0-0
T_4: FRG 2005	45-4-14-8-0-1-0-0	45-4-14-8-0-1-0-0
T_5: FP		

MYG=Medium Yield Goal, HYG= High Yield Goal, IPNS= Integrated Plant Nutrient System, FRG= Fertilizer Recommendation Guide and FP= Farmers Practice

Results and Discussion

The tuber yield and yield contributing characters of potato at Ulipur and Gobindogonj MLT sites are presented in Table 3. The different combinations of fertilizers showed significant variation on the tuber yield of potato at both the locations.

Ulipur MLT site

The highest tuber yield (32.38 t/ha) was obtained from T_3 (IPNS) treatment but it was identical with T_2 i.e., HYG dose (31.50t/ha). The IPNS based dose gave the highest yield as because it contained both organic and inorganic fertilizers essential for plant growth. On the other hand MYG based dose gave the lowest yield (28.93 t/ha). Farmers practice gave reasonable good yield (30.59 t/ha) might be due to use of cowdung along with the chemical fertilizers.

Gobindogonj MLT site

The highest tuber yield (32.69 t/ha) was obtained from T_3 (IPNS) treatment but it was identical with HYG based dose (30.59 t/ha) and FRG 2005 recommended dose (29.78 t/ha). However, the farmers practice gave the lowest tuber yield of 21.39 t/ha.

Farmers' reaction

The farmers are very happy with higher potato yield from IPNS based fertilizer dose compared their own practice.

Conclusion

The IPNS had positive effect on tuber yield of potato. Potato was the first crop of the first cycle. After completion the cycle, final recommendation may be drawn. However, for concrete results the trial should be continued further for at least 2-3 years.

Table 3. Effect of different fertilizer doses on the productivity of potato in Potato-Maize-T.Aman rice cropping pattern at the Two MLT sites OFRD, Rangpur during 2006-2007

Treatment	Plant height (cm)	Tuber/plant (no.)	Weight of tuber/plant (gm)	Tuber yield (t/ha)
Ulipur, MLT Site				
T_1= MYG	58.5b	5.4b	499.7b	28.93c
T_2= HYG	59.7ab	5.8ab	539.0ab	31.50ab
T_3= IPNS	61.7a	6.1a	567.3a	32.38a
T_4= FRG'2005	58.4b	5.6ab	515.5b	29.99bc
T_5= Farmers practice	59.9ab	5.5ab	517.2b	30.59bc
F-test	*	**	**	**
CV (%)	3.2	7.4	6.4	4.6
Gobindogonj MLT site				
T_1= MYG	57.9ab	4.6	431.7c	27.23b
T_2= HYG	58.5a	4.8	498.3ab	30.59ab
T_3= IPNS	59.1a	4.8	530.0a	32.69a
T_4= FRG'2005	53.2b	4.7	473.0bc	29.78ab
T_5= Farmers practice	53.1b	4.6	301.8d	21.39c
F-test	*	NS	**	**
CV (%)	7.3	7.7	7.3	9.5

Integrated Pest Management for Summer Onion Production in the High Barind Tract

Abstract

A field experiment was undertaken during 2006-07 at the Farming System Research and Development (FSRD) site, Kadamshahor, Godagari, Rajshahi to find out the effective management practice for controlling purple blotch disease and thrips attack of summer onion at High Barind area. The treatments combinations were: (i) T_1: Spraying of Malatap at 20 and 40 DAT-2 times (ii) T_2: Rovral and Ridomil spraying at 15, 25, 45 and 60 DAT-4 times iii) T_3: Spraying at treatment 1 and 2 combinely (T_1 + T_2)-6 times (iv) T_4: Control. The yield and yield components of summer onion were significantly influenced by different management packages. The minimum infestation of onion by purple blotch (4%) and thrips (6%) were found in the treatment T_3 (Spraying with fungicide and insecticide). Treatment T_3 also produced the maximum (13.93 t ha^{-1}) bulb yield of onion, which was identical with bulb yield (10.42 t ha^{-1}) obtained from treatment T_2 (only fungicide spray). The highest gross margin of Tk.129500/ha was obtained from T_3 treatment. The highest MBCR (6.86) over control was also obtained in T_3 treatment.

Introduction

Onion (*Allium cepa* L) is one of the most important spice crops in Bangladesh. Among the bulb spices onion ranks second in terms of area (34413 ha) and first in production (138000 mt) covering 24% of the total area under spices and condiments. The average yield of onion in Bangladesh is about 4 t/ha (BBS, 2005). However, onion production of the country does not meet up the domestic demand. The availability of onion for the domestic consumption is 170 thousand metric tons (BBS. 2001). There is an acute shortage of onion in relation to its requirement. Due to limitation of land, it is not possible to increase the area and production of the crop horizontally. The high demand of onion can only be meet up by increasing its per hectare yield. This can be done by judicious application of fertilizer and introduction of high yielding varieties. The increase of area and production of onion in High Barind Tract is comparatively less than other area of Bangladesh. But the acceptance and area coverage of summer onion in Barind area are increasing day by day. The average yield of onion in Barind area is low compared to other parts of the country due to various disease and insect problem. It is highly susceptible to thrips and purple blotch diseases. Sometimes the crop is seriously attacked by the thrips in Kharif-1 season. As a result, the growth and yield is seriously suffered. In Bangladesh very limited works have been carried out to evaluate the effect of integrated pest management for onion production. The present study was, therefore, undertaken to find out the effective management practice for controlling purple blotch disease and thrips attack of summer onion in High Barind area.

Materials and Methods

A Field experiment was conducted at the Farming System Research and Development (FSRD) site, Kadamshahr, Godagari, Rajshahi during 2006-2007 to find out an optimum effective management of purple blotch disease and thrips for summer onion production in High Barind Tract. The experiment was laid out in a randomized complete block design with three replications. The description of the treatments is stated in the following Table 1.

Table 1. Description of the treatments

Treatment	Description of the treatments
T_1	Spraying of Malatap at 20 and 40 DAT-2 times
T_2	Rovral and Ridomil spraying at 15, 25, 45 and 60 DAT- 4 times
T_3	Spraying at treatment 1 and 2 combinely (T_1 + T_2)- 6 times
T_4	Control

The sources of nutrients were urea for N, TSP for P, MP for K and Gypsum for S. The fertilizer dose was $N_{120}P_{40}K_{100}S_{30}$ kg/ha and cowdung 10 t/ha. Full doses of cowdung and all other inorganic fertilizers except urea were applied to individual plot and mixed with soil at the time of final land preparation The urea was top dressed at 15, 35 and 45 DAT. The unit plot size was 3m × 2m. Forty-five days old seedlings of onion (Variety: BARI piaj-2) were transplanted on 22 September 2006. The seedlings were transplanted at the spacing of 20cm × 10cm. Fungicide and insecticide sprays were done as per treatment. Malatap was sprayed @ 2ml/L of water and Ridomil & Rovral were sprayed @ 2 gm/L water. Intercultural operations viz. mulching, weeding and irrigation in order to support normal plant growth were done. The onion was harvested at maturity on 21 January 2007. Data on yield and yield contributing characters of onion were recorded. Observations were made on yield components from 10 randomly selected plants per plot. The data were analyzed statistically and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984). The economic analysis was done for gross return, marginal benefit cost ratio and marginal rate of return (MRR) for different nutrient management packages following the method suggested by Perrin *et al*. (1979).

Results and Discussion

Yield components

Yield components of onion responded significantly to different treatments (Table 2). The height of onion plant varied from 31.10 cm in the control treatment to 60 cm in treatment T_3. The highest plant height (60 cm) was found in the treatment T_3 due to lower infestation of purple blotch and thrips. The maximum number of bulbs/m^2 (43) and leaves (9) per plant were also found in treatment T_3 (Spraying with fungicide and insecticide) due to lower infestation, which significantly differed from all other treatments. The highest bulb length (5.86 cm), bulb diameter (5.92 cm) and average single bulb weight (108.3 g) were obtained from treatment T_3 followed by T_2. This might be due to lower infestation of purple blotch and thrips. The minimum bulb length (3.47 cm), bulb diameter (3.8 cm), and average single bulb weight (78.33 g) were found in control (T_4) due to higher infestation. The maximum days (122) for maturity of onion were found in T_3, which was at par with T_2 (119).

Disease and insect infestation

The infestation by purple blotch and thrips of summer onion responded significantly to different treatments (Table 3). The highly infested of onion by purple blotch (22%) was observed in control plot (T_4) due to no application of fungicide and insecticide. The minimum infestation (4%) was found in the treatment T_3 (Spraying with fungicide and insecticide). It might be due to application of fungicide and insecticide. Similar results were observed in case of thrips attack. The highest infestation of onion by thrips (23%) was observed in control plot (T_4) due to no application of insecticide and fungicide. The second highest infestation of onion by thrips (18%) was observed in T_2 due to no application of insecticide. The minimum infestation of onion by thrips (6%) was found in T_3 (Spraying with fungicide and insecticide).

Bulb yield

Different treatments significantly influenced on the bulb yield of onion (Table 3). The treatment T_3 (Spraying with fungicide and insecticide) produced the higher bulb yield of onion compared to the other treatments. The bulb yield ranged from 7.2 to 13.9 t/ha. The highest bulb yield (13.9 t/ha) was obtained from T_3 showing an increase of 93% over control and was significantly different from all other treatments. The next highest bulb yield (10.42 t/ha) was observed in treatment T_2. The bulb yield is comparatively low due to no rainfall occur in the month of November and December 2006 at experimental site. Monthly total rainfall during crop growing period (From September 2006 to February 2007 have been presented in Figure 1. The treatments T_3 and T_2 produced higher bulb yield due to higher weight of single bulb.

Cost and return analysis

Gross return, variable cost, gross margin and marginal benefit-cost ratio over control of different treatments for onion have been shown in Table 4. The economic analysis of the experiment exhibited that treatment T_3 (Spraying with fungicide and insecticide) produced the maximum gross return of Tk.139300/ha, although its variable cost was high (Tk.9800/ha). The second highest gross return, Tk.104200/ha was recorded from T_2 and the lowest (Tk.72000/ha) in control plot (T_4). The highest gross margin (Tk.129500/ha) was found in T_3 followed by T_2 (Tk. 96400/ha) and the lowest (Tk.72000/ha) in T_4. This variation occurred due to the variation of bulb yield of onion. Karim *et al.* (1994) reported that farmers always try to maximize their returns up to the point where returns to investment are the highest as the capital is scarce. Thus, farmers of the area may be advised to go for treatment T_3 that might give more return. The marginal farmers who are unable to afford necessary cost may choose treatment T_2. Considering MBCR value, the treatment T_3 (Spraying with fungicide and insecticide combinely in 6 times) was found economically profitable and viable among the treatments for the cultivation of summer onion in High Barind Tract area of Bangladesh.

Conclusion

From the results, it may be concluded that the treatment T_3 was economically profitable and viable for the production of summer onion in High Barind Tract soil. So, the treatment T_3 i.e., Rovral and Ridomil spraying at 15, 25, 45 and 60 DAT- 4 times + Spraying of Malatap at 20 and 40 DAT-2 times was the effective management practice for controlling purple blotch disease and thrips attack of summer onion in High Barind area. However, this was first year result. So, it should be continued in the next year for confirmation and final recommendation.

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Table 2. Yield components of onion as influenced by different pest management

Treatment	Plant height (cm)	No. of bulb/m^2	No. of leaf/plant	Bulb length (cm)	Bulb diameter (cm)	Average bulb weight (g)	Days to maturity
T_1	40.12	33.33	7	4.94	4.13	91.67	116
T_2	51.24	35.00	8	5.66	4.80	96.33	119
T_3	60.00	43.12	9	5.86	5.92	108.33	122
T_4	31.10	27.00	5	3.47	3.80	78.33	114
LSD (0.05)	6.09	10.66	1.99	1.36	0.95	8.84	6.02
CV (%)	5.53	7.36	11.79	13.97	10.23	5.72	8.24

Figures in a column having same letter do not differ significantly at 5% level by LSD

T_1-Spraying of Malatap at 20 and 40 DAT-2 times, T_2-Rovral and Ridomil spraying at 15, 25, 45 and 60 DAT-4 times, T_3-Spraying at treatment 1 and 2 combinely (T_1 + T_2)- 6 times& T_4-Control

Table 3. Bulb yield of onion and disease infestation as influenced by different pest management

Treatments	Disease and insect infestation		Bulb yield (t/ha)	
	Purple blotch (%)	Thrips attack (%)	Yield (t/ha)	% Yield increase over control
T_1	12	5	8.23	14
T_2	8	18	10.42	45
T_3	4	6	13.93	93
T_4 (Control)	22	23	7.20	-
LSD (0.05)	1.51	2.89	2.05	-
CV (%)	4.35	7.36	9.05	-

N.B: Figures in a column having same letter do not differ significantly at 5% level by LSD

Table 4: Partial budget analysis for pesticide use in onion production

Treatments	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	MBCR (Over control)
T_1	82300	1800	80500	5.72
T_2	104200	7800	96400	4.12
T_3	139300	9800	129500	6.86
T_4	72000	0	72000	-

Input price (Tk./kg): Malatap= 450, Rovral = 500, Ridomil = 1100
Output (Tk./kg): Onion= 10.00

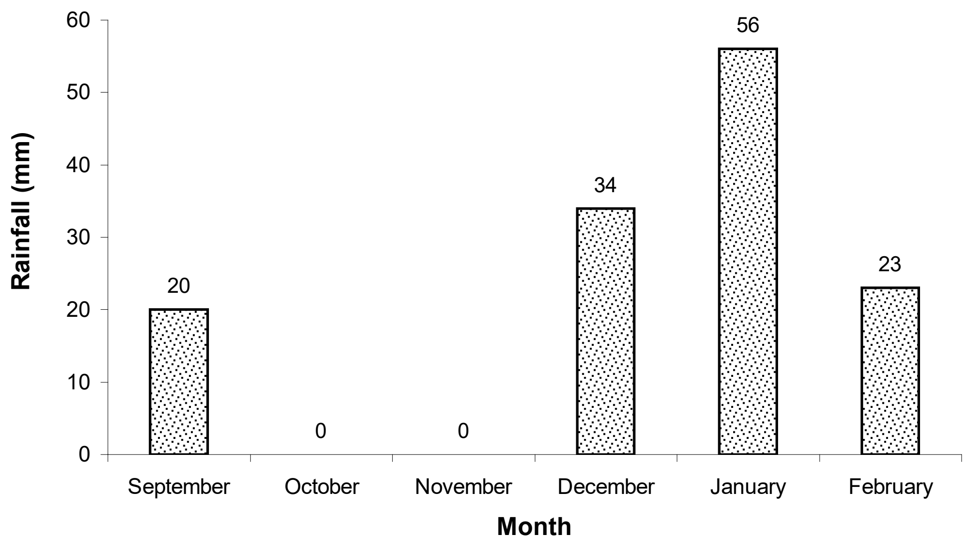

Figure 1. Monthly total rainfall during onion growing period (September 2006 to February 2007)

A. PLAIN LAND

Intercropping Maize with Potato and Jute under the Cropping Pattern Potato+ Maize/ Jute-T.Aman Rice

Abstract

A field experiment of intercropping maize with potato and jute followed by T.aman rice was conducted at Serudanga of Mithapukur upazila under Rangpur district during 2006-07 to synchronize the suitable planting time for better yield and economic performance. The treatments were T_1=Maize sowing 30 days after potato sowing + jute sowing 100 days of maize sowing as relay with only urea as topdressing for jute, T_2=maize sowing 30 days after potato sowing + jute sowing as relay after 115 days of maize sowing with only urea as topdressing for jute and T_3=Farmers practice (jute sowing 125 days of maize). Maize equivalent yield (35.4t/ha), gross return (Tk.354000/ha), gross margin (Tk.241950/ha) and BCR 3.16 were found slightly higher in farmers practice but close to T_2 treatment. Conclusion can be made after completion of cropping cycle.

Introduction

Intercropping, now-a-days, 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. The farmers of Rangpur region are also practicing intercropping system and recently some farmers are cultivating maize as relay with potato and then relay jute at the later stage of maize with their own management practice. Establishment of maize and jute in this system varied among the farmers resulting different performance. Hence, it is essential to synchronize the planting time and fertilizer management of relay crop for better yield.

Materials and Methods

The experiment was conducted at Serudanga, Mithapukur, Rangpur starting from rabi season of 2006-07. The treatments were as follows: T_1=Maize sowing 30 days after potato sowing + jute sowing 100 days of maize sowing as relay with only urea as topdressing for jute, T_2=maize sowing 30 days after potato sowing + jute sowing as relay after 115 days of maize sowing with only urea as topdressing for jute and T_3=Farmers practice (jute sowing 125 days of maize). The experiment was laid out in randomized complete block design with 3 dispersed replications. The unit plot size was 6m x 4.5m. Potato variety diamant was planted on December 6, 2006 with a spacing of 60 cm x 25 cm. One line maize with seed distance of 25 cm was sown in between two rows of potato on 18 January 2007. The verity of maize was BARI hybrid maize-5. Recommended dose of fertilizer i.e. 550-280-280-185-15-12-80 kg/ha urea, TSP, MP, Gypsum, Zinc sulphate, Boric acid and Magnesium sulphate were used. One-third urea, $^1/_3{}^{rd}$ MP and all other fertilizers and cowdung were applied during final land preparation before potato planting. After 25 days of potato planting, $^1/_3{}^{rd}$ urea and $^1/_3{}^{rd}$ MP was top-dressed followed by earthing up and irrigation. After harvesting of potato at 70 DAP when the maize is in its 8-10 leaf stage, the rest urea and MP was top dressed followed by earthing up and irrigation. The jute variety 0-9897 was broadcasted in between the maize rows on 18.04.07 in T_1, 03.05.07 in T_2, and 13.05.07 in T_3. Maize was harvested on 14.06.07. No fertilizers were used in jute except top dressing of urea at the rate of 82 kg/ha at 40 DAS.

Results and Discussions

Yield and yield contributing characters of potato and maize did not vary significantly among the treatments. The highest maize equivalent yield was very close to each other. Gross return, gross margin and BCR were found slightly higher in farmer's practice (T_3) but very close to T_2.

Conclusion should be made after the completion of the pattern.

Table 1. Grain yield and yield contributing characters of *maize* in the cropping pattern potato + maize/jute-T.aman during 2006-07

Treatments	Plants/m^2 (no)	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob breadth (cm)	Grains/ cob (no)	100-grain weight (g)	Grain yield (t/ha)
T_1	5.3	206.73	123.9	21.33	15.83	508.93	29.2	8.20
T_2	5.5	206.50	129.1	20.90	15.90	504.67	27.9	8.30
T_3	5.3	206.8	127.0	20.73	15.30	509.37	28.5	8.60
CV (%)	5.23	7.81	10.88	10.37	5.60	5.64	4.20	6.19

Means in a column without any letter do not differ significantly by DMRT at 5% level.

T_1=Maize sowing 30 days after potato sowing + jute sowing 100 days of maize sowing with only urea as topdressing for jute

T_2=maize sowing 30 days after potato sowing + jute sowing115 days of maize sowing with only urea as topdressing for jute

T_3=Farmers practice (jute sowing 125 days of maize).

Table 2. Yield and economic performance of potato and maize in the cropping pattern potato + maize/jute-T. aman during 2006-07.

Treatments	Yield (t/ha)		MEY (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
	Potato	Maize					
T_1	25.9	8.2	34.1	341000	112050	228950	3.04
T_2	27.0	8.3	35.1	353000	112050	240950	3.15
T_3	26.8	8.6	35.4	354000	112050	241950	3.16

Price: After harvest price of potato = Tk.10/kg and maize = Tk.10/kg. Seed potato = Tk 25/kg, Seed maize = Tk. 200/kg, Urea = Tk.6/kg, TSP = Tk.18/kg, MP = Tk.15.5 /kg, Gypsum = Tk.5/kg, Zinc Sulphate = Tk.80/kg and Boric acid = Tk.90/kg.

Intercropping Maize with Gardenpea

Abstract

A field experiment was conducted at the Farming Systems Research and Development site, Sherpur, Rangpur and Pabna during rabi season of 2006-07 to observe the productivity and economic feasibility of maize + gardenpea intercropping systems. Three treatments were viz. i) maize (sole), ii) two rows of gardenpea in between maize rows and iii) four rows of gardenpea in between paired rows of maize. The highest grain yield of maize was found from sole maize which was statistically similar to two rows of gardenpea in between maize rows. The highest maize equivalent yield, gross return and gross margin as well as benefit cost ratio was found at Sherpur and Rangpur from two rows of gardenpea in between maize normal rows. On the other hand, the lowest gross return, gross margin and BCR was recorded from sole maize.

Introduction

Cereal-legume intercropping is one of the most popular in the tropical and subtropical regions of the world. Among the cereals, maize is considered as one of important and high yield potential crops which need to be popularized in Bangladesh to increase production and income of the poor farmers. As maize competes for land with a number of rabi crops during winter season, intercropping with its contemporary vegetable may be an alternative way of its accommodation in the existing cropping system.

Intercropping system, however, becomes more productive and economical when component crops differ with genetic make up, photosynthetic pathway, growth habit, growth duration and demand of different growth resources. It also depends on the light availability within the canopy of components crops. Since light provides the energy for photosynthesis, the amount of light intercepted by the canopy determines the crop productivity. In general, tall statured maize does not face light shortage but it is likely to affect the productivity of vegetable in maize + vegetable intercropping system. The productivity of undestroyed vegetable, however, varied with variation of species itself. Furthermore, scenario of total intercrop productivity and economic viability may be changed due to growing of maize in association with different vegetables. The present study was undertaken at the Farming Systems Research and Development site, Kushumhati, Sherpur, Rangpur and Pabna during rabi season of 2006-07 to observe the productivity and economic feasibility of maize + gardenpea intercropping systems.

Materials and Methods

The experiment was conducted at the Farming System Research and Development (FSRD) site, Sherpur, Rangpur and Pabna during the rabi season 2006-07. Three treatments were viz. i) maize (sole), ii) two rows of gardenpea in between maize rows and iii) four rows of gardenpea in between paired rows of maize. The unit plot size was 4.5m x 4.0 m. The experiment was carried out with five replications (dispersed). Maize seeds were sown in a planting configuration of 75 x 25 cm spacing and fertilized at the rate of 250-55-140-50-5-1 kg/ha of NPKSZnB and cowdung at the rate of 5 t/ha. Full amount of PKSB and $^{1}/_{3}$rd of N along with full amount of cowdung were applied at the time of final and preparation. The rest N was applied into two equal splits at 8-10 leaves stage and after harvest of gardenpea. Both the seeds of maize and gardenpea were sown in line on November 19, 2006. The planting materials were BARI hybrid maize-3 and BARI motorshuti-1. Three irrigations were applied on December 24, 2006, January 15 and March 10, 2007. Two weedings were on December 17, 2006 and January 18, 2007. The earthing up was done on February 12, 2007. Gardenpea was harvested in the 1st week of February, 2006. Finally maize was harvested on April 15, 2007 at Sherpur. Harvesting of pea was done 3 February 2007 at Rangpur.

For determination of yield components of maize, ten plants were randomly selected from each plot and plant population, number of cobs/plant, kernels/cob and 1000 kernel weight were recorded. Grain yield of maize was determined by harvesting an area of 7.5 m^2 and converted into t/ha at 14%

moisture content. Recorded data were analyzed statistically and means were separated as per LSD test at 5% level of significance.

Results and Discussion

FSRD site, Sherpur

The result indicated that most of the yield attributes of maize was influenced due to intercropping system (Table 1). It was found that plant/m^2 and cobs/plant was found insignificant. The highest number of kernel/cob was found from sole maize (482.4) and was statistically identical to two rows of gardenpea in between maize rows. The lowest kernels/cob was recorded from four rows of gardenpea in between paired rows of maize. Similar pattern of behaviour was also found in case of 1000 grain weight. The highest grain yield (7.92 t/ha) was achieved from sole maize and was statistically identical to two rows of gardenpea in between maize rows (7.72 t/ha). The lowest yield (7.16 t/ha) was recorded from four rows of gardenpea in between paired rows of maize (7.16 t/ha). The highest maize equivalent yield (11.74 t/ha) was obtained from two rows of gardenpea in between maize rows and followed by four rows of gardenpea in between paired rows of maize (11.13 t/ha). The highest gross return (Tk. 135670/ha), highest gross margin (Tk.83427/ha) and BCR (2.60) were obtained from two rows of gardenpea in between maize rows. On the other hand, the lowest gross return (Tk. 93470/ha), lowest gross margin (Tk. 51224/ha) and BCR (2.21) were recorded from sole maize. The gross return, gross margin and BCR from four rows of gardenpea in between paired rows of maize were slightly lower than two rows of gardenpea in between maize rows.

Rangpur

Plants/m^2 and green pod yield was significantly influenced by the treatment but pods/plant and 100-green pod weight was statistically identical. Significantly the highest planta/m^2 was recorded from the treatment T_2. Though slightly higher pods/plant and seed weight was obtained from treatment T_2 but failed to show high yield than T_1 due to lower plants/m^2.

Plant height and yield attributes were higher in sole maize which resulted higher in grain yield in sole situation. Two row or four rows of pea as intercropping with maize did not influence the grain yield of maize.

Higher MEY was recorded from treatment T_2 which was followed by T_3. Both the treatments showed higher MEY than sole maize. Similar trend was followed in case of gross return, gross margin as well as benefit cost ratio (2.88).

Pabna

Plant population per unit area of pea was little higher in T_3 treatment (Appendix 1). Green pod yield of pea obtained from two intercrop treatments were similar with little increase in T_2 treatment. Fresh biomass was little higher in T_3. In case of maize, days required for attaining maturity was similar in all the treatments. Yield contributing characters and yield obtained from different treatments were statistically identical. This result indicated that an additional short duration crop can be successfully grown with maize with retaining the similar maize yield as sole crop. It exerted an added advantage of growing short duration crops without any fertilizer management before ground coverage by maize canopy.

Cost and return analysis

The highest gross return was achieved with T_2 treatment where paired rows pea were grown in between normal maize row and it was followed by 4 rows pea grown between paired maize rows. Benefit cost ratio obtained from two intercrop treatments was higher than maize sole crop. This revealed that short duration pea grown with maize as intercrop was agronomically feasible and economically viable.

Farmer's reaction

Farmers showed their interest for growing pea with maize because they can get additional income earlier from the maize field. They opined that fresh pod of pea had good access as vegetable to nearby urban market with high price in case of early market.

Conclusion

Pea was grown in between maize normal row or paired rows produced similar yield and economic returns over sole cropping of maize. Intercropping of maize with pea was found promising in the locality because of harvesting an additional crop without any fertilizer supplementation which added additional income within a short period of time.

Table 1. Yield attributes and grain yield of maize+gardenpea intercropping systems, Sherpur, 2006-07

Treatment	Plants/m^2 (no.)	Cobs/plant (no.)	Kernels/ cob (no.)	TGW (g)	Yield (t/ha)		Stover yield (t/ha)
					Maize	Intercrop	
T_1	5.00	1.03	482.4 a	320.0 a	7.92 a	-	6.35
T_2	4.90	1.04	470.1 ab	317.0 ab	7.72 a	3.16	6.53
T_3	5.06	1.05	453.6 b	312.0 b	7.16 b	3.12	6.44
F	NS	NS	*	*	**	-	NS
CV(%)	6.37	4.65	8.24	2.43	7.41	-	8.96

Figure in the column having similar letter (s) do not differ significantly

Table 2. Agronomic productivity and economics of maize-gardenpea intercropping systems

Intercropping system	MEY (t/ha)	GR (Tk/ha)	TVC (Tk/ha)	GM (Tk/ha)	BCR
T_1	7.92	93,470.00	42,246.00	51,224.00	2.21
T_2	11.74	1,35,670.00	52,243.00	83,427.00	2.60
T_3	11.13	1,28,870.00	52,243.00	76,627.00	2.46

T_1= Maize (sole), T_2= Two rows of gardenpea in between maize normal rows, T_3=Four rows of gardenpea in between paired rows of maize, Product price (Tk/kg): Gardenpea= Tk.14.00.00, Maize= Tk. 11.00 and Stover=Tk. 1.00

Table 3. Yield and yield contributing characters of pea in intercropping of maize with pea during 2006-07 at Rangpur

Treatments	Green pod yield (t/ha)	Plants/m^2 (no)	Pods/plant (no)	100 green pod weight (g)
T_1 (Sole maize + FRG, 2005)	-	-	-	-
T_2 (Maize normal row + 2 rows pea)	4.20 a	19.5 a	12.5	207
T_3 (Maize paired row + 4 rows pea)	3.6 b	14.9 b	12.6	211
CV (%)	2.76	4.58	5.46	2.55

Means in a column followed by common letter(s) do not differ significantly by DMRT at 5% level.

Table 4. Yield and yield contributing characters of maize in intercropping of maize with pea during 2006-07 at Rangpur

Treatments	Grain yield (t/ha)	Plants/m^2 (no)	Plant height (cm)	Ear height (cm)	Cob length (cm)	Cob breadth (cm)	Grains/cob (no)	100 grain weight (g)
T_1	9.6	5.20	193.23	81.96	23.23	16.88	478.33	37.2
T_2	8.85	5.10	173.83	72.66	22.56	16.46	473.86	34.0
T_3	8.52	5.15	180.43	75.86	22.16	16.07	469.30	34.6
CV (%)	5.25	9.66	5.12	10.30	7.33	4.78	5.46	3.08

Means in a column without any letter do not differ significantly by DMRT at 5% level.

Table 5. Yield and economic performance of intercropping maize with pea during 2006-07 at Rangpur

Treatments	Yield (t/ha)		MEY (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
	pea	maize					
T_1 (Sole maize + FRG, 2005)	-	9.6	9.6	96000	44132	51868	2.17
T_2 (Maize normal row + 2 rows pea)	4.2	8.85	13.89	138900	48430	90470	2.88
T_3 (Maize paired row + 4 rows pea)	3.6	8.52	12.84	128400	47760	80640	2.69

Price: Maize after harvest = Tk.10/kg, Garden pea after harvest = Tk. 12/kg, Seed maize = Tk. 200/kg, Seed pea = Tk. 18/kg Urea = Tk.6/kg, TSP = Tk.18/kg, MP = Tk.15.5 /kg, Gypsum = Tk.5/kg, Zinc Sulphate = Tk.80/kg and Boric acid = Tk.90/kg.

Table 6.Yield of pea and maize and their economic return under intercropping systems at FSRD site, Pushpapara, Pabna during the year 2006-07

Treatments	Green pod yield ($t\ ha^{-1}$)	Grain yield ($t\ ha^{-1}$)	Maize equivalent yield ($t\ ha^{-1}$)	Gross return ($Tk\ ha^{-1}$)	Total variable cost ($Tk\ ha^{-1}$)	Benefit cost ratio
Sole maize (75 cm x 25 cm) + FRG'2005	-	8.96a	8.96a	98560	29020	3.40
Maize normal row + 2 rows BARI Motor-1 + $N_{250}P_{50}K_{100}S_{30}Zn_5$	3.35	9.12a	16.17a	185128	32125	5.76
Maize paired row + 4 rows BARI Motor-1 + $N_{200}P_{40}K_{80}S_{20}Zn_5$	3.43	8.67a	15.89	182150	31350	5.81
CV%	12.17	4.14	-	-	-	-

Green pod of pea = Tk.25.00 kg^{-1}, Fresh biomass = Tk.0.50 kg^{-1}, Maize grain = Tk.11.00 kg^{-1}, Maize straw = Tk.0.50 kg^{-1}

Appendix 1. Performance of pea under intercropping with maize at FSRD site Pushpapara, Modhupur, Pabna during the rabi season of 2006-07

Treatments	Plant population/ m^2 (no.)	Pods/plant (no.)	Grains/pod (no.)	Pod yield (t/ha)	Biomass yield (t/ha)
Sole maize (75 cm x 25 cm) + FRG'2005	-	-	-	-	-
Maize normal row + 2 rows BARI Motor-1 + $N_{250}P_{50}K_{100}S_{30}Zn_5$	61	6.13	4.50	3.35	5.87
Maize paired row + 4 rows BARI Motor-1 + $N_{200}P_{40}K_{80}S_{20}Zn_5$	66	5.63	4.57	3.43	6.30
CV%	8.57	9.61	4.82	12.17	15.35

Appendix 2. Performance of maize under intercropping with pea at FSRD site Pushpapara, Modhupur, Pabna during the rabi season of 2006-07.

Treatments	Days to maturity (days)	Cob length (cm)	Grain/cob (no.)	100-grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)
Sole maize (75 cm x 25 cm) + FRG '2005	154	18.27	492.9	35.47	8.96	8.65
Maize normal row + 2 rows BARI motorshuti-1 + $N_{250}P_{50}K_{100}S_{30}Zn_5$	155	18.17	510.0	33.87	9.12	8.42
Maize paired row + 4 rows BARI motorshuti-1 + $N_{200}P_{40}K_{80}S_{20}Zn_5$	155	17.67	490.8	36.00	8.67	8.75
LSD (0.05)	-	NS	NS	NS	NS	NS
CV (%)	1.85	7.31	10.72	5.18	4.14	7.91

Intercropping Potato with Maize

Abstract

An experiment was conducted at the Farming Systems Research and Development site, Kushumhati, Sherpur during rabi season of 2006-07 to observe the productivity and economic feasibility of potato + maize intercropping systems. Four treatments were viz. i) Sole potato; ii) Potato+ maize (60%) in potato row with plant spacing 50 cm; iii) Potato + maize (60%) between potato row with plant spacing 50 cm and iv) Potato + maize (80%) in potato row with plant spacing 40 cm. The result indicated that most of the yield attributes of potato was found insignificant due to potato + maize intercropping systems. The potato yield varied from 20.46 t/ha to 22.23 t/ha. The highest maize yield was obtained from potato + maize (80%) in potato row with plant spacing 40 cm (6.11 t/ha) which was identical to potato + maize (60%) in potato row with plant spacing 50 cm (5.29 t/ha) and potato + maize (60%) between potato row with plant spacing 50 cm (5.23 t/ha). The highest potato equivalent yield was obtained from potato + maize (80%) in potato row with plant spacing 40 cm (26.71 t/ha) and the lowest was in potato + maize (60%) in potato row with plant spacing 50 cm (24.34 t/ha). The highest gross return (Tk.400650/ha), highest gross margin (Tk.200691/ha) and highest BCR (2.00) were obtained from potato + maize (80%) in potato row with plant spacing 40 cm. On the other hand, the lowest gross return (Tk.317700/ha), gross margin (Tk.146791/ha) and BCR (1.84) were recorded from sole potato.

Introduction

Intercropping practice offers considerable yield advantages over sole cropping due to efficient utilization of growth resources. Potato is an important source of nutritious food for human beings. In Bangladesh, potato is a major winter vegetable grown as sole crops. It is a short statured crop and it can be intercropped with tall crop like maize. Hybrid maize becomes importance in Bangladesh due to its higher yield potentially and favourable agro-climatic conditions for its cultivation. Intercropping maize with potato is one of the ways of increasing its acreage without competition with other winter crops. Keeping the view in mind, an experiment was undertaken at the Farming Systems Research and Development site, Kushumhati, Sherpur during rabi season of 2006-07 to find out the productivity and economic feasibility of potato + maize intercropping systems.

Materials and Methods

The experiment was conducted at the Farming System Research and Development (FSRD) site, Sherpur during the rabi season 2006-07. Four treatments were viz. i) Sole potato; ii) Potato+ maize (60%) in potato row with plant spacing 50 cm; iii) Potato + maize (60%) between potato row with plant spacing 50 cm and iv) Potato + maize (80%) in potato row with plant spacing 40 cm. The unit plot size was 5m x 4.8 m. The experiment was replicated in six dispersed replications. Potato seeds were sown on November 20, 2006 in a planting configuration of 60cm x 25 cm spacing and fertilized with 160-48-60-20-2 kg/ha of NPKSZn. Half on N and full amount of PKSZn were applied at the time of final and preparation. The rest N was top dressed at 40 days after potato planting. Maize seeds were sown after one month of potato sowing on December 20, 2006. The planting materials for potato and maize were Diamant and BARI hybrid maize- 3. Three irrigations were applied on December 26, 2006, January 15 and February 14, 2007. Two weeding followed by earthing up were done on December 18, 2006 and February 12, 2007. Potato was harvested on February 7, 2007 and maize on May 7, 2007. For determination of yield components of potato and maize, ten plants were randomly selected from each plot and yield parameters were recorded. Recorded data were analyzed and means were separated as per LSD test at 5% level of significance.

Results and Discussion

The results indicated that most of the yield attributes of potato was found insignificant in potato + maize intercropping systems (Table 1). The potato yield varied from 20.46 t/ha to 22.23 t/ha. The highest maize yield was obtained from potato + maize (80%) in potato row with plant spacing 40 cm (6.11 t/ha) which was significantly different from other treatments. Other two treatments potato +

maize (60%) in potato row with plant spacing 50 cm and potato + maize (60%) between potato rows with plant spacing 50 cm were at par. The highest potato equivalent yield was obtained from potato + maize (80%) in potato row with plant spacing 40 cm (26.71 t/ha) and the lowest was in potato + maize (60%) in potato row with plant spacing 50 cm (24.34 t/ha). The highest gross return (Tk. 400650/ha), highest gross margin (Tk. 200691/ha) and highest BCR (2.00) was obtained from potato + maize (80%) in potato row with plant spacing 40 cm though higher cost was involved. Maize (60%) between and within potato rows were showed lower benefit than 80% maize as intercrop.

Table 1.Yield attributes and grain yield of potato and maize in intercropping systems, Sherpur, 2006-07

Treatment	Branches/ plant (no.)	Tuber/plant (no.)	Tuber wt/plant (kg)	Tuber length (cm)	Tuber dia. (cm)	Yield (t/ha)	
						Potato	Intercrop (Maize)
T_1	3.50	5.97	0.32	6.27	4.33	21.18	-
T_2	3.47	5.87	0.31	6.33	4.40	20.46	5.29
T_3	3.43	5.60	0.32	6.45	4.36	21..57	5.23
T_4	3.50	6.20	0.44	6.30	4.36	22..23	6.11
F-test	NS	NS	NS	NS	NS	NS	-
CV(%)	6.27	10.43	8.97	4.63	4.36	8.02	-

T_1= Sole potato
T_2= Potato + maize (60%) in potato row with plant spacing 50 cm
T_3= Potato + maize (60%) between potato row with plant spacing 50 cm
T_4= Potato + maize (80%) in potato row with plant spacing 40 cm

Table 2. Agronomic productivity and economics of potato+maize intercropping systems, Sherpur, 2006-07

Treatment	Potato equivalent yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	21.18	317700	170909	146791	1.84
T_2	24.34	365100	198096	167004	1.86
T_3	25.41	381150	198096	183054	1.92
T_4	26.71	400650	199959	200691	2.00

Seed price (Tk/kg): Maize= Tk.50.00 and Maize= Tk. 106.00.
Product price (Tk/kg): Potato= Tk.15.00 and Maize= Tk. 11.00
Total cost considered seeds, fertilizer, labour, irrigation and additional cost only.

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Intercropping Groundnut with Garlic and Onion

Abstract

An experiment was carried out at the Multilocation Testing (MLT) site, Khaloibhora, Pabna, Gabtabli, Bogra and FSRD site, Faridpur during the rabi season of 2006-07 to verify the performance of onion and garlic as intercrop with groundnut. The two rows of garlic intercropped with groundnut produced the highest groundnut equivalent yield along with the highest gross return. All the intercropped system earned higher gross return and equivalent yield than the sole crop of groundnut in all the sites.

Introduction

Groundnut is a long duration slow growing crop especially in Rabi season. It is grown with wide row spacing, which allows long term following of interspaced. Garlic and onion are two most popular and economic spices crops which need much shorter duration for their maturity. The inter row spaces of groundnut could be utilized for growing these crops as short duration crops. Intercrops are also risk aversive and met the diversified farmer's needs. Oilseed Research Center, BARI has developed two intercropping technologies i.e. groundnut + garlic and groundnut + onion with suitable row arrangement. In On station trials, these two intercropping technologies are found agronomically feasible and economically profitable. So, to test their performance in the farmer's field this verification trial was undertaken.

Materials and Methods

The experiment was conducted at the MLT sites Khaloibhora, Pabna, Gabtali, Bogra and FSRD site, Faridpur during rabi season of 2006-07. The experiment was laid out in RCB design with three replications. The unit plot size was 3.6m × 4.0m. There was five treatments viz. T_1= Sole culture groundnut (324 plants of groundnut), T_2= Groundnut with one row of onion (324 plants of groundnut and 440 plants of onion), T_3= Groundnut with two rows of onion (360 plants of groundnut and 640 plants of onion), T_4= Groundnut with one row of garlic (324 plants of groundnut and 440 plants of garlic) and T_5= Groundnut with two rows of garlic (360 plants of groundnut and 640 plants of garlic). Spacing of groundnut was maintained at 30 cm × 15 cm in T_1, T_2, and T_4 where as 40 cm × 10 cm in T_3 and T_5. Onion and garlic spacing was in single row in T_2 and T_4. Between two rows of groundnut two rows of onion and two rows of garlic were planted maintaining 15 cm × 10 cm spacing in T_3 and T_5 respectively. The land was fertilized with 32-46-87-28-4-1 kg N-P-K-S-Zn-B/ha. Additional 32 kg N/ha was applied at 25 and 50 days after emergence (DAE) for intercropping plots only. Seeds of groundnut (var. BARI chinabadam-6), bulbs of onion and garlic were sown/transplant on 26 November 2006 and harvested onion at 20 February, garlic at 3 April and groundnut at 24 May 2007 at Pabna. Groundnut, garlic and onion planted on 14 to 17 December and harvested on 28 March and 10 May (Groundnut) at Gabtali. The field was irrigated twice. To overcome disease infestation Rovral and Ridomil were sprayed. Other intercultural operations were done when necessary. Plant characters were recorded and analyzed statistically.

Results and Discussions

MLT site, Khaloibhora, Pabna

The results reveled that the highest groundnut yield was obtained from sole crop, which was statistically identical with T_4 and T_5 but onion as intercropped showed the lowest yield of groundnut. Ground nut equivalent yield was higher in T_5 treatment. Two rows of onion and garlic in between two rows of groundnut gave higher groundnut equivalent yield than single row system. Two rows of onion and two rows of garlic gave the higher yield of onion and garlic than one row of every crop. The highest gross return was obtained from 2 rows of garlic in between groundnut rows. Onion as intercropped with groundnut failed to show higher return than garlic due to high price of garlic. But the crop showed higher return than sole groundnut.

MLT site, GabtaIi, Bogra

Branches/plant, pods/plant, seed weight/plant, 100-kernel weight and nut yield of groundnut were statistically significant in different treatments (Table 2). Maximum branches/plant (8.10), no. of pods /plant (14.67), seed weight/plant (9.65 g), 100-kernel weight (33.40) and nut yield (2.02 t/ha) were recorded from sole groundnut. Due to the introduction of onion and garlic, yield of groundnut was decreased. Higher groundnut equivalent yields were recorded from all intercrop treatments as compared to sole crop of groundnut. The highest groundnut equivalent yield (2.94 t/ha) was obtained from T_5. Higher gross margin (Tk. 26788/ha.) and highest BCR (2.41) were recorded from T_5. From cost and return analysis it was found that two rows of onion in between 40cm apart rows of groundnut was better than one row of onion in between 30 cm apart of rows of groundnut. Similarly two row of garlic in between 40cm apart rows of groundnut was better than one rows of garlic in between 30 cm apart rows of groundnut. Yield of groundnut with one row of onion and garlic was higher than two rows of onion and garlic and this might be due to higher number of plant population of groundnut in single row intercrops.

FSRD site, Hatgavindapur, Faridpur

Yield and yield attributes of groundnut: Sole groundnut showed maximum plant height as well as yield attributes and resulted higher pod yield. Among the intercrops, higher seed yield was recorded from 2 rows of groundnut in between 2 rows of onion. On an average, higher yield of groundnut was obtained from 2 rows than 1 row in both the combinations. Garlic affected the groundnut yield as intercrop rather than onion.

Yield of intercrop: Among the intercrops (garlic and onion), higher yield was recorded from 2 rows of onion intercropped in groundnut. Similar trend was followed in case of garlic but much lower yield was achieved than onion.

Groundnut equivalent yield: All the intercropped system showed higher groundnut equivalent yield than sole groundnut. The highest groundnut equivalent yield was recorded from 2 rows of onion in groundnut. Other treatment combinations were close to each other.

Cost and return analysis: The highest gross return and gross margin were obtained from 2 rows of onion in between 2 rows of groundnut though cost of cultivation was higher than sole groundnut. Higher benefit cost ratio was also recorded from 2 rows of onion in between groundnut rows.

Farmers reaction

Pabna: Farmers opined that two rows of garlic in between two rows of groundnut could be suitable combination due to moderate yield of groundnut with additional higher yield of garlic. So, farmer showed be motivated to grow onion and garlic in between groundnut rows instead of sole groundnut. Besides, onion and garlic crisis could be met up.

Bogra: Results of intercropping study is very encouraging. They opined that instead of using seedlings of onion, planting of small size onion bulb may be more profitable due to early harvest and higher market price at Gabtali.

Faridpur: Farmers opined that two rows of garlic and onion in between two rows of groundnut was more suitable combination due to moderate yield of groundnut with additional higher yield of onion and garlic.

Findings

Two rows of onion in between two rows of groundnut were the most feasible and profitable combination due to higher groundnut equivalent and BCR (4.30). Two rows of garlic in between two rows of groundnut were also feasible and profitable with groundnut equivalent yield of 4.82 t/ha and BCR (3.53).

Table 1. Yield of groundnut, onion and garlic in different intercropping systems and their economics at Khaloibhora, Pabna during 2006-07.

Combination	Yield (t ha^{-1})		Groundnut equivalent yield (t/ha)	Gross return (Tk./ha)
	Groundnut	Onion/Garlic		
T_1=Sole Groundnut	2.88a	-	2.88	57600
T_2=Groundnut + 1 row Onion	2.50b	11.81	8.41	168200
T_3=Groundnut + 2 row Onion	2.46b	14.44	9.68	193600
T_4=Groundnut + 1 row Garlic	2.63ab	4.62	13.03	260600
T_5=Groundnut + 2 row Garlic	2.54ab	5.90	15.82	316400
LSD (0.05)	0.347	-	-	-
CV (%)	7.11	-	-	-

Price (Tk/kg)**:** Groundnut=20.00, Onion=10.00, Garlic=45.00

Table 2. Yield and yield component of groundnut affected by intercropping with garlic and onion at MLT site Gabtali, Bogra during Rabi 2005-06 to 2006-07

Treatment	Plant height (cm)	Branches/ plant (no)	Pods/ plant (no)	Seeds/pod (no)	Seed wt/plant (g)	100-kernel wt(g)	Yield (t/ha)	
							2006-07	2005-06
Sole groundnut	35.70	8.10a	14.67a	2.37	9.65a	33.40a	2.02a	1.58a
Groundnut + onion	35.90	7.67ab	11.67b	1.80	6.68b	32.27b	1.40b	0.62b
Groundnut + onion	35.63	7.53b	11.57b	1.70	6.38b	32.23b	1.33bc	0.57b
Groundnut +garlic	35.67	7.57b	11.60b	1.73	6.44b	32.13b	1.34bc	0.66b
Groundnut + garlic	35.60	7.50b	11.57b	1.67	6.24b	32.20b	1.29c	0.57b
LSD (0.05)	NS	*	**	NS	**	**	**	**
CV (%)	0.50	2.34	0.99	15.10	2.38	0.26	2.12	7.67

Table 3. Yield of groundnut, onion, garlic and groundnut equivalent yield of groundnut intercropping with garlic and onion at MLT site Gabtali, Bogra during 2005-06 to 2006-07.

Treatment	Yield of groundnut(t/ha)			Yield of onion/garlic (t/ha)			Groundnut equivalent yield (t/ha)
	2005-06	2006-07	Mean	2005-06	2006-07	Mean	
Sole groundnut	1.58	2.02	1.80	-	-	-	1.80
Groundnut + onion	0.62	1.40	1.01	2.09	2.60	2.35	2.57
Groundnut + onion	0.57	1.33	0.95	2.46	2.70	2.58	2.67
Groundnut +garlic	0.66	1.34	1.00	1.41	1.67	1.54	2.72
Groundnut + garlic	0.57	1.29	0.93	1.67	1.80	1.74	2.94

Table 4. Cost and return analysis of groundnut intercropping with garlic and onion at MLT site, Gabtali, Bogra during 2005-06 to 2006-07 (Average of 2 Years).

Treatment	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Sole groundnut	27000	14762	12238	1.83
Groundnut + onion	38550	18325	20225	2.10
Groundnut + onion	40050	18669	21381	2.15
Groundnut +garlic (2 row)	40800	17712	23088	2.30
Groundnut + garlic	44100	18312	26788	2.41

Groundnut = @ Tk-15/kg, Onion = @ Tk-10/kg & Garlic = @ Tk-20/kg.

Table 5. Yield and yield components of groundnut as affected by intercropping with garlic and onion at FSRD site, Faridpur during rabi season 2005-07 (Average of two years)

Treatment	Plant height (cm)	Plant pop/m^2	Branches /plant (no.)	Pods/ plant (no.)	Seeds/ pod (no.)	100-kernel wt (g)	Pod yield (t/ha)
T_1= Sole groundnut	41.26	30	7.27	13.73	1.83	56.10	2.37
T_2= 1 row onion in between 2 row G. nut	39.20	22	6.13	12.53	1.76	55.36	1.95
T_3= 2 row onion in between 2 row G. nut	37.70	18	5.57	10.30	1.66	54.08	2.05
T_4= 1 row garlic in between 2 row G.nut	39.1	22	6.77	12.33	1.77	55.30	1.80
T_5= 2 row garlic in between 2 row G.nut	37.4	25	7.17	12.78	1.82	55.70	1.72
LSD (0.05)	4.56	12.87	1.37	3.24	0.19	2.09	0.69
CV (%)	8.59	13.20	7.68	9.54	10.32	9.98	8.37

Table 6. Yield of groundnut, onion, garlic and groundnut equivalent yield and LER as affected by intercropping with garlic and onion at FSRD site, Faridpur

Treatment	Yield (t/ha)		Groundnut equivalent yield (t/ha)	LER
	Groundnut	Onion/garlic		
Sole groundnut	2.37	-	2.37	1.00
One row onion in between 2 row G. nut	1.95	6.10	4.50	1.39
Two row onion in between 2 row G. nut	2.05	9.20	5.40	1.68
One row garlic in between 2 row G.nut	1.80	1.72	4.24	1.43
Two row garlic in between 2 row G.nut	1.72	2.08	4.82	1.60

Table 7. Cost and return analysis of groundnut intercropping with garlic and onion at FSRD site during rabi season 2005-07

Treatment	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Sole groundnut	71100	30310	40790	2.35
One row onion in between 2 row G. nut	135000	33560	101440	4.02
Two row onion in between 2 row G. nut	162000	37850	124150	4.30
One row garlic in between 2 row G.nut	127200	38483	88717	3.30
Two row garlic in between 2 row G.nut	144600	40650	103950	3.53

Out-put price (Tk./kg): Onion= 12, Garlic= 40 and Groundnut= 30

Intercropping Onion and Garlic with Chilli

Abstract

The experiment was conducted at the MLT site, Manikganj during 2006-07 to verify the performance of onion and garlic as intercrop with chilli. The garlic intercropped with two rows chilli produced the highest gross return (Tk.297000/ha) and gross margin (Tk.181459/ha) with higher LER (1.47). All the intercropped treatments expect one row onion in between two row chilli showed the highest gross returns and LER compared to sole crop of chilli.

Introduction

In Bangladesh total spices production is about 4.5 lakh tons and 11.5 lakh tons are imported to fulfill the national demand. The farmers at Manikganj cultivate onion and garlic as sole crop and sometimes as mixed crop in the chilli field. They do not maintain the proper spacing, planting time and management practices. They also do not analyze the cost and return of these spice crops. The present study was, therefore, taken to find out the yield and economic return of onion and garlic with chilli.

Materials and Methods

The experiment was conducted at the MLT site, Manikganj during 2006-07. The soil of the experimental area belongs to AEZ-8 with sandy loam in texture. The experiment was set in randomized complete block design with five replications. It consisted of 7 treatments as T_1= Sole garlic, T_2= Sole onion, T_3= Sole chilli, T_4= 1 row onion with 100% chilli, T_5= 1 row garlic with 100% chilli, T_6= 2 row onion with 100% chilli and T_7 = 2 row garlic with 100% chilli. The seeds were sown or planted on the last week of November 2006. The unit plot size was 3 m x 2 m. Spacing of chilli was maintained at 40 x 15 cm. The land was fertilized with 100- 60-30 kg N-P-K per hectare. The whole amount of P, K and $^1/_3$rd of N were applied at the time of final land preparation and remaining N was applied in two installments at 35 and 55 DAT. 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 inter cropping were also calculated according to Willey, (1979).

Results and Discussion

Agronomic practices: All the treatments showed a significant influence on different yield, yield contributing characters, economic return and LER of chilli, onion and garlic.

Chilli: The longest plant height (88.50 cm) was found from T_3, whereas T_4 showed shortest plant height. Branches/plant was also found higher in T_3 (8.14). Length of fruit was at par in all the treatment but higher number of fruit/plant (122.60) was recorded from sole chilli. The highest weight of fruits/plant (13.36 g) was obtained from treatment T_3. Dry fruit yield was statistically identical to all the treatments except T_3, which showed significantly the highest yield (1.56 t/ha).

Intercropped yield: Onion and garlic were grown as intercropped in between chilli rows. There was significant reduction in onion yield in both intercropped treatments but two rows of onion showed more yield than one row. Similar trend was followed in case of garlic (Table 2).

Chilli equivalent yield: The highest chilli equivalent yield (2.97 t/ha) was found in T_7. Sole chilli and sole onion failed to show higher equivalent yield but sole garlic showed higher equivalent yield than other treatments except T_7.

Cost and return analysis: The treatment T_7 where two rows garlic inter cropped with chilli showed higher gross return (Tk.297000/ha) as well as gross margin (Tk.181459/ha). All the intercropping treatments except one row onion in between two row chilli (T_4) showed higher gross return than sole chili. Same trend was observed in gross margin. But BCR was the highest from sole garlic or sole onion as intercropped chilli with onion or garlic had the highest production cost was involved. Land equivalent ratio was also higher (1.47) in treatment T_7 which indicated that by inter cropping of onion in between two rows chilli, fanners could produce 0.98 ton chilli and 4.98 ton garlic from one hectare of land instead of growing them separately in 1.47 hectare of land to obtain the same yield (Table 2).

Farmers reaction

Farmers showed interest to grow two rows garlic in between 100% chilli intercropping system due to its higher return and gross margin but higher cost was involved.

Conclusion

Farmers may grow onion or garlic as sole crop but due to higher cost in intercropping might not be encouraging. So, the experiment needs to another year trial for confirmation.

Table 1. Yield and yield components of chilli in sole and intercropped situation at MLT site, Manikganj during 2006-07.

Treatment	Plant height (cm)	Branches/ plant	Length of fruit (cm)	Fruits/ plant	Wt. of fruit/ plant (g)	Dry fruit yield (t/ha)
T_3	88.50	8.14	5.22	122.6	13.36	1.56
T_4	79.31	6.11	5.22	85.08	8.49	0.86
T_5	87.14	7.03	5.18	74.76	9.39	0.98
T_6	86.24	5.73	5.06	93.12	10.69	0.93
T_7	80.42	5.51	5.26	92.28	10.99	0.98
$LSD_{(0.05)}$	1.43	1.31	0.25	17.86	3.27	0.39

Table 2. Yield of chilli, onion, garlic with economic analysis and LER in different intercropping system at MLT site, Manikganj during 2006-07.

Treatment	Yield (t/ha)			Chilli equivalent yield (t/ha)	Gross return (Tk./ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR	LER
	Chilli	Onion	Garlic						
T_1	-	-	5.93a	2.37	237000	78874	158126	3.00	1.00
T_2	-	7.06a	-	1.41	141000	48874	92126	2.88	1.00
T_3	1.56a	-	-	1.56	156000	85541	70459	1.82	1.00
T_4	0.86b	2.67b	-	1.39	139000	89541	49459	1.55	0.93
T_5	0.98b	-	3.29b	2.30	230000	105541	124459	2.18	1.18
T_6	0.93b	5.23a	-	1.98	198000	93541	104459	2.12	1.34
T_7	0.98b	-	4.98a	2.97	297000	115541	181459	2.57	1.47

Relaying Potato with Hybrid Maize Across Environments

Abstract

The experiment was carried out at the Farming System Research and Development (FSRD) site, Pushpapara, Pabna and Agricultural Research Station, Pabna during the year 2006-07 to find out appropriate time of relay cropping potato with maize for quick return. It was observed that the highest maize equivalent yield was obtained from maize sowing at 20 days after planting (DAP) of potato at Puspapara, same trend was at ARS, Pabna. From the economic point of view highest benefit cost ratio (BCR) was obtained from maize sowing at 20 DAP and also same trend was found at FSRD site and on-station.

Introduction

Maize is the third important cereal crop in our country. Now a day's maize is cultivating in our country a vast area and rapidly expanding in a new area. Maize mainly used as feed, fodder, fuel and bakery industry. Maize is a long duration crop intercropping of short duration potato cultivar could help the farmer to earn a quick return. However, to get maximum benefit from intercropping, time and plant population should be optimized. Therefore, an experiment was undertaken with following objectives.

i) To find out appropriate intercropping time of potato with maize
ii) To get a quick return through potato intercropping from long duration maize
iii) To find out the effect of potato intercropping on maize yield

Materials and Methods

The experiment was carried out at the FSRD site, Pushpapara, Pabna and Agricultural Research Station (ARS), Pabna during the Rabi season of 2006-07 under medium high land. The experiment was laid out in RCB design with 4 replications at FSRD site and 3 replications at ARS. The treatments were- T_1 = same day planting of maize and potato, T_2 = Maize sowing at 20 DAP of potato, T_3 = Maize sowing at 35 DAP of potato and T_4 = Sole maize. The unit plot size was 10m × 8m. The maize variety was BARI hybrid maize-3. Potato seeds (var. Diamant) were sown on November 29 and 21, 2006 at FSRD site and ARS, respectively. Potato seeds were sown in between two maize rows having 20 cm spacing from tuber to tuber. Maize seeds were sown on 29 and 21 November and 19 and 11 December 2006 and 4 January, 2007 and 26 December, 2006 as per treatment respectively at FSRD site and ARS. The fertilizer doses were 550-280-280-187-17-12-kg Urea-TSP-MP-Gypsum-$ZnSo_4$-Boric Acid per ha. One third of Urea and all other fertilizer were applied at final land preparation and rest amount of Urea was applied at 8-10 leaf stage and tasseling stage. No additional fertilizer was applied for potato cultivation. Earthing up was done during split application of fertilizer. At the early stage the crop received 3 times rain and hence irrigation was not provided. Single irrigation was applied at late vegetative stage. Other cultural practices were done when required. Potato was harvested on February 12, 2007 and the maize was harvested treatment were at 5 (T_1 and T_4), 22 (T_2) and 30 (T_3) May, 2007. Blight diseases were observed in potato plants and Ridomil gold was applied to control blight. Other plant protection measures were done when required. The data on yield and yield contributing characters of potato and maize were collected and analyzed statistically.

Results and Discussion

Effect of potato as sole and relay crop

Performance of potato with hybrid maize under relay cropping is presented in Table 1a and 1b. Number of tuber/plant and weight/tuber was identical with all treatments at both locations. Higher tuber yield was obtained from the treatment where maize was sown at 20 DAP followed by 35 DAP at FSRD site but significant difference was not found at ARS, Pabna. At the early stage of tuber, there was no competition with maize for nutrient and other growth promoting factors in T_2 and T_3 treatment which resulted better growth and development and finally enhanced yield. The lowest tuber yield was recorded in the treatment where maize seed sowing and potato tuber planting were done at the same day. The reason behind this lower tuber yield in T_1 treatment might be due to the competition between tuber and maize for nutrient, light, water and other yield influencing factors.

Effect of maize as sole and relay crop

In case of maize, days required for tasseling, silking and maturity varied among the treatments. The maximum days were required for tasseling, silking and maturity in the same day planting/sowing of two crops which was followed by sole maize. The minimum days was required where maize seed was sown at 35 DAP of potato tuber followed by 20 DAP. Plant height, number of grains cob^{-1}, 100 grain weight, grain yield and straw yield were statistically identical in all the treatments at FSRD site but at ARS, plant height, cob length and grain yield were differ statistically (Table 2a and 2b). The identical yield from relay crop of maize at FSRD site and higher yield at ARS indicated a scope of adding an additional crop which contributed to more or less two times higher yield over maize sole yield.

Equivalent yield, cost and return analysis

Maximum MEY was recorded from treatment T_2 at Puspapara whereass T_1 at ARS, Pabna. All the intercropped treatment showed higher MEY than sole maize. Similar trend was followed in case of gross return as well as gross margin but BCR was higher in T_2 closely followed by T_4 at Puspapara whereas T_1 at ARS followed by T_4 at ARS, Pabna. Due to higher cost intercropping did not show much benefit than sole maize and yield of potato was low as compared to its potentiality in intercropped situation.

Farmers reaction

Farmers expressed their satisfaction about relaying of potato with BARI hybrid maize-3. They also indicated that late planting of maize gave little lower yield, but the cumulative yield of potato and maize was higher over sole maize, which gave them around two times higher economic return.

Conclusion

Relaying of potato with hybrid maize was found agronomically feasible and economically viable in the site area. But due to high cost intercropped may not be feasible so potato and maize yield should be increased and cost should be reduced to get maximum benefit.

Table 1a. Performance of potato (var. Diamont) with maize under relay cropping at FSRD site, Pushpapara, Pabna during the year of 2006-07

Treatments	Tuber/plant (no.)	Weight/tuber (g)	Tuber yield (t/ha)
T_1=Same date of planting	5.10a	44.75a	7.56
T_2=20 DAP	4.60a	62.00a	8.86
T_3=35 DAP	4.60a	54.25a	8.12
T_4=Sole maize	-	-	-
LSD (0.05)	NS	NS	1.16
CV (%)	11.97	12.20	8.21

Potato tuber = Tk. 12.00 kg^{-1}

Table 1b. Performance of potato (var. Diamont) with maize under relay cropping at ARS, OFRD, Pabna during the year of 2006-07

Treatments	Tuber/plant (no.)	Weight/tuber (g)	Tuber yield (t /ha)
T_1=Same date of planting	5.00	28.20	4.32
T_2=20 DAP	5.07	30.37	4.40
T_3=35 DAP	4.80	29.49	4.79
T_4=Sole maize	-	-	-
LSD (0.05)	NS	NS	NS
CV (%)	8.02	17.19	5.81

Table 2a. Performance of maize (BARI hybrid maize 3) relaying with potato at FSRD site, Pushpapara, Pabna during the year of 2006-07

Treatments	Days to tasseling (days)	Days to silking (days)	Days to maturity (days)	Plant height (cm)	Grains/ cob	Cob length (cm)	100-grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
Same date of planting	93	100	155	196.70	515	18.58	36.03	8.47	10.90
20 DAP	88	93	152	210.10	514	17.75	33.83	7.98	10.06
35 DAP	82	89	144	211.40	508	18.08	37.28	7.95	10.23
Sole maize	92	99	153	205.10	497	18.90	37.92	8.48	10.75
LSD (0.05)	2.23	2.89	0.461	NS	NS	0.90	NS	NS	NS
CV (%)	1.57	1.90	2.19	4.68	3.39	5.07	7.10	6.12	6.15

Table 2b. Performance of maize (BARI hybrid maize 3) relaying with potato at ARS, OFRD, Pabna during the year of 2006-07

Treatments	Days to tasseling (days)	Days to silking (days)	Days to maturity (days)	Plant height (cm)	No. of grain/cob	Cob length (cm)	100-grain wt. (g)	Maize grain yield (t/ha)	Maize straw yield (t/ha)
T_1=Same date of planting	98	101	157	224.0	484.3	16.63	53.00	8.33	14.11
T_2=20 DAP	97	100	143	205.2	492.5	17.33	52.33	7.79	13.77
T_3=35 DAP	96	98	138	258.8	490.6	18.42	45.00	6.87	16.13
T_4=Sole maize	98	101	157	214.1	501.3	17.83	47.67	6.98	14.13
LSD (0.05)	-	-	-	14.08	NS	0.663	NS	0.632	NS
CV (%)	-	-	-	3.13	6.00	9.89	10.56	4.23	9.52

Table 3a. Economic analysis of relaying of potato with maize (BARI hybrid maize 3) at FSRD site, Pushpapara, Pabna during the year of 2006-07

Treatments	Potato yield	Maize yield	Maize equivalent yield (t/ha)	Total cost (Tk.)	Gross return (Tk.)	Gross margin (Tk.)	Benefit cost ratio (BCR)
T_1=Same day planting of maize and potato	7.56	8.47	16.72	48650	189340	140690	3.89
T_2=Maize sowing at 20 DAP of potato	8.86	7.98	17.65	49870	199130	149260	3.99
T_3=Maize sowing at 35 DAP of potato	8.12	7.95	16.81	49870	190005	140135	3.81
T_4=Sole maize	-	8.48	8.48	24850	98655	73805	3.97

Table 3b. Economic analysis of relaying of potato with maize (BARI hybrid maize-3) at ARS, OFRD, Pabna during the year of 2006-07.

Treatments	Potato yield	Maize yield	Maize equivalent Yield (t/ha)	Total cost (Tk.)	Gross return (Tk.)	Gross margin (Tk.)	Benefit cost ratio (BCR)
T_1=Same day planting of maize and potato	4.32	8.33	13.04	48650	150495	101845	3.09
T_2=Maize sowing at 20 DAP of potato	4.40	7.79	12.59	49870	145375	95505	2.92
T_3=Maize sowing at 35 DAP of potato	4.79	6.87	12.10	49870	141165	91295	2.83
T_4=Sole maize	-	6.98	6.98	24850	76780	51930	3.08

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Date of Relaying Mukhikachu with Hybrid Maize

Abstract

An experiment was conducted at the MLT site, Bharamara Kushtia during rabi 2006-07 to find out the appropriate relaying time of Maize with Mukhikachu. There were four treatment combinations viz. T_1= Sole maize, T_2= Maize + mukhikachu planted on 21 February, T_3= Maize + mukhikachu planted on 3 March and T_4= Sole mukhikachu. Maize yield was higher in sole situation followed by maize relay in mukhikachu on 3 March and the lowest from maize relay in 21 February planting.

Introduction

Maize is the third important cereal crop in our country. Maize mainly used as feed, fodder, fuel and bakery industry. 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. Hence the study was undertaken to evaluate the suitable time of relaying Mukhikachu with Hybrid Maize for getting maxjmum benefit.

Materials and Methods

The experiment was conducted at the MLT site, Bharamara Kushtia during rabi 2006-07. The experiment was laidout in RCB design with 3(three) replications. The size of each unit plot was 8m x 5m. Seeds of maize (Pacific-11) were sown on 22 November 2006. The seeds were sown with a spacing of 75cm x 25cm. The trial was fertilized with 562-277-277-187-15-11 urea, TSP, MP, gypsum, zinc sulphate and boric acid kg/ha. One third Urea and all fertilizers were applied as basal and rest urea was applied in 2 (two) equal splits. First top dress was done at 8-10 leaf stage, and 2nd top dress was done at tasseling stage. The relaying of Mukhikachu was planting on 21 February and 3 March 2007. The Mukhikachu seeds were sown with a spacing of 75cm x 45cm between maize rows. Additional 195 kg, urea were applied in two equal splits as top dressed at 40-45-and at 90-100 DAP of Mukhikachu. Plant protection measures were taken. Maize was harvested on 18 April/07 with duration of 147 days. Mukhikachu is a standing crop at farmers field.

Result and Discussions

Plant height, plants/m2, cobs/m2 and 100-grain weight were also mostly similar. Only grains/cob was slightly higher in sole maize crop. Grain yield was reduced in intercropping situation whereas less in planting mukhikachu on 21 February than March planting. Conclusion will be made after harvesting of Mukhikachu.

Table 1. Yield and yield contributing character of maize with maize mukhikachu relaying at Kushtia during rabi 2006-2007

Treatment	Plant height (cm)	No. of cob/15m^2	No. of seed/cob	100-seed wt. (g)	Moisture (%)	Seed wt/m^2 (g)	Yield (t/ha)
Sole maize	204	114	475	32	14	1.36	11.72
Maize + mukhikachu was planting on 21 February	203	111	470	32	15	1.10	9.30
Maize + mukhikachu was planting on 3 March	203	110	470	32	14	1.08	10.77
Sole mukhikachu							

Performance of Different Maize Based Cropping Patterns across Environments

Abstract

A field experiment was conducted at Serudanga of Mithapukur upazila under Rangpur district during 2006-07 to study the agronomic and economic performance of different maize based cropping patterns. The patterns were T_1=Maize–T.aman, T_2=Maize–Mungbean (relay)–T.aman, T_3=Potato–Maize–T.aman and T_4=Maize–Jute (relay)–T.aman. The highest maize equivalent yield (MEY) 30.67 t/ha was recorded in T_3 resulting the highest gross return Tk.306700/ha, gross margin Tk.219445/ha and benefit cost ratio (BCR) 3.51 whereas the lowest MEY 9.3 t/ha and BCR 2.17 were in T_1 and T_4 (Table 3). Although production cost was higher in T_3 compared to other patterns. But the return was quite high (Tk.306700/ha) than other combinations. The complete findings may be given after incorporation of mungbean and rice yield.

Introduction

Maize ranked third in respect of acreage, which is increasing day by day. Maize is cultivated in 1.22 lakh hectares of land in 2005-06, which was 0.93 in 2004-05 (DAE, 2007). Different maize based cropping patterns are being popularly practiced by the farmers due to higher yield and lucrative market price. However, it is reported that due to continuous maize cultivation yield is decreasing alarmingly at Bogra, Rangpur, Dinajpur, Kishoreganj and other districts. As a C_4 crop maize gives high yield (10 t/ha) when planted in rabi season besides, about 12 t/ha stover could be harvested. It is estimated that for yielding 10 t/ha grain and 12 t/ha stover, maize plants uptake about 200 kg N, 30 kg P, 167 kg K and 42 kg S/ha *(BARC, 2005)*. This high uptake reduces the growth of other succeeding crops. Thus to ensure sustainability of hybrid maize based cropping systems, different measures could be taken. However, before formulating any corrective measure, location based nutrient uptake pattern of hybrid maize should be quantified. Therefore, experiment should be undertaken over the years to observe the agronomic and economic performance of different maize based cropping patterns along with its soil nutrient balance.

Materials and Methods

The experiment was conducted in medium highland belong to AEZ 3 at Serudanga, Mithapukur, Rangpur and On-station OFRD, Rangpur during 2006-07. The experiment was laid out in a randomized complete block design with four dispersed replications. Unit plot size was 25m X 12m. Four different maize based cropping patterns were tested. The treatments were T_1=Maize–T.aman, T_2=Maize–Mungbean (relay)–T.aman, T_3=Potato–Maize–T.aman, T_4=Maize–Jute (relay)–T.aman. The first crop maize (variety BARI hybrid maize-5) and potato (var. Diamant) were planted on 07 December 2006 recommended spacing. Maize was harvested on 13 May 2007. Jute (var. O-9897) was sown as relay crop on Apil 20 (130 DAS of maize) and mungbean (var. BARI mung-6) were broadcasted as relay crop on April 05, 2007 (115 DAS of maize). After first plucking within 55-60 days, mungbean biomass was incorporated into the soil. Short duration variety BRRI dhan-33 was selected for T.Aman. 196-36-75-30-3-3-1 kg/ha N-P-K-S-Mg-Zn-B was followed for maize (FRG 2005). One-third of nitrogen and all other fertilizers were applied during final land preparation. Remaining nitrogen was applied in two equal split as topdressing at 8-10 leaf stage and at tasseling stage. Four irrigations were given at 3-5 leaves, 8-10 leaves, tasseling and grain filling stage of maize. For potato recommended dose 300-200-250-120-100-10-10 kg/ha urea, TSP, MP, gypsum, $MgSO_4$, $ZnSO_4$, boric acid and 10 t/ha cowdung were applied (TCRC, 2005). Half of urea and MP, and all other fertilizers including cowdung were applied in soil before planting. Remaining urea and MP were applied as side-dressing at 30 DAP followed by earthing up and irrigation. Weeding and plant protection measures were taken as and when necessary. Soils of the experimental plots were collected before establishment of crop and analyzed results were as follows.

Soil Characteristic	Analysis results	Critical limit
Land type and Soil Texture	MHL and Loamy	-
pH	6.15	-
OM (%)	1.90	-
Mg (ml q/100g soil)	1.68 High	0.5
K (ml q/100g soil)	0.49 Very High	0.12
N (%)	0.10 Low	0.12
P (Micro gram/g soil)	55.47 Very High	10.00
S (Micro gram/g soil)	12.65 Low	10.00
Zn (Micro gram/g soil)	2.17 High	0.60
B (Micro gram/g soil)	0.16 Very Low	0.20

Results and Discussion

From T_3 treatment, the highest potato yield (30.67 t/ha) was. No significant difference in all studied parameters was observed incase of maize as a first crop in the patterns of T_1, T_2 and T_4. The highest yield of maize was found in the T_2 (9.5 t/ha), which is at par with T_1 and T_4.

From the economic analysis, the highest maize equivalent yield (MEY) 30.67 t/ha was recorded in T_3 resulting the highest gross return Tk.306700/ha, gross margin Tk.219445/ha and benefit cost ratio (BCR) 3.51 whereas the lowest MEY 9.3 t/ha and BCR 2.17 was in T_1 and T_4 treatments. Although production cost is higher (Tk.87255/ha) in T_3 compared to other pattern but the return is quite high (Tk.306700/ha) as compared to other treatment. Final conclusion could be made after harvesting of T.aman rice.

References

BARC, 2005. Fertilizer Recommendation Guide (Soils publication no 45), Bangladesh Agricultural Research Council, Farmgate, Dhaka. p:12

DAE, 2007. Krishi Diary, 2007.Agricultural Information Service, Khamarbari, Farmgate, and Dhaka.p: 23 (Appendices)

Table 1. Yield and yield contributing characters of potato in the cropping pattern potato-maize-T.aman during 2006-07 at Serudanga, Rangpur.

Treatments	Tuber yield (t/ha)	Tuber/hill		Final hills/m^2	Stem/hill	Plant height (cm)
			(g)			
T_1: Maize - T.aman	-	-	-	-	-	-
T_2: Maize – Mungbean -T.aman	-	-	-	-	-	-
T_3: Potato – Maize - T.aman	30.67	9.5	516.7	6.2 (93)	3.27	50.96
T_4: Maize – Jute - T.aman	-	-	-	-	-	-

Figure in the parenthesis indicates the survival % of hills

Table 2. Yield and yield contributing characters of maize in the above the cropping pattern during 2006-07 at Serudanga, Rangpur.

Treatments	Plants/m^2 (no)	Plant height (cm)	Ear height (cm)	Grains/ cob (no.)	100-grain weight (g)	Grain yield (t/ha)
T_1	5.8	234.7	125.2	518.86	32.1	9.3
T_2	5.7	221.8	120.2	510.15	31.6	9.50
T_3	-	-	-	-	-	-
T_4	5.9	228.6	120.3	509.3	31.9	9.3
CV (%)	8.27	3.80	5.77	4.74	5.3	8.01

Means in a column without any letter do not differ significantly by DMRT at 5% level.

Table 3. Yield and economic performance of 1st crop of different cropping patterns during 2006-07 at Serudanga, Rangpur

Treatments	Grain yield (t/ha)	MEY (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1: Maize - T.aman	9.3	9.3	93000	41508	51492	2.24
T_2: Maize – Mungbean -T.aman	9.5	9.5	95000	41508	53492	2.29
T_3: Potato – Maize - T.aman	30.67	30.67	306700	87255	219445	3.51
T_4: Maize – Jute - T.aman	9.3	9.3	93000	41508	51492	2.24

Input price (Tk./ha): Seed potato= 25, Seed maize= 200, Urea= 6, TSP= 18, MP= 15.5, Gypsum= 5, Zinc Sulphate = 80 and Boric acid = 90

Output price (Tk./ha): Maize= 10, and Potato = 10

Performance of Bilatidhonia (*Eryngirn foctidum* L.) under Different Management Practices

Abstract

An experiment was conducted in the medium highland situation at the MLT site, Modhupur, Tangail during rabi 2006-07 to evaluate the performance of different shade system (different management) of Bilatidhonia under farmer's field condition. Among the different shade system/management practices, artificial shade gave the highest yield (5.50 t/ha) and the lowest yield (3.33 t/ha) from without shade which is statistically identical to tree shade.

Introduction

Bilatidhonia is one of the valuable cash crops and its cultivation is limited in the eastern part of Bangladesh. The maximum cultivation is concentrated in hilly region of Rangamati, especially in wagga, Beatbonia, Kaikhali, Khagga, Khagrachari and Bandorbon. In Sylhet region it is called Bondhula. In other place it is named "False coriander". It has also been named as 'Banngla Dhania' (Rashid, 2000). Bilatidhonia is used as vegetable, salad and spices. It increases the pungency of curry, dal and vegetables. It is also used as spices in dal, potato and other paste cury (vorta;) and also medicinal value. Its leave, stem & flower contain various type of volatile oil, good pungent and acid like 2 Dodecenoic acid (15.5%) and E-2-Dodecenoic acid (45.5%) for curry/foods (*Leclercq et al*., 1992). There is scope of producing the crop in the plain land or semi hilly area. Besides, it is a shade loving crop. Hence, the study was carried to observe the performance of the crop under different shade management system at the MLT site, Ghatail Tangail.

Materials and Methods

The experiment was conducted at the MLT site, Modhupur, Tangail during rabi 2006-07 under the farmers field condition. It was laid out in RCB design with five replications. Artificially made shade, tree shade and without shade (open sunny area) were considered as three treatments. Artificial shade was made as treli or mutcha with bamboo polls and rice straw + jute stick as covering materials. The seeds were sown on 18th December 2006. The unit plot size was 3m x 3m. Cowdung 15-20 t/ha, urea 275-300 kg/ha TSP 135-150 kg/ha and MP 170-200 kg/ha was applied as per recommendation (Kirshi Projukti Hand Book, 2006). The total amount of cow dung, TSP and half of urea were applied during final land preparation. The rest urea was applied in four equal instalments at 30, 60, 90 and 120 days after sowing (DAS). Urea was applied as top dress just after every harvest followed by irrigation. The crop was harvested first on 15 February 2007 and continued till April 2007 having a total of 5 harvests. The data on different plant characters and yield component were collected from 10 plants randomly selected in each plot and were analyzed using MSTAT package.

Results and Discussion

Results reveal that number of plant/m^2, weight of 10 plants, length of plant and yield varied significantly due to treatments. Plants grown under artificial shade produced the highest number of plant/m^2 (577). The lowest number (372) was obtained from without shade, which was identical to that of tree shade. The highest plant height was obtained in plants grown under artificial shade (15.2 cm) and that of the lowest was in open sunny place (9.8 cm). A similar trend was also found in plant weights. The highest yield was obtained in plants of artificial shade (13.08 t/ha). The lowest yield was found from the control i.e. in sunny place (8.18 t/ha) which was identical to tree shade. As the crop is shade loving, the highest yield under artificial shade was logical.

Farmer's reaction

Farmer's are interested to cultivate the Bilatidhonia because of its higher market price.

Conclusion

Artificial shade showed the highest yield of Bilatidhania. But the trial should be repeated for the next.

Reference

Mojumder, M.N. 2003. Bilatidhonia cultivation, a cash crop of hilly region. A leaflet (BARI-fldr no.01/2003). Agriculture Research Sub center. BARI. Raikhali, Rangaimati.

Table 1. Performance of different shade system on Bilatidhonia, Madhupur, 2006-07

Treatment	Plant/m^2 (no.)	Plant height (cm)	Wt. of 10 plant (g)	Yield (t/ha)
Artificial shade	577 a	15.2 a	24.4 a	13.08 a
Tree shade	396 b	12.3 b	22.8 b	9.08 b
Without shade/Sunny place	372 b	9.8 c	20.2 b	8.18 b
CV (%)	13.40	13.41	11.33	12.21

Performance of Mungbean Varieties in Char Land

Abstract

An experiment was conducted in the charland area under the MLT site, Bhuyapur, Tangail during rabi 2006-07 to evaluate the performance of different varieties of mungbean developed by BARI. Among the varieties, BARI mungben-5 gave the highest grain yield (1.87 t/ha) but it was at par with BARI mungbean-6 (1.78 t/ha). The lowest grain yield was obtained from local cultivar (0.55 t/ha). The BARI mung-6 was the earliest among the varieties.

Introduction

Mungbean is one of the major pulse crops in Bangladesh. Pulses are considered as the poor man's meat because of the cheapest source of protein (Miah, 1978). At present pulses are out of reach to the poor people because of its high price. In Bangladesh, per capita consumption of pulse is only 12g/day (BBS, 1998) while the world health organization (WHO) suggests 45 g/day/capita (PRC, 1998) for a balance diet. Mungbean is an important pulse crop and can be grown both in rabi and Kharif seasons. The growing behaviour of mungbean has made a great opportunity to fit well it in fallow period of the existing cropping pattern Aus/Jute-Fallow-Rabi crop under medium high & high land condition. The different varieties of mungbean developed by BARI can be grown in charland situation where soil is comparatively fertile and well drained. Besides, mungbean could be grown even under low soil fertility and management condition. As such the experiment was conducted to identify the suitable mungbean varieties for Jamuna charland condition.

Materials and Methods

The experiment was conducted at the MLT site, Bhuyapur, Tangail during Rabi 2006-07 in the farmer's field under charland condition. It was laid out in RCB design with six (6) dispersed replications. The varieties were BARI mung-5, BARI mung-6 and local one. The seeds were sown on 26 September 2006. The unit plot size was 6m x 5m. Fertilizer was applied as per Fertilizer Recommendation Guide (FRG, 2005). Weeding irrigation, pests and other crop managements were done as and when necessary. The crop was harvested variety wise during 21-30 November 2006. The data on different plant characters and yield component were collected from 10 plants randomly selected in each plot.

Result and Discussion

All the plant height, yield contributing parameters and yield were significantly influenced by different varieties (Table 1). BARI mung-6 matured earlier (50 days) while the local took the maximum time (76 days). Similar trend was observed in plant height. The highest number of branches/plant, pods/plant and seeds/pod were obtained from BARI mung-5 and that of the lowest were in the local one. BARI mung-5 gave higher grain yield (1.87) through it was similar to that of BARI mung-6 and the lowest from local one. straw yields were not significantly influenced by variety.

Farmer's reaction

Farmers are interested to cultivate BARI mung-5 & BARI mung-6 due to its short growing duration and higher grain yield.

Conclusion

BARI mung-5 and BARI mung-6 may be recommended for the char land situation of Bhuyapur, but repeated experimentation with more number of farmers are to be accommodated.

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Pulse Research Centre (PRC).1998. Annual Report of Pulse Research Centre for the Year 1998 BARI, Joydevpur.

Table 1. Plant height, yield and yield parameters of mungbean varieties under charland of Bhuyapur, Tangail during 2006-07

Verities/lines	Days to maturity	Plant height (cm)	Branches/ plant (no.)	Pods/plant (no.)	Seeds/pod (no.)	Grain yield (t/ha)	Stover yield (t/ha)
BARI mung-5	63 b	51.50 b	7 a	20 a	11 a	1.87 a	3.61
BARI mung-6	54 c	49.00 c	5 b	18 b	9 b	1.78 a	3.17
Local	76 a	66.25 a	4 c	8 c	5 c	0.55 b	3.87
CV (%)	5.29	7.73	9.51	7.74	5.28	12.76	13.69

Efficacy of Some Fungicides in Controlling Leaf Blight of Early Planted Bottle Gourd

Abstract

The experiment was conducted at OFRD, Rangpur during 2006-07 to find out the effective fungicide (s) in controlling leaf blight of early planted bottle gourd caused by Phytophthora parasitica. The fungicides Melody deo (@ 3 g/L water), Secure (@ 2 g/L water), Metaryl (@ 2 g/L water), Rovral (@ 2 g/ L water) and Tilt (@ 0.5 ml/L water) were tested. Out of five fungicides Secure and Metaryl effectively controlled the disease. Only 10.7% & 12% leaf infection and 7.3% & 8.3% fruit infection were recorded from Secure and Metaryl, respectively. The highest bottle gourd yield (40.03 t/ha) was recorded in Metaryl sprayed treatment which was statistically identical with secure sprayed plot (39.14 t/ha).

Introduction

Early planted bottle gourd is prone to leaf blight disease. This disease caused serious yield loss even it brings early maturity of bottle gourd plants. Farmers have no way to escape the disease but effective fungicide can control the disease. At present, there are many types of fungicides are available in the market. So, the experiment was undertaken to fund out effective fungicide(s) against control the said disease.

Materials and Methods

The experiment was conducted at OFRD, Rangpur 2006-07. BARI lau-1 was transplanted with 25 days old seedling in last week of Sept. 2006 following BARI recommended technology. The design was Randomized Complete Block Design with three replications. Two plants were considered as one treatment per replication. Five fungicides viz. Melody deo @ 3 g/L water, Secure @ 2g/L water, Metaryl 2g/L water, Rovral 2g/L water and Tilt @ 0.5 ml/L water were sprayed at 12 days interval separately. It had started just after appearance of disease. Only same quantity of plain water was sprayed to control plot in every spray schedule.

Results and Discussion

The lowest infected leaf (10.7%) was recorded from secure sprayed plant which was statistically identical with Metaryl sprayed treatment (12%). Similar trend was also found in percent of fruit infection. The highest infection was observed in control plot. The highest bottle gourd yield (40.03 t/ha) was observed in Metaryl sprayed treatment which was identical with Secure sprayed treatment (39.14 t/ha). Lower percent of disease infection helped for obtaining higher yield in Secure and Metaryl sprayed treatment. Out of five fungicides, Secure and Metaryl effectively control the disease.

Conclusion

Out of five tested fungicides Metaryl and Secure performed well in controlling blight of bottle gourd. But this is the first year experimentation result, so it needs to continue 2nd year experimentation for confirmation of the result.

Table 1. Efficacy of fungicides in controlling blight of early planted bottle gourd

Fungicide	% Leaf infection	% Fruit infection	Yield (t/ha)
Melody deo	22.7 cd	20.0 b	33.08 b
Secure	10.7 d	7.3 c	39.14 a
Metaryl	12.0 d	8.3 c	40.03 a
Rovral	36.0 b	24.7 b	25.65 c
Tilt	33.0 bc	23.10 b	25.40 c
Control	68.0 a	36.7 a	17.88 d
CV (%)	7.40	6.10	5.30

B. HIGH BARIND TRACT

Productivity and Profitability of Different Tomato Varieties/Lines in the High Barind Tract

Abstract

Sixteen tomato varieties/lines were evaluated at the FSRD site, Kadamshahar, Rajshahi during rabi 2006-07 to find out their productivity and profitability in High Barind Tract. The tomato varieties/lines were namely BARI hybrid tomato-3, BARI hybrid tomato-4, BARI tomato-4, BARI tomato-5, Abinash-3, Sathi, Safal, Hitom, Sabal, Annel, T-1458, T-1387, T-848, T-2028, Minto and Surrokha. Among the sixteen variety/lines, the highest yield was found in T-1458 (43.54 t/ha) followed by T-1387 (42.69 t/ha). BARI hybrid tomato-3 and BARI hybrid tomato-4 produced 30.53 and 39.45 t/ha yields, respectively. On the other hand, BARI tomato-4 and BARI tomato-5 gave 36.93 and 33.64 t/ha yields, respectively. The tomato variety Safal gave the lowest yield (30.16 t/ha) followed by BARI hybrid tomato-3 and Hitom. In respect of economic analysis, the highest gross return (Tk.319758/ha) and gross margin (Tk.248558/ha) was obtained from BARI hybrid tomato-4. The lowest gross return (Tk.191830/ha) and gross margin (Tk.120630/ha) were found in Safal followed by Sabal.

Introduction

Tomato is a popular vegetable in Bangladesh especially in the urban areas. The tomato production in the country is about 1.03 lakh metric ton (BBS, 2004). The farmers of High Barind Tract (HBT) extensively cultivate various local and exotic hybrid tomato varieties at early rabi season (September) after the harvest of T. aus rice (cv. *Parija*). Though a large number of tomato varieties, both local and exotic, are available in the country for cultivation but most of them are not well known as high yielding varieties to the tomato growers. Moreover, some exotic tomato varieties enter into vegetable seed market every year by the seed importers without any performance test in different agro climatic zones of Bangladesh (Islam, 1999). As a result, tomato growers are deceived because most of the exotic varieties may not be suitable in this environment. In these circumstances, the present study was undertaken to evaluate the productivity and profitability of sixteen tomato varieties/lines under High Barind Tract.

Materials and Methods

The field trial was carried out at the FSRD site, Kadamshahar, Rajshahi during rabi 2006-07 in the farmers' field of High Barind Tract. The experiment was laid out in randomized complete block design having three replications. The unit plot size was 3 m x 2.4 m. Seeds were sowing in seedbed was on 22 August 2006. The 29 days old seedlings were transplanted in the main plots on 20 September 2006 with 60 cm row to row distance and 50 cm plant to plant distance. The experimental plot was fertilized with 85-30-45-10-1 kg/ha N-P-K-S-B, respectively in the form of urea, TSP, MP, gypsum and boric acid, respectively and 10 ton cowdung/ha (FRG, 2005). The TSP, boric acid and cowdung were applied during final land preparation as basal. The MP and urea fertilizers were used in two installment after 25 and 40 days after planting, respectively. The tomato varieties tested in the trial presented in Table 1 with their source of collection. Irrigation was applied three times during the crop-growing period. Insecticide (Admire @ 5 ml/L water) and fungicide (Ridomil Gold @ 2 g/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 tomato was harvested ranging from 30 November 2006 to 25 January 2007. 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

.

Table 1. Tomato varieties and their source of collection tested in HBT, 2006-07

Sl. no.	Tomato variety	Source of collection
1.	BARI Hybrid Tomato-3	HRC, BARI
2.	BARI Hybrid Tomato-4	HRC, BARI
3.	BARI Tomato-4	HRC, BARI
4.	BARI Tomato-5	HRC, BARI
5.	Abinash-3	Syngenta, Bangladesh
6.	Sathi	Syngenta, Bangladesh
7.	Safal	Syngenta, Bangladesh
8.	Hitom	Syngenta, Bangladesh
9.	Sabal	Syngenta, Bangladesh
10.	Annel	Syngenta, Bangladesh
11.	T-1458	East West Seed Co.Ltd.
12.	T-1387	East West Seed Co.Ltd.
13.	T-848	East West Seed Co.Ltd.
14.	T-2028	East West Seed Co.Ltd.
15.	Minto	East West Seed Co.Ltd.
16.	Surrokha	Namdhari Malik Seeds

Results and Discussion

The days to flowering ranges from 58- to 68 days depending on variety. Maximum plant height was recorded from the variety T-2028 followed by Abinash-3. The lowest plant height was observed from BARI tomato-5 followed by BARI tomato-4. Higher fruits/plant was recorded from BARI tomato-5 which was at par to BARI tomato-4 and BARI hybrid tomato-4. The lines T-1458 and T-1387 were showed similar fruit weights which were higher than other variety/lines. The former lines also showed higher individual fruit weight.

Of the sixteen variety/lines maximum yield (43.54 t/ha) was found in T-1458 followed by T-1387 (42.69 t/ha). BARI hybrid tomato-3 and BARI hybrid tomato-4 produced 30.53 and 39.45 t/ha yields, respectively. On the other hand, BARI tomato-4 and BARI tomato-5 gave 36.93 and 33.64 t/ha yields, respectively. The tomato variety Safal showed the poorest yield (30.16 t/ha). In respect of economic analysis, the maximum gross return (Tk. 319758/ha) and gross margin (Tk. 248558/ha) were obtained from BARI hybrid tomato-4. The lowest gross return (Tk.191830/ha) and gross margin (Tk.120630/ha) were found in tomato variety Safal followed by Sabal.

Conclusion

From the first year evaluation, it should be suggested that BARI hybrid tomato-4 could be comparable with T-1458 and T-1387. However, the experiment should be continued for the next year.

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Table 2. Plant characters of different tomato varieties evaluated in HBT

Tomato variety/ lines	Days to flowering	Plant height (cm)	Fruits/ plant	Fruit weight /plant	Individual fruit weight (g)	Fruit yield (t/ha)
BARI hybrid tomato-3	58	93.5	38.7	1.21	37.73	30.53
BARI hybrid tomato-4	68	91.4	41.8	1.60	42.60	39.45
BARI tomato-4	61	72.2	42.1	1.54	40.60	36.93
BARI tomato-5	58	63.0	43.1	1.44	38.96	33.64
Abinash-3	65	101.1	36.9	1.43	48.86	32.95
Sathi	65	79.8	32.6	1.38	46.42	34.68
Safal	65	83.0	37.2	1.37	46.95	30.16
Hitom	61	91.8	31.3	1.24	50.86	30.97
Sabal	64	91.4	33.6	1.27	46.50	31.64
Annel	64	85.4	34.8	1.47	46.01	34.45
T-1458	65	96.9	34.8	1.80	54.56	43.54
T-1387	65	97.1	39.9	1.79	49.33	42.69
T-848	64	80.5	35.7	1.40	49.80	37.59
T-2028	65	118.1	37.1	1.58	51.99	38.68
Minto	61	90.9	35.1	1.60	45.55	39.37
Surrokha	65	80.9	31.1	1.53	47.71	36.37
LSD (0.05)	5.79	18.82	6.72	0.37	9.84	7.32
CV (%)	3.14	7.21	8.60	8.44	7.18	6.93

Table 3. Fruit yield at different time of harvest and net return achieved from different tomato variety/lines tested in HBT, 2006-07

Tomato variety/lines	First harvest (30 Nov. 06)		Second harvest (10 Dec. 06)		Third harvest (18 Dec. 06)		Fourth harvest (23 Dec. 06)		Gross return (Tk./ha)	Total cost (Tk./ha)	Gross margin (Tk./ha)
	T/ha	Tk./ha	T/ha	Tk./ha	T/ha	Tk./ha	T/ha	Tk./ha			
BHT-3	11.76	121159	7.95	63664	5.15	20612	5.15	12882	218317	71200	147117
BHT-4	16.88	173812	13.59	108664	5.80	23220	5.62	14062	319758	71200	248558
BHT-4	10.30	106141	14.05	112440	4.30	17220	6.55	16387	252188	71200	180988
BHT -5	10.77	111003	11.70	93664	4.00	16000	6.08	15207	235874	71200	164674
Abinash-3	10.20	105142	7.5	60000	8.88	35552	7.02	17567	218261	71200	147061
Sathi	9.37	96562	9.02	56216	7.50	30000	9.37	23437	206215	71200	135015
Safal	7.26	74819	8.90	71216	6.18	24720	8.40	21075	191830	71200	120630
Hitom	11.70	120592	6.55	52440	3.93	15680	6.50	16387	205099	71200	133899
Sabal	9.37	96562	8.40	67440	4.6	18720	6.08	15207	197929	71200	126729
Annel	11.25	115875	10.30	82440	7.50	30000	6.08	15207	243522	71200	172322
T-1458	11.25	115875	10.77	86216	9.83	39332	11.70	29270	270693	71200	199493
T-1387	9.75	100425	11.70	93664	8.15	32608	11.52	28817	255514	71200	184314
T-848	10.68	110004	8.9	71216	8.43	33612	10.30	25762	240594	71200	169394
T-2028	7.87	81112	12.18	97440	9.37	37500	12.10	30270	246322	71200	175122
Minto	12.18	125454	10.30	82440	7.02	28108	7.02	17567	253569	71200	182369
Surrokha	12.75	131325	7.50	60000	5.62	22500	8.40	21075	234900	71200	163700

BHT= BARI Hybrid Tomato

N.B. Local market price of tomato was Tk. 10.3/kg at first harvest, Tk. 8.0/kg at second harvest, Tk. 4.0/kg at third harvest and Tk. 2.50/kg at fourth harvest.

Productivity of Chickpea as Influenced by Preceding Local and Exotic Rice Varieties in the High Barind Tract

Abstract

A field experiment was conducted at the FSRD site, Kadamshahar, Rajshahi during rabi 2006-07 to find out suitable rice variety for getting higher productivity from both rice and succeeding chickpea crops (var. BARI chola-5) under Barind environments. In this regard fifteen local and exotic rice varieties viz., PANT-10, Judi-567, PNR-381, Judi-582, BRRI Dhan 39, BRRI dhan-32, Super-3004, BR-10, Sada Swarna, Lal Swarna, BRRI dhan-40, BR-11, BRRI dhan-30, BRRI dhan-41 and Barkhe-3004 were transplanted in the farmers' field of HBT. BRRI dhan-41 produced the highest grain yield (4820 kg/ha) but the succeeding chickpea yield was the lowest (763 kg/ha) due to longest duration of rice (143 days). The local cultivars Sada Swarna and Lal Swarna produced 4250 and 4120 kg/ha of grain yields, respectively but subsequent chickpea yielded were 1017 and 1020 kg/ha, respectively. BRRI dhan-39 produced 3860 kg/ha and 1397 kg/ha of chickpea yield, respectively. Maximum chickpea yield was obtained where Judi-567, PANT-10, Judi-582 and PNR-381 were cultivated, respectively. Economic analysis showed that the highest BCR (3.15) was achieved from BRRI dhan-39 followed by chickpea crop.

Introduction

In High Barind Tract, a vast area of land remains fallow after harvest of T.aman rice. Farmer preference for the late maturing, but high quality, rice cultivar Swarna (135-145 days duration) in the HBT reduces the opportunity for establishing rabi crops on residual moisture (Kumar, 2001). There is a great potential for improving the livelihoods of poor farmers in the HBT area by growing chickpea on residual soil moisture. Chickpea occupies an area of about 15385 ha with a total production of only 11000 metric tons (BBS, 2004). It may be mentioned that chickpea is a deep rooting and low water requiring grain legume, so it is well adapted to low soil moisture and drought conditions (Saxena, 1984 and Ali, 2000). After harvest of this variety farmers' generally can not grow chickpea in proper time in residual soil moisture. Farmers' do not want to sacrifice rice yield by using short duration low yielded rice variety. That is why the productivity of chickpea sown in late condition drastically reduced the seed yield. Improvements in chickpea production need to be considered in the context of entire T.aman based cropping system of the HBT. Now a day's various local and exotic rice varieties are available in Barind area but its performance is quite unknown to the farmers'. High yielding short duration rice variety (s) may be suitable for getting higher yields from both rice and following chickpea crops. Therefore, the present study was under taken to find out suitable rice variety (s) for getting higher productivity from both rice and succeeding chickpea crops.

