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Preface

On-Farm Research Division (OFRD) of Bangladesh Agricultural Research Institute (BARI) is going to publish the research reports of experiments conducted during 2002-03 and rabi season 2003-04 at different Farming System Research and Development (FSRD) and Multilocation Testing (MLT) sites across the country. The mandate of OFRD is to conduct research for the improvement of existing farming system and testing and validation of on-station technologies under a wide range of agro-climatic situation for the fine tuning. 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 in improvement of existing cropping system practiced by the farmers' with introduction of new crops and varieties for coastal, rainfed and hill areas to develop suitable technologies for the problematic soils of Bangladesh. Similarly, Soil fertility management is another important issue need to be addressed comprehensively for sustainable crop production. Priority was given on cropping pattern based balanced fertilization for major AEZs and integrated plant nutrient management (IPNS) to maintain and improve soil fertility. Research report on socio-economic studies, integrated farming and on-farm verification of advanced lines and technologies were also included in this report.

On-Farm Research Division has also conducted some research and development activities for improvement of livelihood of rural people through PETRRA subproject at four FSRD sites namely Rajshahi, Faridpur, Rangpur and Noakhali. Similarly, on-farm trial of wheat, maize and farm machinery has done at different MLT and FSRD sites across the country through collaboration with CIMMYT. Reports of these activities also incorporated in this report.

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

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STUDY ON THE PERFORMANCE OF WHEAT VARIETIES DEVELOPED BY BARI

Abstract

On-farm performance of wheat varieties was evaluated at Narail, Goyanghat, Gabtali and Ishan Gopalpur, Faridpur testing sites during rabi seasons of 2003-04 to find out suitable variety of wheat. Five varieties viz. Satabdi, Protiva, Gourab, Sourav and Kanchan were evaluated in RCB design with three dispersed replication in each site. Results revealed that Satabdi produced significantly highest yield at all sites, which was 9-13% higher yield than Kanchan at Narail, 5% at Goyanghat, 41% at Gabtali and 19% at Faridpur, which is currently used by the farmers.

Introduction

Wheat is the second cereal crop in Bangladesh. It ranks second in acreage and production among the cereal crops. Wheat is grown in this area following the improved cropping pattern Wheat-Jute /Aus-T.Aman rice. But most of the farmers use the variety Kanchan at all sites. In Sylhet region, a vast area of land remain fallow after T.Aman harvest and but there may be abundant scope for wheat cultivation after harvest of T.Aman rice under rainfed condition. The yield of Kanchan is decreasing gradually. Wheat Research Center (WRC) of BARI has already developed four varieties with considerable yield advantage over Kanchan. It is therefore, necessary to test the performance of these new varieties against Kanchan for improvement of the cropping pattern.

Materials and Method

The experiment was conducted at Narail, Gabtali of Bogra, Goyanghat of Sylhet and Ishan Gopalpur of Faridpur sites at the farmers' field in rabi season of 2003-04. The experiment was laid out in randomized complete design with six dispersed replications in each site. The tested varieties were Satabdi, Kanchan, Protiva, Sourav and Gourab. The seeds were sown in line at 20 cm apart. Sowing date was 22 Nov. 2003 at Kushtia, 2-10 Dec. 2002 & 14-20 Nov. 2003 at Bogra and 30 Nov. to Dec. 2003 at Faridpur. Fertilizer used at the rate of 120-60-40-20-5-1 kg N, P_2O_5, K_2O, S, Zn and B from urea, triple super phosphate, muriate of potash, gypsum zinc sulphate and boric acid and 5 ton cowdung per hectare. Full amount of P K S Zn and B and half of the urea was applied at the time of land preparation and the rest of the N was applied at first irrigation time. Three times irrigation was given but one irrigation at Sylhet. Plant protection measure was taken. The crop was harvested at 25-30 March 2004 at Narail, 15-26 March 2003 & 7-15 March 2004 at Bogra, 16-24 March 2004 at Sylhet and 20-22 March 2004 at Faridpur. Necessary data were collected and analyzed.

Results and Discussion

Narail

Plant height, grains/spike, spikes/m^2, 1000-grain wt., grain and straw yields were significantly affected by variety but spikes/m^2 was statistically insignificant. The variety Shatabdi showed higher grains/spike which was statistically identical to Sourav. Significantly the highest grain weight was recorded from variety Shatabdi and the lowest from Protiva followed by Gourab. Higher grain yield was recorded from Shatabdi which was statistically at par to Sourav but significantly higher straw yield from variety Shatabdi.

Gabtali, Bogra

Grain, straw yield and yield attributes were significantly influenced by variety. Significantly higher no. of grains/spike was obtained from variety Shatabdi but grain weight showed higher in variety Shatabdi but identical to Sourav and Gourab. Spike/m^2 showed significantly higher from variety

Shatabdi. Significantly highest grain yield was recorded from variety Satabdi which was 9% higher yield than Kanchan in both the year. Straw yield also showed higher from variety Satabdi. On an average, higher grain yield was recorded from variety Shatabdi.

Goyanghat, Sylhet

Plant height, spikes/m^2, 1000-grain wt. and grain yield were significantly affected by variety. Kanchan showed higher plant height which was statically identical to Protiva. Protiva showed higher no. of spikes/m^2 followed by variety Shatabdi. Grains/spike was not significantly influenced by variety. Protiva showed higher grain yield which was closely followed by variety Shatabdi.