Materials and Methods

The experiment was carried out at the FSRD site, Kadamshahar, Rajshahi during 2006-2007 in the farmers' field of High Barind Tract. The design of the experiment was RCBD with three replications. Fifteen local and exotic rice varieties were collected from different sources and were presented in Table 1. The unit plot size was 3 m x 4 m. The seeds of that rice varieties were sown on seed bed on 22 June 2006 at the rate of 40 kg/ha. Thereafter, thirty days old seedlings were transplanted in the main plot on 23-25 July 2006. Previously the rice plots were prepared by applying 65-7-28-8-1 kg/ha N-P-K-S-Zn, respectively (FRG, 2005). All fertilizers except urea were applied as basal. The urea splits into three equal portions and were applied as top dress at 10, 30 and 45 days after planting, respectively. The spacing was 20 cm distance between two rows and 15 cm between two hills. Weeding and plant protection measures were done as per need. The rice varieties were harvested according to their maturity ranging from 29 October-20 November 2006. The data on different plant characters were collected from randomly selected 10 plants from each variety and yields were recorded plot wise. After harvest of rice, the unit plots were applied with 12-19-17-10-1 kg/ha N-P-K-S-B, respectively as basal after final land preparation. Thereafter the chickpea seed was sown within three days after harvest of the respective rice varieties. Weeding was done at 25 days after sowing. As plant protection measure and insecticide (Admire @ 5 ml/L water) in combination with fungicide

(Bavistin @ 2 mg/L water) were applied at three times. The chickpea was harvested according to their maturity ranging from 25 March-8 April 2007. Data on different yield attributes and were taken from randomly selected ten plants of each plot. Then the data of both crops were analyzed statistically and means were separated by Least Significant Difference (LSD) test.

Table 1. List of local and exotic rice varieties used under T.aman-Chickpea cropping pattern in the farmers' field at HBT during 2006-2007

Sl. no.	Name of rice variety	Source of collection
1.	BR-10	BRRI, Rajshahi
2.	BR-11	BRRI, Rajshahi
3.	BRRI dhan-30	BRRI, Rajshahi
4.	BRRI dhan-32	BRRI, Rajshahi
5.	BRRI dhan-39	BRRI, Rajshahi
6.	BRRI dhan-40	BRRI, Rajshahi
7.	BRRI dhan-41	BRRI, Rajshahi
8.	Sada Swarna (check)	Local farmer
9.	Lal Swarna (check)	Local farmer
10.	PANT-10	PROVA, Rajshahi
11.	Judi-567	PROVA, Rajshahi
12.	PNR-381	PROVA, Rajshahi
13.	Judi-582	PROVA, Rajshahi
14.	Super-3004	PROVA, Rajshahi
15.	Barkhe-3004	PROVA, Rajshahi

Results and Discussion

Rice yield

BRRI dhan-41 gave the highest tillers/m^2, filled grains/panicle and 1000-grain weight which resulted higher grain yield. Among the rice varieties, higher grain yield (4820 kg/ha) produced by BRRI dhan-41 followed by BRRI dhan-40 (4530 kg/ha). BRRI dhan-41 also took the longest time (143 days) to maturity. The lowest seed yield was found in PANT-10 (2060 t/ha). The rice cultivars Sada Swarna and Lal Swarna that are widely cultivate at Barind area contributed 4250 and 4120 kg/ha grain yields, respectively and matured in longer times (140 and 139 days, respectively). BRRI dhan-39 gave the grain yield of 3860 kg/ha but matured considerably in short period (119 days). The shortest duration rice variety was PANT-10 (115 days) and produced only 2060 kg/ha grain yield. Maximum straw yield also was recorded from BRRI dhan-41.

Chickpea yield

The succeeding chickpea yield was significantly influenced by different local and exotic rice varieties due to wide variation in maturity times of rice (Table 3). The highest seed yield (1487 kg/ha) was produced after harvest of Judi-567 due to its short of life cycle (117 days) i.e. because of early sowing of chickpea. The rice cultivars Sada Swarna and Lal Swarna after followed by chickpea produced yield of 1017 and 1020 kg/ha, respectively. Chickpea yield was reasonably higher in short duration preceding BRRI dhan-39. The lowest chickpea yield (763 kg/ha) was achieved from preceding the longest duration BRRI dhan-41 (143 days).

Cost and return analysis

From the economic analysis (Table 4) it reveals that BRRI dhan-39 followed by chickpea contributed the highest gross return (Tk.105133/ha), gross margin (Tk.71713/ha) and benefit cost ratio (3.15). The second highest BCR was obtained from Super-3004 (2.98) rice variety followed by chickpea while the lowest was found in PANT-10 (2.57) and chickpea cropping. On the other hand, Sada Swarna and Lal Swarna were exhibited BCR 2.78 and 2.74, respectively. These two varieties are presently used by the local farmers.

Farmers reaction

Farmers are reluctant to sacrifice yield of T.aman rice. They want T.aman rice variety which gave yield and grain quality like locally adapted "Sharna".

Conclusion

In Barind area, the rice variety BRRI dhan-39 could be cultivated for maximizing the productivity and economic return for rice-chickpea cropping pattern.

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Table 2. Plant characters and yield as influenced by different local and exotic rice varieties in the farmers' field at HBT during 2006-07

Varieties	Days to maturity	Plant height (cm)	Tiller/ m^2	Panicle length (cm)	Filled grains/ panicle	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
BR-10	139	95.6	327.8	19.9	95.1	22.7	4270	5310
BR-11	141	100.3	353.7	22.1	93.1	25.6	4170	5660
BRRI dhan-30	139	102.1	347.3	22.6	90.5	24.7	4030	5130
BRRI dhan-32	137	106.7	285.7	22.1	66.1	24.4	3660	4440
BRRI dhan-39	119	93.5	291.6	21.3	61.8	22.4	3860	4320
BRRI dhan-40	139	102.9	377.9	20.9	112.5	26.3	4530	5270
BRRI dhan-41	143	100.1	385.4	22.7	120.3	26.5	4820	5970
Sada Swarna (local)	140	104.3	344.3	18.7	105.9	21.3	4250	5750
Lal Swarna (local)	139	101.3	329.4	21.1	95.9	20.8	4120	5070
PANT-10	115	88.8	240.5	21.0	51.5	19.5	2060	2920
Judi-567	117	89.6	291.2	20.5	54.9	13.2	2720	3490
PNR-381	119	80.2	250.6	21.0	51.4	21.6	2140	3220
Judi-582	117	86.9	234.0	21.5	53.0	13.4	2240	3250
Super-3004	134	97.8	316.9	22.5	86.5	22.5	4190	5320
Barkhe-3004	135	96.9	301.1	22.1	76.2	23.4	3410	4370
LSD (0.05)	3.88	10.84	71.02	NS	24.29	4.47	1230	1480
CV (%)	2.5	4.98	10.07	4.98	10.19	8.55	12.05	13.49

Table 3. Yield and yield components of chickpea as influenced by different rice varieties under T.aman-Chickpea cropping pattern in HBT during 2006-07

Rice varieties	Chickpea sowing date	Pods/ plant	Seeds/ pod	1000-seed weight (g)	Chickpea seed yield (kg/ha)	Chickpea stover yield (kg/ha)
BR-10	15 Nov.06	38.3	1.4	12.4	967	1387
BR-11	17 Nov.06	34.2	1.5	11.7	977	1483
BRRI dhan-30	15 Nov.06	38.3	1.6	12.0	1067	1480
BRRI dhan-32	13 Nov.06	40.4	1.5	12.5	1097	1480
BRRI dhan-39	27 Oct. 06	37.7	1.6	12.7	1397	1407
BRRI dhan-40	15 Nov.06	32.7	1.5	11.8	933	1343
BRRI dhan-41	20 Nov.06	32.9	1.5	11.0	763	1407
Sada Swarna (local)	16 Nov.06	39.7	1.5	12.2	1017	1430
Lal Swarna (local)	15 Nov.06	36.4	1.5	12.5	1020	1417
PANT-10	22 Oct. 06	43.2	1.5	12.8	1473	1723
Judi-567	25 Oct. 06	45.9	1.6	12.8	1487	1717
PNR-381	27 Oct. 06	42.5	1.6	12.9	1453	1633
Judi-582	25 Oct. 06	42.1	1.6	12.9	1467	1553
Super-3004	10 Nov.06	40.2	1.6	12.5	1187	1540
Barkhe-3004	14 Nov.06	40.0	1.5	11.8	1183	1447
LSD (0.05)	-	7.03	NS	5.55	311	211
CV (%)	-	10.78	7.49	5.10	11.77	12.50

Table 4. Economic return of T.aman-Chickpea cropping pattern as influenced by different rice varieties in HBT during 2006-2007

Rice varieties	Rice yield (kg/ha)	Chickpea yield (kg/ha)	Variable cost (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
BR-10	4270	967	33965	93218	59253	2.74
BR-11	4170	977	34565	92385	57820	2.67
BRRI dhan-30	4030	1067	34000	99325	65325	2.92
BRRI dhan-32	3660	1097	33965	90213	56248	2.66
BRRI dhan-39	3860	1397	33420	105133	71713	3.15
BRRI dhan-40	4530	933	34000	95002	61002	2.79
BRRI dhan-41	4820	763	34565	91555	56990	2.65
Sada Swarna (local)	4250	1017	34165	94891	60726	2.78
Lal Swarna (local)	4120	1020	34165	93508	59343	2.74
PANT-10	2060	1473	33420	85961	52541	2.57
Judi-567	2720	1487	33420	84500	61080	2.83
PNR-381	2140	1453	33420	86260	52840	2.58
Judi-582	2240	1467	33420	87958	54538	2.63
Super-3004	4190	1187	33965	101223	67258	2.98
Barkhe-3004	3410	1183	34000	91466	57466	2.69

Effect of Different Sowing Dates on Biomass and Seed Yield of Mungbean and Its Effect on Succeeding T.Aman Rice in the High Barind Tract

Abstract

A field study was carried out at the FSRD site, Kadamshahar, Rajshahi during 2005-06 to 2006-07 with a view to find out optimum sowing date of mungbean to enhance both seed as well as biomass yields for reducing fertilizer dose in succeeding T.aman rice in the Barind area. Mungbean (var. BARI mung-6) was sown in four dates viz., 15 March, 30 March, 15 April and 30 April 2006. Among the sowing dates, 15 March contributed the highest seed yield (813 kg/ha) but 30 April gave no seed yield due to damage by early rainfall. The seed yield sharply declined with delay in mungbean sowing date. The maximum biomass yield (7110 kg/ha) was obtained from 30 March 2006 sowing and the lowest (5290 kg/ha) from 15 March sowing. The highest seed yield of rice (4040 kg/ha) was achieved with the application of 75% recommended dose of fertilizers due to higher amount of mungbean biomass (7110 kg/ha) was incorporated into the soil. The application of 100% recommended dose produced slightly lower rice grain yield (3900 kg/ha) due to over vegetative growth of crop plant. The lowest yield (1420 kg/ha) was contributed by the control treatment.

Introduction

The soil fertility and productivity of High Barind Tract (HBT) is gradually declining due to intensive cultivation with modern varieties of crops and lack of soil management. Traditionally the farmers' are not interested to cultivate green manuring crops as a sole crop but mungbean is a crop which can provides both the biomass and seed yield at a time. Among the various management practices, sowing date is the most important one because growth and development of crop species are largely governed by ecological factors like temperature, light, rainfall, soil moisture, nutrient availability etc. (Mian *et al*. 2002). Incorporation of munbean biomass into the soil can improve the soil fertility status, which may reduce the fertilizers application in succeeding crops. The high Barind tract (HBT) is characterized by low rainfall, soil possess high bulk density, low organic matter, low N and limited available P (Ali, 2000). Therefore, the present study was undertaken to reduce the fertilizer dose through incorporation of mungbean biomass and maximize productivity of succeeding T.aman rice.

Materials and Methods

The experiment was conducted at the FSRD site, Kadamshahar, Rajshahi during 2005-06 to 2006-07 in medium high land with silty clay loam textured soil. The treatments of the experiment designed as four sowing dates of mungbean viz., 15 March, 30 March, 15 April and 30 April 2006. The variety was BARI mung-6. This experiment was laid out in a split plot design with three replications. Sowing date assigned in the main plot and the succeeding T.aman rice imposed in sub plot. The size of each unit plot was 4m × 3m. Initially the soil sample was collected and determined its nutrients content (Table 1). The plot was applied with 12-19-17-10-1 kg/ha N-P-K-S-B, respectively as basal during final land preparation in the form of Urea, TSP, MP, gypsum and boric acid, respectively. Mungbean seeds were sown in the field as per to the treatment specifications maintained 30 cm distance from line to line and 10 cm distance from plant to plant. Weeding, thinning and plant protection measures were done as per need for better crop growth and development. Data for mungbean were collected on plant population, yield components, seed and biomass yield and analyzed statistically. After harvest of mungbean, brown manuring (after pod harvest) was done through incorporation of biomass into the respective experimental plots. After fifteen days of biomass incorporation, the soil sample of each plot was collected and analyzed for nutrient concentration (Table 1). Then each plot was divided into four equal sub plots. Thereafter thirty-day rice seedlings (var. Sada Swarna) were transplanted in sub plots on 15-16 July 2006. Previously the sub plots were applied fertilizers according to the treatment specifications (Table 2). One-third urea and all other fertilizers were applied as basal and the rest urea divided into two equal parts and top-dressed after weeding at 20 and 45 day after transplanting. Other intercultural operations such as irrigation, pest controls etc. were done as per need for better crop growth. Data on yield and yield attributes were recorded and analyzed statistically and means were separated by Least Significant Difference (LSD) test.

Table 1. Nutrient status of soil sample before and after incorporation of mungbean biomass in main plots (0-15 cm depth) during 2005-2006

Mungban sowing date	Soil pH	Organic matter (%)	K meq/100g soil	Total N (%)	P	S	B	Zn
					µg/g soil			
Before sowing	6.05	0.90	0.12	0.06	14.5	10.8	0.25	1.06
15 Mar. (5290)	6.15	0.96	0.13	0.08	14.8	11.0	0.26	1.07
30 Mar. (7110)	6.17	1.04	0.15	0.09	16.0	11.5	0.30	1.09
15 Apr. (6470)	5.16	1.00	0.14	0.08	15.7	11.2	0.28	1.08
30 Apr. (5440)	6.15	0.97	0.13	0.08	15.0	11.0	0.27	1.07

Figures in parenthesis are mungbean biomass yield (kg/ha)

Table 2. Different combinations of fertilizer doses in T.aman rice under Mungbean-T.aman rice cropping pattern in HBT

Treatments	Fertilizer doses for T.aman rice (kg/ha)				
	N	P	K	S	Zn
T_1 = 50% Recommended dose	32.5	3.5	24	4	0.5
T_2 = 75% Recommended dose	48.75	5.25	21	6	0.75
T_3 = 100% Recommended dose	65	7	28	8	1
T_4 = Control (No fertilizer)	0	0	0	0	0

Results and Discussion

Yield and yield attributes of mungbean

Among the sowing dates, 15 March had the highest plant population (47.07 plants/m^2), number of pods/plant (29.62), longer pod length (8.60 cm), seeds/pod (9.27) that contributed highest seed yield (813 kg/ha). There was a trend to decrease seed yield with the advancement of days. On the other hand, 30 April gave no seed yield due to damage by early rainfall. The seed yield sharply declined with delay in mungbean sowing date due to intensity of rainfall. The maximum biomass yield (7110 kg/ha) was obtained from 30 March sowing and the lowest (5290 t/ha) from 15 March.

Effect of sowing date and biomass yield of mungbean followed by rice

Plant height, yield and yield attributes of rice was not significantly influenced by sowing date and biomass yield of mungbean but higher yield was obtained from 30 March with higher mungbean biomass.

Effect of fertilizer dose on rice yield

Plant height, yield and yield attributes were significantly affected by fertilizer combination. All yield contributing characters were higher in 75% recommended fertilizer dose applied in T.aman rice. Grain yield was slightly decreased with 100% recommended dose of fertilizer followed by 50% recommended dose. Without fertilizer produced the lowest grain yield as well as yield attributes.

Interaction between fertilizer dose and sowing date showed insignificant

From one year results, it was observed that mungbean seed yield could be higher if sown earlier (15 March) but higher biomass yield was obtained from 30 March. The same biomass could be incorporated before transplanting of rice which showed higher grain yield of rice as well as reduced 25% fertilizer dose in T.aman rice.

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Table 3. Effect of sowing date on plant characters and yield of mungbean in HBT during 2005-2006

Sowing date	Plant population/m^2	Plant height (cm)	Pods/ plant	Pod length (cm)	Seeds/ pod	1000-seed wt. (g)	Seed yield (kg/ha)	Biomass yield (kg/ha)
15 March	47.07	41.60	29.62	8.60	9.27	5.41	813	5290
30 March	43.17	57.92	20.37	8.07	9.17	4.94	419	7110
15 April	33.33	56.27	19.27	7.53	8.73	4.95	323	6470
30 April	38.33	46.67	-	-	-	-	-	5440
LSD (0.05)	NS	11.99	4.33	0.55	1.25	NS	57.20	900
CV (%)	14.09	12.62	9.55	3.43	7.05	3.46	9.15	9.40

Table 4. Plant characters and yield of rice as influenced by mungbean sowing date (biomass yield) and fertilizer doses in Mungbean-T.aman cropping pattern during 2006-07

Treatments	Plant height (cm)	Tiller/ m^2	Panicle length (cm)	Filled grain/ panicle	1000-grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Mungbean sowing dates (biomass yield of mungbean)							
15 Mar. (529 kg/ha)	74.9	280.1	19.5	72.4	20.4	3230	4290
30 Mar. (711 kg/ha)	75.8	297.5	20.2	79.4	21.0	3910	4320
15 Apr. (647 kg/ha)	75.8	279.7	19.9	77.8	20.9	3570	4450
30 Apr. (544 kg/ha)	75.1	293.0	19.7	76.0	20.6	3400	4420
LSD (0.05)	NS	NS	0.33	NS	NS	NS	NS
Fertilizer doses							
50% Recom. Dose	74.7	298.7	20.1	76.9	20.6	3780	4390
75% Recom. Dose	80.0	302.6	20.7	81.9	21.4	4040	4580
100% Recom. Dose	80.6	301.5	20.6	80.0	21.3	3900	4730
Control (No fertilizer)	66.4	257.5	17.9	66.7	19.8	2420	3780
LSD (0.05)	3.47	10.78	0.83	6.68	0.74	210	220
CV (%)	9.03	10.26	3.68	11.66	3.12	12.22	14.41

C. COASTAL/SALINE AREA

Intercropping Onion and Garlic with Chilli

Abstract

Two field experiments were conducted at the FSRD site, Hazirhat, Noakhali and MLT site of Laxmipur in the growing season of 2006-07 to verify the performance of onion and garlic as intercrop with chilli. The onion intercropped with two rows produced the highest return of Tk. 191900/ha with the highest land equivalent ratio (LER) of 1.31 of FSRD site, Hazirhat, Noakhali. The garlic intercropped with two rows produced the highest return of Tk. 217200/ha with the land equivalent ratio (LER) of 1.16 at MLT site, Laxmipur. All the intercropped system earned highest return and LER than sole crop (chilli).

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 at the major Rabi crop in FSRD site, Noakhali and MLT site, Laxmipur respectively. The farmers cultivate onion and garlic as sole crop and sometimes as mixed crop in the chilli field. They do not maintain the proper spacing, planting date and management. They also do not analyze the cost and return of these spice crops. If intercropping is done then LER and benefit will be increased. The present study was therefore, undertaken to know yield and economic return of onion and garlic with chilli.

Materials and Methods

The experiments were conducted at the FSRD site, Hazirhat, Noakhali and MLT site of Laxmipur in the growing season of 2006-07. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain (AEZ 18f) and 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 7 treatments are as follows: T_1 = Sole garlic, T_2 = Sole onion, T_3 = Sole chilli, T_4 = 1 row onion with 100% chilli, T_5 = 1 row garlic with 100% chilli, T_6 = 2 row onion with 100% chilli and T_7= 2 row garlic with 100% chilli. The seeds were sown on the third week of December 2005. The unit plot size was 3 m x 2 m. Spacing of chilli was maintained at 40 x 20 cm. The land was fertilized with 100- 60-30 kg/ha (N-P-K). The whole amount of P, K and $^1/_3{}^{rd}$ of N were applied at the time of final land preparation and remaining N was applied in two installments at 25 and 50 DAT. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 2.20 to 8.13 dS/m.

Results and Discussion

Yield, yield contributing characters, economic study and LER of chilli, onion and garlic in both the locations (Table 1, 2, 3 and 4).

FSRD site Hazirhat

Chilli: The longest plant height (41.66 cm) was found from T_3, which was statistically identical with those plants of T_4, T_5, T_6 and T_7. The shortest plant height (39.17 cm) was found from T_7. The highest number of branches/plant (4.80) was also found from T_3 and the lowest number of branches/plant (4.00) was recorded in T_7, which was statistically identical with T_5, T_6. The highest length of fruit (6.57 cm) was obtained in T_3 and lowest (5.10 cm) in T_7. Treatment T_3 gave the highest number of fruit/plant (27.65) and the lowest was found from T_5 (22.10). The highest weight of fruit/plant was obtained from treatment T_3 (33.36 g). Higher pod yield (1.39 t/ha) was found from the treatment T_3 but closely followed by T_4 treatment whereas the lowest yield (1.06 t/ha) was found in treatment T_6 but at par to T_7.

Intercropped yield: Onion and garlic was grown as intercropped in between chilli rows. There was significant reduction in onion yield in both intercropped situation but two rows of onion showed more yield than one row. Similar trend was followed in case of garlic. The highest onion yield (9.25 t/ha) was found from the treatment T_2 whereas the lowest yield (4.85 t/ha) was found in treatment T_4. Similarly, the highest yield (2.89 t/ha) was found from the treatment T_1 whereas the lowest yield (1.70 t/ha) was found in treatment T_5.

Cost of benefit analysis: Higher equivalent yield was recorded from all intercropped treatments. Though the treatment T_6 gave the lower yield of chilli but two rows of onion in between 40 cm apart rows of chilli (T_6) produced the highest gross return (Tk.191900/ha) and gross margin (Tk.129600/ha) was also highest in T_6. The second highest gross return (Tk.167750/ha) and gross margin (Tk.101250/ha) was found in T_7, which is about similar to T_6 and the second highest benefit (Tk.113930/ha) was found in T_4 (Table 3). The LER of the different intercropped treatments were 1.03, 1.17, 1.31 and 1.26 in T_4, T_5, T_6 and T_7 respectively. The highest LER was found in treatment T_6 (1.31) and the lowest in T_4 (1.03).

MLT site, Laxmipur

Chilli: The longest plant height (64.83 cm) was found from T_3, which had statistically significant difference with other treatments. The shortest plant height was found from T_7 (54.00 cm). The highest number of branches/plant (5.97) was also found from T_3 showed statistically identical results with T_4. All the treatments showed significant effect on length of fruit. The longest fruit (7.10 cm) was found from T_3, which was statistically significant difference with other treatments. Treatment T_3 gave the highest number of fruit/plant (44.43) and the lowest was found from T_7 (32.17). The highest weight of fruit /plant was obtained from treatment T_3 (45.84 g) and the lowest (33.84) was found in T_7. The highest yield (1.91 t/ha) was also found from the treatment T_3 whereas the lowest yield (t/ha) was found in treatment T_6.

Intercropped yield: Similar trend was followed in case of onion and garlic yield as in Hazirhat.

The highest onion yield (11.16 t/ha) was found from the treatment T_2 whereas the lowest yield (5.12 t/ha) was found in treatment T_4. Similarly, the highest garlic yield (3.55 t/ha) was found from the treatment T_1 whereas the lowest yield (1.86 t/ha) was found in treatment T_5.

Cost of benefit analysis: Higher equivalent yield was recorded from all intercropped treatments. Though the treatment T_7 gave the lower yield of chilli but two rows of garlic in between 40 cm apart rows of chilli (T_7) produced the second highest gross return (Tk.217200/ha) and gross margin (Tk.150700/ha) and was highest in T_6 (Tk.249700/ha) and gross margin (Tk.187400/ha). The LER of the different intercropped fields are 1.07, 1.21, 1.36 and 1.16 in T_4, T_5, T_6 and T_7 respectively. The highest LER was found 1.36 in treatment T_6 and lowest in T_4 (1.07) (Table 4).

Farmer's reaction

Though two rows of onion and two rows of garlic in between 100% chilli intercropping system is the most profitable but it needed irrigation water which is the main problem for the farmers to provide extra irrigation. Farmers opined that where there is an irrigation facility particularly ponds and canals in that area this technology will be profitable. But this technology may not be accepted in totally rainfed chilli area.

Conclusion

It can be concluded that, two rows of onion and two rows of garlic in between 100% chilli intercropping system is the most profitable than the other treatments.

Table 1. Yield and yield components of sole and intercropped chilli at FSRD site, Hazirhat, Noakhali during Rabi 2006-07

Treatment	Plant height (cm)	No. of branches/plant	Length of fruit (cm)	No. of fruit/plant	Wt. of fruit/ plant (g)	Yield (t/ha)
T_3	41.66	4.80	6.57	27.65	33.36	1.39
T_4	40.63	4.50	6.30	27.43	32.53	1.35
T_5	40.44	4.10	5.60	24.15	26.58	1.19
T_6	39.59	4.14	5.48	23.90	26.40	1.06
T_7	39.17	4.0	5.10	22.10	25.44	1.10
LSD(0.05)	NS	0.11	0. 16	4.63	4.374	0.05

Table 2. Yield of chilli, onion, garlic with economic study and LER in different intercropping system at FSRD site, Hazirhat, Noakhali during rabi 2006-07

Combination	Yield/ha			Gross return Tk/ha)	*TVC (Tk./ha)	Gross margin (Tk./ha)	BCR	LER
	Chilli	Onion	Garlic					
T_1	-	-	2.89	101150	45480	55670	2.22	1
T_2	-	9.25	-	138750	42300	96450	3.28	1
T_3	1.39	-	-	90350	35250	55100	2.56	1
T_4	1.35	4.85	-	160500	46570	113930	3.45	1.03
T_5	1.19	-	1.70	136850	49750	87100	2.75	1.17
T_6	1.06	8.20	-	191900	62300	129600	3.08	1.31
T_7	1.10	-	2.75	167750	66500	101250	2.52	1.26

Table 3. Yield and yield components of sole and intercropped chilli at MLT site, Laxmipur during rabi 2006-07

Treatment	Plant height (cm)	No. of branches/plant	No. of fruit/plant	Length of fruit (cm)	Wt. of fruits/ plant (g)	Yield (t/ha)
T_3	64.83	5.97	44.43	7.10	45.84	1.91
T_4	58.77	5.47	40.53	6.83	42.72	1.78
T_5	56.63	4.70	35.90	6.37	37.92	1.58
T_6	55.80	4.30	34.23	6.17	35.28	1.47
T_7	54.00	3.80	32.17	5.80	33.84	1.41
LSD(0.05)	1.14	0.68	4.20	0.13	2.06	0.23

Table 4. Yield of chilli, onion, garlic with economic study and LER in different intercropping system at MLT site, Laxmipur during Rabi 2006-07

Combination	Yield/ha			Gross return (Tk./ha)	*TVC (Tk/ha)	Gross margin (Tk./ha)	BCR	LER
	Chilli	Onion	Garlic					
T_1	-	-	3.55	124250	45480	78770	2.73	1
T_2	-	11.16	-	167400	42300	125100	3.95	1
T_3	1.90	-	-	123500	35250	88250	3.50	1
T_4	1.78	5.12	-	192500	46570	145930	4.13	1.07
T_5	1.57	-	1.86	167150	49750	117400	3.35	1.21
T_6	1.40	10.58	-	249700	62300	187400	4.01	1.36
T_7	1.68	-	3.16	217200	66500	150700	3.26	1.16

∗ TVC = Total variable cost, Market price (Tk./kg): Onion = 15, Garlic =35 & Chilli = 65

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Performance of Cowpea under Different Sowing Date in Saline Area

Abstract

An experiment was conducted at Banerpota Farm, Satkhira to investigate the effect of sowing date on the performance of cowpea. Five different date of sowing were included in the study but three sowing dates have no fruit. Between the two dates, the highest yield was recorded from early sowing (December 26)

Introduction

Cowpea (*Vigna unguiculata L.)* is a comparatively cheap source of quality protein, iron and vitamin B and excellent substitute for meat, eggs and other protein yielding foods when served as grains and vegetables. Cowpea is moderately tolerant to salinity. Farmers are growing local variety in the middle of January in southern belt. During the reproductive phase of the crop soil moisture dries up and the crop suffers from drought as well as salinity stress. Sowing time is one of the most important factors to avoid the stress conditions. The optimum sowing time of cowpea in coastal region is not yet identified. Therefore, this study has been undertaken to identify the optimum sowing time of cowpea for the coastal region.

Materials and Methods

The trial was conducted at Satkhira MLT site, Satkhira during Rabi season, 2006-2007 with five date of sowing (December 24, January 10, January 26, February 22 and March 08) of cowpea following RCB design with three replications. The unit plot size was 5m×4m. The experiment was initiated on 24 December, 2006 as line sowing. Line to line spacing was 30cm. Fertilizer were applied at the rate of 20-16-17-10kg/ha of N, P, K and S respectively. All Urea, TSP and MP were applied as basal. Two irrigations were given at initial growth stage. All the intercultural operations were done as and when necessary. Data on yield and yield attributes were collected. The soil salinity level during 24 December 2006, 10 January 2007, 27 January 2007, 14 February 2007, 3 March 2007, 20 March 2007, 6 April 2007 and 23 April 2007 were 3.87, 3.99, 1.45, 1.66, 4.37, 5.97, 5.34 and 7.50 dS/m, respectively.

Results and Discussion

Performance of cowpea as affected by date of sowing has been presented in (Table -01). The highest plant population was observed in December 24 sowing followed by January 10 sowing. The tallest plant was observed from January 10 sowing. The plant height gradually increases with the delay sowing. Similarly pods/plant and seeds/pod decreased gradually with the delay sowing. Higher number of seeds/pod was obtained from December 24 sowing was followed by January 10 sowing. The highest yield was obtained from December 24 sowing could be due to maximum plant population/m^2 and maximum pod/plant. No seed was formed in January 26, February 22 and March 08 sowing could be to high temperature. The experiment needs further details study.

Table 1. Effect of date of sowing on yield and yield attributes of cowpea at Banerpota Farm, Satkhira during 2006-2007.

Date of sowing	plant population/m^2	Plant height (cm)	Pod/plant	Seed/pod	1000 seed wt. (g)	Grain yield (kg/ha)
24 December ’06	33	78	12	16	80.50	1010
10 January’07	24	87	09	14	79.75	750

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Performance of Cowpea under Different Sowing Date in Costal Area

Abstract

A field experiment was conducted at the MLT site Kuakata, Patuakhali during rabi, 2006-07 to find out the effect of date of sowing on yield and yield components of cowpea. Seeds were sown on December 11, December 21 and December, 2006. Seeds sowing on December 31 failed germination due to lack of sufficient moisture. Yield and all yield contributing characters were higher at 1st sowing than 2nd sowing.

Introduction

Cowpea (*Vigna unguiculata* L.) is a comparatively cheap source of quality protein, iron and vitamin B and excellent substitute for meat, eggs and other protein yielding foods when served as grains and vegetables. Cowpea is moderately tolerant to salinity. Farmers are growing local variety in the middle of January. During the reproductive phase of the crop soil moisture dries up and the crop suffers from drought as well as salinity stress. Sowing time is one of the most important factors to avoid the stress conditions. The optimum sowing time of cowpea in coastal region is not yet identified. Therefore, this study has been undertaken to identify the optimum sowing time of cowpea for the coastal region.

Objectives

1. To find out optimum sowing date for cowpea in coastal area.
2. To avoid salinity as well as drought stress on growth and yield of cowpea.
3. To utilize fallow land and increase production.

Materials and Methods

A field experiment was conducted at the MLT site Kuakata, Patuakhali during rabi, 2006-07. The experiment was laid out in RCB design having three replications with one local cultivar in three sowing time. Unit plot size was 4 m x 5 m. Seeds were sown at a spacing of 40 cm x 15 cm. Seeds were sown in three different sowing dates December 11, December 21and December 31, 2006. Fertilizer 30-45-30 kg/ha urea, TSP and MP was applied as basal dose. The crop was grown under rainfed condition.

Results and Discussion

Yield and yield contributing characters were given in Table 1. Seeds sowing on December 31 failed germination due to lack of sufficient moisture. Yield and all yield contributing characters were higher at 1st sowing than 2nd sowing. It revealed that early sowing would enhance production. Soil sample analysis showed that soil salinity of the experimental plots was less than 2 ds/m. This was first year result and the experiment should be shifted from the next year where soil salinity prevails.

Farmers' reaction

Farmers prefer relay sowing than behind plough sowing and sowing behind plough sowing enhances more vegetative growth.

Table 1. Effect of sowing date on yield and yield contributing characters of cowpea in the saline area in 2006-07

Sowing date	Plant population/m^2	Plant height (cm)	Pods/plant	Seeds/pod	Seed yield (kg/ha)
December 11	21	59.9	9.0	14	1360
December 21	20	49.2	7.6	11	1210
December 31	-	-	-	-	-

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Effect of Mulching on the Yield of Barley in the Coastal Area

Abstract

A field experiment was conducted at MLT site Kuakata, Patuakhali during rabi, 2006-07 to find out the effect of mulching on growth and yield of Barley in coastal area. The experiment was set up in Kuakata and crops were grown under rainfed condition. Mulching was done by rice straw. In Kuakata BB-4, BB-5 and BB-6 gave statistically identical yield. Soil sample analysis showed that soil salinity of the experimental plots was less than 2 dS/m.

Introduction

Barley is not a traditional or widely grown crop in Bangladesh. Plant Breeding Division of BARI has developed a good number of barley varieties. Barley is a salt and drought tolerant crop. So it could be a promising crop in the saline zone where land remains fallow during the rabi season. In rainfed condition soil moisture depleted rapidly that hampered crop growth and yield. Moreover, increasing dryness increases soil salinity. Mulching could conserve soil moisture and as well as low soil salinity could be maintained. With this view, the present study was undertaken to find out the effect of mulching on different varieties of barley.

Materials and Methods

The experiment was laid out in RCB design having three replications with three varieties. Unit plot size was 2 m × 1m. Seeds were sown in a continuous row keeping line to line 25 cm apart. Barley variety BB-4, BB-5 and BB-6 were used. Seeds were sown on December 5, 2006 under rainfed condition. Rice straw was used for mulching. 100-60-40 kg/ha N P K fertilizer was applied. Soil salinity ranges were 1.5 to 1.8 ds/m in the growing season.

Results and Discussion

There was no statistically significant difference among the varieties under mulching condition for both yield and yield contributing characters. The varieties BB-4, BB-5 and BB-6 gave 647, 670 and 697 kg/ha grain yield, respectively. Soil sample analysis showed that soil salinity of the experimental plots was less than 2 dS/m. This was first year result and the experiment should be shifted from the next year where soil salinity prevails.

Farmers' reaction

Post harvest processing was not easy. Marketing was a problem. Farmers are not interested to cultivate barley.

Table 1. Yield and yield contributing characters of barley at coastal area under mulching in rabi, 2006-07

Variety	Plant population /m^2	Plant height (cm)	Spike length (cm)	Grain/spike	Yield (kg/ha)
BB-4	229	59.8	8.5	15	647
BB-5	225	56.2	8.1	16	670
BB-6	231	55.2	8.9	19	697
LSD (0.05)	NS	NS	NS	NS	NS

Adaptive Trial of Mungbean Varieties in the Coastal Area

Abstract

The experiment was conducted at the MLT site, Kuakata, Patuakhali during rabi 2006-07 with varieties of BARI mung-2, BARI mung-5 and BM-01 to select variety/line under farmers' field condition. All the varieties gave statistically identical yield, however, apparently BARI mung-2 gave the highest seed yield (938 kg/ha).

Introduction

A vast coastal and offshore areas (2.85 million ha) in the southern part of Bangladesh are exhibit soil salinity of various magnitudes due to on rush of salt water from the Bay. However, during the dry season (November to March) surface layer of the soil dries up due to evaporation and the saline water from the underground moves up to capillary forces. Thus a considerable amount of salt crust occurs. So, cultivation of winter crops is very limited due to absence of irrigation water. As a result, most of the areas remain fallow during dry months. To increase pulse area and production especially mungbean as it is mostly grown in the southern part of Bangladesh. These marginal lands should be considered. The variation in salinity tolerance between crops and/or varieties of crops is well known (Mass and Hofarmn, 1977; Karim *et al.*, 194; Richard *et al.,* 1987). A judicial choice to grow crop in the saline soil, therefore, considered an important management option to minimize yield loss by salinity. Therefore, the experiment was conducted to select salt tolerant mungbean variety/line under farmers' field condition.

Materials and Methods

The experiment was conducted at the MLT site, Kuakata, Patuakhali during rabi season of 2006-07 with the varieties of BARI mung-2, BARI mung-5 and BM- 01. Sowing was done on December 18, 2006 and harvested on March 05, 2007. Plot size was 5 m × 4 m in each replication of five. Plots were fertilized with 50-85-35 kg/ha Urea, TSP, MP. All fertilizers were applied at the final land preparation. The crop was cultivated totally under rainfed condition.

Results and Discussion

Marked differences among the varieties/lines were found in respect of plant population/m^2, plant height, number of pods/plant and number of seeds/pod but plant height and seed yield insignificant. BM-01 gave statistically higher plant population followed by BARI mung-5 and lowest in BARI mung-2. BARI mung-2 gave statistically the highest number of pods/plant but BM-01 and BARI mung-5 showed identical. BARI mung-2 produced highest number of seeds/pod followed by BARI mung-5 and the lowest in BM 01. Though seed yield was statistically identical but BARI mung-2 showed slightly higher yield. Soil sample analysis showed that soil salinity of the experimental plots was less than 2 ds/m.

Farmers' reaction

- Crop performance was satisfactory.
- Soil moisture reduced rapidly.
- Farmers are interested to cultivate mungbean and they needed drought and salt tolerant varieties.

Table 1.Yield and yield contributing characters of mungbean variety/line in the saline area in 2006-07

Variety/line	Plant pop^n/ m^2	Plant height (cm)	No. of pods/plant	No. of seeds/pod	Seed yield (kg/ha)
BM-01	32.14a	27.02	13.76b	9.04b	863
BARI mung-2	25.95b	26.24	17.82a	10.16a	938
BARI mung-5	28.25ab	25.53	14.03b	8.65ab	906
CV (%)	11.12	7.98	13.14	9.16	11.13

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

D. HILLY AREA

Performance of Intercropping Hybrid Maize with Pea (BARI motorshuti-1) at Hill Valleys

Abstract

A performance trial of hybrid maize (BHM-5) with BARI motorshuti-1 was conducted at Chemee dolo para hill valleys in Bandarban sadar areas during rabi season, 2006-07 with view to determine the agro-economic performance of intercropping and to increase vegetable production at hilly areas. Results revealed that highest grain yield of maize was recorded 8.86 t/ha from maize + 2 line motorshuti but highest gross margin was received Tk.181350/ha from maize + 4 line motorshuti due to higher green pod yield.

Introduction

Intercropping is one of the techniques of vertical expansion of crop justification production. It increases total productivity per unit area than sole cropping. Maize is a cereal crop, which is used as food, feed and fodder. It requires high amount of chemical fertilizer of exploiting its maximum yield potentiality. The vegetable production is much less than the requirement. On the contrary, pea being a leguminous crop needs lower fertilizer dose for its cultivation. Usually short duration crops are grown as component crops with maize. Among the different short duration crop pea is one of them. Intensive cropping without green manuring or continuous of chemical fertilizers produces detrimental effect on physical and chemical properties of soil and also reduces organic matter of the soil. Besides, vegetable production in Bandarban is comparatively lower than other areas. So, it is necessary to increase vegetable production in that area. With this justification, the experiment has been undertaken with the following objectives:

i) To determine the agro-economic performance of intercropping pea with maize.
ii) To increase vegetable production of the locality.

Materials and Methods

An experiment on intercropping hybrid maize with pea was conducted in highland of Chemee dolo para, Bandarban sadar areas at hill district Bandarban of AEZ 29 during rabi season, 2006-07. The soil of the experimental field was sandy loam having pH 4.5-6.5. Organic matter is low and N is very low, P-medium, K-medium, S-medium, Zn-very low and boron is very low (SRDI, 2000). The variety of maize was BARI hybrid maize-5 and pea was BARI motorshutti-1. The unit plot size was 4.5m x 4m. Spacing 75cm x 25cm for maize and 30cm x 10cm for pea was maintained. The sowing date was 25-26 November, 2006. Fertilizers were applied for maize and intercrop 250-53-100-30-5kg NPKSZn/ha and for sole pea 20-18-17-10 kg NPKS/ha. Half of N and full quantity of other fertilizers was applied as basal and rest of N splits in two equal portion and was applied at 30 and 60 DAS in maize rows only as side-dress. The green pods of pea were harvested after 70 days of its sowing date. The maize was harvested 20-23 April, 2007.The yield contributing character of maize were recorded from ten randomly selected plants.

Results and Discussions

Yield components of maize

Plant height, plants/m^2, cobs/m^2 and grains/cob of maize were not significantly influenced by the treatments but only 100-grain weight was statistically different. Maize intercropped with 4 lines of pea combination showed the highest grain weight among the treatments even sole maize.

Yield component of pea

Plants/m^2 and 50 green pod weight showed significant among the treatments but green pods/plant was insignificant. Though plants/m^2 between sole pea and 2 lines pea was intercropped with maize reveal identical and lower from 4 lines of pea in maize. Significantly higher green pod weight was recorded from 4 lines of pea intercropped with maize.

Yield of maize and pea

Grain and straw yield of maize did not significantly affect the treatments but slightly higher yield was recorded from 2 lines pea in maize but higher straw yield from sole maize. Among the intercrop yield, the highest pea yield was obtained from sole pea. Four lines of pea showed higher yield than 2 lines pea in maize.

Maize equivalent yield

Both the intercropped system showed higher MEY than sole maize or sole pea. Four lines of pea intercropped maize reveal higher MEY than 2 rows of pea in maize.

Cost and return analysis

Highest gross return was recorded from maize + 4 line pea intercrop followed by maize + 2 line pea whereas lowest gross return was found form sole pea and sole maize. The gross margin and benefit cost ratio was also the highest in maize + 4 line pea and the lowest from sole maize and pea.

Field observation

No diseases were found in maize but Stem rot disease was found in BARI motorshuti-l but after spraying Ridomill (2gmiliter water) it was recovered

It is noted that at hilly areas, farmers are interested to sell boiling cob to local market due to high price received per cob. Local people are habituated to take boiling cob as their food intake.

Farmers reaction

In Bandarban hilly areas, pea was a new crop. At the beginning of harvesting Pea, local people were not acquaintance with this new crop as a vegetable but they are agreed to keep seed for pulse and they are habituated to take it as pulse. Farmers are agreed to cultivate pea as intercropping with maize but it would need to be motivated them by extension people or through training or field day orientation.

Conclusion

It is evident that intercropping maize with pea is a profitable practice for higher return. This practice has been done last two years. It was found good response from farmers due to higher income.

Table 1. Effect of intercrop combination on yield components of maize

Treatments	Plant height (cm)	Plant/m^2	Number of cobs/m^2	Number of grains/cobs	1000-grain wt. (g)
Sole maize	268	5.33	6.3	476	276
Maize + 2 line pea	267	4.78	6.8	468	247
Maize + 4 line pea	272	5.15	6.5	450	308
LSD (0.05)	14.56	NS	1.23	NS	11.13

(After harvesting of pods plant biomass was incorporated in to the soil)

Table 2. Effect of intercrop combination on yield components of pea (BARI MototShutti-1)

Treatments	Plant/m^2	No. of green pod harvested/plant	50-green pods wt. (g)
Pea sole	58	9	155
Maize + 2 line pea	54	5	120
Maize + 4 line pea	43	6	180
LSD (0.05)	11.13	16.31	1.41

Table 3. Yield of maize and intercrop, maize equivalent yield

Treatment	Yield of maize (t/ha)		Intercrop yield (t/ha)	Maize equivalent yield (t/ha)
	Grain yield	Straw yield		
Sole maize	8.45	15.43	-	8.45
Sole pea	-	-	7.78	3.89
Maize + 2 line pea	8.86	15.26	2.01	10.12
Maize + 4 line pea	8.51	13.10	3.77	10.87
LSD (0.05)	NS	NS	1.12	-

Table 4. Cost and return analysis of hybrid maize as intercrop with pea at Bandarban, 2005-06

Treatment	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Sole maize	1,57,500	43020	1,14,480	3.66
Sole pea	38,900	22,130	16,770	1.76
Maize + 2 line pea	1,80,050	44,190	1,35.860	4.07
Maize + 4 line pea	1,81,350	44,190	1,37,160	4.10

Local Market price of maize Tk. 2.50/cob and Stover = Tk. 0.25/kg and Green pods of pea @ Tk. 5/kg

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Feasibility study of Pointed Gourd at Hill Valleys

Abstract

A feasibility study of pointed gourd cultivation was carried out at hill valleys in Bandarban sadar areas during 2005-06 to examine feasibility of pointed gourd cultivation at hilly areas and to estimate economic return of this new crop. Results revealed that highest fruit yield (26.32 t/ha) was recorded from BARI patol-1. The gross margin received was Tk. 318937/ha and the benefit cost ratio was 7.43. No major diseases were found in pointed gourd variety. As a new economic crop its acceptability to the hilly farmers was remarkable.

Introduction

Recently BARI has been developed two pointed gourd variety i,e. BARI patol-1 and BARI patol-2 which yielded 38 and 30 t/ha, respectively. In Bandarban hill valleys it was cultivating since four years before releasing as a variety. Pointed gourd is usually grown in northwestern parts of Bangladesh. It can be grown in south-eastern parts of Bangladesh mainly on hill foot high lands where large amount of areas remains fallow. Moreover, there is a high demand of summer vegetables like pointed gourd in this region and vegetable deficit may be overcome by introducing it. In Bandarban district, pointed gourd is a new crop. It has high local demand. Unfortunately, pointed gourd was not cultivated in previous day in this region or no research work has been done. In order to fulfill the local demand and met up the deficit of summer vegetables, the crop should be introduced at farmer's level. In this context, an experiment has been undertaken with the following objectives:

i) To observe the yield performance of pointed gourd variety at farmer’s field;
ii) To quantify the cost benefit analysis of pointed gourd cultivation in Bandarban;
iii) To know the farmers feedback of pointed gourd cultivation in their field.

Materials and Methods

A feasibility study of pointed gourd was conducted at Bandarban Sadar areas during 2005-06 at farmer's field. The experiment was set up RCB with 3 dispersed replications. Two varieties, BARI patol-1 and BARI patol-2 were used with support system of Bamboo trellis. The bed size was 4.5m x 1.5m where pit to pit distance 1.5 m. No. of pit/bed was 3 and plant/pit was one. The ratio male and female was 1: 10. Fertilizer application per pit was used cowdung 4-5 kg (12.5 t/ha), TSP 50 g (125 kg/ha) and MP 60 g in three splits 20 g after 20 days and 20 g after 60 days and rest 20 g after 90 days of germination. Urea was applied as 70 g (0+25+25+20): 25 g after 20 days, 25 g after 60 days and 20 g after 90 days of germination. The number of vine was 2500/ha. The vine was planted on October-November, 2005 and harvesting was started on 20 March 2006 and continued. Yield data was recorded from per plot and converted to per hectare. The yield was harvested in each 4-6 days interval and 1st harvest was started on 25 March and it was continued till October last week. The yield data was recorded by monitoring basis in each harvesting days. Irrigation, top dressing, weeding and spraying was done as and where necessary.

Results and Discussion

Yield and yield contributing character

The variety BARI patol-1 showed maximum diameter and individual fruit weight which results higher fruit yield though higher length of fruit was recorded from BARI patol-2.

Cost benefit analysis

The highest gross return was obtained from BARI patol-1 due to highest yield. The gross margin and benefit cost ratio was also higher than BARI patol-2. The cultivation cost were estimated as vines cost

Tk. 1250, cowdung Tk. 6250, Urea Tk. 1225, TSP Tk. 2250, Mp Tk.2550, Insecticide cost- Tk.625, Bamboo trellis- Tk. 24000 and total labour cost at Tk. 11,433/ha. (Table 2).

Field observation

- No major disease was found yet, but fruit fly was attack which was controlled effectively by poison trap (1.3 ml Sabicron with 100 g sweet gourd)
- Fungicide was used for controlling fungal diseases.

Farmer's reaction

- Farmers are interested to grow pointed gourd as a new crop in Bandarban and its local demand and market price is always high.

Conclusion

Pointed gourd is a promising new economic crop for hilly region. Extension personnel should come forward for disseminate it in large-scale production at farmers field.

Table 1. Yield and yield contributing character of pointed gourd cultivation at hill valleys in Bandarban, 2005-06

Variety	Support system (bamboo trellis)			
	Diameter of fruit(cm)	Length of fruit (cm)	Individual wt. of fruit (gm)	Fruit yield (ton/ha)
BARI patol-1	4.8	9.80	49.30	26.32
BARI patol-2	3.9	11.79	38.80	18.48

Table 2. Cost and return of pointed gourd cultivation at hill valleys in Bandarban, 2005-06

Variety	Gross return (Tk./ha)	Total cultivation cost (Tk/ha)	Gross margin (Tk/ha)	Benefit Cost Ratio (BCR)
BARI patol-1	368480	49543	3,18,937	7.43
BARI patol-2	258720	49543	2,09,177	5.22

Sales price of pointed gourd @ Tk.14/kg in local market.

Bread Wheat Adaptive Line Trials

Abstract

The experiment was conducted in the farmer's field of Comilla, Faridpur, Jhenaidah, Narail, Rajshahi, Pabna, Sylhet, Sherpur and Jamalpur in the medium highland situation during rabi 2006-07 to asses the performance of seven bread wheat line/varieties along with check varieties Kanchan. The line BAW-1059 produced higher grain yield across the location.

Introduction

Wheat is the second important cereal crop in Bangladesh 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 difference. BARI has developed some new lines/varieties. These are not tested yet in farmer's field of different AEZs. As such the experiment was conducted in the farmer's field at different locations/AEZ during rabi 2006-07 to verify the yield performance of the advanced lines of wheat in order to release them as variety.

Materials and Methods

The experiment was conducted in the farmer's field of Comilla, Faridpur, Jhenaidah, Narail, Rajshahi, Pabna, Sylhet, Sherpur and Jamalpur in the medium highland situation during rabi 2006-07. The experiment had three replications with RCB design. The unit plot size was 4m × 3m. A total of seven varieties/lines were tested along with check variety Kanchan. The land was well prepared and seeds were sown during 18 November at Jhenaidah, 8 December at Narail, 20 November at Puthia, 27 November at Shibpur, 24-29 November at Faridpur, 27-29 November at Pabna, 21 November at Sherpur, 29 November at Jamalpur and 25-27 November at Sylhet of 2006 irrespective of locations in 20 cm apart from lines. The fertilizer N-P-K-S and cowdung were applied at the rate of 101-36-25-21.5 Kg/ha and 10t/ha respectively. Two third Urea and rest of all other fertilizer were applied at final land preparation and rest urea was top-dressed at 21 DAS (days after sowing). The field was irrigated twice at 23 DAS and 61 DAS. Rat attack was managed by watering at 45 DAS & use of rodenticide (Lanirat) at 54 DAS when necessary. The crop was harvested 15 March at Jhenaidah, 5 April at Narail, 15-29 March at Faridpur 22-26 March at Pabna, 25 at sherpur, 27 March at Jamalpur and 23-39 March at Sylhet of 2007. Data were analyzed by using MSTAT.

Results and Discussion

Chandina, Comilla

Plant height, grains/spike and thousand-grain weight were differed significantly but spikes/m^2, spike length and grain yield did not differ. The highest plant height was recorded in Kanchan that was followed by Shatabdi. Lowest plant height was found in the advanced line BAW-1064 which was similar with BAW-1059. Highest grains/spike was found in BAW-1059 which was similar to all the lines/variety except Kanchan. Highest 1000 grain weight was found in BAW-1064 and lowest in Shatabdi. Grain yield was statistically identical by the variety/line.

Hatgavindapur, Faridpur

In Farmer 1, grain yield, number of spikes/m^2 and 1000-grain weight were significantly influenced by different varieties/lines. The highest number of spikes/m^2 was found in BAW-1036. Significantly highest 1000-grain weight was given by BAW-1064 (51.17 t/ha). Highest grain yield was produced from BAW-1059 (3.63 t/ha). In Farmer 2, yield and yield attributes were also significantly influenced by different varieties/lines. The highest number of spikes/m^2 was obtained from BAW-1036. Grains/spike was highest in BAW-1059. Thousand-grain weight was highest in BAW-1064 like Farmer 1. Similar trend in grain yield was noted in farmer-2.

Kaliganj, Jhenidah and Tularampur, Narail

The line BAW-1059 produced the highest grain yield (4.61 t/ha) at the MLT site Kaliganj. The second highest yield (4.51 t/ha) was obtained from Shatabdi, which was identical with BAW-1064 and it was lowest from Kanchan at Kaliganj. At MLT site Tularampur highest yield (3.80 t/ha) was obtained from BAW-1059 which was identical with BAW-1064 and Shatabdi and it was lowest in case of Kanchan.

Puthia, Rajshahi

Plant height, grain weight and grain yields were significantly influenced by variety/line. Maximum plant height was recorded from Shatabdi followed by BAW-1064. The highest grain weight was recorded from BAW-1064 but grain yield was similar except Kanchan.

Puspapara, Pabna

The days to heading of new lines/varieties were similar except Kanchan. Shatabdi took the highest days to maturity while kanchan took the lowest days. The maximum plant height was in BAW-1064 followed by BAW-1059 and the shortest in the variety Kanchan and Shatabdi. There was similarity in all variety/lines in spikelets/spike. Higher grains/spike was recorded in BAW-1059 which was followed by the lines BAW-1064 and the lowest was in Kanchan. The highest 1000-grain weight was obtained in BAW-1064 which was significantly differed form other line/varieties and the lowest from Kanchan. The variety Shatabdi and two lines showed similar grain yield and higher than Kanchan.

Sujanagar, Pabna

The plant population per unit area was identical except in Kanchan. The longest plant height was found in the line BAW-1059 and the shortest in BAW-1064. The sipike length was highest in line BAW-1059 which was followed by Shatabdi. The maximum number of grains spike^{-1} was in BAW-1059 followed by BAW-1064 and the lowest was observed in Kanchan. Similar trend of response was also observed in 1000 grain weight. The highest grain yield was obtained from the line BAW-1059 due to cumulative positive effect of yield contributing characters like length of spike, grains spike^{-1} and 1000-grain weight. The lowest grain yield was obtained from Kanchan. Grain yield was lower in the site, which might be due to late sowing and stress of residual soil moisture at initial stage of crop establishment. The straw yield was maximum in BAW-1059 and minimum in Kanchan

Kushumhati, Sherpur

All the yield contributing characters were significantly differed due to variety. The tallest plant was found from BAW-1059. The number of plants/m^2 was found highest in Shatabdi and was statistically identical to BAW-1059 which the lowest number from BAW-1064 and Kanchan. The longest spike was obtained from BAW-1064 and it was statistically significant to Shatabdi and Kanchan which BAW-1059 produced the shortest spike. The number of spikelets/spike was found maximum in Shatabdi and was idenical to BAW-1064 and BAW-1059. The lowest number was recorded from Kanchan. Higher grains/spike was achieved from Shatabdi and was similar to BAW-1059. The weight of 1000-grain was found higher in BAW-1064 and was identical to Shatabdi and BAW-1059 which Kanchan showed the lowest 1000-grain weight. The similar trend of pattern was also obtained in grain yield. There was no significant difference in grain yield was found among the line/varieties except Kanchan. Two lines and Shatabdi variety showed higher and similar grain yield.

Malancha, Jamalpur

All most all the yield contributing characters were significantly differed due to variety. The tallest plant was found from BAW-1059 folowed by Shatabdi. The number of plants/m^2 was found insignificant. The longest spike was obtained from BAW-1059 and it was statistically identical to Shatabdi while BAW-1064 produced the shortest spike. The number of spikelets/spike and grains/spike was found insignificant. The weight of 1000-grain was found higher in BAW-1059 followed by Kanchan and the lowest from Kanchan. Grain yield did not vary among the variety/line except Kanchan. Maximum grain yield (4.58 t/ha) was recorded from BAW-1064 at the site and it was the highest across the location studied.

Goyaingahat, Sylhet

The days to maturity ranged from 118 DAS to 123 DAS. The earliest variety was Gourav, which took only 117 days to maturity. The maximum spikes/m^2 was obtained from Satabdi (274), which was followed by Protiva (270). The variety Gourab produced the lowest (227) spikes/m^2 due to less seed germination. Satabdi gave higher seed weight. The highest grain yield was obtained from the variety Satabdi (2.54 t/ha) which might be due to higher number of spikes/m^2 and grains/spike. Protiva and Kanchan gave statistically identical yield (2.32 t/ha and 2.34 t/ha) due to higher seed weight and spike/m^2. So, the variety Satabdi may be suitable for large scale production in this region.

Farmer's reactions

Faridpur: Farmers' are happy to get high yield from BAW-1036. All the farmers are interested to grow BAW-1036 in the next year and they preserved the seed.

Jhenaidah and Narail: Farmer's of this area were so much impressed with the wheat line BAW-1059 for its high yielding potential, bold and white colour of seeds. They are interested to grow this line because of disease resistance.

Pabna: Farmers of the respective sites chose the new wheat lines and newly released variety Shatabdi due to their increased yield over Kanchan. They opined that they would preserve seed for growing crops in the next season They also expressed that winter season is becoming shorter and sudden rising of temperature which affected wheat yield, so late sown heat tolerant variety is needed.

Jamalpur: Farmers preferred both the line BAW-1064 and BAW-1059 for its high yield potential and bold grain.

Sylhet: Wheat production is satisfactory in sylhet area in terms of yield and it can be a good crop to utilize the fallow land of this area.

Conclusion

The highest grain yield was recorded in line BAW-1059 (3.68 t/ha) and the lowest in Gaurav (2.15 t/ha).

Table 1. Yield and yield attributes of wheat variety/lin at Chandpur, Comilla during 2006-07

Lines/variety	Spikes /m^2	Plant height (cm)	Spike length	Grains/spike	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	310.35	99.67	13.07	32.17	47.73	3.44
BAW-1059	333.96	95.67	13.25	42.13	44.13	3.50
Shatabdi	329.67	98.53	12.15	34.93	41.40	3.50
BAW-1064	333.96	95.13	13.74	37.27	51.27	3.44
LSD (0.05%)	NS	1.114	NS	9.31	3.46	NS
CV (%)	9.75	0.57	9.14	12.73	7.52	7.02

Table 2. Yield and yield contributing characters of wheat variety/lines in Farmer 1 at FSRD site, Faridpur during 2006-07

Variety/line	Days to maturity	Plant height (cm)	Spikes/m^2	Grains/spike	1000-grain wt. (g)	Grain yield (t/ha)
BAW-1064	107	91.18	283	32.27	51.17	3.21
BAW-1059	111	87.65	283	36.63	40.83	3.63
BAW-1036	111	93.60	319	35.77	39.60	3.37
Kanchan	114	88.87	292	31.83	42.43	3.26
LSD (0.05)	-	NS	16.4	2.4	3.2	0.24

Table 3. Yield and yield contributing characters of bread wheat lines in Farmer 2 at FSRD site, Faridpur during 2006-07

Variety/line	Days to maturity	Plant height (cm)	Spikes/ m^2	Grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)
BAW-1064	110	80.87	249	30.57	52.10	3.07
BAW-1059	112	77.97	250	33.50	42.63	3.25
BAW-1036	112	85.43	281	32.63	39.90	3.17
Kanchan	112	80.83	269	30.30	41.60	2.96
LSD (0.05)	-	NS	12.5	1.8	4.5	0.18

Table 4. Performance of wheat varieties/lines at MLT site, Kaligonj, Jhenidah during rabi 2006-2007

Variety/lines	Population /m^2	Plant height (cm)	Spike length (cm)	Grains/ spike (no)	1000-grain wt (g)	Grain yield (t/ha)	Straw yield (kg/ha)
BAW-1064	441	92.00c	8.80c	50.56b	36.20c	4.48b	7.15d
BAW-1059	465	93.33bc	9.33b	54.00a	47.43a	4.61a	7.61b
Shatabdi	451	96.33b	9.40b	44.60c	42.60b	4.51b	7.41c
Kanchan	460	101.00a	10.00a	38.86d	36.16c	2.94d	7.98a
CV (%)	14.22	11.72	12.82	7.91	6.70	9.71	15.72
F-test	NS	**	**	**	**	**	**

Table 5. Performance of wheat varieties/lines at MLT site, Tularampur, Narail during rabi 2006-2007

Variety/lines	Population/m^2	Plant height (cm)	Spike length (cm)	Grains /spike (no)	1000-grain wt (g)	Grain yield (t/ha)	Straw yield (t/ha)
BAW 1064	404	75.26	9.97	35.10b	39.13ab	3.53a	5.77
BAW 1059	414	76.90	9.70	41.40a	45.23a	3.80a	5.43
Shatabdi	441	80.13	8.73	35.95b	41.87a	3.37a	6.27
Kanchan	427	74.83	9.20	33.60b	33.67b	1.97b	5.50
CV (%)	8.85	3.20	6.99	10.51	6.05	15.83	14.98
F-test	NS	NS	NS	*	**	*	NS

Table 6. Effect of genotypes on yield and yield attributes under Adaptive Trial of Wheat in 2006-07 at Puthia, Rajshahi

Varieties/ Entries	Head days	Maturity days	Plant height (cm)	Spikes/m^2	Grains/ spike	TGW (g)	Grain yield (kg/ha)
Kanchan	68	109.3	93.3	294.0	38.8	41.0	2100
Shatabdi	68	107.0	97.0	311.8	38.9	40.3	2992
BAW-1059	67	107.5	91.2	315.2	44.6	42.2	2989
BAW-1064	67	107.5	94.6	333. 7	39.4	45.4	2982a
LSD (0.05)	NS	NS	3.39	NS	NS	1.56	287
CV (%)	2.39	1.48	2.87	8.44	8.3	2.93	8.25

Table 7. Yield and yield contributing characters of Wheat varieties/lines at FSRD site Pushpapara during 2006-07

Treatments	Days to heading	Days to maturity	Plant height (cm)	Plant population m^{-2} (no.)	Spike length (cm)	Spikelets $spike^{-1}$ (no.)	Grains $spike^{-1}$ (no.)	1000 Grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Shatabdi	64ab	112.3 a	90.40 b	265.0	9.63	17.50	41.17 b	37.33 b	3.06 a	4.88
Kanchan	63b	103.0 c	90.10 b	262.7	9.63	18.07	32.73 c	29.13 c	2.00 b	4.45
BAW-1059	65a	107.3 b	93.07ab	239.3	9.67	17.47	47.20 a	39.33 b	3.29 a	4.03
BAW-1064	65a	107.3 b	97.37 a	233.7	10.23	18.53	42.93 ab	48.80 a	3.22 a	4.69
LSD (0.05)	1.10	1.99	4.69	NS	NS	NS	4.98	2.22	0.32	NS
CV (%)	0.86	0.93	5.54	9.60	4.40	3.66	6.09	2.88	5.56	10.93

Table 8. Yield and yield contributing characters of wheat varieties/lines at MLT site Sujanagar during 2006-07

Treatments	Plant height (cm)	Plants population m^{-2} (no.)	Spike length (cm)	Grains $spike^{-1}$ (no.)	1000 Grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Shatabdi	85.83	217.3	8.78	39.23	46.60	2.71	3.68
Kanchan	84.80	202.4	8.30	34.77	30.27	1.64	2.17
BAW-1059	89.23	215.2	9.82	43.10	51.00	3.53	3.82
BAW-1064	80.80	214.3	8.43	40.57	48.13	3.14	3.31
LSD (0.05)	2.22	6.33	0.25	1.35	1.43	0.11	0.06
CV (%)	4.31	10.51	4.41	6.72	2.63	7.90	8.53

Table 9. Yield and yield contributing characters of bread wheat line at MLT Site, FSRD site, Kushumhati, Sherpur during 2006-07

Treatment	Plant ht. (cm)	Plant/m^2 (no.)	Spike length (cm)	Spikelets/ spike (no.)	Grains/spike (no.)	TGW (g)	Grain yield (t/ha)	Straw yield (t/ha)
BAW-1064	92.87 b	313.21 b	10.63 a	16.07 ab	31.67 ab	47.67 a	3.87 a	4.83
Shatabdi	93.27 ab	367.00 a	10.33 a	16.33 a	34.53 a	46.67 a	4.07 a	4.97
BAW-1059	94.60 a	355.67 ab	9.23 b	15.93 ab	34.47 a	45.33 a	4.07 a	5.17
Kanchan	93.13 ab	312.00 b	9.87 ab	15.57 b	30.93 b	43.00 b	3.53 b	4.73
F	*	**	*	*	*	**	**	NS
CV(%)	8.34	8.57	4.00	5.52	4.31	2.63	8.68	5.15

Figures in column having similar letter(s) do not differ significantly

Table 10. Yield and yield contributing characters of bread wheat line at MLT Site, Malancha, Melandah during 2006-07

Treatment	Plant ht. (cm)	Plant/m^2 (no.)	Spike length (cm)	Spikelets/ spike (no.)	Grains/ spike (no.)	TGW (g)	Grain yield (t/ha)	Straw yield (t/ha)
BAW-1064	84.53 b	346.67	7.97 c	16.07	32.87	38.33 b	4.58 a	4.74 c
Shatabdi	88.07 ab	307.33	8.70 ab	15.47	27.87	38.33 b	4.17 ab	5.47 bc
BAW-1059	89.80 a	341.33	8.80 a	16.67	28.53	46.00 a	4.13 ab	6.60 a
Kanchan	92.40 a	329.33	8.13 bc	15.67	28.47	37.33 ab	3.70 b	6.53 ab
F	*	NS	*	NS	NS	*	*	*
CV (%)	9.28	8.08	8.34	5.02	7.55	5.64	9.38	6.45

Figures in column having similar letter(s) do not differ significantly

Table 11. Yield and yield contributing characters of five wheat varieties at Goyainghat upazilla under Sylhet district during rabi 2006-07

Variety	Maturity (Days)	Plant height (cm)	Spikes/m^2 (no.)	Grains/spike (no)	1000 -grains wt (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Satabdi	122	102.4	274	29	46.30	2.54	3.74
Protiva	121	101.7	270	28	45.81	2.32	3.56
Gourav	117	100.4	227	28	45.12	2.15	3.39
Sourav	118	100.5	245	26	43.81	2.26	3.12
Kanchan	123	101.2	262	27	44.65	2.34	3.38
$LSD_{0.05}$	NS	NS	NS	1.22	0.80	0.10	0.17
CV%	2.0	1.32	1.80	3.44	1.50	2.25	2.39

Appendix 1. Grain yield (t/ha) of bread wheat at different locations during 2006-07

Variety	Locations										Mean
	Comilla	Fardipur	Jhenaidah	Narail	Rajshahi	Pabna		Sylhet	Sherpur	Jamalpur	
						Puspapara	Suganar				
Kanchan	3.44	2.96	2.94	1.97	2.10	2.00	1.64	2.34	3.53	3.70	2.66
BAW-1059	3.50	3.25	4.61	3.80	2.99	3.29	3.53	-	4.07	4.13	3.68
Shatabdi	3.50	-	4.51	3.37	2.99	3.06	2.71	2.54	4.07	4.17	3.43
BAW-1064	3.44	3.07	4.48	3.53	2.98	3.22	3.14	-	3.87	4.58	3.59
BAW-1036	-	3.17	-	-	-	-	-	-	-	-	3.17
Protiva	-	-	-	-	-	-	-	2.32	-	-	2.32
Shourav	-	-	-	-	-	-	-	2.26	-	-	2.26
Gourab	-	-	-	-	-	-	-	2.15	-	-	2.15

Performance Trial of Hull-Less Barley at different AEZ of Bangladesh

Abstract

The experiment was conducted at Patuakhali, Noakhali, Satkhira, Jessore and Rajshahi during the rabi 2006-07 to find out suitable barley variety for different locations. Four to six genotypes including one check (BB-4) were evaluated under rainfed condition. The result showed that the highest grain yield (3.20 t/ha) was obtained from Barley variety BB-2 at Narail, BHL-13 with yield of 1.5, 1.33 and 2.17 t/ha at Patuakhali, Noakhali and Satkhira whereas 1.80 t/ha from BB-6 at Barind under rainfed condition.

Introduction

Barley (*Hordium vulgare* L.) is the world s 4th most important cereals crops and it has the potential to become one of the important crops in Bangladesh. Barley though a minor crop of the country can play an important role in enhancing the food security of the country and in reducing the drainage of foreign currency. It is nutritionally comparable to wheat and rice being a traditional of this subcontinent. Barley is popular for home consumption of rural people. This has several industrial uses also for which import is unavoidable. Further of all cereals barley is well known for its high resistance to salinity and thus has a great potentiality for expansion is the coastal/saline and drought prone area as well as drought which remains mostly fallow in the rabi season. Therefore, development of high yielding superior quality barley varieties is very much necessary for reducing the drainage of foreign currency and for enhancing the overall food security of the country (Chowdhury, 1962).

Materials and Methods

The experiment was conducted at Patuakhali, Satkhira, Jessore, Noakhali and Rajshahi during rabi 2006-07 under rainfed condition. Four to six hull-less variety considered as treatments. The seeds were sown during 27 November at Khulna, 9 December at Patuakhali, 11 December at Noakhali, 5 December at Rajshahi and 3-12 December at Jessore of 2006. The unit plot size was 10 m × 10 m with plot to plot distance 50 cm and row to row distance 25 cm, continuous sowing was applied. Total fertilizers 100-60-40 kg/ha N-P-K was applied as basal dose. The crop was harvested on 23 March at Patuakhali, 8 March at Rajshahi 15-23 March at Jessore of 2007.

Result and Discussion

Kuakata, Patuakhali

The highest grain yield (1520 kg/ha) was obtained from BHL-13 followed by BHL-19 (1330 kg/ha). The lowest yield was obtained from BHL-18 (1130 kg/ha). Soil sample analysis showed that soil salinity of the experimental plots was less than 2 ds/m. This was first year result and the experiment should be shifted from the next year where soil salinity prevails.

Hazirhat, Noakhali

Maximum plant height was found in BARI barley-4 (76.2cm) which was followed by BHL-12 and the lowest was found in BHL-13 (69.6 cm). Number of effective tillers per m^2 did not differ significantly. The length of spike of different line was statistically at par except BARI barley-13 which showed highest spike length. The line BHL-12 showed the highest no. of grains/spike but statistically identical with BHL-13. In respect of 1000-grain weight, the lines BHL-13, BHL-18 and BHL-19 were found identical and the lowest 1000-grain weight was found in BHL-12 which was identical with BB-4. Significantly higher grain yield was obtained from line BHL-13 which was statistically identical to BHL-18. Other varieties were statistically at par but lower than BHL-13 and BHL-18.

Satkhira

Plant height, spike/m^2, grain/spike, 1000-grain weight and grain yield were significantly influenced by variety/lines. The results revealed that higher grain yield (2.17 t/ha) was obtained from BHL-13 but at par to BHL-13. Higher yield produced by BHL-13 could be due to maximum grain/spike. The lowest yield produced by BB-4 could be due to lower yield attributes.

Kadamshahar, Rajshahi

The results of trial revealed that BARI barley-6 was given the higher seed yield (1.80 t/ha) due to producing the highest number of effective tillers/m^2 (245), longest panicle (9.20 cm) highest number of grains/spike (47) and the highest grain weight (42.28 g). This result followed by the genotypes BHL-7 (1.65 t/ha), BHL-10 (1.50 t/ha) and BHL-19 (1.40 t/ha). The genotype BHL-11 contributed lowest seed yield (1.25/ha) probably due to producing shortest spike length (7.40 cm), lowest number of grains/spike (33) and smallest grain (39.28 g). All the genotypes required 57-61 days for 50% heading and 94-97 days for 50% maturity under rainfed condition in the high Barind Tract. Among the genotypes BARI barley-6 was taken comparatively shorter time (57 days) for heading and longer time (97 days) for maturity.

Tularampur, Narail and Jhikargacha, Jessore

The highest grain yield (3.20 t/ha) was obtained from BB-2 while the lowest yield from BB-1 at MLT site Tularampur. The grain yield of barley varieties at MLT site, Jhikargacha were very low due to poor germination. Moreover continuous rainfall from 3 to 12 February hampers the yield of barley at the site.

Farmers' reaction

Patuakhali: Post harvest processing was not easy. Marketing was a problem. Farmers are not interested to cultivate barley.

Noakhali: Farmer's are not interested to grow barley in this area because the problems of post harvest operation and lack of irrigation.

Satkhira: Farmer's are interested to grow barley in small scale for medicinal purpose. Farmer's dislike it's winnowing, threshing and processing procedure.

Jessore: The yield of barley is satisfactory. But due to lack of marketing facilities the farmers are not interested to cultivate barley.

Conclusion

The highest grain yield (3.20 t/ha) was obtained from BB-2 line. The lowest yield was obtained from BHL-11 (1.25 t/ha). This is first year result; so, the experiment should be repeated further across the location.

Table 1. Yield and yield contributing characters of barley variety during rabi 2006-07 at Kuakata, Patuakhali

Variety	Plant height (cm)	Spike length (cm)	Grain /spike	Effective tiller/hill	Grain yield (kg/ha)
BB-4	72.13	6.4	43.7	4.6	1220 bc
BHL-12	66.43	5.8	39.1	4.6	980 d
BHL-13	75.83	7.1	46.4	4.8	1520 a
BHL-18	54.90	5.17	37.7	4.4	1130 c
BHL-19	70.27	6.7	45.4	4.2	1330 b
CV (%)					10.6

Table 2. Performance of yield and yield contributing characters of different hull-less barley variety in the saline area, Noakhali

Variety	Plant Height (cm)	Effective tiller/m^2 (no.)	Spike length (cm)	Grains/spike (no)	1000-grain Weight (g)	Grain yield (t/ha)
BHL-12	73.3	91.3	13.78	42.62	31.25	1.21
BHL-13	69.6	119.8	14.35	41.62	34.98	1.73
BHL-18	69.9	127.8	13.62	35.81	34.45	1.52
BHL-19	72.3	100.8	13.97	35.64	33.49	1.21
BB-4	76.2	102.1	13.58	34.78	31.80	1.19
LSD (0.05)	3.37	NS	0.505	2.951	2.951	0.437
CV (%)	2.48	11.17	1.94	8.77	4.72	17.00

Table 3. Yield and yield attributes of barley as affected by different lines/variety at Satkhira MLT site, Satkhira during rabi season 2006-07

Lines/variety	Days to maturity	Plant height (cm)	Spike/m^2 (no.)	Spike length (cm)	Grain/ spike (no.)	1000-grain weight (g)	Grain yield (t/ha)
BHL-12	104	78.27	243	8.65	45.47	35.50	1.90
BHL-13	110	78.07	282	8.30	53.87	26.25	2.17
BHL-18	109	84.92	274	8.82	52.55	35.50	1.98
BHL-19	107	82.57	297	8.50	51.85	31.50	2.09
BB-4	104	75.62	342	8.05	38.00	24.50	1.42
LSD (0.05)		8.36	34.75	1.13	2.60	1.72	0.20
CV (%)		6.79	7.85	8.67	3.49	3.65	7.10

Table 4. Performance of different barley genotypes under rainfed condition at Rajshahi, 2006-07

Genotypes	Plant height (cm)	Effective tillers/m^2	Spike length (cm)	Grains/ Spike	1000-grain weight (g)	Grain yield (t/ha)	50% Heading (days)	50% Maturity (days)
BHL-11	61.60	236	7.40	33	39.28	1.25	61	95
BHL-7	62.50	209	8.20	41	40.88	1.65	61	94
BHL-19	64.00	218	8.50	43	39.68	1.40	60	96
BHL-10	68.30	185	8.60	45	41.06	1.50	60	97
BB-6 (Check)	74.20	245	9.20	47	42.28	1.80	57	97

Table 5. Yield and yield contributing characters of barley under pilot production programme at MLT site, Tularampur, Narail during rabi 2006-07

Variety	Plant pop./m^2	Plant height (cm)	Spike length (cm)	Seeds/ spike (no)	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
BB-1	350	90.6	7.6	30.3	36.0	1.5	4.2
BB-2	405	84.3	7.9	27.1	35.2	3.2	5.4
BB-3	480	64.4	7.7	38.1	31.5	2.1	4.8
BB-4	312	76.7	9.0	39.2	29.6	1.7	3.4
BB-5	417	79.9	9.5	28.3	37.6	2.5	4.7
BB-6	465	65.2	8.6	34.2	34.4	2.6	5.1

Table 6. Yield and yield contributing characters of barley under pilot production programme at MLT site, Jhikorgacha, Jessore during rabi 2006-07

Variety	Plant pop./m^2	Plant height (cm)	Spike length (cm)	Seeds/ spike (no)	1000- gr. wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BB-1	160	67	8.75	33	36.30	0.50	2.25
BB-2	102	89	9.80	37	37.00	0.50	2.00
BB-3	133	89	8.90	39	32.60	0.75	2.25
BB-4	121	85	7.80	33	26.40	0.38	2.00
BB-5	150	69	10.00	35	40.75	0.75	2.25
BB-6	221	84	8.10	29	37.25	0.75	2.00

Appendix 1. Yield (t/ha) of hull-less barley across different locations, 2006-07

Variety	Patuakhali	Noakhali	Satkhira	Rajshahi	Narail	Jessore	Mean
BB-1	-	-	-	-	1.50	0.50	1.00
BB-2	-	-	-		3.20	0.50	1.85
BB-3	-	-	-	-	2.10	0.75	1.43
BB-4	1.22c	1.19	1.42	-	1.70	0.38	1.18
BB-5	-	-	-	-	2.50	0.75	1.63
BB-6 (check)	-	-	-	1.80	2.60	0.75	1.72
BHL-7	-	-	-	1.65			1.65
BHL-10	-	-	-	1.50	-	-	1.50
BHL-11	-	-	-	1.25	-	-	1.25
BHL-12	0.98	1.21	1.90	-	-	-	1.36
BHL-13	1.52	1.73	2.17	-	-	-	1.81
BHL-18	1.13	1.52	1.98	-	-	-	1.54
BHL-19	1.33	1.21	2.09	1.40	-	-	1.51

On-Farm Verification Trial of Hybrid Maize

Abstract

The trial was carried out at Pabna, Jhenaidah, Kustia, Bandarban and Rangpur during 2006-07 to compare the performance of advance lines of maize with BARI hybrid maize and commercial variety. Among the tested line/varieties, the highest grain yield was obtained from Pacific-11 followed by BARI hybrid maize-5 and SCO-303. The lowest yield performance was found in TCO-404 in all the sites.

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. Breeding division of BARI recently developed some lines of maize with high yield potential. These lines need on-farm verification trial to select suitable ones under different agro-ecological zones before release as a new variety. Therefore, the trial was conducted with the objectives to compare the performance of advance lines of maize with BARI hybrid maize and commercial variety.

Materials and Methods

The trial was carried out simultaneously at Pabna, Jhenaidah, Kustia, Bandarban and Rangpur under irrigated condition during the rabi season of 2006-07 with two lines SCO-303 and TCO-404 and two maize variety namely BARI hybrid maize-5 and Pacific-11. The experiment was laid out in randomized complete block design with three dispersed replications. Seeds of different line/varieties were sown during 12 December at Pabna, 18 December at Jhenaidah, 6 December at Kushtia, 2-5 December at Bandarban and 26 December at Rangpur of 2006 over the locations with spacing of 75 cm x 25 cm. The trial was fertilized with 250-55-144-34-13-1 kg N- P-K- S- Zn-B/ha. One third urea and the full amount of other fertilizers were applied as basal. The rest urea was applied in 2 equal split at 8-10 leaf stage and tasseling stage, respectively. Earthing up was done after 2nd top dress of urea. One to three irrigation was provided at 60, 90 and 120 days after sowing. Weeding and plant protection measure were taken when required. The crop was harvested during 16 May at Pabna, 10 May at Jhenaidah, 29 April at Kushtia and 22-24 April at Bandarban of 2. Data on different plant characters and yield were collected and analyzed statistically.

Result and Discussion

Puspapara, Pabna

Plant characters like days to maturity, plant height, ear height, no. of grains/cob and 100-grain weight was statistically identical to all lines/varieties. Days required for tasseling and silking was comparatively less in SCO-303 than other line/varieties. Cob length was maximum in BHM-5 which was similar to Pacific-11. Maximum grain yield was recorded in Pacific-11 followed by BHM-3 and SCO-303. Probably slightly higher grain weight was enhanced yield in Pacific-11. The lowest yield performance was observed in TCO-404.

Kaliganj, Jhenaidah

The highest grain yield (13.85 t/ha) was obtained from SCO-303 and it was lowest (12.37 t/ha) from Pacific-11. Though grain weight lower in SCO-303 but due to higher grains/cob reveals higher yield. Pacific-11 also showed the highest grain weight but lower grains/cob reveals lower yield.

Kushtia

The plant height, No. of grains/cob and 100-grain wt. (g) was highest in BHM-5. Both the variety (Pacific-11 & BHM-5) showed similar grain yield and higher than advanced line.

Bandarban

No. of plants and no. of cobs were highest in Pacific-11. Grain yield was lower in BHM-5 comparing Pacific-11due to less number/plant and cob and lower grain weight. At the same time highest percentage of poor husk cover was found in BHM-5 but it was lowest in Pacific-11 and others line/varieties. The total cost of cultivation (excluded fixed cost) was estimated at Tk.13020/ha. The highest gross return was recorded Tk.183250/ha from Pacific-11 followed by TCO-404 and SCO-303 and the lowest from BHM-5. The highest gross margin and benefit cost ratio was also higher in Pacific-11. It is noted that at hilly areas, farmers are interested to sell boiling cob to local market due to high price received per cob. Local people are habituated to take boiling cob as their food intake.

Lahirirhat, Rangpur

There were significant differences among all the tested hybrid maize in respect of all the characters studied. BARI developed hybrid maize produced significantly lower grain yields than commercial maize hybrid (Pacific-11). Among the BARI hybrid maize, BHM-5 gave significantly the highest grain yield (7.49 t/ha) and other two lines produced lower yields (5.01 to 5.23 t/ha). The Pacific-11 gave the highest yield which was 10.4% higher than that of BHM-5. The higher yield contributing characters of Pacific-11 resulted higher yield.

Farmer's reaction

Pabna: Farmers preferred yield and hence they showed their interest to cultivate hybrid Pacific-11 due to its higher yield. Simultaneously some farmers chose the new line SCO-303 because of attractive colour and similar yield.

Kushtia: Farmers were not well known to new varieties except Pacific-11. But farmers are interested to grow BHM-5.

Bandarban: Farmer's are showing interest to grow Pacific -11, TCO-404 & SCO-303 due to its higher yield as well as getting higher benefit than BHM-5 one.

Rangpur: Farmers were not satisfied with the of BARI developed hybrid maize as well promising lines due to its poor performances as compared with the commercial hybrid maize Pacific-11.

Table 1. Yield and yield contributing characters of different hybrid maize variety at FSRD site, Pushpapara, Pabna during the rabi season 2005-06.

Variety/ line	Days to maturity	Days to tasseling	Days to silking	Plant height (cm)	Ear height (cm)	Grains /cob (no.)	Cob length (cm)	100-grain wt (g)	Actual yield (t/ha)		Calculated yield (t/ha)		Yield gap* (t/ha)
									Grain	Stover	Grain	Stover	
SCO-303	150	93	99	186.1	103.5	537.9	17.47	34.27	9.44	7.00	9.83	7.27	0.39
TCO-404	148	97	103	186.1	110.2	505.1	17.47	34.47	7.29	5.73	7.55	5.90	0.26
BHM-5	150	97	103	196.9	109.8	534.7	18.93	34.10	8.56	7.36	9.18	7.68	0.62
Pacific-11	150	97	103	204.6	116.8	509.6	17.80	36.77	9.69	8.87	10.42	9.21	0.73
LSD $_{(0.05)}$	NS	2.77	1.91	NS	NS	NS	1.15	NS	1.48	1.05	1.42	0.98	-
CV (%)	1.38	1.44	2.94	5.36	6.50	3.43	3.20	4.72	8.50	7.26	7.68	6.55	-

*Grain yield gap over plant stand

Table 2.Yield and yield attributes of maize varieties/lines at MLT site, Kaligonj, Jhenaidah during 2006-07

Variety/lines	Plant height (cm.)	Grains/ cob (no.)	100-grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
SCO-303	195.66b	717a	34.70c	13.85a	9.03a
TCO-404	204.66ab	537b	38.30b	12.73ab	7.93b
BHM-5	211.33a	529b	35.80bc	13.44ab	9.36a
Pacific-11	205.33a	458c	41.00a	12.37b	7.81b
F-test	**	**	**	**	**
CV (%)	7.46	5.84	3.28	4.48	5.82

Table 3. Effect of different varieties on yield and yield components of Maize at Kushtia during 2006-07

Variety/lines	Plant pop^n/m^2	Plant height (cm)	No. of cobs/15m^2	No. of grains/cob	100-grain wt. (g)	Grain yield (t/ha)
SCO-303	6	183.56	96	521	30.30	8.53
TCO-404	6	170.90	100	521	28.93	7.87
BHM-5	6	193.18	107	560	33.93	10.00
Pacific-11	7	175.73	127	545	30.43	10.20
LSD (0.05)	4.97	9.54	6.66	NS	1.81	2.33
CV (%)	8.06	2.64	9.30	8.37	2.92	12.74

Price = 10.5 Taka per kg

Table 4.Yield and yield contributing character of hybrid maize at hill valleys in Bandarban, 2006-07

Variety/ Line	Plant height (cm)	No. of plant/m^2	No. of cobs/m^2	1000-grain wt.(g)	Days to maturity	Ear height (cm)	Lodging (%)	Poor husk cover (%)	Grain yield (t/ha)
SCO-303	228	4.10	6.33	284	140-145	100	00	25	8.23
TCO-404	239	4.84	6.67	298	140-145	102	00	21	8.58
BHM – 5	231	4.00	5.53	288	140-144	96	00	29	7.10
Pacific-11	240	5.21	7.33	289	142-145	97	00	17	9.17
LSD(0.05)						-	-	-	NS

Table 5. Economic performance of hybrid maize cultivation at hill valleys in Bandarban, 2006-07

Variety/Line	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	Benefit-cost ratio (BCR)
SCO-303	1,58,250	43020	115230	3.68
TCO-404	1,66,750	43020	123730	3.88
BHM - 5	1,38,250	43020	95230	3.21
Pacific-11	1,83,250	43020	140230	4.25

Note: Local Market price of maize Tk. 2.50 per cob.

Table 6. Days to maturity, yield and yield attributes of hybrid maize in the farmer's field at FSRD site, OFRD, Rangpur druing 2006-07

Variety/ line	Days to maturity	Plant height (cm)	Ear height (cm)	Grain/cob (no.)	Grain wt./ cob (gm)	100-seed wt (gm)	Grain yield (t/ha)
SCO-303	148d	170bc	85.5c	489a	124c	24b	5.23c
TCO-404	156b	177a	86.5c	426b	115d	19d	5.01c
BHM-5	162a	167c	88.7b	522a	151b	27c	7.49b
Pacific-11	153c	174ab	96.7a	509a	170a	28a	8.27a
CV (%)	1.0	2.0	1.5	5.3	6.2	1.4	5.6

Appendix 1. Yield of (t/ha) of on-farm verification trial of hybrid maize during 2006-07

Variety	Location					Mean
	Pabna	Jhenaidah	Kushtia	Bandarban	Rangpur	
SCO-303	9.83	13.85	8.53	8.23	5.23	9.13
TCO-404	7.55	12.73	7.87	8.58	5.01	8.35
BHM-5	9.18	13.44	10.00	7.10	7.49	9.44
Pacific-11	10.42	12.37	10.20	9.17	8.27	10.09

On-Farm Verification Trial of BARI Released Hybrid Maize

Introduction

Maize especially hybrid maize is a new crop in Patuakhali region. Form previous few years BARI has introduced hybrid maize in the area. After T.aman harvest farmers in this area either grow few rabi crops with less care or the land remain fallow. There is no highly profitable rabi crop for the area. With this point of view OFRD, BARI, Patuakhali and recently DAE are trying to introduce hybrid maize as a high profit cereal crop during rabi season for the southern region of Bangladesh. In rabi, 2006-07 a varietal trial was conducted with BARI hybrid maize-3 and 5.

Materials and Methods

The three replicated trial was conducted at MLT site, Kuakata, Patuakhali during rabi season, 2006-2007 with BARI Hybrid maize-3 & 5. Plot size was 100 m^2 and spacing was 75 cm x 20 cm. Sowing was done on 07-15 December, 2006 and harvested on 28 April, 2007. Plots were fertilized with 200-55-150 kg/ha N P K. One third of urea and whole TSP & MP were applied at the final land preparation. Half of the rest portion of urea was applied at 8-10 leaves stage and last rest portion of urea was applied at 50 days after seed germination followed by irrigation. Other intercultural operation were done as per required.

Results and Discussion

BARI hybrid maize-3 (9.08 t/ha) yielded higher than BARI hybrid maize-5 (8.26 t/ha). BCR was also higher in BARI hybrid maize-3 (2.43) than BARI hybrid maize-5 (2.21). Farmers like both the varieties but prefer BARI hybrid maize-5 for its taste.

Farmers' reaction

- Yield was satisfactory, so farmers were interested to grow BARI Hybrid maize.
- Stover was used as fodder and fuel.
- Farmers preferred BARI hybrid maize-5 for attractive colour and taste.

Table 1. Yield and yield contributing characters of BARI hybrid maize-3 & BARI hybrid maize-5 at Kuakata, Patuakhali during 2006-07.

Variety	Plants/ m^2	Plant height (cm)	No of cob/plant	No. of grain/cob	100- grain wt. (gm)	Grain yield (ton/ha)
BARI hybrid maize-3	5.7	185	1	612	28.6	8.08
BARI hybrid maize-5	5.8	197	1	583	27.3	7.26

Table 2. Cost and return analysis of BARI hybrid maize-3 & BARI hybrid maize-5 Kuakata, Patuakhali during 2006-07

Variety	Grain yield (ton/ha)	Gross return (Tk)	TVC (Tk)	Gross margin (Tk)	BCR
BARI hybrid maize-3	8.08	80,800/-	37,350/-	43450/-	2.16
BARI hybrid maize-5	7.26	72,600/-	37,350/-	35250/-	1.94

Output price: Grain Tk. 10.00/kg

Adaptability Trial of Pioneer Hybrid Maize

Abstract

An on-farm trial was conducted at Gangi, Meherpur, Rangpur and Bogra during the rabi season of 200-07 to investigate the performance of pioneer hybrid maize in comparison to commercial hybrid maize. Two pioneer hybrid maize cultivars 30V92 and 30B07 and 900M (as check) were included in the study. The result showed that highest grain yield (11.20 t/ha) was obtained from hybrid maize cultivar of 30V92 at Kushtia, 900M at Rangpur with grain (11.56 t/ha) whereas at Borga the highest grain yield (11.05 t/ha) from 30B07. All the cultivars showed satisfactory yield with more than 10 t/ha. Results revealed that across locations cultivar 30B07 gave the highest grain yield (10.78 t/ha) which was closely followed by 900M and 30V92.

Introduction

Globally the ranking of Maize is 3rd, among the cereal crops next to rice and wheat in terms of area and production. The yield potential of the existing varieties is lower in comparison to hybrid maize. In Bangladesh hybrid maize is being cultivated for the last few years. Farmer in this area mainly grows hybrid variety with imported seed in the country. To observe the performance of Pioneer Company's hybrid maize along with commercial hybrid maize 900M an adaptability trial was undertaken at three important maize growing areas.

Materials and Methods

The trial was initiated Gangi, Meherpur, Rangpur and Bogra during the rabi season of 200-07 with maize varieties namely Pioneer hybrid 30V92, 30B07 and commercial hybrid maize 900M. The unit plot size was 33 decimal. The seeds were sown during 28 November at Gagni, 6 December at Rangpur and 10 December at Bogra of 2006 with a spacing of 75cm x 20cm. The trial was fertilized with 256-55-144-34-13-1 kg NPKSZn/ha as Urea, TSP, MP, Gypsum, Zinc and Boron. One third Urea and all fertilizers were applied as basal and the rest Urea was applied in 2 (two) equal splits. First top dress was done at 8-10 leaf stage and other at tasseling stage. Weeding was done after 3-5 leaf stage. Four to six irrigations were applied at different crop growth stages as par needs of the crop.

Plant protection measure was taken. Cultivar 30V92 was harvested at 145, 152 and 154 days at Gagni, Rangpur and Bogra while 30B07 was harvested at 152, 152 and 157 days at Gagni, Rangpur and Bogra, respectively whereas 900M was harvested at 149, 144 and 159 days at Gagni, Rangpur and Bogra, respectively.

Results and Discussions

Gagni, Meherpur

Higher plant height, cobs/m^2 and 1000-grain weight was recorded from cultivar 30V92. Though higher grains/cob was obtained from cultivar 30B07 but due to lower cobs/m^2 and grain weight failed to show higher yield, The cultivars 30B307 and 900M (check) showed similar grain yield as well as yield attributes. The cultivar 30V92 reveals higher grain yield due to higher yield attributes.

ARS, Rangpur

Plants/m^2 was same for all the cultivar. Maximum plant height was recorded from cultivar 30V92 and shortest from 900M cultivar. The cobs/m^2 was similar in both the cultivars (30V92 and 30B07) and lower in cultivar 900M. The check variety showed higher grains/cob and other two cultivars grains/cob were similar. Grain weight also showed higher in cultivar 900M. This cultivar reveals higher grain yield due to higher yield attributes than other two cultivars.

ARS, Bogra

The cultivar 30V92 showed slightly lower grain than other two cultivars. Maximum plant height was recorded from cultivar 30V92 and other two cultivars were same in height. The cobs/m^2 were also same by two cultivars (30B07 & 900M) and higher than 30V92. But cultivar 900M showed lower grains/cob than other two cultivars. The cultivars 30B07 reveals higer grain yield (11.05 t/ha) than 900M (10.47 t/ha) and 30V92 (9.70 t/ha).

Conclusion

The Pioner hybrid maize cultivar 30V92 showed maximum grain yield at Meherpur, 900M at Rangpur with grain yield (11.56 t/ha) and cultivar 30B07 at Bogra with grain yield (11.05 t/ha). All the Pioneer maize variety showed reasonable good yield around 10 t/ha.

Table 1. Grain yield and its attributes of Pioneer company hybrid maize at Gangni, Meherpur, 2006-07

Cultivar	Days to maturity	Plant/m^2 (no)	Plant height (cm)	Cob/m^2 (no)	Grains/ cob (no)	100-grain weight (g)	Grain yield (t/ha)
30V92	145	5.44	239	7.66	413	34.1	11.20
30B07	152	5.33	225	5.66	508	33.7	10.66
900M (check)	149	5.37	227	5.86	527	33.3	10.26

*Non-replicated trial

Table 2. Grain yield and its attributes of Pioneer company hybrid maize at Rangpur, 2006-07

Cultivar	Days to maturity	Plant/m^2 (no)	Plant height (cm)	Cob/m^2 (no)	Grains/ cob (no)	100-grain weight (g)	Grain yield (t/ha)
30 V 92	152	6.39	205.30	7.03	492.44	30.87	10.55
30 B 07	152	6.39	181.48	7.02	445.34	34.5	10.64
900 M (check)	144	6.39	160.50	6.39	542.84	35.12	11.56

Table 3. Grain yield and its attributes of Pioneer company hybrid maize at Bogra, 2006-07

Cultivar	Days to maturity	Plant/m^2 (no)	Plant height (cm)	Cob/m^2 (no)	Grains/cob (no)	100-grain weight (g)	Grain yield (t/ha)
30 V 92	157	6.33	242.20	6.33	490.20	32.7	9.70
30 B 07	157	6.50	214.80	6.50	489.30	35.3	11.05
900 M (check)	159	6.50	224.16	6.50	441.80	33.0	10.47

Appendix 1. Grain yield (t/ha) of Pioneer company hybrid maize at three different locations, 2006-07

Cultivar	Meherpur	Rangpur	Bogra	Mean
30 V 92	11.20	10.55	9.70	10.48
30 B 07	10.66	10.64	11.05	10.78
900 M (check)	10.26	11.56	10.47	10.76

Performance of Different Varieties of Maize as Fodder in the Coastal Region of Bangladesh

Abstract

The experiment was conducted at MLT site, Kuakata, Patuakhali during rabi 2006-07 with BARI Hybrid maize-3 & 4, Pacific-11 & 60, Khai bhutta, Bornali, Sweet corn and BM-6. Hybrid varieties produced more or less identical green biomass in all three cuts but the inbred varieties yield was somehow different and lower than hybrid varieties.

Introduction

There is a huge amount of domestic animals present at coastal area of Patuakhali. But during the rabi season acute scarcity of fodder makes the cattle and buffalo just skin and bone. Few farmers generally grow khesari as relay with T. aman and use as fodder. After that there is no fodder except dry rice straw. Fields become dry and salinity label increase. For this reason grass or other type of fodder do not produced in the field. With this point of view a number of maize varieties were put under trial in the area.

Materials and Methods

The experiment was conducted at MLT site, Patuakhali during rabi season of 2006-2007 with BARI Hybrid maize-3 & 4, Pacific-11 & 60, Khai bhutta, Bornali, Sweet corn and BM-6. Sowing was done on December 15, 2006 and was harvested three times on 25 January, 15 February and 05 march, 2007 respectively. Plot size was 3.5 m × 2.5 m in each dispersed replication of three. Plots were fertilized with 550-260-220 kg/ha urea-TSP-MP. 15 plants were cut in each time from each replication and fresh weight was taken and was fed as fodder.

Results and Discussion

The variety Pacific-11 showed maximum fodder yield by three cuts but statistically identical to Pacific-60 and BARI hybrid maize-4. The composite variety failed to show higher fodder yield than hybrid.

Farmers' reaction

- Farmers liked green maize plant as fodder.
- But they prefer cob for human consumption so maize should be used for fodder as well as grain.

Table 1. Performance of different maize varieties as fodder crop at Kuakata in rabi, 2006-07

Variety	Fresh weight (kg)/15 plants		
	1st cut (35 DAS)	2nd cut (55 DAS)	3rd cut (75 DAS)
BARI hybrid maize-3	0.89 a	1.93 a	6.10 b
BARI hybrid maize-4	0.95 a	2.00 a	6.75 a
Pacific-11	1.04 a	2.00 a	7.06 a
Pacific-60	1.11 a	1.96 a	6.85 a
Khai bhutta	0.67 b	1.30 d	4.02 e
Bornali	0.70 b	1.42 c	4.21 d
Sweet corn	0.69 b	1.48 c	4.38 d
BM-6	0.74 b	1.60 b	4.76 c
Cv (%)	7.31	10.52	13.25

On-Farm Adaptability Trial of Triticale in Saline Affected Areas of Bangladesh

Abstract

Performance of fifteen Triticale entries namely E_1, E_2, E_3, E_4, E_5, E_6, E_7, E_8, E_9, E_{10}, E_{11}, E_{12}, E_{13}, E_{14}, and E_{15} were evaluated at Banerpota farm, Satkhira and FSRD site Hajirhat, Noakhali during the rabi season of 2006-'07. At Satkhira E_6 and E_{14} produced similar and higher grain yield (2.00 t/ha) from 28 Dec.'07 sowing. While maximum green fodder yield was obtained from E_7 (6.94 t/ha) followed by E_8. However, the line E_6 produced good amount of green fodder yield (5.62 t/ha) as well as maximum grain yield. On the other hand, at Noakhali, entry E_5 gave the highest grain yield (2.48 t/ha) which was at par with E_{11} (2.34 t/ha). In context of green fodder production E_{11} produced the highest amount (9.88 t/ha) which was identical with E_{15}. However for dual purpose E_{11} would be the best but E_5 could also be an alternative. In both the locations it was observed that soil salinity above 6-7 ds/m hampered the growth and development of the crop. To reduce the toxic effect of salinity on seeds, irrigation would be advisable just after sowing. Crop virtually failed above the soil salinity level of 10 ds/m. Further investigations in relation to screening and management practices are needed.

Introduction

Fodder and feed scarcity is one of the major bottlenecks for livestock sector development. Almost no space is available for sole fodder production due to acute land crisis. But duel purpose crops such as triticale/ maize could be becomes alternative option. Triticale is a man-made cross between rye and durum wheat and that has the ability to produce quality green fodder, and then re-growth after and second cutting to produce grain. It could be grown in existing rice-based cropping systems and has the ability to produce 10-12 t fresh weight biomass per ha from two cuts in a season. Its fodder is rich in lysine and tryptophane, essential amino acids for the growth and development of livestock. However, as normal fertile land is employed for different rabi crops and boro rice, its adaptability and potentiality should be tested in fallow land of coastal and moderate saline affected land. The performance of some entries needs to be evaluated in saline area. Keeping this in mind the trial was undertaken in the saline belt of Satkhira and Noakhali.

Materials and Methods

The trial was conducted at Banerpota farm, Satkhira and FSRD site, Hajirhat, Noakhali during the Rabi season of 2006-2007 with fifteen triticale entries namely E_1, E_2, E_3, E_4, E_5, E_6, E_7, E_8, E_9, E_{10}, E_{11}, E_{12}, E_{13}, E_{14}, and E_{15} following RCB design with two replications. The unit plot size was $5m \times 1m$. At Satkhira the crop was sown on 09 and 28 December (as germination was poor in 1st sowing) 2006, while at Noakhali sowing was done on 4 December, 2006 as line sowing. Line to line spacing was 20cm. Fertilizer were applied at the rate of 126-26-38-20kg NPKS /ha as urea, TSP, MP and gypsum respectively. All the TSP, MP and Gypsum were applied as basal while 55 % urea was applied as basal and rest 45 % as top dress after 1st cutting of green fodder. Three irrigations were given during the crop growing period. One cutting of green fodder was done on 45th days after sowing (DAS) at Satkhira and on 42 DAS at Noakhali. All the intercultural operations were done as and when necessary. Data on yield and yield attributes were collected and analyzed statistically and green fodder yield was recorded. The soil salinity levels at both the site were recorded (Fig 1 and Fig 2). About 361 mm rainfall occurred at Noakhali during the crop growing period.

Results and Discussion

At Satkhira Plant height, spike/m^2, 1000-grain weight, green fodder yield, grain yield and straw yield were significantly influenced by entries (Table 1). Performance of triticale lines/variety has been presented in Table 1 and 2. E_6 and E_{14} produced the maximum grain yield (2.00 t/ha) from

28 Dec.'07 sowing. This higher yield could be due to maximum spike/m^2 and heavier seed weight. The maximum green fodder yield (6.94 t/ha) was obtained from E_7 followed by E_8.

For Noakhali all the yield and its attributes (Table 3) were affected by the entries. The entry E5 gave the maximum grain yield which was identical with E11. E5 produced the highest yield because of combined effect of higher number of grains/spike and spikes/m2. For the purpose of green fodder production, the entry E11 performed better (9.88 t/ha) but at par to E15. For dual purpose (fodder and grain production) E11 seems could be in the area.

Farmer's reaction

Farmer's showed interest to grow triticale for both fodder and grain purpose, as it apparently grows better than other crops on saline soil. But its cultivation is costly as it needs good amount of fertilizer along with irrigation. Farmers dislike it's winnowing, threshing and processing procedure.

Lessons learnt

Triticale could be an alternation option for brining rabi season fallow saline areas under cropping. As from preliminary observation it was observed that triticlae is a bit more saline tolerant in comparison to other competitive crops. However, more research work is needed to increase yield and profitability.

Conclusion

From the study it was observed that at Satkhira E_{14} and E_6 performed better, moreover, E6 could be used for both green fodder and grain. Whereas at Noakhali E5 and E11 gave higher grain yield. E11 also produced the highest green fodder yield, hence could be used for dual purpose. Triticale could be grown in Fallow-T.Aman -Fallow cropping pattern of the vast rabi season fallow land of the saline belt. However, 2-3 years field observation is needed for making any conclusion.

Table 1. Yield and yield attributes of Triticale as affected by different entries at Banerpota Farm, Satkhira during rabi season 2006-07 (D.S. 28-12-06)

Entry	Days to maturity	Plant height (cm)	Spike/ m^2 (no.)	Spike length (cm)	Grain/ spike (no.)	1000-grain weight (gm.)	Green fodder yield (t/ha.)	Grain yield (t/ha.)	Straw yield (t/ha.)
E1.	94	66.50	260.0	8.00	29.50	31.01	3.46	1.12	2.25
E2.	99	62.50	308.5	7.50	27.50	31.12	4.50	1.37	2.00
E3.	100	69.50	271.5	7.50	26.50	28.30	4.75	1.12	2.25
E4.	100	74.00	286.5	7.50	24.00	31.21	4.70	0.97	2.00
E5.	99	73.00	243.5	9.00	25.50	27.44	5.80	0.74	2.00
E6.	99	67.00	341.0	9.00	30.50	30.29	5.62	2.00	2.00
E7.	93	62.00	245.5	7.50	21.50	38.27	6.94	0.87	1.75
E8.	94	68.50	252.5	9.00	24.50	29.77	6.37	0.87	2.25
E9.	98	69.50	261.0	9.00	31.50	32.52	5.05	1.24	2.00
E10.	93	64.50	329.0	7.50	26.50	31.85	5.00	1.09	2.50
E11.	95	70.00	336.0	8.50	25.50	30.96	2.87	1.49	1.75
E12.	100	80.00	278.5	7.00	28.00	31.75	4.55	0.87	2.50
E13.	100	66.00	272.0	8.00	22.50	31.31	3.37	1.12	2.25
E14.	101	73.00	373.0	9.00	28.00	30.91	4.45	2.00	3.50
E15.	101	68.50	262.5	9.00	27.00	30.62	2.82	0.87	2.50
$LSD_{(0.05)}$	--	11.37	94.28	2.15	35.13	7.65	0.45	0.29	0.49
CV (%)	--	7.74	15.36	12.28	15.28	11.53	4.54	11.74	10.20

*Fodder yield data was recorded at 45 DAS

Table 2. Yield and yield attributes of Triticale as affected by different entries at FSRD site, Hajirhat, Noakhali during rabi season 2006-2007 (D.S. 4-12-06)

Entry	Days to maturity	Plant height(cm.)	Spike/m^2 (no.)	Grains/ spike (no.)	1000-grain weight (gm.)	Green* grass yield (t/ha.)	Grain yield (t/ha.)
E1	108	106.91a	120.0e	39.5b	35.5bcd	4.89e	1.21c
E2	113	87.41c	139.5cde	32.3cd	31.10efg	7.04cd	1.21c
E3	114	93.02b	162.0cd	38.6b	34.05bcd	6.72d	1.55bc
E4	114	92.33b	171.0bcd	31.2cd	35.00bcd	6.48d	1.59bc
E5	113	96.13b	218.5a	46.3a	33.10cde	7.87b	2.48a
E6	112	80.45d	202.0ab	35.2bc	35.95b	8.32b	1.91b
E7	112	70.50e	161.5cd	35.9bc	30.10g	6.79d	1.41c
E8	113	81.22d	141.0cde	36.1bc	30.50cd	7.95b	1.21c
E9	114	95.84b	137.5cde	30.8cd	31.00efg	6.94cd	1.35c
E10	113	94.15b	131.5de	32.4cd	33.50cd	7.92b	1.28c
E11	114	86.05c	225.5a	39.0b	35.00bc	9.88a	2.34a
E12	114	85.14cd	155.5cde	28.8bcd	41.50a	7.63bc	1.51c
E13	112	80.61d	161.0cde	33.3bcd	32.50def	6.95cd	1.29c
E14	113	96.98b	156.0cde	39.4b	34.50bcd	8.01b	1.50c
E15	112	81.36d	175.0bc	31.5cd	29.50g	9.23a	1.27c
S. level	-	5 %	5%	5%	5%	5%	5%
CV(%)	-	2.3	10.4	7.3	2.9	4.2	10.7

*Fodder yield data was recorded at 42 DAS

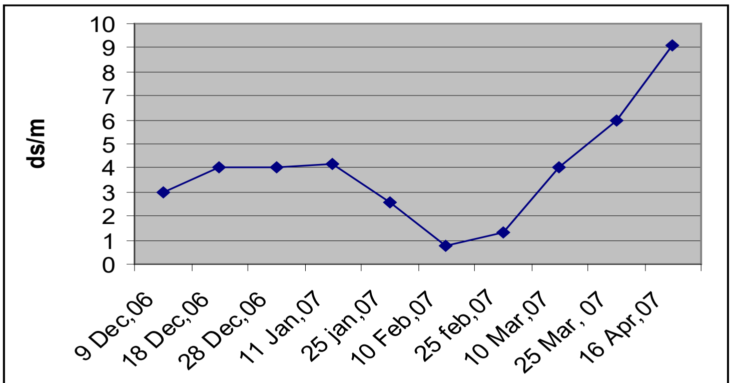

Fig 1. Soil salinity lavel over time, Banerpota, satkhira, 2006-07

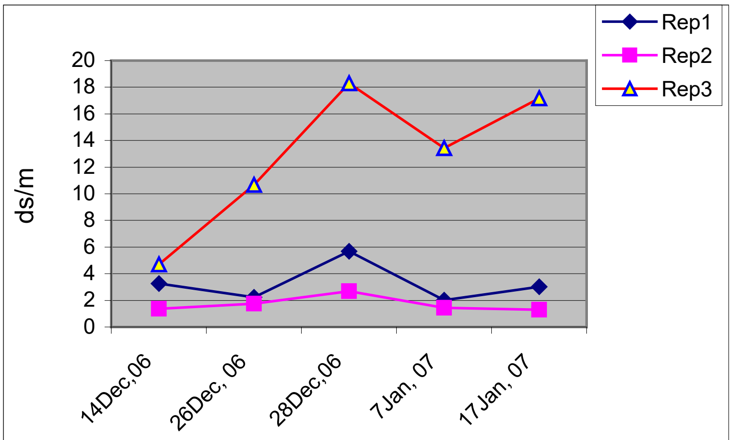

Fig 2. Soil salinity level in differnt replications of triticale field in Noakhali, 2006-07(Rep 3 plant mostly died due to high salinity)

On-Farm Adaptive Trial of Improved Varieties of Sweet Potato

Abstract

On-farm performance of sweet potato varieties viz. BARI SP-4, BARI SP-5, BARI SP-6, BARI SP-7 were evaluated against the farmers' local variety at Kishoreganj, Jhenaidah, Bogra, Jamalpur, Cox's bazar and Patuakhali during rabi 2006-07. The highest tuber yield was obtained from BARI SP-7 followed by BARI SP-4.

Introduction

Sweet potato, a carbohydrate rich root crop can be used as a substitute of cereals in Bangladesh to meet up the food shortage. Generally, poor people are the consumers of sweet potato. It is the main source of carbohydrate and carotene for their survival. Generally, farmers cultivate local variety of sweet potato which are low yielder and contain less carotene. Bangladesh Agricultural Research Institute (BARI) has developed four sweet potato varieties viz. BARI sweet potato-4, BARI sweet potato-5, BARI sweet potato-6 and BARI sweet potato-7 which has high yield potentiality and contain higher amount of carotene. These varieties need to be evaluated at farmers level. Keeping this view, the experiment was undertaken to evaluate their performance of recently developed sweet potato varieties by BARI compared to local variety.

Materials and Methods

The experiment was conducted at Kishoregonj, Bogra, Jamalpur, Cox's bazar and Patuakhali during rabi 2006-07. Four varieties viz. BARI SP-4, BARI SP-5, BARI SP-6 and BARI SP-7 were evaluated against the farmers' local variety in the farmers' field. The experiment was laid out in randomized complete block design with four replications. The unit plot size was 6m ×6 m. The vine was planted at the spacing 40 × 30 cm. The crop was fertilized with 70-16-75 kg/ha of NPK respectively. Half of urea and all others fertilizer were used at final land preparation. Remaining half of N fertilizer was top dressed in two equal splits at 15 and 30 DAT. The vines were planted during 16 November to 6 December 2006. One weeding and earthing up was done after 25 DAT. There was no remarkable disease and pest attack. The crop was harvested variety wise during 29 March to 21 April 2007. The data of yield components were collected from 10 plants selected at random in each plot and tuber yield was recorded plotwise. The collected data were analyzed statistically and means were separated by DMRT.

Result and Discussion

Hossainpur, Kishoreganj

The result showed that vine length/plant, weight of tuber/plant and tuber yields was significantly different in sweet potato varieties. The higher vine length/plant was recorded from variety BARI SP-6 that was statistically at par BARI SP-7. Local variety produced statistically shorter vine length. BARI SP-6 and BARI SP-4 recorded higher tuber wt./plant from variety BARI SP-7 followed. Higher tuber yield (32.43 t/ha) was obtained from BARI SP-7 followed by BARI SP-6 and BARI SP-4. BARI SP-7 gave the higher tuber yield due to higher number of tubers/plant and higher tuber weight/plant. Correspondently, the farmers' variety gave the lowest tuber yield (17.14 t/ha) due to lower number of tuber/plant and tuber weight/plant. The highest gross return (Tk.129720/ha) and benefit cost ratio (4.85) was calculated from BARI SP-7 which was much higher than any other variety in the trial. The local variety gave the lowest gross return due to lower yield than BARI developed varieties.

Kaliganj, Jhenaidah

The highest yield (45.50 t/ha) was obtained from BARI SP-4 followed by BARI SP-7, BARI SP-5 and BARI SP-6. The lowest yield (12.66 t/ha) was obtained from local. Highest yield was achieved due to higher number of tubers/plant and weight of tubers/plant.

Gabtali, Bogra

Vine length, tuber/plant, weight of vine and tuber yield were significantly influenced by variety. Significantly the highest length of vine (155cm) was recorded from BARI SP-5 and this was identical with BARI SP-7 (146 cm). The highest number of tuber per plant (4.45) was recorded with BARI SP-7 and that was statistically identical to BARI SP-4 (4.35) and BARI SP-6 (4.15). Significantly the highest tuber yield (37.00 t/ha) was recorded from BARI SP-7 that was statistically identical with BARI SP-4 (33.74 t/ha). Average of two years result, the highest gross return (Tk. 266230/ha) and benefit cost ratio (5.84) were obtained from BARI SP-7 among the other three improved varieties. All the newly developed improved varieties gave the statistical higher tuber yield than the local varieties. The lowest gross return (Tk. 176113/ha) and benefit cost ratio (3.87) were obtained from local variety.

Melandah, Jamalpur

All the yield contributing character viz. branches/plant, tuber/plant, tuber weight/plant, tuber breadth and root yield were influenced due to treatment variation. The results showed that BARI varieties were better than local variety. The highest root yield was obtain from BARI SP-7 (28.99 t/ha) and it was statistically similar to BARI SP-5 and BARI SP-6. Local variety gave the lowest tuber yield (7.20 t/ha). The highest benefit cost ratio was obtained from BARI SP-7 while the lowest BCR was from local variety.

Cox's bazaar

Higher length of vine (176 cm) was recorded from BARI SP-5 which was identical wih BARI SP-7 (166 cm). Higher number of tuber/plant was recorded from BARI SP-7 but it was at par to other variety. The highest tuber weight/plant was found from BARI SP-7 (448 g) which was statistically similar with BARI SP-6 (418) and BARI SP-4. Higher turber yield (29. 13 t/ha) was showed by BARI SP-7 which was statically similar to BARI SP-6 (26.12 t/ha). The lowest tuber yield was recorded in local variety (17.14 t/ha) which was statistically different from other BARI varieties.

Patuakhali

The maximum no. of tubers/plant was in BARI SP-7 followed by BARI SP-1. The former variety also showed higher weight of tuber and the lowest from BARI SP-5 but the highest tuber weight/plant was recorded from BARI SP-1 followed by BARI SP-7. Maximum tuber yield was obtained from variety BARI SP-1 followed by BARI SP-7.

Farmers' reaction

Kishoreganj: BARI varieties are more profitable than local variety due to higher yield. But local variety had better keeping quality than the BARI released varieties when preserved under normal condition. Among BARI developed varieties they like to prefer BARI sweet potato-7 due to its higher yield. Farmer's also opined that there was no incidence of insect and diseases in the new varieties.

Jhenaidah: BARI sweet potato varieties are less tasty and cheaper than local variety. So farmers are not interested to grow these varieties.

Bogra: Higher yield and sweetness of improved varieties encouraged the farmers. But the lower market price of the improved varieties disappointed the farmers. BARI SP-7 is better in yield performance among the improved tested varieties but approximately 10% of BARI SP-7 are creaking of skin at maturity stage.

Jamalpur: BARI SP-6 was accepted by the farmer because of white colour like the local, higher yielder and was not soft after boiling. The local variety had better storage quality. The BARI varieties may harvest a few days earlier than the local varieties. But it is very difficult to keep the crop in the field at the mature stage because of sweetness. It had lower market prize than the local.

Patuakhali: BARI SP-5 does not taste sweet like local and Doulatpuri and BARI varieties can not be stored as long as local variety.

Table 1. Yield, yield component and cost and return analysis of sweet potato varieties at Hossainpur, Kishoreganj during rabi 2006-07

Variety	Vine length/ Plant (cm)	Tuber/plant (no.)	Tuber wt./ plant (g)	Tuber yield (t/ha)	Gross return (Tkha^{-1})	Total production cost (Tkha^{-1})	Gross margin (Tkha^{-1})	BCR
BARI SP-4	122c	5.26	423	23.97	95880	26720	69160	3.59
BARI SP-5	159b	5.14	395	24.23	95920	26720	69200	3.59
BARI SP-6	198a	5.42	458	28.22	112880	26720	86160	4.22
BARI SP-7	178a	5.61	488	32.43	129720	26720	103000	4.85
Local	102c	5.10	243	19.10	95500	26720	68780	3.57
LSD (0.05)	11.27	NS	67.68	0.34				
CV (%)	12.27	10.65	14.26	7.32				

Figures in a column having similar letter (s) do/does not differ significantly at 5% level of significance.
Price (Tk./kg): Urea-6, TSP-19, MP-16 Sweet potato (local)-5, Sweet potato (BARI variety)-4,

Table 2. Performance of sweet potato tested at MLT site, Kaligonj, Jhenaidah during 2006-07

Variety	Tubers/plant (no.)	Wt. of Tuber/ plant (g)	Tuber yield (t/ha)
BARI SP-4	7.00	910.00	45.50
BARI SP-5	4.33	520.00	25.90
BARI SP-6	6.33	370.66	18.53
BARI SP-7	4.66	760.00	38.00
Local	5.00	446.66	12.66

Table 3.Yield and yield attributes of different sweet potato varieties developed by BARI at MLT site Gabtali,Bogra during 2006-07.

Tests/ Variety	Length of vine (cm)	No. of tuber/plant (no.)	Wt.of Vine/plant (kg)	Wt.of tuber/plant (kg)	Yield (t/ha) 2006-07		Yield (t/ha) 2005-06	
					Vine	Tuber	Vine	Tuber
BARI SP-4	134	4.35	0.60	0.22	60.90	33.74	60.29	34.46
BARI SP-5	155	3.35	0.63	0.20	64.43	29.71	62.21	33.21
BARI SP-6	139	4.15	0.66	0.23	62.00	30.52	61.91	33.68
BARI SP-7	146	4.45	0.70	0.25	62.17	37.00	62.29	34.53
Local	105	3.25	0.55	0.14	55.47	22.16	53.11	24.29
LSD (0.05)	12.35	0.10	0.75	0.75	1.73	6.35	1.75	6.65
CV (%)	4.21	4.7	6.7	3.5	1.31	9.62	5.30	8.50

Table 4. Agro-economic performance on the of different sweet potato varieties developed by BARI at MLT site Gabtali,Bogra during 2005-06 to 2006-07.

Tests/ Variety	Yield (t/ha)				Mean yield (t/ha)		GR	TVC	BCR
	2005-06		2006-07						
	Vine	Tuber	Vine	Tuber	Vine	Tuber			
BARI SP-4	60.29	34.46	60.90	33.74	60.60	34.10	253850	45550	5.57
BARI SP-5	62.21	33.21	64.43	29.71	62.11	31.46	235748	45550	5.18
BARI SP-6	61.91	33.68	62.00	30.52	62.04	32.10	240210	45550	5.27
BARI SP-7	62.29	34.53	62.17	37.00	63.36	35.77	266230	45550	5.84
Local	53.11	24.29	55.47	22.16	54.29	23.22	176113	45550	3.87

Price: Local @ Tk. 8/kg, HYV @ Tk. 7/kg, Vine @ Tk. 0.25/kg

Table 5. Effect of different varieties on yield and yield components of sweet potato at MLT site, Melandah, Jamalpur during rabi 2006-07

Variety	Branches/ plant (no.)	Leaves/ plant (no.)	Tuber/ plant (no.)	Tuber wt /plant (kg)	Tuber length (cm)	Tuber breath (cm)	Tuber yield (t/ha)
BARI SP-4	15.73 b	194.87	3.9 a	336.24 b	10.43	4.18 a	22.48 b
BARI SP-5	14.33 b	189.73	3.9 a	322.52 b	11.01	4.38 a	25.79 a
BARI SP-6	15.47 b	178.73	3.8 a	283.73 c	10.28	4.23 a	24.75 a
BARI SP-7	20.00 a	164.07	4.2 a	414.17 a	9.67	4.07 a	28.99 a
Local	17.20 a	140.07	2.5 b	194.25 d	10.49	2.65 b	7.20 c
F	**	NS	*	*	NS	**	**
CV (%)	8.16	11.60	10.16	12.50	10.13	11.45	7.95

Figure in a column having similar letters do not differ significantly

Table 6. Economic performance of sweet potato varieties developed by BARI at MLT Site, Malancha, Melandah, Jamalpur during 2006-07

Variety	GR (Tk/ha)	TVC (Tk/ha)	GM (Tk/ha)	BCR
BARI SP 4	78680	9635	69045	8.17
BARI SP 5	90265	9635	80630	9.37
BARI SP 6	86625	9635	76990	8.99
BARI SP 7	101465	9635	91830	10.53
Local	25200	9635	15565	4.04

Price Tk/kg): All BARI Product: Tk. 3.50, Inputs: Urea = 6.00, TSP = 15.00, MP = 14.00 and Cowdung = 0.50

Table 7. Yield and yield contributing characters of sweet potato varieties at Cox's bazaar during 2006-07

Variety	Vine length/plant (m)	No. of tuber/plant	Tuber weight/plant (g)	Tuber yield (t/ha)
BARI SP-4	110c	5.26	413a	23.71ab
BARI SP-5	147b	5.14	385b	22.43b
BARI SP-6	176a	5.42	418a	26.12a
BARI SP-7	166a	5.61	448a	29.13a
Local	92	5.10	203c	17.14c
F	*	NS		
CV (%)	10.17	11.62	15.21	6.52

Table 8. Yield and yield contributing characters of sweet potato varieties, Patuakhali, 2006-07

Variety	No. of tuber/plant	Weight/tuber (g)	Tuber wt./plant (g)	Tuber yield (t/ha)
BARI SP-1	4.4	151	550	27.70 a
BARI SP-3	4.2	114	415	19.14 bc
BARI SP-5	4.7	96	430	21.60 b
BARI SP-6	3.8	152	348	16.64 c
BARI SP-7	4.8	171	530	25.93 a
Local	3.7	134	355	16 .23 c
CV (%)				8.64

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

Appendix 1. Yield (t/ha) of Sweet potato under different locations during 2006-07

Variety	Kishoreganj	Jhenaidah	Bogra	Jamalpur	Cox's bazar	Patuakhali	Mean
BARI SP-1	-	-	-	-	-	27.70	27.70
BARI SP-3	-	-	-	-	-	19.14	19.14
BARI SP-4	23.97	45.50	33.74	22.48	23.71	-	29.88
BARI SP-5	24.23	25.90	29.71	25.79	22.43	16.64	24.12
BARI SP-6	28.22	18.53	30.52	24.75	26.12	25.93	25.68
BARI SP-7	32.43	38.00	37.00	28.99	29.13	16 .23	30.3
Local	19.10	12.66	22.16	7.20	17.14	16.23	15.75

Screening of Germplasm/Varieties of Sweet Potato against Salinity

Abstract

The experiment for screening of the salt tolerant sweet potato was conducted in the farmer's field of FSRD site, Hazirhat, Noakhali under rainfed condition during the rabi 2006-07. The highest root weight/plant and individual tuber weight was found in SP-368 but the highest tuber length from SP-310 (17.2 cm). The highest root girth was showed by SP-550 (17.83 cm). The highest vine survival percent was found in SP-166, SP-498, SP-213, BARI SP-6, BARI SP-7 and in Local.

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. It is the main source of carbohydrate and carotene for their survival. Sweet potato grows well in char area of Noakhali district. 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 also contain high amount of carotene. These varieties/ germplasms needed to be an on-farm adaptive trial to evaluate their performance and to identify the suitable variety/ germplasm for saline area of Noakhali and also to get the feed back from the farmers. Keeping these views in mind the experiment was under taken to evaluate their performance and adaptability against salinity.

Materials and Methods

The experiment was conducted at FSRD site, Hazirhat, Noakhali under rainfed condition during the Rabi season of 2006-07 in the farmer's field. The experiment was laid out in single line and each line containing six vines. There were thirty-five lines, three seven varieties of BARI developed sweet potato and a local variety. Vines were planted in line with 60 cm × 30 cm spacing in the 3rd week of December 2006. Two weeding were done during the crop growth period. Harvesting was done in the last week of April 2006.

Results and Discussion

Important characteristics performed by sweet potato varieties/lines are presented in Table 1. The highest number of root per plant (6.8) was found in both BARI sweet potato-6 and BARI sweet potato-7 followed by Local variety (5.8) while the lowest number of root per plant was recorded in SP-278 (1.0) followed by SP-550, SP-102, SP-181 (1.5) 0f each of them. The highest root weight per plant was found in SP-368 (233.3 gm). The highest root length was showed by SP-310 (17.2 cm). The highest root girth was showed by SP 550(17.83 cm). The highest vine survival percent was found in SP- 166, SP -498, SP -213, BARI -SP 6, BARI SP-7 and in Local.

During the period of experiment the salinity range was 2.55 to 8.56 dS/m where the germplasms could survive from planting to harvesting time. In some lines of the field the salinity went up to 10 to 19 ds/m where the other lines could not survive.

Conclusion and Recommendation

In the field, salinity varied from plot to plot, also within few centimetres. As the experiment was not replicated, so it is very difficult to draw any rigid conclusion. However, the experiment should be repeated for the second year with 6 dispersed replications with selected lines.

Table 1. Yield contributing characteristics and other attributes of some Sweet potato germplasms

Name of germplasm	Root/ plant (no)	Root weight/ plant (g)	Individual root weight (g)	Root length (cm)	Root girth (cm)	Root colour	Survived vine (no.)	Plant survival (%)
SP 330	3.0	281.2	93.7	8.33	12.83	White	4	66.67
SP 166	2.0	425.0	212.5	10.7	12.0	Pink	6	100
SP 509	2.0	135.0	67.5	9.0	13.5	Brown	1	16.67
SP 498	4.4	345.0	78.4	15.83	14.57	Brown	6	100
SP 213	2.8	515.0	183.0	10.0	17.33	Brown	6	100
SP 457	2.0	260.0	130.0	9.75	10.80	Cream	2	33.33
SP 443	5.0	476.6	95.2	12.4	11.60	White	3	50.00
SP 367	3.3	300.0	90.9	14.8	16.4	off white	5	83.33
SP 229	1.8	97.5	57.2	8.33	7.67	White	5	83.33
SP 278	1.0	85.0	85.0	8.0	10.0	White	1	16.67
SP 271	5.0	298.0	59.6	7.0	12.6	Cream	5	83.33
SP 447	2.0	100.0	50.0	7.0	11.75	Cream	1	16.67
SP 522	3.0	237.5	79.2	9.5	12.5	Red	2	33.33
SP 368	3.0	700.0	233.3	10.0	20.0	Red	1	16.67
SP 400	3.0	240.0	80.0	8.67	12.5	deep red	3	50.00
SP 550	1.5	215.0	143.3	8.67	17.83	Red	2	33.33
SP 102	1.5	77.5	50.0	8.0	14.0	White	2	33.33
BARI SP 3	2.5	265.0	106.0	7.8	13.2	Red	2	33.33
BARI SP 6	6.8	458.0	67.4	9.67	15.16	Cream	6	100
BARI SP 7	6.8	320.0	47.1	10.3	13.16	deep red	6	100
SP 360	2.3	310.0	134.7	10.3	13.71	Red	3	50
SP 264	3.4	385.0	113.2	11.14	15.28	Red	5	83.33
SP 329	2.6	193.0	74.2	11.00	13.57	Red	5	83.33
SP 243	3.0	285.0	95.0	8.30	14.0	Cream	1	16.67
SP 310	2.5	255.0	102.0	17.2	12.0	White	2	33.33
SP 305	3.0	325.0	108.2	11.33	15.66	Cream	1	16.67
SP 560	2.5	290.0	116.0	8.20	16.0	Red	3	50
SP 535	2.5	152.0	60.8	9.40	14.4	Red	2	33.33
SP 491	3.0	205.0	68.3	9.16	13.83	White	2	33.33
SP 110	2.5	195.0	78.0	9.00	15.30	Cream	2	33.33
SP 181	1.5	95.0	63.3	7.67	16.0	Red	2	33.33
SP 542	4.0	245.0	61.5	10.0	15.7	off white	1	16.67
SP 562	3.0	316.0	105.3	9.16	9.67	Red	3	50.0
Local	5.8	377.0	65.0	9.7	8.3	Red	6	100.0

Screening of Sweet Potato Germplasm in Coastal Area

Abstract

Vines of 73 germplasm of sweet potato supplied by Tuber crop Research Centre, BARI, Gazipur was planted at MLT site, Kuakata, Patuakhali during rabi, 2006-07 to find out salt tolerant germplasm. Seven germplasm yielded >20 t/ha, 23 germplasm yielded 15-20 t/ha, 29 germplasm yielded 10-15 t/ha and 14 germplasms yielded < 10 t/ha. However, salinity level was low (2 dS/m).

Materials and Methods

Vines of 73 germplasm of sweet potato supplied by Tuber crop Research Centre, BARI, Gazipur were planted at MLT site, Kuakata, Patuakhali during rabi, 2006-07. Six cutting of each genotype was supplied and planted in a row maintaining 60 cm × 30 cm spacing. 150-125-180 kg/ha Urea-TSP-MP was applied as basal dose. The crop was cultivated under rainfed condition. Cuttings were planted on 23.12.06 and were harvested on 23.04.07.

Results and Discussion

Tuber yield obtained from the germplasm is shown in Table 1. Yield was converted into t/ha on the basis of single plant yield. Grading was done on the basis tuber yield: a >20 t/ha, b = 15 – 20 t/ha, c = 10 – 15 t/ha, d < 10 t/ha. 7 germplasm yielded >20 t/ha, 23 germplasm yielded 15-20 t/ha, 29 germplasm yielded 10-15 t/ha and 14 germplasm yielded < 10 t/ha.

Table 1. Tuber yield of different germplasms of sweet potato at MLT site, Kuakata in rabi 2006-07

Entry #	Yield (t/ha)	Entry #	Yield (t/ha)	Entry #	Yield (t/ha)
1. SP-1	26.32a	2. 316	14.81c	3. 452	8.33d
4. SP-4	22.15a	5. 320	18.05b	6. 453	12.96c
7. SP-5	19.58b	8. 330	10.42c	9. 456	9.25d
10. SP-6	20.84a	11. 335	12.99c	12. 457	15.74b
13. SP-7	29.04a	14. 340	25.00a	15. 491	9.27d
16. 102	11.11c	17. 357	15.27b	18. 493	13.01c
19. 110	16.67b	20. 360	13.33c	21. 494	8.33d
22. 166	16.67b	23. 367	12.96c	24. 498	18.89b
25. 172	13.89c	26. 369	6.48d	27. 499	11.80c
28. 181	11.11c	29. 370	13.88c	30. 500	16.67b
31. 213	9.44d	32. 383	22.22a	33. 501	6.48d
34. 225	10.48c	35. 390	13.19c	36. 502	11.11c
37. 227	12.96c	38. 400	11.11c	39. 509	17.59b
40. 229	18.52b	41. 404	16.67b	42. 511	8.33d
43. 236	16.67b	44. 417	9.02d	45. 514	19.44b
46. 240	15.27b	47. 422	15.55b	48. 521	9.72d
49. 267	16.67b	50. 424	13.88c	51. 529	11.80c
52. 271	11.10c	53. 434	11.15c	54. 532	22.22a
55. 272	18.52b	56. 438	10.41c	57. 535	14.44c
58. 278	10.55c	59. 440	15.52b	60. 542	12.96c
61. 291	7.22d	62. 443	9.72d	63. 550	18.51b
64. 292	18.05b	65. 444	9.02d	66. 559	13.33c
67. 294	17.78b	68. 447	12.96c	69. 560	18.51b
70. 305	12.22c	71. 448	15.97b		
72. 310	10.55c	73. 449	5.55d		

a >20 t/ha, b = 15–20 t/ha, c = 10–15 t/ha, d < 10 t/ha

Adaptive Trial of Improved BARI Sweet Potato Varieties at Hill Valleys

Abstract

An adaptive trial of sweet potato varieties viz. Kamlasundari, BARI SP-6, BARI SP-7 and Local one (check) was carried out at hill valleys at Chemi dolopara in Bandarban Sadar areas during rabi season 2006-07 with a view to see the yield performance and popularization of these variety. The experiment revealed that the highest tuber yield was recorded from Kamlasundari (35.52 t/ha) followed by BARI SP-6 (28.92 t/ha) while it was lowest from local one (17.85 t/ha). Among the varieties, considering the yield performance, farmer's preferred to Kamlasundari due to higher yield, sweetness and its attractive colour.

Introduction

BARI has recently developed some new variety of sweet potatoes. On-farm trial is essential for valid recommendation throughout the country. In Bandarban district, sweet potato grows well in hill valleys. About 385 acres area covered by sweet potato with average national yield 12.8 ton/ha in Bandarban district (BBS, 1999). Farmers are growing local variety and getting poor yield. It is necessary to identify the suitable variety for this area, an adaptive trial has been undertaken to compare the improve variety with local one and popularization in the farmer's field.

Materials and Methods

An adaptive trial of different varieties of sweet potato was carried out at Chemi dolopara in Bandarban Sadar during 2006-2007.Four varieties i,e. Kamlasundari, BARI SP-6, BARI SP-7 and Local one (check) was carried out at hill valleys at Chemi dolopara in Bandarban Sadar areas during rabi season 2006-2007 with view to yield performance and popularization of these variety. All varieties were planted on 1-3 December 2006 in 7m x 4m plot size maintaining 60cm x 30cm spacing. The design was RCBD with 3 replications. Fertilizers were used at the rate of 74-57-111, N-P-K, respectively. Different intercultural operation i.e. irrigation, weeding, were done as and when necessary. The tuber was harvested on 22-24April, 2007. The yield contributing characters data were recorded from ten randomly selected plants. Yield data was recorded per plot and to convert per hectare yield.

Results and Discussion

Yield and yield components

Number of root/plant, root wt./plant, tuber yield and relevant information are presented in Table 1.The highest root yield was recorded from Kamlasundari due to highest root wt./plant On the other hand the highest number of root/plant was found from local one but root wt./plant was lower resulting lower tuber yield was obtained (Table1).

Cost and return of sweet potato cultivation

Highest gross return was recorded from Kamlasundari followed by BARI SP-6. The lowest gross return was obtained from local one. The highest gross margin and benefit cost ratio was found from Kamlasundari followed by BARI SP-6 and it was lowest for local one(Table 2).

Field observation

No diseases were observed in HYV potato variety;
Rat attack was observed at the pre-matured stage of root.

Farmer reaction

Traditionally farmers prefer local one due to its popularities but they are unknown about BARI variety. But farmers were agreed to grow Kamlasundari due to higher yield, sweetness and its attractive colour.

Conclusion

For getting higher benefit Kamlasunsundari and BARI SP-6 can be grown at farmer's field. But creating local demand and to popularize of BARI variety, motivation work would be fruitful for sustaining these variety at farmers field. Besides these, breeder should give attention to develop another variety which size would be reasonably small but high yielding having good sweetness.

Table 1.Yield performance and related parameter's of sweet potato varieties at hill valleys in Bandarban, 2006-07

Variety	No. of root/plant	Root wt/plant (gm)	Tuber yield (ton/ha)	Time of boiling (min.)	Sweetness	Diseases	Acceptability
Kamlasundari	6.3	1040	35.52	20	high	none	high
BARI SP-6	3.8	757	28.92	22	medium	none	moderate
BARI SP-7	4.9	509	19.25	20	medium	none	high
Local (check)	8.9	571	17.85	30	medium	yes	moderate
LSD (0.05%)	NS	1.00	0.13	-	-	--	-

Table 2. Per hectare cost and return of sweet potato cultivation at hill valleys in Bandarban, 2006-07

Variety	Gross return (Tk./ha)	Cultivation cost (Tk./ha)	Gross margin (Tk./ha)	Benefit cost ratio (BCR)
Kamlasundari	177600	43475	1,34,125	4.08
BARI SP-6	144600	43475	101125	3.32
BARI SP-7	96250	43475	52775	2.21
Local one(check)	89250	43475	45775	2.05

Local market price of sweet potato @Tk.5.00/kg

Adaptive Yield Trial of Improved Varieties of Potato

Abstract

A on-farm trial was carried out at the MLT site, Fatikchari, Chittagong during rabi 2006-07 to find out the suitable potato varieties for higher yield. Five potato varieties were selected for their yield and other agronomic characters. Higher yield (20.22 t/ha) was recorded from the variety BARI TPS-1 followed by Cardinal (19.73 t/ha). The variety provento (15.05 t/ha) produced the lowest tuber yield.

Introduction

Potato (*Solanum tuberosum*) is chiefly used as vegetable in Bangladesh round the year producing annually more than 1.2 million from more than 110 thousand hectare of land (Rashid *et. al.* 1987). The average yield is now 11.4 t/ha. Potato can play a vital role as supplementary to cereals having balanced dietary value. Among the varieties Cardinal (red) is very popular among the farmers. In Bangladesh per hectare production of potato is low as compared to other potato growing countries (Ahmed et. al. 1979). This low yield may be due to the cultivation of low yielding local varieties, poor seed quality, lack of technical know-how, etc. Recently Bangladesh Agricultural research Institute (BARI) has developed some new high yielding varieties of potato. So, the experiment was undertaken to find out the performance of potato varieties developed by BARI in the farmer's fields.

Methods and Materials

The trial was conducted on silt loam soil at Fatikchari MLT site during the rabi season, 2006-07. There were five improved varieties developed by BARI used as experimental materials. Improved varieties were Provento, Asterix, Diamant, Cardinal and BARI TPS-1. The experiment was laid out in RCBD with 4 dispersed replications. The unit plot size was 5 m × 4m with 60 × 25 cm spacing. At the time of final land preparation cowdung @ 10 t/ha was applied. Fertilizers were applied @ 325 kg urea, 220 kg TSP 250 kg MP, 120 kg gypsum per hectare. Half of urea and full dose of TSP, MP, and gypsum were applied and incorporated immediately before planting in the seed furrows and mixed properly with the soil. The rest amount of urea was top dressed at 35 days after planting followed by irrigation. The crop was sprayed with Dithane M-45 @ 0.25 (for late blight) and Dimecron 100 EC @ 0.1% (for aphid) at an interval of 12-15 days. Other intercultural were done when and as necessary. The crops were planted on 8.12.06 and harvested on 12.5.07. Data on yield and yield contributing characters were collected and analyzed statistically.

Results and Discussion

The yield and yield contributing characters of the different potato varieties differed significantly (Table1). The tallest plant height (65.76 cm) was produced by the variety BARI TPS-1 which was statistically similar with the variety Asterix (63.36 cm). The lowest plant height (53.24 cm) was produced by the variety Diamant. Maximum number of tuber/plant (10.8) was produced by the BARI TPS-1 which was followed by the variety Asterix (10.2) and Provento (9.8). Maximuym tuber yield (20.27 t/ha) was found from the variety BARI TPS-1 which was statistically identical with the variety cardinal (19.73 t/ha). The lowest tuber yield was observed from the variety Provento (15.05 t/ha).

Farmers reaction

The cooperator farmer and neighboring farmers are opined that the variety BARI TPS-1 is better due to its size and shape, higher yield and no scabe diseases.

Conclusion

The BARI TPS-1 showed maximum tuber yield followed by Cardinal in the area. The experiment needs to be repeated another year for confirmation.

Table 1. Yield and yield contributing character of potato as affected by different varieties at Fatikchari, Chittagong during 2006

Treatment	Plant height (cm)	No. of shoot/plant	No. of tuber/plant	Tuber yield (t/ha)
Asterix	63.36 a	3.1	10.2 a	16.22 bc
Provento	60.54 b	3.0	9.8 ab	15.05 c
Diamant	53.24 c	2.8	7.9 c	18.54 b
Cardinal	58.49 bc	2.9	8.7 b	19.73 ab
BARI TPS-1	65.76 a	3.2	10.8 a	20.27 a
F-test	*	NS	**	*
CV (%)	8.64	3.54	7.58	9.87

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Screening of Potato Varieties for Saline Areas

Abstract

The experiment was conducted in the farmer's at MLT site, Cox's Bazar, Banerpota farm and Hazirhat, Noakhali during the rabi season of 2006-07 to find out the suitable saline tolerant variety(s) for Cox's Bazar region. Fifteen different varieties/lines (viz. Asterix, Partroaes, Dura, Bintje, V56 Jaerla, Cardinal, Baraka, Provento, Spirit, Laura, Akira, BARI TPS-1 and Diamant) were used in this trial. There was a significant difference among the varieties. The highest tuber yield (19.85 t/h) was obtained from variety Diamant and it was statistically identical with variety Cardinal (19.75 t/ha) at Cox's bazar. But higher yield from Provento and Spirit at Benarpota farm whereass V56, Diamant and Dura at Hazirhat, Noakhali.

Introduction

Potato (*Solanum tuberosum L.*), a carbohydrate rich root crop, is one of the most important vegetables as well as cash crop in Bangladesh. It is grown very limited in the saline area due to upward movement of salinity and insufficient soil moisture in topsoil during rabi season. Out of 2.83 million hectares in the 13 districts of Bangladesh, about 0.84 million ha are affected by varying degrees of soil salinity (Karim & Iqbal, 2001). The vast saline area of the country remains fellow mostly during the rabi season. Through the development of saline tolerant potato varieties, that area may be taken under potato cultivation. TCRC have developed some saline tolerant lines. These lines need to verify in the farmer's field to select suitable varieties for the area. Hence, the study was undertaken to find out the suitable varieties or lines for the saline area of Cox's Bazar region, Banerpota, Satkhira and FSRD site, Hazirhat, Noakhali.

Materials and methods

The experiment was conducted at the farmer's field of OFRD Cox's Bazar, Banerpota farm and Hazirhat, Noakhali during the rabi season of 2006-07. Fifteen different varieties/lines viz. Asterix, Partroaes, Dura, Bintje, V56, Jaerla, Cardinal, Baraka, Provento, Spirit, Laura, Akira, BARI TPS-1 and Diamant were used as experimental material. The experiment was RCB design with 3 replications. Unit plot size was 3 m × 1.8 m. Nutrient doses of 100-24-100 kg/ha of NPK respectively was applied in the form of urea, TSP and MP. All fertilizers were applied as basal dose during the final land preparation. The whole potato tubers were planted at 27.11.06 with 60 cm × 25 cm spacing and harvesting was done 13 February at Cox's bazar. But, 8 & 19 December 2006 was sowing at Banerpota and Hazirhat, whereas potato harvested on 22 February at Hazirhat. All the data were recorded at the time of harvest and were statistically analyzed and the means were separated with DMRT test.

Results and Discussion

MLT site, Cox's bazar

The yield and yield contributing character were affected significantly on potato varieties but not number of shoot/plant (Table 1). Maximum plant height was recorded from the treatment Asterix (53.34 cm) which was statistically identical to BARI TPS-1 Larua and Bintje. The lowest was found from the treatment Provento (38.16 cm). Higher number of tuber/plant was recorded from the variety Diamant (11.6) and it was statistically similar with the variety BARI TPS-1 (11.4), V56 (11.2) and Cardinal (10.2). The lowest number of tuber/plant was found from the variety Dura (6.1). Higher tuber yield was found from the variety Diamant (19.85 t/ha) and it was statistically similar with the variety Cardinal (19.75 t/ha). The variety Baraka was produced lowest tuber yield (10.49 t/ha).

Banerpota farm, Satkhira

The maturity days were same for all the varieties and germplasm. The plants/m^2 was higher in Spirit followed by Laura. The highest plant height was observed in variety Akira and shortest from Patrones. The variety Cardinal showed higher number of stem/hill which was closely followed by Akira. The tuber/hill showed similar in Akira, V-56, Diamant and Patrones but higher than other variety/genotypes. Maximum potato yield was recorded from variety Spirit followed by Provento (Table 2).

Hazirhat, Noakhali

The higher plant height was recorded in V-56 (39.80 cm), which was followed by Asterix (33.03 cm). The lower plant height was found in cardinal (20.53 cm). The higher number of stem (3.03) was found in the variety Dura. Higher number of tuber per plant (5.20) was in variety Diamant, which was followed by Dura (4.80). The higher yield was found in variety V-56 (18.30 t/ha), which was followed by dura (16.60 t/ha) and Diamant (16.20 t/ha). The lower yield was found in Provento (8.10 t/ha) followed by Akira (8.50 t/ha).

BARI TPS-1 needed the higher days i.e. 15 days where Jaerla followed by 14 days. Cardinal, Diamant and Baraka needed the lower days (11) for 80% emergence. Diamant and V-56 showed the maximum foliage coverage (75%) at 60 DAS and Asterix showed the lower foliage coverage i.e. 50% at the same DAS.

Farmer's reaction

Hazirhat: Diamant is the most acceptable variety among the farmers. They also preferred V-56, Dura, Bintje and Patrones for higher yield.

Conclusion

From one year result it showed that the variety Diamant/cardinal may be suitable for Cox's bazaar, Spirit and Provento for Satkhira and V56 & Diamant for Hazirhat, Noakhali. The experiment should be continued another year for confirmation.

Table 1. Yield and yield attributes of potato varieties at Cox's Bazar during rabi 2006-07

Treatment	Plant height (cm)	No. of shoot/plant	No. of tuber/plant	Tuber yield (tha)
Asterix	53.34 a	2.7	9.8 b	12.50 d
larua	45.28 ab	2.6	9.3 b	11.72 de
Dura	43.18 b	2.8	6.1 d	11.73 de
Spirit	41.28 bc	2.3	8.2 bc	14.82 c
Partrones	40.64 c	2.6	11.4 a	17.22 b
Akira	43.64 b	2.3	7.4 c	14.20 cd
BARI TPS-1	50.48 a	2.7	11.4 a	16.91 b
Bintje	45.72 ab	2.4	8.5 bc	15.74 bc
V56	40.64 c	2.3	11.2 a	11.11 e
Jaerla	42.67 bc	2.6	7.8 c	14.50 cd
Baraka	43.67 b	2.4	7.6 c	10.49 f
Provento	38.16 d	2.9	9.7 b	16.97 b
Cardinal	42.16 b	2.5	10.2 ab	19.75 a
Diamant	43.18 b	3.0	11.6 a	19.85 a
F-test	*	NS	*	**
CV (%)	8.67	4.64	12.54	7.54

Table 2. Performance of Potato germplasm/varieties tasted at Banerpota farm, Satkhira during rab season-2006-07

Germplasm /variety	Day's to maturity	Plant population/m^2	Plant height (cm.)	Stem/hill (no.)	Tuber/hill (no.)	Yield (t/ha.)
Akira	89	5.55	44.33	8.13	4.67	9.33
Dura	89	5.68	27.67	4.57	4.00	9.83
Asterix	89	5.37	36.33	5.43	4.33	12.10
V56	89	5.06	34.67	6.77	4.67	12.67
Provento	89	5.06	34.67	6.57	4.00	13.70
Laura	89	6.11	32.67	5.53	3.67	8.30
Esprit	89	6.41	32.33	5.87	4.00	14.10
BARI TPS-1	89	5.24	27.00	6.20	3.67	6.13
Cardinal	89	5.61	24.67	8.47	3.67	10.47
Bintje	89	5.86	32.00	6.06	4.66	8.67
Jaerly	89	4.99	37.33	4.00	3.67	10.43
Diamant	89	5.03	31.33	7.20	4.67	11.43
Patrones	89	5.61	17.00	6.53	4.67	8.30
Baraka	89	5.24	33.33	6.47	4.00	5.13
LSD (0.05)	--	0.77	2.63	0.83	0.77	0.62
CV (%)	--	8.38	4.95	7.81	11.01	3.69

Table 3. Yield and yield attributes of different potato varieties/germplasms at Hazirhat, Noakhali during 2006-07

Name of the variety/ line	Days to 80% Emergence	Foliage coverage (at 60 DAS)	Plant height (cm)	Stem plant^{-1} (no.)	Tuber plant^{-1} (no.)	Tuber yield (t ha^{-1})
Asterix	12	50%	33.03	2.70	4.20	8.40
Cardinal	11	55%	20.53	2.20	3.50	9.60
Provento	12	60%	21.63	2.60	4.50	8.10
Bintje	13	65%	30.57	2.80	3.90	12.00
Diamant	11	75%	27.47	2.80	5.20	16.20
V56	13	75%	39.80	3.00	4.70	18.30
BARI TPS -1	15	65%	26.50	2.80	4.30	10.00
Jaerla	14	65%	30.50	2.10	3.73	9.00
Akira	13	70%	30.50	2.70	3.50	8.50
Patrones	12	70%	30.03	2.90	4.10	12.50
Baraka	11	60%	31.23	2.60	3.80	10.40
Dura	12	60%	32.80	3.03	4.80	16.60
LSD (0.05)			4.41	0.59	0.66	1.13
CV (%)			8.82	12.98	9.43	5.79

Adaptive Trial with Released Potato Varieties and Seedling Tuber Progenies

Abstract

The experiment was conducted at FSRD site, Razakhali and MLT Site, Kuakata, Patuakhali during rabi season of 2006-07. Four varieties/lines were planted to evaluate their performance in coastal area. Diamont, Provento and Asterix gave statistically identical and higher yield thna BARI TPS-1.

Introduction

Southern region of Bangladesh is mainly rice based. Cultivation of vegetables is very low here. It is a vegetable deficit area. Potato is a promising crop for this area. Potato is a vegetable and also is carbohydrate containing crop that can less pressure on rice. Though production is somewhat lower than North Bengal or Munsiganj area, price is higher than that of those areas. So farmers are highly interested to cultivate potato. With this point of view Tuber Crop Research Center (TCRC), Bangladesh Agricultural Research Institute developed some potato varieties and genotypes. These varieties and genotypes were evaluated to find out suitable variety(s)/genotype(s) for coastal area.

Materials and Methods

The experiment was conducted at FSRD site, Razakhali and MLT Site, Kuakata, Patuakhali during rabi season of 2006-07. Four varieties were planted in RCB design with 5 replications on 5-8 December, 2006. Seeds were sown with 60 cm x 25 cm spacing in unit plots of 4.5 m x 3.5 m in size. Irrigation was given twice at 25 days interval of sowing. Crops were harvested on Mach 12-15, 2007.

Results and Discussion

Tuber yield of four potato varieties are given in Table 1. Diamont, Provento and Asterix gave statistically identical and higher yield and the lowest from BARI TPS-1 at Kuakata. At Razakhali, Diamant and Provento yielded identical and higher yield whereas BARI TPS-1 gave the lowest yield. The experiment should be shifted from the next year where soil salinity prevails.

Conclusion

The variety Diamant or Provento showed better performance in the both year. Though the experiment was designed for saline area but salinity level in much lower (2 dS/m) and site should be changed.

Farmers'reaction

- Farmers are highly interested to grow potato as a cash crop
- Seed availability is a problem in area
- There is no storage facility for their seed.

Table 1. Yield of potato varieties/ genotypes at two location of, Patuakhali in 2006-07.

Varieties/ genotype	Tuber yield (t/ha)		Mean tuber yield (t/ha)
	Razakhali	Kuakata	
Diamant	24.24 a	23.79 a	24.01
Provento	23.86 a	23.35 a	23.60
Asterix	20.52 b	22.91 a	21.71
BARI TPS-1	17.50 c	16.29 b	16.89
CV (%)	8.34	10.04	-

Adaptive Trial of Improved Stolon Producing Panikachu Varieties/Lines

Abstract

The experiment was conducted at Narail, Magura, Kishoreganj, Sherpur and Noakhali during rabi 2006-07. The variety Latiraj and line PK-176 were studied to compare with the local variety but at Kishoreganj, cultivar Joypurhat also included. Latiraj produced highest yields in all the locations except Kishoreganj area. PK-176 produced the lowest yields. In case of rhizome production, PK-176 gave the highest yield (30.31 t/ha).

Introduction

Panikachu is an important edible aroid in Bangladesh and it contributes to the total supply of bulky vegetables during the 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 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. Monitoring of cultivation practices of Panikachu revealed that all the farmers got very poor yield by using local varieties. Recently, Bangladesh Agricultural Research Institute (BARI) has developed high yielding of Panikachu, viz. Latiraj, Keeping the views in mind the experiment was undertaken during the Kharif season 2007 in the farmer's field of different locations.

Materials and Methods

The study was conducted at Narail, Magura, Kishoreganj, Sherpur and Noakhali during 2006-07 to compare the improved variety/line of panikachu with local one. The unit plot was 10 m x 10 m. The seedlings were planted during 20 January 2007 at Narail, 21 February at Kishoreganj, 24 February at Sherpur 2007 and 15-17 December 2006 irrespective of locaions maintaining the spacing of 60 cm x 45 cm. Fertilizers were applied at the rate of 5 ton cowdung and Urea, TSP, MP: 150-125-175 kg/ha respectively. All fertilizers were applied during final land preparation and urea was applied in two equal splits at 45 and 90 DAT. Irrigation and weeding were done as and when necessary. Harvesting started from 25 March and up to September 2006. Data on length of stolen, number of stolen/plant, weight of stolen/plant, stolen yield/plot and yield (t/ha) were collected.

Results and Discussion

Tularampur, Narail and Shalikha, Magura

Latiraj produced the highest yield at both MLT site. PK-176 produced the lowest yield at MLT site, Tularampur whereas the local variety produced the lowest yield at MLT site, Shalikha. Higher yield from latiraj was due to higher yield contributing characters.

Katiadi, Kishoreganj

All the yield and yield contributing characters of panikachu varieties varied significantly. Number of stolon/plant, length of stolon, weight of stolon/plant and stolon yield were significantly highest in Latiraj but weight of rhizome/plant, diameter of rhizome, length of rhizome and rhizome yield were highest in Joypurhat (Local). However, weight of rhizome/ plant, length of rhizome and yield of Joypurhat and Local were statistically identical. Stolon yield of local variety was the lowest (15.28 t/ha) but the rhizome yield was the lowest (17.66 t/ha) in Latiraj. However, the Latiraj gave significantly the highest (21.46 t/ha) stolon yield but highest rhizome yield (28.55 t/ha) was obtained from Joypurhat, which was statistically identical to Local variety. The result clearly indicated that Latiraj is better for stolon followed by Joypurhat but both Joypurhat and Local varieties are better for rhizome production.

Cost and return analysis: The panikachu Joypurhat (Local) gave the highest gross return (Tk 322050/ha), gross margin (Tk 288291/ha) and benefit cost (9.54) due to higher rhizome yield and good stolon yield. Latiraj gave the lowest gross return (Tk 285240/ha), gross margin (Tk 251481/ha) and benefit cost ratio (8.45). Local variety also gave higher BCR than Latiraj due to higher rhizome yield as well as reasonable yield of stolon. All the varieties performed better in respect of BCR (8.45-9.54).

Jhenaigati, Sherpur

The results obtained from the study indicated that the highest plant height was obtained from PK-176 The highest number of stolon/plant was found in latiraj and the local variety produced lowest number of stolon/plant. The similar trend was also observed in case of stolon length. But the stolon diameter was found largest in PK 176. The smallest diameter was found in local. The highest stolon wt./plant was found in Latiraj while the lowest stolon wt/plant was noted from local. The highest stolon yield was obtained from Latiraj (14.14 t/ha). The second highest yield was noted from PK 176 (11.17 t/ha) while the lowest from local (7.05 t/ha). On the other hand, the highest rhizome yield was obtained from PK 176 (37.81 t/ha) which was statistically different from Latiraj (30.94 t/ha). The local variety produced the lowest rhizome yield (21.96 t/ha). The highest gross margin (Tk.90300/ha) and BCR (2.50) was obtained from PK 176 followed by Latiraj with BCR (2.46).

Noakhali

All the yield contributing characters of Panikachu varieties varied significantly. Number of stolon/plant (15.37), length of stolon (88.7 cm), weight of stolon/plant (743.3 gm) and stolon yield (20.07 t/ha) were significantly highest in Latiraj variety but length of rhizome/plant (25.0 cm), girth of rhizome (26.3 cm) and rhizome yield (22.74 t/ha) was highest in local variety. Stolon yield of local variety was lowest (7.07 t/ha) but rhizome yield was the lowest (12.88 t/ha) in PK-176. However, Latiraj gave significantly the highest (20.07 t/ha) stolon yield but highest rhizome yield (22.74 t/ha) was obtained from local. The result clearly indicated that Latiraj is better for stolon followed by PK176 but local variety is better for rhizome production.

Economic analysis: The panikachu variety Latiraj gave the highest gross return (Tk.230040/ha), gross margin (Tk.189490/ha) and benefit cost ratio (5.67) due to higher stolon and rhizome yield. PK-176 gave the lowest gross return (Tk.141120/ha), gross margin (Tk.100570/ha) and benefit cost ratio (3.48).

Farmers' reaction

Kishoregonj: Farmers are very much interested to grow the variety Joypurhat for its dual production of stolon and rhizome. Though Latiraj gave better stolon yield, its rhizome quality and yield was not satisfactory. The farmers preferred the rhizome quality of Joypurhat and Kishoregonj local.

Noakhali: Farmer's liked Latiraj variety for its high yielding and more profit. It is more tasty and non itchy. Farmers of those locations showed their interest about cultivating this variety if the planting materials are available to them. They are not interested about PK-176 because of its lower yield and benefit than the local variety.

Conclusion

Latiraj produced the highest yield of 17.51 t/ha (stolon) while PK-176 produced the highest rhizome yield (30.31 t/ha). Whereas the local variety produced the lowest yield both for stolon (12.05 t/ha) and for rhizome (20.31 t/ha)

Table 1. Performance of yield and yield contributing characters of panikachu at MLT site, Tularampur, Narail during 2006-07

Variety/lines	Stolon/plant (no.)	Length of stolon (cm)	Weight of stolon/plant (g)	Yield/ plot (kg)	Yield (t/ha)
Latiraj	26.5	62.00	723	173	17.30
PK-176	21.8	42.50	544	130	13.00
Local	27.0	46.50	690	165	16.50

Table 2. Performance of yield and yield contributing characters of panikachu at MLT site, Magura during 2006-07

Variety/ lines	Stolon/plant (no.)	Length of stolon (cm)	Weight of stolon/ plant (g)	Yield/ plot (kg)	Yield (t/ha)
Latiraj	23.60	56.00	540	146	14.60
PK-176	20.20	44.50	460	112	11.20
Local	18.00	38.00	390	92	9.20

Table 3. Yield and yield parameters of panikachu varieties at MLT site, Katiadi, Kishoregonj during Kharif, 2006

Varieties	Stolon/ plant (no.)	Length of stolon (cm)	Weight of stolon/ Plant (g)	Weight of rhizome/ Plant (g)	Diameter of rhizome (cm)	Length of rhizome (cm)	Stolon yield (t/ha)	Rhizome yield (t/ha)
Latiraj	28.6	66.13	693	369	22.40	36.20	21.46	17.66
Joypurhat	23.4	56.41	549	885	28.34	47.60	17.93	28.55
Local	22.9	49.65	498	852	25.86	45.10	15.28	26.54
LSD(0.05)	2.89	5.87	46.29	34.91	1.69	2.97	2.65	3.21
CV (%)	8.66	7.08	11.40	9.81	6.79	9.15	10.23	11.23

Table 4. Cost and benefit analysis of panikachu varieties at MLT site, Katiadi, Kishoregonj during Kharif, 2006

Varieties	Gross return (Tk./ha)	Total production cost (Tk./ha)	Gross margin (Tk./ha)	BCR
Latiraj	285240	33759	251481	8.45
Joypurhat	322050	33759	288291	9.54
Local	285500	33759	251741	8.46

Price: Stolon of all varieties: Tk. 10/kg, Rhizome of Latiraj: Tk 4/kg, Rhizome of Joypurhat and Local: Tk 5/kg

Table 5. Yield and yield contributing characters of panikachu at Jhenaigati, Sherpur

Varieties	Plant ht. (cm)	Stolon/plant (no.)	Stolon length (cm)	Stolon dia (cm)	Stolon wt/plant (g)	Stolon yld. (t/ha)	Rhizom yld. (t/ha)
Latiraj	140.93 b	16.28 a	73.24 a	1.26 b	432.8 a	14.14 a	30.94 b
PK-176	149.01 a	12.32 b	55.25 b	1.49 a	362.1 b	11.17 b	37.81 a
Local	105.12 c	9.20 c	45.77 c	1.16 c	248.9 c	7.05 c	21.96 c
F-test	*	*	**	**	*	*	*
CV(%)	12.69	9.96	9.33	10.04	8.68	11.54	8.55

Figure in the column having similar letter(s) do not differ significantly

Table 6. Yield and economic performance at Jhenaigati, Sherpur

Varieties	Rhizome yield (t/ha)	Stolon yield (t/ha)	Gross return (Tk/ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
Latiraj	30.94	14.14	1,48,050.00	60,075.00	87,975.00	2.46
PK-176	37.81	11.17	1,50,375.00	60,075.00	90,300.00	2.50
Local	21.96	7.05	90,150.00	60,075.00	30,075.00	1.50

The price per kg of rhizome and stolon was Tk. 2.50 and Tk. 5.00, respectively, Production cost considered seed cost, fertilizer, labour etc

Table 7. Yield and yield contributing characteristics of stolon producing panikachu varieties at Noakhali

Variety	Plant height (cm)	Stolon/plant (no.)	Length of stolon (cm)	Weight of stolon/ plant (g)	Yield of stolon (t/ha)	Length of rhizome (cm)	Girth of rhizome (cm)	Yield of rhizome (t/ha)
Latiraj	112.3	15.4	88.7	743.3	20.07	21.3	23.6	17.37
Local	104.7	9.4	42.3	262.0	8.070	25.0	26.3	22.74
PK-176	116.3	9.6	68.7	415.0	12.20	15.0	21.3	12.88
LSD(0.05)	2.56	2.30	5.68	101.5	2.74	0.76	1.51	4.39
CV (%)	4.02	9.72	3.76	9.46	9.46	7.63	2.80	10.98

Table 8. Cost benefit analysis of panikachu varieties during Kharif season of 2006, Noakhali

Varieties	Gross return (Tk./ha)	∗TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Latiraj	230040	40550	189490	5.67
Local	147520	40550	106970	3.63
PK-176	141120	40550	100570	3.48

∗TVC = Total variable Cost, Market Price (kg/ha): Stolon= 8, Rhizome= 4

Appendix 1. Yield (t/ha) if stolon of Panikachu varieties under different locations during 2006

Variety/lines	Norail	Magura	Kishoreganj	Sherpur	Noakhali	Mean
Latiraj	17.30	14.60	21.46 (17.66)	14.14 (30.94)	20.07 (17.37)	17.51
PK-176	13.00	11.20		11.17 (37.81)	8.07 (22.74)	10.87
Joypurhat	-	-	17.93 (28.55)	-		17.93
Local	16.50	9.20	15.28 (26.54)	7.05 921.96)	12.20 (12.88)	12.78
CV (%)	-	-	10.23 (11.23)	11.54 (8.55)	9.46 (10.98)	

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Adaptive Trial of Improved Varieties/Lines of Mukhikachu

Abstract

The study was conducted at Jhenaidah, Jessore, Kishoreganj and Bogra during rabi 2006-07 to compare the yield performance of improved varieties/lines with farmer's own. Advance lines MK-140 produced the highest yield among the lines/varieties tested and the lowest in farmer's own variety in all the sites.

Introduction

Mukhikachu (*Colocasia esculenta*) is an important edible aroid in Bangladesh and it contributes remarkable to the total supply of bulky vegetables during the 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. Monitoring of cultivation practices of mukhikachu revealed that all the farmers got very poor yield by using local varieties. Bangladesh Agricultural Research Institute (BARI) has already developed high yielding variety of Mukhikachu viz. Bilashi and some promising lines were also found. All those lines along with Bilashi variety needs to be verified at farmers field for its yield potential.

Materials and Methods

The study was conducted at Jhenaidah, Jessore, Kishoreganj and Bogra during 2006-07 to compare the improved variety/line of mukhikachu with local one. The unit plot was 10m × 10m. The seed/corms were sown during 13 February to 12 April 2006 irrespective of locations maintaining the spacing of 60 cm × 45 cm. Fertilizers were applied at the rate of 5 ton cowdung and urea, TSP, MP: 150-125-175 kg/ha respectively. All fertilizers and $^{1}/_{3}^{rd}$ urea were applied during final land preparation. The rest urea was applied in two equal splits at 30 and 60 DAS. Irrigation and weeding were done as and when necessary. Harvesting was started from 12 August and ended on 10 November 2006. Data on plant height, cormel/plant, wt. of cormel/plant, wt. of cormel (t/ha) were collected.

Results and Discussion

Jhenaidah and Jessore

The highest yield (28.25 t/ha) was obtained from MK-140 and it was lowest (11.50 t/ha) from farmers own at kaliganj. Similar trend was found at Kuadabazar. The loal variety showed lower yield attributes resulted lower yield.

Kendua, Kishoreganj

The number of secondary corm and cormels/plant showed the highest from line MK-029. But weight of secondary corm per plant was the highest in MK-140 (356.70 g) and the lowest in local. The weight of secondary corm per plant was 24 and 33% higher in MK-140 than Bilashi and local due to higher number of secondary corm. The weight of cormels per plant was recorded the highest in MK-140 (496g). The line MK-140 produced the highest yield (33.53 t/ha) which was statistically differ from MK-029 (30.91t/ha) and the lowest yield was recorded in local variety (21.42 t/ha). The yield of Mukhikachu line MK-140 was about 18 and 57 % higher than Bilashi and local variety. It might be due to contribution of higher yield attributes. The Mukhikachu line MK-140 gave the highest gross return (Tk 335300 /ha), gross margin (Tk 302983/ha) and benefit cost (10.38) due to higher yield. The gross return and gross margin of MK-140 was 18 and 57 % higher than Bilashi and local. Local variety gave the lowest gross return (Tk 214200/ha), gross margin (Tk 181883/ha) and benefit cost ratio (6.63).

Majira, Bogra

The weight of primacy corm per plant and number of secondary corm/plant was more or less similar in all the varieties. Weight of secondary corm per plant was higher (331.67 g) in line MK-140 and it was followed by MK-029 (316.67g) and Bilashi (303.33g). The lowest secondary corms/plant was obtained from local variety (283.33g). Similar trend was followed in cormel weight. Higher yield was also obtained from MK-140 (22.33 t/ha) and it was followed by Bilashi (21.17 t/ha) and MK-029 (21.00 t/ha). The lowest yield was obtained from the local variety (19.80 t/ha).

Farmers' reaction

Kishoreganj: 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.

Bogra: Farmers liked the high yielding variety / lines for their higher yield and tasty due to softness after cooking. The size of corm and skin color of Bordhaman (local variety) was attractive. The market price of local variety is higher than that of high yielding variety/lines.

Table 1. Performance of yield and yield contributing characters of mukhikachu at MLT site, Kaliganj, Jhenidah during 2006-07.

Variety/ lines	Plant height (cm)	Cormel/plant (no)	Weight of cormel/plant (g)	Yield (t/ha)
MK-029	94.3	43.2	760.3	27.75
MK-140	85.2	45.8	770.5	28.25
Belashi	75.5	41.4	690.6	25.36
Local	56.3	31.5	440.8	11.50

Table 2. Performance of yield and yield contributing characters of mukhikachu at MLT site, Kuadabazar, Jessore during 2006-07.

Variety/ lines	Plant height (cm)	Cormel/plant (no)	Weight of cormel/ plant (g)	Yield (t/ha)
MK-029	57.00	42.00	500	18.51
MK-140	62.17	45.00	600	22.22
Belashi	63.50	40.50	450	16.67
Local	50.50	35.00	400	10.81

Table 3. Yield and yield contributing characters of Mukhikachu varieties / lines at MLT Site, Kendua, during Kharif, 2006

Variety/ Line	Weight of primary Corm (g/plant)	No. of sec. corm /plant	No. of cormels /plant	Weight of sec. corm /plant (g)	Weight of cormels /plant (g)	Wt. of edible part (sec. corm and cormel) /plant (g)	Yield (t/ha)
MK-029	123.33a	15.33a	16.35a	305.00b	436.76b	741.76b	30.91b
MK-140	115.00ab	12.76b	14.23b	356.70a	496.00a	852.70a	33.53a
Bilashi	108.30b	11.67bc	11.33c	286.70c	396.00c	682.70c	28.45c
Local	92.07c	10.00c	8.76d	268.11c	246.00d	514.11d	21.42d
CV (%)	10.67	9.98	11.23	12.44	8.96	7.88	12.11

In a column, means followed by common letters are not different at 5% level by DMRT

Table 4. Cost and benefit analysis of Mukhikachu variety/line at MLT site, Kendua , during Kharif, 2006

Variety/Line	Gross return (Tk./ha)	Total production cost (Tk./ha)	Gross margin (Tk./ha)	BCR
MK-029	309100	32317	276783	9.56
MK-140	335300	32317	302983	10.38
Bilashi	284500	32317	252183	8.80
Local	214200	32317	181883	6.63

Price: All varieties cormels: Tk. 10/kg

Table 5. Yield and yield contributing characters of Mukhikachu at Majira, Bogra during 2006-07.

Variety	Weight of primary corm/plant (g)	No. of Secondary corm/plant	Weight of secondary corm/plant (g)	Corm weight of crop area (10m^2) (kg)	Yield t/ha
MK-029	157.33	12.17	316.67ab	21.03ab	21.00ab
MK-140	155.00	13.40	331.67a	22.33a	22.33a
Bilashi	155.00	12.43	303.33ab	21.17ab	21.17ab
Bordhaman	167.30	12.10	283.33b	19.83b	19.80b
F-test	NS	NS	*	*	*
CV (%)	6.68	5.51	7.66	3.48	3.46

Appendix 1. Yield (t/ha) of mukhikachu varieties at different location during 2006-07.

Variety/ lines	Location				Mean
	Jhenaidah	Jessore	Kishoreganj	Bogra	
MK-029	27.75	18.51	30.91	21.00	24.54
MK-140	28.25	22.22	33.53	22.33	26.58
Belashi	25.36	16.67	28.45	21.17	22.91
Local	11.50	10.81	21.42	19.80	15.88

On-Farm Adaptive Trial of Advanced Lines of Turnip Rape (*Brasica campestris*)

Abstract

The field trial was conducted at Rajshahi, Barhmanbaria, Narsingdi, Jessore, Pabna, Manikganj and Tangail during rabi 2006-07 to evaluate the performance of advanced lines of turnip rape in the farmers' field condition. The experiment was consisted of three advanced lines of turnip rape viz., BC-10000, BCWY-03 and BC-2193 with two check varieties viz. BARI sarisha-6 and BARI sarisha-9. The variety BARI sarisha-6 performed better seed yield at Barind, Jhikargacha, Atgoria, Manikganj and Tangail but at Narsingdi the line BC01000 showed higher yield with short duration but no signficant difference. Across the locations, the highest grain yield was obtained from BARI sarisha-6 (1543 kg/ha) whereas BARI sarisha-9 yielded the lowest (1286 kg/ha). However, all the tested cultivars (BC-2193, BC-1000 and BCWY-03) produced lower yield than BARI sarisha-6 except Narsingdi area. BARI sarisha-9 had the lowest field duration (74-85 days).

Introduction

Bangladesh has an acute shortage of oil seeds in respect of its demand. The farmers of Barind area generally grow mustard variety Tori-7 after harvest of T.aman rice. The productivity of this mustard variety is very low that can not 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 Swarna/BR11 that drastically reduced the mustard yield. Therefore, the farmers seek a new mustard variety, which can perform well under the existing cropping pattern. Oil seed Research Centre of BARI recently has developed some advanced promising varieties/lines of turnip rape, which possess the high yield potential and less disease susceptible and has high oil content (44%). In relation to the above situation, the study was undertaken to evaluate the performance of advanced lines of turnip rape under farmers' condition.

Materials and Methods

The experiment was conducted at Rajshahi, Barhmanbaria, Narsingdi, Jessore, Pabna, Manikganj and Tangail during rabi 2006-07 to evaluate the performance of advanced lines of turnip rapes. The design of the experiment was RCBD with 4 replications but only 3 replications was at HBT, Rajshahi. The performance of three advanced lines of turnip rape viz., BC-1000, BCWY-03 and BC-2193 were evaluated in the experiment. Two check varieties viz., BARI Sarisha-6 and BARI Sarisha-9 were used in the experiment. The unit plot size was 10 rows and 5 m long. The spacing was 30 cm between rows, 4-5 cm between plants and 1 m between plots. The seed rate was 7 kg/ha. Seeds were sown on 4 November at Rajshahi, 5 November at Brahmanbaria, 22 November at Shibpur, Narsingdi, 9-18 November at Jessore, 19 November at Pabna, 9 November at Pabna and 26 January of 2006. Initially the experimental plots were fertilized with 260-170-90-160-5-10 kg/ha urea, TSP, MP, gypsum, zinc oxide and boric acid, respectively. All the fertilizers were applied as basal except urea. Urea was applied as top dress on 20 and 45 days after sowing, respectively. The crop was harvested according to their maturity during 2-4 February at Rajshahi, 23-29 January at Brahmanbaria, 12 February at Narsingdi, 15 February at Pabna, 9-15 February at Manikganj and 26 January at Tangail of 2007. Intercultural operation and plant protection measures were taken as and when necessary. The data on different plant characters were collected from 10 plants selected at random in each plot and yields were recorded plot wise. All necessary data were collected and analyzed statistically.

Result and Discussion

Kadamshahar, Rajshahi

Among the plant characters studied days to maturity, number of branch/plant, number of siliqua/plant, number of seed/siliqua, siliqua length, thousand seed weight and seed yield were statistically significant. Results revealed that the check variety BARI sarisha-6 produced the highest seed yield (2267 kg/ha) followed by BCWY-03. It also contributed highest number of number of siliqua/plant

(94.4), number of seed/siliqua (21.2), siliqua length (6.4) and 1000-seed weight (4.2). The advanced lines BC-2193 and BC-1000 gave 1997 and 1747 kg/ha seed yield, respectively. The lowest seed yield was obtained from check variety BARI sarisha-9 (1513 kg/ha).

Shibpur, Narsingdi

The line BC-01000 took the shortest days to flowering and days to maturity while BARI sarisha-6 attained maturity with the maximum days. The highest plants/m^2 was recorded from the line BC-01000 and the lowest from BARI sarisha-6. Maximum plant height was obtained from line BC-01000 followed by BCWY-03. Number of pods/plant was the highest in BC-01000 but seeds/pod was similar with BCWY-03. There was no significant different in seed weight between the lines BCWY-03 and BC-2193 but higher weight than other variety/lines. Though, maximum yield was recorded from BC-01000 but very close to each other. But consider yield and maturity, the line BC-01000 was found suitable.

Jhikargacha, Jessore

The performances of advanced lines of turnip have been presented Table 5. Highly significant differences were observed in case of plant height, number of siliqua/plant, number of seeds/siliqua, 1000-grain weight except plant population, grain yield and stover yield among the genotype. Maximum seed yield (1.91 t/ha) was produced by BARI sarisha-6 and the lowest yield (1.51 t/ha) in BARI sarisha-9. But there was no significant difference in yield among the variety/lines.

Atghoria, Pabna

Plant population per unit area for different lines/varieties was identical. The maximum plant height was observed in BARI sarisha-6 which was identical to line BC-01000. Comparatively dwarf stature plants were observed in the rest of the lines/variety. The highest number of pods/plant was recorded in BC-2193. Maximum seeds/pod was in BARI sarisha-6 followed by BCWY-03. The maximum weight of 1000 seed was in BC-01000 followed by BARI sarisha-6 probably due to their bold sized seed. Higher seed yield was from BARI sarisha-6 but it was statistically identical with with lines BC-01000 and BCWY-03. The cumulative effect of plant population/m^2, seeds/pod and 1000- seed weight might have contribution to increased yield. The lowest seed yield was in BARI sarisha-9. The highest straw yield was recorded in BARI sarisha-9 which was differed with other lines/variety.

Manikganj

The variety BARI sarisha-9 and BCWY-03 took the shortest time for maturity (85 days). The check variety BARI sarisha-6 took the longest time to mature. Plant height was found significantly shorter in BARI sarisha-9 and the longest in BARI sarisha-6. Plant population was the highest in BARI sarisha-9 and lower in OTBC-2193. Number of pods per plant was found maximum in BARI sarisha-6, which was statistically identical to OTBC-01000, OTBC-2193 and BARI sarisha-9. Seeds/pod was the highest in BARI sarisha-6. Thousand seeds weight was not significantly influenced but higher weight from line OTBC-2193. Maximum seed yield was obtained from BARI sarisha-6 which was statistically identical to line BCWY-03. This yield was influenced by the number of pod/plant and the number of seeds/pod. So, in respect of yield performance the check variety BARI sarisha-6 along with the advance line BCWY-03 were found to be superior compared to check variety and others lines.

Ellenga, Tangail

Plant height, days to maturity, seed yield and yield attributes were significantly influenced by different lines/variety. The result shows that BARI sharisha-9 matured earlier (77 days) while the highest time was required in BARI sharisha-6 (94 days). No. significant variation was observed in plant population/m^2. The highest plant height was observed from BARI sharisha-6 (129.75 cm) and the shortest in BCWY-03 (109.25 cm) and it was at par with other three varieties/lines similarly. Higher number of siliqua/plant (76) was obtained from BARI sharisa-9, which was at par with other varieties/lines except BCWY-03 which bear the lowest number of siliqua/plant (40). Both the varieties BARI sharisha-6 and line BCWY-03 produced the highest number of seeds/siliqua (21). The line BC-2193 and BARI sharisa-9 provided the highest 1000-seed weight (4.45 g) which was at par with line BC-01000 (4.12 g) and the lowest 1000-seed weight (3.62 g) was obtained from BCWY-03. The variety BARI sharisha-6 produced the highest seed yield (1.70 t/ha) which was at par with that of line BC-01000 (1.53 t/ha) and BC-0293 (1.54 t/ha). The lowest seed yield was produced by the line BCWY-03 (1.31 t/ha).

Conclusion

Across the locations, the highest grain yield was obtained from BARI sarisha-6 (1543 kg/ha) whereas BARI sarisha-9 yielded the lowest (1286 kg/ha). However, all the tested cultivars (BC-2193, BC-1000 and BCWY-03) produced lower yield than BARI sarisha-6 except Narsingdi area. BARI sarisha-9 had the lowest field duration (74-85 days). The experiment should be repeated with the addition of more number of locations for getting clear observation on the adaptability of turnip cultivars.

Table 1. Plant characters of different advanced lines of turnip rape tested under on-farm adaptive trial at Barind, Rajshahi during 2006-07

Variety/line	Plant pop. /m^2	Days to maturity	Plant height (cm)	Branches/ plant	Siliqua/ plant	Seed/ siliqua	Siliqua length (cm)	1000-seed wt. (g)	Seed yield (kg/ha)
BC-2193	27.5	87.0	101.6	4.5	73.7	14.2	4.1	3.6	1997
BC-1000	23.0	86.3	85.2	4.1	69.3	15.1	4.2	3.1	1747
BCWY-03	25.7	90.0	101.8	6.3	92.3	19.9	5.1	3.5	2143
BARI sarisha-6	26.8	92.0	109.7	4.9	94.4	21.2	6.4	4.2	2267
BARI sarisha-9	24.5	83.0	98.9	4.5	67.9	14.6	4.5	3.0	1513
LSD (0.05)	NS	3.43	NS	1.09	14.58	3.81	1.21	0.76	278.9
CV (%)	10.22	6.43	12.94	8.17	11.76	8.18	9.07	2.6	10.27

Table 2. Yield and yield contributing characters of tested turnip rape seed lines/variety at MLT site, Shibpur, Narsingdi during 2006-07

Variety/line	Days to flowering	Days to maturity	Plant pop./m^2 (no.)	Plant height (cm)	Pods/ plant (no.)	Seeds/ pod (no.)	1000-seed weight (g)	Seed yield (kg/ha)
BC-01000	28	72	82	105	72	20	2.60	1700
BCWY-03	33	75	74	101	66	20	2.80	1580
BC-2193	30	78	74	98	64	14	2.80	1600
BARI sarisha-6	32	81	76	84	62	16	2.50	1620
BARI sarisha-9	32	74	73	84	62	13	2.40	1480
LSD (0.05)	1.435	1.876	3.375	4.724	2.896	1.143	0.138	0.119
CV (%)	3.06	1.60	2.89	3.25	2.88	4.45	3.48	4.02

Table 3. Yield and yield contributing characters of turnip rape at MLT site, Jhikorgacha, Jessore during rabi 2006-07

Variety/line	Plant height (cm)	Plant pop./m^2 (no.)	Siliqua/ plant (no.)	Seeds/ siliqua (no.)	1000- seed wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
BC-01000	110.75a	46.50	97.75ab	17.75b	2.88ab	1.82	3.65
BCWY-03	110.75a	47.00	61.75c	22.25a	2.68b	1.52	2.98
BC-2193	105.75ab	49.25	110.00a	18.25b	2.70b	1.61	3.00
BARI sharisa-6	114.75a	49.00	79.00bc	22.25a	3.10a	1.91	3.94
BARI sharisa-9	97.00b	52.25	105.50a	18.25b	2.65b	1.50	2.97
CV (%)	5.55	13.12	13.95	8.52	7.33	16.84	17.62
F-test	**	NS	**	**	*	NS	NS

Table 4. Performance of different varieties/lines of Turnip rape mustard at MLT site, Atghoria, Pabna during 2006-07

Variety/line	Plants/ m^2 (no.)	Plant height (cm)	Pods/plant (no.)	Seeds/pod (no.)	1000-seed wt. (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
BC-01000	49.22a	110.00a	90.10b	17.20c	5.60a	1323a	3610b
BCWY-03	45.02a	94.30b	74.45b	21.42ab	5.28b	1299a	3290c
BC-2193	47.52a	96.90b	133.80a	20.40b	4.33c	1171b	2898d
BARI sarisha-6	49.05a	113.40a	89.90b	22.35a	5.40ab	1356a	2816d
BARI sarisha-9	48.45a	91.25b	98.00b	15.10d	4.55c	1085c	4431a
CV (%)	10.08	6.11	18.97	5.58	3.50	4.44	3.41

Table 5. Yield and yield contributing characters of different turnip rape mustard varieties/line at MLT site, Manikganj, 2006-07

Variety/line	Days to maturity	Plants /m^2	Plant height (cm)	Pods/ plant	Seeds /pod	1000-seed wt. (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
OTBC-01000	88	147.50 b	113.00 b	62.00 a	13.25 c	3.00 ab	983.52 d	3279.63 c
BCWY-03	85	139.00 c	102.18 c	51.75 b	21.75 b	2.65 d	1583.00 a	2770.18 c
OTBC-2193	88	135.00 c	113.50 b	64.50 a	13.25 c	3.10 a	1150.00 c	3616.48 ab
BARI Sarisha-6	92	145.70 b	117.00 a	65.00 a	24.25 a	2.88 bc	1600.19 a	3868.71 a
BARI Sarisha-9	85	159.50 a	95.25 d	62.25 a	13.50 c	2.82 c	1337.96 b	3100.93 c
CV (%)		4.80	1.76	5.31	4.38	3.13	7.28	8.00

Table 6. Yield contributing parameters of turnip rape lines at FSRD site, Ellenga, Tanigali during 2006-07

Varieties/lines	Days to 50% flowering	Days to 80% maturity	Plant pop^n/m^2	Plant height (cm)	Siliqua/plant (no)	Seed/siliqua (no)	1000-seed wt. (g)	Seed yield (t/ha)
BC-01000	35d	85b	79	112.50b	65a	18c	4.12ab	1.53ab
BCWY-03	42b	82bc	79	109.25b	40b	21a	3.62c	1.31c
BC-2193	35d	81c	79	114.75b	72a	19b	4.45a	1.54ab
BARI Sarisha-6	45a	94a	78	129.75a	69a	21a	4.10b	1.70a
BARI Sarisha-9	40c	77d	81	112.00b	76a	17c	4.45a	1.51b
CV (%)	2.76	2.27	9.33	6.96	12.08	3.99	4.90	7.02

Appendix 1. Seed yield (kg/ha) of turnip rape at different locations during 2006-07

Variety/lines	Location						
	Shibpur	Barind	Jessore	Tangail	Manikganj	Pabna	Mean
BC-2193	1600	1997	1540	1540	1150	1171	1500
BC-1000	1700	1747	1530	1530	984	1323	1469
BCWY-03	1580	2143	1310	1310	1583	1399	1554
BARI sarisha-6	1620	2267	1700	1700	1600	1356	1707
BARI sarisha-9	1480	1513	1510	1510	1338	1085	1406
CV (%)	3.48	10.27	7.02	-	7.28	4.44	

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On-Farm Adaptive Trial of Advanced Lines of Rapeseed (*Brassica napus)*

Abstract

The field experiment was conducted in the farmer's field of Kadamshahar, Rajshahi, Hatgavindapur, Faridpur, Shibpur, Narsingdi, Jhikargacha, Jessore, Kashinathpur, Pabna and Kushumhati, Sherpur during rabi 2006-07 to evaluate the performance of advanced lines of rapeseed. The experiment comprises of three advanced lines of rapeseed viz., Nap-179, Nap-2001 and Nap-9906 and check variety BARI sarisha-13. The advance line Nap-9906 showed higher seed yield in all the sites except Sherpur where higher yield was recorded from line Nap-179 followed by Nap-2001. Across the locations the highest seed yield (1731 kg/ha) was obtained from Nap-2001 followed by Nap-9906 whereas BARI sarisha-13 gave the lowest mean yield (1582 kg/ha). Among the locations Nap-2001 gave the highest yield (2161 kg/ha) at Kadamshahar, Rajshahi.

Introduction

Bangladesh has to import huge amount of vegetable oil and oil seed every year to meet up the deficiency. Mustard is the major oil seed crop in Bangladesh. It covered about 70% of the total oil seed production of Bangladesh. The yield of this crop in Bangladesh is found much lower than the other countries due to low yield potential of local varieties and its poor management practices. Oil Seed Research Center (ORC) of BARI has developed some advanced promising varieties/ lines of rape- mustard which possess the high yield potential and less diseases susceptible and less high oil content (44%). Hence, the study was undertaken to evaluate the performance of advanced lines under farmer's field condition.

Materials and Methods

The field experiment was conducted in the farmer's field of Kadamshahar, Rajshahi, Hatgavindapur, Faridpur, Shibpur, Narsingdi, Jhikargacha, Jessore, Kashinathpur, Pabna and Kushumhati, Sherpur during rabi 2006-07 to evaluate the performance of advanced lines of rapeseed. The design of the experiment was RCBD with four replications. Three advanced lines of rapeseed viz., Nap-179, Nap-2001 and Nap-9906 were included in the study and the variety BARI sarisha-13 was used as check. The unit plot size was 10 rows and 5 m long. The spacing was 30 cm between rows, 4-5 cm between plants and 1m between plots. The seed rate was 7 kg/ha. Seeds were sown on 4 November at Barind, Rajshahi, 30 October at Faridpur, 30 November at Shibpur, Narsingdi, 9-18 November at Jessore, 13 November at Pabna and 1 November at Sherpur of 2006. The experimental plot was fertilized with 260-170-90-160-5-10 kg/ha urea, TSP, MP, gypsum, zinc oxide and boric acid, respectively. All the fertilizers were applied as basal except urea. Urea was applied as top dress on 20 and 45 days after sowing. The crop was harvested according to their maturity during 7-9 February at Rajshahi, 4-7 February at Faridpur, 25-28 February at Shibpur, Narsingdi, 7 February at Pabna and 5 February at Sherpur of 2007. Intercultural operation and plant protection measures were taken as and when necessary. The data on different plant characters were collected from 10 plants selected at random in each plot and yields were recorded plot wise.

Results and Discussion

Kadamshahar, Barind, Rajshahi

All the plant characters significantly influenced due to different advanced lines of rapeseed. Among the plant characters studied days to maturity, number of branch/plant, number of siliqua/plant, number of seed/siliqua, Siliqua length, thousand seed weight and seed yield were significantly affect by cultivars. Among the advanced rapeseed lines Nap-2001 produced maximum seed yield (2162 kg/ha) followed by Nap-9906 (2065 kg/ha). The lowest seed yield was obtained from Nap-179 (1788.33 kg/ha) compared to the check variety BARI sarisha-13 (1830 kg/ha).

Hatgavindapur, Faridpur

The yield and yield contributing characters of mustard is presented in Table 3. Plant height, no. of plants/m^2, yields and yield attributes was significantly influenced by variety or lines. The advanced line Nap 9906 showed higher yield (1840 kg/ha) followed by BARI sarisha-13 (1760 kg/ha). It may be due to higher seed/siliqua and bolder seed size (3.93g). Flowering and maturity was earlier in Nap 179. Nap-9906 took 48 and 94 days for flowering and maturity.

Shibpur, Narsingdi

Results obtained from the study indicated that almost all the yield contributing characters were significantly influenced due to variety/line. Higher seed yield was found in Nap-9906 which was similar to Nap-2001. BARI sarisha-13 produced the lowest yield (1.40 t/ha) but this yield is within the normal yield potentiality of this variety. All the variety performed better in the site.

Jhikorgacha, Jessore

The seed yield and yield component of different varieties/lines of the experiment were presented in Table 5. Yield and yield contributing characters did not differ significantly but higher seed yield (1.52 t/ha) was recorded in Nap-9906 followed by Nap-179 (1.49 t/ha) and the lowest (1.39 t/ha) slighty lower yield but there was no significant difference.

Kashinathpur, Pabna

The result indicated that no remarkable variation was observed regarding days to flower and days to maturity among the tested lines/variety. Maximum plant height was recorded BARI sarisha-13 which was similar to the lines Nap-9906 and Nap-2001. Dwarf plant was observed in Nap-179. Plant population per unit area was identical to all the lines/variety. But numerically lower plant stand was observed in case of Nap-179. Pods/plant was significantly varied with the lines/variety. The maximum numbers of pods/plant was recorded in line Nap-9906 which was similar with Nap-2001. The lowest pods/plant was obtained from the line Nap-179 and the variety BARI sarisha-13 respectively. The highest no. of seed/pod was recorded in Nap-9906 which was varied with other lines/variety. Similar response was found in 1000 seed weight. The highest seed yield was obtained from the line Nap-9906 followed by Nap-2001. The cumulative effect of maximum plant stand, pods/plant, seeds/pod and 1000-seed weight might be attributed to increased yield in Nap-9906. The lowest yield performance was recorded in the variety BARI sarisha-13 which was statistically similar with Nap-179.

Kushumhati, Sherpur

The longest plant was recorded from Nap-179 and was statistically identical to Nap-9906 and BARI Sarisha-13. Nap 2001 produced the shortest plant. The number of plants/m^2 was found insignificant due to varieties. The highest number of pods/plant was recorded from Nap-179 which differed from other three varieties. These varieties produced identical pods/plant. The similar trend was also recorded in case of seeds/pod. The highest 1000-seed weight was recorded from Nap-2001 which was identical to BARI sarisha-13. The lowest 1000-seed weight was noted from Nap-179 was similar to Nap-9906. However, the highest seed yield was recorded from Nap-179 (1710 kg/ha) and was identical to Nap-2001 (1639 kg/ha). The lowest yield was from Nap-9906 (1550 kg/ha).

Conclusion

Across the locations the highest seed yield (1731 kg/ha) was obtained from Nap-2001 followed by Nap-9906 whereas BARI sarisha-13 gave the lowest mean yield (1582 kg/ha). Among the locations Nap-2001 gave the highest yield (2161 kg/ha) at Kadamshahar, Rajshahi. The experiment should be repeated with the addition of more number of locations for getting clear observation on the adaptability of Nap cultivars.

Table 1. Plant characters of different advanced lines of rapeseed tested under on-farm adaptive trial in farmers' field at high Barind Tract, 2006-07

Entries	Plant pop./Lm	Days to maturity	Plant height (cm)	Branches/ plant	Siliqua/ plant	Seed/ siliqua	Siliqua length (cm)	1000-seed wt. (g)	Seed yield (kg/ha)
Nap-179	29.93	94	93.00	2.73	49.20	21.93	6.11	3.17	1788
Nap-2001	30.80	96	95.60	3.57	63.33	27.00	6.9	3.81	2161
Nap-9906	30.17	97	92.47	3.37	58.73	25.67	6.75	3.73	2065
BARI Sarisha-13	27.80	95	92.40	2.63	51.33	23.00	6.13	3.16	1830
LSD (0.05)	NS	1.63	NS	13.2	8.08	3.27	0.46	0.41	205.40
CV (%)	9.04	3.85	8.67	9.08	12.79	7.72	6.56	3.88	12.24

Table 2. Yield and yield attributes of different advanced lines and varieties of mustard at Faridpur, 2006-07

Treatment	Days to flowering	Days to maturity	Plant pop^n/m^2	Plant height (cm)	Siliqua/ plant (no.)	Seed/ siliqua (no.)	1000-seed wt. (g)	Seed yield (kg/ha)
Nap -179	43	90	62	121.80	77	19.10	3.66	1620
Nap-2001	43	90	62	124.2	84	20.10	3.73	1730
Nap-9906	48	94	64	121.8	89	21.30	3.93	1840
BARI Sarisha- 13	51	94	63	123.9	81	19.9	3.86	1760
LSD (0.05)			NS	NS	2.14	NS	NS	55.2
CV (%)			10.40	12.90	12.30	4.52	2.05	9.78

Table 3. Yield and yield contributing characters of tested rape seed lines/variety at MLT site, Shibpur, Narsingdi during 2006-07

Treatment	Days to flowering	Days to maturity	Plant pop^n (no.)	Plant height (cm)	Pods/ plant (no.)	Seeds /pod (no.)	1000-seed weight (g)	Seed yield (kg/ha)
Nap-179	39	86	996	101	58.55	23.20	3.09	1410
Nap-2001	38	87	997	102	57.40	24.10	3.27	1580
Nap-9906	38	87	1004	103	63.00	23.25	3.52	1660
BARI Sarisha-13	38	88	1006	89	59.90	23.65	2.84	1260
LSD (0.05)	NS	1.65	NS	9.59	5.36	NS	NS	NS
CV (%)	3.63	1.18	1.25	6.06	5.61	4.78	16.29	15.50

Table 4. Performance of advanced lines of rape seed (*Brassica napus*) at MLT site, Jhikorgacha during rabi 2006-07

Entries	Plant Pop./m^2 (no.)	Plant height (cm)	Pods/ plant (no)	Seeds/ pod (no)	1000-seed wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
Nap-179	46	101.00	78.75	23.50	2.90	1.49	3.00
Nap-2001	43	101.25	81.50	26.75	3.05	1.43	3.12
Nap-9906	40	102.00	88.75	28.00	2.95	1.52	3.39
BARI Sarisha-13	43	101.25	85.75	24.25	2.90	1.39	3.27
CV (%)	7.81	12.70	7.07	7.83	9.32	10.05	12.97
F-test	NS	NS	NS	NS	NS	NS	NS

Table 5. Yield and yield contributing characters of different advanced lines /variety of rape seed at MLT site, Kashinathpur, Pabna during 2006-07

Treatments	Days to flower	Days to maturity	Plant height (cm)	Plant pop^n/m^2 (no.)	Pods/plant (no.)	Seeds/ pod (no.)	1000-Seed wt. (g)	Seed yield (kg/ha)
Nap-179	30	92	91.95	95.00	57.00	21	2.70	1562
Nap-9906	33	95	96.97	122.80	63.90	24	2.88	1645
Nap-2001	33	94	95.97	120.50	61.00	23	2.78	1600
BARI Sarisha-13	34	95	100.30	118.80	58.03	21	2.78	1532
LSD (0.05)	1.007	0.799	4.942	37.63	5.537	1.322	0.087	41.61
CV (%)	1.94	0.53	3.21	20.59	5.76	3.72	1.92	11.64

Table 6. Yield and yield contributing characters of different turnip rape mustard at Kushumhati, Sherpur during 2006-07

Treatment	Maturity (days)	Plant ht (cm)	Plants/m^2 (no.)	Pods/plant (no.)	Seeds/pod (no.)	1000-seed wt (g)	Seed yield (kg/ha)
Nap-179	86	101.08a	71.95	83.85a	23.15a	3.06b	1710a
Nap-2001	87	96.83b	76.70	73.55b	20.28b	3.35a	1639ab
Nap-9906	85	99.53ab	67.00	67.23b	19.75b	3.11b	1550b
BARI Sharisha-13	88	98.08ab	68.98	70.83b	20.18b	3.22ab	1587b
F-test	NS	**	NS	*	*	**	*
CV (%)	3.12	6.84	9.10	8.16	6.56	4.33	9.25

Figure in the column having similar letter (s) do not differ significantly

Appendix 1. Yield (kg/ha) of different rapeseed variety/lines at different location during rabi 2006-07

Variety/ lines	Locations					
	Rajshahi	Faridpur	Shibpur	Jessore	Pabna	Mean
Nap-179	1788	1620	1410	1490	1562	1574
Nap-2001	2162	1840	1580	1430	1645	1731
Nap-2006	2065	1730	1660	1520	1600	1710
BARI sarisha-13	1830	1760	1260	1390	1532	1582
LSD (0.05)	205.40	55.2	NS	NS	41.61	-
CV (%)	12.24	9.78	15.50	10.05	11.64	-

On-Farm Trial of Mustard and Rapeseed

Abstract

An on-farm trial was carried out to compare and determine the best rapeseed mustard varieties at the FSRD site, Jalalpur, Sylhet and Patuakhali during 2006-07. Four rapeseed/mustard varieties were evaluated for their yield and yield contributing characters. The highest yield was obtained from BARI sarisha-8 (1730 kg/ha) followed by BARI sarisha-11 (1520 kg/ha). Comparatively the short duration variety BARI sarisha-9 gave reasonable seed yield (1180 kg/ha) at Sylhet whereas BARI sarisha-11 performed better at Razakhali with the seed yield of 1100 kg/ha.

Materials and Methods

The trial was carried out at the FSRD site, Jalalpur, Sylhet and Patuakhali during November 2006 to March, 2007. Four rapeseed/mustard varieties viz. Tori-7, BARI sarisha-8, BARI sarisha-9 and BARI sarisha-11 were used in the trial. The plot size was 10m $\times$3m. Fertilizer was applied at the rate of 250-170-85-150-10 kg/ha of Urea, TSP, MP, Zipsum and Borax, respectively. The seeds were sown on 17 November 2006 at Sylhet and 25 November to 5 December 2006 at Patuakhali and spacing was 30cm $\times$ 10cm. The crop was harvested during 2nd week of February to 1st week of March 2007. Data were collected on yield and yield attributes.

Result and Discussions

Jalalpur, Sylhet

Mustard varieties were evaluated for their yield and yield contributing characters. The yield and yield contributing characters of different mustard varieties were presented in Table 1. The highest yield was obtained from BARI Sarisha-8 (1730 kg/ha) followed by BARI Sarisha-11 (1520kg/ha). The comparatively earliest variety BARI Sarisha-9 gave the reasonable seed yield (1180 kg/ha).

Patuakhali

BARI sarisha-11 produced the highest seed yield at Razakhali (1100 kg/ha) followed by Amtali (950 kg/ha) and Kuakata (820 kg/ha) but BARI sarisha-9 produced higher yield at Razakhali.

Farmers reactions

Sylhet: Farmers of this locality has preferably selected the variety BARI sarisha-8 and BARI sarisha-11 and they also selected the variety BARI sarisha-9 as a short duration variety.

Patuakhali: Farmers are satisfied to get this yield and If it is possible to sow early they expect to get higher yield.

Conclusions and Recommendation

Due to higher yield performance, BARI sarisha-8 (1730 kg/ha) and BARI sarisha-11 are the profitable varieties for this area in terms of yield and economics return. But as a short duration variety BARI Sarisha-9 is also a promising variety with reasonable seed yield performance.

Table 1. Yield and yield contributing characters of five mustard and rapeseed varieties at FSRD site, Jalalpur, Sylhet during 2006-07

Variety	Days to 50% flowering	Days to maturity	Plant height (cm)	Siliqua/ plant (no.)	Seeds/ siliqua (no.)	1000-seed wt.(g)	Seed yield (kg/ha)
Tori- 7	30	76	77.44	55.32	15.23	2.94	914
BARI sharisha-8	42	93	104.55	118.25	22.95	3.12	1730
BARI sharisha-9	33	82	89.22	91.45	15.95	2.84	1180
BARI sharisha-11	45	102	113.76	116.55	13.33	3.21	1520

Table 2. Yield of Mustard varieties at Razakhali, Amtali and Kuakata of Patuakhali during 2006-07

Variety	Location	Yield (t/ha)
BARI sarisha-9	Rhazakali	950
	Amtali	600
	Kuakata	790
BARI sarisha-11	Rhazakali	1100
	Amtali	950
	Kuakata	820

On-Farm Adaptive Trial of Advanced Lines of Groundnut

Abstract

An adaptive trial was conducted in the farmers' field of Noakhali, Kishoreganj and Cox's bazar during rabi 2006-07 to evaluate the performance of groundnut varieties in char area. The highest seed yield (2.39 kg/ha) was recorded in ICGV-90265 while the lowest seed yield was found in Dhaka-1 (1.59 t/ha).

Introduction

Most of the farmers Noakhali, Kishoreganj and Cox's bazar districts cultivate local variety of groundnut with traditional management practices resulting the very low yield compared to HYV. Oilseed Research Center of BARI selected some advanced lines of groundnut on the basis of their performance in the regional yield trials. The yield performances of the selected materials need to be tested in the farmer's field before released as variety for cultivation. So, the present study was undertaken to evaluate the performance of some advanced lines of groundnut under farmers' field conditions.

Materials and Methods

The study was conducted at Noakhali, Kishoreganj and Cox's bazar during the Rabi season of 2006-07. Five groundnut varieties/lines namely; PK-1, ICGV-90227, ICGV-90265, Dhaka-1 and BARI chinabadam-6 were included in the experiment. The experiment was laid out in RCB design with three replications. Unit plot size was 4m × 2m and 25, 160, 85, 30 and 10 kg/ha of Urea, TSP, MP, Gypsum and Boric acid were applied respectively. All fertilizers were applied as basal dose during final land preparation. Seeds were sown in lines maintaining 30 cm × 10 cm spacing. Seed sowing was done during 13 December at Noakhali & Kishoreganj and 12 December of 2006 and harvesting from 13-22 May 2007 at Kishoreganj and 5-18 May 2007 at Cox's bazar.

Results and Discussion

Hazirhat, Noakhali

Maximum plant height (33.47 cm) was found in Dhaka-1and the lowest plant height (30.83 cm) was found in BARI chinabadam-6. Highest number of branch/plant (8.40) was recorded in BARI chinabadam-6 that was followed by ICGV-90265 (8.34) and the lowest number from PK-1. The maximum pod per plant (22.26) was recorded in Dhaka-1 that was followed by ICGV 90265 (20.91) while the minimum number of pod per plant was recorded in ICGV-90227 (16.34). The maximum seeds/pod (1.80) was recorded from ICGV 90227 followed by ICGV-90265, BARI **c**hinabadam-6 and PK-1. The lowest seeds/pod (1.59) was found in Dhaka-1. But in case of the weight of 100 kernels the highest kernels weight (48.33 g) was calculated from BARI Chinabadam-6, which was followed by ICGV 90227 (47 g) and the lowest found in Dhaka-1 (31.33 g). The highest seed yield (1.43 kg/plot) was recorded in ICGV 90265 that was followed by BARI Chinabadam-6 (1.39 kg/plot) and ICGV-90227 (1.37 kg/plot) while the lowest seed yield was found in PK-1 (1.06 kg/plot).

Hossainpur, Kishoregonj

The result showed that plant height, pods/plant, kernels/pod, 100-kernel wt., shelling percentage and pod yields were significantly different in groundnut varieties/lines. The higher plant height was recorded from BARI chinabadam-6 which was statistically at par to ICGV-90227 and ICGV-90265 lines. The line ICGV-90265 showed higher pods/plant followed by ICGV-90227 and BARI chinabadam-6 and PK-1. Shelling percent was statistically at par in all advanced groundnut lines. Higher 100-kernel weight and pod yield was recorded from ICGV-90227 which was statistically similar to ICGV-90265 line. The line ICGV-90227 gave the higher nut yield due to higher number of kernel/pod, higher100-kernel weight and higher shelling percent. The highest gross return (Tk.76500 ha^{-1}) and benefit cost ratio (2.32) was calculated from ICGV-90227 which was very closely to ICGV-90265.

Cox's bazaar

The result showed that plant height, pods/plant, seeds/pod, 100-seed weight and pod yield were significantly different among the groundnut varieties/lines. The highest plant height (47.80 cm) was recorded from BARI badam-6 which was statistically different from other varieties. The maximum number of branches/plant (8.3) was recorded from ICGV-90265 which was statistically identical with the line ICGV-90227 (7.2). The highest number of pods/plant (21.03) was recorded from PK-1. Higher 100-seed weight (53.28 g) was recorded from variety BARI badam-6 which was statistically identical with ICGV-90265 and PK-1. Higher pod yield (3.14 t/ha) was recorded from ICGV-90265 which was statistically identical with ICGV-90227 (2.97 t/ha) and BARI badam-6 (3.04 t/ha). The lowest pod yield (1.85 t/ha) was recorded from the local variety.

Farmer's reaction

Noakhali: Farmers of this area were interested about ICGV-90227. They also preferred BARI chinabadam-6 and ICGV-90227 for their higher yield.

Kishoreganj: Farmer's of MLT site, Hossainpur opined that there was an incidence of insect and diseases in the line ICGV-90227 and ICGV-90265. They also opined that the yield of ICGV-90227 was higher than other lines/varieties. Farmers preferred ICGV-90227 due to higher, pod size and disease and insect resistant.

Table 1. Performance of advanced groundnut varieties/lines in the coastal area of FSRD site, Hazirhat during 2006-07

Variety/line	Plants/plot (after germination)	Plant/plot (at harvest)	Days to maturity	Plant height (cm)	Branches / plant	Pods/ plant	Seeds/ pod	100-kernel wt (g)	Nut yield (kg /plot)	Nut yield (t/ha)
PK-1	122	97	148	31.83	6.88	16.90	1.75	37.00	1.06	1.32
ICGV-90227	134	99	150	32.39	7.96	16.34	1.80	47.00	1.37	1.71
ICGV-90265	111	91	148	31.25	8.34	20.91	1.80	41.67	1.43	1.78
Dhaka-1	138	98	142	33.47	7.12	22.26	1.59	31.33	1.09	1.36
BARI chinabadam-6	127	92	150	30.83	8.40	17.85	1.76	48.33	1.39	1.73
LSD (0.05)	-	-	-	4.225	0.699	4.613	0.133	5.202	1.191	
CV (%)	-	-	-	7.07	10.50	13.00	4.25	6.73	15.82	

Table 2. Performance of groundnut lines/varieties at MLT site, Hossainpur, Kishoregonj, during rabi 2006-07

Variety	Plant height (cm)	Pod/plant (no.)	Kernel/pod (no.)	100-kernel wt. (g)	Shelling %	Days to maturity	Nut yield (t/ha)
PK-1	50.66	19	1.43	34.60	63	150	2.15
ICGV-90227	55.80	24	1.66	43.40	71	154	3.06
ICGV-90265	54.70	30	1.60	30.53	69	157	2.89
Dhaka-1	41.80	16	1.50	26.03	65	147	1.82
BARI chinabadam 6	56.06	22	1.66	42.37	69	153	2.47
LSD (0.05)	3.69	11.70	ns	3.09	3.82	1.79	0.40
CV (%)	3.79	28.03	11.69	4.65	3.01	0.62	7.79

Table 3. Cost and return analysis of groundnut lines/varieties tested at MLT site, Hossainpur during, rabi 2006-07

Variety	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
PK-1	53750	32625	21125	1.65
ICGV-90227	76500	33018	43482	2.32
ICGV-90265	72250	33018	39232	2.18
Dhaka-1	45500	32625	12875	1.39
BARI chinabadam-6	61750	32625	29125	1.89

Price (Tk./kg): Urea= 6, TSP= 19, MP= 16, Gypsum= 4, Boric acid= 110, Labour= 100, Pod= 25

Table 4. Performance different varieties/lines of groundnut at Cox's bazar during 2006-07

Treatment	Plant height (cm)	Plants/ m^2	Branches/ plant	Seeds/ pod	Pods/ plant	100-seed wt. (g)	Nut yield (t/ha)
PK-1	35.53c	24.67c	6.70b	1.87ab	21.03a	48.57ab	2.84b
ICGV-90227	34.60c	25.00c	7.20ab	2.00a	15.73c	45.58b	2.97ab
ICGV-90265	29.87d	26.24b	8.30a	1.80ab	17.23b	48.33ab	3.14a
Dhaka-1	42.87b	23.72d	4.70c	1.90ab	16.73bc	35.31d	2.82b
BARI chinabadam-6	47.80a	27.00b	5.43bc	1.70b	15.67c	53.28a	3.04ab
Local	33.67c	29.33a	4.77c	1.47c	14.17c	39.87c	1.85c
F-test	*	*	**	*	**	*	**
CV (%)	7.18	5.97	2.17	1.27	10.69	7.21	12.32

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Screening of Groundnut Genotypes under Rainfed Condition in Char Area

Abstract

The experiment was conducted in the farmers' field of FSRD site at Hazirhat, Noakhali during the Rabi season of 2006-07 to evaluate the performance of groundnut genotypes in char area. The highest nut yield (2835 kg/ha) was recorded in BARI chinabadam-6 followed by JX-87015-SL-1 (2772 kg/ha) and ICGV-90227 (2632 kg/ha) while the lowest nut yield was found in ICGV-96342 (1810 kg/ha).

Introduction

In Noakhali and Laxmipur districts, groundnut is a major oilseed crop generally grown in char areas. Now-a-days groundnut is grown sporadically especially in some pocket areas due to expansion of Boro rice cultivation. Most of the farmers of the coastal area of Noakhali usually cultivate local variety of groundnut with traditional management practices resulting in very low yield compared to HYV. Oilseed Research Center of BARI developed some advanced lines of groundnut on the basis of their performance in the regional yield trials. The yield performances of the developed materials need to be tested in the farmer's field before recommendation as variety for wide spread cultivation. So, the present study was undertaken to evaluate the performance of some advanced lines of groundnut under farmers' field condition.

Materials and Methods

The study was conducted at FSRD site, Hazirhat, Noakhali during the Rabi season of 2006-07. Thirteen groundnut varieties/lines namely; ICGV-96342, ICGV-96346, ICGV-96390, ICGV-97262, ICGV-98369, ICGV-98371, ICGV-94322, ICGV-90227, PK-1, Dhaka-1, BARI chinabadam-6, ACC-12 and JX-87015-SL-1 were included in the experiment. The experiment was laid out in RCB design with three replications. Unit plot size was 4m × 2m. Fertilizer at the rate of 25, 160, 85, 30 and 10 kg/ha of Urea, TSP, MP, Gypsum and Boric acid were applied respectively. All fertilizers were applied as basal during final land preparation. Seeds were sown in lines maintaining 40 cm × 10 cm spacing. Seed sowing was done first week of January 2007 and harvesting was done at maturity for each line and variety. During the experiment period salinity range was 3 to 8.7 ds/m.

Results and Discussion

It was observed that days to flowering (70%) were generally 70-73 days but in BARI chinabadam-6. It was 75 days and days to maturity varied between 142 to 153 days. Maximum plant height (43.40 cm) was found in JX-87015-SL-1 but it was statistically identical with ACC-12 (43.27 cm) and ICGV-96390. The lowest plant height (28.86 cm) was found at PK-1. The highest number of branch/plant (9.10) was recorded in ICGV-98369 and the lowest number of branch/plant (6.63) was found in ICGV-96346. All other lines/varieties were statistically similar in case of branch per plant. The highest (24.87) mature pod per plant was found in ICGV-98369 and lowest mature pod per plant (17.24) in ICGV-96342. The highest (9.87) immature pod per plant was found in ICGV-96390 and lowest immature pod per plant (5.14) in ICGV-96342. The maximum 100-nut weight was found in ICGV-90227 which was followed by BARI chinabadam-6 and JX-87015-SL-1. The minimum weight was found in Dhaka-1. But in case of 100-weight of kernel, the highest kernels weight (73.76 g) was observed from ICGV-90227 and it was statistically identical with BARI chinabadam -6 (68.42 g) and the lowest (42.55 g) in Dhaka- 1. The highest nut yield (2835 kg/ha) was recorded in BARI Chinabadam-6 that was followed by JX-87015-SL-1 (2772 kg/ha) and ICGV-90227 (2632 kg/ha) while the lowest nut yield was found in ICGV-96342 (1810 kg/ha). The highest shelling percentage (67.06 %) was found in Dhaka-1 and the lowest (56.00 %) was in ACC-12 and there was no significant difference among them.

Farmers reaction

Farmers usually cultivate Dhaka-1. They preferred BARI cinabadam-6 owing to its better yield and good market price. They also showed their interest about JX-87015-SL-1 and ICGV-90227 for their better performance.

Conclusion

From the study it was observed that, BARI cinabadam-6, JX-87015-SL-1 and ICGV-90227 performed better regarding yield in coastal area. For more confirmation the experiment should be repeated in the next year.

Table 1. Plant characteristics of groundnut genotypes under rainfed condition in char area of Noakhali during 2006-07

Variety/ Lines	Days to flowering (70%)	Days to maturity	Initial plant pop^n/ plot (20 DAG)	Final plant pop^n/plot (at harvest)
ICGV-96342	72	147	110	95
ICGV-96346	70	149	105	87
ICGV-96390	70	145	105	92
ICGV-97262	69	150	115	92
ICGV-98369	72	150	155	108
ICGV-98371	72	152	105	90
ICGV-94322	70	150	140	107
ICGV-90227	70	154	120	102
PK-1	69	146	115	100
Dhaka-1	73	142	165	129
BARI chinabadam-6	75	153	130	111
ACC-12	73	148	135	103
JX-87015-SL-1	73	153	115	97

Table 2. Yield and yield contributing characteristics of groundnut genotypes under rainfed condition in char area of Noakhali during 2006-07

Variety/ Lines	Plant height (cm)	Branches/ plant	Mature pods/plant (no.)	Immature pods/plant (no.)	100-kernel wt. (g)	Weight of kernel/ 100-nut (g)	Nut yield (kg/ha)	Shelling (%)
ICGV-96342	30.16	6.73	17.24	5.14	88.41	56.18	1810	63.54
ICGV-96346	34.04	6.63	20.97	6.88	81.87	50.17	1867	61.28
ICGV-96390	40.01	6.73	21.53	9.87	77.83	48.25	1927	62.00
ICGV-97262	28.91	6.79	20.43	6.45	87.89	54.67	2065	62.20
ICGV-98369	38.35	9.10	24.87	7.63	75.62	45.24	2539	59.82
ICGV-98371	34.91	7.77	23.63	8.17	93.85	56.30	2495	59.99
ICGV-94322	31.16	7.70	17.81	7.14	86.06	53.66	2050	62.35
ICGV-90227	29.03	7.35	17.95	7.13	115.00	73.76	2632	64.14
PK-1	28.86	7.00	23.60	8.43	72.88	46.44	2150	63.72
Dhaka-1	29.61	7.19	21.23	6.07	63.45	42.55	2172	67.06
BARI chinabada-6	32.96	8.74	19.42	9.59	105.21	68.42	2835	65.03
ACC-12	43.27	7.01	18.02	7.58	85.34	46.94	1980	56.00
JX-87015-SL-1	43.40	7.94	22.77	8.67	100.40	59.67	2772	59.43
LSD (0.05)	5.730	1.088	5.743	3.074	17.61	5.912	606.8	NS
CV (%)	9.94	15.36	9.44	14.01	7.45	5.88	19.27	12.95

On-Farm Adaptive Trial of Advanced Lines of Soybean

Abstract

An experiment was conducted at Mymensingh, Kishoreganj, Laxmipur, Noakhali, Satkhira and Patuakhali during rabi' 2006-07 to test the performance of advanced lines/varieties of soybean with a local check. A total of 10 advance lines were undertaken where 4-8 lines were considered under different locations. Among the tested lines and varieties, higher yield was observed from Amber followed by TGX-814 and BARI soybean-4 at Mymensingh, TGX-814 at Kishoreganj, Amber at Laximpur, Shohag and BARI soybean-5 at Satkhira, the line MACS-75 at Noakhali whereas BARI soybean-5 and Bangladesh soybean-4 showed similar yield at Patuakhali.

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. We use soybean oil for cooking. Extraction of soybean oil from 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. Soybean produced in the country is used in poultry industry and for making nutritious food items like soyadal, soyakhechuri, soyamisty, soyapolao, soyamilk, soyacake, soyabiscuits, soyabread etc. Oil Seed Research Centre, BARI has developed some varieties/advanced lines of soybean which need to be tested in the farmers field. So, the experiment was designed to evaluate the performance of advanced line/varieties of soybean at different locations.

Materials and Methods

The experiment was conducted at farmers' field of simultaneously of Mymensingh, Kishoreganj, Laxmipur, Naokhali and Satkhira during rabi 2006-07. 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 the 10 advanced lines where 4 to 8 lines were included under different locations. The crop was fertilized with NPKS @ 25-33-55-18 kg/ha, respectively. Half of N and all other fertilizers were applied as basal. Rest half of N was applied at 30 days of sowing after first weeding. Second weeding was done at 50 days of sowing. The seeds were sown during 7 December 2006 at Mymensingh & Kishoreganj, 15 January 2007 at Noakhali, 10 December 2006 at Satkhira and 22 December 2006 at Patuakhali. The crop was sown at a spacing 30cm apart row 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 seed. Other intercultural operations were done as and when necessary. At maturity the crop was harvested during 15 April 7 Mymensingh, 7 May at Noakhali and 30 March at Patuakhali of 2007. Data on yield and yield contributing characters were recorded and analyzed statistically following computer package program MSTAT-C.

Results and discussion

MLT site, Trishal, Mymensingh

The plant characters viz. population/m^2, number of pods/plant, number of seeds/pod and 1000 seed weight were not statistically significant. But grain and stover yield, plant height and number of branches/plant were significant. Higher plant height (49.0 cm) and number of branches/plant (1.68) were observed in the variety Shohag followed by TGX-814. The advanced line Amber gave higher seed yield, but it was identical to TGX-814 and BARI soybean-5. Higher seed yield in Amber was attributed due to higher 1000 seed weight, higher number of seeds/plant and higher population per unit area. The local variety gave the lowest seed yield (1.15 t/ha) and it was statistically identical Shohag. Higher stover yield (1.61 t/ha) was observed in the advanced line TGX-814 which was identically to line Amber and variety BARI soybean-5.

Hossainpur, Kishoreganj

The line TGX-814-230 took minimum days (98 days) to mature along with short plant type (55.88 cm). The higher number of pods/plant was found in TGX-814-230 with higher number of seed per pod followed by Amber. The advance line TGX-814-230 gave the highest seed yield. The TGX-814-230 gave 11 and 13% higher yield than BARI soybean-5 and Shohag, respectively. It might be due to higher number of pods/plant, higher seed/pod and 100-seed weight. All the varieties were more or less susceptible to insect and diseases. The maturity days close to each other by variety/line.

Laxmipur

Higher plant height was found in Amber followed by TGX-814-230 and both are statistically identical. The lowest plant height (39.6 cm) was found in BARI soybean-5. The maximum no. of pods per plant (37.37) was recorded in Amber and the minimum no. of pods per plant (27.23) was found in BARI soybean-5. The line TGX-814-230 and Shohag are statistically similar with BARI Soybean-5 in case of pods per plant. The highest 100seeds weight (14.33 gm) was recorded in Amber and the lowest 100 seeds weight (13.33 gm) was recorded in BARI soybean-5. The maximum seed yield (3.15 t/ha) was obtained in Amber followed by line TGX814-230. The variety Sohag and BARI soybean-5 showed similar yield but lower yield than other variety/lines.

Noakhali

Higher plant height (46.5cm) was found in MACS followed by LG-92-P-1141(45.6 cm) and both were statistically identical. The lowest plant height (39.6cm) was found at Shohag. There are no significant difference in branch per plant of all lines and the maximum branch per plant (3.4) was found in MACS-57 and lowest branch per plant (2.8) found in Shohag.The maximum no. of pods per plant (34.1) was recorded in TGX-814-230 followed by MACS-57 and Sohag. The lowest no. of pods per plant (27.1) was found in JS-335 followed by JZ-1 and Amber. The highest 100-seeds weight (15 g) was recorded in MACS-57 and the lowest 100-seeds weight (13.33 g) was recorded in BARI soybean-5. Maximum yield (2.78 t/ha) was obtained in MACS-57 followed by line LG-92-P-1141 and TGX-814-230.

Satkhira

Pods/plant, 100-seed weight and seed yield were differed significantly by varieties. The result revealed that the maximum seed yield (1.87 t/ha) was obtained from Shohag but all the varieties were identical. The lowest yield produced by Bangladesh soybean-4 could be due to minimum plant population/m^2, seed/pod and seed weight. No viral disease infestation was observed in any variety. Aphid infestation was observed.

Patuakhali

BARI soybean-5 produced the maximum seed yield (1083 kg/ha) which was identical to that of Bangladesh soybean-4 (1040 kg/ha). Soil sample analysis showed that soil salinity of the experimental plots was less than 2 dS/m. This was first year result and the experiment should be shifted from the next year where soil salinity prevails.

Farmer's reaction

Mymensingh: The farmers preferred the advanced lines TGX-814 and Amber and also the variety BARI Soy-5 for their higher yield than the control.

Kishoreganj: All the varieties were more or less susceptible to insect and diseases. They preferred the line TGX-814-230 due to its higher yield, bolder seed size.

Laxmipur: Farmers are very much interested for the new lines (Amber and TGX 8142-30) for their higher yield.

Noakhali: MACS-57, LG -92-P-1141, TGX-814-230 are highly accepted by the farmers for higher yield as well as bold seed size.

Patuakhali: Farmers take it as a new crop. Soybean seed was not available in the local seed market. There is no marketing of soybean in this area.

The experiment should be repeated with more number of replications

Table 1. Yield and yield contributing characters of soybean at MLT site, Trishal, Mymensingh during rabi' 2006-07

Varieties/lines	Plant population/ m^2	Plant height (cm)	No. of branches / plant	No. of pods/ plant	No. of seeds/ pod	1000-seed weight (g)	Seed yield (t/ ha)	Stover yield (t/ha)
TGX -814	35.3	49.0	1.65	30.7	2.0	126.3	1.58	1.61
BARI soybean-5	37.0	42.1	1.43	30.5	2.1	123.8	1.55	1.58
Amber	39.8	47.7	1.35	29.5	2.1	125.0	1.66	1.59
Sohag	30.8	49.0	1.68	30.1	2.1	122.5	1.20	1.26
Local	34.8	48.6	1.38	29.7	2.0	125.0	1.15	1.30
LSD (0.05)	NS	2.93	0.18	NS	NS	NS	0.26	0.22
CV (%)	11.21	4.02	7.84	12.31	4.32	3.52	11.93	9.74

Table 2. Yield performance of soybean varieties /lines at MLT site, Hossainpur, Kishoreganj, during rabi, 2006-07

Varity/line	Days to maturity	Plant height (cm)	Pods/plant (no.)	Seeds/pod (no.)	100-seed wt. (g)	Seed yield (kg/ha)
Amber	101	58.87	33.97	2.55	10.20	1216
TGX-814-230	98	55.88	34.27	2.60	10.50	1256
BARI soybean-5	102	57.90	31.60	2.60	9.93	1127
Sohag	100	57.52	28.58	2.41	9.29	1107
CV (%)	0.93	5.40	12.29	5.92	2.96	8.87
LSD (0.05)	1.46	4.98	5.28	0.248	0.449	35.23

Table 3. Yield and yield contributing characteristics of adaptive trial of advanced lines/varieties of soybean at Laxmipur during 2006-07

Variety/ Lines	Plant height (cm)	Pods/plant (no.)	Seeds/pod (no.)	100-seed weight (gm)	Seed yield (t/ha)
Amber	48.27	37.37	2.2	14.33	3.15
TGX 814-230	45.70	29.97	2.0	14.00	2.89
Sohag	39.63	30.40	2.1	13.67	2.81
BARI soybean-5	42.50	27.23	2.0	13.33	2.71
LSD (0.05)	5.701	4.691	0.252	0.744	0.32
CV (%)	6.48	7.49	6.07	2.69	5.64

Table 4. Yield and yield contributing characteristics of soybean varieties and lines at Noakhali during 2006-07

Variety/ Lines	Plant height (cm)	Branches/ plant (no.)	Pods/plant (no.)	Seeds/pod (no.)	100-seed weight (gm)	Seed yield (t/ha)
BARI soybean-5	42.3	2.9	28.2	2.1	13.33	2.16
Sohag	39.6	2.8	32.3	2.0	13.67	2.23
JS-335	41.4	3.1	27.1	2.0	14.33	2.10
MACS-57	46.5	3.7	32.2	2.1	15.00	2.78
JZ-1	44.7	3.4	27.3	2.2	14.00	2.34
TGX-814-230	43.6	3.4	34.1	2.0	14.00	2.58
LG -92-P-1141	45.6	3.5	32.3	2.1	14.67	2.68
Amber	42.1	3.4	27.5	2.3	13.67	2.36
LSD (0.05)	4.99	NS	4.25	0.25	0.66	0.56
CV (%)	6.58	17.45	8.07	6.78	2.68	13.35

Table 5. Yield and yield attributes of soybean as affected by varieties tested at Banerpota Farm, Satkhira during rabi season, 2006-‘07.

Variety	Days to maturity	Plant pop^n/m^2	Plant height (cm.)	Pod/ plant	Seeds/ pod	100 seed weight (gm.)	Seed yield (t/ha.)	Stover yield (t/ha.)
Sohag	117	64.00	69.00	62.67	2.97	11.20	1.87	1.17
Bangladesh soybean-4	117	62.67	79.33	70.33	2.37	8.00	1.67	2.53
BARI soybean -5	126	64.67	64.67	55.67	2.90	12.00	1.84	1.10
LSD (0.05)		12.06	16.99	10.25	2.08	2.31	NS	1.23
CV (%)		2.98	3.77	2.57	11.96	3.51	2.06	12.24

Table 6. Yield and yield attributes of different soybean varieties at Kuakata, Patuakhali during 2006-07

Variety	Plant pop^n (m^{-2})	Plant height (cm)	# Pods/plant	Seed yield (kg/ha)
Bangladesh soybean-4	39	36.4	22	1040a
BARI soybean-5	39	34.6	28	1083a
Sohag	33	27.2	27	957b
CV (%)				11.2

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On-Farm Adaptive Trial of Advance Lines of Sesame

Abstract

The experiment was conducted at FSRD site, Razakhali Patuakhali during rabi 2006-07 with BARI Til-2, 3, Atsira and local one as check to observe their performance in farmers' field. Atsira yielded highest (950 kg/ha) followed by BARI Til-3. Local variety produced the lowest yield (590 kg/ha).

Materials and Methods

The experiment was conducted at FSRD site, Razakhali, Patuakhali during rabi season of 2006-2007 with BARI Til-2, 3, Atsira and local one as check. Sowing was done on 28 January, 2007 and was harvested on 20 May, 2007. Plot size was 4 m × 5 m in each dispersed replication of five. Plots were fertilized with 60-30-40 kg/ha N P K. All fertilizers were applied at the final land preparation. The crop was cultivated totally under rainfed condition.

Results and Discussion

Atsira yielded highest (950 kg/ha) followed by BARI Til-3 (820 kg/ha). Local variety produced the lowest yield (590 kg/ha). This was first year result and the experiment should be repeated for next year.

Farmers' reaction

- Farmers liked Atsira.
- They demand seeds of BARI variety.

Table 1. Yield and yield attributes of different sesame varieties at Razakhali in rabi, 2006-07

Variety/line	Plants/m^2	Plant height (cm)	# capsule/ plant	# seeds/ capsule	Seed yield (kg/ha)
BARI Til-2	38	84	40	52	785 b
BARI Til-3	35	79	43	54	820 ab
Atsira	36	76	39	62	950 a
Local	35	62	34	42	590 c
CV (%)					8.75

On-Farm Trial of Brinjal Varieties

Abstract

An experiment was conducted at Mymensingh, Sherpur and Gazipur during rabi session 2006-07 to test the performance of BARI begun-6. Out of the two tested varieties, BARI begun-6 gave the highest marketable yield with the highest BCR (7.77 at Mymensingh and 3.09 at Sherpur).

Introduction

Brinjal is one of the most important vegetables grown round the year in Bangladesh. Vegetable section of Bangladesh Agricultural Research Institute has developed some high yielding varieties of brinjal. Greater Mymensingh specially Mymensingh Sadar, Jamalpur, Sherpur are intensive brinjal growing area. On-farm testing of BARI developed brinjal varieties is needed in farmer's field.

Materials and Methods

The experiment was conducted at Mymensingh, Sherpur and Gazipur district during rabi 2006-07 to evaluate the relative performance of the BARI developed brinjal variety along with the farmer's local. The design of the experiment was randomized complete block with four replications. The varieties were BARI begun-6 and local. The unit plot size was 3.5 m × 5.6 m. Forty days old seedlings were planted at spacing 70cm × 70 cm. The crop was fertilized with soil test based (STB) fertilizer dose for high yield goal following FRG 2005. The STB fertilizer dose was 116-45-60-8000 kg/ha of N, P, K and cowdung. Half of the quantity of cowdung was applied during land preparation. The remaining cowdung and the entire amount of P and $^{1}/_{3}$ of each of N and K were applied during pit preparation. The rest of N and K were applied in two equal splits during 21 and 35 DAT. All other intercultural operations like weeding, pest control and irrigation were done as and when necessary. First fruit harvest was started from 16 February in BARI begun-6 and 5 February in local and harvest continued up to 24 April 2007 for both the varieties. Data on yield and yield contributing characters and economical data were recorded and analysed statistically.

Results and Discussion

Mymensingh: Out of the two varieties, BARI begun-6 gave higher yield attributes and yields. Plant height was higher (106.9 cm) in BARI begun-6 which was close to local. Number of branches/plant was highest (7.0) in BARI begun-6 and the lowest (5.6) in local. Local variety gave the highest number of fruits/plant (19.4). Higher fruit weight/plant (1.34 kg) was obtained from BARI begun-6 and local variety produced 1.26 kg. However, BARI begun-6 gave the highest fruit yield of 27.45 t/ha and local produced 25.95 t/ha. Out of the two varieties, BARI begun-6 gave the highest gross return (Tk.219600/ha), gross margin (Tk. 191340/ha) and benefit cost ratio (7.77).

Jhenaigati, Sherpur: Plant height and no. of fruits/plant was maximum in local variety but other yield attributes were maximum in BARI begun-6. This is the why the yield was higher in BARI begun with maximum benefit (7.77).

Dhirashram, Gazipur: Out of two varieties, local gave better plant height (92.6 cm), no. of branches/plant (9.7) and no. of fruits/ plant (15). But BARI begun-6 gave better weight of fruits/plant (1.61 kg/plant) and weight/fruit (189.10 g/plant). BARI begun-6 gave the highest fruit yield (31.12 t/ha) and local produced 20.7 t/ha due to lower weight of fruits/plant (1.04 kg) and individual fruit weight (69.35 g). BARI begun-6 gave the highest gross return (Tk. 248960/ha), gross margin (Tk.206235/ha) and benefit cost ratio (5.83) .

Farmer's reaction

Mymensingh: The farmers preferred the variety BARI begun-6 for its good colour, large round size and interested to grow the BARI begun-6 in the Mymensingh area. Supply of seed (BARI begun-6) should be ensured.

Sherpur: The yield of BARI bagun-6 is higher than the local. The local farmers did not accept it because of round shape. On the other hand, the local variety is long and preferred by the farmers.

Gazipur: The farmers are not interested to grow the BARI Begun-6 due to the lower number of fruits/plant and its taste.

Table 1. Yield, yield contributing characters and cost and return analysis of brinjal varieties (Mymensingh Sadar, 2006-07)

Varieties	Plant height (cm)	No. of branches/ plant	No. of fruits/ plant	Wt. of fruits/plant (kg)	Marketable yield (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
BARI begun-6	106.9	7.0	5.3	1.34	27.45	219600	28260	191340	7.77
Local	100.3	5.6	19.4	1.26	25.95	129750	28260	101490	4.59

Price (Tk./kg): BARI begun-6= 8 and Local= 5

Table 2. Yield of brinjal varieties in the farmer's field at MLT site, Jhenaigati, Sherpur during 2006-07

Varieties	Plant height (cm)	No. of fruits/ plant	Fruit dia. (cm)	Wt. of fruits /plant (kg)	Marketable yield (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
BARI begun-6	71.5	9.5	7.16	1.76	35.95	179750	58133	121617	3.09
Local	83.2	11.4	4.58	1.60	32.67	163350	58133	105217	2.80

TVC includes the cost of seeds, fertilizer, insecticides and human labour cost etc. Price: Tk.5.00/kg

Table 3. Yield and yield contributing characters of Brinjal varieties at MLT site, Dhirashram, Gazipur sadar during the rabi season of 2006-07.

Varieties	Plant height (cm)	No. of branches/ plant	No. of fruits/ plant	Weight/fruit (g)	Weight of fruits/plant (kg)	Yield (t/ha)
BARI begun-6	86.0	7.1	8.6	189.1	1.61	31.12
Local	92.6	9.7	15	69.4	1.04	20.7

Table 4. Cost and return analysis of Brinjal varieties at MLT site, Dhirashram, Gazipur sadar during the rabi season of 2006-07.

Varieties	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI begun-6	248960	42725	206235	5.83
Local	103500	42725	60775	2.42

Price (Tk./kg): BARI Begun-6= 8/- & Local= 5/-

Appendix 1. Yield (t/ha) of BARI begun-6 is compared to local cultivars under two different location during 2006-07

Varieties	Location			Mean
	Mymensingh	Sherpur	Gazipur	
BARI begun-6	27.45	35.95	31.12	31.51
Local	25.95	32.67	20.70	26.44

On-farm Trial of BARI Tomato Varieties

Abstract

The experiment was conducted at Shibpur, Narsingdi, Mymensingh and Noakhali during rabi season of 2006-07 to evaluate the performance of BARI released tomato varieties under farmers' conditions. Four varieties viz. BARI tomato-3, BARI tomato-6, BARI tomato-7 and BARI tomato-12 along with local variety were tested. The highest fruit yield was obtained from BARI tomato-7 with BCR (5.85) at Shibpur, BARI tomato-12 at Noakhali BARI tomato-7 and BARI tomato-8 performance better whereas at Mymensingh higher BCR was obtained from BARI tomato-8 due to high price.

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 parameters (Hossain *et al*., 2006). These varieties have potential to help generate farmers' income in a very short period of time. The present study aims at evaluating the performance of some BARI developed varieties in farmers' field condition and popularize them among the farmers to promote their adoption in that area.

Materials and Methods

The experiment was conducted at Shibpur, Narsingdi, Mymensingh and Noakhali during Rabi season of 2006-07. Four varieties viz. BARI tomato-3, BARI tomato-6, BARI tomato-7 and BARI tomato-12 along with local variety were tested in the farmers' field. The experiment was laid out in RCB design with four replications. The unit plot size was 4.8 m x 1m with plant spacing of 60 cm x 40 cm. Twenty-five days old seedling were transplanted in the field from 26 November to 2 December 2006. Manures and fertilizer were applied at the rate of 10 tons cowdung/ha, Urea 550 kg/ha, TSP 450 kg/ha and MP 250 kg/ha. Half quantity of cowdung was applied during land preparation. The remaining half of cowdung, the entire amount of TSP and $^{1}/_{3}$ each of urea and MP were applied during pit preparation. The rest of urea and MP were applied in two equal installments 21 and 35 days after transplanting. All intercultural operations were done as and when necessary. Tomato was harvested during 22 March to 24 April 2007. Data were collected and analyzed statistically.

Result and Discussion

Shibpur. Narsingdi

Plant height was statistically identical in all the variety except local one. Maximum number of fruits per plant was found in BARI tomato-3 (36.05) and minimum in local variety. The highest individual fruit weight was found in BARI tomato-7 (135.75 g). The highest fruit yield was obtained from BARI tomato-7 (124.50 t/ha) due to individual fruit weight. All the variety performed better with reseasonable yield except local one.

Cost and return analysis: Out of the four tested varieties and one local variety, BARI tomato-7 gave higher gross return (Tk. 996000/ha), gross margin (Tk. 826000/ha) and benefit cost ratio (5.85). Other varieties also gave satisfactory benefit cost ratio (5.15-5.50). The lowest benefit cost ratio was found in local variety (2.03).

Trishal, Mymensingh

All the yield contributing characters and yield of the tomato varieties differed significantly. The longest plant height (106.6 cm) was in BARI tomato-7 whereas the local one shorter (72.3 cm). Number of branches/plant was higher (19.0) in local variety. Number of fruits/plant was higher in local variety but BARI tomato-6 gave the lowest number of fruits/plant (9.5). Weight of fruits/plant was the highest (1.20 kg) in BARI tomato-12. The highest fruit yield was obtained from variety BARI tomato-12. BARI tomato-8 gave the second highest yield which was identical to local variety. BARI tomato-12 showed the highest yield due to higher weight of fruits/plant.

Cost and return analysis: Out of the five tested varieties, BARI tomato-8 gave higher gross return (Tk.347200/ha), gross margin (Tk.296400/ha) and benefit cost ratio (6.83). BARI tomato-12 gave the highest yield but due to its lower price it failed to give the highest economic return.

Noakhali

The varieties differed significantly in all characters. Among the varieties BARI tomato-8 produced the maximum number of fruits (14.70/plant) followed by other three varieties except local variety. Maximum individual fruit weight was found in BARI tomato-7 (50.60 g) followed by other variety except local one. The lowest individual fruit weight was found in local variety. The variety BARI tomato-8 given the highest yield but it was statistically similar with BARI tomato-7. The lowest yield was recorded in local variety (14.59 t/ha).

Farmer's reaction

Mymensingh: The farmers preferred the variety BARI Tomato 8 for its high yield, high price, good size (elongate) and colour, suitable for marketing, transporting, less damage during carrying and handling. The variety BARI Tomato 12 was also preferred for its high yield but its demand and price was less.

Noakhali: Farmers are not interested to grow all the BARI tomato varieties because of their soft skin which are not favourable for carrying and also for short shelf-life. Farmers only interested for BARI tomato-8 for its hard skin.

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Table 1. Yield and yield contributing characters of BARI Tomato varieties at Shibpur, Narsingdi during 2006-07

Variety	Plant height (cm)	Branches/ plant	Fruits/ plant	Individual fruit wt. (g)	Wt. of fruit/plant (kg)	Fruit yield (t/ha)
BARI tomato-3	151	2.55	36.05	92.85	3.34	115.87
BARI tomato-6	156	2.75	34.65	96.65	3.34	117.00
BARI tomato-7	151	2.75	32.80	135.75	4.44	124.50
BARI tomato-12	154	3.30	33.75	93.20	3.14	109.50
Local	129	2.65	24.30	36.60	0.89	30.50
LSD (0.05)	7.16	0.51	1.99	6.78	0.22	7.44
CV (%)	3.13	11.74	3.99	4.83	4.70	4.58

Table 2. Cost and return analysis of BARI Tomato varieties at Shibpur, Narsingdi during 2006-07.

Variety	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI tomato-3	926960	170000	756960	5.45
BARI tomato-6	936000	170000	766000	5.50
BARI tomato-7	996000	170000	826000	5.85
BARI tomato-12	876000	170000	706000	5.15
Local	244000	120000	124000	2.03

Table 3. Yield and yield contributing characters of Tomato varieties at MLT site, Trishal, Mymensingh during Rabi 2006-07

Varieties	Plant height (cm)	No. of branches/plant	No. of fruits/plant	Weight of fruits/ plant (kg)	Fruit yield (t/ha)
BARI tomato-6	100	3.05	9.5	0.86	34.37
BARI tomato-7	107	3.12	12.0	0.98	33.07
BARI tomato-8	76	2.97	16.3	1.03	43.40
BARI tomato-12	105	3.15	12.5	1.20	49.58
Local	72	4.25	19.0	1.01	42.96
LSD(0.05)	4.69	0.29	2.66	0.13	5.24
CV(%)	3.31	5.73	12.47	8.45	8.37

Table 4. Cost and return analysis of different tomato varieties

Varieties	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	B/C ratio
BARI tomato-6	171850	50800	121050	3.38
BARI tomato-7	165350	50800	114550	3.25
BARI tomato-8	347200	50800	296400	6.83
BARI tomato-12	247900	50800	197100	4.87
Local	343680	50800	292880	6.76

Price (Tk./kg): BARI tomato-6, BARI tomato-7 and BARI tomato-12= 6, BARI tomato-8 and Local =8

Table 5. Yield and yield attributes of tomato varieties at FSRD Site, Noakhali during 2006-07

Variety	Plant height (cm)	Fruits/plant (no)	Individual fruit weight (gm)	Fruit yield (t/ha)
BARI tomato-6	94.47	11.40	45.07	21.82
BARI tomato-7	99.82	13.98	50.60	29.93
BARI tomato-8	99.00	14.70	49.57	30.79
BARI tomato-12	90.78	12.40	48.70	25.50
Local	95.50	9.250	37.37	14.59
LSD (0.05)	3.34	3.854	7.217	11.62
CV (%)	7.85	16.56	8.29	25.16

Appendix 1. Fruit yield (t/ha) of tomato varieties across the locations during 2006-07

Variety	Narsingdi	Mymensingh	Noakhali	Mean
BARI Tomato-3	116.75	-	-	116.75
BARI Tomato-6	117.75	34.37	21.82	57.98
BARI Tomato-7	125.37	33.07	29.93	62.79
BARI Tomato-8	-	43.40	30.79	37.09
BARI Tomato-12	110.67	49.58	25.50	61.92
Local	31.05	42.96	14.59	29.53
LSD (0.05)	7.50	5.24	11.62	
CV (%)	4.58	8.37	25.16	

On-Farm Trial of Carrot Varieties

Abstract

An experiment was conducted at Mymensingh, Tangail, Jamalpur and Sherpur during rabi 2006-07 to find out the performance of three imported carrot varieties. Out of the tested varieties, Sakata was agro-economically better than other two varieties (SB-Kurada and New Kurada). Sakata gave 19.2 t/ha of root yield with gross return Tk.153600/ha, gross margin Tk.131525/ha and benefit cost ratio 6.96 followed by the variety New Koroda. The farmers showed their interest to grow the carrot varieties. Sakata and New koroda were better for their good yields and economic returns.

Introduction

Carrot is one of the most important winter vegetable in Bangladesh. The vast floodplain and the char area of Jamuna and Brahmaputra rivers are especially suitable for the crop. In the recent years, carrot cultivation is becoming popular in this area. Though there is no variety recommended by BARI, some imported varieties are performing well in Bangladesh condition. The present study aims at evaluating the performance of available imported varieties in farmers` field to popularize them among the farmers to promote their adoption in greater Mymensingh area.

Materials and Methods

The experiment was conducted at Mymensingh, Tangail, Jamalpur and Sherpur during rabi 2006-07 to evaluate the performance of carrot varieties. The design of the experiment was randomized complete block with three to four replications. The treatments were three Japanese carrot varieties viz i) SB-Kurada ii) Sakata and iii) New Kurada. The unit plot size was 4m× 3m. Seeds were sown during 16 October at Mymensingh, 22-28 November at November & Jamalpur of 2006 with spacing of 25cm × 15 cm following a seed rate of 5 kg/ha. The crop was fertilized with soil test based (STB) fertilizer dose for high yield goal following FRG' 05. The STB fertilizer dose was 116-48-60-6000 kg/ha of N, P, K and cowdung. The entire quantity of cowdung, P and half of each N and K were applied during final land preparation. The rest of N and K were applied in two equal instalments at 3 and 5 weeks after sowing. Intercultural operations were done as and when necessary. The crop was harvested during 15 January at Mymensingh and 10-17 February at Jamalpur of 2007. Data on yield and yield contributing characters were recorded and analyzed statistically. Economic analysis was done on the basis of prevailing market price of input and out put.

Results and Discussions

Mymensingh

Plant height, root length, weight of root/plant and root yield varied significantly However, plant population/m^2 and diameter of root did not vary significantly. Plant height of the varieties ranged from 65.4-71.1 cm, length of root/plant varied from 11.4-11.9 cm and weight of root/plant varied from 72.8-90.6 g. Maximum root yield (19.2 t/ha) was obtained from the variety Sakata which was statistically identical to New Koroda. The variety SB Koroda gave the lowest yield of 15.7 t/ha. Higher root yield in Sakata due to better yield contributing characters in this variety.

Cost and return analysis: Out of the three tested varieties, Sakata gave better economic return than other two varieties. Gross return, gross margin and benefit cost ratio from the Sakata variety were Tk. 153600/ha, Tk. 131525/ ha and 6.96, respectively which were higher than other two varieties. Due to lower yield in SB-Kurada it gave the lower gross return (Tk.125600/ha) and benefit cost ratio (5.69). But all the three varieties showed better economic return (BCR 5.69-6.96).

Ellenga, Tangail

Plant height (cm) and leaves/plant varied were insignificant due to variety. The variety SB Kuroda gave the highest root yield (12.52 t/ha) which was at par with other two varieties new kuroda (11.42

t/ha) and Shin kuroda (11.00 t/ha). The F_1 hybrid produced the lowest yield (9.95 t/ha) though it was at par with new Kuroda and shin Kuroda.

Jamalpur

Plant height, plants/m^2 and root length were found insignificant due to variety variation. But the diameter of the root was found highest in Newkuroda. The other two varieties produced identical root diameter. But the root weight/m^2 was found higher in Takills which was statistically identical t Newkuroda. The variety Konoshinkuroda produced significantly lowest root wt/m^2. However, the highest root yield was obtained from Takills (24.67 t/ha) was statistically identical to Newkuroda (23.67 t/ha). Konoshinkuroda produced the lowest root yield (22.33 t/ha). The highest gross return Tk.123350/ha, gross margin Tk. 78511/ha and benefit cost ratio 2.75 was found from Takills. But BCR (2.49-2.75) did not varied widely.

Jhenaigati, Sherpur

Plant height, plants/m^2 and root length were not found significant due to variety variation. But the diameter of the root was found highest in Newkuroda Gosun. The other two varieties produced significantly identical root diameter. The same pattern of behaviour was also obtained in case of root wt/m^2. The variety Shinkuroda produced significantly lowest root wt/m^2. However, the highest root yield was obtained from Newkuroda Gosun (30.33 t/ha) was statistically identical to Shinkuroda (27.86 t/ha). Newkuroda produced a little lower root yield (27.80 t/ha). Other two varieties yields were idenditcal but lower than former one. The highest gross return Tk.151650/ha, gross margin Tk.106811/ha and benefit cost ratio 3.38 was found from Newkuroda Gosun.

Farmer's reaction

Mymensingh: Farmers were satisfied with the yield of carrot varieties. They are interested to grow the carrot crop as it has a good price (Tk. 8/kg) and demand in the local market.

Tangail: Farmer's were interested to grow this crop because its market price is high. But they are worried regarding the availability of its seeds.

Jamalpur: Farmers were satisfied with the yield of carrot because of better market price in both the locations. The farmers faced the problem of uprooting of carrot by the children when it was not fully matured. They opined that if large scale cultivation was initiated than the problem can be overcome. However, the farmers were interested to grow the carrot as it has good price and demand in the market.

Table 1. Yield and yield contributing characters of different carrot varieties, Mymensingh, 2006-07

Varieties	Plant pop^n/m^2	Plant height (cm)	Root length (cm)	Diameter of root (cm)	Wt. of root/ plant (g)	Root yield (t/ha)
SB Kurada	22.0	65.4	11.4	10.5	72.8	15.7
Sakata	21.2	68.9	11.9	10.4	90.6	19.2
New Kurada	22.0	71.1	11.6	10.1	82.8	18.2
LSD (0.05)	NS	2.87	0.41	NS	8.02	1.76
CV (%)	7.49	2.87	2.43	3.81	6.70	6.82

Table 2. Economic analysis of different carrot varieties at Mymensingh, 2006-07

Varieties	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	B/C ratio
SB Kurada	125600	22075	103525	5.69
Sakata	153600	22075	131525	6.96
New Kurada	145600	22075	123525	6.60

TVC includes cost of seed, fertilizer, insecticide, human labour cost. Price of carrot: Tk. 8.00 /kg.

Table 3. Yield and yield contributing parameter of different varieties/lines under FSRD site Ellenga, Tangail during 2006-07

Variety/lines	Leaves/plant (no)	Plant height (cm)	Root wt/Plant (g)	Root wt (t/ha)
New Kuroda	12 a	59.00 a	127.75 ab	11.42 ab
S. B Kuroda	10 a	60.75 a	137.50 a	12.52 a
Shin Kuroda	11 a	57.00 a	127.00 ab	11.00 ab
F-Hybrid	10 a	55.00 a	111.50 b	9.95 b
CV (%)	11.19	6.43	11.01	10.18

Table 4. Yield and yield contributing character of carrot varieties at Jamalpur Sadar during 2006-07

Variety/lines	Plant ht. (cm)	Plants/m^2 (no.)	Root length (cm)	Diameter (cm)	Root wt./m^2 (g)	Yield (t/ha)
Konoshinkuroda	48.67	63.33	9.60	2.87 b	2.23 b	22.33 b
Takills	56.33	72.33	10.37	2.91 b	2.47 a	24.67 a
Newkuroda	54.07	69.33	9.90	3.29 a	2.37 a	23.67 a
F-test	NS	NS	NS	**	**	**
CV (%)	10.27	14.33	4.07	6.74	8.42	7.42

Figures in column having similar letter(s) do not differ significantly

Table 5. Cost and return analysis of different carrot varieties at Jamalpur Sadar during 2006-07

Variety/lines	GR (Tk/ha)	TVC (Tk/ha)	GM (Tk/ha)	BCR
Konoshinkuroda Takills	111650	44839	66811	2.49
Takills	123350	44839	78511	2.75
Newkuroda	118350	44839	73511	2.63

TVC includes the cost of land preparation, seeds, fertilzer, insecticides, intercultural operations and human labour cost etc. Price: Tk.5.00/kg,

Table 6. Yield & yield contributing character of carrot varieties at Jhenaigati, Sherpur during 2006-07

Variety/lines	Plant ht. (cm)	Plants/m^2 (no.)	Root length (cm)	Diameter (cm)	Root wt/m^2 (g)	Yield (t/ha)
Newkuroda	46.02	64.03	9.62	3.53 b	2.98 b	27.80 b
Newkuroda Gosun	52.69	75.11	9.90	3.72 a	3.14 a	30.33 a
Shinkuroda	53.71	70.14	9.64	3.58 b	2.97 b	27.86 b
F-test	NS	NS	NS	**	**	**
CV (%)	11.32	11.23	7.34	8.16	6.98	6.87

Figures in column having similar letter(s) do not differ significantly

Table 4. Cost and return analysis of different carrot varieties at Jhenaigati, Sherpur during 2006-07

Variety/lines	GR (Tk/ha)	TVC (Tk/ha)	GM (Tk/ha)	BCR
Newkuroda	139000	44839	94161	3.72
Newkuroda Gosun	151650	44839	106811	3.38
Shinkuroda	139300	44839	94461	3.10

TVC includes the cost of seeds, fertilzer, insecticides and human labour cost etc., Price: Tk.5.00/kg

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On-Farm Trial of BARI Motorshuti Varieties

Abstract

The experiment was conducted at MLT site Trishal, Mymensingh and Dhirashram, Gazipur during rabi 2006-07 to evaluate two BARI developed Motorshuti varieties, viz., BARI motorshuti-1 and BARI motorshuti-3. BARI motorshuti-3 was a short duration variety maturing within 69 days whereas BARI motorshuti-1 matured by 98 days. Green pod yield of BARI motorshuti-3 was higher (7.83 t/ha) than BARI motorshuti-1 (6.13 t/ha). But the economic performance of BARI motorshuti-1 was better with gross return Tk. 183900/ha and benefit cost ratio 8.94 compared to BARI motorshuti-3 with gross return Tk.156600/ha and benefit cost ratio 7.61 due to higher price at later part of the season. At Gazipur, higher pod yield (6.3 t/ha) was obtained from BARI motorshuti-1 with the highest BCR (3.79).

Introduction

Motorshuti is a short duration high value winter crop suitable for generating farmers income in short time. It's green pod has high demand as vegetables in the urban areas. Motorshuti contains all the essential amino acids, which are needed for won health. Considering its economic importance BARI made efforts to develop high yielding varieties of the crops and so for recommended three varieties for farmer's use. The present study was undertaken to evaluate the performance of BARI motorshuti varieties under farmers field condition and promote their adoption by the farmers.

Materials and Methods

The experiment was conducted of farmer's field at MLT site, Trishal, Mymensingh and Dhirashram, Gazipur during the rabi 2006-07. Three varieties of motorshuti, viz BARI motorshuti-1, BARI motorshuti-3 and IPSA motorshuti-1 were included in the study for evaluating this performance. The experiment was laid out in a RCB design with 3 replications. The unit plot size was 5m x 3m with plant spacing of 20 cm x 15 cm. The seeds were sown on 13 November at Gazipur and 27 November at Mymensingh of 2006. Manures and fertilizer were applied at the rate of 10 t cowdung/ha, urea 60 kg/ha, TSP 150 kg/ha and MP 100 kg/ha. Full cowdung, TSP and half of urea and MP were applied during the final land preparation. The rest Urea and MP were top dressed after 20 and 30 days of sowing. All intercultural operations were done as and when necessary. BARI Motorshuti-3 and IPSA motorshuti-1 were harvested from 1-12 February 2007 and BARI motorshuti-1 was harvested from 2-8 March, 2007. Data on yield and yield attributes along with other parameter were collected properly and subjected to statistically analysis.

Results and Discussion

Trishal, Mymensingh

Days to maturity of BARI motorshuti-3 variety were 69 days whereas in BARI motorshuti-1 it was 98 days. BARI motorshuti-3 gave higher number of pods/plant and higher pod weight/plant than BARI motorshuti-1. BARI motorshuti-3 gave higher average number of pods/plant (7.1), weight of pods/plant (26.2 g) and 100-green pod weight (417 g). In BARI motorshuti-1, number of pods/plant, weight of pods/plant and 100-green pod weight was 6.4, 23.54 g and 365 g, respectively. Green pod yield was higher in BARI motorshuti-3 (7.83 t/ha) compared to BARI motorshuti-1 (6.13 t/ha). But gross return and benefit cost ratio was higher in BARI motorshuti-1 due higher price obtained at the late harvest time of BARI motorshuti-1. Gross return and benefit cost ratio of BARI Motorshuti-1 were Tk.183900/ha and 8.94, respectively. However, in BARI motorshuti-3 also the reasonable gross return and benefit cost ratio were Tk.156600/ha and 7.61, respectively.

Dhirashram, Gazipur

The results obtained from the study indicate that the tallest pea plant was recorded from BARI motorshuti-3 (57.5 cm) and the shortest (27.8 cm) from IPSA motorshuti-1. The number of pods/plants was found higher in BARI motorshuti-1 (35.2) and the other two varieties produced identical pods/plant. Significantly height number of seeds/plant was recorded from BARI motorshuti-1 (7.7). On the other hand, BARI motorshuti-3 gave higher 100-pods weight (477.3 g) than BARI motorshuti-1 (462.3 g). Higher green pod yield (6.30 t/ha) was obtained from the BARI motorshuti-1 due to higher pods/plant and seeds/pod. The lowest green pod yield (4.0 t/ha) was recorded in IPSA motorshuti-1.

Out of three tested varieties, BARI motorshuti-1 gave better economic return than that of other two varieties. Gross return, gross margin and benefit cost ratio were Tk. 94500/ha, Tk. 69580/ha and 3.79 respectively. Due to lower yield in BARI motorshuti-3 and IPSA motorshuti-1 they gave lower gross return and benefit cost ratio.

Farmer's reaction

Mymensingh: Farmers preferred both the BARI motorshuti varieties for their higher yield and economic return. They are interested to grow both BARI motorshuti-1 and BARI motorshuti-3 varieties in the next year if seeds are available.

Gazipur: Farmers are satisfied with the yield and test of BARI Motorshuti-1. They also got better price of it (Tk. 15/kg). The farmers faced a problem uprooting of motorshuti plant by the small boys and girls to eat when it was not fully matured. However, the farmers are interested to grow the motorshuti as it has a good price and demand in the local market.

Table 1. Yied and yield contributing characters of BARI motorshuti varieties at MLT site, Trishal, Mymensingh during 2006-07

Varieties	Days to maturity	Plant height (cm)	No. of pods/plant	Wt. of green pods/ plant (g)	Wt. of 100-green pod (g)	No. of seed/pod	Green pod yield (t/ha)
BARI motorshuti -1	98	58.3	6.4	23.54	365	3.95	6.13
BARI motorshuti-3	69	57..0	7.1	26.20	417	4.55	7.83

Table 2. Economic analysis of BARI Motarshuti varieties at MLT site, Trishal, Mymensingh during 2006-07

Variety	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	Benefit cost ratio
BARI motarshuti- 1	183900	20575	163325	8.94
BARI motarshuti -3	156600	20575	136025	7.61

BARI motorshuti-1 Tk. 30.00/kg, BARI Motorshuti 3 Tk. 20.00/kg

Table 3. Yield and yield contributing characters of different Motorshuti varieties at Dhirashram MLT site Gazipur Sadar (AEZ 28), during 2006-2007

Treat mentis	Plant height (cm)	Pods/plant (no.)	Seeds/pod (no.)	100-pod wt. (g)	Fresh pod yield (t/ha)
BARI motorshuti-1	54.2b	35.2a	7.7a	462.3b	6.3a
BARI motorshuti-3	57.5a	23.8b	5.9b	477. 3a	5.0ab
IPSA motorshuti-1	27.8c	24.2b	4.0c	341. 0c	4.0b
CV (%)	1.84	2.01	8.29	1.38	17.75

Table 4. Cost and return analysis of different Motorshuti varieties

Treatments	Yield (t/ha)	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI motorshuti-1	6.3	94500	24920	69580	3.79
BARI motorshuti-3	5.0	75000	24920	50080	3.0
IPSA motorshuti-1	4.0	60000	29920	30080	2.0

Price: Motorshuti (all varieties) = Tk. 15/kg

On Farm Trial of Different Varieties of Hyacinth Bean

Abstract

The experiment was conducted at the MLT site, Joypurhat and FSRD site, Jalalpur, Sylhet during 2006-07 to find out the performance of BARI hyacinth been variety along with other varieties. The highest yield was obtained from BARI shim-1 (19.91 t/ha). The lowest yield was obtained from IPSA shim-1 (9.82 t/ha) and it was identical with IPSA shim-2 (10.56 t/ha) and local variety (11.72 t/ha) from Bogra but local variety showed higher yield at Sylhet.

Introduction

Country bean is one of the important vegetable in Bangladesh. It has to compete with other winter vegetable, pulse and oil seeds. Farmers are cultivating country bean with local varieties and do not follow the recommended practices. BARI has developed high yielding variety of country bean which is known as BARI shim-1. To popularize the variety with recommended practices for large scale production is needed. Therefore, a trial was designed to find out the suitable variety of hyacinth bean variety for Bogra area.

Materials and Methods

The trial was conducted at Joypurhat MLT site under Bogra during Rabi 2006-07. The variety BARI shim-1 compared with IPSA shim-1, IPSA shim-2 and local variety. Seeds were sown on August 5-8, 2006 in pit with a spacing 2.5m × 2.5m. The size of pit was 45 × 45 × 45 cm. The crop was fertilized with recommended fertilizer dose of 50-150-150-10,000 kg urea, TSP, MP and cowdung, respectively. Half of cowdung and TSP were applied at the time of final land preparation. Remaining half of cowdung, full MP, half urea and half TSP were applied at pits. Remaining half of urea was applied as top dress at 30 DAS. Inter cultural operation was done as and when necessary. The crop was harvested during November, 2006 and continued up to January, 2006.

Results and Discussion

MLT site, Joypurhat

The harvest duration was more or less similar except local variety. The highest seeds/pod was obtained from BARI shim-1 (4.67) and the lowest from IPSA shim. The highest pods/plant was obtained from BARI shim-1. Pods/plant was identical with other three tested varieties but lower than BARI shim. The highest yields/plot was also obtained from BARI shim-1 (19.26 kg). Yield attributes were the highest from BARI shim-1 which results the highest pod yield but it takes 6 days more than local variety.

FSRD site, Jalalpur, Sylhet

The highest yield was obtained from local cultivar Gualgadda followed by BARI shim-1. The lowest yield was obtained from IPSA-1, but it is an early variety and farmers can sale product earlier with a high price. BARI shim-1 is a good variety in terms of yield and market price. But local goalgadda is more productive and its market price is also higher than that of BARI shim-1 due to excellent size, shape, colour and taste and this cultivar grows well in slightly acidic soil of the highland situation of Sylhet area. For this reason this cultivar having a good prospect to be release as a variety.

Farmers reaction

Bogra: Farmers satisfied with heavy bearing, beside good demand in the market of BARI shim. Farmers expressed their satisfaction for softness and taste. No virus infestation was observed.

Sylhet: Farmers opined tha Goalgadda is a highly productive, profitable variety and local demand cultivar.

Conclusion

BARI shim-1 is better performar among the tested variety in respect of yield, heavy bearing, good market demand, softness and good taste at Bogra. At Sylhet, BARI shim-1 is a good variety due to its yield and market price. But local Goalgadda is more productive and its market price is also higher than that of BARIshim-1 due to excellent size, shape, colour and taste and this cultivar grows well in slightly acidic soil of the highland of Sylhet area as such the cultivar having a good prospect to release as a variety.

Table 1. Yield and yield attributes of different varieties of country bean at MLT site, Joypurhat, Bogra during 2006-07.

Tretments/ Variety	Harvest duration (days)	Seeds/ pod (no)	Pods/plant (no.)	Yield kg/plot ($9m^2$)	Fruit yield (t/ha)
IPSA shim-1	72.00a	3.73bc	171.30b	8.84b	9.82b
IPSA shim-2	71.67a	3.50c	186.00b	9.51b	10.56b
BARI shim-1	72.67a	4.67a	364.00a	19.26a	19.91a
Local	65.00b	4.13b	207.70b	10.55b	11.72b
F-test	*	*	*	*	*
CV (%)	8.50	3.50	17.01	12.84	17.61

Table 2. Performance of different Hyacinth bean at FSRD site, Jalalpur, Sylhet, 2006-07

Variety	days to1st and last harvest	No of pods/plant	Pod yield/plant	Pod yield (t/ha)
BARI shim-1	31.10.06 & 15.03.07	410	9 kg	14.33
IPSA shim-1	20.10.06 & 08.03.07	370	6.5 kg	10.82
IPSA shim-2	22.10.06 & 10.03.07	350	7 kg	11.66
Gualgadda (local)	20.10.06 & 25.03.07	385	10 kg	16.66

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On-Farm Trial of BARI Stem amaranth

Abstract

An experiment was conducted at Sabjipara, Shambhuganj under Mymensingh Sadar Upazila during Kharif-1 season, 2007 to see the performance of BARI developed stem amaranth variety, Laboni against the local one. Better yield and economic return was obtained from Laboni. It gave the highest yield of 40.20 t/ha against 36.80 t/ha in the local variety. The higher gross return (Tk. 201000/ha), gross margin (Tk.180105/ha) and benefit cost ratio (9.62) were obtained from Laboni.

Introduction

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 and released for farmers' use. The present study aims at evaluating the performance of BARI developed variety Laboni in farmers' field condition and to promote its adoption by the farmers in Mymensingh area.

Materials and Methods

The experiment was conducted at Sabjipara, Shambhuganj under MLT site, Mymensingh during Kharif-1 season, 2007. The design of the experiment was randomized complete block with five dispersed replications. The BARI developed stem amaranth variety Laboni was tested with the local check. The unit plot size was 5.0 m x 4.0 m. The seeds were sown as broadcast @ 3.0 kg/ha during first week of March 2007. The crop was fertilized with STB fertilizer dose for high yield goal following FRG 2005. The STB fertilizer dose was 113-33-40-6000 kg/ha of N, P, K and cowdung. Full cowdung, TSP and half of urea and MP was applied during final land preparation. The rest urea and MP was applied as top dressing after 20 and 30 days of sowing. Other intercultural operations like weeding and irrigation was done as and when necessary. The crop was harvested during 23 April 2007. Data on yield and yield contributing characters were recorded. Data related to cost and return and farmers' reaction were also recorded.

Results and Discussion

The agro-economic performances of the two stem amaranth varieties have been shown in Table 1. From Table it is evident that the BARI developed stem amaranth variety Laboni was agronomically and economically viable. Plant population/m^2, plant height, diameter of stem, weight of plant and also the yield was higher in the variety Laboni compared to the local check. The Laboni variety gave higher yield of 40.20 t/ha compared to 36.80 t/ha in local. Higher gross return (Tk. 201000/ha), higher gross margin (Tk. 180105/ha) and higher benefit cost ratio (9.62) were obtained from Laboni against gross return (Tk. 165600/ha), gross margin (Tk. 145425/ha) and benefit cost ratio (8.21) in the local.

Farmer's reaction

Farmers are very much interested to grow the BARI developed high yielding Laboni variety of stem amaranth. The colour, taste and market demand of Laboni is better than that of the local. The farmers also opined that the Laboni variety is soft and palatable to eat.

Conclusion: Variety Laboni may be recommended for large-scale production in the locality.

Table 1. Agro-economic performance of stem amaranth varieties at MLT site, Mymensingh sadar during Kharif-1, 2007

Varieties	Plant pop^n /m^2	Plant height (cm)	Diameter /plant (cm)	Wt./ plant (g)	Yield (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Laboni	45	69	4.10	95.2	40.20	201000	20895	180105	9.62
Local	41	61	3.80	89.2	36.80	165600	20175	145425	8.21

*TVC includes cost of seed ,fertilizer, man and animal labour cost

Price : Stem amaranth : Laboni Tk. 5.00 / Kg, Local: Tk. 4.50/kg

On-Farm Adaptive Trial of Advanced Lines of Lentil

Abstract

The experiment was carried out in the farmer's field at at Pabna, Jessore and Kushtia during rabi 2006-2007 to evaluate the performance of advance lines of lentil. Three lines viz. X95S-136, X95S-167(4), X95S-167(5) and the varieties viz. BARI masur-4, BARI masur-5 and BARI masur-6 were tested. Among the lines, X95S-167 (4) and BARI masur-6 provided higher yield (1.82 t/ha) at Kushtia but yield was not satisfactory in other two sites with yield 1.04 at Jessore from line X955-167.

Introduction

Lentil is the most important pulse crop of Bangladesh. A high yield potential variety with well fit in to a cropping pattern is needed for lentil production. BARI has developed some promising lines and varieties. These line/varieties need to verify under on-farm verification. So, the experiment was undertaken to evaluate the field performance of different varieties/lines at farmers' field.

Materials and Methods

The experiment was carried out in the farmer's field at Pabna, Jessore and Kushtia during rabi 2006-07 to evaluate the performance of advanced lines of lentil. The experiment was laid out in a RCBD with 4 replications. The unit plot size was 10 rows × 4m long maintaining a spacing of 30 cm between rows. Seeds of different entries were sown during 31 October to 17 November 2006. N, P, K & B fertilizers were applied @ 45-85-35-10 kg/ha in the form of urea TSP, MP and Boric acid respectively. All fertilizers were applied as basal. The crop was harvested during 25 February to 10 March 2007. Data were recorded on plant height, plant population/m^2, branch/plant, pods/plant, seeds/plant, 1000 seeds weight and seed yield. The collected data were analyzed statistically and the means were separated by DMRT.

Results and Discussion

Atghoria, Pabna

Days to fifty percent flowering, days to maturity and plant population m^{-2} were identical in case of all lines/variety. More or less similar plant height was observed for all the entries. The number of pods plant^{-1} was statistically identical for all entries with little increase in variety BARI mosur-4. The maximum weight of 1000 seeds was obtained from the line X95S-136 which was similar to X95S-167(5) and X95S-167(4). The seed yield obtained from all the entries was identical. The unexpected rain in late January affected the crop at flowering stage which resulted in lower seed yield. It was indicated that the yield potentiality of the tested lines was more or less equal to popular lentil variety BARI mosur-4.

Kuadabazar, Jessore

No significant differences were observed in case of plant height, number of pods/plant, number of seeds/pod, plant population, grain yield and straw yield among the lines. Higher grain yield (1.04 t/ha) was obtained from X95S-167 (4) and lowest (0.89 t/ha) from BARI masur-4. But there was no significant difference. Yield of lentil hampered severely due to rainfall on 7 and 12 February at flowering stage.

Kushtia

Plant population/m^2 plant height (cm), pods/plant, (No.) and 100 seeds wt. (g) was highest in the lines X-955-167 (4). This line showed maximum grain yield but statistically identical to BARI masur-6 with yield (1.82 t/ha).

Farmer's reaction at Pabna

Though the poor yield obtained from all the entries, farmers of the respective sites chose the new lentil lines X 95S-167 (5), X 95S-136 and variety BARI masur-4 due to their increased yield and bold seed over the traditional variety. Moreover they opined that the bold seed of lentil have good market demand.

Conclusion

All the tested lines and variety performed identical yield. The occurrence of unexpected rain at flowering stage adversely affected the crop and hence the poor yield was obtained at Pabna and Jessore.

Recommendation

The tested line is to be needed for further study along with other promising lines and standard variety in the next year.

Table 1. Yield and yield attributes different lines of Lentil at Atgharia, Pabna during 2006-07

Lines/variety	Days to 50 percent flowering	Days to maturity	Plant pop^n/m^2 (no.)	Plant height (cm)	Pods/plant (no.)	100-Seed wt. (g)	Seed yield (kg/ha)
X95S-136	57.50	112.8	107.5	21.70	32.65	2.00	752.3
X95S-167 (4)	58.75	112.5	106.6	22.15	31.25	1.95	728.0
X95S-167 (5)	57.00	111.3	106.9	22.70	33.35	1.96	772.5
BARI masur-4	57.25	111.8	107.3	23.40	35.20	1.86	761.5
LSD (0.05)	NS	NS	NS	1.411	5.858	0.088	NS
CV (%)	3.28	1.12	6.52	3.92	11.06	2.60	5.40

Table 2. Yield and yield contributing characters of lentil at MLT site, Kuadabazar, Jessore during rabi 2006-07

Lines/variety	Plant height (cm)	Plant/m^2 (no.)	Branches/ plant (no)	Pods/pla nt (no)	Seeds/ pod (no.)	1000- gr. wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
X 95 S-136	30.87	121	4.15	54.27	1.7	18.65	0.912	1.64
X 95 S-167 (4)	31.52	134	4.17	41.65	1.6	18.60	1.037	1.71
X 95 S-167 (5)	29.87	117	4.02	42.82	1.67	18.05	1.000	1.55
BARI masur-4	31.42	106	4.02	43.25	1.6	19.15	0.887	1.65
CV (%)	12.02	11.40	6.31	13.51	7.33	7.91	10.36	13.84
F-test	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Yield and yield components of lentil as influenced by differents varieties of lentil at Kushtia during rabi 2006-07

Lines/variety	Plants/m^2	P.hieght (cm)	Pods /plant (No.)	100 seed wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
X955-167 (4)	120	38.0	91.55	1.98	1.82	4.4
BARI masur -4	119	34.9	102.45	1.75	1.53	3.6
BARI masur -5	119	33.2	77.10	1.83	1.62	4.8
BARI masur -6	118	36.9	89.28	1.75	1.81	4.6
LSD (0.05)		2.9	41.99	0.56	0.28	1.07
CV (%)		5.07	29.14	19.24	10.14	15.59

Appendix 1. Yield (t/ha) of on-farm adaptive trial of advance lines of lentil during 2006-07

Lines/variety	Pabna	Jessore	Kushtia	Mean
X95S-136	0.752	0.912	-	0.83
X95S-167 (4)	0.728	1.037	1.82	1.20
X95S-167 (5)	0.772	1.000	-	0.89
BARI masur-4	0.761	0.887	1.53	1.06
BARI masur -5	-	-	1.62	1.62
BARI masur -6	-	-	1.81	1.81

Adaptive Trial of Salt Tolerant Mungbean Variety/Line in the Coastal Area

Abstract

The experiment was conducted at Banerpota Farm, Satkhira during 2006-2007 to select the salt tolerant variety of mungbean. Results of two year's trials showed that mungbean variety BARI Mung-2 performed better at Banerpota Farm, Satkhira. Further investigation in relation to screening and management practices need to be done.

Introduction

In Bangladesh, more than 30% of the cultivable area is in the coast. Coastal areas are seriously affected by various degrees of salinity. After harvesting of T.Aman vast land remain fallow. During rabi season, the soil salinity levels increase through capillary movement. For higher salinity most of the rabi crops do not survive in the area. BARI recently developed many high yielding varieties/line of mungbean. The performances of the varieties of mungbean need to be evaluated in saline area. The present study was therefore, undertaken to find out the suitable variety of mungbean in saline area.

Materials and Methods

The trial was conducted at Banerpota Farm, Satkhira during 2006-2007. Mungbean was sown on 22 February 2007 at Banerpota Farm, Satkhira. Four varieties/lines of mungbean (BM-01, BARI mung-2, BARI mung-5 and local) were included in the study. The unit plot size was 2m×1.5m. Seeds were sown following RCB design with three replications. The seeds were sown as line sowing. Line to line spacing was 30cm. 20-16-15-10kg/ha of N-P-K-S was applied as basal. Two irrigation were applied at initial stage. Intercultural operations were followed as and when necessary. The soil salinity level at the site were 12 Feb'07, 25 Feb'07, 10 Mar'07, 25 Mar'07, 10 Apr'07 and 25 Apr'07 were 1.55, 1.51, 5.00, 6.00, 7.03 and 9.44 mmhos/cm respectively. Data on yield and yield attributes were collected and analyzed statistically.

Results and Discussion

Plant height, pod/plant, seed/pod and seed yield differed significantly by variety/line. The result revealed that the highest seed yield (1310 kg/ha) was obtained from BARI mung-2. The highest seed yield produced by BARI mung-2 could be due to maximum plant population/m^2 and maximum pod/plant. However, both BARI mung-5 and BM-01 gave similar yield with BARI mung-2. The lowest seed yield produced by local could be due to minimum seed/pod. No viral disease infestation was observed in any variety except local one. Aphid infestation was observed in the field. Two year's average results showed that mungbean variety BARI mung-2 performed better at Banerpota Farm, Satkhira.

Farmer's reaction: They preferred BARI mung-2 for excellent yield.

Conclusion

It was observed that mungbean variety BARI mung-2 showed better adaptability at Banerpota Farm, Satkhira. Further investigation in relation to screening and management practices could be done to evaluate the performance of above mentioned crop.

Table 1.Yield and yield attributes of mungbean as affected by varieties/lines tested at Banerpota Farm, Satkhira during rabi season, 2006-'07.

Variety/line	Day's to maturity	Plants/ m^2	Plant height (cm)	Pods/ plant	Seeds/ pod	1000-seed wt. (g)	Seed yield (kg/ha)		
							2004-05	2006-07	Mean
BM-01	65	25.33	54.00	41.67	10.13	36.14	844	1070	957
BARI mung-2	65	27.00	43.00	44.00	8.07	35.35	766	1310	1038
BARI mung-5	65	25.66	43.33	43.33	10.10	28.09	389	1110	750
Local	65	26.00	53.67	35.00	8.13	36.30	728	0840	784
LSD (0.05)		4.56	4.38	2.80	0.82	10.23	67.30	310	-
CV (%)		8.79	4.52	3.43	4.50	15.07	5.60	14.26	-

Performance of Different Chickpea Varieties in Sylhet Region

Abstract

An experiment was carried out at FSRD site Jalalpur, Sylhet and MLT site Sonamgonj to find out the yield and suitability of chickpea variety(s) after harvest of T.aman rice in the Sylhet region. Seven BARI developed chickpea varieties (BARI chola-2, 3, 4, 5, 6, 7 & 8) were evaluated during 2006-07. BARI chola-8 gave the highest yield of 1382 kg/ha at Sylhet and 1262 kg/ha at Sunamganj. BARI chola-3 also gave omparable yields at both the locations.

Introduction

Pulses as a group can utilize limited soil moisture and nutrients more efficiently than cereal and mainly for this reason these crops are grown in areas the harvest of T.aman rice. In the Sylhet region, a vast area remains fallow for a long time (December-May) after the harvest of aman rice due to soil moisture stress. Chickpea is a drought tolerant and deep rooted crop. So, the crop 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(s) after harvest of T.aman rice in the Sylhet region.

Materials and Methods

The experiment was conducted in rainfed condition at the FSRD site Jalalpur, Sylhet and MLT site, Sunamganj during rabi 2006-07. Seven BARI developed chickpea varieties viz. BARI chola-2, BARI chola-3, BARI chola-4, BARI chola-5, BARI chola-6, BARI chola-7 and BARI chola-8 were evaluated during 2006-06 at FSRD site, Sylhet and MLT site, Sunamganj. Treatments were arranged in the RCB design with three replications. The plot size was $4m \times 3m$. Fertilizers were applied at the rate 20-18-17 kg/ha of N, P and K, respectively. The seeds were sown on 25-28 November 2006 at FSRD and MLT sites with pacing was $40cm \times 10cm$.

Results and Discussions

FSRD site, Jalalpur, Sylhet

The days to maturity ranged from 115 DAS to 125 DAS. The earliest varieties was BARI chola-4 and BARI chola-2. The lowest pod/plant was observed from BARI chola-5 (30.25). Maximum 1000-seed weight was recorded from BARI chola-8 (21.82 g) followed by BARI chola-3 (18.29 g) but BARI chola-5 & 7 showed minimum 100-seed weight. In 2006-07, the highest yield (1382 kg/ha) was obtained from BARI chola-8 due to the biggest seed size which was closely followed by BARI chola-3 (1287 kg/ha).

MLT site, Sunamgonj

Similar trend was observed in yield contributing characters and yield at MLT site Sunamgonj, BARI chola-8 gave the highest yield (1262 kg/ha) followed by BARI chola-3 (1187 kg/ha).

Conclusion

The variety BARI Chola-8 produced higher seed yield at both the locations due to more number of pods per plant and comparatively bigger seed size. BARI chola-8 could be regarded as suitable chickpea cultivar for fallow land of Sylhet region. BARI chola-3 is a promising variety for this area. Pod borer is a problem but using Carate and Ripcord successfully controlled it. The experiment would be repeated across the locations with more number of farmers (replications).

Table 1. Yield and yield contributing characters of chickpea varieties at FSRD site, Jalalpur, Sylhet during Rabi 2006-07.

Variety	Days to maturity	Plant height (cm)	Pods/plant (no.)	100-seed wt. (g)	Seed yield (kg/ha)
BARI chola-2	116	36.25	38.01	13.27	1025
BARI chola-3	120	42.80	36.34	18.29	1287
BARI chola-4	115	32.91	31.66	12.79	890
BARI chola-5	123	29.42	30.25	12.18	843
BARI chola-6	117	33.83	35.29	14.59	1014
BARI chola-7	118	37.95	37.58	12.22	887
BARI chola-8	125	43.52	32.79	21.82	1382

Table 2. Yield and yield contributing characters of chickpea varieties at MLT site, Sunamganj during rabi 2006-07.

Variety	Days to maturity	Plant height (cm)	Pods/plant (no.)	100-seed wt. (g)	Seed yield (kg/ha)
BARI chola-2	116	35.62	35.83	12.18	964
BARI chola-3	123	42.15	34.22	18.22	1187
BARI chola-4	118	34.65	29.48	13.43	786
BARI chola-5	122	29.15	30.72	11.22	777
BARI chola-6	117	37.12	34.55	14.48	878
BARI chola-7	118	37.55	36.36	12.64	758
BARI chola-8	123	42.45	33.47	20.83	1262

Effect of Sowing Dates on the Incidence of Foot and Root Rot and Yield of Bushbean Varieties

Abstract

The experiment was conducted at ARS, Bogra during 2006-07 to find out the effect of sowing dates on foot and root rot and yield of Bush bean varieties. Two BARI Bushbean varieties were used in main plot and five sowing dates were applied in sub plot. The highest foot and root rot infection (18.27%) was observed in BARI Jharshim-2 × October 30 sowing, and the lowest (9.32%) was in BARI Jharshim-1 × December 10 sowing. The highest yield (17.74 t/ha) was recorded in BARI Jharshim-1 × November 10, and the lowest yield (9.8 t/ha) was in BARI Jharshim-2 × December 10 sowing. Though November 10 and 20 sowing showed comparatively higher disease incidence than later sowing, but yield and yield attributes were higher with vigourous growth of plants for both the varieties in these periods. So, BARI Jharshim-1 or BARI Jharshim-2 may be cultivated from November 10 to 20 for higher yield.

Introduction

Bushbean (*Phaseolus vulgaris*) is the second largest legume producing vegetable in the world. It is used as tender vegetable, shelled green beans, dry bean and pulses. Now-a-day, it is considered as one of the most important exporting vegetables of Bangladesh to earn foreign currency. But the average yield of French bean is very low due to various reasons, where diseases are one of the important factors. Among the diseases, foot and root rot caused by Fusarium species and Sclerotium rolfsii is a serious disease. Avoiding the use of chemicals, if sowing date is adjusted for reducing foot and root rot of Bushbean, this may help saving the foreign currency as well as may reduce the environmental pollution. So, the experiment was undertaken to find out the effect of sowing dates on the incidence of foot and root rot and yield of Bush bean varieties.

Materials and Methods

The experiment was conducted at ARS, Bogra during 2006-07. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. Cowdung @ 10 t/ha, urea @ 50 kg/ha, TSP @ 150 kg/ha, MP @ 150 kg/ha were applied. The experiment was carried out in split plot design with three replications. BARI Jharshim-1 and BARI Jharshim-2 were used in main plot and five sowing dates viz. October 30, November 10, 20, 30 and December 10 were applied in sub plot. Size of the plots was 2.0 m × 1.2 m and plant spacing was 30 cm × 15 cm. Intercultural operations were done as per need. Data were recorded on germination, germination failure or seed rot, foot and root rot, plant stand, shoot length, root length, seedling vigour after 30 days of sowing, plant height at last harvest, number of pods/plant, weight of pods/plant and pod yield. The plots were inspected regularly to take observations on foot and root rot disease from seedling to maturity stage of the crop. For seedling vigour or vigour index, data were recorded after 30 days of sowing for each treatment combination. Vigour index was calculated by the following formula of Baki and Anderson (1973):

Vigour Index = (Mean shoot length + mean root length) × Germination (%)

The recorded data were analyzed statistically to find out the level of significance and the variation among the respective data was compared following Duncan's New Multiple Range Test (DMRT).

Results and Discussions

Germination, germination failure, foot and root rot and plant stand were significantly influenced by the varieties and sowing dates of Bushbean. Maximum germination (95.00%) was recorded in BARI Jharshim-1 (V_1) × December 10 sowing (S_5) which was statistically similar to all other treatment combinations except V_1 × October 30 sowing (S_1) with 88.66% and BARI Jharshim-2 (V_2) × S_1 with 89.66%. The maximum germination failure or seed rot (11.34%) was recorded in V_1 × S_1 and the lowest (5.00%) was recorded in V_1× S_5. The highest foot and root rot (16.75%) was obtained from V_1 × S_1 and the lowest (9.32%) was in V_1× S_5. The maximum plant stand (90.68%) was observed in V_1×S_5 and the lowest (81.73%) was observed in V_2 × S_1.

Results of interaction effect of varieties and sowing dates on seedling vigour and plant height of Bushbean varieties are presented in Table 2. Shoot length, root length, seedling vigour and plant height at last harvest were significantly influenced by the varieties and sowing dates of Bush bean. The highest shoot length (30.83 cm) after 30 days of sowing was recorded in V_1 x S_2 and the lowest (18.94 cm) was in V_1 x S_5. The maximum root length after 30 days of sowing was recorded in V_1 x S_2 (19.83 cm) and the lowest was recorded in V_2 x S_5 (14.00 cm). The highest seedling vigour (4582.67) was obtained from V_1 x S_2 and the lowest (3166.49) was in V_1 x S_5. The maximum plant height (43.07 cm) at last harvest was observed in V_1 x S_2 and the lowest (32.27 cm) was observed in V_1 x S_5.

Results of interaction effect of varieties and sowing dates on yield and yield attributes of Bush bean are presented in Table 3. Varieties and sowing dates showed significant effect on number of pod per plant, weight of pod per plant and pod yield of Bush bean during harvest. The highest number of pod per plant (26.89) was recorded in V_1 x S_2 and the lowest (15.60) was in V_2 x S_5. The maximum weight of pod per plant (118.31 g) was recorded in V_1 x S_2 and the minimum (62.40 g) was in V_2 x S_5. The highest pod yield (17.74 t/ha) was obtained from V_1 x S_2 and the lowest (9.98 t/ha) was in V_2 x S_5.

Conclusion

It may be concluded that later sowing of Bush bean showed less disease incidence and lower yield than earlier sowing. Plant of early sowing resulted higher yield due to vigourous growth of survived plants and higher number and weight of pods per plant. So, BARI Bush bean 1 or BARI Bush bean 2 may be cultivated from November 10 to 20 for higher yield.

Table 1. Interaction effect of varieties and sowing dates on foot and root rot of Bush bean varieties

Interaction	Germination (%)	Germination failure or seed rot (%)	Foot and root rot (%)	Plant stand (%)
$V_1 \times S_1$	88.66 c	11.34 a	16.75 a	83.25 de
$V_1 \times S_2$	90.33 abc	9.67 ab	14.48 cd	85.52 cd
$V_1 \times S_3$	93.66 ab	6.34 c	12.48 ef	87.52 bc
$V_1 \times S_4$	94.57 ab	5.44 c	10.59 g	89.41 ab
$V_1 \times S_5$	95.00 a	5.00 c	9.32 g	90.68 a
$V_2 \times S_1$	89.66 bc	10.34 a	18.27 a	81.73 e
$V_2 \times S_2$	93.33 abc	6.67 bc	16.40 ab	83.60 de
$V_2 \times S_3$	94.35 ab	5.65 c	14.76 bc	85.24 cd
$V_2 \times S_4$	94.00 ab	6.00 c	12.74 de	87.26 bc
$V_2 \times S_5$	93.33 abc	6.67 c	10.86 fg	89.14 ab

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance
V_1= BARI Jharshim-1, V_2= BARI Jharshim-1, S_1= Oct. 30, S_2= Nov. 10, S_3= Nov. 20, S_4= Nov. 30 and S_5= Dec. 10

Table 2. Interaction effect of varieties and sowing dates on seedling vigour and plant height of Bushbean varieties

Interaction	Shoot length (cm)	Root length (cm)	Seedling vigour	Plant height at last harvest (cm)
$V_1 \times S_1$	26.89 abc	16.17 bcd	3817.10 bc	38.07 abc
$V_1 \times S_2$	30.83 a	19.83 a	4582.67 a	43.07 a
$V_1 \times S_3$	25.39 abc	17.61 ab	4026.53 ab	36.27 bc
$V_1 \times S_4$	21.61 cd	17.15 abc	3662.07 bc	33.00 c
$V_1 \times S_5$	18.94 d	14.39 cd	3166.49 c	32.27 c
$V_2 \times S_1$	24.67 bcd	15.61 bcd	3611.53 bc	37.80 abc
$V_2 \times S_2$	30.00 ab	18.33 ab	4507.26 a	42.80 ab
$V_2 \times S_3$	24.11 bcd	16.09 bcd	3795.72 bc	37.00 abc
$V_2 \times S_4$	22.78 cd	15.72 bcd	3618.57 bc	34.67 c
$V_2 \times S_5$	22.55 cd	14.00 d	3405.41 bc	33.07 c

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Table 3. Interaction effect of varieties and sowing dates on yield and yield attributes of Bushbean varieties (during harvest)

Interaction	No. of pod/plant	Wt. of pod/plant (g)	Pod yield (t/ha)
V_1 x S_1	22.95 bc	96.38 c	15.41 abc
V_1 x S_2	26.89 a	118.31 a	17.74 a
V_1 x S_3	23.55 bc	101.26 bc	16.20 ab
V_1 x S_4	19.33 d	81.18 d	13.80 bc
V_1 x S_5	15.91 e	63.64 e	10.81 d
V_2 x S_1	21.90 c	91.97 c	14.71 bc
V_2 x S_2	24.27 b	106.77 b	16.01 ab
V_2 x S_3	22.45 bc	96.53 c	15.44 abc
V_2 x S_4	18.57 d	77.99 d	13.35 c
V_2 x S_5	15.60 e	62.40 e	9.98 d

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Control of Foot and Root Rot of Chickpea by Seed Treatment

Abstract

The experiment was conducted at ARS, Bogra during 2006-07 to find out the control measure of foot and root rot of Chickpea by seed treatment and its effect on yield. BARI chola-6 was used as test variety. Eight seed treating agents and one control were used. All seed treating agents had a positive effect on foot and root rot and yield. Among them, seed dipped in Vitavax 200 (0.25%) solution for 3 hours showed the highest germination (85.09%), lowest foot and root rot (12.67%) and highest yield (1600 kg/ha). Bavistin and Biofertilizer also reduced foot and root rot which ultimately increased yield.

Introduction

Chickpea (*Cicer arietinum*) is the third major pulse crop of Bangladesh in respect of acreage and production. It supplies protein for animals. Average yield of chickpea is low due to various diseases, where foot and root rot caused by Fusarium species and Sclerotium rolfsii is the most serious disease. Biofertilizer decrease foot and root rot of leguminous crops. If foot and root rot of chickpea can be controlled by seed treatment with chemicals and Biofertilizer, then yield will increase. So, the present study was undertaken to find out the control measure of foot and root rot of chickpea by seed treatment and its effect on yield.

Materials and Methods

The experiment was conducted at ARS, Bogra during 2006-07. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. Urea @ 50 kg/ha, TSP @ 90 kg/ha, MP @ 40 kg/ha and Boric acid 5 kg/ha were applied during land preparation. The experiment was carried out following Randomized Complete Block Design with three replications. Chickpea variety BARI Chola 6 was used in the experiment. Size of the plots was 2.0 m × 1.2 m and plant spacing was 40 cm x continuous sowing.

The nine treatments were T_1 = Dry seed treatment by Vitavax 200 (0.25%), T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours, T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours, T_4 = Dry seed treatment by Bavistin (0.15%), T_5 = Seed dipped in Bavistin (0.15%) solution for 3 hours, T_6 = Seed dipped in Bavistin (0.15%) solution for 6 hours, T_7 = Biofertilizer (40 g/kg seed), T_8 = Healthy looking seeds and T_9 = Untreated seeds (control). Seeds were sown on November 19, 2006. Intercultural operations were done as per needed and to maintain the normal hygienic condition of crop in the field. Data were recorded on germination, germination failure or seed rot, foot and root rot, plant stand, shoot length, root length, seedling vigour after 30 days of sowing, plant height at last harvest and yield. The plots were inspected regularly to take observations on foot and root rot disease from seedling to maturity stage of the crop. For seedling vigour or vigour index, data were recorded after 30 days of sowing for each treatment combination. Vigour index was calculated by the following formula of Baki and Anderson (1973):

Vigour Index = (Mean shoot length + mean root length) x germination (%)

The recorded data were analyzed statistically to find out the level of significance and the variation among the respective data was compared following Duncan's New Multiple Range Test (DMRT).

Results and Discussions

Results of seed treating agents and healthy looking seeds on germination, germination failure or seed rot, foot and root rot and plant stand of Chickpea are presented in Table 1. Germination, germination failure or seed rot, foot and root rot and plant stand were significantly affected by the treatments. Germination ranged from 70.33 to 85.09%, where the highest germination was recorded in seed dipped in Vitavax 200 (0.25%) solution for 3 hours which was statistically similar to all other treatments except untreated control which was the lowest (70.33%). The maximum germination failure or seed rot (29.67%) was recorded in untreated control which was statistically dissimilar to all other treatments and the minimum (14.90%) was in seed dipped in Vitavax 200 (0.25%) solution for 3 hours. The highest foot and root rot (34.05%) was obtained from untreated control which was followed by healthy looking seeds (29.75%) and the lowest (12.67%) was in seed dipped in Vitavax 200 (0.25%) solution for 3 hours. The maximum plant stand (87.33%) was observed in seed dipped in Vitavax 200 (0.25%) solution for 3 hours and the lowest (65.95%) was observed in untreated control which was statistically at par with healthy looking seeds (70.25%).

Results of seed treating agents and healthy looking seeds on shoot and root length, seedling vigour and plant height of Chickpea are presented in Table 2. Shoot length, root length, seedling vigour and plant height at last harvest were not significantly influenced by the treatments. Shoot length after 30 days of sowing ranged from 16.37 to 17.39 cm, where the highest shoot length was recorded in healthy looking seeds and the lowest was in seed dipped in Bavistin (0.15%) solution for 1 hours. The maximum root length (12.72 cm) after 30 days of sowing was recorded in Biofertilizer and the lowest (10.67 cm) was recorded in seed dipped in Vitavax 200 (0.25%) solution for 1 hours. The highest seedling vigour (2490.58) was obtained from seed dipped in Vitavax 200 (0.25%) solution for 3 hours and the lowest (2070.51) was in untreated control. The maximum plant height (47.85 cm) at last harvest was observed in Biofertilizer and the lowest (42.27 cm) was observed in dry seed treatment by Vitavax 200 (0.25%).

The treatments showed significant effect on yield of Chickpea (Table 3). The highest yield (1600.49 kg/ha) was obtained from seed dipped in Vitavax 200 (0.25%) solution for 3 hours and the lowest (1190 kg/ha) was in untreated control which was statistically identical to healthy looking seeds (1338 kg/ha).

Conclusion

It may be concluded that all seed treating agents showed significantly better effect on foot and root rot and yield. Among them, seed dipped in Vitavax 200 (0.25%) solution for 3 hours showed the highest germination (85.09%), lowest foot and root rot (12.67%) and highest yield (1600.49 kg/ha). Bavistin and Biofertilizer also reduced foot and root rot and increased yield.

Reference

Baki, A.A. and J. D. Anderson. 1973. Vigour determination in soybean by multiple criteria. Crop Sci., 13 : 630-633.

Table 1. Effect of seed treating agents and healthy looking seeds on germination, seed rot, foot and root rot and plant stand of Chickpea

Treatments	Germination (%)	Germination failure or Seed rot (%)	Foot and root rot (%)	Plant stand (%)
T_1 = Dry seed treatment by Vitavax 200 (0.25%)	80.95 a	19.05 bc	15.33 bc	84.67 ab
T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours	82.67 a	17.33 bc	14.34 bc	85.66 ab
T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours	85.09 a	14.90 c	12.67 c	87.33 a
T_4 = Dry seed treatment by Bavistin (0.15%)	78.00 ab	22.00 b	18.45 bc	81.55 ab
T_5 = Seed dipped in Bavistin (0.15%) solution for 1 hours	80.45 a	19.55 bc	16.95 bc	83.05 ab
T_6 = Seed dipped in Bavistin (0.15%) solution for 3 hours	83.67 a	16.33 bc	15.69 bc	84.31 ab
T_7 = Biofertilizer (40 g/kg seed)	80.99 a	19.01 bc	20.47 b	79.53 b
T_8 = Healthy looking seeds	77.85 ab	22.15 b	29.75 a	70.25 c
T_9 = Untreated seeds (control)	70.33 b	29.67 a	34.05 a	65.95 c
F-test	*	**	**	**

Means bearing same letter(s) within same column do not differ significantly at 5% (*) and 1% (**) level of significance

Table 2. Effect of seed treating agents and healthy looking seeds on shoot and root length, seedling vigour and plant height of Chickpea

Treatments	Shoot length (cm)	Root length (cm)	Seedling vigour	Plant height at harvest (cm)
T_1 = Dry seed treatment by Vitavax 200 (0.25%)	17.17	11.66	2334.59	42.27
T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours	16.50	10.67	2246.14	43.93
T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours	16.94	12.33	2490.58	43.40
T_4 = Dry seed treatment by Bavistin (0.15%)	16.81	12.28	2269.02	44.30
T_5 = Seed dipped in Bavistin (0.15%) solution for 1 hours	16.37	11.50	2242.14	43.97
T_6 = Seed dipped in Bavistin (0.15%) solution for 3 hours	16.72	12.28	2426.43	43.70
T_7 = Biofertilizer (40 g/kg seed)	17.00	12.72	2407.02	47.85
T_8 = Healthy looking seeds	17.39	11.37	2238.96	43.95
T_9 = Untreated seeds (control)	17.00	12.44	2070.51	42.33
F-test	NS	NS	NS	NS

NS=Not Significant

Table 3. Effect of seed treating agents and healthy looking seeds on yield of Chickpea

Treatments	Yield (kg/ha)
T_1 = Dry seed treatment by Vitavax 200 (0.25%)	1450 ab
T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours	1491 ab
T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours	1600 a
T_4 = Dry seed treatment by Bavistin (0.15%)	1410 b
T_5 = Seed dipped in Bavistin (0.15%) solution for 1 hours	1481 ab
T_6 = Seed dipped in Bavistin (0.15%) solution for 3 hours	1501 ab
T_7 = Biofertilizer (40 g/kg seed)	1489 ab
T_8 = Healthy looking seeds	1339 bc
T_9 = Untreated seeds (control)	1190 c
F-test	**

Means bearing same letter(s) within same column do not differ significantly at 1% level of significance

Control of Foot and Root Rot of Lentil by Seed Treatment

Abstract

The experiment was conducted at ARS, Bogra during 2006-07 to find out the control measure of foot and root rot of Lentil by seed treatment and its effect on yield. BARI masur-3 was used as test variety. Eight seed treating agents and one control were used. All seed treating agents showed significant better effect on foot and root rot and yield. Among them, seed dipped in Vitavax 200 (0.25%) solution for 3 hours showed the lowest foot and root rot (15.05%) and highest yield (1611 kg/ha). Bavistin and Biofertilizer also reduced foot and root rot and increased yield.

Introduction

Lentil (*Lens culinaris*) is the second major pulse crop of Bangladesh in respect of acreage and production. It is cultivated as sole and intercrops. Lentil supplies protein for animals. Average yield of lentil is low due to various diseases, where foot and root rot caused by Fusarium species and Sclerotium rolfsii is the most serious disease. Biofertilizer decrease foot and root rot of leguminous crops. If foot and root rot of Lentil may be controlled by seed treatment with chemicals and Biofertilizer, then yield will increase. So, the present study was undertaken to find out the control measure of foot and root rot of Lentil by seed treatment and its effect on yield.

Materials and Methods

The experiment was conducted at ARS, Bogra during 2006-07. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. Urea @ 50 kg/ha, TSP @ 90 kg/ha, MP @ 40 kg/ha and Boric acid 5 kg/ha were applied during land preparation. The experiment was carried out following Randomized Complete Block Design with three replications. Lentil variety BARI Masur 3 was used in the experiment. Size of the plots was 2.0 m X 1.2 m and plant spacing was 30 cm x continuous sowing. The nine treatments were T_1 = Dry seed treatment by Vitavax 200 (0.25%), T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours, T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours, T_4= Dry seed treatment by Bavistin (0.15%), T_5 = Seed dipped in Bavistin (0.15%) solution for 3 hours, T_6 = Seed dipped in Bavistin (0.15%) solution for 6 hours, T_7 = Biofertilizer (40 g/kg seed), T_8 = Healthy looking seeds and T_9 = Untreated seeds (control). Seeds were sown on November 19, 2006. Intercultural operations were done as per needed and to maintain the normal hygienic condition of crop in the field. Data were recorded on foot and root rot, plant stand, shoot and root length after 30 days of sowing, plant height at last harvest and yield.

The plots were inspected regularly to take observations on foot and root rot disease from seedling to maturity stage of the crop. For seedling vigour or vigour index, data were recorded after 30 days of sowing for each treatment combination. Vigour index was calculated by the following formula of Baki and Anderson (1973) :

Vigour Index = (Mean shoot length + mean root length) x Germination (%)

The recorded data were analyzed statistically to find out the level of significance and the variations among the respective data were compared following Duncan's New Multiple Range Test (DMRT).

Results and Discussions

Results of seed treating agents and healthy looking seeds on foot and root rot and plant stand of Lentil are presented in Table 1. Foot and root rot and plant stand were significantly affected by the treatments. The highest foot and root rot (35.95%) was obtained from untreated control which was statistically identical to healthy looking seeds (30.48%) and the lowest (15.05%) was in seed dipped in Vitavax 200 (0.25%) solution for 3 hours. The maximum plant stand (84.95%) was observed in seed dipped in Vitavax 200 (0.25%) solution for 3 hours and the lowest (64.05%) was observed in untreated control which was statistically identical to healthy looking seeds (69.62%).

Results of seed treating agents and healthy looking seeds on shoot and root length and plant height of Lentil are presented in Table 2. Hoot length, root length and plant height at last harvest were not significantly influenced by the treatments. Shoot length after 30 days of sowing ranged from 9.19 to 13.63 cm, where the highest shoot length was recorded in dry seed treatment by Bavistin (0.15%) and the lowest was in seed dipped in Bavistin (0.15%) solution an hour. The maximum root length (8.55 cm) after 30 days of sowing was recorded in dry seed treatment by Bavistin (0.15%) and the lowest (7.55 cm) was recorded in seed dipped in Vitavax 200 (0.25%) solution for an hours. The maximum plant height (30.93 cm) at last harvest was observed in Biofertilizer and the lowest (27.30 cm) was observed in untreated control.

Results of seed treating agents and healthy looking seeds on yield of Lentil are presented in Table 3. The treatments showed significant effect on yield of Lentil. Maximum yield (1611 kg/ha) was obtained from seed dipped in Vitavax 200 (0.25%) solution for 3 hours which was statistically identical to all other treatments except healthy looking seeds (1313 kg/ha) and untreated control (1221 kg/ha).

Conclusion

It may be concluded that all seed treating agents showed better effect on foot and root rot disease as well as higher yield. Among them, seed dipped in Vitavax 200 (0.25%) solution for 3 hours had the lowest foot and root rot (15.05%) with highest yield (1611 kg/ha). Bavistin and Biofertilizer also reduced foot and root rot and increased yield.

Reference

Baki, A.A. and J. D. Anderson. 1973. Vigour determination in soybean by multiple criteria. Crop Sci., 13 : 630 633.

Table 1. Effect of seed treating agents and healthy looking seeds on germination, seed rot, foot and root rot and plant stand of lentil

Treatments	Foot and root rot (%)	Plant stand (%)
T_1 = Dry seed treatment by Vitavax 200 (0.25%)	18.33 bc	81.67 ab
T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours	16.45 bc	84.65 ab
T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours	15.05 c	84.95 a
T_4 = Dry seed treatment by Bavistin (0.15%)	22.67 b	77.33 b
T_5 = Seed dipped in Bavistin (0.15%) solution for 1 hours	20.38 bc	79.62 ab
T_6 = Seed dipped in Bavistin (0.15%) solution for 3 hours	17.95 bc	82.05 ab
T_7 = Biofertilizer (40 g/kg seed)	20.95 bc	79.05 ab
T_8 = Healthy looking seeds	30.48 a	69.52 c
T_9 = Untreated seeds (control)	35.95 a	64.05 c
F-test	**	**

Means bearing same letter(s) within same column do not differ significantly at 1% level of significance

Table 2. Effect of seed treating agents and healthy looking seeds on shoot and root length and plant height of lentil

Treatments	Shoot length (cm)	Root length (cm)	Plant height at harvest (cm)
T_1 = Dry seed treatment by Vitavax 200 (0.25%)	10.68	8.00	29.13
T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours	9.52	7.55	28.30
T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours	11.77	8.42	28.33
T_4 = Dry seed treatment by Bavistin (0.15%)	13.63	8.55	30.46
T_5 = Seed dipped in Bavistin (0.15%) solution for 1 hours	9.19	7.92	28.70
T_6 = Seed dipped in Bavistin (0.15%) solution for 3 hours	11.28	7.57	29.13
T_7 = Biofertilizer (40 g/kg seed)	12.77	8.32	30.93
T_8 = Healthy looking seeds	12.10	7.92	27.95
T_9 = Untreated seeds (control)	12.18	8.10	27.30
F-test	NS	NS	NS

NS=Not Significant

Table 3. Effect of seed treating agents and healthy looking seeds on yield of Lentil

Treatments	Yield (kg/ha)
T_1 = Dry seed treatment by Vitavax 200 (0.25%)	1490 ab
T_2 = Seed dipped in Vitavax 200 (0.25%) solution for 1 hours	1531 ab
T_3 = Seed dipped in Vitavax 200 (0.25%) solution for 3 hours	1611 a
T_4 = Dry seed treatment by Bavistin (0.15%)	1385 abc
T_5 = Seed dipped in Bavistin (0.15%) solution for 1 hours	1411 abc
T_6 = Seed dipped in Bavistin (0.15%) solution for 3 hours	1581 a
T_7 = Biofertilizer (40 g/kg seed)	1595 a
T_8 = Healthy looking seeds	1313 bc
T_9 = Untreated seeds (control)	1221 c
F-test	*

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Chemical Control of Tomato Early Blight Disease

Abstract

The experiment was conducted at Joypurhat MLT site, Bogra during 2006-07 to find out the effect of fungicide in controlling early blight disease of tomato. The maximum infected plants (45.00%) were recorded in untreated control and no infected (0.00%) plants are in mancovit (0.2%). The highest disease reduction (100%) over untreated control was obtained from mancovit followed by (83.90%) rovral (0.2%). The highest yield (39.58 t/ha) was recorded from mancovit (0.2%) and the lowest (14.22 t/ha) was recorded in untreated control. The highest yield increased (178%) over untreated control was obtained from mancovit (0.2%). Among the two fungicide, mancovit showed comparatively better results.

Introduction

Tomato is the most important and very widely popular vegetable in Bangladesh. It is moderately high in vitamin A and C, high cash value and has a high potential for value added in processing. But the different diseases are present in tomato. Among the diseases, early blight disease is a serious disease of tomato. The disease is assumed to cause profuse yield loss. Because of this, the farmers face financial loss every season. So far it is known that the effective control measure of the same. A new fungicide "Mancovit" has been identified through on station research that can control the disease. The efficacy of this new fungicide against early blight of tomato is needed to be verified at farmers field. So, the experiment was undertaken to find out the effect of "Mancovit" in controlling early blight disease of tomato.

Materials and Methods

The experiment was conducted at Joypurhat MLT site, Bogra during 2006-07. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. A susceptible tomato variety (Ratan) was used as a planting material. The unit plot size was 1.2m X 3m with a plant spacing of 60cm × 50cm. Twenty five days old seedling were transplanted in the field from November 12-15, 2006. Manures and fertilizer were applied at the rate of 10 tons cow dung/ha, Urea 550 kg/ha, TSP 450 kg/ha and MP 250 kg/ha. Half quantity of cow dung was applied during land reparation. The remaining half of cow dung, the entire amount of TSP and 1/3 each of urea and MP were applied during pit preparation. The rest of urea and MP were applied in two equal installments 21 and 35 days after transplanting. All intercultural operation were done as and when necessary. Tomato harvesting was started last week of January and continued up to March 25, 2007. Data were recorded on number of fruits per plant, weight of fruits per plant, yield per plant and yield ton per hectare. Data were analyzed statistically and means were separated as DMRT.

Results and Discussions

Infected fruits were significantly affected by fungicide. Infected fruits ranged from 0.00 to 16.10% where the maximum infected plants were recorded from untreated control which was significantly different from other treatments. The highest disease reduction (100%) over control was obtained from Mancovit and the lowest from Rovral.

Results of fungicide on number and weight of fruits per plant and fruit yield of tomato are presented in table-2. Fungicide showed significant effect on number of fruits per plant, weight of fruits per plant and yield of fruits of tomato during harvest. Number of fruits per plant (20.80) and weight of fruits per plant (1.32 kg) were recorded from Mancovit which were significantly different from other treatments. The lowest of these parameters were obtained from untreated control. Yield was significantly influenced by the fungicides from the control plot. The yield of tomato ranged from 39.58 to 14.22 t/ha while higher yield was obtained from mancovit followed by rovral. The lowest yield was obtained from untreated control. The highest yield increased (178%) over untreated control was recorded from mancovit.

Conclusion

It is revealed from the study, that two fungicides use resulted least disease incidence and higher yield than control. The highest disease reduction was obtained from mancovit. As a result, higher tomato yield was recorded in mancovit followed by rovral. So the mancovit (0.2%) may be sprayed for controlling early blight disease of tomato.

Table 1. Effect of fungicide in reducing early blight of tomato at Joypurhat MLT site, Bogra during 2006-07

Treatment	% of infected fruits	Disease reduction over control (%)
T_1 =Mancovit	0.00 b	100
T_2 = Rovral	16.10 b	83.90
T_3 = Control	45.00 a	-

Table 2. Effect of fungicide on yield and yield attributes of tomato at Joypurhat MLT site, Bogra during 2006-07

Treatment	No. of fruits/plant	Weight of fruits/plant (kg)	Fruit yield (t/ha)	Yield increased over control (%)
T_1 =Mancovit	20.80a	1.32a	39.58a	178
T_2 = Rovral	20.05a	1.05b	26.21ab	84.32
T_3 = Control	13.70b	0.45c	14.22b	-
F-test	* *	* *	* *	-
CV (%)	5.85	4.97	12.65	

Efficacy of Different Fungicide in Controlling Leaf Spot/ Leaf Blight Disease of Turmeric

Abstract

An experiment was conducted in the medium hilly land situation at the MLT site, Ghatail, Tangail during rabi 2006-07 to test the efficacy of fungicides in controlling leaf spot/leaf blight disease of turmeric under farmer's field condition. Bavistin, Folicur,. Suncoraizing, Sedagin Genume, Rovral, Score, Carbendozin along with a control were considered as treatments. Among the fungicide Score treated plants gave the highest finger yield (25.28 t/ha) and falicur treated plants provided the lowest yield (15.56 t/ha).

Introduction

Turmeric is one of the popular spices crops of Bangladesh. It has medicinal value and also used in various cultural program. But many disease specially leaf spot/leaf blight attack the crop severely and reduce its yield and production. Leaf spot/leaf blight disease is caused by *Paphino* spp. It is the major fungal disease of turmeric. Many fungicides are available in the market which may control/prevent the disease. As such, the experiment was conducted to identify the suitable fungicide in controlling/preventing the leaf blight/ spot disease in turmeric.

Materials and Methods

The experiment was conducted at the MLT site, Ghatail, Tangail during rabi 2006-07 under the farmer's field condition. It was laid out in RCB design four replications. Different fungicides were consired as treatments. They were Bavistin, Folicur, Suncoraizing, Sedagin, Genume, Rovral, Score, Carbendozin and control (no spray). Plot size was 3m x 2m. The seeds were sown on 24 April 2006 and the corms were harvested on 16 January 2007. Intercultural operations, irrigation and other crop management practice were done as and when necessary. Data on disease infestation and corm yield were recorded and analyzed statistically using MSTATC Package.

Results and Discussion

The highest tillers/clump was recorded from Sedagin but leaves/plant was maximum from Rovral followed by carbendozin. The maximum plant height was recorded from Sedagin followed by control. The highest primary finger/clump was obtained from Genume. Table 1 reveals that the plants treated with fungicide Score gave the maximum yield (25.28 t/ha), which was at par with that of plants treated with Carbendozin (23.28 t/ha) and Sedagin (22.78 t/ha). The lowest yield was obtained from the plants treated with Falicur (15.56 t/ha).

It was the results of first year trial. For concrete decision the trial may be repeated.

Table 1. Effect of different fungicide treatment on corm yield of Turmeric, Ghatail, Tangail, 2006-07

Treatment	Tillers/ clump (no.)	Leaves/ plant (no.)	Plant height (cm)	Primary finger/ clump (no.)	Finger yield (t/ha)
Bavistin	4.76 bc	15.67 bc	133.9 abc	17 cde	20.00 bcd
Falicur	4.70 bc	16.00 abc	124.7 cde	16 de	15.56 e
Suncoraizing	4.23 cd	15.00 bcd	124.4 cde	15 e	18.94 de
Sedagin	5.73 a	14.67 cd	142.2 a	19 bc	22.78 abc
Genume	4.60 bc	13.67 de	119.6 e	22 a	20.28 bcd
Rovral	4.53 bcd	15.33 bcd	127.3 cde	18 cd	21.94 abcd
Score	4.40 cd	17.67 a	131.5 bcd	16 de	25.28 a
Carbendozin	4.00 d	16.67 ab	122.7 de	20 b	23.28 ab
Control (no spray)	5.03 b	12.00 e	138.3 ab	18 bcd	19.17 cde
CV (%)	6.90	6.75	4.74	6.40	7.02

Cucurbit Fruit Fly (*Bactrocera Cucurbitae*) Management with the Joint Effort of Poison Bait and Pheromone Mass Trapping (Sweet gourd and Ash gourd)

Abstract

A trial was conducted at the MLT site, sadar, Tangail under Agro Ecological Zone-8 during November 2006 to April 2007 to observe the performance of sex pheromone and bait trap to control the fruit fly of cucurbit crops under farmer's field condition. Bait trap + Sex pheromone trap + destruction of infested fruits, farmers practice and absolute control (no control measures at all) were considered as three treatments. The highest number of fresh fruits (36/plot) gross return (Tk. 206000/ha) and BCR (3.13) were obtained from the plants treated with bait trap+sex pheromone trap along with the destruction of infested fruits. But in case of Ash groud similar findings were obtained with BCR (2.83).

Introduction

Fruit fly is the major insect-pest of cucurbit crops in Bangladesh. Pest loses around 10 to 60% of the crop. Therefore, the present study was initiated to develop the controlling practices of cucurbit fruit fly with the following objectives-

1. To reduce fruit fly infestation
2. To increase marketable yield by reducing fruit fly infestation in cucurbit
3. To conserve natural enemy population by reducing insecticide use in cucurbit field

Materials and Methods

The experiment was carried out in the medium highland situation under irrigated condition at farmer's field of MLT site, Tangail sadar during November 2006 to April 2007. Local cultivator of sweet gourd and ash gourd was used in this regard. The trial was laid out in RCB design with 3 replications. Three treatments viz. T_1 = Bait trap + sex pheromone trap + Destruction of infested fruits T_2 = Farmers practices and T_3 = Absolute control were considered in this regard. The plot size was 5 × 4 m^2 and plant spacing was 2 m × 2 m between rows and hills, respectively. Seed of sweet gourd was sown on 20th November 2006 whereas ash groud on 20 March 2006. Three times irrigation and two times weeding were done. Harvesting was done on 10th to 15 April 2007 for sweet gourd and 1 May to 10 June 2006 for ash gourd. The data on different plant characters and yield components were recorded through random selection of samples and was calculated plot wise. Data were analyzed by using MSTAT package.

Results and Discussions

Sweet gourd

Singnificant variation was found among the treatments. The highest number of fresh fruits (36) was obtained from plants treated with sex pheromone and bait trap along with the destruction of infested fruits. The lowest number of fresh fruits was obtained from absolute control plot (21/plot). The lowest number of infested fruits (2) was produced in plants treated with sex pheromone and bait trap while the plants of absolute control plot produced the maximum number of infested fruits (11/plot).

Ash gourd

A sharp statistical variation was found among the treatments. Significantly the highest number of fresh fruits (209/plot) was obtained from plants treated with Bait trap+Sex pheromone along with the destruction of infested fruits. Farmer's practice occupied the second position (122/plot) The lowest number of fresh fruits was obtained from absolute control plot (82/plot) significantly the lowest number of infested fruits (30/plot) was produced in plants treated with sex pheromone and bait trap along with destruction of infested fruits, while the plants of absolute control plot produced the maximum number of infested fruits (66/plot).

Cost and return analysis

Sweet gourd: The highest gross return (Tk.206000/ha) and benefit cost ratio (3.13) was obtained from plants treated with sex pheromone + bait trap along with the destruction of infested fruits. The lowest gross return (Tk.135000/ha) and BCR (2.62) was found in the absolute control plot.

Ash gourd: The highest gross return (Tk.185000/ha) and benefit cost ratio (2.83) were obtained from plants treated with sex pheromone trap + bait trap along with the destruction of infested fruits. The lowest gross return (Tk.105000/ha) and BCR (2.15) were found in the absolute control plot.

Farmer's reaction

The growers of the locality showed keen interest to apply sex pheromone trap. They are eager to have or even purchase the pheromone trap regularly.

Conclusion

The results of two year trial had a positive impact on the vegetable growers in the locality. For concrete decision, the trial should be repeated for the next year.

Table 1. Effect of pheromone on the production of sweet gourd at Tangail, 2006-07

Treatments	Fresh fruits/ plot	Infested fruits/ plot	Damaged fruit/ plot	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Bait trap + sex pheromone trap + Destruction of infested fruits	36a	2c	2c	206000	65650	140,350	3.13
Farmers practices	28b	5b	4b	175000	62550	112450	2.79
Absolute control	21c	11a	7a	135000	50520	84480	2.62
CV (%)	10.32	11.16	9.42				

Table 2. Effect of pheromone on the production of Ash gourd at Tangail, 2006-07

Treatments	Fresh fruits/ plot	Infested fruits/ plot	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Bait trap + sex pheromone trap + Destruction of infested fruits	209a	30 c	185000	65325	119675	2.83
Farmers practices	112 b	48 b	135000	61522	73478	2.19
Absolute control	82 c	66 a	105000	48650	56350	2.15
CV (%)	6.93	8.47				

Price of inputs (Tk./ha): Urea= 6, TSP= 15, MP= 16, Gypsum= 5, Cowdung= 1, and Bait trp= Tk. 18/piece & Sex pheromone= Tk. 30/piece

Price of fruits (Tk./fruit):
Sweet gourd: Fresh fruit-15 and infested fruit-5.50, Fruit weight: 3.0-5.0
Ash gourd: Fresh fruit-10 and infested fruit-5, Fruit weight: 3.0-5.0

Performance of Different Pesticides Free Vegetables Production under IPM Program at Farmer's Field

Introduction

A study was carried out at Choukibari village, Atghoria, Pabna to see the performance of pesticide free vegetable production and marketing. There are many technologies under way for controlling pest with different types of crops including vegetables. A high efficiency controlling pest method has been developed and yield loss was minimized under pesticide free vegetable production. The demand and price of pesticide free produce is always higher in world market including Bangladesh. But for getting a good price a market demand need to be created. Thus, this program was essential for popularizing pesticide free vegetable production and creating the market for its produce. Per day at least 200 g of vegetable is needed for an adult man/women where as Bangladeshi people are consuming only around 30 g/day (except potato and sweet potato). Besides this 30 g vegetable is mostly contaminated with toxic pesticide. Therefore, peoples are suffering with many fatal diseases due to the residual effect of toxic pesticide.

Objectives

- To popularize pesticides free vegetable production and create market opportunities.
- To reduce production cost and increase farmers income.
- To know farmers reaction.

Materials and Methods

Before start of the program a discussion meeting was organized with intending vegetable grower farmers at choukibar village, Atghoria, Pabna during 2006-07. Farmers were provided their knowledge and estimates of production technologies and return from cabbage, cauliflower as winter vegetables and cucumber, brinjal, sweet gourd as summer vegetables. Farmers shared their skill and knowledge about land suitability, experience on relevant crops, ability to manage production etc. Finally 40 co-operator farmers with 10 ha land was selected for cultivation during winter season of 2006-2007. This program was implemented in participating approach, except insect control the participating farmers procured all inputs. Training was provided on pesticide free vegetable production. Biological control agents including *Trichogramma* wasp, *Bracon* wasp, Green lac wing (*chrysoperla* sp) and sex pheromone trap "zadur phad" etc was supplied. *Trichogramma* wasp was applied @ 2 cards or vials per hectare, 3 times at 10 days intervals of the crop cycle. *Trichogramma* are minute wasp parasitic on eggs of Lepidopteran insect's pests. It lays its eggs in the host insect eggs, multiply therein, thus preventing hatching of host insect larvae.

Bracon wasp was applied @ one bunker per hectare, 5 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.

Green lace wing is a voracious predator of sucking pests including white flies, aphids, thrips, mealy bugs, eggs and young larvae of a group of insects. Its larvae with sickle shaped mouth parts feed on pests in large numbers and during 8-10 days life cycle span each larva can eliminate over 500 aphids/ 500 thrips/800-1000 eggs. Green lace wing eggs were applied @ 5000 eggs per hectare, 5 times at 15 days interval of the crop cycle. Sex pheromone traps were set up @ 105 boxes per hectare. Necessary data were collected and analyzed statistically. The progress of production and selling was monitored regularly and finally the data on yield, total cost and return were taken for analysis.

Results and Discussion

Apparently less insect infestation was observed in different vegetable of IPM program compared to non-IPM program. The yield and gross return also found higher in IPM than non- IPM program (Table 1).

Marketing

Under this IPM program, the products (pesticides free vegetables) were supposed to buy by Safe Agro-Biotec. limited from the farmers farm gate with 10-15% hike price of the local market. But unfortunately, Safe Agro-Biotec. did not able to market those pesticides free vegetables due to their unavoidable situation. On-Farm Research Division of Pabna took a initiative to open a shop for marketing pesticides free vegetable at Pabna town. The team also appeals to the people through leaflet, banner and festoon to use pesticides free vegetable at Pabna town. Really it was observed that there was a good response and people willing to pay more prices for pesticides free vegetable than the pesticides added vegetables. But people demanded diversified pesticides free vegetables with continuous supply and available in the market round the year. It was also observed that if possible to create market opportunities for pesticides free vegetable, more farmers will come forward and will involved under IPM program for pesticide free vegetable production.

Farmer's reaction

They opined that the application of biological agents and sex pheromone box is very helpful and non hazardous for farmers and consumers. They were happy to get satisfactory yield. But their desire was to get biological agents and sex pheromone timely and sufficiently in the local market with low price.

Conclusion

The program is going on. This program created a good motivation to the high value crop growers because of good yield and economic return.

Table 1. Performance of different pesticide free vegetable production under IPM program at Choukibari village, Pabna during 2006-07

Name of the Vegetables	Area covered (ha)	IPM				Non IPM			
		Insect infestation (%)	Yield (t/ha)	Average price (Tk./kg)	Gross return (Tk./ha)	Insect Infestation (%)	No. of spray per hectare with cost	Yield (t/ha)	Gross return (Tk./ha)
Cucumber	8	7.5	16.50*	8.5	140250	20	8 times (Tk. 9000/ha)	15.20	129200
Brinjal	3.5	12.5	25.20	8	201600	30	12 times (Tk. 27000/ha)	16.80	134400
Sweet gourd	0.5	10	31.25	2.5	78125	42	6 times (Tk. 1200/ha)	26.25	65625
Cabbage	1.5	8	119.60	2	239200	12	12 times (Tk. 10500/ha)	111.31	222620
Cauliflower	3.5	2	46.00	6.5	294400	4	6 times (Tk. 2250/ha)	43.44	282360

*Due to virus attack, yield was decreased

Integrated Pest Management for Summer Onion

Abstract

An experiment was carried out at Moulvibazar MLT site, OFRD, BARI, Sylhet during kharif-1 2007 to observe the efficacy of different pesticides on summer onion production. Five treatments a) Spraying of Malathion at 20 and 45 DAT, b) Rovral and Ridomil spraying at 15, 25, 45 and 60 DAT. c) Spraying of treatment a and b combined d) Rovral only and e) Control were tested. A significant treatment effect was found in case of yield having the highest yield (9.513 t/ha) from plants combinedly treated with malathion, Rovral and Ridomil. Pests and diseases were controlled succesfully with combined dose of insecticide and fungicides for the production of summer onion.

Introduction

Summer onion is a highly cash crop but farmers are reluctant to cultivate summer onion due to various disease and insect problem. It is highly susceptible crop to thrips and purple blotch diseases. Often the crop is seriously attacked by the thrips in Kharif–1 season. As a result, the growth and yield is seriously suffered. So, the integrated management study has been done at farmers field to determine an effective management of purple blotch disease and thrips of summer onion.

Materials and Methods

The experiment was carried out at Moulvibazar MLT site, OFRD, BARI, Sylhet during kharif-1 season, 2007. Five treatments viz. a) spraying of Malathion at 20 and 45 DAT, b) Rovral and Ridomil spraying at 15, 25, 45 and 60 DAT, c) Spraying of treatment (i) and (ii) combinedly, d) Rovral only and e) Control were considered. The design was RCBD with 3 replications. Plot size was 2 m x 3 m with recommended spacing. Recommended fertilizer doses were applied. The crop was transplanted with 35-day-old seedlings on 12 February 2007 and harvested on 7 May 2007.The crop was harvested earlier than the optimum maturity due to high rainfall which was responsible for lower yield.

Results and Discussions

Significant difference was found in all the parameters due to treatments effect. Maximum plant height was obtained from treatment T_3 (44.34 cm) followed by T_2 (44.02 cm) which was statistically identical and the lowest from T_5 (33.57 cm). Similar trends were found in case of leaves/plant, bulb diameter and weight/bulb. A significant different was found among the treatments in case of yield. Higher bulb yield (9.513 t/ha) was obtained from T_3 (Spraying of treatment a and b combinedly) which was statistically similar with T_2 (9.333 t/ha) and T_4 (8.967 t/ha). The lowest yield (5.307 t/ha) was obtained from control plot that was statistically similar to T_1. Pests and diseases were controlled successfully with combined dose of insecticides and fungicides.

Conclusion

Pests and disease were controlled susceptibly with combined dose of insecticide and fungicides (Rovral + Ridomil and Malathion) in summer onion.The experiment needs to be repeated another year for confirmation.

Table 1. Effect of different doses of pesticide on the yield and yield attributes of summer onion (OF-4) at MLT site, Moulvibazar, Sylhet, 2007

Treatment	Plant height (cm)	Leaves/ plant	Bulb diameter (cm)	Weight/bulb (g)	Bulb yield (t/ha)
T_1	37.68	8.86	11.18	32.75	6.810
T_2	44.02	11.31	16.66	42.01	9.333
T_3	44.34	13.11	17.58	42.81	9.513
T_4	41.32	11.91	16.57	40.31	8.967
T_5	33.57	7.79	8.71	29.89	5.307
LSD (0.05)	2.914	1.185	1.347	2.79	0.62
CV (%)	3.86	5.94	5.06	3.95	4.16

Effect of High Speed Rotary Tiller on the Performance of Dry Land Preparation for Onion Production

Abstract

A field demonstration was conducted at Multilocation Testing (MLT) site, Khaloibhara, Kashinathpur, Pabna during 2006-07 to see performance of high-speed rotary tiller ploughing (HRP) on the performance of onion production compared to conventional ploughing (CP) method. The bulb yield, gross return and BCR were higher in both sole high speed rotary tiller cultivated land and combination with that of power tiller ploughing land only conventional power tiller cultivated land. It was observed that the highest bulb yield increased (19.47 %) over conventional method in HRP (1) +CP (1) treatment.

Introduction

Onion is one of the most important spices crop in Bangladesh. Pabna is famous for onion production. .But successful onion production mainly depends on tilth condition. For onion land preparation, farmer of this area used power tiller driven by Sifang engine, which required 6-8 times tillering for fine tilth. It is very costly and time consuming. Wheat Research Centre and CIMMYT Bangladesh have a good program to introduce Chinese made power tiller operated minimum tillage seeder for sowing wheat earlier. Similar to wheat seeder the scientist of BARI developed a high speed rotary tiller for onion land preparation. Due to its high speed rotary action on soil surface, tilth quality is very fine in sandy to clay loam soil. For dry land crop cultivation, use of this high speed rotary tiller can be a good option for land preparation. The tiller was used for ploughing onion and garlic lands. The study was conducted for the following objectives:

1. To find out the effect of high speed rotary tiller on the performance of onion
2. To monitor the farmers reaction on high speed rotary tiller.

Materials and Methods

The trial was conducted at MLT site, Khaloibhara, Pabna during 2006-07 to see the performance of high speed rotary tiller ploughing (HRP) method. The crop was cultivated with 104-39-30-11 kg N, P, K, S respectively (Farmer dose). In conventional ploughing (CP) driven by Sifang power tiller is needed 6-8 times ploughing and cross ploughing (50 minutes/plough) for land preparation. But in high speed Rotary tiller ploughing (HRP), it was needed only one time (90 minutes/plough) or 1 time traditional power tiller (50 minutes/plough) and 1 time HRP for land preparation (60 minutes/plough) and its tillage condition is better than normal power tiller. Four different ploughing method were involved under this trial i.e. i) Only one time ploughing with high speed rotary tiller (HRP-1) ii) One time conventional ploughing followed by one time high speed rotary tiller ploughing (CP-1+HRP-1), iii) two times conventional ploughing followed by one time high speed rotary tiller ploughing (CP-2 + HRP-1) and iv) Only six times conventional ploughing with sifang power tiller (CP-6). Onion seedlings were planted during first week of January 2007. The crop was grown under irrigated condition. Intercultural operations were done when required. The crop was harvested on first week of April, 2007. Yield and yield contributing characters were recorded and analyzed statistically.

Results and Discussion

Higher bulb yield (17.55 t/ha) was obtained from one conventional ploughing followed by one high speed rotary tiller ploughing (T_2) treatment which was identical with T_3 and T_1 treatment (Table 1). Lower bulb yield (14.69 t/ha) was obtained from conventional ploughing (T_4). The result clearly indicated that additional yield advantage was observed by high speed rotary tiller over conventional power tiller. Yield increased by CP-1+HRP-1 treatment was 19.47% and it might be due to deep ploughing, less clod and fine and leveled soil. But in CP-2 + HRP-1 treatment the increasing rate was less though the tilth condition was same and it might be due to loss of moisture between 2 conventional ploughing and 2 days after high speed rotary tiller ploughing.

Higher gross margin was recorded in CP-1+HRP-1 treatment. Comparatively lower return was obtained from conventional power tiller where higher cost was involved for intensive and repeated ploughing.

Farmer’s reaction

Farmer’s liked the performance of high speed rotary tiller for their onion land preparation. Because it needs less time, labour, fuel but land preparation quality is better than traditional power tiller. They also opined that it should be made available with lower price in the market and modify the present model with less weighty so that it can be easily used by 12 horse power Sifang power tiller.

Conclusion

Land prepared by high speed rotary tiller is very good and it facilities increase of onion yield. Land can be prepared by rotary tiller timely within short period and fine and good tilth condition is achieved with less ploughing which is economically viable. But for better tilth condition and less pressure on engine, one conventional power tiller ploughing should be given before high speed rotary tiller ploughing.

Table 1. Yield and yield attributes of Onion as affected by different ploughing method at MLT site Khaloibhara, Kashinathpur, Pabna during 2006-07

Treatments	Plant pop^n /m^2	Plant height (cm)	Bulb length (cm)	Bulb bredth (cm)	Bulb yield (t/ha)	Yield increase (%)
T_1=HRP-1	80.50	36.65	3.08	3.02	15.36	4.56
T_2=CP-1+HRP-1	86.08	37.53	3.14	3.18	17.55	19.47
T_3= CP-2+HRP-1	85.08	36.84	3.13	3.12	17.05	16.07
T_4=CP- 6	89.25	38.98	3.04	2.95	14.69	-
LSD (0.05)	12.960	3.179	0.464	0.442	2.552	-
CV (%)	7.61	4.24	7.53	7.22	7.91	-

- HRP = High speed Rotary Tiller ploughing
- CP = Conventional ploughing
- () = No. of ploughing

Table 2. Cost and return analysis of Onion production as affected by different ploughing methods at MLT site,Khaloibhara, Kashinathpur Pabna during 2006-07

Treatments	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1=HRP -1	153600	39420	114180	3.90
T_2=CR-1+HRP-1	175500	40170	135330	4.37
T_3= CP-2+HRP-1	170500	40920	129580	4.17
T_4=CP-6	146900	42420	104480	3.46

Price of input: HRP 1 plough= Tk.1500/ha, CP 1 plough = Tk. 750/ha, Urea = Tk. 6.50/kg, TSP= Tk. 16.50/kg, MP= Tk. 15/kg, Gypsum = Tk. 5/kg, Zinc sulphate= Tk. 60/kg, Borax = Tk. 60/kg

Price of out put: Onion bulb = Tk. 10/kg

Field Performance of Mango Harvester

Introduction

In Bangladesh mango harvester is not made commercially. For harvesting mango, farmers usually make net harvesting device of their own by pleated bamboo and net made of jute rope. This device is fastened on top of a bamboo pole. When mangoes are harvested with this device, mangoes are detached from the end of pedicel. To avoid this problem, mangoes are harvested with 1 to 1.5 cm of pedicel attached to the fruit in other countries. Because of the harvesting problem and other problems, in Bangladesh about 20 to 25 percent post harvest losses of mango occur. Assuming 50 per cent of the mangoes are locally consumed other 50 percent are shipped to city areas. The post harvest losses occur mainly due to stem-end rot disease, faulty packaging and transportation. Stem-end rot disease is assumed to be responsible for 15 per cent post harvest loss. Total production of mango is about 187220 ton. Assuming 15 percent loss in half of this mangoes, and market price in city of Tk 40/kg, post harvest loss would be Tk 56 crore. Use of good mango-harvesters can save this loss to a great extent. A mango harvester has been developed and tested at research station. The harvester can cut the peduncle keeping 1 to 2 cm with mango. Stem-end rot disease, which is responsible for major post harvest loss, does not occur if the peduncle is kept. Therefore, the trial was undertaken at farmer garden to study the field performance.

Objectives

i) To test the performance of the mango harvester in farmers garden

ii) To know the farmers reaction and suggestion for further improvement of the harvester (if necessary)

Materials and Methods

The trial was carried out at BARI Technology Village, Modhupur, Pushpapara, Pabna and Razakhali, Patuakhali during 2006-07. Before starting the experiment, four mango tree from each variety (var. 1. Gopalvog, 2. Khirsapat and 3. Langra) were selected and each tree was treated as one replication. The ages of those mango trees were 18-20 years. Two types of harvester were used for mango harvesting i.e. 1) BARI Mango Harvester (BMH) and 2) Traditional Mango Harvester (TMH). Finally six treatments combination were tested for this trial and those treatments combinations were- T_1= BMH + Gopalvog, T_2= TMH + Gopalvog, T_3= BMH + Khirsapat, T_4= TMH + Khirsapat, T_5= BMH + Langra and T_6= TMH + Langra. But at Patuakhali only 2 treatments (Traditional and BARI harvester) was used. Flowers were initiated of those mango trees during 15 to 20 January 2007. Cypermethrin in the brand name of 'Phan phan' were sprayed two times for controlling mango hopper at before flower blooming and at the stage of pea size mango at Feb.10, 2007 and March 07, 2007 respectively. The maturity of different mango variety became in different time; so, harvesting was done in different dates. Gopalvog, Khirshapat and Langra mango were harvested at May 22, May 28 and June 04, 2007, respectively. Mango harvesting efficiency was recorded per 10 minutes basis with the same person and finally it was converted in per hour. After harvesting, all types of mango were kept on the gunny bag and counted the number of rotten mango regularly. Data on different parameters were collected and analyzed statistically.

Results and Discussion

FSRD site, Puspapara, Pabna

From the results, it was found that all parameters were differing significantly among them due to different treatments (Table 1). Higher numbers of mango was harvested from Langra variety with BMH (T_5) which was also statistically identical with T_1 and T_3 treatments. The lowest number of mango was harvested from Khirshapat and Gopalvog varieties with traditional harvester and it was also statistically identical with T_6 treatment. On an average higher number of mangoes (697 no.) could harvest with BMH and 18.53% increased by BMH over TMH. From the results, it was found that more no. of mangoes could be harvested Langra variety where BARI Mango Harvester was used, it was easy to harvest mango. Higher number of rotten mangoes was counted from TMH+Gopalvog treatment and it was identical with T_4 and T_6. Relatively less number of mangoes were rotting incase of Langra than Gopalvog and Khirshapat due to its good quality of skin. It was also observed that more percentage of rotten mangos was found with Traditional Mango Harvester. When mangoes are harvested with Traditional Mango Harvester, it was detached from the end of pedicel but BARI Mango Harvester could harvest with 1 to 1.5 cm of pedicel attached to the fruit. As a result the mango sap secretion was high in case of TMH and less of BMH, which influence the stem end rot disease. However, some mangoes were also found drop out incase of BMH due to subsequent jerking effect on nearby mangoes and those mangoes were rotten mainly.

Conclusion

BARI Mango Harvester is a very good device for mango harvesting with maintaining good quality. It should be make available at local level, so that farmer can get it easily with low price.

Table 1. Performance of different mango harvester at BARI Technology Village, Modhupur, Pushpapara, Pabna during 2006-07

<table>
<tr><th rowspan="2">Treatments</th><th rowspan="2">Mango harvested (no. hr $^{-1}$)</th><th colspan="2">Av. mango harvested (no. hr $^{-1}$)</th><th rowspan="2">Drop out mango (no. hr $^{-1}$)</th><th rowspan="2">Post harvest mango rotten (%)</th><th rowspan="2">Average harvesting increased by BMH over TMH (%)</th></tr>
<tr><th>BMH</th><th>TMH</th></tr>
<tr><td>T_1=BMH+Gopalvog</td><td>693</td><td rowspan="6">697</td><td rowspan="6">588</td><td>5.25</td><td>1.70</td><td rowspan="6">18.53</td></tr>
<tr><td>T_2=TMH+Gopalvog</td><td>579</td><td>12.50</td><td>4.64</td></tr>
<tr><td>T_3= BMH+Khirsapat</td><td>684</td><td>3.50</td><td>0.84</td></tr>
<tr><td>T_4= TMH+Khirsapat</td><td>566</td><td>15.25</td><td>4.18</td></tr>
<tr><td>T_5= BMH+Langra</td><td>714</td><td>3.50</td><td>0.49</td></tr>
<tr><td>T_6= TMH+Langra</td><td>620</td><td>18.25</td><td>3.02</td></tr>
<tr><td>LSD</td><td>79.70</td><td>-</td><td>-</td><td>5.445</td><td>1.969</td><td>-</td></tr>
<tr><td>CV (%)</td><td>8.23</td><td>-</td><td>-</td><td>37.31</td><td>52.74</td><td>-</td></tr>
</table>

BMH= BARI Mango Harvester & TMH= Traditional Mango Harvester

Table 2. Performance of BARI mango harvester at FSRD site, Rajakhali, Patuakhali during 2006-07

Harvesting method	% Injured fruits	% Fresh fruits	% fruits without peduncle	% fruits with peduncle
Traditional	32	68	94	6
BARI harvester	2	98	12	88

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Farmers Participatory Research on Integrated Farming for Improved Livelihood for Resource Poor Farm Households

A. Year Round Vegetable Production in the Homestead Area

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 vegetable per day. So, increased production of vegetable is urgently needed. Intensive vegetable production could provide not only nutritional security but also be useful for employment generation, higher total farm income, better export potential and lower dependency on cereal food. 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 field. 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 it is a good option to grow vegetables intensively in the homestead. Hence, an experiment was conducted to find out the profitable vegetable production sequence in the homestead. The objectives of the study were:

1. To supply fresh vegetables for family consumption.
2. To ensure food security round the year from homestead and improve family nutrition.
3. Create employment opportunity for family members including woman and children.

Materials and Methods

The experiment was conducted at Mymensingh, Bogra, Gazipur, MLT sites and Sylhet, Sherpur, Rajshahi, Pabna, Patuakhali, Noakhali FSRD sites during kharif II and rabi seasons, 2006-07 to find out suitable and profitable patterns and utilize the unused place of homestead area.

MLT sites Mymensingh (Palima Model)

To test the vegetable patterns, 6 farmers homestead of each site were selected and vegetable growing was started from Kharif II, 2006. The Kharif II vegetables were sown/planted on 22 August 2006 in Trishal and 3 September 2006 in Mymensingh Sadar. Whereas the rabi vegetables were sown/planted during 9-14 November 2006 in Trishal and 8-19 November 2006 at Mymensingh Sadar. The kharif vegetables were harvested after 35-68 days of sowing/planting and rabi vegetables were harvested after 35-127days of sowing /planting in both the locations. Five patterns consisting of 14 different kinds of vegetables were cultivated round the year. The tested patterns were as follows (Nerikeli vegetable model):

Bed no.	Kharif 1	Kharif II	Rabi
Bed 1	Indian spinach	Danta	Tomato
Bed 2	Kangkong	Kangkong	Lalshak + Cabbage
Bed 3	Okra	Danta/Lalshak	Coriander + Onion
Bed 4	Chilli	Chilli	Spinach + Garlic
Bed 5	Latiraj kachu + Lalshak	-	Carrot

In Kharif II season, different kinds of vegetables were cultivated such as Indian spinach, Danta, Lalshak, Kangkong. The rabi vegetables were Lalshak, Tomato, Cabbage, Coriander, Spinach, Carrot, Onion and garlic. The plot size was 5m × 1m. Recommended seed rate, seedling age, spacing and fertilizer doses were used for all the vegetables. At harvest, data were recorded for each crop. Total variable cost including seed/seedlings, fertilizers, insecticide were calculated. Gross return was calculated by the total yield multiply by the market price of each crop.

Sylhet, FSRD site (Golapganj Vegetable Model)

Sl.#	Production units	Cropping pattern
1.	Sunny area	Bed I – Radish-Tomato-Amaranth
		Bed II-Laishak –Cabbage-Okra.
		Bed III- Brinjal +Lalshak-Gimakalmi.
		Bed IV-French bean-Lalshak-Yard long bean.
2.	Trelli	Yard long bean- BARI Lau-Country bean
3.	Under trelli	Turmeric and Mukhikachu
4.	Homestead boundary	Plantation of guava, litchi, lemon, orange, pumello etc.

This model designed for homestead vegetables under four cropping patterns in 5m$\times$1.5 m per bed. But the size of the bed is not fixed. Near by vegetable beds, we used one decimal of land for cultivation creeper vegetables like yard long bean or ridge 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 and mukhikachu.

MLT site, Gabtali, Bogra (Goyeshpur Model)

There are five homestead were used in each location. The Pabna Goyeshpur model of homestead utilization system was used. It included nine production units under following patterns.

Sl. no.	**Spaces**	**Cropping Patterns**
1	Open land	a. Radish-stem amaranth-Indian spinach. b. Cabbage-Brinjal-Red amaranth c. Tomato + Spinach –Okra. d. Bitter gourd-Ribbed gourd-Sponge gourd e. Snake gourd-potato yam
2	Roof	Bottle gourd-wax gourd.
3	Trellis	Bottle gourd-Sweet gourd.
4	Tree Support	Country bean-yard long bean
5	Partial shady area	a. Elephant foot yam b. Leaf aroid (Molovi kacha) c. Ginger d. Perennial Chilli
6	Marshy Land	Pani Kachu
7	Fence	Bitter gourd-yard long been –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 free) b. Plantain Banana (1-2 Plant)

The recommended production practice guided by krishi projocti hatbai but biological pest control was followed for each crop. The cost of all operations and include seeds and seedling except family labour was borne by ATT project. Weekly monitoring was done and MLT site team members guided all operations.

FSRD site, Kushumhati, Sherpur (Nerikeli Model)

The patterns were as follows:

Bed	Kharif-I	Kharif-II	Rabi
Plot 1	Indian spinach	Data	Tomato
Plot 2	Kangkong	Kangkong	Lalshak + Cabbage
Plot 3	Okra	Okra	Coriander + Onion
Plot 4	Chilli	Chilli	Spinach+ Garlic
Plot 5	Latiraj kachu	Latiraj kachu	Carrot+ Bitter gourd

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 Latiraj kachu: and in Rabi different vegetables were Tomato, Lalshak, Cabbage, Coriander, Onion, Spinach, Garlic, Carrot and Bitter gourd. The experiment was conducted in a randomized complete block design. 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. Total variable cost including fertilizer; human labour, seed and insecticide were calculated. Gross return were calculated by the total yield and multiplied by the market price on each crop.

FSRD site, Kadamshahar, Rajshahi (Barind Model)

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	Jute leaf (*Pat Shak*)
Bed-4	China cabbage (*Batishak*)	Okra + Red amaranth	Onion + 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/Boundary	Country bean	Bitter gourd, yardlong 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	-

FSRD site, Puspapara, Pabna (Goyeshpur Model)

The model 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.	Trelli	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 (moulobi 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)

The development work was initiated at Chaukibari village, an extrapolation area of FSRD site Pushpara Pabna during the rabi season 2006 to kharif-I season of 2007. Fifteen cooperator farmers were selected for the program. The cooperator farmers were trained up about the production technologies for different vegetables, marketing and income generation. The farmers accordingly practiced recommended production packages for each crop. The cost of all the operations and inputs except seeds and seedlings was beard by farmers. Weekly monitoring was done and all operations were guided by FSRD team members.

MLT site, Dhirashram, Gazipur (Palima Model)

To test Palima Model, out of fifteen home gardens (Open sunny place) eleven owners practiced the whole of the vegetable sequences fully and the rest practiced partially, during rabi season. The yield of vegetable obtained from eleven home gardens have been presented here. The rabi vegetable were sown/ planted during November, 2006 and harvested after 31-94 days of sowing/planted at that location. Four patterns consisting of 10 different kinds of vegetables were Radish, Tomato, Brinjal, Lalshak, Spinach, Stem amaranth and Cabbage was cultivated round the year. The plot size was 5.8 m x 1.8m. Recommended seed rate, seedling age, spacing and fertilizer doses were used for all the vegetable. At harvest, data were recorded for each crop. Total variable cost including seed/seedling, fertilizers and insecticides are calculated. Gross return was calculated by the total yield multiply by the market price of each crop. The tested patterns were as follows:

No of Bed	Pattern (Unit : open sunny place)		
	Rabi	Kharif-1	Kharif-2
Bed-1	Radish-Tomato	Okra	Indian Spinach
Bed-2	Brinjial + Lalshak	Indian Spinach	Okra-Lalshak
Bed-3	Spinach/Lalshak-Stem Amaranth	Kangkong	Kangkong
Bed-4	Cabbage	Stem Amaranlth	Indian Spinach.

FSRD site, Hazirhat, Noakhali (Atkapalia Model)

Table 1. Cropping/fruits patterns for different types of space, Atkapalia, Noakhali, 2002-04

1. Open sunny space		**Rabi**	**Kharif-1**	**Kharif-2**
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
2. House roof	:	Countrybean/Gourd	Ash gourd	
3. Trellis	:	Gourd	Ribbedgourd/Cucumber/Bittergourd	

FSRD site, Razakhali, Patuakhali

Five beds of each 8m × 1.5m were taken for Lebukhali model. A fence was made with bamboo. Vegetables were cultivated round the year one after another. Twelve homesteads were used for this purpose. From September, 2006 to 15 March, 2007 yield data was recorded.

Bed No.	Crop
01	Red amaranth
	Brinjal
02	French bean
	Okra
03	Red amaranth
	Tomato
	Kangkong
04	Coriender leaf
	Cabbage
	Indian spinach
05	Red amaranth
	Potato
	Stem amaranth

Results and Discussion

MLT site, Mymensingh

Yield and economic return of homestead vegetables at Trishal

Yield, economic return and utilization pattern of homestead vegetables grown during Kharif II and rabi seasons at Trishal have been shown in Tables 1-4. Table 1 showed the agro-economic performance of different vegetables while the Table 2 shows the utilization pattern of the homestead produce during Kharif-II, 2006. Tables 3 and 4 showed the performance of rabi vegetables. Field duration of the Kharif II vegetables varied from 35-68 days. Field duration of rabi vegetables varied from 36-112 days. Danta and lalshak was the most short duration crop whereas tomato required the maximum days to harvest. Yield of different vegetables were: Lalshak 12.5 kg (in kharif 11) and 4.58 kg in rabi, Danta 12.0 kg, Kangkong 13.7 kg, Indian spinach 8.75 kg. Tomato 24.1 kg, Cabbage 30.66 kg, Coriander 1.25 kg, Onion 5.0 kg, Spinach 10kg, Garlic 3.18 kg and Carrot 6.83 kg/bed. Net return varied from Tk. 15.8-242.2 /bed. BCR ranged from 1.52-6.15 for different vegetables. From utilization pattern it was shown that farmers produced 42.2-52.50 kg vegetable in Kharif II season and 81.8-94.0 kg in rabi season. From that produce they consumed the large portion and some was distributed to the neighbourers. They also sold a little portion. Consumption period in Kharif season ranged from 42-46 days and in rabi season 63-71 days.

Yield and economic return of homestead vegetables at Mymensingh Sadar

Yield, economic return and utilization pattern of homestead vegetables grown during Kharif II and rabi seasons at Mymensingh Sadar have been shown in Tables 5-8.

Table 5 shows the agro-economic performance of different vegetables whereas the Table 6 shows the utilization pattern of the homestead produces during Kharif-II, 2006. Table 7 and Table 8 showed those performance of rabi vegetables. Field duration of the Kharif vegetables varied from 33-69 days. Field duration of rabi vegetables varied from 35-127 days. Danta and lalshak was the most short duration crop whereas Tomato required the maximum days to harvest. Yield of different vegetables were: Lalshak 11.6 kg (in kharif 11) and 6.1 kg in rabi, Danta 11.0 kg, Kangkong 11.4 kg, Indian spinach 7.4 kg. Tomato 34.0 kg, Cabbage 28.0 kg, Coriander 1.8 kg, Onion 6.6 kg, Spinach 12 kg, Garlic 3.0 kg and Carrot 9.0 Kg/bed. Net return varied from Tk. 25.0-360.0 /bed. BCR ranged from 1.83-8.5 for different vegetables. From utilization pattern it was shown that farmers produced 31.5-47.0 kg vegetable in Kharif II season and 87.6-118.6 kg in rabi season. From that produces they consumed the large portion and some was distributed to the neighbourers. They also sold a little portion. Consumption period in Kharif season ranged from 37-40 days and in rabi season 68-73 days.

Farmer's reaction

Farmers were very happy with the homestead vegetable production model because they are harvesting different fresh vegetables with a few days intervals. They can eat the vegetables when they feel need. The women and children can participate in the home gardening. They can also distribute some vegetables to the neighbourer and can also sell some portion of their produce in the local market to earn cash money.

Table 1. Yield, cost and return analysis of different vegetables at Naodhar, Trishal, (Kharif-11'2006)

Crops	Field duration (Days)	Yield (kg/bed)	Total return (Tk./bed)	Total variable cost (Tk./bed)	Net return (Tk/bed)	BCR
Lalshak	64 (2 times)	12.5	150.00	48.00	102.00	3.13
Danta	35	12.0	60.00	30.00	30.00	2.00
Kangkong	68	13.7	109.60	40.00	69.6	2.74
Indian Spinach	62	8.75	87.50	38.00	49.5	2.30

Lalshak:12 Tk/kg , Kangkong: 8Tk/kg ,Indianspinach: 10 Tk/kg ,Danta: 5.00 Tk/kg

Table 2. Utilization pattern of homestead vegetables grown in the home garden at Naodhar, Trisal (Kharif 11' 2006)

Farmer	Total production (kg/ garden)	Consumption (kg)	Distribution (kg)	Sell (kg)	Consumption period (days)	Production period (days)
Farmer 1	47.00	30.00	7.00	10.00	44	68
Farmer 2	47.50	30.00	5.00	12.50	43	65
Farmer 3	52.50	37.00	6.50	9.00	45	70
Farmer 4	49.50	35.00	5.50	9.00	42	70
Farmer 5	43.00	32.00	5.00	6.00	46	69
Farmer 6	42.2	30.00	4.00	8.20	44	68

Table 3. Yield, cost and return analysis of different vegetables at Naodhar Trishal, (Rabi'2006-07)

Crops	Field duration (Days)	Yield (kg/bed)	Total return (Tk/ bed)	Total Variable Cost (Tk./bed)	Net return (Tk/ bed)	BCR
Tomato	112	24.1	289.2	47.00	242.2	6.15
Lalshak	36	4.58	45.8	30.00	15.8	1.52
Cabbage	108	30.66	183.96	42.00	141.96	4.38
Coriander	39	1.25	100.00	32.00	68.00	3.12
Onion	85	5.00	70.00	43.00	27.00	1.63
Spinach	44	10.0	100.0	34.00	66.00	2.94
Garlic	126	3.18	159.00	39.00	120.00	4.07
Carrot	106	6.83	81.96	36.00	45.96	2.27

Table 4. Utilization pattern of homestead vegetables grown in the home garden at Naodhar, Trishal (Rabi 2006-07)

Farmer	Total production (kg/ garden)	Consumption (kg)	Distribution (kg)	Sell (kg)	Consumption period (days)	Production period (days)
Farmer 1	76.2	50	6.2	20	70	126
Farmer 2	81.8	60	11.8	10	68	124
Farmer 3	87.8	60	7.8	20	65	122
Farmer 4	94.0	65	14	15	71	122
Farmer 5	84.8	55	4.8	25	66	119
Farmer 6	88.5	60	8.5	20	63	120

Table 5. Yield, cost and return analysis of different vegetables at Sabjipara, Shambhuganj, Mymensingh (Kharif 11' 2006)

Crop	Field duration (day)	Yield/bed (kg)	Total return (Tk./bed)	Total variable cost (Tk./bed)	Net return (Tk./bed)	BCR
Lalshak	59 (2 times)	11.6	139.20	48	91.2	2.90
Danta	33	11.0	55.00	30	25	1.83
Kangkong	59	11.4	91.2	40	51.2	2.28
Indian spinach	59	7.4	74.00	38	36	1.95

Price: Lalshak-Tk. 12.00/kg, Danta-Tk. 5.00/kg, Kangkong-Tk. 8.00/kg, Indian spinach-Tk. 10.00/kg.

Table 6. Utilization pattern of homestead vegetables grown in the home garden at Sabjipara, Shambhuganj, Mymensingh (Kharif 11' 2006)

Farmer	Total production (kg)	Consumption (kg)	Distribution (kg)	Sell (Kg)	Consumption period (days)	Production period (days)
Farmer 1	45.5	30.5	5	10	39	59
Farmer 2	46.0	33.0	6	7	38	61
Farmer 3	37.0	28.0	4	5	35	54
Farmer 4	47.0	30.0	4	13	40	63
Farmer 5	31.5	29.0	2.5	-	36	55
Farmer 6	41.4	30.0	5	6.4	37	57

Table 7. Yield, cost and return analysis of different vegetables at Sabjipara, Shambhuganj, Mymensingh (Rabi' 2006-07)

Crop	Field duration (day)	Yield (kg/bed)	Total return (Tk./bed)	Total variable cost (Tk./bed)	Net return (Tk./bed)	BCR
Tomato	119	34	408	48	360	8.5
Cabbage	112	28	168	41	127	4.09
Lalshak	35	6.1	61	32	29	1.90
Onion	97	6.6	92.4	42	50.4	2.2
Coriander	41	1.8	144	31	113	4.65
Garlic	127	3	150	40	110	3.75
Spinach	46	12	120	35	85	3.43
Carrot	110	9	108	36	72	3

Price: Tomato-Tk. 12.00/kg, Cabbage-Tk. 6.00/kg, Lalshak-Tk. 10.00/kg, Onion--Tk. 14.00/kg, Coriander-Tk. 80.00/kg, Garlic- Tk. 50.00/kg, spinach-Tk. 10.00/kg, Carrot Tk. 12.00/kg.

Table 8. Utilization pattern of homestead vegetables grown in the home garden at Sabjipara, Shambhuganj, Mymensingh (Rabi' 2006-07)

Farmer	Total production (kg)	Consumption (kg)	Distribution (kg)	Sell (kg)	Consumption period (days)	Production period (days)
Farmer 1	118.60	74	18.6	16	72	147
Farmer 2	105.50	75	13.5	17	70	144
Farmer 3	87.60	67	10.6	10	68	142
Farmer 4	109.50	80	15.5	14	73	147
Farmer 5	96.50	73	9.5	14	70	145
Farmer 6	95.30	75	10.3	10	67	141

FSRD site, Jalalpur, Sylhet

Three farm households, one from each of marginal, small & medium category were intervened under integrated farming study at Jalalpur FSRD site, Sylhet during 2006-07 with a view to maximize the utilization of all available farm resources, farm productivity and income. The results of intervention with improved technologies/practices as compared to the pre-intervention period are presented below.

Farm Resource Utilization: During the pre-intervention period, most of the farms had serious under utilization of available resources for productive/ income generating purposes. But during the intervention period the farmers introduced several alternatives practices & new enterprises in almost all farming subsystems. This led to full utilization of both physical & other farm resource available in the disposal of the farm & mobilized resources for food security, income generation and improvement of livelihoods.

Farm Productivity: Farm productivity increased due to increase of yield per unit area as well as addition of new alternative enterprises. In the first place, the crop yields increased due to adoption of recommended technologies & better use of farm resources. Secondly, addition of new enterprises added new commodities. However, considering the volume the data of individual farm, they are not included here.

Family labour utilization: Utilization of surplus family (Viz. women, children) and hired labour increased due to huge intervention of technologies in integrated farming. The higher participation of women in agricultural activities made positive impact on equity issues within the family & the community as a whole.

Changes in food habit & food security: During the pre-intervention period the farmers consumed much less amount of vegetables, fruits & animal protein as compared to post intervention period. Introduction of the newly developed year round vegetable production model (Golapgonj Model), raring of layer and broiler chickens, fish policulture in seasonal and perennial ponds and ditches, etc. ensured availability of and consumption of balanced and nutritious food to all members of the households. The per day vegetable production averaged 1.37kg/farm with the new model, which can fulfill the requirement of five member per family.

Table 1. Productivity of different technologies before and after intervention at FSRD site Jalalpur, Sylhet

Resource	Before intervention		After intervention		Remarks
	Variety/item	Yield (t./ha)	Variety/item	Yield(t./ha)	-
T.Aman	Pajam	2.44	BRRI Dhan 32 BRRI Dhan 33 BRRI Dhan 39	4.42 4.12 4.53	-
Homestead	White gourd Bottle gourd Sweet gourd	19 no. 16 no. 12 no.	Local white BARI Lau-1 Snake gourd Bitter gourd Indian spinach	18N/pit 25N/Pit 9kg/pit 5 kg/pit 12kg/pit	Proper nutrient and manageme nt
Partial shady area	unused	-	Turmeric Zinger Mukhi kachu	17 kg/deci. 13 kg/deci. 15 kg/deci.	-
Trellis	unused	-	Potato yam BARI shim-1	8 kg/pit 8 kg/pit	-
Ponds surroundings			Bottle gourd	15 N	-
Livestock	local cow	2(no vaccination)	-	vaccination introduced	-
	Local hen	6(no vaccination)	-	vaccination introduced	-
Fisheries	Pond (Trad.)	15kg	Mixed culture	32kg	2 times/year

Production Efficiency of Year Round Homestead Utilization System under Golapgonj Model

Production and utilization of income from vegetables round the year are shown in table 1. Production of the vegetables round the year was 352 kg and their gross return was Tk 4383. The utilization pattern of vegetables showed that the farmers not only consumed their products but also distributed a portion of the product to relatives and neighbors, and a portion was sold.

Table 2. Average performance of year round vegetables in homestead area of 3 farmers at under FSRD site, Jalalpur, Sylhet.

Crop	Amount harvested (kg)	Return Tk.	Amount distributed (kg)	Own consumption (kg)	Amount sold (kg)
Bed I					
Radish	45(3)	675	5	10	30
Tomato	52(3)	682	5	12	35
Amaranth	7(3)	56	-	5	2
Bed II					
Laishak	8(3)	160	1	3	4
Cabbage	42(3)	256	6	10	26
Okra	10(3)	105	-	4	6
Bed III					
Brinjal	24(3)	288	3	8	13

Crop	Amount harvested (kg)	Return Tk.	Amount distributed (kg)	Own consumption (kg)	Amount sold (kg)
Lalshak	6(3)	120	1	3	2
Gimakalmi	28(3)	180	3	8	17
		Bed IV			
French bean	4(3)	96	-	2	2
Lalshak	7(3)	140	-	3	7
Yard long bean	12(3)	180	-	4	8
Total	245	2938	24	69	152
		Trellis			
Yard long bean	25(3)	375	2	9	14
Country bean	35(3)	630	5	12	18
Total	60	1005	7	21	32
		Under trellis			
Turmeric	32(3)	320	-	15	17
Mukhikachu	15(3)	120	-	4	11
Total	47	440	0	19	28
Grand total	352	4383	31	109	212

Price (Tk/kg): Radish= 15, Tomato=13, Amaranth= 10, Laishak= 20, Cabbage= 6 Okra= 10, Brinjal= 12, Lalshak= 20, Gimakalmi= 6, French bean= 24, YLB= 15, Country bean= 18, Mukhikachu= 8, Turmeric= 10.

Farmers 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 maintaining remission of malnutrition and also gaining additional cash income.

Impacts

The following general impacts were observed after intervention of technologies through holistic approach in integrated farming:

1. Farming systems research has proved itself to be a very useful and important approach in understanding and identifying farmer’s problems and designing and testing appropriate technologies at the farm level. The overall goal has been to raise the farm productivity while relying on the existing resources and facilities available to the farmers.
2. In integrated farming system (IFS) farmers are preserved the kitchen waste, manures, crop residues, animal waste, poultry litter, cowdung at their farm level scientifically and using properly for crop production, which ultimately helped to improve soil fertility and moisture conservation, thereby reducing environmental pollution in order to get sustainable agricultural production.
3. Timely application of recommended seeds, fertilizers and plant protection measure in holistic approach helped to boost production,. The same technology was rapidly disseminated to many farmers around the program.
4. The holistic farm approach directly and indirectly changed in food habit, nutritional status, generating more income, health care, clothing and sanitation, saving pattern and borrowing of the practicing farmers.
5. Integration of crop enterprise with livestock and fisheries got advantage of complementary and supplementary relationship among them, which have created more employment opportunity and better utilization of resources.

MLT site, Gabtali, Bogra

The output of the model harvested are presented in table 1 and 2. The amount harvested from open land, Roof, Trellis, Tree support and fence were 154.63 kg at Joypurhat and 150.10 kg at Gabtali. The harvesting period December to February in both the sites. The average per day production per family were 1.72 kg at Joypurthat and 1.67 kg at Gabtali. The consumption, distribution and sold were 80.60, 20.26 and 53.51 kg per homestead at Joypurhat and 76.95, 19.75 and 53.4 kg per homestead at Gabtali.

Economic return

The economic return of the model on presented in table 3 and 4. The total economic net return per homestead were 1369.01 and 1305.20 taka at Joypurhat and Gabtali, respectively. The highest economic return from tomato in both the sites.

Table 1. Vegetable production per homestead of Joypurhat MLT site, Bogra during Rabi 2006-07

Name of place	Name of Vegetable	Use of harvest vegetable			Total harvest (kg)
		Consumption (kg)	Distribution (kg)	Sold (kg)	
Open of Place	Radish	8.64	2.00	7.30	17.94
	Cabbage	11.86	3.38	6.50	21.72
	Tomato	14.25	4.00	8.25	26.50
	Spinach	7.00	1.25	5.30	13.55
	Bitter gourd	8.30	2.00	7.45	17.75
	Red amaranth	5.25	2.25	4.45	11.95
Roof	Bottle gourd	6.56	2.00	5.60	14.16
Trellis	Bottle gourd	8.56	1.50	4.16	14.22
Tree support	Country bean	7.52	1.38	3.00	11.90
Fence	Bitter gourd	2.68	0.50	1.50	4.68
	Total	80.60	20.26	53.51	154.63
Pantial shady area	Elephant foot yam = 2 Plant distribution per homestead.				
	Leaf aroid (molovi kachu) = 2 plant distribution per homestead				
Homestead boundary	Papaya = 3 Plant distribution per homestead.				
	Guava = 2 Plant distribution per homestead.				
	Lemon = 2 Plant distribution per homestead.				
Back yard/ Waste Land	Laizna = 1 Plant distribution per homestead.				
	Plantain Banana= 2 Plant distribution per homestead.				

Table 2. Vegetable production per homestead of Gabtali MLT site, Bogra during 2006-07

Name of place	Name of Vegetable	Use of harvest vegetable			Total harvest (kg)
		Consumption (kg)	Distribution (kg)	Sold (kg)	
Open of Place	Radish	7.50	2.50	7.25	17.25
	Cabbage	12.25	3.00	7.15	22.40
	Tomato	10.25	3.50	8.30	22.05
	Spinach	6.50	2.00	6.00	14.50
	Bitter gourd	8.50	1.50	6.45	16.45
	Red amaranth	6.25	1.25	4.50	12.00
Roof	Bottle gourd	6.25	2.50	4.50	13.25
Trellis	Bottle gourd	9.00	1.50	4.00	14.50
Tree support	Country bean	7.45	2.00	4.00	13.45
Fence	Bitter gourd	3.00	-	1.25	4.25
	Total	76.95	19.75	53.4	150.10
Pantial shady area	Elephant foot yam =2 Plant distribution per homestead.				
	Leaf aroid (molovi kachu)= 2 Plant distribution per homestead.				
Homestead boundary	Papaya = 2 Plant distribution per homestead.				
	Guava = 2 Plant distribution per homestead.				
	Lemon= 2 Plant distribution per homestead.				
Back yard/ Waste Land	Laizna = 1 Plant distribution per homestead.				
	Plantain Banana= 2 Plant distribution per homestead.				

Table 3. Economic return per homestead at Joypurhat MLT site, Bogra during 2006-07

Vegetable Name	Total vegetable production (kg)	Vegetable price (Tk./kg)	Gross return (Tk.)	Total cost (Tk.)	Net return (Tk.)
Radish	17.94	6	107.76	250.00 (without family labour)	1369.01
Cabbage	21.72	10	217.20		
Tomato	26.50	16	424.00		
Spinach	13.55	10	135.50		
Bitter gourd	22.43	10	224.30		
Red amaranth	11.95	7	83.65		
Bottle gourd	28.38	10	283.80		
Country bean	11.90	12	142.80		
		Total	1619.01		

Table 4. Economic return per homestead at Gabtali MLT site, Bogra during 2006-07

Vegetable Name	Total vegetable production (kg)	Vegetable price (Tk./kg)	Gross return (Tk.)	Total cost (Tk.)	Net return (Tk.)
Radish	17.25	6	103.50	250.00 (without family labour)	1305.20
Cabbage	22.40	10	224.00		
Tomato	22.05	16	352.80		
Spinach	14.50	10	145.00		
Bitter gourd	20.70	10	207.00		
Red amaranth	12.00	7	84.00		
Bottle gourd	27.75	10	277.40		
Country bean	13.45	12			
		Total	1555.20		

Farmers reaction

Farmers are more interested to economic crops with high cash return. They are less aware about nutritional need and the contribution of mini production (1-2 decimal) of homestead. As the program was production based more motivation needed for them to wards consumption and utilizing the potential contribution of the model and safe foods for their health and nutrition.

Location: FSRD site, Kushumhati, Sherpur

Results pertaining to the yield, cost and return analysis of Kharif-I, Kharif-II, Rabi and performance of the vegetables patterns were presented in the table 1, 2, 3 and 4.

Kharif-I

Field duration (days): Latirajkachu took maximum field duration i.e. 115 days and Kangkong took manimum 65 days (Table 1).

Yield : The highest yield was obtained from Kangkong (100 kg/dec.) while the lowest from Chilli (40 kg/dec.). But the highest gross margin was recorded from chilli (Tk.620.00/dec.) and the lowest from Indian spinach (Tk. 180.00/dec.) The highest benefit cost ratio was found in Kangkong (3.46) and the lowest from Indian spinach (2.13) (Table 1).

Kharif-II

Field duration (days): Maximum field duration was taken by Data (65 days from sowing to final harvest) and the minimum was 50 days by Okra (Table 2).

Yield: The highest yield was recorded from Data (80 kg/dec.) while the lowest from Chili (15 kg/dec.). Kangkong produced the second highest yield (70 kg/dec.) and Chilli gave the lowest yield (15 kg/dec.). The highest gross margin was obtained from Chilli (Tk.345/dec.) which followed by

Latrajkachu (Tk. 310/dec.). The lowest gross margin was obtained from Okra (Tk. 126/dec.). The highest benefit cost ratio was recorded from Chilli (4.29) and lowest (2.29) was from Data (Table 2).

Rabi

Field duration (days): Maximum days required for Garlic (140 days) followed by Bitter gourd (130) while the minimum days required for Coriander (30 days) at the field (Table 3).

Yield: The highest yield was obtained from Tomato (325.00 kg/dec.) which followed by Lalshak+ Cabbage (45.00+180.00 kg/dec.) and Spinach+Garlic (65.00+26.00 kg/dec.). The lowest yield was obtained from Coriander+Onion (15.00+30.00 kg/dec). The highest gross margin (Tk. 2815.00/dec.) and benefit cost ratio (7.47) were obtained from Tomato. The lowest gross margin (Tk.260.00/dec.) was obtained from the plot Carrort+ Bitter gourd. But the lowest benefit cost ratio (1.97) was also obtained from Coriander+Onion (Table 3).

Performance of the vegetables patterns

Performance of vegetable patterns was shown in Table 4. From the table, it was revealed that the pattern Indian spinach-Data-Tomato performed better than the other patterns. This pattern gave the highest gross return (Tk. 3910.00/dec.) and gross margin (Tk.3175.00/dec.) The BCR (5.32) was also the highest in this pattern. The lowest gross return (Tk.1326.00/dec.) and gross margin (Tk.696.00/dec.) were obtained from Okra-Okra-Coriander + Onion pattern. The lowest BCR (2.10) was also found in this pattern.

Conclusion

Among the five vegetable patterns, Indian spinach-Data -Tomato gave the highest gross margin (Tk.3175.00/dec.). All of the patterns might be benefited for the farmer both in nutritional and economic point of view as the source of vitamin and minerals which most essentials for the farmers health and cash earning.

Table 1. Yield, cost and return analysis of different vegetables of Kharif-I at FSRD site, Kushumhati, Sherpur, 2006

Crop	Field duration (days)	Yield (kg/dec.)	Gross return (Tk/dec.)	Total variable cost (Tk/dec).	Gross margin (Tk/dec.)	BCR
Ind. Spinach	65	85	340.00	160.00	180.00	2.13
Kangkong	64	100	450.00	130.00	320.00	3.46
Okra	85	42	420.00	190.00	230.00	2.21
Chilli	85	40	1000.00	380.00	620.00	2.63
Latiraj kachu	115	50	500.00	155.00	345.00	3.23

Price: Indian Spinach - Tk.4.00/kg, Kangkong - Tk.4.50/kg, Okra - Tk10.00/kg Latiraj kachu-Tk. 10.00/kg, Chilli- Tk. 25.00

Table 2. Yield, cost and return analysis of different vegetables of Kharif-II at FSRD site, Kushumhati, Sherpur, 2006

Crop	Field duration (days)	Yield (kg/dec.)	Gross return (Tk/dec.)	Total variable cost (Tk/dec.)	Gross margin (Tk/dec.)	BCR
Data	65	80	320.00	140.00	190.00	2.29
Kangkong	60	70	350.00	120.00	230.00	2.92
Okra	50	18	216.00	90.00	126.00	2.40
Chili	60	15	450.00	105.00	345.00	4.29
Latiraj kachu	60	35	420.00	110.00	310.00	3.82

Price : Data - Tk.4.00/kg, Kangkong - Tk.5.00/kg, Okra- 12.00/kg, Chilli -Tk.30.00/kg, Latiraj kachu-Tk.12.00/kg

Table 3. Yield, cost and return analysis of different vegetables of Rabi at FSRD site, Kushumhati, Sherpur, 2006-07

Crop	Field duration (days)	Yield (kg/dec.)	Gross return (Tk/dec.)	Total Variable Cost (Tk/dec.)	Gross margin (Tk/dec.)	BCR (TVC basis)
Tomato	105	325	3250.00	435.00	2815.00	7.47
Lalshak +	35	45	1125.00	415.00	720.00	2.71
Cabbage	100	180				
Coriander +	30	15	690.00	350.00	340.00	1.97
Onion	95	30				
Spinach +	45	65	1235.00	380.00	855.00	3.25
Garlic	140	26				
Carrot +	100	60	500.00	240.00	260.00	2.08
Bitter gourd	130	25				

Price: Tomato - Tk. 10.00/kg, Coriander - Tk. 22.00/kg, Lalshak - Tk. 5.00/kg, Onion - Tk. 12.00/kg, Cabbage- Tk. 5.00/kg, Spinach- Tk. 5.00/kg, Garlic- Tk.35.00/kg, Carrot - Tk. 5.00/kg, Bitter gourd - Tk.8.00/kg

Table 4. Cost and return analysis of different vegetables pattern round the year at FSRD site, Kushumhati Sherpur 2006-07

Patterns	Total return (Tk./dec.)	TVC (Tk./dec.)	Net return (Tk./dec.)	BCR
Indian spinach -Data- Tomato	3910	735	3175	5.32
Kangkong -Kangkong- Lalshak + Cabbage	1925	665	1260	2.89
Okra-Okra- Coriander + Onion	1326	630	696	2.10
Chilli-Chilli- Spinach+ Garlic	2685	865	1820	3.10
Latiraj kachu - Carrot+ Bitter gourd	1420	505	915	2.81

Location: FSRD stie, Kadamshahar, Rajshahhi

Vegetable production: The performances of vegetables crops grown in homestead area from marginal group are presented in Table 1. After intervention of "Barind Model" the total vegetable production was 145 kg, of which 82 and 63 kg were from open space and creeper vegetables, respectively during rabi season (2006-07). Before the intervention the vegetable production was only 48 kg. Therefore the production was increased by 228%. In Kharif-II season, after intervention, the production was 69 kg and before intervention it was 18 kg and thus the production was increased by 278%.

Table 1. Year round average vegetable production of a marginal farmer in homestead area at FSRD site, Kadamshahar, Rajshahi during 2006-2007

Season	Before Intervention			After Intervention			% Increased
	Open space vegetables (kg)	Creeper vegetables (kg)	Total	Open space vegetables (kg)	Creeper vegetables (kg)	Total	
Rabi	12	36	48	82	63	145	228
Kharif-I	18	22	40	-	-		-
Kharif-II	-	18	18	69	-	69	278
Total =	30	76	106	151	63	214	

From small farmer group after intervention of Barind Model the total vegetable production was 155 kg of which open space and creeper vegetables contributed 94 and 61 kg, respectively during Rabi season (2006-07). On the other hand, before intervention, the production was only 40 kg in rabi season. Therefore the production was increased about 288%. In kharif-II season, the production was

223 and 118 kg, before and after intervention, respectively. The production was increased about 433% in kharif-II season (Table 2).

Table 2. Year round average vegetable production of a small farmer in homestead at FSRD site, Kadamshahar, Rajshahi during 2006-2007

Season	Before Intervention			After Intervention			% Increased
	Open Space vegetables (kg)	Creeper vegetables (kg)	Total	Open Space vegetables (kg)	Creeper vegetables (kg)	Total	
Rabi	12.79	31.22	40.01	94.52	60.99	155.51	288
Kharif-I	20.67	40.27	60.94	-	-		-
Kharif-II	-	12.66	12.66	67.52	-	67.52	433
Total	33.46	84.15	117.61	162.04	60.99	223.03	

Disposal pattern of vegetables

From marginal group, the total vegetables production was 106 kg of which 91, 3.0 and 12 kg were consumption, distribution and sold respectively and on the basis of the disposal pattern the consumption per person per day was 52 g before intervention of the model. On the other hand, after intervention the production was 221 kg of that the consumption, distribution and sold amount were 164, 9 and 47 kg respectively and the consumption per person per day was 123 g (Table 3).

Table 3. Disposal pattern of vegetables of marginal farmer during kharif-II & rabi (2006-07)

Vegetables	Total harvest (kg)	Consumption		Distribution (kg)	Sold (kg)
		Amount (kg)	Per person/day (g)		
Before					
a. Open space	29.57	24.57		1.00	4.00
b. Creeper	76.62	66.36	52	2.0	8.26
Total =	106.19	90.93		3.00	12.26
After					
a. Open space	158.19	121.54		5.9	30.75
b. Creeper	62.72	42.75	123	3.57	16.40
Total =	220.91	164.29		9.47	47.15

The total production of homestead vegetables was 118 kg, which was divided among the consumption, distribution and sold as 95, 4 and 17 kg respectively and consumption per person per day was 55 kg during before intervention. On the other hand, after intervention of model vegetables production was 226 kg of which 175, 7 and 44 kg were used as consumption distribution and sold respectively and the consumption was 152 g per person per day.

Table 4. Disposal pattern of vegetables of a small farmer during kharif-II & rabi (2006-07)

Vegetables	Total harvest (kg)	Consumption		Distribution (kg)	Sold (kg)
		Amount (kg)	Per person/day (g)		
Before					
a. Open space	33.46	27.12		1.33	5.01
b. Creeper	84.15	68.42	55	3.20	12.53
Total	117.61	95.54		4.53	17.54
After					
a. Open space	165.04	130.14		5.19	29.73
b. Creeper	60.99	44.75	152	1.57	14.67
Total	116.03	174.90		6.76	44.40

Uptake 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 88 kcal, 44 mg, 9462 (μg), 0.11 mg and 0.20 mg, respectively and after intervention these were increased as 294 kcal, 250 mg, 45038 (μg), 0.95 mg and 1.33 mg, respectively.

Table 5. Nutrient uptake by a family member of marginal farmer during kharif-II & rabi (2006-2007)

Nutrient category	Before Intervention		After Intervention	
	Total	Per person/day	Total	Per person/day
Food energy (kcal)	32088	88	70589	294
Vit-C (mg)	16060	44	60014	250
Vit-A/Carotene (μg)	3455351	9467	11049024	45038
Vit-B_1 (mg)	40	0.11	228	0.95
Vit-B_2 (mg)	74	0.20	320	1.33

After intervention of "Barind Model" rapidly increased the consumption of food value as well as vitamins simultaneously 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 82 kcal, 42 mg, 9141 μg, 0.12 mg and 0.18 mg, respectively and after intervention that were increased to 306 kcal, 285 mg, 46282 μg, 1.39 mg and 1.75 mg, respectively.

Table 6. Nutrient uptake by a family member of small farmer during kharif-II & rabi (2006-07)

Nutrient category	Before Intervention		After Intervention	
	Total	Per person/day	Total	Per person/day
Food energy (kcal)	29958	82	73349	306
Vit-C (mg)	15262	42	68339	285
Vit- A/Carotene (μg)	3336354	9141	11107784	46282
Vit-B_1 (mg)	46	0.12	334	1.39
Vit-B_2 (mg)	66	0.18	420	1.75

Farmer's reaction

Farmers were very much interested to involve themselves in homestead gardening as they earn some cash money and harvest fresh vegetables daily to meet up their demand.

FSRD site, Puspapara, Pabna

Vegetable production: Initially 2 to 3 production niches were brought under cultivation with the suggested vegetables of Goyeshpur model with 15 farm families under different farm categories at Chaukibari village an extrapolation area of FSRD site Pushpapara during the rabi season of 2006 to kharif-I season 2007. Vegetables were grown at open sunny place and trellis for medium and marginal farm. In addition, roof top was used in small farm group. Total production of vegetables was comparatively higher in medium farm followed by small farm probably due to higher production from big trellis. In case of small farm additional vegetable cultivation on roof top contributed to better production. Lower production was observed in marginal farm because of limited scope and resource.

Utilization of vegetables: Disposal of different vegetables produced under different farm was recorded regularly. The result indicated that disposal pattern of vegetables varied with farm categories. The intake was higher in medium farm over small and marginal farm. Vegetable intake per day per head was 195.11, 178.72 and 103.72 g for medium, small and marginal farm respectively. The distribution of vegetable was recorded 71.49, 51.76 and 35.35 kg for medium, small and marginal farm category. The vegetables sold by different farm categories were 120.49, 169.96 and 54.17 kg for medium, small and marginal farm respectively (Table 2a, 2b & 2c). The result indicated that the intake and distribution of vegetables by medium farm category was higher followed by small farm. Vegetables sold by small farm were higher followed by medium farm. Intake, distribution and sold by marginal farm was lower probably due to limited resources. Irrespective of farm category, the average total production round the year of a farm was 247.71 kg and its disposal was 143.27 kg intake, 52.87 kg distribution and 114.87 kg sold respectively (Table 2d).

Income: Total income recorded from medium, small and marginal was Tk.2958, 25723 and 1335 respectively. The net income round the year recorded by medium, small and marginal farmer was Tk.2353, 1968 and 730 respectively. The net income was higher in medium farm followed by small farm and lower net income was observed in marginal due to lower production (Table 2a, 2b and 2c).

Nutrient uptake: Nutrient uptake especially protein, iron, carotene, vit.B_1 and vit.C by farm categories through year round vegetable consumption was estimated. Nutrient uptake was varied with different vegetable growing months (Table 3a, 3b & 3c). Uptake of nutrient was positively correlated with vegetable consumption. Nutrients such as protein, iron, carotene, vit.B_1 and vit.C uptake by medium farm group was higher followed by small farm probably due to intake more quantity of vegetables. Lower production of vegetables by marginal farm affected the satisfactory uptake.

Nutrient supplementation: For better growth and development of human body necessary nutrient requirement are to be fulfilled daily. The supplementation of nutrients from the vegetables produced in homestead was estimated. The result showed that the percentage of the requirement of protein supplied from the homestead source was 4.00, 3.11 and 2.01 which was for medium, small and marginal farm categories. The percentage of iron supplementation from the homestead vegetable was 9.83, 8.06 and 5.62 for medium, small and marginal farm. The highest percentage of vit.A requirement (71.10) was supplied from homestead vegetable for medium farm category which was followed by small farm (55.56) group. Probably due to uptake of vit.A enriched vegetable, the supplementation of this nutrients were comparatively higher. Vit.C supplementation was also higher in medium farm followed by small farm category. Percent of vit. B_1 supply by medium, small and marginal farm was recorded 5.35, 5.41 and 4.05 respectively.

Table 1a. Round the year vegetables production from different niches of medium group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Space		Rabi	Kharif-1	Total
		Aasheen-Falgun	Chaitra-Jaistha	
Open sunny space	Bed 1	50.8	-	50.8
	Bed 2	46.75	-	46.75
	Bed 3	36.55	11.5	48.05
Trellis		152.75	-	152.75

Table1b: Round the year vegetables production from different niches of small group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Space		Rabi	Kharif-1	Total
		Aasheen-Falgun	Chaitra-Jaistha	
Open sunny space	Bed 1	57.42	-	57.42
	Bed 2	40.17	-	40.17
	Bed 3	85.14	12.75	97.89
Roof top		25.25	9.00	34.25
Trellis		71.0	-	71

Table 1c: Round the year vegetables production from different niches of marginal group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Space		Rabi	Kharif-1	Total
		Aasheen-Falgun	Chaitra-Jaistha	
Open sunny space	Bed 1	24.71	-	24.71
	Bed 2	35.67	-	35.67
	Bed 3	31.76	1.0	32.76
Trellis		61.91	-	61.91

Table 2a: Round the year vegetables production and utilization pattern of a medium group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Benglali month	Name of vegetable	Total production (Kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income
			Intake	Distribution	Sell				
Kartik	Spinach	1.000	1.000	-	-	-	7.00		
Agrahaon	Raddish, Spinach, Bean, Bottle gourd	48.5	33.79	15.08	12.5	135.5	453.39		
Poush	Raddish, Cabbage, Spinach, Bean, Bottle gourd	99.8	49.21	22.16	54.33	544.3	1043.86		
Magh	Raddish, Cabbage, Tomato, Bean, Bottle gourd	94.0	49.43	19.5	40.66	394.16	875.75		
Falgun	Cabbage, Tomato, Been, Bottle gourd	43.55	32.67	12.75	13.0	144.0	440.01		
Chaitra	Tomato,	11.5	9.5	2.000	-	-	138.0		
Total		298.35	175.6(195. 11g/head/ dau)	71.49	120.49	1217.96	2957.91	605	2352.91

Table 2b: Round the year vegetables production and utilization pattern of a small group farmer at FSRD site, Pushpapara, Pabna during Rabi and Kharif-1 2006-07.

Benglali month	Name of vegetable	Total production (kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income
			Intake	Distribution	Sell				
Kartik	Spinach	1.000	1.000	-	-	-	7.00		
Agrahaon	Raddish, Spinach, Bean,	36.63	19.63	5.67	20.75	126.00	188.16		
Poush	Raddish, Cabbage, Spinach, Bean, Bottle gourd,Tomato	81.67	41.6	13.76	50.71	465.65	778.29		
Magh	Raddish, Cabbage, Tomato, Bean, Bottle gourd, Data	104.42	64.54	18.00	57.00	494.5	931.28		
Falgun	Cabbage, Tomato, Bean, Bottle gourd, Data	45.25	24.58	12.58	26.5	271.5	425.12		
Chaitra	Tomato, Bottle gourd	21.75	9.5	1.75	15.00	168.00	243.00		
Total		290.72	160.85(17 8.72g/hea d/day)	51.76	169.96	1525.65	2572.83	605	1967.83

Table 2c: Round the year vegetables production and utilization pattern of a marginal group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Benglali month	Name of vegetable	Total production (Kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income
			Intake	Distribution	Sell				
Kartik	Spinach	1.000	1.000	-	-	-	7.00		
Agrahaon	Spinach, Raddish	16.63	9.75	2.63	6.00	42.00	116.66		
Poush	Raddish, Cabbage, Spinach, Bottle gourd, Bean	47.88	28.42	9.09	19.67	200.2	439.66		
Magh	Cabbage, Raddish, Tomato, Bottle gourd,Been	62.78	34.55	18.50	21.00	235.5	535.38		
Falgun	Cabbage, Tomato, Bottle gourd, Bean	25.75	19.63	5.13	8.00	42.00	235.11		
Chaitra		-	-	-	-	-			
Total		154.05	93.35(103.72g/head/day)	35.35	54.17	519.7	1334.81	605	729.81

Table 2d: Round the year mean vegetables production and utilization pattern of a farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Total production (Kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (Tk)	Total cost (Tk)	Net income
	Intake	Distribution	Sell				
247.71	143.27 (159.18g/head/day)	52.87	114.87	1087.77	2288.52	605	1683.52

Table 3a: Nutrient intake by a family of medium group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07

Benglali month	Protein(gm)	Iron(mg)	Carotene (microgram)	Vit-B_1(mg)	Vit-C(mg)
Kartik	33	100	84.7	03	870
Agrahaon	823.95	1670.01	7839.68	14.617	15626.4
Poush	1018.07	748.05	24907.85	26.26	7217.8
Magh	887.75	430.58	27277.9	29.061	2997.81
Falgun	495.87	233.1	50092.5	23.36	4209.3
Chaitra	103.5	46	41170	13.8	3222
Total	3362.14	3227.74	151372.36	107.40	34141.39

Table 3b: Nutrient intake by a family of small group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Benglali month	Protein(gm)	Iron(mg)	Carotene (microgram)	Vit-B_1(mg)	Vit-C(mg)
Kartik	33.0	100.0	84.7	0.3	870.0
Agrahaon	616.29	1283.75	9978.76	42.19	11273.1
Poush	691.82	505.15	18028.53	17.56	4928.6
Magh	884.34	522.16	22354.5	23.66	3986.0
Falgun	298.04	195.89	44545.0	16.77	3404.9
Chaitra	91.5	41.0	23270	8.1	1940
Total	2614.99	2647.95	118261.47	108.59	26402.6

Table 3c: Nutrient intake by a family of marginal group farmer at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Benglali month	Protein(gm)	Iron(mg)	Carotene (microgram)	Vit-B_1(mg)	Vit-C (mg)
Kartik	33.0	100.0	84.7	0.3	870.0
Agrahaon	311.75	927.5	798.475	3.075	8132.5
Poush	283	125.0	9350.0	5.8	770.0
Magh	203.75	89.75	12382.5	5.95	917.5
Falgun	261.07	125.96	33050.6	39.28	2814.2
Chaitra	9.0	4.0	3580.0	1.2	280.0
Total	1684.43	1846.24	65202.07	81.23	19049.0

Table 4: Percentage of nutrient supplied from a homestead on the basis per head requirements at FSRD site, Pushpopara, Pabna during Rabi and Kharif-1 2006-07.

Farmers category	% Protein	% Iron	% Vit-A	%Vit-B_1	%Vit C
1. Medium	4.00	9.83	71.1	5.35	24.94
2. Small	3.11	8.06	55.56	5.41	19.29
3. Marginal	2.01	5.62	30.6	4.05	13.92

Location: MLT site, Dhirashram, Gazipur Sadar

Yield, economic return and utilization pattern of homestead vegetables grown during rabi have been presented in table 1 and 2. Field duration of rabi season varied from 31-94 days. Red Amaranth (lalshak), radish and stem amaranth (danta) were the most short duration (31-40 days) crop where as brinjal, tomato and cabbage required the maximum days (70-94 days) to harvest. Yield of different vegetable were : Radish 33.3 kg. Tomato 28.5 kg, Red amaranth 34.6 kg. Brinjal 11kg Cabbage 53.8 kg, Spinach 15 kg and Stem amaranth 18.5 kg/ home garden. Net return varied from 35-343 Tk/garden and BCR ranged from 1.4-8.8 for different vegetables. On the average 159 kg of different vegetables could be obtained from a single homegarden during rabi season. The Produced vegetables 19-48% (about 52 kg) were consumed by the families, 35-76% (about 97 kg) were sold and rest 6-23% (about 17 kg) were distributed to their relatives and neighbours. The rate of the consumption per day/person was 100 g. The nutritional requirement of the families either partially fully. Moreover, the periodic income from the sale proceed of the vegetables were used to meet up the daily necessities of the families. Regular supply and maintenance of different vegetable seeds in small quantities appeared to be a limiting factor in smooth running of the home garden.

Table 1. Yield, cost and return analysis of different vegetables at Dhirashram MLT site, Gazipur Sadar during rabi season of 2006-07

Name of the vegetables	Field duration (days)	Yield (kg/household)	Total return (Tk/household)	Total variable cost (Tk/ household)	Net return(Tk/ household)	BCR
Radish	38	33.33	167.0	65.0	102	2.6
Tomato	70	28.50	228.0	62.0	166	3.7
Red amaranth	31	34.60	415.2	47.0	368	8.8
Brinjal	94	11.00	110.0	75.0	35	1.4
Cabbage	81	53.80	430.4	87.0	343	4.9
Spinach	55	15.00	165.0	47.0	118	3.5
Stem amaranth	40	18.50	185.0	45.0	140	4.1

Radish : 5 Tk/kg, Tomato : 8 Tk/kg, Red amaranth: 12 Tk/kg, Brinjal : 10 Tk/kg, Cabbage : 8 Tk/kg, Spinach : 11 Tk/kg, Stem amaranth : 10 Tk/kg

Table 2. Utilization pattern of homestead vegetables grown in the home garden at Dhirashram MLT site, Gazipur Sadar, during the rabi season of 2006-07

Farmers	Total production (kg/garden)	Consumption (kg/ household)	Distribution (kg/household)	Sell (kg/ household)
Farmer-1	191	52	36	103
Farmer-2	182	39	09	134
Farmer-3	183	44	-	139
Farmer-4	193	37	12	144
Farmer-5	116	49	27	40.0
Farmer-6	79	38	12	39.0
Farmer-7	81	33	14	34.0
Farmer-8	176	68	12	96.0
Farmer-9	216	79	-	137
Farmer-10	159	53	-	106
Farmer-11	174	71	10	93
Average	159	52	17	97

Farmer's reaction

Farmers were very interested to involve themselves in homestead gardening for meeting up their family need and to earn cash money.

Location: FSRD site, Noakhali

Homestead gardening was introduced among the 15 RPFs. due to different agro-ecological situation Atkapalia model was followed here within 25-35 m homestead area for year round vegetable production .in the homestead 10 number of vegetables (red amaranth, okra, Indian spinach, kang-kong, amaranth, batishak, radish, spinacn, tomato, brinjal) introducing for cultivation .the average vegetable production in every homestead during the previous month was given in table 1.in each homestead harvested vegetable ranged from 30 kg /family. The area of homestead is very small but from nutritional point of view its importance is more. Though the amount is small but it helped very positively in mitigating daily need of nutrient. Particularly marginal and landless farmers had increased their food security. They had limited food, which they had to purchase from the market. But now with the increase in homestead production of vegetables, they don't have to go to market for purchase of vegetable. 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 tendency to take more nutritious vegetables. Also, 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.

1. Performance of homestead vegetable production up to 30/05/ 2007 at FSRD site, Noakhali

Vegetable	Qty. Harvested (Kg/ Family)	Consumption (Kg/ Family)	Amount Distribution (Kg/ Family)	Amount Sold (kg/Family)	Value in (Tk)
1.Red amaranth	30	18	7	5	300/-
2.Okra	11	7	2	2	132/-
3. Indian Spinach	20	12	4	4	200/-
4. Kang-kong	23	13	4	6	184/-
5. Amaranth	20	11	5	4	200/-
6. Batishak	23	12	4	7	138/-
7. Radish	23	13	4	6	184/-
8. Spinach	25	11	9	5	250/-
9. Tomato	25	16	4	5	250/-
10. Brinjal	28	16	6	5	308/-
Total					2146/-

Total Homestead: 15

FSRD site, Razakhali, Patuakhali

Yield of different vegetables of one homestead are placed in table 1. Most of its production was used for family consumption. Seed, fertilizer and fencing cost were approximately Tk. 750.00. Total value of the vegetables up to 15 March, 2007 was about Tk. 2269.00. Main benefit is consumption of fresh and pesticide free vegetables round the year.

Bed No.	Crop	Yield (kg)	Value (Tk)
01	Red amaranth	8.5	102.00
	Brinjal	32	384.00
02	French bean	12	120.00
	Okra	8.5	68.00
03	Red amaranth	7	84.00
	Tomato	41.5	415.00
	Kangkong	10.5	110.00
04	Coriender leaf	2.5	75.00
	Cabbage	35	350.00
	Indian spinach	8.5	51.00
05	Red amaranth	7.5	90.00
	Potato	22	330.00
	Stem amaranth	18	90.00
Total Tk.			**2269.00**

Farmers' reaction

1. Farmers are pleased to consume fresh vegetables.
2. It is an extra income indirectly.

Utilization of Fisheries Gher Boundary through Vegetable and Fruit Production in Coastal Area

Abstract

An experiment was initiated to find out suitable vegetable and fruit species for planting in the bund around fisheries gher at Bagerhat MLT Site. Four vegetable patterns were designed in this context. Different crops within pattern were evaluated of which Tomato-Gimakalmi pattern performed better with high benefit cost ratio. Among those tested patterns, Tomato-Gimakalmi was found feasible and profitable.

Introduction

The medium lowland 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

Trials on different vegetables and fruit growing patterns at fisheries gher area round the year were initiated at Bagerhat MLT site during rabi 2004-05 with a view to find out suitable vegetable and fruit species and to utilize the unused/under utilized places of gher. Four different patterns were included in the study. The pattern was as follows:

	Rabi	Kharif
Pattern – 1 :	Brinjal	Okra
		Edge : Papaya
Planting date	: 19-21 Nov.'06	03-05 June'06
Pattern – 2 :	Tomato	Gimakalmi
		Edge : Country bean
Planting date	: 14-16 Nov'06	03-05 June'06
Pattern – 3 :	Water Melon	Bottle gourd
	Edge :	Munkachu
Planting date	: 12-15 Feb.'06	21-23 July '06
Pattern – 4 :	Sweet gourd	Bitter gourd
Planting date	: 05-08 Nov.'06	20 June '06

The experiment was conducted in four farmer's field. The unit plot size was 6m×1.5m. Recommended spacing and fertilizer dose were used. Data on yield, cost and returns were recorded.

Results and Discussion

Performance of vegetable patterns during 2005-06 has been presented in Table 1. From the results it was observed that Tomato-Gimakalmi pattern performed better than other patterns. Tomato-Gimakalmi pattern gave the highest benefit cost ratio (Table 2). Although tomato involved higher cost of cultivation but due to its higher market price higher gross return was achieved. Water melon was damaged at February. From the above results it was shown that Tomato-Gimakalmi pattern could be grown at gher area. This is the 2nd year result. It needs further details study.

Table 1. Yield of different vegetables patterns at Bagerhat MLT Site during 2004–05 to 2005-06

Pattern		Field durations (day's)						Yield (t/ha.)					
Rabi	Kharif	2004-05		2005-06		Mean		2004-05		2005-06		Mean	
		C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Brinjal	Okra	130	110	140	120	135	115	2.50	8.33	2.65	11.38	2.57	9.86
Tomato	Gimakalmi	110	110	126	130	118	120	49.10	24.44	51.85	42.50	50.48	33.47
Water melon	Bottle gourd	--	120	--	120	--	120	--	26.66	--	26.94	--	26.80
Sweet gourd	Bitter gourd	125	125	128	125	126.5	125	35.00	8.78	31.48	7.22	33.24	8.00

Table 2. Economic performance of different vegetables patterns at Bagerhat MLT site

Pattern		Gross return (Tk./ha.)						TVC (Tk./ha.)						Gross Margin Mean	BCR
Rabi	Kharif	2004-2005		2005-2006		Mean		2004-2005		2005-2006		Mean			
		C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2		
Brinjal	Okra	12500	66640	13250	91040	12875	78840	98000	60,000	98000	78000	98000	69000	-75285	--
Tomato	Gimakalmi	284000	97760	362950	127500	323475	112630	105000	45,000	137000	58500	121000	51750	263355	2.52
Water melon	Bottle gourd	-	79980	--	80832	--	80406	--	66,000	--	55277	--	60638	19768	1.32
Sweet gourd	Bittergourd	142000	87800	188888	86640	165444	87220	68600	70,000	91000	72500	79800	71250	101614	1.67

Price (Tk./kg.): Brinjal= 5.00, Gimakalmi= 3.50, Okra= 8.00, Bottle gourd= 3.00, Tomato= 6.50, Sweet gourd= 5.00 & Bitter gourd= 11.00

Farmers' reaction

Tomato should be planted within October to get better market price. Farmers' prefer white big size Brinjal. Farmers' liked Gimakalmi as a tasty and new crop.

Study on Integrated Farming System involving Crop, Livestock, Poultry and Off-farm Activities

Introduction

The study was initiated at FSRD site, Laharirhat Rangpur in June 2006 and continuing till now. BARI has developed a number of technologies for the different category of farmers. There included three categories of farmer i.e. Landless, marginal and small under the program. Agricultural Technology Transfer (ATT) program is an efficient way to generate more income and to develop livelihood specially for land less to small farmers. Farmers cultivate potato, rice, jute, maize etc in their field with poor management and low quality seed. They keep pond bank unutilized, but culture fish in pond and rear livestock with less or no management. They do not known how to use proper technology to generate more money from these resources. It is possible to improve their livelihoods by reaching the modern agricultural technologies to the farmers' door under the ATT program. However, the program is conducted with the objectives-

1) To popularize the effective use of modern BARI developed technology to the farmers.
2) To increase the awareness of knowledge about agricultural technology.
3) To improve the livelihood of the poor farmers.

Methodology

The farmers of the FSRD site, Laharirhat, Rangpur being mostly resource-poor, are often malnourished and there is an urgent need for the development and adoption of crop field, homestead agro-forestry, livestock, fisheries and home gardening practices for year round production of vegetables and quick growing fruits mainly for income and family consumption Considering the above circumstances, the ATT program has been under taken to implement at the Laharirhat FSRD Site of Rangpur. The FSRD site is about 15 km away from ARS, BARI, Rangpur on Rangpur-Badorganj metalled road. It spreads over Shabaspur village of Rangpur sador upozilla. The project site is located at $21^0 24$ N′ latitude and $88^0 23$ E′ longitudes. The site area is 31.3m above the sea level. It represents mostly highland and medium highland areas of the Tista meander Floodplain (AEZ# 3). The area experiences annual rainfall of around 2169 mm with relatively early onset and late cessation. Similarly, the onset of winter is about 15 days earlier and the duration of winter is about a month longer compared to the other parts of the country.

Selection of participating farm families

According to the aim of the project only landless, marginal and small farmers of one village of the FSRD site were under the selection. Among the total farm households of three categories only 25 farm households taking 10, 15 and 5 each from landless (0-50 decimal land holdings), marginal (51-125 decimal land holdings) and small (126-250 decimal land holdings) were selected through purposive random sampling technique.

Selection of net working members

The lead researcher of this sub-project is On-Farm Research Division (OFRD), BARI, Rangpur and for integration of farming components many others stakeholders as net working members at local level like DAE, DLS, DOF, BRRI, BJRI, SRDI, NGOs e.g. RDRS, BRAC and Grameen krishi Foundation. The main objective of collaboration of these stakeholders is to introduce them with farmers of this sub-project and finally farmers can utilize their technologies after termination of the project.

Research conduction

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) and members of the local net working group. The cooperator farmers (both the male and female) of each farm groups were given orientation separately 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. Scio-agro-economic data of each of the program activities of all the selected households were recorded and all collected data considering up to 31 May 2007 were analyzed using simple statistical tools and their results have incorporated in this report.

Results and Discussion

Crop sector

Homestead

The participatory farmers are effectively utilizing the open space, partially shady places and boundary (ail) of the homestead, which were previously remained either unutilized or underutilized. After intervention through ATT project, target farm families are growing 15-20 nos. of different vegetables year round in their homestead area with modern variety and recommended management. They are growing lalshak, data, okra, gimakalmi, indian spinach, snake gourd, sponge gourd, ribbed gourd, ash gourd, cucumber etc, in summer and cabbage, cauliflower, tomato, radish, garlic, spinach, napa shak, brinjal, carrot, pepper, coriander shak, country bean etc. during winter at their homestead area. They also cultivate bitter gourd, ribbed gourd as fenced crop and papaya (Shahi) as ail crop (homestead boundary) successfully. They are utilizing partial shady place for ginger and turmeric (BARI hybrid 3) with proper management. Female members do most of the activities for homestead gardening but sometimes their husband and children support them. Even at present female members are selling their excess vegetables. ATT beneficiaries are producing 2019 kg different vegetables from 1115 m^2 of homestead area per year (Table I.A.a). They produced of 400 kg ginger and turmeric from shady place of 460 m^2 (17 household) per year (Table I.A.b). They got profit Tk. 47814 per year where production cost was Tk. 8338 (Table I.A.a) from the homestead. After intervention no vegetables have to be purchased from the market for their own consumption, besides farm families' intake more vegetables, which lead them better calorie intake. The cooperator farmers used the farm waste effectively and utilized the compost in the vegetable and potato production. Now, neighbours of target farm families are motivated to grow more vegetables at their homestead area with modern varieties and proper management.

I.b. Roof top

Year round creeper vegetable production on rooftop is one of the most profitable technologies for landless, marginal and small farm family at FSRD site, Rangpur. Before ATT program the rooftop of farm families were not utilized properly. But under ATT project the target farm families are utilizing their rooftop properly for creeper vegetable production with good quality seed and high management. It is observed that the farm families who have one roof top can grow easily Bottle gourd- Ash gourd or BARI shim-1 – Sweet gourd but who have two roof top can grow both in profitable way.

Twenty five beneficiary used rooftop and benefit Tk. 17540 (Table I.A.c).

I.c. Plantation crops

At FSRD Site, Rangpur mango trees were sprayed with Tilt-250 EC & Ripcord two times to control the anthracnose disease and mango hopper. Simultaneously, fertilization, pruning and irrigation were also applied. Similar management was also taken for jackfruit and guava trees. These resulted higher yield. Introduction of improved variety of papaya (Shahi) increased papaya production. Increased production of fruits paved the way for increased consumption by the family members and increased income Tk 30520 where production cost is Tk. 11650 after intervention (Table I.A.i). Besides, 50 guava and 30 litchi saplings were planted in 25 households.

I.d. Field crops

Use of improved varieties, better quality seeds and recommended production practice has increased the yield of different crops of the farm substantially. Total productivity of the field crops increased significantly. The increased production came mainly through potato, vegetables, rice, wheat, mustard, mungbean and jute due to the use of better quality of seed and optimum management by the framers. Potato-Boro rice-T.aman rice is a dominating cropping pattern followed by Potato-Maize-T.aman and Boro-Fallow-T.aman of ATT project site, Rangpur. Before intervention the farm families of this area do not produce crops with good quality seed and proper management. After intervention the target farm families are producing potato and rice with modern variety and proper management specially balanced dose of fertilizer and pest control. Now the beneficiaries know that where quality seeds are available. The participatory farmers are using foundation or certified seeds of BR-33 and BR-11 for T.Aman, BRRI dhan-28 or BRRI dhan-29 for Boro season and Granola or Diamant variety for potato. They apply recommended fertilizer dose for potato production but 50% less amount of TSP and MP of total requirement for following Boro and T. aman rice. Because they have come to know that TSP and MP fertilizers have positive residual effect on successive crop. As a result production cost of those crops becomes lower but the yield of said crops is higher (Table I.B). The beneficiaries are also practicing recommended management for rest crops with good quality seeds. They are using O–9897 variety for jute, Shatabdi for wheat, BARI Mug 6 for Mungbean, BARI hybrid maize 3 and improved high yielding varieties for vegetable production. The present practice of target farm families is influencing the neighbor farm families to do so.

Fishery

Farmers cultured fish with poor management i.e. dense fingerlings, less feeding, no pond management etc before intervention. But after intervention recommended management for fish culture was done. Thus the production of fish was higher resulting the net income of Tk. 32670 and BCR 4.69 against Tk.10420 and 2.80 respectively before intervention (Table 2).

Livestock

Before intervention, farmers reared cattle with poor or no management. After intervention deworming, vaccination, feeding and beef fattening technology were used and farmers got benefit of Tk. 276350, which was Tk.112750 (Table 3) before intervention. In case of duck and poultry net return were Tk.170450 and Tk.82485 respectively for before and after intervention (Table 4).

Off- farm

Only two farmers were involved in off farm activities. They used to produce bamboo can goods but faced cash money problem for the production. After intervention as their income increased from other sectors, they invest that money in off farm activities as and when necessary. Consequently, their production and income increased substantially (Table 5).

Conclusion

After intervention of ATT programme, the farmers were able to use modern technology developed by BARI in homestead, field crops, fruits trees, livestock and fishery sector which increased their net income Tk. 767046 (Table 6) against Tk.213455 before intervention. So through the transfer of BARI technology the livelihood of farmers can be increased as they can generate more income using their existing resource.

Table 1. Yield and economics of technologies before and after intervention

I. Homestead

A.a. Sunny place: **1115 m²**

Before intervention					**After intervention**				
Crop	Total produc. kg) (kg/dec.)	GR (Tk.)	TVC (Tk.)	BCR	Crop	Total produc. (kg) (Kg/dec.)	GR (Tk.)	TVC (Tk.)	BCR
Pat Shak	172 (32)	688	258	2.67	Brinjal	725 (133)	7248	763	9.50
Napa Shak	239 ( )	1195	216	5.53	Napa Shak	170 (53)	850	192	4.43
Babui Shak	108 (20)	432	258	1.67	Lal Shak	382 (31)	1526	453	3.37
Red. Ama	143 (32)	572	216	2.65	Red. Ama.	1756 (104)	3508	860	4.08
Amaranth	585 (104)	1170	337	3.47	Ind. pinach	384 (48)	1152	480	2.40
Spinach	373 (66)	1865	315	5.92	Kangkong	174 (27)	512	160	3.20
Garlic	138 (20)	5520	1375	4.01	Okra	90 (23)	718	210	3.42
Mara Shak	261 (40)	1044	330	3.16	Toamato	1350 (146)	10800	1350	8.00
2019					Cabbage	300 (133)	1795	675	2.66
					Cauliflower	400 (133)	3204	900	3.56
					Spinach	322 (66)	1609	291	5.53
					Corian.Shak	266 (33)	5318	384	13.85
					Bati Shak	105 (25)	210	70	3.00
					Babui Shak	80 (20)	316	72	4.40
					Carrot	108 (48)	864	180	4.80
					Gardenpea	49 (28)	588	140	4.20
					Bushbean	84 (14)	319	96	3.33
					Chili	721(133)	14417	762	18.92
					Garlic	30 (20)	1200	300	4.00
		Total=12478	**3305**	**3.77**			**Total=56154**	**8338**	**6.77**

A.b. Partial shady place

Before intervention					***After intervention***				
Crop	Total produc.(kg)	GR (Tk.)	TVC (Tk.)	BCR	Crop	Total produc.(kg)	GR (Tk.)	TVC (Tk.)	BCR
Zinger	140(40)	4200	2000	4.5	Zinger	400(61)	12000	2200	4.45
Turmeric	680(68)	6800	2000	3.4	Turmeric	874(76)	8740	2400	3.75
	Total	**11000**	**4000**	**275**		**Total**	**20740**	**4600**	**4.1**

A.c. Rooftop: 48

Bottle gourd	780	1950	130	15.00	Bottle gourd	1500	6000	240	25.00
Ash gourd	560	840	160	5.25	Ash gourd	800	1600	240	6.67
Country bean	425	2125	170	12.50	Country bean	800	6400	240	26.67
Sweet gourd	600	1800	100	18.00	Sweet gourd	1500	4500	240	18.75
	Total	**6715**	**560**	**12.00**		**Total**	**18500**	**960**	**19.27**

A.d. Marshy land: 168 m²

Aroid	180	720	60	12.00	Aroid	336	1344	120	11.20
	Total	**720**	**60**	**12.00**	**Total**	**336**	**1344**	120	11.20

A.e. Trellis

Bottle gourd	610	1525	420	3.63	Bottle gourd	920	3680	435	8.46
Ash gourd	255	382	280	1.36	Ash gourd	440	880	310	2.84
Country bean	188	940	375	2.50	Country bean	318	2544	405	6.28
Sweet gourd	377	1125	415	2.71	Sweet gourd	505	1515	425	3.56
	Total	**3972**	**1490**	**2.66**		**Total**	**8619**	**1575**	**5.47**

A.f. Fence crop

Fallow	-	-	-	-	Country bean	350	2800	250	11.20
	-	-	-	-	Bitter gourd	60	480	150	3.20
	-	-	-	-	Ribbed gourd	150	900	150	6.00
	Total					Total	4180	560	7.46

A.g. Ail crop

Papaya	85	595	150	3.97	Papaya	*			
	Total	**595**	**150**	**3.97**		Total			

* Fruiting stage

A.h. Pond bank: 35 linear m

Before intervention					**After intervention**				
Crop	Total roduc. (kg)	GR (Tk.)	TVC (Tk.)	BCR	Crop	Total produc. (kg)	GR (Tk.)	TVC (Tk.)	BCR
Fallow	-	-	-	-	Country bean	120	980	450	2.12
	-	-	-	-	Ash gourd	200	400	100	4.40
						Total	**1380**	**550**	**2.47**

A.i. Fruit tree: 213 (3)

Mango	900	18000	4500	4.00	Mango	1500	30000	6500	4.61
Jack fruit	315	1890	1500	1.26	Jack fruit	650	3900	2600	1.50
Guava	250	2500	1200	2.08	Guava	375	3750	1575	2.38
Litchi	-	-	-	-	Litchi	-	-	-	-
Black berry	45	675	200	3.37	Black berry	60	900	350	2.57
Lemon	450	225	100	2.25	Lemon	690	345	190	1.81
Jambura	85	425	100	4.25	Jambura	115	575	185	3.10
Coconut	300	1800	125	14.40	Coconut	450	2700	250	10.80
	Total	**25515**	**7725**	**3.17**	**Total**	**Total**	**42170**	**11650**	**3.62**

A.j. Non-fruit tree:

Fallow	-	-	-	-	Country bean	150	1200	270	4.44
-	-	-	-	Sponge gourd	125				
1	-	-	-		**Total**	**1825**	**370**	**4**	

I.B. Field crop

Potato	67206	672060	334412	2.00	Potato	219958	2639496	413968	6.38
Jute	3757	45084	45141	1.00	Jute	*	-	-	-
Boro rice	29959	299590	187246	1.60	Boro rice	34716	347160	222950	1.56
T. Aman	38562	308496	218522	1.41	T. Aman	40567	405670	264650	1.53
Wheat	4605	59865	28947	2.07	Wheat	5000	90000	35525	2.53
Maize	16366	147294	86295	1.71	Maize	41963	461593	202872	2.28
Mustard	354	6372	7591	0.84	Mustard	394	9880	6352	1.56
					Mung bean	48	2400	680	3.53
	Total	**1538761**	**908154**	**1.69**		**Total**	**3956199**	**1146997**	**3.45**

* Not yet harvested

2. Fish culture: 73 dec.

Before intervention					After intervention				
Crop	Total produc. (kg)	GR (Tk.)	TVC (Tk.)	BCR	Crop	Total prod. (kg)	GR (Tk.)	TVC (Tk.)	BCR
Mixed fish in seasonal pond	160	8800	3650	2.41	GIFT Telapia (Seasonal)	100	6000	1575	3.81
					Raj puti (Seasonal)	105	5775	1920	3.01
Mixed fish in perennial pond	130	7410	2140	3.46	Mixed Fish in seasonal pond (Silver carp, Katla, Mrigel, Ruhi)	215	11950	2655	4.5
					Mixed Fish in perennial pond (Silver carp, Katla, Mrigel, Ruhi)	330	17800	2705	6.58
	Total	**16210**	**5790**	**2.80**		**Total**	**41525**	**8855**	**4.69**

3. Livestock: 37

Ox	350	56000	22520	2.49	*Beef Fattening	575	93600	27050	3.46
Milch cow	1200	18000	10430	1.73	Milch cow	4375	65625	24215	2.71
Calf rearing	705	112800	79200	1.42	Calf rearing	1430	228800	111960	2.04
Goat rearing	200	40000	7640	5.24	Goat rearing	350	60000	9450	6.35
	Total	**226800**	**114050**	**1.99**		**Total**	**448025**	**172675**	**2.59**

* Deworming was done in all cattle after intervention

4. Duck and poultry

Before intervention						After intervention					
Tech.	Yield		GR (Tk.)	TVC (Tk.)	BCR	Tech.	Yield		GR (Tk.)	TVC (Tk.)	BCR
	Meat (kg)	Egg (no)					Meat (kg)	Egg (no)			
Duck	275	15000	67000	18590	3.60	Duck	375	35000	135000	33600	4.02
Poultry	234	7500	48275	15200	3.18	Poultry	400	15000	89000	19950	4.46
		Total	**115275**	**33790**	**3.41**			**Total**	**224000**	**53550**	**4.18**

5. Off-farm

Bamboo goods making	250 nos	3750	1500	2.50	Bamboo goods making	250	5000	2000	2.50
Mat making	130	3250	1000	3.25	Mat making	130	3900	1300	3.00
		7000	2500	2.80			8900	3300	2.70
	Total	**14000**	**5000**	**2.80**		**Total**	**17800**	**6600**	**2.70**

Table 6. Economics of sector wise production in the farms (average of 25 farmers) at FSRD site, Lahirirhat, Rangpur before (2005-07) and after (2006-07) intervention

	Before			After		
Resource	GR(Tk.)	TVC(Tk)	GM(Tk)	GR(Tk)	TVC(Tk)	GM(Tk)
Sunny place	12478	3305	9173	56154	8338	47816
Partial Shaddy place	11000	4000	730	20740	4600	16140
Roof top	6715	560	6155	18500	960	17540
Marshy land	720	60	660	1344	200	114
Trailee	3972	1490	38231	8619	1575	7044
Fence crop	0	0	0	4180	560	3620
Ail crop	595	150	365	100	550	830
Pond bank	0	0	0	1380	11650	30520
Fruit tree	25515	7725	17790	42170	370	1455
Non fruit tree	0		0	1825	8855	3267
Field crop	1538761	908154		3956199	1146997	275350
Fish culture	16210	5790	10420	41525	172675	170450
Live stock	226800	114050	112750	448025	172675	11200
Poultry	115775	33790	81285	224000	53500	170500
Off farm	14000	5000	9000	17800	6600	11200
		Total	**213455**		**Total**	**767046**

B. Integrated Farming System (Fishery component)

Seasonal Fish Culture in Mini Pond at FSRD site, Kushumhati, Sherpur

Abstract

A fish production programme was executed at the Farming Systems Research and Development Site, Kushumhati, Sherpur during October, 2006 to February, 2007 in the seasonal mini pond to raise the income and family nutrition of the farmers by utilizing the unused ponds. The result showed that out of 200 fingerlings from silvercarp, a total of 33 kg fishes were harvested after three and half months. Again, 100 fingerlings from Ruhit gave 8 kg and Talapia gave 12 kg of marketable fishes. The valuation of the products were Tk. 2720.00. The cost of fingerlings and other materials viz. fish meal, lime etc. were Tk. 1532.00. The gross margin was Tk.1188.00 where the benefit cost ratio was 1.17.

Materials and Methods

A fish production programme was executed at the Farming Systems Research and Development Site, Kushumhati, Sherpur during October, 2006 to February, 2007 in the seasonal mini pond to raise the income and family nutrition of the farmers by utilizing the unused ponds. The fish species were Silvercarp, Ruhit and Talapia. At first the ponds were cleaned and some liming solution were applied before rearing of fingerlings. The size of the actual water bodies was 160 m^2. A total of 400 fingerlings out of which Silvercarp were 200, Ruhit were 100 and Talapia were 100. After three and half months rearing the fishes were sold on February, 10, 2007.

Results and Discussion

The result showed that out of 200 fingerlings from silvercarp, a total of 33 kg fishes were harvested after three and half months. Again, 100 fingerlings from Ruhit gave 8 kg and Talapia gave 12 kg of marketable fishes. The total valuations of the products were Tk. 2720.00. The cost of fingerlings and other materials viz. lime, fish meal etc. were Tk. 1532.00. The gross margin was Tk. 1188.00 where the benefit cost ratio was 1.77.

Table 1. Cost and income of fingerlings

Fingerlings (no.)	Cost of fingerlings	Product	Income
Silvercarp	400.00	33 kg	1320.00
Ruhit	200.00	8 kg	560.00
Talapia	200.00	12 kg	840.00
Total	800.00		2720.00

Price/fingerlings= Tk.2.00, Selling price: Silvercarp Tk. 40.00/kg, Ruhit and Talapia= Tk. 70.00/kg

Table 2. Cost and return analysis

Gross return (Tk.)	Cost of cultivation (Tk.)	Gross margin (Tk.)	BCR
2720.00	1532.00	1188.00	1.77

Cost of cultivation includes liming, fishmeal and labour

Cost of cultivation

Sl. No.	Item	Price (Tk)
1.	Fingerling	800.00
2.	Fishmeal	720.00
3.	Lime	12.00
Total		1532.00

Monoculture of *Nilotica* in Seasonal Ponds at FSRD site, Barind, Rajshahi

Fish is an important part of our national economy and it contributes about 4.86% of GDP (BER 2006). In Barind area there are numerous mini ponds and ditches. The owners of these mini ponds/ ditches are poor. They can profitably use these ponds/ditches for fish culture either for their subsistence or as a commercial enterprise. On-Farm trials have indicated the feasibility of rising. Rajputi (*Puntius gonionotus*) and Nilotica (*Oreochromis niloticas*) is seasonal mini ponds/ditches, which can retain water for 4 to 6 months (Gupta, 1990). In the Barind area the water retains in the mini ponds/ ditches for June to December. These mini ponds/ditches owners can culture Rajputi or Nilotica and harvest one crop in this period and improve their economic condition. Considering above view in mind the present study was taken with following objectives:

i) To utility the mini ponds/ditches and ii) To increase family nutrition

Methodology

The program was conducted at FSRD site, Kadamshahar Rajshahi during June 2006. Four seasonal mini ponds were selected for this program. From the farmers group discussion with FSRD team Nilotica was selected to culture in the pond. Before stocking the fingerlings, ponds were prepared by removing weeds and other debris. The liming was done in ponds at the rate of 1kg/decimal (250 kg/ha). After 5-6 days of liming organic manure and inorganic fertilizer (Urea: TSP=1:2) were applied 750 kg/ha and 75 kg/ha respectively. Rice bran was used as fish feed in the pond.

Results

The growth performance of Nilontica was satisfactory. It attained 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 11).

Table 11. Performance of *Nilotica* in seasonal ponds during 2006-2007

Sl. no.	Pond size (decimal)	Amount harvested (kg)	Harvest rate (kg/decimal)
1.	5.0	18.50	3.7
2.	3.5	20.50	5.86
3.	7.5	33.50	4.47
4.	3.0	16.00	5.33
Total	19	88.50	4.66

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.

Modern Fish Cultivation at Farmers Pond at FSRD site, Puspapara, Pabna

Objectives

1. To observe the performance of polyculture system under farmers management
2. To promote the existing production of fish and economic benefit from the ponds of FSRD site.

Materials and Methods

Pond selection and

A total of 5 ponds were selected in the present study. The average size of the ponds was 30 decimal. At first weed and predatory fish were removed by using a selective poison 'rotenone'. Then liming was done using 1 kg decimal^{-1} limestone to increase the p^{H} of the pond water. Finally both cowdung (5 kg decimal^{-1}) and inorganic fertilizer (Urea + TSP -100g each decimal^{-1}) were used to promote the natural productivity of the ponds. Recommended stocking density was maintained. Proper feed with recommended ratios were supplied to the fish during the growing period. The fish were harvested after 9-10 months.

Results and Discussion

The growth of different fish species was satisfactory. Proper stocking density of fingerling and optimum feed management increased fish production in the tested ponds. The harvest of different fish species per decimal was 13.75 kg. The gross return and gross margin was achieved Tk. 942 and Tk. 812 per decimal, respectively which was encouraging for the participatory farmers.

Conclusion

The tested technology was found economically viable for fish cultivation and it should be popularize to the large area through extension services.

Table 1. Polyculture of fish with improved management at FSRD site, Pushpapara, Pabna during 2006-07.

No. of ponds (Area in dec.)	Fish species	Stocking density (no. of fish $dec.^{-1}$)	Fish harvest $dec.^{-1}$ (kg)	Gross return (Tk $dec.^{-1}$)	Cost (Tk $dec.^{-1}$)	Profit (Tk $dec.^{-1}$)	Management
5 (153)	Catla	05-07	2.25	180	30	150	♦Before stocking finger-lings undesirable fish species was removed ♦Lime applied for increasing pH of water bodies ♦Recommended fertilizer applied for optimum growth of python and zoo planktons ♦ Proper fish feed was provided at recommended ratios.
	Ruhi	10-12	3.85	308	35	273	

Seasonal Fish Culture In Mini pond at FSRD site, Hazirhat, Noakhali

Gift tilapia and sharputi were supplied to 11 households. Before intervention these homestead ditches and ponds were cultivated with local fish. The supplied fingerlings were harvested after five months. Average fish production was 113.5 kg /family and 9.08 kg/decimal. It was observed that improved management of ponds and regular feeding of fishmeal increased the production of fish. it increased the consumption of fish and income of the farmers from fish.

2. Performance of fishery at FSRD site, Noakhali

Resource	Harvesting period	Qty. Harvested (Kg/ Family)	Consumption (Kg/ Family)	Amount Distribution (Kg/ Family)	Amount Sold (Kg/ Family)	Value in (Tk)
Gift Telepia and Sharputi	Dec/06 to 07/02/07	113.5	29	5	79.5	9080/-

* No. Of family: 11

Feasibility of Polyculture in the farmers' ponds at MLT site, Dhirashram, Gazipur

Materials and Methods

Nine farmers ponds of different size average 12.33 decimal were selected for the polyculture of carps at Dhirashram MLT site. Gazipur Sadar in 200-6-07 under AEZ 28 (Modhupur Tract). Five species of fish viz. Rui, Catla, Mrigal, Sharpunti and Silver carp were released at different ratio. Before stocking the fish, the ponds were limed at the rate of 1 kg per decimal. Seven days after liming the ponds were fertilized with organic manure (4-5 kg per decimal) and inorganic fertilizer(100 g Urea + 100 g TSP per decimal). The average length of fingerlings were recorded before stocking. The fish were harvested after nine months. Then the total yield and survivability of stocked fishers were recorded.

Results and Discussions

The growth performance of major Carps was observed in Gazipur Sadar area. Average stocking density/decimal was 50. Among 50 fingerlings 8 were Rui, 10 were Catla, 10 were Mrigal 12 were Sharpunti and 10 were Silver carp respectively. Out of five species Rui (905g) had shown the highest average growth than other species (Table 1) in terms of body weight.

Table 1. Growth performance of different species in polyculture at Dhirashram MLT site, Gazipur Sadar, during 2006-07

Types of fish	No. of fingerlings released (Per dec)	Size of fish after 9 months (inch.)	Final wt. (g) (after 9 months)	Average Yield (kg/dec.)
Rui	08	17	905	7.24
Catla	10	17	515	5.13
Mrigal	10	12	405	4.05
Sharpunti	12	6	305	3.66
Silver Carp	10	14	520	5.20

Table 2. Economics of polyucuture of carps at farmers ponds.

Total Yield (kg/dec.)	Gross return (Tk./dec)	Total cost (Tk./dec.)	Net. Benefit (Tk./dec.)	Benefit cost Ratio
25.2	2895	460	2435	6.3

Catla (515 g) Silvercarp (520g) and Sharpunti (305 g) showed medium growth and Mrigal (4059) showed lower growth rate performance. The average yield and net return per decimal gained from carp's polyculture were 25.2 kg and Tk. 2435 respectively within 9 months (Table-2). The cost benefit ratio was 6.3. It is evident from the results that growth rate was low because of not giving supplementary feed regularly. From the results it is observed that fish production as well as net income can easily be increased by utilizing the ponds under polyculture system through scientific way.

C. Integrated Farming System (Livestock and poultry component)

Vaccination of livestock's and rearing of goose and pigeon at FSRD site, Barind, Rajshahi

Introduction

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 by 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. Pigeon and goose rearing are proven technology in High Barind condition of their profitability and nutritional aspect. 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.

Methodology

The program is going on at the FSRD site, Kadamshahar, Rajshahi during June 2006 to up to date. About 125 animals of different types were vaccinated on 28 June 2006. In the vaccination group viz., FFD & Antrax for cattle PPR for goat, RDV and Duck plague for poultry bird's vaccines were used as per recommended schedule. In poultry rearing program 20 pigeon and 30 gooses were distributed among the five families of small and marginal categories with 50% financial support of them. Quality poultry feeds were also provided to them with 50% financial support. Necessary data were recorded time to time.

Results

The results of the vaccination program presented in Table 9-10. The results showed that after vaccination program mortality percentage become very low compared to before vaccination in ease of all livestock population. Before vaccination the mortality rate of poultry, goose, goat and cattle were 18, 10, 23 and 5% and after vaccination those percentage reduces as 6, 0, 9 and 0%. This program has created awareness and interest among the co-operator farmers.

Farmer's Reaction

- Farmers positively opined due to low mortality rate of their livestock.
- Farmers are highly interested of pigeon and goose rearing to generate income at household level.

Table 9. Name and performance of vaccine to livestock's population

Name of animal	Farmer category and number	Date of vaccination	No. of animal vaccinated	Name of vaccine	Mortality rate (%)	
					Before vaccination	After vaccination
Poultry	5 Small & 5 Marginal	28.06.2006	85	RDV & Duck Plague	18	6
Goose	2 Small & 4 Marginal	do	25	do	10	0
Goat	1 Small & 3 Marginal	do	11	PPR	23	9
Cattle	2 Small & 4 Marginal	do	10	FMD & Anthrax	5	0
Total =			**125**	**-**	**-**	**-**

Table 10. Goose and pigeon rearing

Name of animal	Farmer category and number	Date of distribution	No. of poultry birds	Present condition	Remarks
Pigeon	1 Small & 3 Marginal	10.03.2007	25	Became marketable size	Provided technical assistance and grain mixture as feed with 50% sharing of farmer
Goose	2 Small & 2 Marginal	15.01.2007	30	Good codition	
Total =			**55**	-	

Deworming, Vaccination and Beef Fattening of Cattle at FSRD site, Puspapara, Pabna

Introduction

Like all other rice growing countries in Asia, straw contribute more than 80-90% of the total available feed for livestock (FAO, 1980). Due to inherent low digestive, low crude protein and unbalanced mineral composition coupled with low intake, the cattle do not ingest sufficient quantities of straw to satisfy the nutrient requirement. Many experiments have already proved that feed value of rice straw could be improved by treating urea with molasses. The urea-molasses treated straw helps in developing microbes of the ruminants. Then the healthy microbes pass inside the small intestine and absorbed into the blood to meet up the protein requirement of the rapidly grown up cattle. Scientists reported that significant success in beef fattening did not achieve through maintaining only UMS diet when dewarming and vaccination were ignored. To get success in beef fattening it is imperative to implement integrated approach with dewarming, vaccination and beef fattening. Therefore, a program was undertaken to demonstrate the effect of UMS treatment on cattle health.

Objectives

i. To increase the efficient feed intake and health condition of cattle
ii. To increase the income generation of the rural people.
iii. To popularize the technologies

Materials and Methods

The development work was carried out at FSRD site Pushpapara, Pabna in farmers condition during October to December, 2006. The breeds of the treated cattle were local improved and crossbreed types (age around 2 years). Before starting the fattening program, around 104 cattle's were de-wormed by Rulnax and Facinax for roundworm and liver fluke as per recommendation of the body weight and provided Anthrax vaccine before 20 days of the studies. Finally 7 cattle's of three co-operators were selected for beef fattening. The treated mixed feed was prepared at the rate of 82:3:15 straw, urea, and molasses respectively. The amount of mixed feed as diet was maintained regularly 1% concentrates mixture and 3% treated straw of the total body weight of the cattle. Preventive and curative measures were done as and when required. Necessary data were collected and complied.

Results and Discussion

The body weights of the treated cattle's were remarkably increased due to feeding with UMS diet. After two month the average body weight increased by 27% over initial weight. The average body weight gained per day was around 394 g. which was very much encouraging for the cattle growers. The cell price increased by 89% over initial price. The average profit obtained from each cattle was Tk. 6640.

Farmer's opinion

The cooperator farmers are interested about the tested technology. Some of the poor farmers also opined that it required large amount of primary investment.

Out put/impact

The cooperator farmers are interested about the tested technology & admitted that it is a good economic source for the village people.

Recommendation

* It is an economically profitable technology and farmer could easily adopt this technology with some cost investment. So, it can be practiced for large-scale extension to the farmers.

Table 1. Beef fattening with Urea Molasses Straw diet, Vaccination and Deworming program at FSRD site, Pushpapara, Pabna during 2006-07.

Cooperators	No. of Cattle	Age (years)	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.)	Profit (Tk.)	Remarks
Mokhtar Hossain	1	2	100	62	125	403	9000	16000	7000	Before starting the program all cattle were dewormed and vaccinated
	1	2	105	62	129	387	9000	16500	7500	
	1	2	105	62	131	419	9000	16500	7500	
	1	1.5	70	62	93	371	6000	-	-	
Md. Nahid	1	2	90	61	112	361	9000	14200	5200	
	1	2	70	61	94	393	7000	-	-	
Abu Zafor	1	2	90	61	116	426	9000	15000	6000	

Vaccination of Poultry at FSRD site, Puspapara, Pabna

Introduction

Poultry rearing are common practices of rural Bangladesh. But disease is the main problem faced by the farmers for poultry rearing. From the survey it was revealed that major part of the poultry birds died by diseases. Only proper vaccination can reduce the mortality rate of poultry. But at the farmer condition this vaccine is not available and even they do not know the technical know how about the vaccination. It is imperative to train up farmers for proper vaccination activities to safe their poultry.

Objectives

i. To reduce mortality of poultry
ii. To investigate the effectiveness of vaccine at farm level.

Materials and Methods

The program was conducted at the farmer's field of the FSRD Site, Pushpapara, Pabna. The vaccination program for poultry was started last week of July, 2007 and continued to March 31, 2007. The program was carried out with 60 farm families. In the vaccinated group BCRDV, RDV and Foul pox vaccine for poultry were used as per recommended schedule.

Results and Discussion

Date of vaccination, name of vaccine and mortality (%) is presented in Table-1. It was observed that after vaccination mortality rate of poultry remarkably decreased. A few percentages of birds were died because of attack of predator animals and bacterial disease infestation.

Out put/ impact

The cooperator farmers are very much interested about the vaccination program and admitted that it is the best way to reduce mortality rate of their poultry birds.

Recommendation

It is an economically profitable and farmer could easily adopt this practice with minimum cost involvement.

Table 1. Vaccination program of poultry at FSRD site, Pushpapara, Pabna during 2006-07.

Date of vaccination	Name of the vaccine	No. of bird	Mortality (%)	Causes of death
26-31.07.06	BCRDV RDV	150 308	4 5	Predator animal and bacterial diseases
26-30.09.06	BCRDV RDV	320 741	5 3	
30.11.06	BCRDV RDV	67 200	4 5	
1-2.12.06	BCRDV RDV	216 431	6 4	
14-18.03.07	BCRDV RDV	562 945	5 5	
30-31.03.07	Foul pox	1254	4	

Deworming, Vaccination and Beef Fattening of Cattle at FSRD site, Hazirhat, Noakhali

Livestock

Intervention in livestock and poultry enterprises included vaccination of poultry, deworming of cattle, and beef fattening with UMS. It has created a positive impact among the farm families'. This has contributed for better nutrition, income generation and effective participation of the women members of the family.

a) Vaccination of poultry

Among the 23 family 410 poultry was vaccinated. Due to vaccination the mortality percentage was decreased.

b) Deworming of cattle

Among the 17 family 40 cattle was considered for deworming. Due to do this, feed intake and physical health was increased.

c) Beef fattening with UMS

This programme was conducted at 10 cattle among the 6 households. It revealed that the UMS diets gave higher body weight gain in comparison to farmers traditional feeding and management practices. Though it gives the better result but farmers are not interested to do this by their own capital.

Performance of livestock up to 30/05/ 2007 at FSRD site, Noakhali

Poultry			**Remarks**
a) Vaccination	No. of family	No. of poultry vaccinated	
	23	410	Completed and all poultry are in healthy condition.
Livestock:			**Remarks**
a) Deworming of cattle	No. of family	No. of cattle	Completed and all livestock are in healthy condition.
	17	40	
b) Beef fattening with UMS	No. of family	No. of cattle	Farmers are not interested to do this with their own capital
	6	10	

Vaccination Program on Cattle Health at MLT site, Dhirashram, Gazipur

In our country a large number of cattle are suffering from different contagious and non contagious diseases every year. Many of them die subsequently. The milk and body weight of infected cattle decrease. If the vaccines are used properly the mortality and morbidity may be reduced and the overall performance of cattle health would be increased.

Objectives

- To popularize the technology among the village.
- To reduce the mortality rate of cattle,

A vaccination program was initiated from the 21 August, 2006 at Dhirashram MLT site, Gazipur Sadar during 2006-07. Seventy five cattle of 53 households were vaccinated against Foot and Mouth disease, Black Quarter (B Q), Anthrax and Haemoxrhagic Septicemia. It was observed that the treated cattle were more disease free comparatively than non treated animals.

Vaccine	No. of cooperative farmers	No. of cattle	Remarks
Foot and Mouth Disease, Anthrax, Black Quarter (BQ), Haemoxrhagic Septicemea (H.S)	53	75	All treated animal are free from FMD, Anthrax, BQ, H.S diseases

Farmers should be more convinced to contract with TLO's office where vaccines are available and they should keen interest with the vaccination program.

Deworming of Cattle

The health condition of own native cattle is very poor due to different diseases and infestation of various types of parasites. The geographical (sub-tropical) condition of our country is suitable for the living of both ecto and endo parasites. The internal (endo) parasites lives in stomach, intestine, liver and occasionally in lungs of the cattle. The presence of endoparasites creates disturbance is proper digestion, blockage of stomach and absorption of feeds. As a result, the cattle suffering from diarrhea, anemia, anorexia, labored breathing and occasionally edema in lungs and voluntary feed intake, weight gain and milk production of infected cattle also declines. The existing situation may be improved primarily by de-warming program.

- To improve the health condition of existing cattle,
- To increase the milk production through de-warming,
- To increase the meat quality and also the lactation period of cows.

The deworming of cattle program has been undertaken at Dhirashram MLT site, Gazipur Sadar during 200-07. Fifty six cattle of 22 cooperative farmers were selected for de-warmed by LTvet and Benamox tablet. It was observed that the de-warmed cattle were comparatively good in health, growth and milk production than control animal.

Treatment	No. of farmers	No. of cattle	Remarks
Treated with LTvet and Benamox tablet.	22	56	All treated animal were comparatively good in health, growth and milk production than control animal.

The cooperative farmers were interested about the de-worming technology because of it is an economically profitable and farmer could easily adopt this technology with minimum cost involvement. So it can be disseminated to larger with wider program.

Intensified Use of Homestead Spaces for Increased Production of Vegetables and Fruits

COLLABORATIVE PROGRAM: BARI-IC SAAKTI

Introduction

Landless, marginal and small households comprises of >70% of the rural population and among them 34% have only homestead. Homesteads are the resources that provide major share of livelihood especially for poor farmers. Those resource poor farmers (RPF) get about 50% of their food and cash from homestead. In these circumstances, OFRD of BARI initiated homestead vegetable production model known as "Kalikapur model" in 1984. Later on it was felt to modify the model based on the existing eco-systems (niches) of each homestead, along with vegetables different fruits were also included. Thus productivity and nutrition supplying capacity of each homestead increased to a significant level (3-4 times than previous).

The BARI scientists exposure visit and need analysis of CBOs in IC-LEAF programme area revealed that homestead spaces available for cultivation of fruits and vegetables are in partial use by space and time. Such short comings can be over come by using different niches (7-9 spaces) with fruits and vegetables organized in patterns as indicated by the farmers promoting BARI varieties and tested pattern technologies among the farmers.

However, it was observed that sustainability of the production program was fragile due to scarcity of quality seeds/seedlings/saplings and also due to lack of proper motivation. In reality the developed production models were formulated mostly through researcher's managed trial. It is needless to say that for greater motivation it should mostly be participatory. However, those developed vegetables/fruits patterns would be a valuable basis for creating a homestead productivity revolution.

In this context, it expected that active cooperation of IC with BARI could enhance the efforts in making the technology viable and sustainable. Such an interaction would be very effective in improving the livelihood of RPFs of northern Bangladesh, where poverty and malnutrition are more prevalent.

Considering the above facts, homestead space utilization program was initiated from rabi season of 2005 at Rangpur, Pabna and Barind area of Rajshahi

Program objectives

- To utilize maximum resources of the homestead for growing vegetables and fruits in relation to agroforestry systems
- To enhance intake of vegetables and fruits ,thereby to ensure family nutrition

Expected outcome

- Use of homestead spaces round the year by farmers
- Income from homestead crops increased
- Increased intake of fruits and vegetables by farm family members
- High quality seedlings/saplings/graft will be developed and distributed

Materials and Methods

1. Thirty small, marginal and landless farmers were selected from both the FSRD and CBO sites based on prefixed criteria from Rangpur and Barind and 40 from Pabna.
2. Farmers’ homestead available resources, needs and choice assessment were done with active participation of the family members (both male and female) through several informal sitting between farmers, researchers and NGO workers.

3. Program planning was done on year round vegetable production pattern and also a work plan was made in this regard. Pre sowing farmers training was conducted on 24 September to 25 November 2005 on production and management of pattern basis vegetable cultivation in different niches of a homestead. In the trainings, 200 farmers (50 % male and 50% female) participated from three locations.
4. OFRD, BARI supplied the critical inputs like fruit and vegetable seed/seedlings, net (for fencing), watering cane etc. Primarily, the seeds were supplied on free of cost to the farmers with condition to produce and preserved it for next year use.
5. OFRD personnel provided technical support to the FSRD and CBO farmers group as per local need.
6. The data on total production per homestead were collected and documented in a register.
7. For technology transfer field day and hand-on training was arranged
8. Nutritional education was given through showing pictures and drama

Different vegetable patterns were tested in different locations as per the need of the farmers. For the open sunny place and other places round the year vegetable pattern were as follows:

Barind, Rajshahi

Nitchi/space	Cropping pattern for year round homestead vegetable production		
	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 (*Katua Data*)	Jute leaf (*Pat Shak*)
Bed-4	China cabbage (*Batishak*)	Okra	Onion + Red amaranth
Bed-5	Bushbean	Chili	Chili
Cottage roof/top	Country bean, bottle gourd	Sweet gourd	White gourd
Trellis	Country bean, bottle gourd	Sweet gourd, cucumber, yard long bean, bitter gourd (*Gaj corola*)	-
Fences/Boundry wall	-	Bitter gourd (*Gaj corola*), yard long bean	-
Non-fruit trees	-	-	White gourd, potato yam
Partially shady land	Coriander leaf	Zinger, turmeric, aroids	-
Homestead areas	Brinjal, onion, garlic	Red amaranth, kangkong, chili, plantain banana, papaya, drumstick	-
Pond/ditch banks and slope	Bottle gourd, country bean	Indian spinach, sweet gourd, bitter gourd (*Gaj corola*)	-
Muddy wall	-	Bitter gourd (*Gaj corola*), yard long bean	-

Pabna

Spaces		Cropping patterns	
1.	Open sunny place	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.	Panikachu
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)

Rangpur

Before intervention	After intervention
A. Open sunny place	
Fallow	**Present status** Bed No. 1: Spinach + Tomato – Indian spinach - Red Amaranth Bed No. 2: Turnip + Red Amaranth –Kangkong – Kangkong Bed No. 3: Radish – Indian spinach – Red Amaranth Bed No. 4: Cabbage+ Napashak-Okra+ Juteshak – Danta Bed No. 5: Brinjal+ Coriandershak + Kangkong – Kangkong
B. Partial shady place	
Fallow	- Turmeric and Zinger cultivation with proper management
C. Fence crop	
Never used	i) Bitter gourd: 4 pits ii) Ribbed gourd: 5 pits iii) Snake gourd: 3 pits iv) Cucumber: 3 pits
D. Roof Top: 1	
Country bean + Fallow with traditional management	Under proper management RT1: Country bean + Sweet gourd
E. Marshy Land: 1 dec.	
Aroid cultivation without proper management	Aroid cultivation with proper management (Planting distance and fertilizer)
F. Timber Trees	
Neem: 14, Suktani: 1 Without management	With proper management Sponge gourd: 2 pits
G. Fruit Tree	
Mango: 3, Jackfruit: 2 Guava: 1 Without management	Under proper management (Pruning, Training, Pest control, Fertilizer and Irrigation)
H. Trellis: 2	
Country bean + Ash gourd Country bean + Ash gourd Under traditional management No crop under trellis	Country bean + Ash gourd Country bean + Ash gourd Under Trellis: Ginger, Turmeric Under recommended management
I. Ditch:	
Seasonal pisi culture	Vegetable (Bottle gourd, Ribbed gourd cultivation on the bank of the ditch

Results and Discussion

FSRD site, Barind, Rajshahi

Vegetables production per homestead: In December, the maximum amount of vegetables (95.97 kg) was produced from each homestead. The second highest fresh vegetables was produced in November (71.25 kg) and sharply declined after December (Table 1). Six vegetable crops viz., brinjal, red amaranth, spinach, radish (with leaf), bush bean and China cabbage (*batishak)* grown in five beds of open sunny place produced 23.35, 28.20, 30.94, 33.97, 15.45 and 39.75 kg fresh vegetables, respectively during *rabi* season. However Brinjal and red amaranth were grown in same bed simultaneously. On the other hand, two-cripper vegetable crops viz., bottle gourd and country bean were grown on the farmers' cottage roof and trelli gave 22.40 and 15.50 kg fresh vegetables per homestead. It was observed that the highest amount of vegetable was produced in chaina cabbage (39.75 kg). Actually china cabbage is a quick growing vegetable. It covered canopy quickly. This is the main reason of higher yield in china cabbage. In *rabi* season, it was revealed that a total of 209.56 kg fresh vegetables were produced per homestead.

Vegetables intake per family: The maximum amount of vegetable (41.45 kg) was consumed by each family in the month December, followed by November (30.31 kg) and after December it was declined (Table 2). The each farmer's family intake were 12.37, 9.21, 12.76, 13.74, 7.97, 17.65, 15.40 and 8.6 kg fresh brinjal, red amaranth, spinach, radish (with leaf), bush bean, China cabbage (*batishak*), bottle gourd and country bean, respectively from the month November to February. It was observed that each family (4 members) consumed a total of 97.70 kg fresh vegetables during *rabi* 2005-06.

Vegetables distributed by a family: In December, the highest amount of vegetable (16354 kg) was distributed to farmers' relatives and neighbors (Table 3). Each family distributed 3.76, 4.57, 4.76, 6.09, 2.38, 8.8, 1.2 and 1.9 kg fresh brinjal, red amaranth, spinach, radish (with leaf), bushbean, China cabbage (batishak), bottle gourd and country bean, respectively from November to February. During *rabi* season the total amount of distributed vegetables by a family was 33.46 kg.

Vegetables sold by a family: Each farmer's family sold 7.21, 14.42, 13.41, 14.15, 5.09, 13.30, 5.80, and 5.00 kg fresh brinjal, red amaranth, spinach, radish (with leaf), bush bean, China cabbage (*batishak*), bottle gourd and country bean, respectively from November to February. During *rabi* season there were 78.38 kg fresh vegetables were sold by a farmer family (Table 4).

Economic return per homestead: After implementation of the project during *rabi* season each farm family produced 23.35, 28.20, 30.94, 33.97, 39.75, 15.45, 22.40 and 15.50 kg fresh brinjal, red amaranth, spinach, radish (with leaf), China cabbage (*batishak*), bush bean, bottle gourd and country bean, respectively from November to February. During this period each family sold a portion of the products after fulfill their family nutrition requirements. Each farm family earned 1518.57 and 1398.57 Taka gross and net return, respectively in respect of local market value of the products during *rabi* season (Table 5).

Table 1. Vegetables production per homestead at Barind, Rajshahi during rabi 2006-07

Month	Vegetable production/bed (kg/5m^2)						B.gourd	Bean	Total
	Brin.	R.ama.	Spin.	Rad.	B.bean	Batisak			
November	3.82	17.57	8.50	17.82	3.74	19.80	-	-	71.25
December	13.88	10.64	22.44	16.15	11.71	19.95	-	1.20	95.97
January	5.47	-	-	-	-	-	14.4	9.20	29.07
February	0.18	-	-	-	-	-	8.00	5.10	13.28
Total =	23.35	28.20	30.94	33.97	15.45	39.75	22.4	15.50	209.56

Table 2. Vegetables intake per family at Barind, Rajshahi during rabi 2006-07

Month	Vegetable production/bed (kg/5m^2)						B. gourd	Bean	Total
	Brinjal	R.ama	Spin.	Radis	B.bean	Batisak			
November	2.58	5.00	3.88	7.00	2.35	9.50	-	-	30.31
December	6.65	4.21	8.88	6.74	5.62	8.15	-	1.20	41.45
January	3.03	-	-	-	-	-	9.00	4.80	16.83
February	0.12	-	-	-	-	-	6.40	2.60	9.12
Total =	12.37	9.21	12.76	13.74	7.97	17.65	15.40	8.60	97.70

Table 3. Vegetables distributed by a family at Barind, Rajshahi during rabi 2006-07

Month	Vegetable production/bed (kg/5m^2)						B. gourd	Bean	Total
	Brinjal	R.ama	Spin.	Rad.	B.bean	Batisak			
November	0.65	2.86	1.21	3.41	0.44	4.30	-	-	12.87
December	2.15	1.71	3.56	2.68	1.94	4.50	-	-	16.54
January	0.91	-	-	-	-	-	1.20	0.80	2.91
February	0.06	-	-	-	-	-	-	1.10	1.16
Total =	3.76	4.57	4.76	6.09	2.38	8.80	1.20	1.90	33.46

Table 4. Vegetables sold by a family at Barind, Rajshahi during rabi 2006-07

Month	Vegetable production/bed (kg/5m^2)						B. gourd	Bean	Total
	Brinjal	R.ama	Spin.	Rad.	B.bean	Batisak			
November	0.59	9.71	3.41	7.41	0.94	6.00	-	-	28.06
December	5.09	4.71	10.00	6.74	4.15	7.30	-	-	37.99
January	1.53	-	-	-	-	-	4.20	3.60	9.33
February	-	-	-	-	-	-	1.60	1.40	3.00
Total =	7.21	14.42	13.41	14.15	5.09	13.30	5.80	5.00	78.38

Table 5. Economic return per homestead at Barind, Rajshahi during rabi 2006-07

Vegetables name	Total vegetable production (kg/bed)	Vegetable price (Tk./kg)	Gross return (Tk.)	Total cost (Tk.)	Net return (Tk.)
Brinjal	23.35	8	186.80	120.00	1398.57
Red amaranth	28.20	5	141.10	(Without	
Spinach	30.94	8	247.52	family labour)	
Radish	33.97	5	169.85		
China cabbage	39.75	5	198.75		
Bush bean	15.45	15	231.75		
Bottle gourd	22.4	7	156.80		
Country bean	15.5	12	186.00		
		Total =	1518.57		

Out put of the project during rabi 2006-2007

1. Due to use of modern varieties the homestead vegetable production has increased.
2. Farmers are being familiar with the BARI released improved vegetable varieties.
3. 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.
4. Women employment has increased which ensure women participation in agricultural activities as well as made positive effect on equity within the family and in community.

5. Consumption of fresh vegetables by the family has been increased and also has changed the consumption habit towards vegetables.
6. Farmers' dependency on local vegetable market has been decreased due to own homestead vegetable production.
7. Above all the nutrition demand of the farmers family is fulfilled as well as they earns some money to sell the products in the local market.

FSRD site, Puspapara, Pabna

Vegetable production: More or less nine production niches of the homestead were brought under cultivation with the suggested vegetables of Goyeshpur model under different farm categories at FSRD site Pushpapara during the rabi season of 2006 to kharif-2 season 2007. It was observed that the production of vegetables was higher at open sunny space in all farm categories. Among the season, more crops and production units were covered in rabi season. The overall production was higher in small farm probably due to their optimum management. Medium farmers were to some extent reluctant because of having some other resources (Table 1a, 1b & 1c). Though marginal farmers have made their best effort but they had resource constraints and probably hence their total production was lower.

Utilization of vegetables: Disposal of different vegetables produced under different farm was recorded regularly. The result indicated that disposal pattern of vegetables varied with farm categories. The intake was higher in small farm over marginal and medium farm. Vegetable intake per day per head was 227.53, 181.61 and 170.62 g for small, marginal and medium farm respectively. The distribution of vegetable was recorded 138.87, 158.27 and 140.19 kg for medium, small and marginal farm category. The vegetables sold by different farm categories were 117.5, 307.33 and 196.33 kg for medium, small and marginal farm respectively. The result clearly indicated that the intake, distribution and sold of vegetables by small farm category was higher followed by marginal farm. 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 in small farm group. Irrespective of farm category, the average total production round the year of an inorganic farm was 691.04 kg and its disposal was 352.69 kg intake, 145.78 kg distribution and 207.05 kg sold respectively (Table 2d).

Income: Total income recorded from medium, small and marginal was Tk.4007, 2908 and 4033 respectively. The net income round the year recorded by medium, small and marginal farmer was Tk.3402, 2303 and 3428 respectively. The net income was higher in marginal and medium farm probably they sold their vegetables with high price (Table 2a, 2b and 2c).

Nutrient uptake: Nutrient uptake especially protein, iron, carotene, vit.B_1 and vitamin C by farm categories through year round vegetable consumption was estimated. Nutrient uptake was varied with different vegetable growing months. Uptake of nutrient was positively correlated with vegetable consumption. Nutrients such as protein, iron, carotene, vit.B_1 and vitamin C uptake by small farmer group was remarkably higher over other farm group probably due to intake of more quantity of vegetables.

Nutrient supplementation: For better growth and development of human body necessary nutrient requirement are to be fulfilled daily. The supplementation of nutrients from the vegetables produced in homestead was estimated. The result showed that the percentage of the requirement of protein supplied from the homestead source was 6.31, 8.82 and 5.32 which was for medium, small and marginal farm categories. The highest percentage of iron and vit.A requirement (90.41 and 91.74) was supplied from homestead vegetable for small farm category which was followed by medium farm group. Probably due to uptake of iron and vitamin A enriched vegetable the supplementation of these two nutrients were comparatively higher. Vitamin C supplementation was also higher in small farm category.

Table 1a. Round the year vegetables production from different niches under inorganic system of medium group farmer at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Space		Rabi (Aasheen-Falgun)	Kharif-1 (Chaitra-Jaistha)	Kharif-2 (Aashar-Bhadra)	Total
Open sunny space	Bed 1	36.58	57.16	27.0	120.74
	Bed 2	52.34	16.82	21.17	89.93
	Bed 3	29.66	15.16	14.18	59.0
Roof top		23.0	-	-	23.0
Trellis		68.83	2.5	11.00	82.33
Shady place		23.82	7	17.5	47.92
Marshy land		21.5	-	-	21.5
Unproductive tree		9.0	16.0	-	25.0
Fence		-	.5	-	.5
Back yard		-	-	-	-
Boundary		81.75	-	-	81.75

Table 1b. Round the year vegetables production from different niches under inorganic system of small group farmer at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Space		Rabi (Aasheen-Falgun)	Kharif-1 (Chaitra-Jaistha)	Kharif-2 (Aashar-Bhadra)	Total
Open sunny space	Bed 1	39.75	90.25	19.666	149.666
	Bed 2	53.166	20.033	14.299	87.498
	Bed 3	36.166	17.866	12.616	66.684
Roof top		17.75	18.5	-	36.25
Trellis		106.333	12.0	30.0	148.333
Shady place		22.0	21.833	54.332	98.165
Marshy land		18.5	-	6.75	25.25
Unproductive tree		6.999	-	-	6.999
Fence		-	8.4	7.25	15.65
Back yard		-	-	-	-
Boundary		88.582	-	2.0	90.582

Table 1c. Round the year vegetables production from different niches under inorganic system of Marginal group farmer at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Space		Rabi (Aasheen-Falgun)	Kharif-1 (Chaitra-Jaistha)	Kharif-2 (Aashar-Bhadra)	Total
Open sunny space	Bed 1	24.958	46.833	29.75	101.541
	Bed 2	47.083	18.166	23.485	88.707
	Bed 3	34.332	21.103	15.958	71.393
Roof top		-	2.5	9.0	11.5
Trellis		66.499	-	-	66.499
Shady place		19.833	14.0	30.999	64.832
Marshy land		30.916	-	16.33	47.246
Unproductive tree		8.15	-	-	8.15
Fence		-	9.17	7.25	16.82
Back yard		3.00	-	20.5	23.5
Boundary		48.582	-	1.0	49.582

Table 2a. Round the year vegetables production and utilization pattern of a medium group farmer under inorganic system at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Benglali 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	53.83	29.18	17	12.5	50.00	262.16		
Jaistha	Indian spinach, Brinjal Lady`s finger, Sweet gourd	31.08	18.69	5.3	4.00	48	291.8		
Aashar	Indian spinach, Brinjal Ladys finger, Sweet gourd,Moulobi Kchu	59.35	47.52	11.8	-	-	366.34		
Sraban	Indian spinach, Brinjal, Ladys finger, gourd, Moulobi Kchu	24.25	20.75	3.5	-	-	171.25		
Bhadra	Brinjal, gourd, Moulobi Kchu	7.25	5.92	1.33	-	-	49		
Aasheen	Papaya, Water taro	23.75	10.75	13	-	-	115.5		
Kartik	Papaya, Water taro	38.67	13.50	5.17	20	120	216.02		
Agrahaon	Spinach, Bottle gourd, Bean, Elephant foot yam, Potato yam, Papaya	59.58	34.58	13.67	11.33	79.98	536.13		
Poush	Raddish, Cabbage, Spinach, Bottle gourd, Elephant foot yam, Papaya, Potato yam	102.58	61.40	26.01	17.16	131.2	900.5		
Magh	Raddish, Cabbage, Bottle gourd, Elephant foot yam, Papaya,	80	38.08	22.42	19.5	19.5	586.12		
Falgun	Cabbage, Tomato, Data, Bottle gourd,, Papaya,	41.5	18.83	7.67	15	45	264.97		
Chaitra	Data, Potato yam	29.83	12.17	12.0	14.66	162.64	247.32		
Total		551.67	311.38 (170.62g/head/day)	138.87	117.5	831.82	4007.1	605	3402.1

Table 2b. Round the year vegetables production and utilization pattern of a small group farmer under inorganic system at FSRD site, Pushpapara, Pabna during April 2006 to March 2007.

Benglali 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, Brinjal, Lady`s finger, Long yard bean, Moulobi Kachu	52.516	25.049	10.882	23.00	156	289.48		
Jaistha	Brinjal, Lady`s finger, Indian spinach, Long yard bean, Sweet gourd, Moulobi Kachu	106.116	54.882	32.150	45.5	210	658.01		
Aashar	Brinjal, Lady`s finger, Indian spinach, Sweet gourd, Moulobi Kachu	81.748	49.244	12.824	44.5	134.5	474.92		
Sraban	Brinjal, Lady`sfinger, Indian spinach, Long yard bean, Sweet gourd, Moulobi Kachu	86.428	20.591	9.333	29.75	93.38	209.41		
Bhadra	Brinjal, Papaya, Moulabi Kachu, Water taro	18.75	14.166	5.25	-	-	92.5		
Aasheen	Brinjal, Papaya, Moulabi Kachu, Water taro	48.333	25.833	9.17	22.00	116	292.99		
Kartik	Papaya, Moulabi Kachu, Water taro, Potato yam, Spinach	43.833	19.666	5.50	18.67	111.99	264.50		
Agrahaon	Raddish, Bottle gourd Papaya, Bean, Potato yam, Spinach, Elephant foot yam	51.365	31.221	9.33	18.17	167.66	167.66		
Poush	Raddish, Bottle gourd Papaya, Bean, Potato yam, Spinach, Elephant foot yam, Cabbage	107.133	62.966	27.58	31.5	358	117.22		
Magh	Raddish, Bottle gourd, Papaya, Bean, Spinach, , Cabbage, Tomato	106.666	61.666	19.17	49.25	459.5	899.62		
Falgun	Bottle gourd, Data, Papaya, Bean, Spinach, , Cabbage, Tomato	58.333	37.416	17.08	15	115	513.99		
Chaitra	Data	30.250	112.5	7.75	10	44	121		
Total		972.467	415.235(227.53g/head/day)	158.27	307.33	1992.03	2907.65	605	2302.65

Table 2c. Round the year vegetables production and utilization pattern of a marginal group farmer under inorganic system at FSRD site, Pushpapara, Pabna during April 2006 to March 2007.

Benglali 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, Indian spinach Brinjal, Lady`s finger, Long yard bean, Moulobi Kachu	28.44	18.52	8.92	1.00	4.00	167.86		
Jaistha	Indian spinach, Brinjal, Lady`s finger, Long yard bean, Moulobi Kachu,Sweet gourd	59.83	32.08	15.25	36.5	241	485.18		
Aashar	Indian spinach, Brinjal, Lady`s finger, Long yard bean, Moulobi Kachu,Sweet gourd	77.42	49.69	19.22	15.67	106.42	568.76		
Sraban	Indian spinach, Brinjal, Lady`s finger, Moulobi Kachu,Water taro, Banana	44.46	23.92	14.38	30.00	75.00	229.96		
Bhadra	Indian spinach, Brinjal, , Moulobi Kachu,Water taro, Banana, Papaya	32.37	20.21	7.75	10.00	40.00	149.9		
Aasheen	Brinjal, , Moulobi Kachu,Water taro, Banana, Papaya	43.42	16.42	8.83	15.67	62.64	144.89		
Kartik	Moulobi Kachu Water taro, Papaya	20.75	10.58	4.83	10.00	60.00	106		
Agrahaon	Raddish, Spinach, Bottle gourd, Bean, Potato yam Elephant foot yam Papaya	52.07	33.33	9.83	23.00	108.00	491.88		
Poush	Raddish, Cabbage, Spinach, Bottle gourd, Bean, Potato yam Elephant foot yam Papaya	67.99	39.49	19.17	18.00	219	646.01		
Magh	Raddish, Cabbage Spinach, Bottle gourd, Bean, Papaya	54.67	35.67	14.42	22.00	160.00	345.14		
Falgun	Data, Cabbage, Tomato, Bottle gourd, Papaya	44.14	30.88	10.42	9.5	36.75	283.89		
Chaitra	Data, Tomato	23.5	14.67	7.17	5.00	20.00	138.00		
Total		549.037	331.44 (181.61g/head/day)	140.19	196.33	1181.92	4033.17	605	3428.17

Table 2d. Round the year mean vegetables production and utilization pattern of a farmer under inorganic system at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Name of Group	Total production (Kg)	Vegetable utilization (kg)			Cash income (Tk)	Total income (TK)	Total cost (TK)	Net income
		Intake	Distribution	Sell				
Inorganic	691.04	352.69 (193.25g/head/day)	145.78	207.05	1335.26	3649.31	605	3044.31

Table 3a. Nutrient intake by a family of medium group farmer under inorganic system at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Benglali month	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B_1 (mg)	Vit-C (mg)
Baishakh	300.24	2606.45	47104.7	28.13	2180.9
Jaistha	345.54	3083.4	4962.38	12.27	4709.5
Aashar	946.04	8628	7055.2	31.4	13407.2
Sraban	453.5	4552.5	4699.6	15.13	3915
Bhadra	142.65	2211.8	721.17	5.9	-
Aasheen	242.75	124.75	840.73	3.15	-
Kartik	306.	157.5	1080.9	4.05	-
Agrahaon	885.75	1238.21	11203.42	12.41	10238.3
Poush	835.04	1038.75	2947.33	20.38	5971.8
Magh	574.52	296.72	1065.63	13.63	1455
Falgun	222.97	120.32	29306.75	4.03	2477.4
Chaitra	42	125.06	23383.5	0.917	917
Total	5296.91	24283.46	134371.31	151.40	45272.1

Table 3b. Nutrient intake by a family of small group farmer under inorganic system at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Benglali month	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B_1 (mg)	Vit-C (mg)
Baishakh	256.5	2430.92	37906.83	26.27	2629
Jaistha	966.6	6172.2	33935.2	39.7	12031
Aashar	887.6	5660.9	35928.2	36.1	10041.2
Sraban	443.99	3363.36	3649.02	15.35	4290
Bhadra	370.98	2152.34	2281.26	11.48	-
Aasheen	610.32	5441.49	1893.53	18.05	-
Kartik	301.65	308.49	1963.26	7.35	-
Agrahaon	631.99	1012.82	3694.79	9.56	7214.42
Poush	1196.02	976.83	13099.6	25.64	7514.14
Magh	1005.82	722.98	10692.67	22.91	5431.14
Falgun	730.52	1232.18	18513	14.82	9924.7
Chaitra	-	225	31875	1.25	1250
Total	7402.04	29699.53	195432.38	228.49	60810.6

Table 3c. Nutrient intake by a family of marginal group farmer under inorganic system at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Benglali month	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B_1 (mg)	Vit-C (mg)
Baishakh	0.2535	2.6643	23.44843	0.21599	1.8618
Jaistha	1.7442	6.1485	33.1209	0.16954	4.98
Aashar	254.4	151.3	2889.8	8.55	840
Sraban	439.48	3625.59	5677.94	57.701	4342.5
Bhadra	442.74	2340.661	3830.97	13.3622	1216
Aasheen	430.23	3523.57	2562.11	13.29	-
Kartik	332.31	176.24	1620.68	6.07	-
Agrahaon	798.56	1169.48	7006.55	12.29	8307.14
Poush	774.79	815.11	8034.67	16.08	6666.25
Magh	654.97	535.48	8702.36	15.58	3668.3
Falgun	335.40	241.33	37286.25	16.83	3075.74
Chaitra	27	221.98	40488.3	4.76	2006.6
Total	4465.54	12817.93	118192.29	165.12	28133.45

Table 4: Percentage of nutrient supplied from a homestead on the basis per head requirements under inorganic system at FSRD site, Pushpopara, Pabna during April 2006 to March 2007.

Farmers categories	% Protein	% Iron)	% Vit-A	%Vit-B_1	%Vit C
1. Medium	6.31	73.92	63.12	7.54	33.08
2. Small	8.82	90.41	91.74	11.38	44.43
3. Marginal	5.32	39.02	55.5	8.22	20.55

Farmers reaction at Pabna

Farmers are more interested to economic crops with high cash return. They are less aware about nutritional need and the contribution of mini production unit (2-3 decimal unused) of homesteads. As the program was production based more motivation needed for them towards consumption and utilizing the potential contribution of the model and safe foods for their health and nutrition.

FSRD site, Lahirirhat, Rangpur

Through homestead gardening intake of vegetable and fruits were largely increased. Additionally most of the farmers free distributed a portion of the products among their neighbor and relatives. Also they sold a small amount to get cash income. Except land preparation and marketing most of the day to works of home gardening were done by female members and children.

01. Head of the household: Mr. Amin Mia (Age-42 years) Occupation : Agriculture

Family description

Sl. no.	Name of family member	Relation with family Head	Age	Marital status	Occupation
01.	Mrs. Sahera Begum	Wife	32	Married	Housewife
02.	Mr. Shahin Mia	Son	13	Un- married	Student
03.	Miss. Ajmira Begum	Daughter	9	Un- married	Student
04.	Miss. Anjuara Begum	Daughter	6	Un- married	Student

Land occupation status. (dec.)

Present own cultivable land	Present own homestead	Present own pond	Others land rented in	Total own land	Remarks
26	10	03	-	**49**	Bamboo bush 10 dec.

Homestead Area

A. Sunny place : 02 dec.	
Before intervention	**After intervention**
Fallow & rice straw heap	**Present status** **Each bed - 8m × 1m** Bed No. 1: Cabbage + Spinach – Okra/Red Amaranth-Amaranth (35kg) (6 kg) (13 kg) (5.5 kg) (17 kg) Bed No. 2: Brinjal + Coriander shak – Amaranth – Red Amaranth (35kg) (4.5 kg) (15 kg) (6 kg) Bed No. 3: Brinjal + Coriander shak – Amaranth – Red Amaranth (35kg) (4.5 kg) (15 kg) (6 kg) Bed No. 4: Tomato + Babuishak - Kangkong – Kangkong (32 kg) (6 kg) (11 kg) (11 kg) Bed No. 5: Tomato + Babuishak - Kangkong – Kangkong (32 kg) (6 kg) (11 kg) (11 kg) Bed No. 6: Cauliflower +Napashak-Jute shak/Red Amaranth- Amaranth (24 kg) (8 kg) (6 kg) (5 kg) (19 kg) Bed No. 7: Cauliflower +Napashak-Jute shak/Red Amaranth-Amaranth (24 kg) (8 kg) (6 kg) (5 kg) (19 kg) Bed No. 8: Cabbage + Spinach – Indian spinach- Red Amaranth (38 kg) (7 kg) (13 kg) (6.5 kg) Bed No. 9: Turnip/Spinach – Indian spinach- Red Amaranth (42 kg) (6 kg) (12.5 kg) (6 kg) Bed No. 10: Chili/Mulashak –Okra/Jute shak- Red Amaranth (12 kg) (10 kg) (13 kg) (7 kg) (7 kg)

B. Partial shady place : 02 dec.	
Zinger & Turmeric cultivation with traditional management	- Zinger & Turmeric cultivation with proper management
C. Fence crop: 30 meter	
Never used	i) Country bean- Ribbed gourd (24 kg) (21 kg*) ii) Country bean- Bitter gourd (10kg) (4 kg*)
D. Roof Top: 4 Nos.	
Before intervention	**After intervention**
i) RT_1: Bottle gourd + Ash gourd (45 kg) (25 kg) ii) RT_2: Country bean + Sweet gourd (24 kg) (42 kg)	Under proper management i) RT_1: Bottle gourd + Ash gourd (105 kg) (74 kg) ii) RT_2: Country bean + Sweet gourd (45 kg) (75 kg)
E. Marshy Land: 15 m^2	
Aroid cultivation with traditional management	Aroid cultivation with proper management (Planting distance and fertilizering)
F. Timber Trees	
Tree : Neem-02; Jigni-10; Mehogoni-02; Pitraj-05 & Korai-01 Without management	Tree under management (Irrigation, Fertilizer, Pest management, Pruning & Training) Sponge gourd on tree
G. Fruit Tree	
Mango-04: 15 kg Black berry-02: 2 kg Jackfruit-02: 100 kg Citrues-01: 35 kg Without management	Under proper management (Pruning, Training, Pest control, Fertilizer and Irrigation) Mango-04: 62 kg Black berry-02: 16 kg Jackfruit-02: 280 kg Citrues-01: 75 kg

H. Pond Bank:	
No use	
I. Ail:	
No use	Papaya production
J. Pond Bank:	Vegetable production using Trailee
Country bean + Ash gourd (21 kg) (35 kg)	Country bean + Ash gourd (36 kg) (62 kg)

* Harvesting going on

Production, Intake, Distribution & Income from Home gardening

A. Vegetables:

Name of vegetable	Total production (kg)	Vegetable utilization (kg)			Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
		Intake (kg)	Distribution (kg)	Sell (kg)			
Cabbage	73	28	05	40	200	265	80
Spinach	19	10	02	07	35	95	15
Red amaranth	35	15	05	15	60	140	40
Amaranth	86	35	15	36	72	172	52
Brinjal	70	40	05	25	100	560	90
Coriander shak	09	03	01	05	100	180	45
Tomato	64	30	05	29	232	512	95
Babui shak	12	05	-	07	35	60	10
Kangkong	44	20	04	20	60	132	40*
Cauliflower	48	10	05	33	264	384	65
Napa shak	16	07	-	09	45	80	15
Jute shak	19	08	-	11	33	57	12
Indian spinach	25.5	12	1.5	12	48	102	22*
Turnip	42	12	05	25	200	336	42
Chilli	12	12	-	-	-	240	40*
Mula shak	10	04	01	05	20	40	05
Okra	26	10	02	14	140	260	40*
Bottle gourd	105	50	10	45	135	315	25
Ash gourd	136	40	15	81	162	272	45*
Sweet gourd	75	30	-	45	135	225	20*
Ribbed gourd	21	09	-	12	96	208	30*
Bitter gourd	04	04	-	-	-	40	10*
Country bean	115	50	05	60	480	920	35
Sponge gourd	20	10	02	08	40	120	10*

*On going

B. Fruits:

Name of fruits	Total production (kg)	Fruits utilization (kg)			Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
		Intake (kg)	Distribution (kg)	Sell (kg)			
Mango	62	26	04	32	640	1240	75
Black berry	16	8	02	06	72	192	30
Jackfruit	280	130	30	120	720	1680	85
Citrus (Pamela)	75	21	09	45	225	375	30

Distribution of labour in Homestead space utilization

Activities	Male (%)	Female (%)	Children (%)
Land preparation	75	10	15
Seeding/planting	20	50	30
Intercultural operation	20	60	20
Harvesting	15	50	35
Cooking	-	100	-
Marketing	50	35	15
Others	-	-	-

02. Head of the household: Mr. Atour Rahman (Age-30 years), Business
Family description

Sl. No.	Name of family member	Relation with family Head	Age	Marital status	Occupation
01.	Mrs. Lovely Begum	Wife	23	-	Housewife
02.	Mr. Sabi Ullah	Father	55	Married	Agriculture
03.	Mrs. Anowara Begum	Mother	45	Married	Housewife
04.	Mr. Delowar Hossain	Brother	20	Un-married	Agriculture
05	Mr. Raju Mia	Nephew	12	Un-married	Student

Land occupation status. (dec.)

Present own cultivable land	Present own homestead	Present own pond	Others land rented in	Total own land	Remarks
12	09	06	00	27	-

Homestead Area

A. Sunny place : 02 dec.	
Before intervention	**After intervention**
Fallow	**Present status** **Each bed - 8m × 1m** Bed No. 1: Cabbage + Spinach – Okra/Red Amaranth-Amaranth (33kg) (7.5 kg) (14 kg) (6 kg) (19 kg) Bed No. 2: Cabbage + Spinach – Okra/Red Amaranth-Amaranth (33kg) (7.5 kg) (14 kg) (6 kg) (19 kg) Bed No. 3: Brinjal + Coriander shak – Amaranth – Red Amaranth (34kg) (4 kg) (18 kg) (6.5 kg) Bed No. 4: Brinjal + Coriander shak – Amaranth – Red Amaranth (34kg) (4 kg) (18 kg) (6.5 kg) Bed No. 5: Tomato + Babuishak - Kangkong – Kangkong (32 kg) (7 kg) (12 kg) (10 kg) Bed No. 6: Tomato + Babuishak - Kangkong – Kangkong (32 kg) (7 kg) (12 kg) (10 kg) Bed No. 7: Cauliflower +Napashak-Jute shak/Red Amaranth-Amaranth (40 kg) (8 kg) (7.5 kg) (6 kg) (21 kg) Bed No. 8: Cauliflower +Napashak-Jute shak/Red Amaranth-Amaranth (40 kg) (8 kg) (7.5 kg) (6 kg) (21 kg) Bed No. 9: Chili/ Red Amaranth –Chili - Amaranth (10 kg) (8 kg) (10* kg) (20 kg) Bed No. 10: Turnip/Coriander shak –Okra/Jute shak - Amaranth (45 kg) (5 kg) (14 kg) (7.5 kg) (22 kg)
B. Partial shady place : 02 dec.	
Fallow	- Zinger and Turmeric
C. Fence crop: 30 meter	
Never used	Ribbed gourd 6 pits with proper management (4 kg*)
D. Roof Top: 2 Nos.	
RT_1: Bottle gourd + Ash gourd (42 kg) (28 kg) RT_2: Country bean+ Sweet gourd (22 kg) (35 kg) RT_3: No crop	RT_1: Bottle gourd + Ash gourd (95 kg) (68 kg*) RT_2: Country bean + Sweet gourd (50 kg) (60 kg*) RT_3: Bottle gourd + Ash gourd (75 kg) (50 kg*)
E. Marshy Land: 01 decimal	
Aroid cultivation without management	Aroid cultivation with proper management (Planting distance and fertilizer)
F. Timber Trees	
Neem-40; Jigni-01; Korai-01 & Mehogoni Without management	Tree under management (Irrigation, Fertilizer, Pest management, Pruning & Training) Sponge gourd on tree

G. Fruit Tree	
Jackfruit-4, Mango-4, Guava-1, Pamalo-4, Olive-2, Lemon-1, Battle nut-7, Litchi-1, Coconut-1 & Kamranga-1 without management	Under proper management (Pruning, Training Pest management, Fertilizer and Irrigation)
H. Pond bank	
I. Ali crop	
No used	Papaya production fruit setting stage

* Harvesting going on

A. Production, Intake, Distribution & Income from Home gardening

Name of vegetable	Total production (kg)	Vegetable utilization (kg)			Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
		Intake (kg)	Distribution (kg)	Sell (kg)			
Cabbage	66	30	05	31	155	330	65
Spinach	15	08	02	05	25	75	15
Red amaranth	45	23	03	19	76	180	83
Amaranth	119	59	10	50	100	238	58
Brinjal	68	42	-	26	208	544	50
Coriander shak	13	03	01	09	180	260	25
Tomato	64	39	05	20	160	512	70
Babui shak	14	08	-	06	30	70	12
Kangkong	22	10	-	12	36	66	25*
Cauliflower	80	25	05	50	400	640	75
Napa shak	16	08	-	08	40	80	15
Jute shak	22.5	7.5	-	15	45	67.5	12
Turnip	45	17	05	22	176	360	40
Chilli	20	20	-	-	-	400	48*
Okra	28	14	02	12	120	280	45*
Bottle gourd	170	80	15	75	225	510	40
Ash gourd	118	50	09	59	118	236	42*
Sweet gourd	60	30	-	30	90	180	25*
Country bean	50	30	05	15	120	400	18
Sponge gourd	18	10	-	08	40	90	10*

*On going

B. Fruits:

Name of fruits	Total production (kg)	Fruits utilization (kg)			Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
		Intake (kg)	Distribution (kg)	Sell (kg)			
Mango	95	50	05	40	800	1900	120
Guava	20	12	02	06	60	120	30
Jackfruit	320	150	40	130	780	1920	90
Coconut	72	45	05	22	220	720	60
Citrus (Pamela)	105	40	10	55	275	525	20

Distribution of labour in Homestead space utilization

Activities	Male (%)	Female (%)	Children (%)
Land preparation	55	30	15
Seeding/planting	40	40	20
Intercultural operation	30	55	15
Harvesting	15	65	20
Cooking	-	100	-
Marketing	50	35	15
Others	-	-	-

03. Head of the household: Mrs. Rina Parvin (Age-22 years) Occupation: Housewife
Family description

Sl. No.	Name of family member	Relation with family Head	Age	Marital status	Occupation
01.	Mrs. Abeda Khatun	Mother in law	48	Married	Service
02.	Mr. Ashraful Islam	Husband	26	Married	Brickfield labour
03.	Mr. Ariful Islam	Brother in law	17	Un-married	Labour
04.	Mr. Raisul Islam	Son	03	Un-married	-

Land occupation status. (dec.)

Present own cultivable land	Present own homestead	Present own pond	Others land rented in	Total own land	Remarks
20 (Bamboo)	07	00	00	27	-

Homestead Area

A. Sunny place : 02 dec.	
Before intervention	**After intervention**
Fallow	**Present status** Each bed 6 m × 1 m Bed No. 1: Brinjal+ Red Amaranth-Red Amaranth-Amaranth (30 kg) (5 kg) (8 kg) (14 kg) Bed No. 2: Chili+ Spinach– Okra +Jute shak– Red Amaranth (4 kg) (5 kg) (10 kg*) (5 kg) (14 kg) Bed No. 3: Turnip + Coriander shak-Indian spinach-Amaranth (15 kg) (3 kg) (8 kg*) (15 kg) Bed No. 4: Tomato+ Napa shak + Kangkong – Kangkong (20 kg) (6 kg) (10 kg*) (7 kg*)
B. Partial shady place : 1 dec.	
Fallow	- Turmeric and Zinger with proper cultivation
C. Fence crop: 36 meter	
Never used	Ribbed gourd 6 pits with proper management (11 kg)
D. Roof Top No. 3	
RT_1: Bottle gourd + Ash gourd RT_2: Bottle gourd + Sweet gourd RT_3: No crop	RT_1: Bottle gourd + Ash gourd (85 kg) (30 kg) RT_2: Bottle gourd + Ash gourd (50 kg) (23 kg) RT_3: Bottle gourd + Sweet gourd (50 kg) (32 kg)
E. Marshy Land: 01 decimal	
Aroid cultivation with proper management	Aroid cultivation with proper management (Fertilizer & distance)
F. Trailee	
RT_1:Country bean + Sweet gourd RT_2: Bottle gourd + Sweet gourd without management	With proper management under Trailee cultivated RT_1: Country bean + Sweet gourd (35 kg) (28 kg) RT_2: Bottle gourd + Sweet gourd (50 kg) (30 kg) Zinger & Turmeric cultivation with proper management
G. Timber Trees	
Neem-06 Without management	Tree under management (Irrigation, Fertilizer, Pest management, Pruning & Training) Sponge gourd on tree
H. Fruits trees	
Mango: 02, Jackfruit: 01, Olive: 01, Guava: 01 & Dalim: 01	

- **Yield in parenthesis ( ) * + Harvesting going on**

A. Production, Intake, Distribution & Income from Homestead area

Name of crop	Total production (kg)	Intake (kg)	Utilization (kg) Distribution (kg)	Sell (kg)	Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
Brinjal	30	30	-	-	-	240	35
Red amaranth	20	16	04	-	-	80	10
Spinach	05	05	-	-	-	25	05
Turnip	15	12	03	-	-	120	05
Coriander shak	03	01	-	02	40	60	10
Indian spinach	08	08	-	-	-	32	08*
Tomato	20	14	02	04	32	160	25
Okra	10	05	-	05	50	100	18*
Napa shak	06	05	01	-	-	30	06
Kangkong	17	10	02	05	15	51	10*
Jute shak	05	05	-	-	-	15	5
Chilli	04	04	-	-	-	80	10*
Bottle gourd	235	125	20	90	270	705	85
Sweet gourd	90	42	10	38	114	270	75*
Ash gourd	53	31	05	17	34	106	25*
Amaranth	29	16	05	08	16	58	15
Country bean	35	19	05	11	88	280	50
Sponge gourd	20	10	01	09	45	120	12*

*On going

B. Fruits:

Name of fruits	Total production (kg)	Fruits utilization (kg)			Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
		Intake (kg)	Distribution (kg)	Sell (kg)			
Mango	60	40	05	15	300	1200	80
Guava	25	15	03	07	70	250	25
Jackfruit	120	80	10	30	180	720	45
Olive	08	04	01	03	36	96	15
Kamranga	20	15	05	-	-	160	10
Dalim	30	20	04	06	60	300	25

Distribution of labour in Homestead space utilization

Activities	Male (%)	Female (%)	Children (%)
Land preparation	25	75	-
Seeding/planting	-	100	-
Intercultural operation	-	100	-
Harvesting	-	100	-
Cooking	-	100	-
Marketing	-	100	-
Others	-	-	-

Conclusion

A lot of mature technologies are going to intervene in selected households according to their need. A good impact has created among the farmers to adopt the modern technologies in homestead area of agriculture. It was observed that the applied technology had spread to the neighboring farmers also. A considerable amount of net income has increased through the adoption of technologies. Side by side the food habit of farm families is also changing day by day in positive way.

Sustainability of the program

Sl. No.	Area of consideration	Impacts created
01.	Income	- Net income is increasing considerably - Use modern varieties - Use more area of homestead for cultivation/ production
02.	Family nutrition	- Consumption of vegetables and fruits increased - Change consumption habit - Reduced disease infestation
03.	Resource use pattern	- Introduction of new crops - Homestead area utilized properly - Use of farm yard wastage
04.	Education and knowledge	- Increased knowledge of family member
05.	Social status	- Social status increased - Improved mental strength - Increased acceptability to people
06.	Micro environment	- Household waste used for composting - New plantation improve environment - Irrigation to crop and trees improve environment
07.	Others	- More utilization of family labor - Improve the cattle health

Problems encountered in Pabna

1. Tidious, laborious and continuous work, needing skills in production techniques of huge number of crops. Needs one/two year of practice to start as a regular work by farmers.
2. Women farmers were not ready to cooperate spontaneously with the male scientific assistants in the implementation process.
3. Creeper crop got less emphasizes with lack in adequate amount of organic matter, size of pit, fertilization and other cares.
4. Long drought and water scarcity drastically reduced production of many crops like brinjal, okra, bitter gourd etc.
5. Lack in easy analytical tool to interpret data comfortably. (Needs a computer programming on Analysis of results)

Limitations at Barind

i) Quality seed of improved variety is not available to the farmers.
ii) Usually farmers collect the seed of local variety from the local market
iii) Drought and high temperature hampered the program.
iv) Lack of sufficient water for growing vegetables in drought season.
v) Most of the cowdung is being used as cooking fuel due to severe fuel crisis in the Barind area.
vi) Lack of proper knowledge in preparing compost.

Opportunity

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

Farm Level Production of Active Compost with Homestead and Poultry Waste and Its Application for Safer Fruits and Vegetable in Homestead

Abstract

A study was undertaken at Farming Systems Research and Development (FSRD) site, Pushpapara, Pabna for testing possibility of growing homestead crop production under organic system. The conventional method of crop production under Goyeshpur model was carried out during April 2006 to March 2007. The result revealed that except Bhadra and Asheen in all other months each category of farm had a surplus vegetable production. In terms of nutrition (per head of a 5 members family) surplus amount of Vitamin A were obtained, while 12.86%, 72.16%, 116.28%, 20.7%, 39.27% for marginal farmers group, 8.85%, 74.12%, 146.34%, 38.87%, 42.05% for small farmers group and 5.03%, 70.62%, 76.98%, 73.79%, 29.67% for medium farmers group of protein, iron, vitamin A, vitamin B1 and vitamin C respectively were available. In a year, the mean of 3 group of farmer's total income was 8.51 times higher than production cost. Besides those this type of homestead utilization had a profound impact on the health of family members, as well as supply of fresh and safe organic vegetables in the local market.

Introduction

There are many production technologies under way for organic farming with different types of crops including vegetables. A high efficiency composting method has been developed and no yield loss was experienced under organic condition, even with its lowest dose of 7.5 tons per hectare for modern rice and stem amaranth. The lands are gradually improved in quality and normally no risk involved with organic production systems. The demand and price of organic produce is always higher in world market including Bangladesh. But for getting a good price a market demand need to be created. Thus some organic produce must go to market and there should be a continuous supply in the market to create a persistent demand. On the other hand, since it needs about three years under consecutive organic cropping to get accreditation for acceptance to international markets as organic food. Local people should consume the produce of the interim period. Thus as a step for popularizing organic farming technologies and creating the market for its produce some production program was essential. Now, homestead is the easiest environment with rich soil to start with organic. Per day at least 200 g of vegetable is needed for an adult man/woman where as Bangladeshi people are consuming only around 30 g/day (except potato and sweet potato). About 30 thousands children are becoming blind each year for vitamin A deficiency. Vitamin C. iron and other mineral nutritional deficiency are widespread resulting in different types of diseases, hampering physical growth and retarding brain development.

Homestead contains most of the common fruits and vegetable, which meet up most part of daily needs and are responsive to organic fertilizers. Therefore, a production program with a total homestead production system under organic farming was under taken at FSRD site, Pushpapara, Pabna.

Objectives

i. To evaluate possibility of conversion to organic system of currently chemical based homestead agriculture under local condition
ii. To popularize organic agriculture and create market opportunities
iii. To increase income and improve family nutrition

Materials and Methods

The Goyeshpur model of homestead utilization system was followed. It included nine production units under following patterns

	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.	Trelli	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)

Initiative of homestead farming has been taken very recently at FSRD site Pushpapara, Pabna. Before initiation of the homestead program a bench marks survey was carried out to identify the resource base and potentials of different farm categories. It was generally observed that the farmers of the locality had no concept about Goyeshpur model for year round vegetable production and organic farming. However, finally 15 farmers were selected for the program. The selected farmers were categorized as under organic management group. The crop was selected according to the preference of the farmers through participatory innovation method. Training was provided on vegetable and fruit production following the Goyeshpur model and compost preparation at farmers' level for better cooperation among the group farmers two farmer leaders were selected for group management and input supply and information dissemination. The FSRD team provided technical assistance to the co-operator farmers for compost preparation, method of application, and other cultural management under organic homestead farming. The crops were grown at homestead under organic management during the rabi season 2005-06. The data were recorded and analyzed as par farm categories.

Results and Discussion

Crop yield: The output of the model harvested during the period April 2006-March 2007 has been presented in Table- 1a, 1b and 1c. For a family of five each group of farm produced a good amount of vegetable in all the months except Bhadra (Fig. 1a, 1b and 1c). Higher amount of vegetables were harvested during the month of Poush to Magh month from all group of farm (Fig. 1a, 1b and1c). The highest amounts of vegetables harvested from open sunny place were 312.91, 366.00 and 263.20 kg under marginal, medium and small farm respectively. The result indicated that the production of vegetables was higher at open place than that of other places for all categories of farm. It was also observed that the total production of vegetables was higher in small farm category than that of marginal and medium farm might be due to intensive management and utilization of homestead area with utilization of own labour.

Vegetable intake by family members: The highest intake 398.42 kg was observed in small farm group and the lowest was 251.6 kg in medium farm group (Fig. 2a, 2b and 2c).Average intake by a farm family was 341 kg per year (Fig. 2d). The highest 218.31 gm/day /person were intake by the small farm group and the lowest 137.86 gm/day /person in the medium farm group (Table 2a, 2b and 2c).

Nutrient intake by family members: The highest different nutrients intake were observed in small farm group and the lowest were in medium farm group (Table- 2a,2b and 2c). In terms of nutrition (per head of a 5 members family) surplus amount of Vitamin A were obtained, while 12.86%, 72.16%, 116.28%, 20.7%, 39.27% for marginal farmers group, 8.85%, 74.12%, 146.34%, 38.87%, 42.05% for small farmers group and 5.03%, 70.62%, 76.98%, 73.79%, 29.67% for medium farmers group of protein, iron, vitamin A, vitamin B_1 and vitamin C respectively were available (Fig. 3a, 3b and 3c). The highest percent of nutrient supplied by a homestead per head per day were in small farm family (Fig. 3b).

Cash income: The highest cash money of Tk. 3138 per family was observed in marginal farm group which was liquid cash in hand over the year and had a good contribution towards mitigation of day to day family needs (Fig. 4a, 4b and 4c).The mean total income, net benefit and cash income of a farm family were Tk.5152, Tk.4546 and Tk.2285 respectively (Fig. 4d).

Farmers reaction

Farmers are more interested to grow economic crops with high cash return. They are less aware about nutritional need and the contribution of mini production unit (2-3 decimal unused) of homesteads. As the program was primarily family nutrition based, more motivation is needed for them for increased consumption of safe foods for their health and nutrition.

Impact at farmers level

- ⇒ Meet up the daily required vegetables
- ⇒ Fulfill nutrition
- ⇒ Cash generation
- ⇒ Employment opportunity
- ⇒ Learn scientific vegetables, fruit, production technologies
- ⇒ Create friendly environment
- ⇒ Entrepreneurship development at local level.
- ⇒ Development of market channel
- ⇒ Development of service provider at village level

Opportunity created from the program

1. Supplementary support for the mandatory activities
2. Capacity building of staff member
3. Formulation of farmers need based program/ activities
4. Access to learn farmers group based approach for technology transfer
5. Opportunity to know the farmers real problems.
6. Participatory technology development innovation
7. Give continuous effort for livelihood development, So that farmers can solve their problem by themselves

Conclusion

The crops are now being grown with organic inputs from farmer's own source. ARS, Pabna collaboration with IC-SAAKTI arranged the training program to the cooperator farmers for learning the cultivation technique, nutritional deficiency, its remedies and compost preparing method.

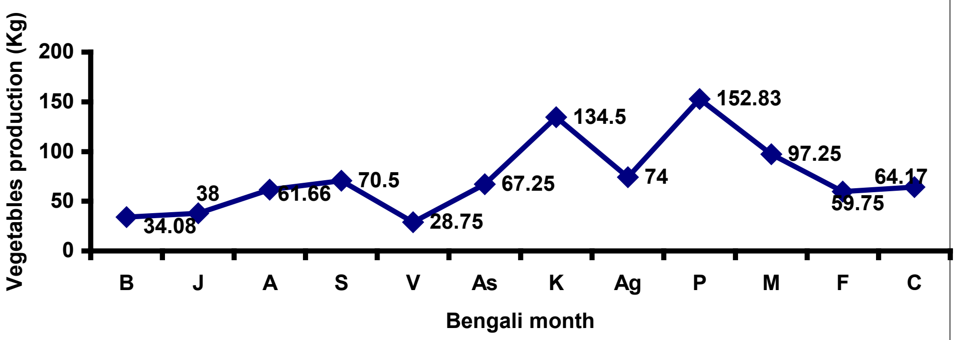

Fig.1a: Round the year vegetables production in the homestead area(marginal group)

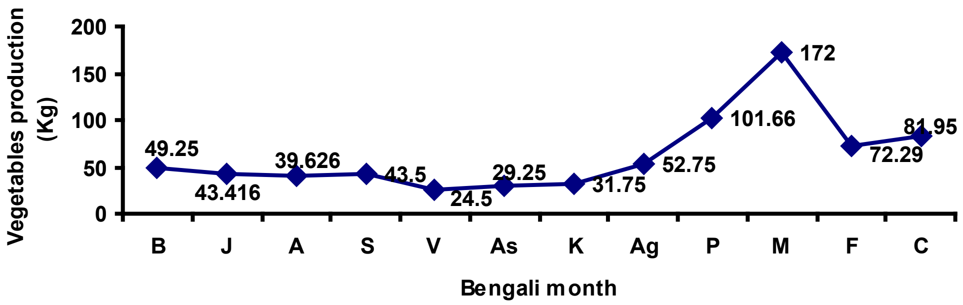

Fig.1b: Round the year vegetables production in the homestead area(small group)

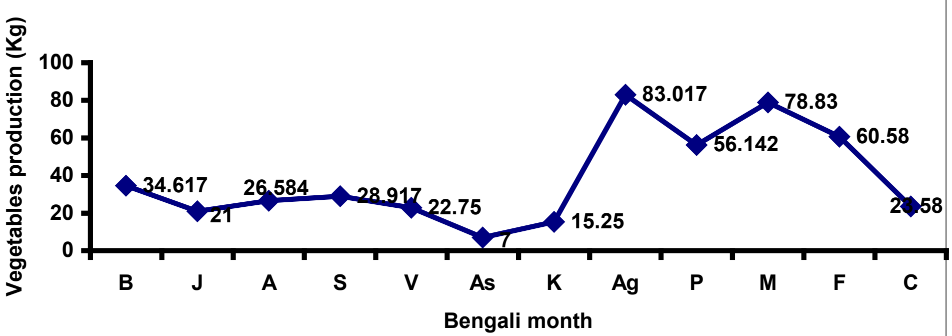

Fig.1c: Round the year vegetables production in the homestead area(medium group)

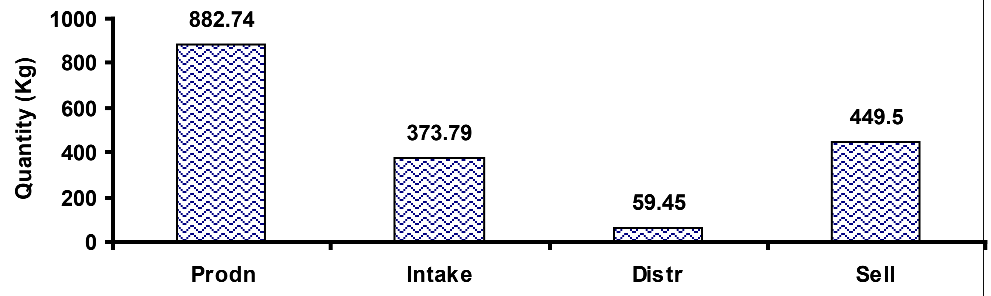

Fig.2a: Yearly disposal pattern of homestead vegetables (marginal group)

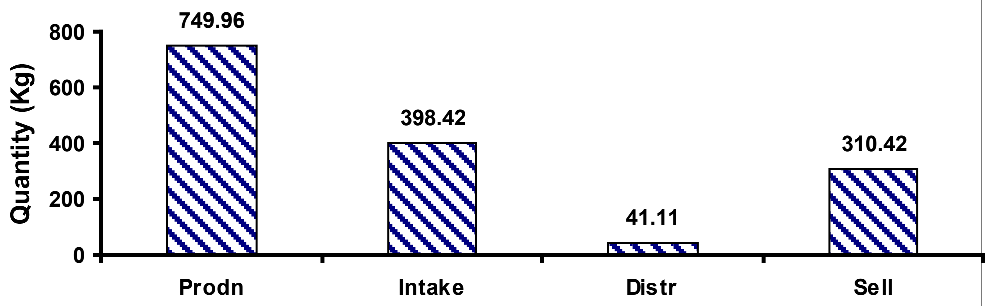

Fig.2b: Yearly disposal pattern of homestead vegetables (small group)

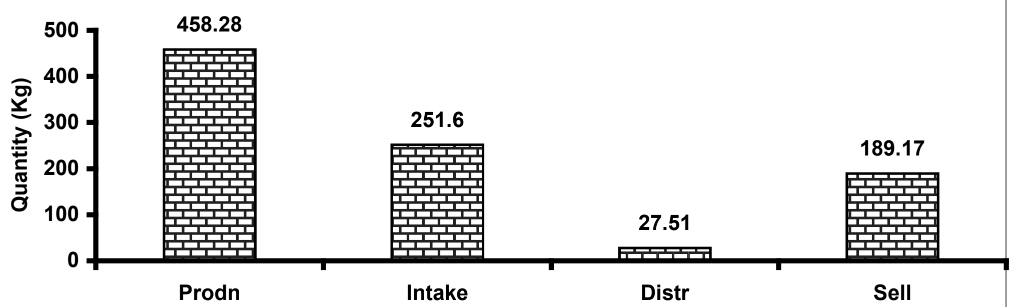

Fig.2c: Yearly disposal pattern of homestead vegetables (medium group)

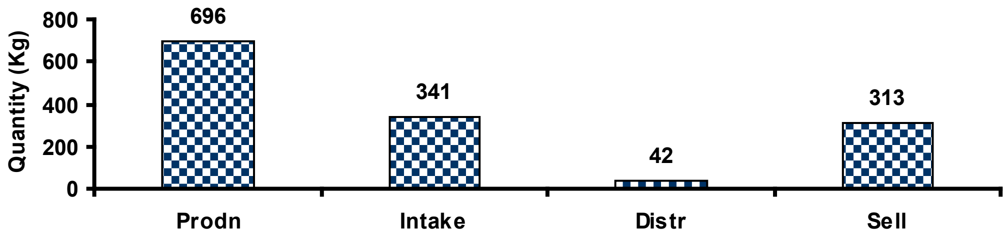

Fig.2d: Yearly mean disposal pattern of homestead vegetables (mean of organic group)

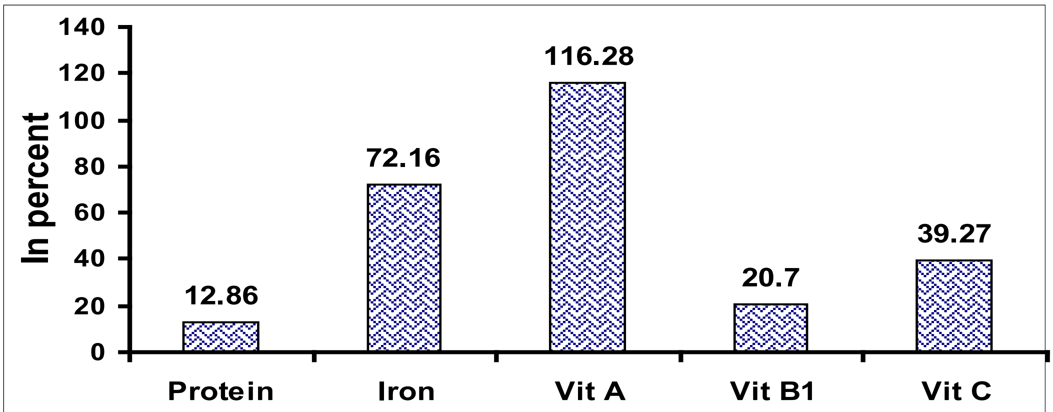

Fig.3a: Percentage of nutrient supplied from a homestead on the basis of per head per day requirements (marginal farmers group)

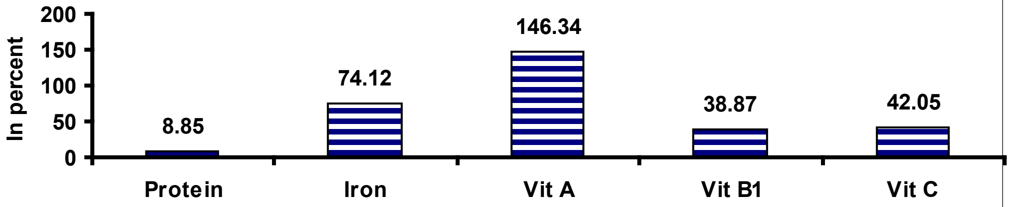

Fig.3b: Percentage of nutrient supplied from a homestead on the basis of per head per day requirements (small farmers group)

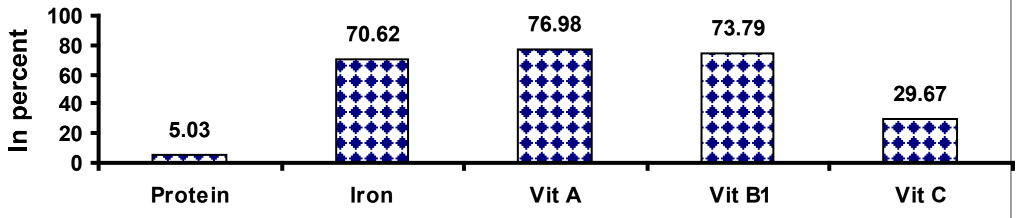

Fig.3c: Percentage of nutrient supplied from a homestead on the basis of per head per day requirements (medium farmers group)

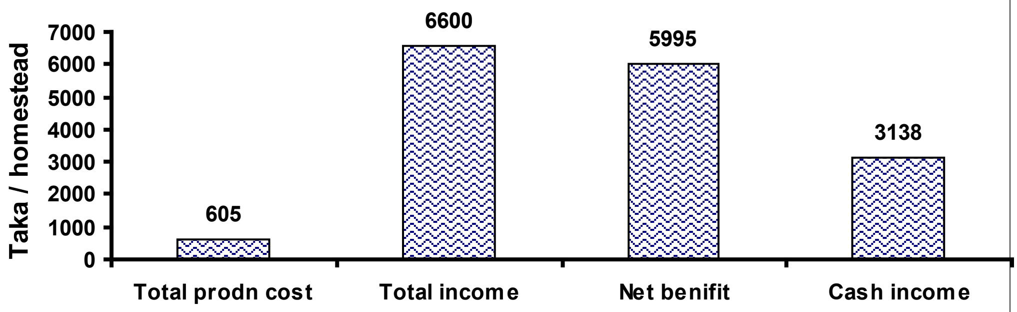

Fig.4a: Yearly cost and return from a homestead vegetables area (marginal group)

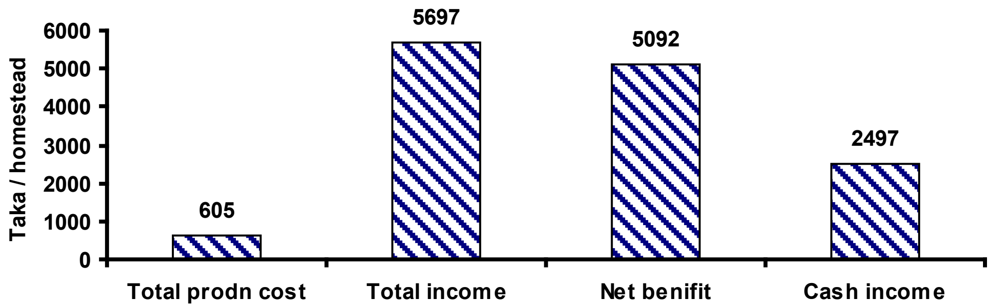

Fig.4b: Yearly cost and return from a homestead vegetables area (small group)

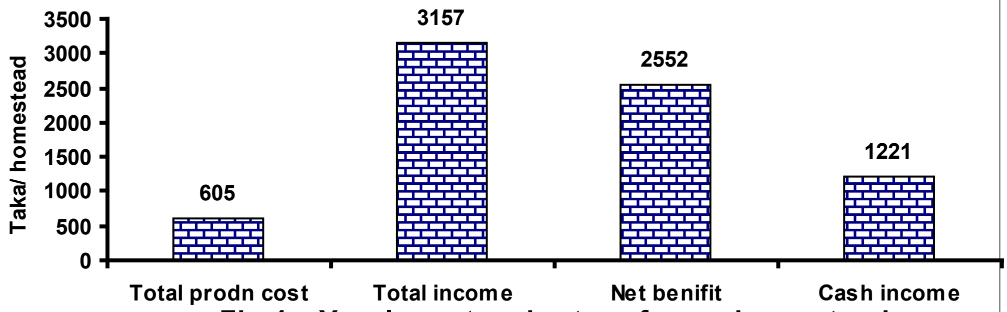

Fig.4c: Yearly cost and return from a homestead vegetables area (medium group)

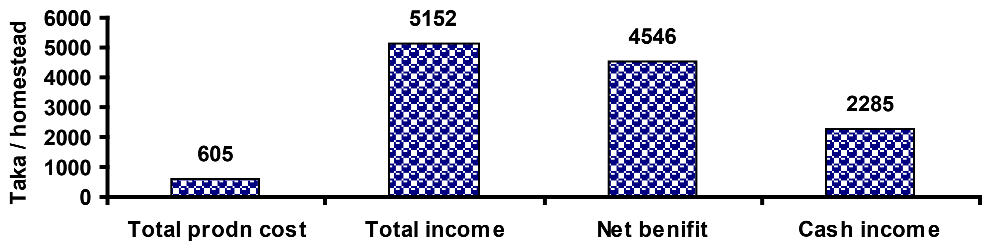

Fig.4d: Yearly mean cost and return from a homestead vegetables area (mean of organic group)

Table 1a. Round the year vegetables production from different niches under organic system at FSRD site, Pushpopara, Pabna during April 2006-March2007 (marginal group farmer)

Space		Rabi (Aasheen-Falgun)	Kharif-1 (Chaitra-Jaistha)	Kharif-2 (Aashar-Bhadra)	Total
Open sunny space	Bed 1	43.33	58.0	30.91	13224
	Bed 2	51.25	16.83	16.0	84.08
	Bed 3	49.92	36.42	10.25	96.59
Roof top		-	-	-	-
Trellis		134.25	18.5	21.5	178.25
Shady place		33.08	-	10.75	43.84
Marshy land		78.0	-	-	78.0
Unproductive tree		30.0	-	-	30.0
Fence		-	65	6.5	13.0
Back yard		88.0	-	-	88.0
Boundary		48.5	-	65.0	113.5

Table 1b. Round the year vegetables production from different niches under organic at FSRD site, Pushpopara, Pabna during April 2006-March2007 (small group farmer).

Space		Rabi (Aasheen-Falgun)	Kharif-1 (Chaitra-Jaistha)	Kharif-2 (Aashar-Bhadra)	Total
Open sunny space	Bed 1	42.5	74.333	40.833	157.666
	Bed 2	72.375	20.5	12.167	105.042
	Bed 3	45.916	34.0	23.375	103.291
Roof top		29.0	-	-	29.0
Trellis		86.25	14.0	-	100.25
Shady place		73.666	-	15.0	88.666
Marshy land		-	-	-	-
Unproductive tree		29.5	-	-	295
Fence		-	31.792	3.25	35.042
Back yard		-	-	-	-
Boundary		88.5	-	13.0	101.5

Table 1c. Round the year vegetables production from different niches under organic system at FSRD site, Pushpopara, Pabna during April 2006-March 2007 (medium group farmer)

Space		Rabi (Aasheen-Falgun)	Kharif-1 (Chaitra-Jaistha)	Kharif-2 (Aashar-Bhadra)	Total
Open sunny space	Bed 1	43.084	49.833	35.334	128.251
	Bed 2	61.0	10.284	17.0	88.284
	Bed 3	30.416	6.833	9.417	46.666
Roof top		-	-	-	-
Trellis		75.25	-	-	75.25
Shady place		18.375	-	11.0	29.375
Marshy land		-	-	-	-
Unproductive tree		7.95	-	-	7.95
Fence		.5	12.25	-4.5	17.25
Back yard		-	-	-	-
Boundary		64.25	-	1.0	65.25

Table 2a. Vegetables and nutrient intake by a family of under organic system at FSRD site, Pushpopara, Pabna during April 2006-March 2007 (marginal group farmer)

Benglali month	Vegetable intake (kg)	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B1 (mg)	Vit-C (mg)
Baishakh	22.00	303	2526.75	22663.7	13.15	3422.5
Jaistha	23.25	309.5	6435.75	3292.40	135.48	4122.1
Aashar	38.91	4840.3	5827.2	30356.25	142.30	10476.2
Sraban	41.00	772	4532.5	2737.97	20.77	5090
Bhadra	18.75	345.5	176.75	781.1	6.37	1440.0
Aasheen	17.13	399.72	208.17	1621.03	6.07	-
Kartik	25.25	652.75	716.75	2782.22	10.35	4365.0
Agrahaon	29.84	742.07	1165.85	7664.42	14.32	10021.8
Poush	61.83	1355.4	1171.11	31003.3	30.197	6171.35
Magh	45.25	714.25	454.65	20730	17.77	2270
Falgun	23.25	253.25	148.25	24030	6.125	2375
Chaitra	27.33	105	340.98	70281.5	2.733	3993
Total	373.79 (204.82g/head/day)	10792.74	23704.67	247574.92	415.669	53746.95

Table 2b. Vegetables and nutrient intake by a family under organic system at FSRD site, Pushpopara, Pabna during April 2006-March 2007 (small group farmer)

Benglali month	Vegetable intake (kg)	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B1 (mg)	Vit-C (mg)
Baishakh	23.25	256.29	3072	35784.5	42.66	5601
Jaistha	25.00	492.5	6953	8687.61	18.00	7210.7
Aashar	25.292	514.5	6335.8	6908.16	14.95	9686
Sraban	16.5	360	319	4279.1	7.90	3595.00
Bhadra	14.5	1213.2	200.9	4000.42	8.12	550
Aasheen	16.75	294.5	144.7	540.85	2.62	24
Kartik	18.25	311.5	152.5	540.85	2.77	300
Agrahaon	32	392.7	1137.65	5770.82	10.54	8610.00
Poush	66.08	1580.5	2845.5	4749.3	25.54	7266.6
Magh	83.166	119.7	792.5	35136.2	115.92	3652
Falgun	32.041	305.2	873.6	43014	6.93	3644
Chaitra	45.583	187.2	721.4	162145	524.53	7413
Total	398.415 (218.31g/head/day)	7427.79	24348.25	311550.82	780.49	57552.30

Table 2c. Vegetables and nutrient intake by a family under organic system at FSRD site, Pushpopara, Pabna during April 2006-March 2007 (medium group farmer)

Benglali month	Vegetable intake (kg)	Protein (gm)	Iron (mg)	Carotene (microgram)	Vit-B1 (mg)	Vit-C (mg)
Baishakh	16.867	143.85	1832.58	32990.85	52.7	6588
Jaistha	17.001	248.65	6350.38	24417.04	1237.93	3253.51
Aashar	19.417	311.17	5079.37	2565.46	117.84	4946.09
Sraban	13.083	291.49	3043.67	2268.83	588	3427.5
Bhadra	10	238	3837.75	3726	6.45	1920
Aasheen	4.083	76.82	607.66	24685.27	3.37	-
Kartik	13.125	301.75	383.82	1043	4.21	379.25
Agrahaon	34.351	673.35	945.98	1851.50	11.06	7768.68
Poush	28.975	424.8	336.42	633.02	8.89	2660
Magh	45.58	624.23	366.49	1867.71	18.27	2740.73
Falgun	33.25	889.82	1128.83	34777.66	9.03	3195.74
Chaitra	15.87	64.75	286.50	37080.8	3.24	3736.7
Total	251.60 (137.86 g/head/day)	4223.98	23199.49	163861.95	1481.61	40616.2

Improved Adaptive Capacity to Climate Change for Sustainable Livelihoods in the Agricultural Sectors: BARI-FAO Collaborative Program

Program 1: Homestead Vegetable Gardening

Introduction

High Barind Tract (HBT) is situated in the northwestern Rajshahi division of Bangladesh. This region has a distinct physiography of terraced lands at about 30 m above sea level situated at latitude 24° 25′ to 25° 10′ N and longitude 88-89° E. The region experienced high temperature with limited soil moisture storage along with low and erratic rainfall. Moreover no river/water bodies are present within the HBT. Also vegetation is scanty compared to other parts of the country. These situations make the area drought prone along with poor crop productivity. Thus the areas livelihood is often vulnerable to climate change particularly to drought.

Homesteads are the resources that provide major share of livelihood especially for poor and marginal farmers. The farmer of droughty area faces from food and nutrition insecurity due to low production of vegetables, rice and other crops because of low organic matter, water scarcity and high temperature. Those resource poor farmers get about 50% of their food and cash from homestead. On-Farm Research Division, Barind, BARI, Rajshahi has developed a year round homestead vegetable production technology which known as “Barind Model”. The model comprises locally adapted low water requiring vegetables and other quick growing vegetables. It should be disseminated to all over the Barind area to ensure farm family nutrition and sustainable livelihoods. In this context FAO funded pilot production program of homestead vegetable gardening was undertaken in four Upazilas of High Barind Tract viz. Nachole, Gomastapur (Nawabgonj), Porsha and Shapahar (Naogaon) during the period from January 2006 to March 2007.

Program objectives

(i) To utilize maximum resources of the homestead for growing vegetables
(ii) To enhance intake of vegetables for ensuring family nutrition and sustainable livelihoods
(iii) To increase cash income and facilitates women empowerment

Methodology

The study was undertaken in four different locations of High Barind Tract viz. Nachole, Gomostapur, Porsha and Shapahar during the kharif-I, kharif-II seasons of 2006 and rabi season of 2007 to intensify the use of homestead spaces for increased vegetable production and to meet the demand of family nutrition. A total of twelve households (three household from each location) were selected mostly from small, marginal and landless group of farmers. The selection of farmers was made on the basis of homestead suitability for vegetable production and eagerness and cooperativeness of the farmers. The farmers’ were selected BARI scientists in collaboration with DAE personnel through on spot visit. Farmers’ homestead available resources, needs and choice assessment were done with active participation of the family members (both male and female) through discussion between BARI scientists, farmers, DAE and FAO personnel. The year round homestead production pattern known as “Barind Model” was applied in this regard (Table 1). OFRD supplied the critical inputs like fruit and vegetable seed/seedlings, nylon net (for fencing), watering cane etc. Primarily, the seeds were supplied on free of cost to the farmers with condition to produce and preserved it for next year use. BARI scientists made regular monitoring and visit in every household. The data on total production and disposal patterns per homestead were collected and documented carefully. Other qualitative and quantitative data were recorded on the basis of field observation and conversation with the farmers, particularly with the women.

Table 1. Space utilization by year round vegetables cultivation at farmers' homestead area under "Barind Model" during 2006-2007

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	Jute leaf (*Pat Shak*)
Bed-4	China cabbage (*Batishak*)	Okra + Red amaranth	Onion + 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/Boundary	Country bean	Bitter gourd, yardlong 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	-

Results and Discussion

Data presented in Table 1 found that intake of vegetable increased to a significant level (on the average 136 g/h/day instead of 40 g/h/day bench mark), which helped the farmers to meet the demand of vegetables and to reduce the daily expenditure of vegetable purchase. Though the intake of 136 was below 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. Actually yield of vegetable was reduced in rabi season due to serious water crisis/drought and farmers engagement in T.Aman rice harvesting and processing. 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.

From house to house enquiry it was found that most of the sell proceeds were kept by women and they used this money for children education and for meeting small needs. In the homestead new leafy vegetables like Kangkong and Batisak (Chinese cabbage) were introduced, these two crops produced good amount of biomass in comparison to water requirement (i.e. water efficient). For drought prone area, water use efficiency of the selected vegetable would preferably be high to adapt with the local conditions. Moreover locally adapted stem amaranth (*Katua danta*) was also grown, which was also well adapted to low soil moisture and high temperature.

From Table 2 it was observed that except land preparation and marketing, all other works were done by women and children. Thus it created women employment, as well as empowerment. Moreover, on daily basis they took fresh, nutritious and poison free vegetables. Farmers were keeping some vegetable seeds for the next year production.

Table 1. Average vegetable production and disposal pattern in kharif and rabi seasons at four upazilas of HBT during May 2006- March, 2007

Location	Total vegetable production (kg/homestead)	Total own consumption (kg)	Own consumption (g/head/day)*	Free distribution (kg)	Sold (kg)	Total cash income (Taka)
Porsha	320	272 (85)**	165	35 (11)	13 (4)	156
Shapahar	259	205 (79)	124	15 (6)	39 (15)	468
Nachole	330	218 (66)	132	33 (10)	79 (24)	948
Gomastapur	257	198 (77)	120	41 (16)	18 (7)	216
Mean	292	225 (77)	136	29 (10)	38 (13)	456

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

Table 2. Average work distribution among the family members for the homestead vegetable production, High Barind Tract, Bangladesh, 2006-07

Sl. no.	Operations	Men	Women and children
1.	Land preparation	98	2
2.	Seed/seedling sowing	60	40
3.	Intercultural operations	15	85
4.	Harvesting	08	92
5.	Cooking	0	100
6.	Marketing	81	19

Limitations

- Quality seed of improved variety is not available to the farmers.
- Drought and high temperature hampered the program.
- Lack of sufficient water for growing vegetables in dry season (February-May).
- Most of the cowdung is being used as cooking fuel not as manure, due to severe fuel crisis in the Barind area.

Future plan

- Women empowerment and socio-economic condition of the farmers is in will be increased
- The project should be continued for sustaining the ‘‘year round homestead vegetable production technology’’.
- The program should be extended in other locations of Barind area to ensure the family nutrition of poor farmers’ family to make them ready with the changing climate.

Research need

Research work should be undertaken to find out more number of drought tolerant, short duration and water efficient vegetables and fruits. Management packages should also be developed. The technology could cope with the change of climate in the near future. Watershed management concept might get preference for better livelihood of resource poor farmers in the drought prone High Barind Tract.

Conclusion

The program created great enthusiasm among the women farmers. Vegetable consumption was increased considerably. However, to make the enterprise sustainable, 2-3 years continuous technical back up is needed along with imparting of training and nutrition education. Besides, more cooperation from DAE personnel is needed for dissemination of the technology to larger area.

Program 2: Pilot Production of T.Aman Rice-Chickpea Cropping Pattern

Introduction

High Barind Tract (HBT) is characterized by low annual rainfall (1363 ± 311mm) compared to other parts of Bangladesh with uneven rainfall distribution and wide variation from year to year. The HBT is not a stable ecosystem and farming is vulnerable to interruption because of a) absence of large water bodies, b) sparse vegetation, c) low and erratic rainfall with limited resources of groundwater and high temperature in summer (Hunt, 1984). The HBT covers 160,000 ha of which 90% is rainfed in the rabi season (November- March). Of the rainfed area 55 % is fallow (Ali, 1998). In the kharif season (June-October) the major area is under long duration T.Aman rice, which hampers timely planting of rabi crops like chickpea .The predominant cropping patterns of these rainfed lands are: Fallow-T.Aman-Fallow. But the research work of On-Farm Research Division (OFRD), Barind Station of Bangladesh Agricultural Research Institute (BARI) proved that chickpea could be cultivated after the harvest of T.Aman rice in residual soil moisture under rainfed conditions (OFRD, 1990). It may be mentioned that chickpea is a deep rooting and low water requiring grain legume. So, it is well adapted to low soil moisture and drought conditions (Saxena, 1984; Ali, 2000). For adaptation with the climate change and ensuring sustainable and better livelihood, chickpea cultivation after T.Aman rice could be an alternative.

Methodology

Pilot production program (each block was 10 Bigha) of chickpea (Variety: BARI Chola-5) was undertaken at two locations viz., Nachole (Nawabgonj) and Shapahar (Naogaon) of the HBT after the harvest of T.Aman rice (Variety: Swarna) during 2006-2007. A field day was also arranged on 18 March 2007 at Sapahar, Naogaon to disseminate the technology among the farmers of that locality. A technology book on chickpea (in Bengali) was also widely distributed among the farmers to made the best research based protocol on the hand of farmers.

Results and Discussion

From agronomic data (Table 3 & 4) it was observed that chickpea sowing was a bit late due to late release of land from long duration T.Aman rice, which was one of the reason of low chickpea grain yield (123-153 kg/Bigha) in comparison to potential (266 Kg/Bigha) along with the acidic soil. After chickpea harvest, door to door survey revealed that farmers would keep 60-70 % of their produce for next year sowing and also for selling as seed (for getting higher price). They will consume and sell (at farm gate) rest 30-40%. From cropping pattern basis, economic analysis (Table 5) it was found that traditional T.Aman-Fallow cropping pattern gave only 6033 Taka gross return having 2.32 benefit cost ratio, while recommended T.Aman-Chickpea fetched almost double gross margin (11553 Taka) with higher benefit cost ratio (3.21). Chickpea production was highly profitable with 4.91 to 6.13 benefit cost ratio compared to 2.10-2.54 benefit cost ratio of T.Aman rice (Table 6). Thus chickpea production after the harvest of T.Aman rice could ensure food security as well as it would increase income of farmers, which in turn would ensure sustainable livelihoods matching with the changing climate.

Research Need

Research work would be undertaken to find out better adapted and more prolific and deep rooting genotypes of chickpea with shorter life span for better yield after the harvest of T.Aman rice. Causes of low yield of chickpea would be found out, including mitigation of low soil pH. T.Aman rice with shorter growth duration having yield potential like local Swarna variety would be find out with repeated trial. Moreover search for other low water requiring and remunerative crops would be find out for crop rotation and diversification. Diversification is one of the ways of adaptive mechanism for the changing climate.

Table 3. Agronomic performance of T.Aman rice (cv. Swarna) in two locations of High Barind Tract during 2006

Parameters	Locations	
	Nachole (Nawabgonj)	Shapahar (Naogaon)
Date of sowing in seed bed	10-12 June, 2006	2 July, 2006
Date of tranplanting	10-14 July, 2006	9 August, 2006
Date of harvest	10-15 Nov, 06	18 Nov, 06
Duration (days: seed to seed)	153	138
Plant height (cm)	114.6	122
No. of effective tillers/m^2	12.6	12
No of filled grain/panicle	97.4	90.3
Grain yield (kg/Bigha)	660	547

Table 4. Agronomic performance of chickpea (cv. BARI Chola 5) under T.Aman-Chickpea cropping pattern in two locations during 2006-2007

Parameters	Locations	
	Nachole (Nawabgonj)	Shapahar (Naogaon)
Date of sowing	19-22 Nov, 06	22-24 Nov, 2006
Date of harvest	30 March, 2007	31 March, 2007
Duration (days)	130	129
Plant height (cm)	37	36
Plant population/m2	30	27
No. of pod/plant	48	40
No.of seed plant	1.5	1.6
Grain yield (Kg/Bigha)	153	123

Table 5. Comparative average economic performance (two locations) of traditional T.Aman rice-Fallow and recommended T.Aman rice-Chickpea cropping patterns in High Barind Tract during 2006-2007

Cropping pattern	Production cost (Tk./Bigha)	Gross return (Tk/.Bigha)	Gross margin (Tk./Bigha)	Benefit cost ratio
Traditional T.Aman-Fallow	2600	6033	3433	2.32
Recommended T.Aman-Chickpea	3600	11553	7953	3.21

Table 6. Economic performance of recommended T.Aman-Chickpea cropping pattern at two locations of High Barind Tract during 2006-2007

Location	Production cost (Tk./Bigha)			Gross return (Tk./Bigha)			Gross margin (Tk/Bigha)			Benefit cost ratio		
	Aman	Chick	Total	Aman	Chick	Total	Aman	Chick	Total	Aman	Chick	Total
Nachole	2600	1000	3600	6600	6133	12733	4000	5133	9133	2.54	6.13	3.54
Shapahar	2600	1000	3600	5467	4907	10374	2867	3907	6774	2.10	4.91	2.88

Note: 1 Bigha: 33 Decimal or 1320 m^2 Price (Tk./kg): T.Aman rice grain= 10, Chickpea grain= 40

Visit of the project area by the BARI scientist and field workers

Thirteen different levels of BARI scientists and field workers including Director (Research), Dr. Md. Abu Sufian visited the project areas since the inception of works from February 2006 to March 2007. Dr. I. Juergens (SDRN) visited the BARI working site, from FAO head quarter, Rome. Different levels of DAE officials, NGO personnel and farmers group visited the project sites.

Publication of Booklet/Poster for farmers

Two technology booklets in Bengali language (T.Aman-Chickpea cropping pattern and *Dioscorea* i.e. potato yam cultivation on non-fruit trees) were published and distributed among the farmers/ extension/NGO personnel of the project area. A colored and picture dominated poster on malnutrition, poverty reduction and homestead vegetable cultivation was published and distributed among the stakeholders as per plan.

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Livelihood Improvement of Tribal People through Agricultural Production in High Barind Tract

Introduction

The Barind Tract is a distinctive physiographic unit in the North-West of Bangladesh, which is characterized by extreme environmental conditions for agricultural production. The High Barind tract is characterized by grey terrace soil, low organic matter, low rainfall and high temperature. Single T.Aman rice crop under rainfed condition is the major cropping pattern practiced by the farmers of Barind area. Most of the lands are owned by the absentee landlords and are cultivated by the tenant farmers. Most of tenant farmers are tribal or landless farmers. There are about 70 thousand tribal farmers' lives in Barind area of Rajshahi region (ASED, 2004). Locally they are called as Saotal. They are very poor and neglected in the society. Most of them sell their labour to other land and few of them are tenant farmers. The tenant tribal has less financial capability and they have no access to any institutional loan. They are also not much interested to diverse cropping. Tribal of this area are always fighting against insecure food, malnutrition, unemployment and poverty. They do not know about the modern technology of agriculture. They have a limited knowledge to use their existing farm resources efficiently. Social problems like tenant farmer and lack of motivation hinder the vegetable production (BARI, 1999). Alam *et al*. (2005) reported that year round vegetable production in High Barind area increased the vegetable consumption of resource poor farmers. Homestead area can be utilized to grow different vegetables, which can significantly improve rural health as well as economic condition (Abdullah, 1986). Integrated farming approach provides to improve farming condition and livelihood of tribal Saotal farmers by integrating their available resources. Above these circumstances, the program has been implemented by OFRD, Barind Station of BARI under technology transfer projects funded by BARC for improvement of the livelihood through agricultural production for the local tribal farmers (Saotal) of High Barind Tract.

Project objectives

- To utilize the present resources of local tribal (Saotal) in a better and systematic way
- To improvement of livelihood of tribal farmers through agricultural production
- To enlarge the current income level of Saotal family through intervention of new and profitable agricultural technologies

Methodology

The project activities were implemented by On-Farm Research Division, Barind Station of BARI at two villages (Paitapukur and Fulbari village, Godagari, Rajshahi) with twenty Sautal farm families (10 of each location) during 2006-2007. The tribal families were selected on the basis of farm size and existing resources. The tribal need-based technologies were chalked out through an orientation workshop and pre-sowing training program with the active participation of Saotal farmers' on 27 November 2006. After the training program OFRD, Barind Station of BARI supplied seed of modern varieties of vegetables, potato, wheat, chickpea, lentil and mustard. The year round homestead vegetables production pattern was designed following "Barind model". The OFRD staff also provided appropriate agricultural technologies from time to time during the cropping period based on local problems and needs. The field and socio-economic data were collected simultaneously which were incorporated the report.

Results and Discussion

Homestead vegetable production during rabi 2006-2007

After harvesting in rabi season, the total vegetables production of Saotal farmer was 16.36 kg in Paitapukur village. Of the vegetables 12.85 and 3.51 kg were consumed and distributed, respectively (Table 1). But before intervention of the project they produced only 5.5 kg creeper vegetables at homestead level. Most of the spaces of Saotal homestead remain fallow. That is why they are suffering from malnutrition due to lack of fresh vegetables. They have not enough money for buying vegetables from the market. It was revealed that the vegetable production satisfactorily increased due to use of modern varieties and proper management practices.

Table 1. Saotal farmers and their homestead vegetable production at Paitapukur village, Godagari, Rajshahi during rabi 2006-2007

Sl. no.	Name of the Saotal farmers'	Total vegetable production (kg/homestead)	Consumption/family (5 members/family) (kg)	Distributed (kg)
1.	Sabistin	21.8	15.8	6.0
2.	Bajon Hazda	19.4	17.4	2.0
3.	Kamol Hazda	17.62	14.62	3.0
4.	Nilu Hamron	18.2	15.8	2.4
5.	Jatin Murmu	26.32	18.42	7.9
6.	Fajar Murmu	16.95	13.85	3.1
7.	Sakutudu	16.7	13.2	3.5
8.	Gulu Hazda	20.3	15.5	4.8
9.	Naren Saren	14.0	10.1	3.9
10.	Bin Zamin	8.67	6.67	2.0
	Average production/homestead	16.36	12.85	3.51
Creeper vegetable production before intervention		5.5	5.5	-

In Fulbari village, the total vegetable production of Saotal farmer was 24.85 kg during rabi season. From the total production they consumed and distributed 19.05 and 5.71 kg fresh vegetables, respectively (Table 2). But before intervention of the project they produced only 4.5 kg vegetables that are not sufficient to meet up their demand.

Table 2. Saotal farmers and their homestead vegetable production at Fulbari village, Godagari, Rajshahi during rabi 2006-2007

Sl. no.	Name of the Saotal farmers'	Total vegetable production (kg/homestead)	Consumption/family (5 members/family) (kg)	Distributed (kg)
1.	Munshi Sarpu	25.5	20.4	5.1
2.	Sapan Hajda	23.9	16.4	7.5
3.	Gupin Saren	27.4	24.1	3.3
4.	Philip Saren	20.4	15.9	3.5
5.	Mekail Murmu	24.25	20.15	4.1
6.	Jakaria Hajda	23.1	15.5	7.6
7.	Sakhil	32.5	23.5	9.0
8.	Refail Hamron	35.3	26.8	8.5
9.	Rashid Saren	22.75	17.75	5.0
10.	Kabiraj Murmu	38.2	29.0	9.2
	Average production/homestead	24.85	19.05	5.71
Creeper vegetable production before intervention		4.5	4.5	-

Field crops production during rabi 2006-2007

The modern varieties of different field crops were grown both in Paitapukur and Fulbari village during rabi season (Table 3). The average yield of wheat was 250 kg/bigha and for chickpea 110, lentil 80, mustard 90 and potato 1250 kg/bigha.

Table 3. Production of different crops in tribal field at Paitapukur and Fulbari village, Godagari, Rajshahi during 2006-2007

Sl. no.	Crops	Variety	Area (Bigha)	No. of Saotal farmer	Sowing time	Harvesting time	Yield (kg/bigha)
1.	Wheat	Gourab	7	7	1-7 Dec. 06	25-30 Mar. 07	250
2.	Chickpea	BARI Chola-5	4	6	15-20 Nov. 06	28-30 Mar. 07	110
3.	Lentil	BARI Masur-4	2.5	4	7-10 Nov. 06	7-10 Mar. 07	80
4.	Mustard	BARI Sarisha-9	2	2	10-12 Nov. 06	5-7 Feb. 07	90
5.	Potato	Cardinal	2	10	5-10 Dec. 06	18-20 Feb. 07	1250

Crop museum during rabi 2006-2007

Under the project, a crop museum was established at Paitapukur village during rabi season which consisted of 22 modern varieties of BARI under 16 crops with a view to study the adaptability of that crop varieties among the Saotal farmers. The museum helped to become familiar with the BARI crop varieties among the Saotal farmers.

Field day and Saotal family' training

A field day and training program were conducted at Paitapukur village on 23 March 2007 to disseminate the modern agricultural technology among the Saotal farmers of the locality. There were fifty Saotal family were present in the program.

Training on grafting and budding of fruit trees

The scientific staff of OFRD, Barind Station, Rajshahi and five tribal farmers of the project site were given training on grafting and budding of fruit trees at Fruit Research Station, BARI, Binodpur, Rajshahi on 26 April 2007 to establish fruit tree at tribal homestead area and disseminate the modern fruit varieties of BARI among the Saotal farmers for their nutrition.

Reaction of Saotal farmers'

The Saotal farmers are very much interested in homestead vegetable production to consume fresh vegetables from their own garden. The awareness was built up among the tribal farmers of the project sites for the consumption of vegetables. They demanded quality vegetable seeds in proper time. They were also satisfied to see the performance of wheat, chickpea, mustard, lentil and potato varieties of BARI.

Limitations

- Lack of knowledge of Saotal farmers' about the modern crop production technology
- Drought and high temperature slightly hampered the program.
- Lack of sufficient water for growing vegetables and field crops.
- Cowdung is being used as fuel purpose instead of manure.
- Lack of sufficient fund in Saotal farmers training, mobilization etc.

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Comparative Economic Performance of Ginger and Turmeric in the Madhupur Tract

Abstract

The study was conducted at the Multi Location Testing (MLT) site, Madhupur of Tangail district to assess the existing production practices and to identify the constraints of ginger and turmeric production during April-May 2007. A total of 60 ginger and turmeric growers were selected purposively for farm level data collection. The study revealed that farmers did not use nitrogen but applied 55-67 percent lower dose of P and 57-67 percent higher dose of K in ginger compared to recommendation (160-60-20-4 kg NPKS/ha). The highest ginger yield (12.78 t/ha) was recorded from large farmers followed by medium (8.97 t/ha) and small (7.60 t/ha) farm while the national average yield was 6.09 t/ha. The same trend was observed in gross return, gross margin and benefit cost ratio. About 62 percent ginger growers reported that root rot disease was the most acute constrain to ginger production. In case of turmeric, it was observed that farmers did not also use nitrogen but applied 63-75 percent and 72-84 percent lower dose of phosphorus and potassium, respectively compared to recommended dose (160-48-140-20-4 kg NPKSZn/ha). The highest turmeric yield (11.36 t/ha) was obtained from large farmer followed by small (9.30 t/ha) and medium (8.60 t/ha) farm while the national average dry yield was 3.84 t/ha. The same trend was observed in gross margin and benefit cost ratio. Abut 38 percent farmers reported that leaf blight was the most acute problem in turmeric which burnt the leaf and caused low yield.

Introduction

Ginger and turmeric are valuable and very popular spices in Bangladesh. These two spices have to import every year from our neighboring countries like India, Thailand and Myanmar. Ginger is produced in 7917 ha land in Bangladesh and its total production is 48185 metric ton while the area coverage and production of turmeric are 18441 ha and 70730 metric ton, respectively in Bangladesh (YBAS,2004). Most of the farmers are growing ginger and turmeric in Madhupur tract. Madhupur tract is a region of complex relief and soils are developed over Madhupur clay. The soils are strongly acidic in reaction with low status of organic matter, low moisture holding capacity and low fertility level (FRG 2005). This tract is highly potential for agriculture especially ginger and turmeric and some other fruit and vegetable. Ginger and turmeric are growing extensively in that area which are also essential species crop to the farmers. But recently the area and production of ginger are decreasing gradually; on the other hand, the production area of turmeric is increasing. It may be due to some cultivation problem. Though, the price of ginger comparatively higher than turmeric but farmers interested to grow turmeric. So it is need to identity the reason of changing the entrepreneurship. Therefore, the present study was undertaken to meet up the following objectives.

Objectives

1. To know the socio-economic characteristics of the ginger and turmeric growers.
2. To assess the production and management practices of ginger and turmeric.
3. To identify the constraints related to ginger and turmeric production.

Methodology

The study was conducted at the MLT site, Madhupur, Tangail during April-May 2007 to assess the management practices, productivity and to identify the problems of ginger and turmeric. A total of 60 ginger and turmeric growers were selected randomly as sample to collect necessary information. The selected farmers were categorized in small (0.50-1 ha), medium (1.01-2 ha) and large (2.01 ha and above) farm groups. Out of 60 selected farmers 25 for small, 25 for medium and 10 for large farmers. Data were collected with a pre-tested survey schedule by face to face interview method and participatory approach. 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 form.

Results and Discussion

Socio-economic characteristics of the sample farmers

The socio-economic characteristics affect their production, management practices and other activities of ginger and turmeric. The characteristics were farmers' age, education level, occupation and farm size.

Age group of the sample farmers

Age itself is an influencing factor for the acceptance of improved technology and in bearing risk. It was showed that 30 percent farmers were under 41-50 age group and 30 percent under 51-60 age group considering all farm categories. None of farmers had the age group 21-30 in the large farm category (Table 1).

Education status of the sample farmers

Considering all farm categories, about 65 percent sample farmers belonged to the education level of class V-X. Only 3 percent farmers were found illiterate, 19 percent were SSC level and 13 percent farmers were under the education level of HSC and above (Table 2).

Occupation

The highest percentage (65%) of the sample farmers were engaged with agriculture and lowest percent (10%) with agriculture + service in all farm categories. The agricultural occupation decreased with the increase of farm size. Same trend was found in Agriculture + Business and agriculture + service. None of the farmer of small farms was engaged with agriculture and service but 16 and 20 percent farmers of medium and large farm were engaged with that occupation, respectively (Table 3).

Distribution of land holdings

According to farm size category, the total cultivated land was 0.82 ha for small, 1.95 ha for medium and 3.06 ha for large farmer. The average size of homestead was found 0.17 ha for all farm categories. Own cultivated land was 0.66 ha for small, 1.20 ha for medium, 2.79 ha for large and 1.55 ha for all farm categories. It was observed that small farm belonged to subsistence level and they had limited land to cultivate. The small and medium farmers supplemented their cultivated land by renting in from others to increase their farm income while the large farms were fond to have rented out and mortgaged out more land (Table-4).

Agronomic and economic performance of ginger and turmeric

Ginger: Farmers is Madhupur tract grown ginger in sole and sometime in between row of pineapple. They sown local variety of ginger after rain in the Bengali month 'Baishakh' (April-May) and the spice was collected in 'Poush' (December-January) and 'Magh' (January-February). They prepared their land 4 times ploughing with power tiller. The small, medium and large farmer used ginger seed at the rate of 760, 762 and 864 kg per hectare respectively. Human labour was required on an average 94, 103 and 142 man-days in small, medium and large farm category, respectively during cultivation. Cowdung was applied as manure at the rate of 287, 335 and 208 kg per hectare in the study area by the small, medium and large farmers, respectively while ash was used at the rate of 162, 193 and 219 kg/ha by small, medium and large farm. They did not apply N but P & K in ginger. The fertilizer application rates of small, medium and large farm category were 20 kg P & 50 kg K, 27 kg P & 60 kg K and 21 kg P & 47 kg K per hectare, respectively. It was observed that the farmers used 55-67 percent lower dose of P and 57-67 percent higher dose of K in ginger compared to recommended dose (160-60-20-4 kg NPKS/ha). Phosphors and potassium were applied at the time of final land preparation. Farmers applied 13 kg P and 32 kg K per hectare as first top dress in 60 DAS. On the other hand 10 kg P and 20 kg K per hectare in second top dress on 120 DAS in ginger. They applied 2 to 3 times insecticides or pesticides in ginger to control root rot disease. All farm categories of farmers weeded their field 2 times on an average. The small, medium and large farmers got 7.60, 8.97 and 12.78 t/ha yield from ginger in Madhupur tract, respectively (Table 5) due to disease infestation in ginger and use of local variety while the potential yield of modern variety was 15 t/ha. Farmers preserved ginger in underground which was the traditional practices in the study area.

The total production cost of ginger was estimated Tk 50185, Tk 51310 and Tk. 58414 per hectare in small, medium and large farm category of farmers. The total production cost increased with the increase of farm size. About 61 percent of the total production cost was spent for seed cost considering all farm categories (Table 6).

The highest gross return (Tk 511120), gross margin (Tk 452706) and benefit cost ratio (8.75) were found from large farmers due to higher yield followed by medium and small farm category of farmer in ginger cultivation (Table 7).

Turmeric: All farm category of farmers cultivated turmeric in highland and medium highland in Madhupur tract. They produced turmeric as sole and in between rows of pineapple. They used local and 'Patnai' variety of turmeric and sown on April-May. Farmers prepared their land with 2 ploughing by power tiller. Considering all farm category, they use seed at the rate of 665 kg/ha. The large farmers used highest seed rate (741 kg/ha) followed by small and medium farmers. The highest (114 man-days) human labour was used by the medium farm followed by small and large farmers. Cow dung was used as manure at the rate of 441 kg, 688 kg and 171 kg per hectare in turmeric field by small, medium and large farmers, respectively. Ash was also used in turmeric field at the rate of 140-162 kg per hectare in all farm categories. They did not apply any fertilizer except P and K. Per hectare P and K application rate were 18 kg and 29 kg, respectively in small farm, 12 kg and 22 kg respectively in medium farm and 15 kg and 39 kg, respectively in large farm. No insecticides and pesticides were found to be applied in turmeric. One top dress was done by all farm categories at the rate of 13 kg P and 32 kg K per hectare 60 DAS in broadcast method in turmeric spices. They weeded the turmeric field one time in all farm categories. It was noticed that farmers applied 63-75 percent and 72-84 percent lower dose of P and K, respectively compared to recommended dose of fertilizer (160-48-140-20-4 kg NPKSZn/ha) in turmeric. The highest turmeric yield (11.36 t/ha) was recorded from large farm followed by small (9.30 t/ha) and medium (8.60 t/ha) farm category of farmers (Table 5).The lower yield obtained due to leaf blight, local variety, low fertilization as well as low management practices while the potential yield of modern variety was 25 t/ha.

Per hectare cost of production of turmeric was calculated and presented in Table 6. The highest turmeric production cost (Tk. 22443) was recorded from large farmers followed by medium (Tk. 22431) and small farm (TK. 22054). About 40 percent of the total production cost of turmeric was spent for human labour utilization followed by seed cost (22%) and ploughing cost (17%) considering all farm category of farmers (Table 6).

Per hectare highest yield (11.36 t/ha), gross return (Tk. 79534) as well as gross margin (Tk. 57091) were recorded from large farm category. The highest benefit cost ratio (3.54) was found in large farm category followed by small (2.95) and medium (2.68) farm category of farmers (Table 7).

Disposal pattern of ginger and turmeric

Ginger and turmeric was a cash crop to the sample farmers. They produced the two spices for good economic return as well as home consumption. It was observed that 97 percent of total production of ginger was sold by all farm categories. About 0.65%, 1.70% and 0.94% of total production of ginger were consumed, distributed and waste by the sample farmers, respectively. On the other hand 98 percent of the total product of turmeric was sold, 1.08 percent was consumed by the family members, 0.60 percent was distributed to the neighbor and relatives and 0.24 percent was wasted by insects or pest and poor preservation facilities (Table 8).

Problems faced by the ginger and turmeric growers

Incase of ginger, most of the farmers (62%) reported that root rot disease was the main constraint to ginger production. About 38 percent sample farmers opined that ginger plants died because of disease and pest. Decrease of cultivated area and yield, adulteration of insecticides/pesticides were the main problem to 30 percent sample farmers in the study area. About 20 percent farmers reported that lack of good quality seed was the fourth most acute problem. About 12, 8 and 7 percent farmers reported that lack of storage capacity, low output price and lack of knowledge also exist in ginger production, respectively (Table 9).

Incase of turmeric, most of the farmers (38%) reported that leaf blight was the main problem which burnt the leaf of turmeric and caused low yield. Adulteration of insecticides/pesticides and severe spot on leaf of turmeric were the second most problem to 30 percent sample farmers. Root rot disease also the third most constraint to 23 percent farmers. About 20, 10 and 5 percent respondent reported that lack of good quality seed, lower yield and low output price were the some constraints, respectively for turmeric cultivation in Madhupur tract (Table 9).

Conclusion

Among the spices crops, ginger and turmeric are important for domestic consumption and good economic return. Those two spices showed high gross margin as well as financial return but domestic production is insufficient due to above mentioned constraints which caused lower yield, decrease of ginger production area and farmers are not interested to grow ginger. So, government as well as research, extension and NGOs should give more emphasis on ginger and turmeric to help improve the socio-economic livelihood of the ginger and turmeric growers of Madhupur tract in Tangail district.

Table 1. Distribution of sample farmers according to age group at MLT site Madhupur, Tangail

Age group (year)	Farm category			All Farmers
	Small	Medium	Large	
21-30	5 (20)	6 (24)	-	4 (20)
31-40	5 (20)	4 (16)	2 (20)	4 (20)
41-50	10 (40)	6 (24)	3 (30)	6 (30)
51-60	5 (20)	9 (36)	5 (50)	6 (30)
All groups	25 (100)	25 (100)	10 (100)	20 (100)

Figure in parentheses indicate percentage.

Table 2. Distribution of sample farmers according to the level of education at MLT Site, Madhupur

Education level	Farm category			All farmers
	Small	Medium	Large	
Illiterate	2(8)	-	-	1(3)
V-X	18(72)	16(64)	6(60)	13(65)
SSC	4(16)	5(20)	2(20)	4(19)
HSC and above	1(4)	4(16)	2(20)	2(13)
Total	25(100)	25(100)	10(100)	20(100)

Figure in parentheses indicate percentage.

Table 3. Occupation of the sample farmers according to farm category at MLT Site, Madhupur

Occupation	Farm category			All farmers
	Small	Medium	Large	
Agriculture	19(76)	16(64)	4(40)	13(65)
Ag + Business	6(24)	5(20)	4(40)	5(25)
Ag + Service	-	4(16)	2(20)	2(10)
Total	25(100)	25(100)	10(100)	20(100)

Figure in parentheses indicate percentage.

Table 4. Average size of land holding (ha) according to farm size at MLT site, Madhupur

Type	Farm category			All farmers
	Small	Medium	Large	
Homestead	0.08	0.17	0.25	0.17
Own cultivated land	0.66	1.20	2.79	1.55
Rented in	0.03	0.25	-	0.09
Rented out	-	0.09	0.19	0.09
Mortgaged in	-	0.36	0.17	0.18
Mortgaged out	-	-	0.11	0.04
Fallow land	0.05	0.06	0.15	0.09
Total cultivated land	0.82	1.95	3.06	1.95

Table 5. Per hectare average input use and yield of ginger and turmeric according to farm category

Items	Level of input used							
	Ginger				Turmeric			
	Small	Medium	Large	All	Small	Medium	Large	All
Human labour (Man-days)	94	103	142	113	92	114	91	101
Mechanical power (no.)	4	4	4	4	4	3	4	4
Seed Rate (kg)	760	762	864	795	661	592	741	665
Manure(kg)	287	335	208	277	441	688	171	433
Ash (kg)	162	193	219	191	162	155	140	152
P	20	27	21	23	18	12	15	15
K	50	60	47	52	29	22	39	30
Insecticides/ Pesticides use (no.)	3	2	2	2	-	-	-	-
Weeding (no.)	2	2	2	2	1	1	1	1
Crop yield (t/ha)	7.60	8.97	12.78	9.78	9.30	8.60	11.36	9.75

Table 6. Per hectare cost of production of ginger and turmeric at MLT site Madhupur

Inputs use	Inputs use cost (Tk/ha)							
	Ginger				Turmeric			
	Small	Medium	Large	Total	Small	Medium	Large	Total
Human labour	5800	7500	11900	8400	7600 (34)	10900 (49)	7300 (33)	8600 (40)
Mechanical power	4940	4940	4940	4940	4940	3705	4940	3528 (17)
Seed	30400 (61)	30480 (59)	34560 (59)	31813 (61)	4627	4144	5187	4653 (22)
Manure/Cowdung	144	168	104	139	221	344	86	217
Ash	81	97	110	96	81	78	70	76
P	1485	2025	1605	1705	1380	870	1155	1135
K	1485	1800	1395	1560	855	640	1155	883
Weeding	3600	2800	2300	2900	1600	1000	1800	1467
Pesticides/insecticides	2250	1500	1500	1750	750	750	750	750
Total production cost	50185	51310	58414	53303	22054	22431	22443	21309

Figure in parentheses indicate percentage of the total production cost.

Input cost (Tk/kg): Turmeric seed= 7, Ginger seed = 40, Cowdung = 0.50 Ash=0.50, TSP = 75, MP = 30 and human labour = Tk 100/man-day

Output price (Tk/kg): Ginger = 40 and Turmeric =7

Table 7. Per hectare yield, cost and return of ginger and turmeric at MLT site Madhupur, Tangail

Items	Ginger				Turmeric			
	Small	Medium	Large	All	Small	Medium	Large	All
Crop yield (kg)	7597	8968	12778	9781	9298	8598	11362	9753
Gross return (Tk.)	303880	358720	511120	391240	65086	60186	79534	68269
Total variable cost (Tk.)	50185	51310	58414	53303	22054	22431	22443	22309
Gross margin (Tk.)	253695	307410	452706	337937	43032	37755	57091	45959
Benefit cost Ratio	6.06	6.99	8.75	7.27	2.95	2.68	3.54	3.06

Table 8. Disposal patterns of ginger and turmeric at MLT site Madhupur, Tangail

Farm category	Ginger (kg)					Turmeric (kg)				
	Total	Consumed	Sold	Distributed	Wasted	Total	Consumed	Sold	Distributed	Wasted
Small	7597	34	7400	87	76	9298	39	9215	31	14
Medium	8968	70	8640	175	83	8598	110	8406	59	23
Large	12778	88	12336	236	118	11362	166	11077	87	32
All farm	9781	64	9459	167	92	9753	105	9566	59	23
(%)	100	0.65	97	1.70	0.94	100	1.08	98	0.60	0.24

Table 9. Problems faced by the sample farmers of ginger and turmeric at MLT site Madhupur

Nature of Problem	% Farmers responded			
	Ginger	Rank	Turmeric	Rank
1. Root rot disease	62 (37)	1	23 (14)	3
2. Lower yield	30 (18)	3	10 (6)	5
3. Died of whole plant by disease	38 (23)	2	-	-
4. Decrease of cultivated area	30 (18)	3	-	-
5. Adulteration of insecticides/ Pesticides	30 (18)	3	30 (18)	2
6. Lack of good quality seed	20 (12)	4	20 (7)	4
7. Lack of storage capacity	12 (7)	5	-	-
8. Low output price	8 (5)	6	-	-
9. Lack of knowledge	7 (4)	7	5 (3)	6
10. Severe spot on leaf	-	-	30 (18)	2
11. Leaf blight	-	-	38 (23)	1

Figure in parentheses indicate number of the sample farmer.

Study on the Assessment of Profitability and Technical Efficiency of Potato Producers in Some Selected Areas of Bangladesh

Abstract

A study was carried out in three potato growing areas viz. Munshiganj, Bogra and Jessore covering 75 potato growers to measure technical efficiency and economic performance of potato production. Farmers obtained average tuber yield of 24.90 t/ha which was higher than the average yield of Bangladesh (14.90 t/ha) but close to potential yield (25-30 t/ha) of diamant and cardinal varieties. The estimated results showed that gross margin and BCR for potato cultivation were Tk 174319/ha and 2.40, respectively. The average level of technical efficiency among the sample farmers was 75%. This implies that given the existing technology and level of inputs the output could be increased by 25%. Training on the potato production, extension linkage and quality seed played a significant role in the technical efficiency of the potato production.

Introduction

Potato (*Solanum tuberosum*) is the third largest food crop in Bangladesh. Its area and production are increasing day by day (BBS, 2004). In declaring 2008 the international year of the potato, the UN General Assembly seeks to focus world attention on the role of the potato that can play in defeating hunger and poverty. Usually farmers follow a different level of production inputs and management depending upon their infrastructural facility and socio-economic condition which ultimately result variability in yields. Potato, a high biomass yielder, utilizes huge quantities of nutrient particularly nitrogen, phosphorus and potassium (Elias *et al.* 1992). The proper management of fertilizer is fully dependent upon the ability of the manager, his attitude, knowledge, skill and resource condition (Hossain and Islam, 1986). The relative efficiency in agricultural production is an important aspect in developing countries' agriculture (Radam and Latif, 1995). Farm efficiency has long been an area of interest in the investigation of farm operation. Farmers' production performance does not only depend on physical resources and technology available to them, but also on existing farm management conditions. Studies examining farming efficiency in developing countries, production efficiency levels within a range of 60-82% irrespective of crop types and regions (Rahman, 2003; Coelli *et al.*, 2002; Wang e*t al.,* 1996). The efficient use of resources is an important indicator of increased production in agriculture. Efficient use of inputs can help farmers to get higher production from a given amount of resources. Several studies in other countries have showed that there is significant potential for raising agricultural output or profitability by improving productive (technical and allocative) efficiency using existing resources (Rahman, 2002). The present study was, therefore, designed to measure technical efficiency of potato producers.

Objectives

i) To estimate the profitability and technical efficiency of potato producers.

ii) To find out the factors effecting inefficiencies of potato production

Methodology

Data collection

Based on area and production, the present study was conducted in the potato growing districts of Bangladesh to collect primary data. Among the three districts, high, moderate and low concentrated area was selected for each potato growing areas. Munshiganj was chosen as high concentrated area, Bogra was selected as moderate concentrated area and Jessore as low concentrated area for potato production. Two villages were selected purposively for collecting farm level data from each district. A total of 75 farmers (25 farmers from each location) were selected purposively. Data were collected during April-May 2007. Pre testing was done before finalization of the interview schedule. Secondary data on area and production related to potato were also used to supplement the information that was collected through field survey.

Empirical model

The Cobb-Douglas production function is used for functional analysis of the data. It is the most widely used model for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillon, 1969). It is a homogeneous function that provides a scale factor enabling one to measure the return to scale and to interpret the elasticity coefficients with relative ease. It is also relatively easy to estimate because in logarithmic form it is linear and parsimonious (Beattie and Taylor, 1985). Thus, Cobb-Douglas specification provides an adequate representation of the agricultural production technology.

The empirical Cobb-Douglas frontier production function model with double log form can be expressed as:

$$
\begin{aligned}
LnY_i = \; & \beta_0 + \beta_1 LnX_{1i} + \beta_2 LnX_{2i} + \beta_3 LnX_{3i} + \beta_4 LnX_{4i} + \beta_5 LnX_{5i} + \beta_6 LnX_{6i} \\
& + \beta_7 LnX_{7i} + \beta_8 LnX_{8i} + \beta_9 LnX_{9i} + \beta_{10} LnX_{10i} + v_i - u_i
\end{aligned}
$$

Where,

Ln = Natural logarithm,

Y_i = Yield of potato of the i-th farm (kg/ha)

X_{1i} = Human labor used by the i-th farm (man-days/ha)

X_{2i} = Seed used by the i-th farm (kg/ha)

X_{3i} = Nitrogen used by the i-th farm (Tk/ha)

X_{4i} = Phosphorus used by the i-th farm (kg/ha)

X_{5i} = Potassium used by the i-th farm (kg/ha)

X_{6i} = Sulphur used by the i-th farm (kg/ha)

X_{7i} = Cowdung used by the i-th farm (kg/ha)

X_{8i} = Ploughing cost of the i-th farm (Tk/ha)

X_{9i} = Pesticide cost of the i-th farm (Tk/ha)

X_{10i} = Irrigation cost of the i-th farm (Tk/ha)

$v_i - u_i$ = error term

v_i's were assumed to be independently and identically distributed random errors, had N $(0, \sigma_v^2)$ distribution.

Technical inefficiency effect model

The u_i's in equation were non-negative random variables, assumed to be independently distributed such that the technical inefficiency effect for the i[th] farmer, u_i, were obtained by truncation of normal distribution with mean zero and variance, σ_u^2, such that

$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i} + \delta_8 Z_{8i} + W_i$

Where,

z_{1i} = Ln Operated land of the i-th farm operator (ha)

z_{2i} = Age of the i-th farm operator (years)

z_{3i} = Education level of the i-th farm operator (year of schooling)

z_{4i} = Family size of the i-th farm operator (persons/household)

z_{5i} = Experience in potato farming of the i-th farm operator (years)

z_{6i} = Dummy for potato training of the i-th farm operator (1 = yes, 0 = No)

z_{7i} = Dummy for extension linkage of the i-th farm operator (1= yes, 0 = No)

z_{8i} = Dummy for seed source (1 = Govt. organization, 0 = otherwise)

W_i s were unobservable random variables or classical disturbance term, which are assumed to be independently distributed, obtained by truncation of the normal distribution with mean zero and unknown variance, σ^2, such that u_i is non negative.

The β, η and δ coefficients are unknown parameters to be estimated, together with the variance parameters which are expressed in terms of

$$\sigma^2 = \sigma_u^2 + \sigma_v^2$$

and $$\gamma = \sigma_u^2 / \sigma^2$$

γ is the ratio of variance of farm specific technical efficiency to the total variance of output and has a value between zero and one.

The estimates for all parameters of the stochastic frontier and inefficiency effect model was estimated in a single stage by using the Maximum Likelihood (ML) method with the help of computer software package FRONTIER 4.1 (Coelli, 1996).

Results and Discussion

Agronomic profile

The study revealed that all the farmers used potato variety of Diamant and Cardinal. The average seed rate used by the farmers was 1.98 t/ha while Choudhury *et al.* (2006 edt) suggested 2.20 t/ha seed rate for Munshiganj area. All the farmers apply high dose of nitrogen, phosphorus and potassium than the recommended dose. The average rate used by the farmers was 175, 93, 216 and 58 kg/ha of N, P, K and S, respectively against the recommendation by Hussain *et al,* 2006 edt. for N (100-115 kg/ha), P (24-30 kg/ha), K (110-125 kg/ha) and S (18-22 kg/ha), respectively. The farmers of Munshiganj applied 3-4 times of higher dose of N, P and K fertilizer than the recommended dose in the potato field (Choudhury *et al.,* 2006 edt.). Farmers believed that higher dose of fertilizer would be increased higher yield. But the previous study proved that fertilizer that applied by the farmers also increased the yield but it was not significant nor economically viable (Choudhury *et al.,* 2006 edt.). Only 56 % of the farmers were found to apply cowdung in the field. Farmers received an average yield of 24.90 t/ha which was higher than the average yield of Bangladesh (14.90 t/ha) (DAE, 2007) but close to the potential yield of potato (Hussain *et al,* 2006 etd). It was observed from the previous study the potato yield varied from 30 to 38 t/ha in different potato growing areas due to different fertilizer management options (Choudhury *et al.,* 2006 edt.).

Economic performance

Among the variable cost, seed cost incurred the single highest cost followed by human labour cost for potato cultivation. Only seed tuber cost is about 40% of total cost of production in potato cultivation (Anon, 2002). Another study showed that the seed cost was 50-60% of the total variable cost of potato production (Hoque *et al.* 2006). As potato is labour intensive for seed cutting, planting, mulching, fertilizer application, crop management, harvesting etc. it shared about 21% of the total variable cost. Among the different inorganic fertilizers, phosphorus showed higher cost followed by potassium. The gross return, gross margin and BCR were obtained Tk. 298800/ha, Tk.174319/ha and 2.40, respectively. The BCR was close to Hoque *et al.* (2006) who found BCR for potato cultivation was 2.41 to 2.92 in different treatment of cut size and spacing.

Effect of productivity variables

The empirical results indicated that the coefficients of seed rate and potassium were positive and significant, while that of nitrogen, cowdung, ploughing cost and irrigation cost were positive but not significant. It indicated that seed rate and potassium had significant and positive impacts on potato production. It might be due to lower seed rate and potash loving nature of potato. The coefficient of human labour and phosphorus were found negative and significant. Sulphur and pesticide cost were found also negative but not significant. Holding other things remaining constant, the yield of potato would be increased by 0.223 and 0.216 percent as farmers spent 1 percent additional money for seed and applied 1 percent additional potassium, respectively. On the other hand, there was negative co-efficient found in human labour, phosphorus, sulphur and pesticide cost. It indicated that there was no need to invest on those items for potato production and if the investment was done on those items, the production would be decreased.

Effect of inefficiency variables

The estimated coefficients presented in Table 2 showed that training, extension linkage and dummy for seed sources were negative and significant in the inefficiency effect model. It indicated that potato production would be increased with the increase of training, extension linkage and good quality seed. There was a positive effect of education, family size and potato farming experience on potato production but not significant. There was negative effect of cultivated potato land area and farmers' age but not significant.

Farm specific technical efficiency

It is revealed that farm-specific technical efficiencies varied from 46 to 97% with a mean of 75 ± 14 %. Maximum farmers were in the group of 71 to 80 followed by 81-90% efficiency group. Lower efficiency was in few farmers (Fig. 1)

Conclusion

The estimated technical efficiency among the sample farmers varied to 97% with an average of 75%, this means that on an average there appears to be 25% technical inefficiency for potato production. As positive and significant co-efficient, further increase in seed rate, potassium will increase potato production. Training on potato production and ensuring quality seed could play a significant role in technical efficiency. Therefore, emphasis should be given on formal and informal training on modern technology of potato production by research, extension and non government organization. Supply of good quality seed should be ensured by BADC and other seed agencies.

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Table 1. Agro-economic profile of potato production in the selected study areas during 2007

Item	Agronomic profile	Economic performance (in Tk)
A. Variable cost		
Cultivated area of potato (ha)	0.61	-
Variety used	Diamant /Cardinal	-
Sowing period	Last week of November to first week of December	-
Human labour (Man-days/ha)	259	25900 (20.81)
Seed (kg/ha)	1984	49600 (39.85)
Nitrogen (kg/ha)	174	2464 (1.98)
Phosphorus (kg/ha)	93	7922 (6.36)
Potassium (kg/ha)	216	6480 (5.21)
Sulphur (kg/ha)	58	1600 (1.29)
Cowdung (t/ha)	2.78	13900 (11.17)
Ploughing (no.)	2-3	4617 (3.71)
Pesticide (no.)	2-3	1873 (1.50)
Irrigation (no.)	2	973 (0.78)
Interest on operating capital (Tk.)	-	4152 (3.34)
Harvesting period	4th week of February to 1st week of March	-
Tuber yield(t/ha)	24.90	-
Total variable cost	-	119481
B. Fixed cost (Rental value of land)	-	5000 (4.00)
C. Total cost (A+ B)	-	124481(100)
Gross return (Tk.ha)	-	298800
Gross margin (Tk/ha)	-	174319
Benefit Cost Ratio (BCR)	-	2.40

Figure in the parenthesis indicate percent of total cost

Note: Interest on operating capital has been calculated @ 12% for 4 month period.

Input price (Tk/kg): Potato seed (tuber) = 25, N = 14, P= 85, K= 30 and CD= 0.50, Potato tuber= 12

Table 2. Maximum likelihood estimates of the stochastic Cobb-Douglas frontier production function and technical inefficiency model for potato in some areas (average)

Independent variables	Para- meters	Co-efficient	Standard error
Stochastic frontier model:			
Constant	β_0	0.792	0.996
Ln Human labor	β_1	-0.031*	0.359
Ln Seed	β_2	0.223*	0.635
Ln Nitrogen	β_3	0.015	0.638
Ln Phosphorus	β_4	-0.084*	0.541
Ln Potassium	β_5	0.216*	0.424
Ln Sulphur	β_6	-0.046	0.051
Ln Cowdung	β_7	0.031	0.194
Ln Ploughing cost	β_8	0.051	0.209
Ln Pesticides cost	β_9	-0.005	0.131
Ln Irrigation cost	β_{10}	0.009	0.282
Technical inefficiency model:			
Constant	δ_0	0.121	1.001
Ln cultivated area of potato	δ_1	0.083	0.834
Farmers age (years)	δ_2	0.011	0.024
Farmers education level (year of schooling)	δ_3	-0.021	0.062
Family size (person/farm)	δ_4	-0.030	0.086
Potato farming experience (years)	δ_5	-0.022	0.028
Dummy for potato training (1=Yes, 0= No)	δ_6	-0.269*	0.746
Dummy for Extension linkage (1=Yes, 0= No)	δ_7	-0.165*	0.922
Dummy for seed source (1=Govt. org., 0= others)	δ_8	-0.115*	0.981
Variance parameters:			
Sigma-squared	σ^2	0.075	0.046
Gamma	γ	0.968	0.480
Log likelihood function		25.806	

* indicate significant at 5% level of probability

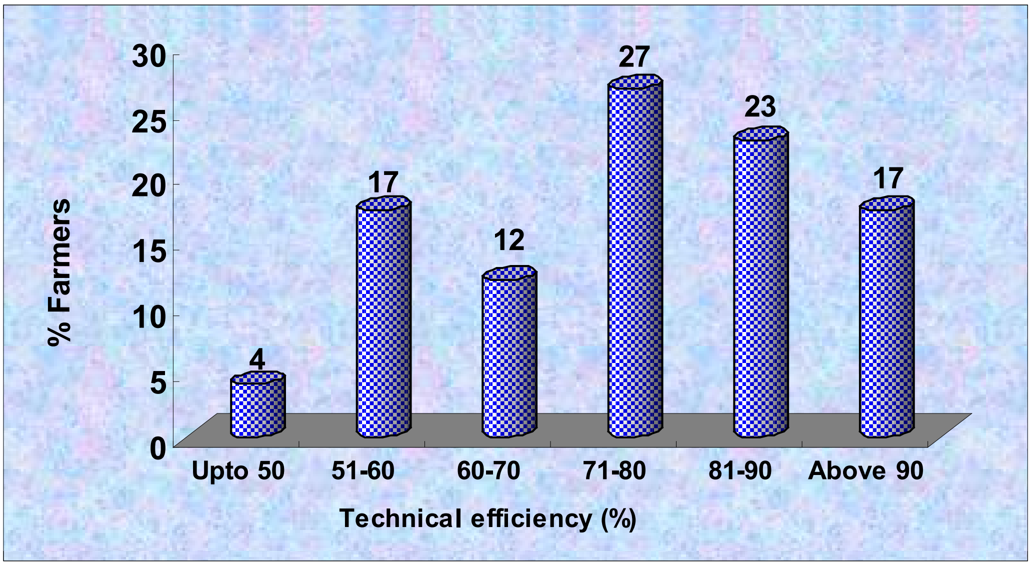


Figure 1. Frequency distribution of technical efficiency of potato producers in the study areas

Land Use Pattern and Growth Analysis of Major Crops in Khagrachhari District

Abstract

The present study analyzed land utilization pattern and growth rates of major crops grown in Khagrachhari district for the period 1994-95 to 2003-04. The data were collected from different issues of agricultural year book of Bangladesh. The total cropped area were increased 40 percent over the period where forest area declining 133 percent. But the cropping intensity was highest in 1998-99 and it was slightly decreased in current year (2002-2003).The growth rates of acreage, production and yield of said crops were all significantly positive except the Onion (acreage and production), Coriander (production), Mustard (acreage), Sesame (area and production), Sugarcane, Banana and Papaya (prod. and yield) and Cotton, Brinjal, Beans, Guava, Orange, Pomelo, Lemon and Litchi were found negative growth rate in yield/ha/year. So the emphasis should be given to the increase of yield and intensity of cropping through technological advancement and its dissemination throughout the area, varietal research and strengthening extension services.

Introduction

The hilly region of Bangladesh with an area of 13,295 sq. km. consisting of about 77 per cent high land, 20 per cent undulating bumpy land and 3 per cent plains represents a region with high potential for agriculture development which consists of three hill districts i.e. Rangamati, Khagrachhari and Bandarban. In Khagrachhari district total area occupied 667000 acres where 101000 acres was total cropped area, 64000 acres was net cropped area. Total cropped area increased by 40 per cent, net cropped area by 39%, single cropped area 40%, double cropped area 33% and triple cropped area increased by 50 per cent over the period of 1994-95 to 2002-03 (BBS, 2004). The cropping intensity was 157.82 in the period of 2002-03.

Bangladesh agriculture has attained its extensive margin of cultivation of land and there is practically no additional land to be brought under new cultivation (Alan, 1992). Therefore, the achievement of output growth of major crops in Khagrachhari district has to be attempted mainly through yield augmenting efforts and crop intensification. The present study aims at identify the existing land use pattern and analyzing the growth rates of acreage, production and yield of major crops grown in Khagrachhari. In the context of Bangladesh, therefore, the information to be generated from this study bears a great importance for policy makers, researchers, extension personnel and those who are thinking in these regards.

Objectives

1) To identify the existing land use pattern and cropping intensity of Khagrachhari district over the period 1994-95 to 2003-2004.
2) To analyze the growth rates of acreage, production and yield of major crops grown in the above district during the period 1994-95 to 2003-2004.
3) To suggest some policy guide line for improvement of agriculture production in Khagrachhari district.

Methodology

Secondary data used to carry out the study. The data were collected from various issues of statistical yearbooks of Bangladesh and agricultural year books of Bangladesh (BBS 1999 to 2004). Ten years (1994-95 to 2003-04) period of data were estimated. Simple statistical tools were used for calculating average, Standard deviation (SD) and Co-efficient of Variation (CV) of the respective parameters.

Growth models: The exponential growth model was run to estimate the growth rates of production, acreage, and yield of major crops in Khagrachhari district. The growth model was applied as follows (Gujrati, 1988).

Exponential: $Y=ae^{bt}$--------------------------(1)

or, $\text{Ln}Y = \text{Ln}\, a + bt$

Where, Y is the amount of production, acreage, yield, t is the time and b is the growth parameter to be estimated.

Results and Discussion

Land use pattern and cropping intensity

Land use pattern and cropping intensity are presented in Table1 &2. It can be observed that the total cropped area increased by 40 per cent where net cropped area was 39 percent and highest percentage increased of triple cropped area followed by single cropped area while forest area remarkably declining over the period. The cropping intensity drastically decreases in the period of 1995-96 than it was significantly upward just to the next year than slightly increased and in 1998-99 it was reached at highest but it again decline slowly up to the period of 2002-03 (Graph 1).

Growth rates of Spices crops

The annual percentage increase of acreage was highest for Coriander (19.08) following by Turmeric (10.78%), Ginger (7.98%), Rabi Chilli (5.84%) but Onion was negative (-15.45%). The annual percentage increase of spices production was highest for Turmeric (9.61%), followed by Rabi Chill (5.98%) and Ginger (5.29%) but Onion and Coriander (were -4.61%). The annum increases of yield of different types of spices was highest in Rabi Chilli (39.63%) followed by Turmeric (30.19%) but lowest was Ginger, 2.84% (Table 3).

Growth rates of Oil and Pulse crops

The annual percentage increase of acreage was highest for Mungbean (15.37%) followed by Motor(9.49%) and Groundnut (6.30%) and lowest for Lentil (4.10%) but Mustard and Til were negative, -7.20% and -2.18%, respectively. The annual percentage increase of production was highest for Groundnut (5.43), followed by Mungbean (4.97%) and lowest was Mustard -2.52%. The annum increases of yield was highest in Groundnut (24.40%) followed by Til (16.19%) but lowest was Motor, 1.05% (Table 4).

Growth rates of Cereal crops

The annual percentage of acreage of cereal crops were increased significantly. The highest percentage increased in yield of Aman and Boro (40.62% & 24.64%, respectively) lowest for Maize (6.18%). But in case of acreage and production higher percentage increased for Aman than Boro and Maize (Table 5).

Growth rates of vegetable crops

All the growth parameters of acreage, production and yield of vegetables are highly significant except the yield of Brinjal and Beans but acreage and production was the 3rd & second highest of beans among the crops. The annual increased of area was highest for Cabbage (23.25%), followed by Cauliflower and lowest for brinjal (3.53%). The annual production increased by percentage as highest in Cauliflower (11.45%), followed by Beans (9.49%) and lowest was for Brinjal (4.00%) (Table 6).

Growth rates of Cotton, Sugarcane and Tobacco

It was found that annual increase of acreage of Cotton was 8.5% but per hectare yield increased negative -26.25% while production increased fewer 0.69% per year. On the other hand area of Sugarcane was increased significantly 23.29% but per year negative increased was found in production and yield, -7.39% and -12.52%, respectively. The per year per hectare yield of Tobacco was increased significantly by 30% and its acreage and production was also increased by 13% and 5.35%, respectively (Table 7).

Growth rates (exponential) of Fruits

The annual increase of acreage of selected fruits in Khagrachhari district are highly significant and it was highest for Jackfruit, 113%, followed by Mango, 52.40%, Litchi,27.19%, Lemon, 19.17%, Banana, 14.96%, Pomelo, 7.69%, Pineapple, 7.25%, Guava, 5.10%, Orange, 1.05% and lowest for Papaya, 0.88%. The per year increase of production was highest for Jackfruit, 57.70%, followed by Lemon, 31.23%, Litchi, 25.25% and Mango by 20.88%.The production of Banana and Papaya decreased by 8.18% and 0.86% per annum. The yield of Jackfruit increased remarkably by 68.17%, followed by Mango, 20.88% and Pineapple, 8.07% but rest of fruits per annum per hectare yield decreased significantly (Table 8).

Conclusion and policy recommendation

The negative growth of per hectare yield of major fruits i.e. Banana, Papaya, Guava, Orange, Pomelo, Lemon, and Litchi could be positive through enhancing management research in locally i.e. timely and appropriately fertilization, mulching/ irrigation, weeding etc. Motivational work could play a vital role for increasing awareness to the tribal or local people. Improve fruit varieties could be introduce all local level. High yielding Cotton and Sugarcane variety should be introduced by the help of concern department throughout the area not only specific area. Sugarcane and vegetable area might be loosing until Tobacco cultivation could be discourage and it can be done by extension personnel, NGOs, local administration as well as media through motivational work. Annual growth of per hectare yield of Beans and Brinjal was found negative; it has an ample opportunity to increase per hectare yield by introducing BARI Sheem-1 & BARI Begun. Albeit all growth parameters of Maize were positive but it can be increased by introducing BARI hybrid maize in Jhum cultivation or others land. In case of Oil and Pulse crop, the acreage of Mustard and Til could be positive through mass and rapid dissemination of that variety in local level. The annual growth of acreage and production of Onion and Coriander can be improved by introducing summer onion and Belatidhonia in large scale by the close supervision and interaction of research and extension people. So, Intensity of cropping can be increased through technological advancement and its dissemination throughout the hilly area by strengthening extension services.

Table 1. Land utilization pattern of Khagrachhari district during 1994-95 to 2002-03

'000' acres

Year	Total area	Forest area	Not available for cultivation	Single cropped area	Double cropped area	Triple cropped area	Net cropped area	Total cropped area
1994-95	667	112	437	21	14	04	39	61
1995-96	667	110	441	39	11	02	46	61
1996-97	667	194	357	21	13	05	39	62
1997-98	667	55	573	21	13	05	39	62
1998-99	667	56	573	20	12	06	38	62
1999-00	667	67	554	24	15	07	46	75
2000-01	667	58	554	30	17	08	55	88
2001-02	667	52	554	33	20	08	61	97
2002-03	667	48	554	35	21	08	64	101
% change	00	-133	21	40	33	50	39	40

Source: Year Book of Agriculture Statistics, BBS, 2004.

Table 2. Land use and cropping intensity in Khagrachhari district during 1994-95 to 2002-03

Year	Total crops area ('000' acres)	Net cultivable land ('000' acre)	Cropping intensity (%)
1994-95	61	39	156.41
1995-96	61	46	132.61
1996-97	62	39	158.97
1997-98	62	39	158.97
1998-99	62	38	163.16
1999-00	75	46	163.04
2000-01	88	55	160.00
2001-02	97	61	159.02
2002-03	101	64	157.82
Mean	74.33	47.44	156.67
Sd.	16.67	10.14	9.29
C.V. (%)	22.43	21.37	5.93

Source: Year Book of Agriculture Statistics, BBS, 2004.

Table 3. Growth rates (exponential) of acreage, production and yield of different types of Spices crops in Khagrachhari District (1994-95 to 2003-04)

Spices crops	Growth rate (%) per year		
	Acreage	Production	Yield
Ginger	7.98*(5.20) R^2=0.77	5.29**(2.86) R^2=0.51	2.84 (0.39) R^2=0.019
Turmeric	10.78*(4.28) R^2=0.69	9.611*(7.54) R^2=0.87	30.19*(3.68) R^2=0.62
Rabi Chilli	5.84**(2.60) R^2=0.45	5.98*(3.24) R^2=0.56	39.63**(1.59) R^2=0.24
Onion	-15.48**(-3.31) R^2=0.57	-4.61**(-0.94) R^2=0.099	6.65(0.36) R^2=0.10
Coriander	19.08*(6.59) R^2=0.84	-4.61(-0.37) R^2=0.099	6.65(0.96) R^2=0.10

Figures in the parenthesis indicate respective t-ratios. * and ** indicated significant at 1% and 5% level of probability

Table 4. Growth rates (exponential) of acreage, production and yield of different types of Oil and Pulse crops in Khagrachhari District (1994-95 to 2003-04)

Oil & Pulse crops	Growth rate (%) per year		
	Acreage	Production	Yield
Groundnut	6.30**(2.37) R^2=0.41	5.43**(2.94) R^2=0.52	24.4**(2.09) R^2=0.35
Mustard	-7.20 (-0.70) R^2=0.05	2.52 (0.80) R^2=0.07	4.19 (1.42)R^2=0.20
Til	-2.18 (-4.80) R^2=0.74	-2.11(-4.35) R^2=0.70	16.19*(0.65) R^2=0.05
Mungbean	15.37*(3.31) R^2=0.57	4.97(1.76) R^2=0.27	3.30(0.72) R^2=0.06
Lentil	4.10*(3.66)R^2=0.62	4.26*(4.66) R^2=0.73	11.27(0.92) R^2=0.09
Motor	9.49*(6.25) R^2=0.83	4.44**(2.42) R^2=0.42	1.05(0.25) R^2=0.008

Table 5. Growth rates (exponential) of acreage, production and yield of different types of Cereal crops in Khagrachhari District (1994-95 to 2003-04)

Cereal crops	Growth rate (%) per year		
	Acreage	Production	Yield
Aman	7.46*(7.11) R^2=0.86	6.35*(6.30) R^2=0.83	40.62**(2.51) R^2=0.44
Boro	4.78*(5.55) R^2=0.79	4.39*(8.39)R^2=0.89	24.64*(3.74) R^2=0.63
Maize	2.38*(5.95) R^2=0.81	1.57*(6.26)R^2=0.83	6.18*(3.56) R^2=0.61

Table 6. Growth rates (exponential) of acreage, production and yield of different types of Vegetable crops in Khagrachhari district (1994-95 to 2003-04)

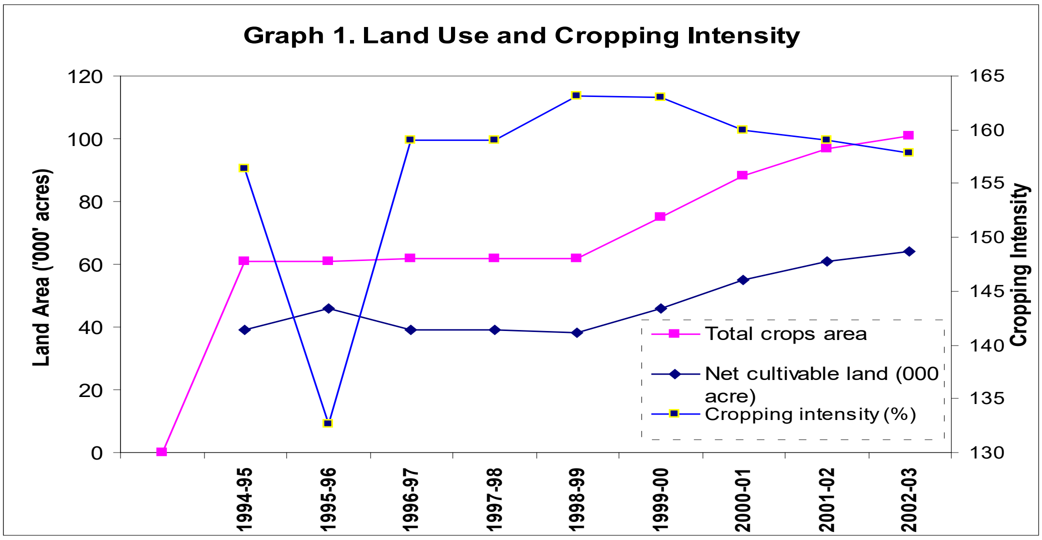
Vegetable crops	Growth rate (%) per year		
	Acreage	Production	Yield
Brinjal	3.53**(2.10) R^2 (0.35)	4.00**(1.95) R^2 (0.32)	-8.58*(-1.12) R^2 (0.13)
Lady's finger	10.71*(9.87) R^2 (0.92)	7.47**(6.36) R^2 (0.83)	9.84*(1.44) R^2 (0.20)
Karala	11.10*(10.63) R^2 (0.93)	9.09**(5.46) R^2 (0.78)	2.78*(0.22) R^2 (0.006)
Cabbage	23.25*(8.62) R^2 (0.90)	4.52*(1.71) R^2 (0.26)	2.03*(0.58) R^2 (0.04)
Cauliflower	21.32*(11.72) R^2 (0.94)	11.45**(3.35) R^2 (0.58)	5.60*(0.52) R^2 (0.03)
Beans	11.61**(6.18) R^2 (0.82)	9.49**(3.59) R^2 (0.61)	-10.69*(-0.75) R^2 (0.06)

Table 7. Growth rates (exponential) of acreage, production and yield of others crops in Khagrachhari District (1994-95 to 2003-04)

Others crops	Growth rate (%) per year		
	Acreage	Production	Yield
Cotton	8.5**(2.81) R^2=0.49	0.691(0.10) R^2=0.0014	-26.25*(-5.9) R^2=0.81
Sugarcane	23.29**(1.33) R^2=0.18	-7.39 (-0.73) R^2=0.063	-12.52 (-1.39) R^2=0.19
Tobacco	13.06*(3.73) R^2=0.63	5.35*(2.91) R^2=0.51	30.05*(1.83) R^2=0.29

Table 8. Growth rates (exponential) of acreage, production and yield of different types of Fruit crops Khagrachhari district (1994-95 to 2003-04)

Fruit crops	Growth rate (%)/year		
	Acreage	Production	Yield
Banana	14.96*(1.81) R^2=0.29	-8.18**(-2.32) R^2=0.40	-8.96*(-3.58) R^2=0.61
Jackfruit	113.14**(3.95) R^2=0.66	57.70**(6.35) R^2=0.83	68.77*(3.37) R^2=0.58
Pineapple	7.25*(.95) R^2=0.10	5.95**(2.33) R^2=0.40	8.07**(2.48) R^2=0.43
Papaya	0.88 (0.38) R^2=0.01	-0.86 (-0.60) R^2=0.04	-0.87* (-1.98) R^2=0.33
Mango	52.40**(6.49) R^2=0.84	19.80**(2.82) R^2=0.49	20.88** (1.37) R^2=0.19
Guava	5.10**(4.15) R^2=0.68	4.46**(3.02) R^2=0.53	-16.12** (-1.55) R^2=0.23
Orange	1.05**(4.23) R^2=0.89	4.26**(3.96) R^2=0.88	-4.32**(-3.58) R^2=0.86
Pomelo	7.69*(8.49) R^2=0.9	0.42 (0.19) R^2=0.004	-2.90*(-1.88) R^2=0.30
Lemon	19.17*(9.68) R^2=0.92	31.23**(3.60) R^2=0.61	-30.68*(-7.19) R^2=0.86
Litchi	27.19*(12.09) R^2=0.94	25.25**(5.60) R^2=0.79	-19.74** (-0.77) R^2=0.069



Yield Gap Analysis of BARI tomato-3 under Different Management Practices

Abstract

The study was conducted at Shibpur, Narsingdi during 2006-07 to find out the causes of difference between yield level that obtained at farmers field and researchers managed plot. Yield gap between researchers managed and farmers practices plot was found 54 t/ha as well as gross margin gap was Tk. 229676/- (46%) per hectare. It was estimated that the key factors behind the yield gap were seeds, urea, TSP and MP which significantly influenced the yield gap of BARI Tomato-3. This research suggests the apparent yield and economic gap could be minimized at farm level through adopting recommended package of technologies.

Introduction

Tomato is grown in a vast area at Shibpur, Narsingdi. It is usually observed that the yield of tomato (BARI Tomato-3) in farmers field differ from that obtained in researchers managed plot. This might be due to some variations in cultural practices. So, the study has been undertaken to identify the factors behind this yield gap.

Objectives

1. To minimize the yield gap between researchers managed plot and farmers plot
2. To popularize BARI released varieties of different crops
3. To monitor the farmers feedback.

Materials and Methods

The experiment was carried out at the MLT site, Shibpur, Narsingdi during 2006-07. BARI Tomato-3 was used in this experiment. The unit plot size was one Bigha. The seedlings were transplanted on 1 December 2006 maintaining 60cm x 40cm. The researchers managed plot was fertilized cowdung @ 10 t ha^{-1}, and 254, 90 and 125 kg ha^{-1} of N, P, K and farmers plot was fertilized with cowdung @ 6 t/ha and 121, 39 and 64 kg ha^{-1} of N, P, K, respectively. In the farmers plot, full cowdung, TSP and MP were applied during the final land preparation. N fertilizer was used in two equal installments at 20 and 40 DAT. In researchers managed plot, half of cowdung was applied during land preparation. The rest of cowdung the whole amount of P and $^{1}/_{3}$ each of N and P were to be applied during pit preparation. The rest of N and P were to be applied in two equal installments at 15 and 35 DAT. The crop was harvested on 20 February to 30 March 2007. Intercultural operations and plant protection measures were taken as and when necessary.

Results and Discussion

It was observed that the highest yield was found in the researchers managed plot (110 t ha^{-1}) while farmers plot gave half yield (56 t ha^{-1}). The yield potentiality of BARI tomato-3 is 90 t/ha (Anon, 2000) and the yield obtained in the researchers managed plot is higher than this. The gross margin obtained was Tk. 474870/- per hectare in researchers managed plot while it was Tk. 257184/- for farmers plot.

Farmers' reactions

Farmers showed interested to cultivate BARI tomato-3 for its higher yield and fruits size, higher market price as well as good benefit.

Reference

Anonymous 2000. Sabjir Unnatajat O Uttpadan Paddati (In Bengali). Published by Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur 1701.

Table 1. Per hectare yield and inputs use gap of tomato (BARI Tomato-3) between researchers managed and farmers plot at OFRD, Shibpur, Narsingdi, 2006-07

Explanatory variable	Researchers managed plot (RMP)	Farmers managed plot (FMP)	Gap between RMP and FMP
Mechanical power (no.)	3	2	1
Human labour (Mandays)	157	101	56
Fertilizer (kg):			
Cowdung (ton)	10	6	4
N	253	121	132
P	90	39	51
K	125	64	61
Staking (no.)	900	150	750
Insecticides used (no.)	2	2	-
Pesticides used (no.)	4	2	2
Hormone applied (no.)	1	-	1
Irrigation (no.)	4	3	1
Fruit yields (ton.)	110	56	54

Table 2. Cost and return of tomato (BARI Tomato-3) between researchers managed and farmers plot at OFRD, Shibpur, Narsingdi, 2006-07

Variable	Researchers managed plot (Tk/ha)	Farmers managed plot (Tk/ha)	Gap between RMP and FMP (Tk/ha)
Mechanical power	3500	2500	1000
Human labour	15750	10125	5625
Transplant	17400	20300	(-) 2900
Fertilizer:			
Cowdung	15000	9000	6000
N	3300	1572	1728
P	9000	3900	5100
K	4500	2304	2196
Staking	30000	15000	15000
Irrigation cost	5625	4500	1125
Pesticide	4875	3750	1125
Total production cost	108950	72951	35999 (33%)
Gross return	660000	336000	324000 (49%)
Gross margin	551050	263049	288001 (52%)
BCR	6.05	4.60	

Yield Gap Analysis of BARI Hybrid Maize under Different Management Practices

Abstract

The experiment was conducted at the Multi location Testing (MLT) site, Manikganj during rabi season 2006-07 to minimize the yield gap between research station and farmers field through variety and management practices of hybrid maize. It was observed that 35% gap in total variable cost caused 33% gap in grain yield and 45% gap in gross margin. It was also noticed that inputs and management practices like optimum planting time, fertilizer, seed rate, sowing time irrigation were played an important role in yield gap of maize cultivation.

Introduction

Maize is the third important cereal crop in Bangladesh. Its production and area were increasing day by day. Plant Breeding Division of BARI has released high yielding varieties of BARI Hybrid Maize-3 and BARI Hybrid Maize-5. Yield potentialities of those varieties are 2-3 times higher than national average yields under researchers managed trial. It is usually noticed that this yield gap between researchers guided farmers plot (RGFP) and farmers own practiced plot (FOPP) is due to manifold reasons viz. i) knowledge gap, ii) resource constraints of farmers including quality seed, iii) environmental hazard. However, from previous yield gap research it was observed that this gap could be minimized to a considerable level by variety and management practices. So, in this context, the experiment has been undertaken to minimize the yield gap of BARI Hybrid Maize 3 and BARI Hybrid Maize-5 between researchers guided farmers plot and farmers own practices plot and to popularize BARI released considering farmers feedback.

Objectives

i) To minimize the yield gap of BARI Hybrid Maize 3 and 5 between researchers guided farmers plot and farmers own practices plot.
ii) To popularize BARI released verities of hybrid Maize.
iii) To document farmers feedback.

Materials and Methods

The experiment was conducted at MLT site, Manikganj during rabi 2006-07 to estimate the yield and benefit gap between RGFP and FOPP of BARI Hybrid Maize 3 and 5. Four farmers were selected to collect necessary data with the technical guidance of research in RGFP. Materials and methods were shown in Table 1. The plot size was 0.53 hectare. Fertilizer was applied according to recommended dose in RGFP. Two-third N was applied twice as top dress in RGFP. Two weeding and irrigation were given at 32 DAS (8-10 leaf stage) and 60 DAS tussling stage in RGPP. Dursban was applied on 27 November 2006 (9 DAS) to control cutworm and Furadan for controlling stem borer on 24 January 2007 (36 DAS) in RGPP. Other cultural practices were done as per whole family maize training manual in RGFP. The maize was harvested during 17-26 April 2007 in RGFP. In case of farmers practice they sown seed delay and used higher dose of fertilizer except N and P compared to recommendation.

Results and Discussion

The results of yield gap analysis of maize production were showed in Table 1 and 2. It was found that the farmers did not use Zn and B in FOPP it might be due to lack of knowledge which caused less seed per cob as well as low yield .It was observed that the highest yield of BARI Hybrid Maize-3 (9.95 t/ha) and BARI Hybrid Maize-5 (11.27 t/ha) were recorded from researchers guided farmers plot due to seed rate, recommended fertilizer dose, two irrigation and timely control of cut warm. The yield of Pacific-11 gave the lower yield (7.16 t/ha) in farmers own practice plot it might be due to one irrigation, variety, late sowing time and lower amount of fertilizer (Table 1).

From the above results, it was observed that 35% gap in total cost caused 33% gap in maize yield and 45% gap in gross margin (Table 2).

Farmers' reaction

Farmers showed interest to grow BHM-5 for its higher yield, seed color, good farm gate price and market demand. They decided to grow maize in proper time with proper seed rate and fertilizer dose and proper management like weeding, irrigation, plant protection measure which played a significant role to minimize yield gap. They requested to supply mechanical or manually operated maize Sheller in their village through extension personnel.

Conclusion

The study suggested that the yield gap could be minimized by following the recommended package (optimum planting time, seed rate, fertilizer, weeding, irrigation and plant protection measure) in the production technology with good variety of hybrid maize at farmers' field.

Table 1. Level of technology employed and yield obtain in different hybrid maize cultivation under different management practices at MLT site, Manikganj during 2006-07

Management practices/factor	Level of technology employed	
	Researchers guided farmers plot (RGFP)	Farmers own practices plot (FOPP)
Variety	BARI Hybrid Maize-3 and 5	Pacific-11
Spacing (cm)	75 x 25	75 x 20
Seed rate (kg/ha)	11.25	18
Ploughing by tractor (No.)	3-4	2-3
Human labor (man-days/ha)	46	31
Sowing time	18 November	1st December
Fertilizer (kg/ha):		
Cowdung	5000	2000
N	256	276
P	55	56
K	144	50
S	34	26
Zn	13	-
B	1	-
Weeding (no.)	2	1
Insecticides used	Dursban, Furadan	Dursban
Irrigation (no.)	2	1
Harvesting time	17-26 April	2 May
Grain yield (t/ha): BHM-3	9.95	Pacific-11: 7.16
BHM-5	11.27	
Stover yield (t/ha): BHM-3	12.44	Pacific-11: 8.93
BHM-5	14.09	
Yield Gap: 3. 45 t/ha (33%)		

Table 2. Cost and return of different hybrid maize production under different management practices at MLT site, Manikganj during 2006-07

Management practices/factor	Researchers guided farmers plot (Tk./ha)	Farmers own practices plot (Tk./ha)	Gap between RGFP and FOPP (Tk./ha)
Mechanical power	2470	1852	618
Human labor	4600	3400	1200
Seed cost	1800	2880	640
Fertilizer cost:			
Cowdung	5000	2000	3000
N	3328	3588	(-)260
P	4400	4480	-80
K	4320	1500	2820
S	1122	858	264
Zn	2535	-	2535
B	1176	-	1176
Weeding cost	3600	1800	1800
Insecticides cost	1040	820	220
Irrigation	3000	1500	1500
Total variable cost	38391	24678	13659
Gross return: BHM-3	120645	Pacific-11: 76065	58255 (42%)
BHM-5	142285		
Gross margin: BHM-3	83052	Pacific-11: 51333	44995 (45%)
BHM-5	104692		
BCR: BHM-3	3.14	Pacific-11: 3.08	-
BHM-5	3.71		

Input price (Tk./kg): Human labor= 100, Seed= 160, Cowdung= 1, N= 13, P= 80, K= 30, S= 33, Zn= 195 and B = 1176 Output price (Tk./kg): BHM-3= 11.50, BHM-5= 12, Pacific-11 = 10 and Stover = 0.50

Yield Gap Analysis of Mustard Production under Different Management Practices

Abstract

The trail was conducted at B. Baria, Pabna and Comilla during rabi season 2006-07. The trial was laid out in block approach with researcher managed plot and farmers managed plot. The variety BARI sarisha-9 was introduced at B. Baria, BARI sarisha-11 at Pabna and BARI sarisha-15 at Comilla. The trial revealed that BARI developed variety of mustard showed higher yield (904-1230 kg/ha) in researcher managed plot compared to farmers managed plot across locations it might be due to maintain recommended package of production technology and intensive monitoring during mustard cultivation.

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 crop 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 high oil content (44%) 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.

Objectives

i) To minimize the yield gap between researcher's managed plot and farmers managed plot
ii) To introduce BARI released variety of Mustard
iii) To observe farmer's reaction about the new technologies.

Materials and Methods

The trial was conducted at MLT site, Atghoria of Pabna, Sultanpur of B. Baria and Homana of Comilla district to minimize the yield gap between research station and farmers field of mustard during rabi season, 2006-07. The trial was laid out in block approach with research managed plot and farmers managed plot. The variety BARI sarisha-9 was introduced in B. Baria, BARI sarisha-11 in Pabna and BARI sarisha-15 in Comilla with the help of 10, 30 and 7 co-operative farmers respectively. The plot size was 1.33 ha in B. Baria, 2 ha in Pabna and 0.93 ha in Comilla, Fertilizer was applied at the rate of 138-36-50-32-205-2 kg NPKS ZnB/ha (recommended dose of mustard). Half of N and the amount of other fertilizers were applied during the final land preparation. Remaining N was applied at 20 DAS. The seeds were sown on 3-9 Nov. at B-Baria and Comilla. The Mustard was harvested on last week of January at B. Baria, 2nd week of February at Comilla and 3rd week of February at Pabna of 2007. Data on yield and yield components were recorded from research managed plot and farmers managed plot (Table 1, 2 & 3).

Results and Discussion

B-Baria: The result was showed in Table 4. It was observed that the highest seed yield was obtained 904 kg/ha seed yield from researcher managed plot due to proper sowing time and use of boron. In case of farmers managed plot, farmers' didn't use Sulphur and Boron fertilizer and never thinned their plots. Due to such management practice they were getting lower yield (500 kg/ha). The seed yield increased about 45%. For getting 45% higher yield from research managed plot, farmers had to use new variety BARI Sarisha-9 with some improved management practices and spend additional Tk.2835/ha only (Table 1 and 4).

Pabna: The result of the yield gap analysis was presented in Table 5. The satisfactory grain yield (1980 kg/ha) and gross return (Tk 49500/ha) 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. In case of farmer's management practices, sowing of seed was delayed along with poor management practices resulted in lower yield (930 kg/ha) and gross return (Tk.23250/ha). The seed yield increased about 113% over farmer's management. It was notice that 27% gap in total variable cost caused 53% gap in seed yield and 70% gap in gross margin. It indicated that the cost incurred at farmers managed plot was not rational and poor management practices caused yield gap in mustard production.

Camilla: The results were showed in Table 3 and 6. About 1230 kg/ha seed yield was obtained from researcher managed plot due to adoption of improved management practice. Gross return, gross margin and BCR were found Tk.22600, Tk. 8615/ha and 1.62, respectively form researcher managed plot. On the other hand, from farmers managed plot mustard yield was 700 kg/ha. They got lower yield due to use of local variety (Tori-7), late sowing time and lower fertilizer dose. It was noticed that the seed yield was increased about 43%. About 19% increased total cost caused 74% benefit gap and 43% yield gap.

Farmers Reaction

B. Baria: Farmers are highly satisfied with the yield of BARI Sarisha-9 and said it can be fit in their existing cropping pattern and if seeds can be provided for 2-3 years local variety will be replaced.

They also requested as to supply the seeds in proper time for 2–3 years and need more training regarding cultivation methods.

Pabna: Farmer's reacted very positively with new high yielding variety BARI Sharisha-11. Farmer's expressed their satisfaction considered this variety with high yield, bold size seed, high percent of oil content and maximum stover yield compare to any local variety. It is note worthy that this variety was perform well even in late sowing condition, with the improve management condition. The farmers' have stored huge quantity of seeds of the variety for large area extension in the next season.

Comilla: Farmers opined that normally they cultivate local sarisha (Tori-7), didn't use Sulphur & Boron fertilizer and never thinned their plots. Due to such management practice they were getting lower yield and this year they got only 700 kg/ha seed yield from their own managed plot.

Conclusion

From the study it was noticed that about 43-53% yield gap and 70-87% benefit gap were exist between researcher managed plot and farmers managed plot. In order to minimize the yield gap, monitoring and motivational program should be increased and strengthened from the research and extension department to encourage the farmers to follow the recommended package of mustard cultivation.

Table 1. Level of technology employed and yield obtain in mustard cultivation under researchers and farmers management plot at MLT site, Brahman Baria

Management practices	Level of input used	
	Research guided farmers plot	Farmers own practice plot
Variety	BARI sarisha-9	Tori-7
Plant/m^2	62	106
Seed rate (kg/ha)	7	12
Mechanical power (no.)	2	2
Human labor (Man-days/ha)	45	30
Sowing time	Nov 03-09	Nov 10-25
Fertilizer (kg/ha):		
N	92	64
P	32	38
K	43	50
S	18	-
B	1.2	-
Melathion (ml)	500	500
Fungicide (g)	600	500
Weeding & Thinning	2	-
Harvesting time	January 20-28	January 20-28
Seed Yield (kg/ha)	904	500
Yield gap	404 kg/ha (45%)	

Table 2. Level of technology employed and yield obtain in mustard cultivation under researchers and farmers management plot at MLT site, Atghoria, Pabna

Management practices	Level of technology employed	
	Research managed farmers plot	Farmers managed plot
Variety	BARI Sarisa-11	BARI Sarisa-11
Seed rate (kg/ha)	5.25	8
Ploughing by Power Tiller (no.)	2	2
Human labor (Man-days/ha)	41	26
Sowing time	Nov 15-20	Nov 25- Dec.7
Fertilizer (kg/ha):		
N	138	69
P	36	23
K	50	27
S	32	-
Zn	2	-
B	2	-
Weeding & Thinning	1	-
Insecticides (no.)	2	1
Fungicide (no.)	2	-
Irrigation (no.)	1	-
Harvesting time	February 18-25	March 1-4
Seed yield (kg/ha)	1980	930
Yield gap	1050 kg/ha (53%)	

Table 3. Level of technology employed and yield obtain in mustard cultivation under researchers and farmers management plot at MLT site, Homna, Comilla

Management practices	Level of technology employed	
	Research guided farmers plot	Farmers own practice plot
Variety	BARI sarisha-15	Tori-7
Plant/m^2	55	100
Seed rate (kg/ha)	7	12
Mechanical power (no.)	2	2
Human labor (Man-days/ha)	45	30
Sowing date	November 10-15	November 15-20
Fertilizer (kg/ha):		
N	92	92
P	30	26
K	45	30
S	22	-
B	1.5	-
Melathion (ml/ha)	800	720
Fungicide (g/ha)	1200	1000
Irrigation (no.)	-	-
Weeding & Thinning	2	-
Harvesting period	January 25-30	February 12-15
Seed Yield (kg/ha)	1230	700
Yield gap	530 kg/ha (43%)	

Table 4. Per hectare cost and return (Tk./ha**)** of mustard production under researchers and farmers management plot at MLT site, Brahman Baria

Management practices	Researcher managed farmers plot	Farmers managed plot	GAP between RMP& FMP
Seed cost	350	600	-250
Mechanical power cost	750	750	0
Human labor cost	4500	3000	1500
Fertilizer :			
N	1200	840	360
P	2560	3040	-480
K	1275	1500	-225
S	500	0	500
B	1050	0	1050
Melathion cost	720	720	0
Fungicide cost	1380	1000	380
Total variable cost	14285	11450	2835 (19%)
Gross return	22600	12500	10100
Gross margin	8315	1050	7265 (87%)
BCR	1.58	1.09	

Input price (Tk./kg): Human labor= 100, Seed= 50, N= 13, P= 75, K= 32, S= 27, Zn= 165 and B = 235
Output price (Tk./kg Seed = 25

Table 5. Per hectare cost and return (Tk./ha) of mustard production under researchers and farmers management plot at MLT site, Atghoria, Pabna

Management practices	Research managed farmers plot	Farmers managed plot	GAP between RMP& FMP
Seed cost	158	240	-82
Mechanical power cost	2470	2470	-
Human labor cost	4600	2600	2000
Fertilizer :			
N	1797	898	899
P	2700	1725	975
K	1600	864	736
S	889	-	889
Zn	335	-	335
B	470	-	470
Weeding & Thinning	1822	-	1822
Insecticides & Fungicide	1315	730	585
Irrigation cost	1500	-	1500
Total variable cost	19656	14265	5391 (27%)
Gross return	4900	23250	26250 (53%)
Gross margin	29844	8985	20859 (70%)
BCR	2.52	1.63	

Input price (Tk./kg): Human labor= 100, Seed= 30, N= 13, P= 75, K= 32, S= 27, Zn= 165 and B = 235
Output price (Tk./kg Seed = 25

Table 6. Per hectare cost and return (Tk./ha) of mustard production under researchers and farmers management plot at MLT site, Homna, Comilla

Management practices	Research managed farmers plot	Farmers managed plot	GAP between RMP& FMP
Seed cost	350	600	-250
Mechanical power cost	750	750	-
Human labor cost	4500	3000	1500
Fertilizer :			
N	1200	1200	-
P	2560	2080	480
K	1275	900	375
S	500	-	500
B	1050	-	1050
Melathion cost	700	800	-100
Fungicide cost	1100	1000	100
Total variable cost	13985	10330	3655 (26%)
Gross return	22600	12500	10100(45%)
Gross margin	8615	2170	6445(74%)
BCR	1.62	1.21	

Input price (Tk./kg): Human labor= 100, Seed= 50, N= 13, P= 75, K= 32, S= 27, Zn= 165 and B = 235
Output price (Tk./kg Seed = 25

Yield Gap Analysis of Lentil (BARI Mosur-4) under Different Management Practices

Introduction

Pulse crops are said to be friend to the human, livestock and soil health as well as highly economic when the 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-4) 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 minimize the yield gap between researcher's managed plot and farmers managed plot
ii) To introduce BARI released variety of Lentil
iii) To observe farmer's reaction about the new technologies.

Materials and Methods

The program was carried out at Multi Location Testing (MLT) site, Atghoria, Pabna during the rabi season of 2006-07. Before implementing the program a discussion meeting was arranged with local farmers by the site team of the location. Farmers shared their skill and knowledge about land suitability experience of the production of relevant crop. As per the principles of the program all sorts of inputs were bought and procured by the participating farmers and researcher through participatory approach. Finally 13 cooperator farmers with 2 hectares area were selected to implement the program. The crop was sown on 6-12 Nov. and 25-28 Nov., 2007 in research management and farmer's management, respectively. Fertilizers were applied as basal @ 21-17-19-0.7 kg N-P-K-B ha^{-1} and 35-21-14 kg N-P-K ha^{-1} in research management and farmer's management, respectively. Plant protection measures were taken as and when required. Eight monitored farmers were selected for data collection. The crop was harvested on 18 to 24 March, and 25-27 March, 2007 in research management and farmer's management, respectively.

Results and Discussion

The result of the program is presented in Table 1 and 2. The result indicated that seed yield was not achieved at satisfactory level due to two time's unexpected rainfall during flowering stage. But compared to farmers' management, yield was increased 130% with improved management. The management practices were presented in Table 1, which indicated that farmer's managed plot was very poor compare to research managed plot. Gross return and benefit cost ratio were higher compared to farmer's managed plot (Table-2). It was observed that 8% gap in variable cost caused 57% gap in seed yield as well as gross return and 80% gap in gross margin (Table-1 and 2).

Farmer's reaction

The crop growth up to flower initiation stage was better which attracted the farmers. But two times occurrence of unexpected rain at the flowering stage affected the crop which resulted lower yield. As a result farmers were quite disinterested.

Table 1. Level of technology employed and yield obtain in BARI mosur-4 cultivation under different management practices at MLT site, Atghoria, Pabna during 2006-07

Management practices	Level of technology employed	
	Research managed farmers plot	Farmers managed plot
Variety	BARI Mosur-4	BARI Mosur-4
Seed rate (kg/ha)	30	45
Mechanical Power (no.)	2	2
Human labor (Man-days/ha)	42	31
Sowing time	6-12 November	25-28 November
Fertilizer (Kg/ha):		
N	21	35
P	17	21
K	19	14
B	0.7	-
Insecticides used (no.)	2	1
Fungicide used (no.)	2	-
Harvesting time	18-24 March	25-27 March
Seed yield (kg/ha):	1120	487
Yield gap	633 kg/ha (57%)	

Table 2. Per hectare cost and return (Tk/ha) of BARI mosur-4 cultivation under different management practices at MLT site, Atghoria, Pabna during 2006-07

Management practices	Research managed farmers plot	Farmers managed plot	GAP between RMP& FMP
Seed cost	1800	2400	-600
Mechanical power cost	2470	2470	-
Human labor cost	4500	3100	1400
Fertilizer :			
N	273	455	(-)182
P	1275	1575	(-) 300
K	512	448	64
B	165	-	165
Insecticides & Fungicide	1905	1423	482
Total variable cost	12900	11871	1029 (8%)
Gross return	39200	17045	22155 (57%)
Gross margin	26300	5174	21126(80%)
BCR	3.04	1.44	

Input price (Tk./kg): Human labor = 100, Seed= 60, N= 13, P = 75, K= 32 and B = 235
Output price (Tk./kg) Seed = 35

Yield Gap Analysis of Chickpea under Different Management Practices

Abstract

A pilot production program was initiated at Shimultoli village under MLT Site, Amnura, Nachol, Chapai Nawabgonj during rabi season of 2006-2007 to minimize yield gap between research station and farmers field through variety and management practices. The maximum number of plant /m^2 (35.4), plant height (31 cm), pods/plant (30), seeds/pod (1.52) and hundred seed weight (10.49 g) were found in researchers managed trial field. The highest seed yield (1.15 t/ha) was found in researchers managed trial field which was 46% increased over farmers field (0.79 t/ha). Same trends were observed in case of stover yield. The highest stover yield (1.34 t/ha) was found in researchers managed trial field, which was 28%, increased over farmers field (1.05 t/ha). The yield gap between researcher managed plot and farmers managed plot was due to time of sowing, fertilizer and pest management.

Introduction

Chickpea (*Cicer arietinum L.*) is the third most important pulse in respect of area and production. Its yield is probably most unstable among pulses due to its more sensitivity to microenvironment. Chickpea is found to be a very suitable dry land rabi crop with residual soil moisture condition. Under Barind stress situation it can be successfully grown after harvesting of short duration T.aman rice. The average yield of chickpea is low (600-700 kg/ha) compared to other neighboring countries (ICRISAT, 1990). Bangladesh has been developing a good number of varieties of chickpea. BARI has released high yielding and disease resistant/ tolerant varieties of chickpea. Yield potentialities of those varieties are 2-3 times higher than national average yields under research station/researchers managed trial. It is assumed that this yield gap between research station and farmers field is due to manifold reasons viz. i) knowledge gap, ii) resources constraints of farmers including quality seed, iii) environmental hazard. However, from previous yield gap research it was observed that this gap could be minimized to a considerable level by variety and management practices. In this context, a massive pilot production program was initiated to minimize yield gap between research station and farmer's field through variety and management practices, to popularize BARI released varieties of different crops and to monitor/record farmer's feedback.

Materials and Methods

The field trial was conducted at Shimultoli village under MLT Site, Amnura, Nachole, Chapai Nawabgonj during rabi season of 2006-07. The area of the block was 1.33 hectare by 3 cooperative farmers. Seeds were sown on 25-27 November 2006. The seed rate was maintained 50 kg/ha. The land was fertilized with 12-20-17-10-1 kg N-P-K-S-B per hectare, respectively as basal after final land preparation in the form of urea, triple super phosphate, muriate of potash, gypsum and boric acid, respectively. All fertilizers were applied as basal during the final land preparation. The crops were harvested on 20-25 March 2007. Data on yield and yield contributing characters of chickpea were recorded.

Results and Discussion

The highest seed yield (1.15 t/ha) was found in Researchers managed plot, which was 46%, increased over farmers managed plot (0.79 t/ha). Same trends were observed in case of straw yield. The highest straw yield (1.34 t/ha) was found in Researchers managed plot, which was 28%, increased over farmers managed plot (1.05 t/ha) (Table 1). It was observed that 30% gap in total variable cost caused 31% gap in seed yield and 33% gap in gross margin (Table 2).

Farmers' reaction

The co-operator farmers and their neighbors were encouraged to observe the performance of BARI Chola-5 at Researchers managed plot. They expressed their willingness to cultivate BARI Chola-5 in the next year under this management practices.

Table 1. Level of technology employed and yield obtain in BARI Chola 5 cultivation under different management practices at MLT site, Amnura, Nachole, Chapai Nawabgonj during 2006-07

Management practices	Level of technology employed	
	Research managed farmers plot	Farmers managed plot
Variety	BARI Chola-5	BARI Chickpa-5
Seed rate (kg/ha)	50	55
Mechanical power (no.)	3	2
Human labor (Man-days/ha)	45	28
Sowing time	25-27 November	1st week of December
Fertilizer (Kg/ha):		
N	12	-
P	20	16
K	17	-
S	10	-
B	1	-
Weeding	1	-
Insecticides used (no.)	3	-
Fungicides used (no.)	3	-
Harvesting time	20-25 March	1st April
Seed yield (t/ha):	1.15	0.79
Stover yield (t/ha):	1.34	1.05
Yield gap	0.360 t/ha (31%)	

Table 2. Per hectare cost and return (Tk/ha) of BARI Chola 5 cultivation under different management practices at MLT site, Amnura, Nachole, Chapai Nawabgonj during 2006-07

Management practices	Research managed farmers plot	Farmers managed plot	GAP between RMP& FMP
Seed cost	3000	3300	(-) 300
Mechanical power cost	3000	2000	1000
Human labor cost	4000	3100	900
Fertilizer :			
N	156	-	156
P	1500	1200	300
K	544	-	544
S	334	-	334
B	235	-	235
Insecticides & Fungicide	1019	-	1019
Total variable cost	13788	9600	418 (30%)
Gross return	46670	31600	15070 (32%)
Gross margin	32882	22000	10882 (33%)
BCR	3.38	3.29	

Input price (Tk./kg): Human labor= 100, Seed = 60, N = 13, P = 75, K = 32, S = 33 and B = 235
Output price (Tk./kg Seed = 40 straw = 0.50

MATURE TECHNOLOGIES

1	**Name of Technology**	:	**Intergraded Nutrient Management for Wheat-Mungbean-T.Aman rice Cropping Pattern under AEZ 11 (2004-05 to 2005-06)**		
2	Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)		
3	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur		
4	Location of application	:	Irrigated Medium Highland areas of greater Pabna with similar soils of AEZ 11		
5	Key characteristics of technology	:	• Incorporation of mungbean stover along with STB inorganic fertilizer produce higher yield and economic return in Wheat - Mungbean-T.Aman rice cropping pattern • Incorporation of crop residues (mungbean) sustain soil health and thereby improve long term soil fertility for higher yield		
6	Production guideline	:			
	Crop		Wheat	Mungbean	T.Aman
	Variety	:	Sourav/Shatabdi	BARI mung 5	BR 23
	Seed rate/spacing	:	120 kg/ha	30 kg/ha	25 cm x 15 cm
	Sowing/Planting date	:	Last week of November	Mid March	1st week of August
	Fertilizer application	:	All PKSB and ½ N as basal. Rest N before flowering stage as top dress	Seed treated with inoculum	All PKSZn as basal. N in 3 equal splits at 15, 35 and 55 DAT as top dress
	Yield (t/ha)	:	3.0-3.5	0.9-1.2	4.0-4.5
7	Risk involvement in adopting the technology		No risk involvement		
8	Impact on environment		No harmful effects on environment compared to existing farmers fertilization practice		
9	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk		
10	Expected outcome	:	Increase crop productivity and profitability and sustain soil health		
11	Socio-economic aspects	:	Considering the whole cropping pattern Total variable cost = Tk. 54202/ha Gross margin = Tk. 73936/ha		
12	Recommendation	:	Fertilizer dose for the cropping pattern (kg/ha)		

Crop	N	P	K	S	Zn	B	OM (t ha^{-1})
Wheat	100	25	30	15	0	1	CD 5
Mungbean	0	0	0	0	0	0	CR*
T.Aman	70	10	15	5	2	0	

* Mungbean stover incorporate with soil after pod harvest

1	**Name of Technology**	:	**Plant spacing and Nitrogen levels on the Growth and Yield of Batishak in the coastal area (2005-06 to 2006-07)**
2	Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)
3	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Joydebpur, Gazipur
4	Location of application	:	Medium highland areas of Noakhali district with similar soils of coastal areas (up to salinity 9 dS/m)of Bangladesh
5	Key characteristics of technology	:	Yield of Batishak increased with 40 cm X 15 cm spacing with 120 kg N/ha
6	Production guideline	:	
	Crop		Batishak
	Variety	:	BARI Batishak
	Spacing	:	40 cm X 15 cm
	Seedling age	:	Twenty days
	Sowing date	:	3 rd week of December
	Fertilizer dose (N-P-K kg/ha)		120-30-65
	Fertilizer application	:	All P and K as basal and N as two splits at 10 days intervals after planting.
	Yield (t/ha)	:	Green biomass : 20-30
7	Risk involvement in adopting the technology		No risk involvement.
8	Impact on environment		No harmful effects on environment
9	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk etc.
10	Expected outcome	:	Increase productivity and profitability of Batishak
11	Socio-economic aspects	:	New crop in the coastal area of Noakhali. The farmers were very much interested about this crop for its higher yield and taste over other leafy vegetables. Total variable cost = Tk.47900/ha Gross margin = Tk. 131250/ha BCR = 3.74
12	Recommendation	:	Batishak should be grown in 40 cm X 15 cm spacing with 120 kg/ha N in the coastal area of Noakhali where partial irrigation facility is available

1	**Name of Technology**	:	**Nutrient Management for Chilli in the coastal area (2005-06 to 2006-07)**
2	Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)
3	Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Gazipur
4	Location of application	:	Medium highland areas of Noakhali district with similar soils of coastal areas (up to salinity 8 dS/m)of Bangladesh
5	Key characteristics of technology	:	Balanced dose of fertilizer increased the Chilli yield in the coastal area
6	Production guideline	:	
	Crop		Chilli
	Variety	:	Local
	Spacing	:	40 cm X 30 cm
	Transplanting date	:	Last week of January
	Fertilizer application	:	All PK and 1/3rd N as basal. Rest N in 2 equal splits at 25 and 50 DAT.
	Yield (t/ha)	:	1.2-1.5 (dry)
7	Risk involvement in adopting the technology		No risk involvement.
8	Impact on environment		No harmful effects on environment
9	Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk
10	Expected outcome	:	Increase higher yield as well as economic benefits
11	Socio-economic aspects	:	Considering the whole cropping pattern Total variable cost = Tk. 31180/ha Gross margin = Tk. 34110/ha BCR = 2.09
12	Recommendation	:	Fertilizer dose for the cropping pattern (kg/ha)

Crop	N	P	K
Chilli	100	50	30

1. Name of Technology	:	**Integrated Nutrient Management for Sesame-T.Aman rice cropping pattern (**2001-02 to 2005-06)	
2. Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)	
3. Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Gazipur	
4. Location of application	:	Rainfed Medium Highland areas of Khulna with similar soils of AEZ 13	
5. Key characteristics of technology	:	STB Fertilizer Recommendation for HYG produces higher yield and return.	
6. Production guideline	:		
Crop		Sesame	T.Aman
Variety	:	BARI Til 2 or 3	BRRI dhan 23
Seed rate (kg/ha)		8	40
Spacing	:	30 cm X 5 cm	20 cm x 15 cm
Sowing/Planting date	:	2nd week of Feb.	Mid August
Fertilizer application	:	All KZn and ½ N as basal. Rest N at DAS as top dress	All K as basal. Rest N in 3 equal splits at 15 DAT, maximum tillering and before panicle initiation stage as top dress.
Yield (t/ha)	:	1.0-1.2	4.0-4.50
7. Risk involvement in adopting the technology		No risk involvement.	
8. Impact on environment		No harmful effects on environment compared to existing farmers fertilization practice	
9. Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk	
10. Expected outcome	:	Increase soil fertility for sustainable higher yield as well as economic benefits	
11. Socio-economic aspects	:	Considering the whole cropping pattern Fertilizer cost = Tk. 4502/ha Gross margin = Tk. 57567/ha MBCR = 2.19	
12. Recommendation	:	Fertilizer dose for the cropping pattern (kg/ha)	

Crop	N	P	K	Zn
Sesame	60	15	5	-
T.Aman	70	10	20	2.0

1. Name of Technology	:	**Integrated nutrient management for Cabbage and Cauliflower under AEZ 28 (2005-06 to 2006-07)**	
2. Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)	
3. Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Gazipur	
4. Location of application	:	Irrigated Medium Highland areas of Gazipur with similar soils of AEZ 28	
5. Key characteristics of technology	:	• IPNS and STB Fertilizer dose for HYG produces higher yield and return. • Applications of organic manure along with inorganic fertilizers sustain soil health for higher yield.	
6. Production guideline	:		
Crop		Cabbage	Cauliflower
Variety	:	Hybrid (Autumn Queen)	Hybrid (Shirigiku F_1)
Spacing	:	60 cm X 60 cm	60 cm X 60 cm
Planting date	:	1^{st} week of November	1^{st} week of November
Fertilizer application	:	All PSB and ½ K as basal. Total N and rest ½ of K in 3 equal splits at 7-10, 25-30 DAT and heading (cabbage) or curd (cauliflower) formation	
Yield (t/ha)	:	100-110	50-60
7. Risk involvement in adopting the technology		No risk involvement.	
8. Impact on environment		No harmful effects on environment compared to existing farmers fertilization practice	
9. Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk	
10. Expected outcome	:	Increase crop productivity and profitability and sustain soil health	
11. Socio-economic aspects	:		

	Cabbage	Cauliflower
Fertilizer cost (Tk/ha)	17689	15349
Gross margin (Tk/ha)	288366	322391
MBCR	12	14

12. Recommendation : Fertilizer dose for the cropping pattern (kg/ha)

Crop	N	P	K	S	Zn	PM (t/ha)
Cabbage	165	10	50	25	1	5
Cauliflower	100	10	80	20	1	5

1. Name of Technology	:	**Intercropping Groundnut with Garlic and Onion (2005-06 to 2006-07)**
2. Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)
3. Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Gazipur
4. Location of application	:	Faridpur, Pabna and groundnut growing areas in Bangladesh
5. Key characteristics of technology	:	Two rows of garlic and two rows of onion in between two rows of groundnut as intercropped found suitable and profitable then the sole groundnut
6. Production guideline	:	
Crop	:	Groundnut, Onion and Garlic
Variety	:	Graoundnut : BARI Chinabadam 6
Seed rate	:	Groundnut : 110 kg/ha, Sole onion : 4 kg/ha, Garlic : 500 kg/ha
Sowing/Planting date	:	November
Spacing and plant population	:	Groundnut : 40 cm X 10 cm, Garlic : 15 cm X 10 cm and Onion : 15 cm X 10 cm Groundnut : 360/ha and Garlic/Onion : 640/ha
Fertilizer dose (N-P-K-S-Zn-B kg/ha)	:	32-46-87-28-4-1 Additional 32 kg N/ha in two splits at 25 and 50 DAE of groundnut
Irrigations	:	Two irrigations depending upon on the soil moisture
Yield (t/ha)	:	Groundnut: 2.0 -2.5; Onion: 8.0-9.0; Garlic: 2.0-2.5
7. Risk involvement in adopting the technology		No risk involvement.
8. Impact on environment		No harmful effects on environment Soil could be sustained due to groundnut cultivation
9. Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk
10. Expected outcome	:	Total productivity could be increased
11. Socio-economic aspects	:	

	Gross return (Tk/ha)	Total variable cost (Tk/ha)	BCR
Sole groundnut	71100	30310	2.85
Groundnut + 2 rows of onion	162000	37850	4.30
Groundnut + 2 rows of garlic	144600	40650	3.53

12. Recommendation	:	This technology should be widely disseminated to the groundnut growing areas and farmers should be suggested to grow onion and garlic with groundnut as intercropping instead of growing sole groundnut

1. Name of Technology	:	**Intercropping Chilli with Garlic and Onion in the coastal area (2005-06 to 2006-07)**
2. Name of the organization	:	Bangladesh Agricultural Research Institute (BARI)
3. Contact division/person/unit	:	CSO, On-Farm Research Division, BARI, Gazipur
4. Location of application	:	Medium highland areas of Noakhali district with similar soils of coastal areas (up to salinity 8 dS/m) of Bangladesh
5. Key characteristics of technology	:	Two rows of garlic and two rows of onion in between two rows of chilli as intercropped found suitable and profitable then the sole chilli
6. Production guideline	:	
Crop	:	Chilli, Onion and Garlic
Sowing/Planting date	:	Last week of December
Spacing	:	Chilli : 40 cm X 20 cm, Garlic : 15 cm X 10 cm and Onion : 15 cm X 10 cm
Fertilizer dose ans application (N-P-K kg/ha)	:	100-60-30 All PK and 1/3rd N as basal. Rest N in two equal splits at 25 and 50 DAT.
Yield (t/ha)	:	Chilli 1.0-1.5; Onion 8.0-10.0; Garlic 2.5-3.0
7. Risk involvement in adopting the technology		No risk involvement.
8. Impact on environment		No harmful effects on environment
9. Procedure of transfer	:	Block demonstration, Farmers training, Field day, Booklet/Leaflet, Radio Talk
10. Expected outcome	:	Total productivity could be increased
11. Socio-economic aspects	:	

	Gross margin (Tk/ha)	Total variable cost (Tk/ha)	BCR
Sole Chilli	88250	35250	3.50
Chilli + 2 rows of onion	187400	62300	4.01
Chilli +2 rows of garlic	150700	66500	3.26

12. Recommendation : This technology should be widely disseminated to the chilli growing areas and farmers should be suggested to grow onion and garlic with chilli as intercropping instead of growing sole chilli

Year Round Onion Production in Homestead

Abstract

An experiment on year round onion was conducted at central station, Joydebpur, Gazipur during 2004 to 2006. The three years average bulb yield of year round onion (OF-5) was 68.08 kg/10 m^2 plot in a year. September planting (average yield 29.66 kg/10 m^2 plot) showed superiority over February (average yield 20.89 kg/10 m^2 plot) and May (average yield 17.53 kg/10 m^2 plot) planting. The adaptability trial of year round onion was also conducted at MLT sites of 20 different district of Bangladesh in 2006-07. In September-October planting, yield varied from 10.75 to 27.59 kg/10 m^2 plot in different locations with an average of 19.15±4.88 kg/10 m^2 plot. But in February planting, yield varied from 6.95 to 18.83 kg/10 m^2 plot with an average of 11.34 ± 3.87 kg/10 m^2 plot in different locations. Higher yield was found from Moulavibazar in both planting dates. Farmers of these locations were very much interested to cultivate year round onion in their homestead.

Introduction

Onion is one of the most important spices crop in Bangladesh. In our environmental condition onion cultivated in the rabi season. On-farm Research Division identified one promising onion line (OF-5) which can be cultivated throughout the year. If onion is produced throughout the year in a 5m x 2m plot in the homestead for 3 times/year about 70 kg onion could be produced. This amount of onion is sufficient to meet up the yearly onion need of 5-7 member family. Bangladesh has about 2 crore homestead (BBS, 2003). Out of these 2 crore homestead if we can grow onion in only 60 lakhs homestead in a 30 sq. m plot/year, the total production of onion will be equivalent of our national deficit. The yield performance of this advance line is promising in research station. So, to know the yield performance of advance line and local variety and to fulfill the yearly onion requirement of 5-7 members family from 10 m^2 plot was under taken in farmers' homestead in different districts of Bangladesh.

Materials and Methods

The experiment was conducted at On-station, Joydebpur, Gazipur as well as farmers homestead of MLT site, Lalmonirhat, Barind (Rajshahai), Pabna, Tangail, Jamalpur, Gazipur sadar, Shibpur (Narsingdi), Manikganj, Mymensing, Kishoreganj, Sherpur, Moulavibazar, Comilla, Noakhali, Feni, Laxmipur, Hathazari, Faridpur and Patuakhali district. The size of experimental plot was 10m^2. The number of cooperator farmer varied from 4-9 in different locations. The seedlings were raised in central research station, BARI, Gazipur. The onion seedling aged varied from 40-45 days. The seedlings were transplanted with the spacing of 15cm x 10cm. The field was fertilized with 120-45-100-32 kg/ha of N, P, K and S, respectively along with 4-5 kg/10 m2 plot cowdung or 3 kg/10 m2 plot poultry manure. The fungicides Rural 50 WP and Ridomil @ 2 gm + 2 gm = 4 g/liter was sprayed every 10-12 days interval up to 2 months for controlling of purple blotch diseases. The seedlings were transplanted in last week of September to 1st week of October and harvested in last week of January. The 2nd transplanting was done in 1st week of February and harvesting was done in 4th week of May. The 3rd planting was done in 4th week of May to 1st week of June, 2007 and at the present, the seedlings are still in the field.

Results and Discussion

On-station, Gazipur: Among the three planting dates, September planting showed higher yield than the February amand May planting over the years at Joydebpur, Gazipur (Table 1).In an average of three years, the yield of September planting was 29.66 kg/10 m^2 plot which was 42 and 69 percent higher than that of February and May planting, respectively. It might be due to prevailing of favorable environment during this season. Lowe yield was obtained from May planting over the years. Considering the year, the yield varied from 66.17 to 70.10 kg/10 m^2 plot with an average of 68.08 kg/10 m^2 plot from the same plot.

Other stations: The yield of September-October planting was better comparing the February planting over the locations (Table 2). The yield varied 10.75 to 27.59 kg/10 m^2 plot in different locations with an average of 19.15 ± 4.88 kg/10 m^2 plot. Higher yield 27.59 t/h was obtained from Moulivibazar during this season. Out of the 20 stations, the yield was more than 20kg/10 m^2 plot in 9 stations. The lower yield 10.75 kg/10 m^2 plot was obtained from Patuakhali. Average yield of September-October planting was 69% higher than the February planting. In February planting, yield varied from 6.95 to 18.83 kg/10 m^2 plot with an average of 11.34 ± 3.87 kg/10 m^2 plot in different locations. Higher and lower yield of year round onion 17.76 t/hand 6.95 kg/10 m^2 plot was obtained from Faridpur and Sherpur, respectively.

Farmers' reaction

Farmers are very much interested to cultivate the year round onion. Extension personnel were very much impressed to see the performance of advance line OF-5 and motivated to disseminate this technology to the farmers. Farmers expressed that onion production from the homestead (10 m^2) with the two plantings is sufficient to fulfill their need up to July-August. Purple blotch and thrips are two major problems for this crop.

Conclusion

From the result of research station and farmers field, it was found that year round onion showed better performance in all locations. Necessary steps should be taken for the availability of seeds and seedling among the farmers. Training programmes should be arranged to transfer this technology.

Reference

BBS, 2003. Year book of Agricultural Statistics, 2001 (17^{th} ed), Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning, Governments of the People Republic of Bangladesh, Dhaka. P. 70.

Table 1. Yield of year round onion at Joydebpur, Gazipur (on-station) during 2004 to 2006

Time of planting	Bulb yield (kg/10 m^2 plot)			
	2004	2005	2006	Average (3 years result)
February	21.00	21.17	20.50	20.89
May	17.00	18.00	17.60	17.53
September	30.00	27.00	32.00	29.66
Total	68.00	66.17	70.10	68.08

Table 2. Average bulb yield of year round onion in different locations during 2006-07

Locations	Bulb yield (kg/10 m^2 plot) at two planting time	
	September/October'06	February'07
Lalmonirhat	17.73	10.18
Barind (Rajshahi)	12.36	12.78
Pabna	18.50	-
Tangail	18.10	-
Jamalpur	24.83	15.60
Gazipur	20.94	11.20
Shibpur	24.18	14.10
Manikganj	22.47	8.65
Mymensingh (Sadar)	20.33	-
Mymensingh (Trishal)	16.50	8.20
Kishorgonj	20.18	8.20
Sherpur	15.60	6.95
Moulavibazar	27.59	18.83
Comilla	17.10	14.50
Noakhali	19.13	7.69
Feni	25.93	10.59
Laxmipur	13.47	6.18
Hathazari	12.10	10.00
Faridpur	25.14	17.76
Patuakhali	10.75	-
Average	**19.15**	**11.34**
S.D.	**4.88**	**3.87**

Production Program on Potato-Boro-T.Aman Cropping Pattern in the Irrigated Medium Highland of Sherpur

Abstract

A production program on Potato-Boro-T.Aman cropping pattern was started at Farming Systems Research and Development Site, Kushumhati, Sherpur during 2006-07 to disseminate the pattern and also to verify the best treatments found from the SFFP trial. The result showed that IPNS treatment performed better than the farmers' practice in all the crops viz. Potato, Boro and T.Aman.

Introduction

Potato-Boro-T.Aman cropping pattern is now becoming popular in medium highland of AEZ 9. During the last three years six fertilizer doses were tested under SFFP for this pattern. Out of six different fertilizer doses IPNS treatment performed better. Hence, a production program was taken at Farming Systems Research and Development Site, Kushumhati, Sherpur during 2006-07 on Potato-Boro-T.Aman to compare the IPNS treatment with the farmers' practice.

Materials and Methods

A production program on Potato-Boro-T.Aman cropping pattern was started at Farming Systems Research and Development Site, Kushumhati, Sherpur during 2006-07 to compare the IPNS treatment with the farmers' practice. The design of the experiment was randomized complete block with six dispersed replications. The unit plot size was 10m x12m. The treatments were T_1= IPNS basis fertilizer management with cowdung and T_2= Farmers' practice. The programme was started from T.Aman season, 2006. The land was prepared properly as for the crop requirement. The details of the fertilizer combination and crop management have been shown in Appendix 1 and Appendix 2.

Ten plants were collected prior to harvest from each plot after attaining the maturity of the crop to collect data on yield attributes. The collected data were averaged and presented in the table.

Results and Discussion

Yield and yield contributing characters of the crop potato under the pattern Potato-Boro-T.aman have been shown in Table 1. All the yield contributing characters was higher in IPNS treatment and was lower in farmer' practice. However, IPNS treatment gave the potato yield of 26.78 t/ha while the farmers' practice gave 19.65 t/ha of potato yield.

For Boro also all the yield contributing characters were higher in IPNS treatment and lower in farmer' practice. However, IPNS treatment gave the grain yield of 6.46 t/ha while the farmers' practice gave 5.75 t/ha of boro yield.

For T.Aman also all the yield contributing characters were higher in IPNS treatment and lower in farmer' practice. However, IPNS treatment gave the grain yield of 4.37 t/ha whiles the farmers' practice gave 3.75 t/ha of T.Aman yield.

Table 1. Yield contributing characters of Potato as influenced by fertiliser levels in the CP Potato- Boro-T. Aman at FSRD Site, Kushumhati, Sherpur under demonstration programme during 2006-07

Treatment	Plant height (cm)	Tuber/plant (no.)	Tuber wt. /plant (g)	Tuber length (cm)	Tuber dia (cm)	Tuber yield (t/ha)
IPNS	43.87	5.01	332.8	4.51	2.52	26.78
FP	40.17	4.13	265.2	4.12	2.34	19.65

Table 2. Yield contributing characters of Boro as influenced by fertiliser levels in the CP Potato- Boro-T.Aman at FSRD Site, Kushumhati, Sherpur under demonstration programme during 2007

Treatment	Plant height (cm)	Panicle/m^2 (no.)	Grain/panicle (no.)	TGW (g)	Grain yield (t/ha)	Straw yield (t/ha)
IPNS	91.38	414.28	112.00	26.8	6.46	8.37
F.P	89.00	3454.62	98.54	24.0	5.75	7.18

Table 3. Yield contributing characters of T.aman as influenced by fertiliser levels in the CP Potato-Boro-T.Aman at FSRD Site, Kushumhati, Sherpur under during 2006

Treatment	Plant height (cm)	Panicle/m^2 (no.)	Grain/panicle (no.)	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
IPNS	84.34	296.6	83.33	24.6	4.37	5.08
F.P	84.08	274.4	81.33	24.0	3.75	4.86

Appendix 1. Fertilizer doses of Potato- Boro-T.Aman at FSRD Site, Kushumhati, Sherpur under during 2006

Trt	Potato						Boro				T. Aman			
	N	P	K	S	Zn	CD	N	P	K	S	N	P	K	S
	kg/ha													
IPNS	132	27	105	19	4	5 t/ha	147	15	59	12	98	10	41	6
F.P	120	20	80	0	0	0	112	25	45	18	60	10	0	0

Appendix 2. Crop management in Potato-Boro-T.Aman CP during 2006 -07

Crop	Variety	Planting time	Harvesting	Top dressing		Weeding		Irrigation	
				No	DAS/ DAT	No	DAS/ DAT	No.	DAS/ DAT
Potato	Diamant	22-25Nov./06	20-25Jan./07	1	30	1	30	2	20,40
Boro	BRRI dhan 28	23-30 Jan./07	4-7 May/07	2	15,45	2	17,50	Cont.	-
T.Aman	BRRI dhan 33	10-20Aug./06	8-16Nov/06	2	45	1	20		-

Production Program at Faridpur

Crops	Variety	Numbers of farmers	Date of sowing	Area (bigha)	Yield (kg/ha)	Remarks
Lentil	BARI mashur 4	15	10-11-2006 to 01-11-06	25	1300-1510	Farmers happy for higher yield
Mustard	BARI Sarisha 11	15	30-10-2006 to 08-11-06	15	1700-1780	Farmers choose new variety
Chickpea	BARI chola 5	16	06-11-06 to 4-12-06	30	900-1520	Yield is satisfactory but pod borer is problem
Wheat	Satabdi	6	15-11-06 to 20-11-06	10	3250-3850	Farmers choose new variety
Mungbean	BARI mung 5	5	8-3-2007 to 15-3-2007	6	1270-1300	Farmers choose new crop of the area

Pilot Production Program of different Locations under OFRD in 2006-2007

Crop	Location	Variety	Area (ha)	Yield (t/ha)
Wheat	Kaliganj, Jhenaidah	Shatabdi	-	4.50
	Kuadabazar, Jessore	Shatabdi	-	3.00
	Pushpapara, Pabna	Gourab	-	2.08
	Pushpapara, Pabna	Prodip	-	3.30
	Rajshahi	Gourab	-	3.12
	Rajshahi	Bijoy	-	3.42
	Rajshahi	Prodip	-	4.25
	Rajshahi	Shatabdi	-	4.18
	Rajshahi	Sourav	-	3.64
	Majigram, Pabna	Shatabdi	1.0	3.74
	Majigram, Pabna	Sourav	0.5	4.02
	Kadamshahar, Rajshahi	Gourab	4.0	2.34
Chickpea	Kadamshahar, Rajshahi	BARI Chola-5	1.5	1.30
Mustard	Kadamshahar, Rajshahi	BARI Sarisha-9	2.0	1.05
	Keshobpur, Jessore	BARI Sarisha-9	1.0	1.42
	Jhikorgacha	BARI Sharisha-9	1.0	2.0
	Jalalpur, Sylhet	BARI Sharisha-9	1.0	1.18
	Sultanpur, Comilla	BARI Sharisha-9	1.0	0.90 (non irrigated)
	Tangail	BARI Sharisha-9	1.0	1.10
	Kadamshahar, Rajshahi	BARI Sharisha-11	1.0	1.44
	Labutala, Jessore	BARI Sharisha-11	1.0	2.02
	Hatgobindapur, Faridpur	BARI Sharisha-11	1.0	1.70
	Jalalpur, Sylhet	BARI Sharisha-11	1.0	1.52
	Sultanpur, Comilla	BARI Sharisha-11	1.0	1.23 (non irrigated)
	Tangail	BARI Sharisha-11	1.0	2.20
	Mirzapur, Tangail	BARI Sharisha-15	1.0	1.73
Barley	Kadamshahar, Rajshahi	BARI Barley-6	0.20	1.32
Lentil	Kadamshahar, Rajshahi	BARI Masur-4	1.5	0.75
	Shalikha, Magura	BARI Masur-4		1.5
	Damurhuda, Kushtia	BARI Masur-4	2.0	1.7
	Faridpur	BARI Masur-4	-	1.5
Maize	Kadamshahar, Rajshahi	BARI Hybrid Maize-2	0.66	6.75
	Kadamshahar, Rajshahi	BARI Hybrid Maize-5	1.0	8.56
Potato	Kadamshahar, Rajshahi	Cardinal	0.26	12.2
	Kadamshahar, Rajshahi	Diamont	0.5	10.5
	Faridpur	Cardinal	-	22.30
		Diamont	-	26.5
		Multa	-	20.80
		Petronis	-	16.60
Black gram	Bharamara, Gangni and Kushtia	BARI Muas kali-3	1.0	1.33
Mung bean	Bharamara, Damurhuda and Gangni in Dushtia	BARI Mung-6	-	1.23
	Bharamara, Damurhuda in	BARI Mung-6	1.5	1.12

Crop	Location	Variety	Area (ha)	Yield (t/ha)
	Kushtia			
	Bharamara, Damurhuda in Kushtia	BARI Mung-6	2.5	0.95
Sesame	Rajakhali, Pautakhali	BARI Til-3	-	0.69
	Kauakata, Pautakhali	BARI Til-3	-	0.61
Countrybean	Mymensingh	BARI Shim-1	0.1	24.25
Groundnut	Char Martin, Lazmipur	BARI Chinabadam-6	0.4	3.16
		Jhingabadam	0.4	2.83
		DG-2	0.4	2.32
	Char Lawrence, Laxmipur	BARI Chinabadam-6	0.4	2.92
		Jhingabadam	0.4	2.56
		DG-2	0.4	2.27
	Subarna Char, Noakhali	BARI Chinabadam-6	0.4	2.70
		Jhingabadam	0.4	2.31
		DG-2	0.4	2.03
Soybean	Char Martin, Laxmipur	BARI soybean-5	0.4	2.62
	Char Lawrence, Laxmpiru	Shohag	0.4	2.75
	Subarna Char, Noakhali	BARI soybean-5	0.4	2.75
	Kutiparhabu, Burirhat	BARI soybean-5	0.4	1.97

Production Program, Crop Museum and Activities of BARI Technology Village

Performance of Cabbage produced with USG as a block approach at FSRD site, Pushpapara, Pabna during 2006-07

No. of co-operators	Area covered of the block (ha)	Av. whole plant wt. (kg)	Av. marketable wt. (Kg)	Yield (t ha^{-1})	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
4	0.70	3.64	3.25	120.57	241140	27105	214035	8.89

Area and performance of crops under different cropping patterns at Faridpur during 2006-07

Cropping pattern	Area covered (bigha)	No. & category of co-operator	Mean yield (t/ha)	GR (Tk/ha)	TC (Tk/ha)	GM (Tk/ha)	BCR
1. Chickpea-T.aman	5.0	3 (1 small & 2 marginal)	C.pea = 1.05 T.aman = 3.50	81000	32000	49000	2.53
2. Wheat-T.aman	4.5	2 (small)	Wheat = 2.40 T.aman = 3.62	90110	39900	50210	2.26
3. Potato-T.aman	2.0	2 (small)	Potato= 13.00 T.aman= 3.70	15200 0	84000	68000	1.84
4. Mustard-Boro-T.aman	5.0	3 (2 small & 1 marginal)	Mustard= 1.12 T.aman= 3.75	74850	33400	41450	2.24

Year Round Vegetable and Creeper Production in Homestead by Following Goyespur Homestead Model at Prophullapara, Soalok, Bandarban during 2006-07

Kharif-2 2006 Plot size: 20sq.m.

Bed no./ Space used	Crops	Yield (kg)	Income (Tk)	Distribution of vegetables (kg)			
				Own Consumption	Gift	Sale	Cash income(Tk.)
01	Lalshak	19	228	6	3	10	72
02	Dheros	11	176	5	-	6	96
03	Danta	20	100	6	3	11	55
04	Kankong	27	162	8	3	16	96
05	Batishak	10	50	4	2	4	20
Creeper	Bean	17	340	6	2	9	180
Boundary	Papaya	16p	256	3	1	12p	192
Total		104	1312	38	13	56	711

Rabi, 2006-07

Bed No	Crops	Yield(kg)	Income (Tk)	Distribution of vegetables (kg)			
				Consumption	Gift	Sale	Cash(Tk.)
01	Radish	8	48	3	-	5	30
02	Lalshak	18	216	5	2	11	132
03	Brinjal	14	140	5	1	8	80
04	Bushbean	7	56	4	1	2	16
05	Tomato	15	180	4	-	11	132
	Total	62	**640**	21	4	37	**390**

Homestead Activities at Faridpur

Vegetables	Farmer no.	Quantity harvested/farmer (kg)	Value (Tk) (kg)	Consumption / farmer (kg)	Sold/ farmer (kg)	Cash income/ farmer (Tk)
Gimakalmi	7	25	156	7	18	150
Lalshak	6	10	95	4	6	60
Radish	7	30	150	10	20	150
Spinach	5	20	140	10	10	120
Cabbage	5	22	132	13	9	54
Summer onion	7	14	140	14	-	-

Utilization fisheries gher boundaries through vegetables production in coastal area at Khulna

Name of The Technology	No. of farmer's	Area (ha.)	Initiation	Yield (t/ha.)	Gross return (Tk./ha)	TVC (Tk./ha.)	Gross margin (Tk./ha.)	Remarks
Gimakolmi-Tomato Bitter gourd-Sweet gourd.	16	0.12	June'06	Gimakolmi-36.1 Tomato-45.50 Bitter gourd-6.50 Sweet gourd-28.60	12635 295750 71500 143000	43000 120000 60000 66000	30365 175750 11500 77000	Farmer's are interested to follow the pattern.

Performance of different fruit trees in the homestead, 2006-07

Tree species	Name of variety	No. of tree planted	Date of planting	Plant height (cm) on 24.6.06	Plant height(cm) on 15.5.07	No. of trees flowered	No. of fruit bearing trees
Location:Trishal							
Mango	Amropali	6	24.6.06	129.17	169.33	2	1
Kanthal	Deshi	6	24.6.06	124.00	221.83	-	-
Litchi	Mongalbari	6	24.6.06	43.67	58.33	-	-
Jamrul	Apple	6	24.6.06	52.17	101.50	-	-
Guava	Swarupkathi	6	24.6.06	81.00	138.40	3	2
Jujube	BAU Kul-1	6	24.6.06	39.83	146.80	-	-
Lime	Kagugi	6	24.6.06	42.17	79.33	-	-
Lemon	Santed	6	24.6.06	68.17	89.50	-	-
Pumelo	Misti	6	24.6.06	52.83	87.50	-	-
Location: Mymensingh Sadar							
Mango	Amropali	6	24.6.06	124.43	183.43	2	1
Kanthal	Deshi	6	24.6.06	117.00	214.83	-	-
Litchi	Mongalbari	6	24.6.06	39.00	76.60	-	-
Jamrul	Apple	6	24.6.06	71.43	159.43	-	-
Guava	Swarupkath	6	24.6.06	91.00	176.71	6	6
Jujube	BAU Kul-1	6	24.6.06	40.43	162.00	2	1
Lime	Kagugi	6	24.6.06	41.29	97.00	-	-
Lemon	Santed	6	24.6.06	67.43	120.00	-	-
Pumelo	Misti	6	24.6.06	42.57	55.00	-	-

Distribution of fruit trees among the farmers at the FSRD site, Kushumhati, Sherpur, 2006-07

Fruit tree	Variety	Sampling (no.)	Cooperator farmers (no.)	Survival (%)
Mango	BARI Aam-1	9	30	
	BARI Aam-2	11		90
	BARI Aam-3	11		
Litchi	BARI litchi-3	80	40	80
Lemon	Alachi	32	25	90
Coconut	Local	29	25	90
Guava	BARI peara-2	32	28	90
	Sharapkathi	25	25	75
Jujube	Apple kul	50	10	80
Carambula	Local	25	25	80
Olive	Local	25	25	80
Karamcha	Local	25	25	75
Sharifa	Local	25	25	80
Golapjam	Local	25	25	90
Hog plant	Local	25	25	80
Jambura	Local	25	25	80
Bilambi	Local	25	25	90

Plantation of trees at Faridpur

Sapling	Farmers no.	Variety	Number of sapling	Present condition
Mango	25	Amropali	50	100% survive
Guava	20	Kazi peara	40	90% good
Litchi	10	BARI litchi 2	20	75% Good
Neem	40	Deshi	40	90% Good
Drumstick	54	Local	200	76% good

Fruit trees

Items		No. of co-operators	Mango	Coconut	Citrus	Nashpati	Litchi	Guava
No. of supplied seedlings	2004	60	49	-	-	-	11	-
	2005	27	29	14	39	13	10	-
	2006	40	27	26	26	-	26	56
	Total	127	105	40	65	13	47	56
Living trees			74	30	38	9	26	44
Mortality rate (%) over 3 years			29.52	25	41.53	30.77	44.68	21.42
Present status			Some trees (planted in 2004) are initiating fruit	Vegetative stage	Vegetative stage	Vegetative stage	Vegetative stage	Vegetative stage

Management of Different Plantation Trees at the FSRD site, Pushpapara, Pabna during 2006-07

Existing trees	Management provided	No. of trees monitored	Present condition	Impact
Mango	Spraying insecticide for controlling mango hopper	650	Heavy fruit bearing	Gradually build up awareness among the farmers
	Grafting	60	Good	Farmers are initiated practice on their existing trees after learning on grafting
	Irrigation and fertilizer management	80	Retain increased fruit bearing due to less fruit dropping	Farmers are being motivated to see the better results
Litchi	Irrigation and fertilizer management	50	Better vegetative growth of newly planted seedling and seemed to be increased in fruit bearing of the existing trees.	Farmers are being motivated to see the better results
Guava	Irrigation and fertilizer management	20	Comparatively better growth of the existing trees	Making awareness to the farmers
Jujubee	Grafting	25	Grafted successfully (80%)	Farmers showed their great interest and they have been practicing because of high price of grafted seedling of quality jujubee
	Irrigation and fertilizer management	25	Better fruit bearing	Farmers are motivated to do this practice

Livestock Activities at Faridpur

Activities	Household No.	Breed/variety	No. of bird/cattle	Present condition
Layer rearing	2	Faomi	60	Egg production started
Vaccination of poultry	100	Local	200	Mortality decreased
Dewarming	50	Local	80	Good
Vitamin feeding	40	Local	60	Good
Grass	20	Napier	20	100% good, Farmers happy for fodder crop

Growth and yield of Tilapia fish in the mini ponds at Mymensingh Sadar MLT site during rainy season of 2006

Name of farmers	Pond size (dec.)	No. of fish		Length of fish (cm)		Breadth of fish (cm)		Weight of fish (g)		Yield (kg/ dec.)
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	
Md. Rostam Ali	4.5	500	425	2.40	19.4	1.30	8.15	7.0	121.5	11.47
Md. Ibrahim Miah	4	420	390	2.45	17.6	1.35	7.25	6.5	112.0	10.92

Crop Museum (2006-07)

Barind, Rajshahi

Crops	Crop variety	Plot size	Date of sowing/ transplanting	Date of harvest	Mean yield (kg/ha)
Wheat	Gourab	3 x 4m	17 Nov. 2006	21 Mar. 2007	3170
	Shatabdi	Do	Do	Do	3320
Chickpea	BARI Chola-4	Do	Do	03 April. 2007	890
	BARI Chola-5	Do	Do	Do	1167
	BARI Chola-6	Do	Do	Do	810
	BARI Chola-7	Do	Do	Do	945
Mustard	BARI Sharisa-6	Do	Do	24 Feb. 2007	1120
	BARI Sharisa-8	Do	Do	Do	978
	BARI Sharisa-9	Do	Do	11 Feb. 2007	890
	BARI Sharisa-10	Do	Do	24 Feb. 2007	1225
	BARI Sharisa-11	Do	Do	24 Feb. 2007	1356
	BARI Sharisa-12	Do	Do	11 Feb. 2007	1056
	BARI Sharisa-13	Do	Do	24 Feb. 2007	1320
Lin seed	Nila	Do	18 Nov. 2006	12 Mar. 2007	950
Niger	Shova	Do	Do	07 Mar. 2007	875
Sunflower	BARI Sunflower-2	Do	Do	28 Mar. 2007	1080
Barley	BARI Barley-3	Do	Do	03 April 2007	1250
	BARI Barley-6	Do	Do	Do	1464
Maize	BARI Hybrid Maize-2	Do	22 Nov. 2006	25 April 2007	6830
	BARI Hybrid Maize-5	Do	Do	20 April 2007	8520
Lentil	BARI Masur-4	Do	17 Nov. 2006	07 Mar. 2007	1015
Coriander	BARI Dhania-1	Do	Do	21 Mar. 2007	956 (seed)
Methi	BARI Methi-1	Do	28 Nov. 2006	21 Mar. 2007	960 (seed)
Soybean	Bangladesh Soybean-4	Do	17 Nov. 2006	25 Mar. 2007	1070
	BARI Soybean-5	Do	Do	Do	1165
Garden pea	BARI Motorshuti-1	Do	Do	17 Feb.-14 Mar. 2007	12.65 ton (vegetable)
Red amaranth	BARI Lalshak-1	Do	Do	12 Mar. 2007	1230 (seed)
Spinach	Kopi Palong	Do	Do	10 Apr. 2007	2220 (seed)
Bush bean	BARI Jharseem-1	Do	Do	5 Mar. 2007	1556 (seed)
China cabbage	BARI Batishak-1	Do	Do	20 Mar. 2007	850 (seed)
Onion	BARI Piaj-1	Do	27 Nov. 2006	02 April 2007	10.5 ton (bulb)
Radish	BARI Mula-1 (Tasakisan)	Do	17 Nov. 2006	10-15 Feb. 2007	25 ton (with leaf)
	BARI Mula-2 (Pinki)	Do	Do	Do	19 ton (with leaf)
	BARI Mula-3 (Druti)	Do	Do	Do	23 ton
Brinjal	BARI Begun-4 (Kajla)	Do	27 Nov. 2006	30 Feb.-28 Apr. 07	28.2 ton
	BARI Begun-5 (Nayantara)	Do	Do	Do	26 ton
Potato	Cardinal	Do	Do	10 Mar. 2007	16.2 ton
	Diamont	Do	Do	Do	14.5 ton
Sholuk	Advanced Line	Do	17 Nov. 2006	12 March 2007	1550 (seed)
Firingi	Do	Do	Do	Do	255 (seed)
Black cumin	Do	Do	Do	Do	650 (seed)

Pabna

Name of crop	Name of variety	Seed rate (kg/ha)/ Spacing (cm)	Date of sowing/ Planting	Date of harvest	Plant population m^{-2}	Plant height (cm)	No. of pod/ grain/tuber/ fruit /plant	1000 seed/ single tuber/ weight (g)	Yield (t ha^{-1})	Cost of cultivation (Tk ha^{-1})	Gross margin (Tk ha^{-1})
1	2	3	4	5	6	7	8	9	10	11	12
Rabi crop											
Batishak	BARI Batishak-1	2.00	29/11/06	04/03/07	45	113.6	77.9(15.6)	2.00	9.00	18105	71895
Coriander	BARI Coriander-1	10.00	27/11/06	14/03/07	126	77.30	-	-	1.82	16750	92450
Bushbean	BARI Bushbean-1	50.00	27/11/06	02-28/02/07	21	26.5	19.7	-	13.00	22400	107600
Tomato	BARI Tomato-2	60X40cm^2	27/11/06	19/02-10/03/07	2.66	75.3	24	-	43.00	28150	401850
	BARI Tomato-3	60X40cm^2	27/11/06	19/02-10/03/071	2.57	78.8	21.5	-	60.00	28150	571850
	BARI Tomato-8	60X40cm^2	27/11/06	19/02-10/03/07	2.74	81.07	31.2	-	42.00	28150	391850
	BARI Tomato-9	60X40cm^2	27/11/06	25/02-18/03/07	2.64	83.5	24.5	-	35.00	28150	321850
Potato	Diamont	2000	13/12/06	22/02/07	6.67	38.1	5.3	-	16.00	63120	128880
	Cardinal	2500	07/12/06	22/02/07	6.67	27.70	6.9	-	14.66	73120	102800
	Patrones	1500	07/12/06	22/02/07	8.00	13.6	4.8	-	6.67	53120	13580
Red amaranth	BARI Red amaranth-1	2	27/11/06	21/03/07	48	111.9	-	-	2	15680	4320
Garden pea	BARI Garden pea-1	50	27/11/06	28/02/07	32	72.3	7.3(5.8)	-	6.00	19400	52600
	BARI Garden pea-2	50	29/11/06	28/02/07	35	73.6	6.6(5.6)	-	5.90	19400	51400
Wheat	Shatabdi	120	27/11/06	28/03/07	265	87	(43.1)	43.8	3.35	20850	39450
	Shourav	120	27/11/06	28/03/07	386	84.5	(42)	41.8	3.65	20850	44850
	Gourab	120	27/11/06	21/03/07	302	80.5	(29.8)	49	2.65	20850	26850
	Prodip	120	27/11/06	21/03/07	268	86.3	(44.9)	51.8	3.90	20850	49350
Barley	BARI Barley-5	120	27/11/06	10/03/07	262	110.1	(37.3)	38	2.30	20100	16700
Sunflower	BARI Sunflower-2	10	27/11/06	18/03/07	8	153.5	(931.8)	72	2.04	19300	21500
Mustard	BARI Mustard-8	4	27/11/06	23/02/07	68	124.5	103.2(37.1)	3.8	1.75	19215	24535
	BARI Mustard-9	5.50	27/11/06	19/02/07	46	107.8	73.5(19.8)	3.3	1.65	19215	22035
	BARI Mustard-11	5.50	27/11/06	06/03/07	50	142.9	235.7(11.3)	3.3	1.90	19215	37785
Lentil	BARI Lentil-3	30	27/11/06	11/03/07	129	36.6	55.4	16	0.90	13350	24900
	BARI Lentil-4	30	27/11/06	11/03/07	96	33.8	82	18	1.10	13350	33400
Radish	BARI Radish-1	2.5	27/11/06	28/01/07	9	18.5	-	-	41.00	24580	139420
Maize	BARI Hybrid Maize-2	20	27/11/06	02/05/07	5.33	184.2	568.8	330.0	10.11	33070	78140
	BARI Hybrid Maize-3	20	27/11/06	02/05/07	5.33	182.9	543.2	346.0	9.72	33070	73850
	BARI Hybrid Maize-5	20	27/11/06	02/05/07	5.33	164.5	444.4	351.0	8.67	33070	62300
Kharif crop											
Stem amaranth	BARI Stem amaranth-1	3	17/04/07	28/05-10/06/07	25.33	84.8	-	-	39	15450	179550
Lady's finger	BARI dheros-1	7	17/04/07	5-16/06/07	3.7	127.5	25.1	-	9.5	16800	40200
Kankong	BARI gima kolmi-1	7	17/04/07	17/05-16/06/07	43.3	29.3	-	-	33	16800	148200

Tangail

Name of crop	Name of variety	Date of sowing	Date of harvesting	Yield (t/ha)	Cost cultivation (Tk./ha)	Net return (Tk./ha)
Cereal crops						
Wheat	Prodip	22.11.06	15.3.07 to 19.3.07	3.15	24990	30135
	Gaurab			3.05	24990	28385
	Surab			3.22	24990	31360
	Shatabdi			3.5	24990	36260
	Bijoy			3.97	24990	44485
Pulse crops						
Chickpea	BARI chola-4	18.1106	28.03.07	1.27	16515	34285
	BARI chola-5	18.1106	26.03.07	1.60	16515	48685
Lentil	BARI lentil 4	4.11.06	16.03.07	1.54	14500	56100
Oil crops	BARI sarisha-6	06.11.06	20.02.07	1.5	20490	17010
	BARI sarisha-8	06.11.06	20.02.07	1.55	20490	18260
	BARI sarisha-9	06.11.06	22.01.07	1.25	20490	10760
	BARI sarisha-11	06.11.06	31.01.07	1.60	20490	20210
	BARI sarisha-13	06.11.06	23.02.07	1.20	20490	10010
	BARI sarisha-14	06.11.06	24.02.07	1.45	20490	15760
	Tori 7	06.11.06	17.01.07	0.85	18500	2060
Vegetables						
Potato	Petronis	22.11.06	19.02.07	20.50	75825	231675
	Diamand	22.11.06	21.02.07	22.70	75825	260505
	Cardinal	22.11.06	23.02.07	21.95	75825	253425
Garden pea	BARI garden pea-2	08.11.06	05.03.07	8.25	18500	45500
Bushbean	BARI bushbean 1	07.1106	22.03.07	7.52	17190	12810
Brinjal	BARI begun 4	14.12.06	18.04.07	35.25	67520	108660
	BARI begun 5	14.12.06	28.04.07	32.50	67520	95980
Coriander	BARI coriander 1	10.11.06	-	1.725	20520	48630

Faridpur

Name of crop	Name of variety	Date of sowing	Date of harvesting	Yield (t/ha)	Cost cultivation (Tk./ha)	Net return (Tk./ha)
Cereal crops						
Wheat	Prodip	22.11.06	15.3.07 to 19.3.07	3.15	24990	30135
	Gaurab			3.05	24990	28385
	Surab			3.22	24990	31360
	Shatabdi			3.5	24990	36260
	Bijoy			3.97	24990	44485
Pulse crops						
Chickpea	BARI chola-4	18.1106	28.03.07	1.27	16515	34285
	BARI chola-5	18.1106	26.03.07	1.60	16515	48685
Lentil	BARI lentil 4	4.11.06	16.03.07	1.54	14500	56100
Oil crops	BARI sarisha-6	06.11.06	20.02.07	1.5	20490	17010
	BARI sarisha-8	06.11.06	20.02.07	1.55	20490	18260
	BARI sarisha-9	06.11.06	22.01.07	1.25	20490	10760
	BARI sarisha-11	06.11.06	31.01.07	1.60	20490	20210
	BARI sarisha-13	06.11.06	23.02.07	1.20	20490	10010
	BARI sarisha-14	06.11.06	24.02.07	1.45	20490	15760
	Tori 7	06.11.06	17.01.07	0.85	18500	2060
Vegetables						

Name of crop	Name of variety	Date of sowing	Date of harvesting	Yield (t/ha)	Cost cultivation (Tk./ha)	Net return (Tk./ha)
Potato	Petronis	22.11.06	19.02.07	20.50	75825	231675
	Diamand	22.11.06	21.02.07	22.70	75825	260505
	Cardinal	22.11.06	23.02.07	21.95	75825	253425
Garden pea	BARI garden pea-2	08.11.06	05.03.07	8.25	18500	45500
Bushbean	BARI bushbean 1	07.1106	22.03.07	7.52	17190	12810
Brinjal	BARI begun 4	14.12.06	18.04.07	35.25	67520	108660
	BARI begun 5	14.12.06	28.04.07	32.50	67520	95980
Coriander	BARI coriander 1	10.11.06	-	1.725	20520	48630

Sylhet

Crop	**Varieties**	Area	**Yield (t/ha)**
Rabi season (2006-2007)			
Mustard	BARI sharisha-8 BARI sharisha-9 BARI sharisha-11	15m×2m	1.73 1.18 1.52
Chickpea	BARI chola-3 BARI chola-8	”	1.56 1.62
Tomato	BARI tomato-2 BARI tomato-8 BARI tomato-9	”	72.75 77.35 63.52
Garden pea	BARI motorshuti-1 BARI motorshuti-2 BARI motorshuti-3	”	6.82 8.58 11.25
Bush bean	BARI Jarshim-1	”	12.35
Brinjal	BARI -4 (Kazla) BARI -5 (Noyantara)	,,	28.25 24.42
Radish	BARI mula-1 BARI mula-3	”	62.35 38.25
Potato	Diamant Patronis	,,	9.43 7.55
Lalshak	BARI lalshak-1	”	7.45
Sunflower	BARI -2	”	1.12
Maize	BARI hybrid maize-4 BARI hybrid maize-5	”	4.32 5.64
Kharif season (2007)			
Gimakalmi	BARI Gimakalmi-1	5m x 8m	Vegetative stage
Lady’s finger	BARI dherosh-1	”	do
Stem amaranth	BARI data-1	”	do
Indian spinach	BARI-1	”	do
Yardlong bean	BARI-1	”	do
Brinjal	BARI-8	”	do
Ashgourd (wax gourd)	BARI chalkumra-1	”	do
Bittergourd	BARI-1	”	do
Sesame	BARI-2 BARI-3	”	do

Activities of BARI Technology Village under OFRD

Taratpara

Crop & Sowing date	Variety	Yield (t ha^{-1}) Mean & Range	No. of farmer	Remarks
Summer tomato Jul. 22-25-06	BARI hybrid tomato-3 BARI hybrid tomato-4	6.08 16.52	2 2	Good prospect of marketing but often affected by virus.
Aroid April 14-16,06	Latiraj	11.5(7.19-13.19)	5	Spreading among the farmers due to god return in comparison to rice.
Aroid April 14-16,06	Bilasi	7.1 (4.2-100)	5	Need more demo.
Radish Oct. 3,06	BARI Mula 2	20.63	1	-
Garden pea Nov 2-6, 06	BARI Matarsuti 1	8	2	Good market price but need more demo.
Potato Dec 2-8,06	Diamant Cardinal Mula Patronese	22.4(14-30.04) 21.7(13-29.59) 15.2(11-21.9) 14.7(9-22.6)	30	Potato seems to be more prospective than earlier due to good quality seed and better management. Particularly sowing in sunny place.
Wheat Dec. 12,06	Shourab	2.54	2	Water scarcity is a problem for extension of wheat
Lential Nov. 5,06	BARI Masur 3	1.25	1	Possibility only in packet where soil is a bit light.
Tomato OC\ct 13-15,06	BARI Tomato 2	33.49	3	Good return from tomato. Has more prospects.
Country bean Oct 4-9, 06	BARI Seem-1	8.75-10	8	Good return from c. bean
Stem Amaranth Mar 15-20,06	Laboni	30	5	Good return within 45 days.
Turmeric April 5-20,06	BARI Halud 3	22.9	3	Proved to be suitable for fallow shady place.

Pabna

Name of crop	Name of variety	No. of farmers.	Seed production and preservation (Kg)	Remarks
Wheat	Shatabdi Prodip Sourav Gourab	1	5 5 5 5	Farmers being impressed to see the performance of the varieties specially yield and grain quality of Shatabdi and Prodip. They will collect seed from contact farmer and other sources and grow large scale in the coming season
Mustard	BARI Sarisha-11	2	8	Local farmers and some growers from distant areas will grow this variety at wider area in the next season with their own preserved seed and other sources
	BARI Sarisha-9	2	4	Farmers will grow this variety at wider area with their own preserved seed
	BARI Sarisha-8	1	2	Contact farmer will grow this variety at small scale because shattering problem
Lentil	BARI Lentil-3	1	-	Due to low yield farmer did not preserve seed.
	BARI lentil-4	9	53	Satisfactory yield, bold seed and market demand encouraged the farmers. Local farmers will cultivate this variety at large area with their preserved seed.
Sunflower	BARI Sunflower-2	1	2	Because of less market demand and complexicity of processing, only a few farmer will grow.
Maize	BARI Hybrid Maize-2	5	-	Still not harvested
Potato	Diamont	7	1500	Higher yield encouraged the local farmers to preserve seed and to grow in the next season at larger area.
	Cardinal	5	500	Farmers wishes to grow this variety at wider area in the coming soon due to its higher yield and taste
	Patrones	4	-	Farmers did not preserve seed because of its low yield and less taste

Jamalpur

Crop	Variety	Yield (t/ha)	Remarks
Wheat	Prodip	-	
	Bijoy	-	
	Gourab	-	
	Shatabdi	-	
Maize	BHM-3	-	
	BHM-5	-	
Mustard	BARI Sharisha 6	1.33	BARI Sharisha 9 and 11 were preferred by the farmers because of higher yield.
	BARI Sharisha 8	1.48	
	BARI Sharisha 9	1.60	
	BARI Sharisha 11	1.50	
Potato	TPS	20.75	Cardinal is preferred because of reddish colour.
	Dhira	27.60	
	Cardinal	25.00	
	Lauda	22.80	
Sweet potato	BARI SP-6	-	
	BARI SP-7	-	
Tomato	BARI Tomato-3	-	
	BARI Tomato-6	-	
	BARI Tomato-9	-	
	BARITomato-12	-	
Radish	BARI Mula-1	65.5	Farmers preferred because of higher yield
Motorshuti	BARI Motorshuti-1	6.50	-
Chinasak	BARI China sak-1	17.50	-
Batisak	BARI Batisak-1	16.0	-
Lalsak	BARI Lalsak-1	22.5	Farmers preferred for short duration
Lentil	BARI lentil 4	-	
Chickpea	BARI Chickpea 7	-	
Barley	BARI Barley 1	-	

Plantation tree

Fruit tree	Variety	Sampling (no.)	Cooperator farmers (no.)	Survival (%)
Mango	BARI Mango 1	9		
	BARI Mango 2	11	30	90
	BARI Mango 3	11		
Litchi	BARI Litchi 3	80	40	80
Lemon	Alachi	32	25	90
Coconut	Local	29	25	90
Guava	BARI Guava 2	32	28	90
	Sharapkathi	25	25	75
Jujube	Apple kul	50	10	80
Carambula	Local	25	25	80
Olive	Local	25	25	80
Karamcha	Local	25	25	75
Sharifa	Local	25	25	80
Golapjam	Local	25	25	90
Hog plant	Local	25	25	80
Jambura	Local	25	25	80
Bilambi	Local	25	25	90

Field and vegetable crops (2006-07)

Crops	Variety	Amount (kg/no.)	Cooperator farmers (no.)	Yield (t/ha)
Wheat	Shatabdi	20	4	3.46
Potato	Diamont	285	14	26.25
	Cardinal	240	12	27.50
	Patronise	100	10	25.35
	Multa	100	10	26.5
Tomato	BARI Tomato 2	0.035	3	45.25
	BARI Tomato 3	0.035	3	42.28
	BARI Tomato 8	0.014	2	50.54
	BARI Tomato 9	0.010	3	44.25
Brinjal	BARI Brinjal 4	0.100	21	30.12
	BARI Brinjal 5	0.045	1	28.56
Jharshim	BARI Jharshim 1	0.650	4	7.25
Gardenpea	BARI Motorshuti 1	3.40	4	5.25
Lalshak	BARI Lalsak 1	2.00	3	12.15
Chikpea	BARI Chola 4	5.00	1	1.75
	BARI Chola 5	2.50	1	1.65
	BARI Chola 7	5.00	1	1.70
Mustard	BARI Sharisha 8	2.00	1	1.30
	BARI Sharisha 9	3.00	2	1.42
	BARI Sharisha 11	3.00		1.52
Lentil	BARI Lentil 3	20.00	1	1.25
	BARI Lentil 4	50.00	1	1.35
Radish	BARI Mula 1	0.550	3	59.6
	BARI Mula 3	0.050	1	47.5
Derosh	BARI Derosh 1	1.15	8	12.5
Data	BARI Data 1	0.55	10	33.4
Panikachu	Latiraj	1000 sucker	10	31.65
	PK 176	1000 sucker	10	29.42
Country bean	BARI Shim 1	3.00	50	11.25
Banana	Tissue culture	10	5	
	BARI Banana 1	125	27	

Faridpur

A. Field Crop Production Program of Improved Varieties

Sl. no.	Name of crop & variety	Farmers involved (no)	Date of sowing	Yield (t/ha)	Gross return (Tk./ha)	Net return (Tk./house hold)	Remarks
LENTIL							
1	BARI Moshur- 4	01	28.11.06	1.5	67500	53000	Lentil yield poor due to late shower
MUSTARD							
2	BARI Sarisha-11	07	27.11.06 to 30.11.06	1.7-1.9	45000	30500	Farmers like due to yield
	BARLEY						
3	BARI barley 3	01	29.11.06	2.30	46000	28550	

B. Potato Production Program

Sl. no.	Name of crop & variety	Farmers involved (no)	Date of sowing	Yield (t/ha)	Gross return (Tk./ha)	Net return (Tk./household)	Remarks
POTATO							
1	Cardinal	06	12.12.06	22.30	33450	258675	Seed quality was good
2	Diamand	06	13.12.06	26.5	397500	321675	
3	Multa	02	11.12.06	20.80	312000	236175	
4	Petronis	02	14.12.06	16.60	249000	173175	Seed quality was not good

Homestead activities

Crops	Variety name	Farmers involved (no)	Supplied seed/seedling (g/no)	Stored seed (g)	Remarks
Raddish	BARI mula 1	10	460	170	Farmers choose more due to yield
	BARI mula 3	10	900	100	
Gimakalmi	BARI kalmi 1	08	270	400	Farmers like, market price low
Spinach	BARI palong shak 1	10	300	500	Seed germination was not good.
Lalshak	BARI lalshak 1	01	100	--	Good
Bush Bean	BARI bush bean 1	04	500	--	Farmers dislike, are not habituated and also market price low.

Fruit Tree Plantation

Name of fruit	Varieties	No of seedlings	No of cooperators	Remarks
Mango	Amrapalli	8	8	6 seedlings damaged and rest good
	Mallika	6	6	
	Mahananda	2	2	
Litchi	BARI litchi 2	22	18	14 dead and 29 are good
	BARI litchi 3	21	21	
Guava	Kazi peara	30	30	Dead 2 & rest good condition
Coconut	BARI coconut 1 & 2	10+11=21	10	Condition of all are good but 6 dead
Lemon	BARI lebu 2 and 3	25	25	10 seedlings damaged and rest good

Tangail

Name of Variety	Crop duration (days)	Yield (t/ha)
BARI sharisa-8	89	1.35
BARI sharisa-9	81	1.25
BARI sharisa-11	104	2.05
BARI Mula-1	51	74.7
BARI Mula-2	51	64.0
BARI Mula-3	50	42.5
BARI Tomato-3	111	38.2
BARI Tomato-8	110	47.4
BARI Tomato-9	99	32.4
Diamont	72	17.00
Petronis	72	14.50
Multa	72	18.50
BARI bushbean-1	52	15.4
BARI-Motorshuti-1	83	9
BARI lalsak-1	28	14.24
Wheat		
Sourab	107	4.00
Shatabdi	107	4.35
Prodip	115	4.30
BARI Palanshak-1	31	12.73
BARI Sunflower-1	99	1.65
BARI Dhaina-1	105	0.92
TBARI Sarisha-9	89	1.35
BARI Sarisha-11	81	1.25
BARI Sarisha-8	104	2.05
BARI Fulcopi-1	51	16.73
BARI Sarisha-11	81	19.79

Pautakhali

Crops	Varieties	No. of farmer	Area (dec.)	Date of sowing/ planting	Harvesting started	Yield range (t/ha)	Average Yield (t/ha)
Radish	BARI-1	8	16	5-15 Nov, 06	08/01/07	50-55	52.5
	BARI-2	8	16	5-15 Nov, 06	08/01/07	33-38	35
	BARI-3	8	16	5-15 Nov, 06	08/01/07	30-35	32.5
Bushbean	BARI-1	11	22	8-15 Nov, 06	25/12/07	10-11	10.5
Motorshuti	BARI-1	5	10	15-20 Nov, 06	15/02/07	6-8	6.5
	BARI-2	5	10	15-20 Nov, 06	01/02/06	8-10	8.9
Cauiflower	BARI-1	8	14	5-10 Nov, 06	07/01/07	21-22	21.5
Cabbage	BARI-2	8	12	5-10 Nov, 06	05/01/07	40-45	42.5
Tomato	BARI-2	10	16	2-15 Nov, 06	10/02/07	52-60	56
	BARI-3	10	15	2-15 Nov, 06	10/02/07	54-62	56.5
	BARI-8	8	12	5-15 Nov, 06	15/02/07	56-63	57
	BARI-9	8	12	5-15 Nov, 06	15/02/07	45-52	47
Brinjal	BARI-4	10	18	22-30 Nov, 06	25/02/07	40-45	42.5
	BARI-5	10	18	22-30 Nov, 06	05/03/07	41-45	43
	BARI-6	8	10	22-30 Nov, 06	10/03/07	35-40	37.5
	BARI-7	8	12	22-30 Nov, 06	28/02/07	30-35	33
	BARI-8	8	12	22-30 Nov, 06	28/02/07	25-30	27
Potato	Diamond	10	100	15-20/12/06	20/3/07	18-22	20
	Cardinal	10	100	15-20/12/06	20/03/07	18-22	20
	Heera	10	100	15-20/12/05	20/03/07	18-20	19
	Patronis	05	10	15-20/12/05	20/03/07	17-20	18.5
	Multa	05	10	15-20/12/05	20/03/07	18-20	19
	Heera (Zero Tillage)	03	10	05/12/06	14/03/07	20-22	21
Maize	BMH-3	10	50	1-6/1/06	02/05/07	6.5-9.2	7.6
Mustard	BARI-8	5	25	20-25/11/05	27/02/07	0.9-1.1	1.0
	BARI-9	6	30	25-30/11/06	24/02/07	0.9-1.0	0.95
	BARI-11	10	40	25-30/11/06	08/03/07	1.0-1.2	1.1
Lalshak	BARI-1	10	16	10-15/11/06	05/12/06	8-12	10

Sylhet

Name of Technology	No. of cooperator	Area	Yield (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)
BARI Tomato-2	5	15 dec	67.58	405480	62950	342530

Price (Tk/kg): Tomato-6

Rangpur

Field Crops

Sl.	Crop	Variety	No. of practiced Farmers	Yield range (t/ha)	Yield potentiality (t/ha)
01.	Mustard	BARI Sharisha-12	12	1.1-1.35	1.4-1.65
02.	Potato	BARI Potato-8 (Cardinal)	6	25-28.2	25-30
		BARI Potato-7 (Diamant)	6	24.28-28.9	25-30
		BARI Potato-6 (Petronise)	6	23.0-26.0	20-25
		BARI Potato-5 (Multa)	6	24.1-26.5	20-25
03.	Wheat	BARI Gom-21 (Shatabdi)	3	3.61-3.8	3.6-5.0

Season Winter: Vegetables

Sl. No.	Crop	Variety	No. of practiced Farmers	Yield range (t/ha)	Yield potentiality (t/ha)
01.	Tomato	BARI Tomato-2	10	75-85	80-85
		BARI Tomato-4	4	21-22	20-22
02.	Bush bean	BARI Bush bean-1	7	12-14	13-14
03.	Garden pea	BARI Motorshuti-1	5	10.5-12.0	10-14
04.	Batishak	BARI Batishak-1	5	50-52	45-55
05.	Cauliflower	BARI Caulifolwer-2	4	25-27	25-28
06.	Radish	BARI Mula-1	3	70-80	70-80
07.	Brinjal	BARI Begun-4	5	50-57	55-60
		BARI Begun-8	5	20-20	-
08.	Chili	BARI Lanka-1	9	20-24	30-32
09.	Bottle gourd	BARI Law-1	6	40-44	40-45
10.	Country bean	BARI Shim-1	6	12-20	20-22
11.	Red Amaranth	BARI Lalshak-1	7	12-14	12-14

Sl. No.	Crop	Variety	Area (m^2)	Date of Sowing/ Planting	Harvesting period	Yield (t/ha)	Consump tion (kg)	Distribu tion (kg)	Sale (kg)	Preserva-tion as Seed
Mst. Shahida Begum										
01.	Wheat	BARI Gom-21	800	5-12-06	6-4-07	3.8	-	-	304	-
Md. Sayed										
01	Wheat	BARI Gom-21	720	1-12-06	1-4-07	3.75	270	-	-	-
02	Potato	BARI Potato 8 (Cardinal)	160	6-12-06	15-2-07	27.18	90	5	170	170
03	Potato	BARI Potato-7 (Diamant)	280	6-12-06	15-2-07	26.25	185	40	340	170
04	Potato	BARI Potato-6 (Petronise)	160	4-12-06	10-2-07	26.0	76	-	170	170
05	Potato	BARI Potato-5 {Multa)	120	4-12-06	10-2-07	27.0	54	15	170	85
06	Mustard	BARI Mustard-12	2000	21-12-06	28-2-07 29-2-07	1.5	50	4	46	200
Md. Momotaz										
01	Potato	BARI Potato 8 (Cardinal)	120	5-12-06	1-3-07	28.2	85	-	85	170
02	Potato	BARI Potato-7 (Diamant)	240	5-12-06	1-3-07	26.04	170	-	285	170
03	Potato	BARI Potato-6 (Petronise)	120	2-12-06	27-2-07	25.0	61	-	69	170
04	Potato	BARI Potato-5 {Multa)	80	2-12-06	27-2-07	26.25	40	-	85	85
Md. Akber Ali										
01	Mustard	BARI Mustard-12	480	28-11-06	28-2-06	1.2	-	-	58	-
02	Wheat	BARI Gom-21	720	3-12-06	4-4-07	3.61	60	-	200	-
03	Potato	BARI Potato 8 (Cardinal)	120	8-12-06	6-3-07	27.9	-	-	80	255
04	Potato	BARI Potato-7 (Diamant)	240	8-12-06	6-3-07	24.79	85	-	255	255
05	Potato	BARI Potato-6 (Petronise)	120	3-12-06	2-3-07	25.5	51	-	85	170
06	Potato	BARI Potato-5 {Multa)	80	8-12-06	6-3-07	26.5	5	-	40	170
Md. Bashir Uddin										
01	Potato	BARI Potato 8 (Cardinal)	200	10-12-06	7-3-07	25.5	55	-	200	255
02	Potato	BARI Potato-7 (Diamond)	280	10-12-06	7-3-07	24.28	85	-	85	510
03	Potato	BARI Potato-6 (Petronise)	200	5-12-06	2-3-07	25.5	85	-	85	340
04	Potato	BARI Potato-5 (Multa)	120	5-12-06	2-3-07	25.0	45	-	85	170
Md. Kashem Ali										
01	Potato	BARI Potato 8 (Cardinal)	120	8-12-06	6-3-07	25.0	45	-	85	170
02	Potato	BARI Potato-7 (Diamant)	160	8-12-06	6-3-07	28.9	37.4	-	85	340
03	Potato	BARI Potato-6 (Petronise)	120	4-12-06	1-3-07	23.0	50	-	56	170
04	Potato	BARI Potato-5 (Multa)	80	4-12-06	1-3-07	26.2	-	-	40	170
Md. Elahi Bokh										
01	Potato	BARI Potato 8 (Cardinal)	200	10-12-06	22-2-07	25.5	170	-	170	170
02	Potato	BARI Potato-7 (Diamant)	240	10-12-06	22-2-07	26.45	125	-	340	170
03	Potato	BARI Potato-6 (Petronise)	200	6-12-06	18-2-07	25.5	85	-	340	85
04	Potato	BARI Potato-5 (Multa)	80	6-12-06	18-2-07	25.8	36	-	85	85

Seed production of BARI varieties

Barind

Crops	Variety	Area (*Bigha*)	No. of farmers	Seed yield (t/ha)	Cost of cultivation (Tk/ha)	Gross margin (Tk./ha)	BCR
Wheat	Shatabdi	2	2	3.25	13500	50500	3.74
	Gourab	3	2	2.75	13500	41500	3.07
Chickpea	BARI Chola-4	1	2	1.02	9200	41800	4.54
	BARI Chola-5	3	4	1.22	9200	51800	5.63
	BARI Chola-7	1	1	1.05	9200	43300	4.70
Mustard	BARI Sarisha-8	2	1	1.02	9500	16000	1.68
	BARI Sarisha-9	3	4	0.98	9500	15000	1.58
	BARI Sarisha-11	3	3	1.35	9500	24250	2.55
Lentil	BARI Masur-3	5	7	0.87	9350	21100	2.26
	BARI Masur-4	7	10	0.94	9350	23550	2.52

Note: Wheat-Tk. 20/kg, Chickpea-Tk. 50/kg, Mustard-Tk. 25/kg, Lentil-Tk. 35/kg

Patuakhali

Crops	Varieties	No. of farmers	Quantity of seed
Red amaranth	BARI red amaranth-1	10	5 kg
Brinjal	BARI begun-4	3	50 g
	BARI begun -5	3	50 g
	BARI begun -6	3	50 g
	BARI begun -7	1	30 g
	BARI begun -8	1	30 g
Tomato	BARI Tomato-2	2	20 g
	BARI Tomato-3	2	20 g
	BARI Tomato-8	1	10 g
	BARI Tomato-9	1	10 g
Mustard	BARI sarisa-8	2	2 kg
	BARI sarisa-9	5	10 kg
	BARI sarisa-11	5	10 kg
Bushbean	BARI bushbean-1	1	250 g

Bogra

Crops	Variety	Yield (t/acre)	Total Area
Wheat	1. Kanchan (1 Acre)	0.85	
	2. Protiva (1 Acre)	1.00	5 acres
	3. Shatabdi (1 Acre)	1.20	
	4. Shaurav (1 Acre)	1.10	
	5. Gourav (1 Acre)	1.15	
Mustard (2006-07)	1. BARI Sharisa 9 (1 Acre)	0.85	3 acres
	2. BARI Sharisa 6 (2 Acre)	0.78	

Training and Field days, 2006-07

Project: ATT

A. Field days on summer onion production technologies

Location	Date	Category of participants	No. of participants
Dhirshram, Gazipur	18, January, 2007	BARI, DAE, NGO & Farmers	50
Hathazari, Chittagang	-	"	80
Noakhali	-	"	50
Sylhet	-	"	50
Camilla	-	"	50
Faridpur	14 January 2007	"	60

B. Field day on technology transfer through farmers participation

Location	Date	Category of participants	No. of participants
Khulna	3 April 2007	BARI, DAE, NGO & Farmers	56
Khulna	10 May, 2007	-	76
Rajshahi	28.03.07	-	80
Rajshahi	23.02.07	-	60
Faridpur	20 May, 2007	-	100
"	28 March,2007	-	50
"	29 March,2007	-	60
"	15 March 2007	-	250
Noakhali	30 November 2006	-	50
"	19 December 2006	-	50
"	01, February , 2007	-	50
"	16, April, 2007	-	50
Patuakhali	9 May 2007	-	40
Dhirashram, Gazipur	18, January, 2007	-	41

Funded by BARI

Location	Date	No. of field day	Category of participants
Lahirirhat Rangpur	10, October,2006	1	DAE,BARI,NGOs DFO, DLO, BRRI, BJRI, BINA, SRDI and farmers.
Dinajpur	14, February 2007	1	DAE,BARI, NGOs and farmers.
Domar, Rangpur	28, January	1	DAE, BARI, NGOs and farmers.
Najirhat, Rangpur	14 February 2007	1	DAE, BARI, NGOs and farmers.

Funded by BARC

Location	Date	No. of field day	No. of participants	Category of participants
Kurigram, Rangpur	20, February	1	-	DAE, BARI, NGOs & farmers

Project: ICM

A. Training activities

Location	Date	Category of Participants	No. of Participants
Rangpur	21 January 2007	SA/SSA/SAAO	26
Rangpur	17 June 2007	SA/SSA/SAAO	26
Shyampur, Rajshahi	17 December 2006	Farmers	12
Barind, Rajshahi	25 January 2007	Farmers	30
Pabna	-	Farmers	12
Rangpur	29 March 2007	Farmers	30

B. Field days

Location	Date	Category of participants	No. of participants
Barind, Rajshahi	25 January,2007	Scientists, Extension personnel, Farmers, NGO, personal	50
Barind, Rajshahi	31 January,2007	"	50
Pabna	31 January 2007	"	50
Mymensingh	29 January,2007	"	50
Pabna	-	DAE, BADC, CCDB, IC-SAAKTI, PCD, BTV & News reporter	50
Ulipur, Rangpur	20 June, 2007	DAE, BARI and farmers	50
Ulipur, Rangpur	25 June, 2007	DAE, BARI and farmers	50
Gobindagonj, Rangpur	21 May, 2007	DAE, BARI and farmers	50
Gobindagonj, Rangpur	19 June, 2007	DAE, BARI and farmers	50
Gobindagonj, Rangpur	24une, 2007	DAE, BARI and farmers	50

Project: **IC-SAAKTI/FAO**

A. Training

Location	Date	Category of participants	No. of participants
Barind, Rajshahi	20-21 May 2007	SSA/SA	14
Pabna	-	SS/SSA	15
Rangpur	21-22 June 2007	SA/SSA	-
Rangpur	24 June 2007	Farm family, DAE,AIS, NGOs, BARI personnel-	
Rangpur	5-6 May 2007	OFRD scientists	20

B. Field days

Location	Date	No. of field day	No. of participants	Category of participants
Pabna	-	3	146	IC-SAAKTI-3, DAE-3, CCDB-2
Lahirirhat, Rangpur	16 December 2006	1	170	DAE,BARI, NGOs and farmers
Barind, Rajshahi	-	1	180	DAE,BARI, NGOs and farmers
Barind, Rajshahi (FAO)	24 March 2007	1	150	DAE,BARI, NGOs and farmers

List of Scientists Involved with On-Farm Research Division (2006-07)

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Quamrun-Naher, SO
Md. Akhtar Hossain, SO
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Shibpur
Md. Asaduzzaman, SO

Tangail
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Md. Mohi Uddin, SSO
Md. Mahmudul Islam Nazrul*, SSO
Md. Aminur Rahman**, SO
Md. Mahmudur Rahman*, SO
Mostak Ahmed, SO
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Md. Abdullah Al Mamum, SO

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Md. Shafiqul Islam*, SSO
Md. Alimur Rahman, SSO (AC)
Md. Abdus Salam, SO
Md. Faruque Hossain, SO
Md. Shakhawat Hossain, SO

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Md. Kawser Uddin Ahmmad, SSO
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*Higher study, **Lien, ***Transfer to other Division

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FSRDS = Farming System Research and Development Site and MLTS = Multilocation Testing Site

List of FSRD and 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. Hatobindapur, Faridpur sadar, Faridpur
7. Rajakhali, Dumki, Patuakhali
8. Hazirhat, Noakhali sadar, Noakhali
9. Kadamshahar, Godagari, Barind, Rajshahi

B. MLT SITES

Region-1

Pabna	:	Pakshi, Sadar, Bhabanipur-Sujanagar, Khaloibhara-Sathia, Atgoria
Shyampur, Rajahahi	:	Noudapara-Paba, Baneshar-charagata, Rajshahi
Barind, Rajshahi	:	Aamnura-Chapai nawabganj sadar
Rangpur	:	Domar-Nilphamari, Ulipur-Kurigram, Gobindaganj-Gaibandha
Bogra	:	Sherpur, Shibganj, Joypurhat, Gabtali
Rajbari, Dinajpur	:	Biral, Sadar (Takurgaon)

Region-2

Jamalpur	:	Tatultala-Jhenaigati, Maloncha-Melandah
Tangail	:	Gatail, Madhupur, Gobindadasi-Bhuyapur
Mymensingh	:	Trishal, Netrakona sadar, Mymensingh sadar
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)
Kushtia	:	Bamondi, Alamdanga, Kazirhat-Bharamara
Faridpur	:	Rajbari sadar, Mostafapur-Madaripur
Patuakhali	:	Aamtali, Alipur/Mohipur
Barisal	:	Goranadi-Barisal, Dakkin Ratanpur-Bhola, Nazirhat-Pirojpur

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
Bandarban	:	Lemujiri-Buhalong

Region-5

Gazipur	:	Manikganj sadar, Munshiganj sadar, Dhirashram, Gazipur sadar
Shibpur, Narsingdi	:	Shibpur, Narsingdi

THE END

List of FSRD and MLT sites

A. FSRD SITES

1. Kushumhat, Sherpur sadar, Sherpur
2. Jalalpur, Sylhet sadar, Sylhet
3. Ellenga, Kalihati, Tangail
4. Lahirirhat, Rangpur
5. Pushpapara, Pabna sadar, Pabna
6. Hat Gobindapur, Faridpur sadar, Faridpur
7. Rajakhali, Dumki, Patuakhali
8. Hazirhat, Noakhali sadar, Noakhali
9. Kushum Shahor, Godagari, Barind, Rajshahi

B. MLT SITES

Region-1

Pabna	:	Pakshi, Sadar, Bhabanipur-Sujanagar, Khaloibhara-Sathia, Atgoria
Shyampur, Rajahahi	:	Noudapara-Paba, Baneshar-charagata, Rajshahi
Barind, Rajshahi	:	Aamnura-Chapai nawabganj sadar
Rangpur	:	Domar-Nilphamari, Ulipur-Kurigram, Gobindaganj-Gaibandha
Bogra	:	Sherpur, Shibganj, Joypurhat, Gabtali
Rajbari, Dinajpur	:	Biral, Sadar (Takurgaon)

Region-2

Jamalpur	:	Tatultala-Jhenaigati, Maloncha-Melandah
Tangail	:	Gatail, Madhupur, Gobindadasi-Bhuyapur
Mymensingh	:	Trishal, Netrakona sadar, Mymensingh sadar
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)
Kushtia	:	Bamondi, Alamdanga, Kazirhat-Bharamara
Faridpur	:	Rajbari sadar, Mostafapur-Madaripur
Patuakhali	:	Aamtali, Alipur/Mohipur
Barisal	:	Goranadi-Barisal, Dakkin Ratanpur-Bhola, Nazirhat-Pirojpur

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
Bandarban	:	Lemujiri-Buhalong

Region-5

Gazipur	:	Manikganj sadar, Munshiganj sadar, Dhirashram, Gazipur sadar
Shibpur, Narsingdi	:	Shibpur, Narsingdi

THE END