Ishan Gopalpur, Faridpur

Plant height, grains/spike, 1000-grain wt., grain & straw yield were significantly influenced by variety. Spikes/m^2 and days to maturity did not influence by variety. Spike/m^2 and days to maturity did not influence the variety. But Gourab variety less time & Kanchan more time required mature. Kanchan followed by Gourab showed lowest grains/spike and other variety were similar and higher than former two variety. Higher grain wt. was recorded from Shatabdi followed by Protiva. Higher grain yield was obtained from variety Shatabdi but statistically at par to other varieties except Kanchan. Straw yield showed significantly higher from Shatabdi.

The experiment should be repeated another year for confirmation.

Farmers Reaction

In those five varieties, Satabdi is found better but in context of bread wheat, Protiva variety is more soft and tasty. Kanchan is susceptible to disease.

Table 1. Yield and yield attributes of different wheat varieties at Narail MLT site in 2003-04

Variety	Plant height (cm)	Spike/m^2 (no.)	No. of grains /spike	1000-grain wt (gm)	Grain yield (t/ha)	Straw yield (t/ha)
Satabdi	98.3ab	355	42a	44.57a	4.64a	5.72a
Protiva	93.2c	360	40c	38.02c	4.33bc	4.93b
Gourab	94.3bc	349	38d	39.32bc	4.30c	4.86b
Sourav	98.4ab	324	40ab	40.37b	4.56ab	4.91b
Kanchan	100.3a	356	40bc	40.22b	4.36bc	5.03b
F-test	**	NS	**	NS	*	*
CV (%)	3.57	2.02	2.1	2.46	4.41	8.26

Table 2. Yield and yield attributes of wheat varieties at Gabtali MLT site, Bogra during 2003-04

Variety	Crop duration (days)	Plant height (cm)	Spike/m^2 (no.)	No. of grains /spike	1000-grain wt (gm)	Grain yield (t/ha)		Straw yield (t/ha)
						2002-03	2003-04	
Shatabdi	111a	80.75a	289a	37a	35.88a	4.01a	4.09a	4.99a
Protiva	109b	77.64b	253cd	33c	30.36b	3.08d	3.35b	3.93c
Gourab	109b	78.48ab	260c	33c	34.34a	3.32bc	3.30b	4.20b
Sourav	109b	80.05ab	271b	35b	35.57a	3.53b	3.44b	4.21b
Kanchan	108c	78.07b	245d	30d	24.8b	3.20c	2.36c	2.97d
LSD(0.05)	0.92	2.59	10.63	1.71	2.75		0.19	0.24
CV (%)	0.70	2.12	3.55	4.05	6.90		4.15	4.39

Table 3. Yield and yield attributes of wheat varieties at Goyanghat MLT site in 2003-04

Variety	Crop duration (days)	Plant height (cm)	Spike/m^2 (No.)	No. of grains /spike	1000-grain wt (gm)	Grain yield (t/ha)
Shatabdi	106	82.5	246	34	46.52	2.62
Protiva	104	83.82	259	35	42.08	2.74
Gourab	98	96.6	188	33	42.32	1.73
Sourav	102	81.28	240	33	41.80	2.19
Kanchan	104	84.10	230	34	43.77	2.51
LSD (0.05)	6.2	1.35	15.89	NS	0.95	0.37

Table 4. Yield and yield attributes of wheat varieties at Ishan Gopalpur, Faridpur during 2003-04

Variety	Crop duration (days)	Plant height (cm)	Spike/m^2 (no.)	No. of grains /spike	1000-grain wt (gm)	Grain yield (t/ha)	Straw yield (t/ha)
Shatabdi	106	88.9a	278	40a	40.2a	3.34a	5.20a
Protiva	101	86.3ab	270	40a	38.8ab	3.12ab	4.53b
Gourab	98	84.7b	263	37b	37.8bc	3.00ab	4.12b
Sourav	104	84.7b	247	39ab	36.7c	3.11a	4.42b
Kanchan	108	88.6a	261	37b	36.2c	2.81b	4.24b
LSD(0.05)	-	*	NS	*	**	*	**
CV (%)	-	3.5	11.3	11.0	4.1	9.4	8.1

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YIELD POTENTIALITY OF MUSTARD THROUGH AGRONOMIC MANIPULATION

Abstract

A field experiment was conducted at Mymensingh sadar Upazila during rabi season of 2003-04 to evaluate the optimum levels of agronomic practices of mustard. The result showed that recommended practices were statistically identical to T_6 (Variety + recommended fertilizer + one irrigation at flowering stage + plant protection) in respect of grain yield. Only variety and fertilizer were not sufficient to increase yield but irrigation, weeding and plant protection measure is needed.

Introduction

Mustard is the principal oleagious crop of Bangladesh. It covers 58.6% of the total oilseed area and produces 52.2% of the total oilseed production in the country. The average yield of mustard per unit area in the farmers' field of Bangladesh is very low compared with other mustard producing countries. It has also been noticed by the scientists and other development organizers that there is gap in between the yield of research stations and farmers field. In general, Brassica needs higher management practices. Among the management practices, variety, required fertilizers, weeding, irrigation, plant protection measures etc. are the most important. The present investigation was, therefore, undertaken to identify the optimum levels of agronomic practices for better mustard (var. BARI Sarisha 9) production in the farmers' field.

Materials and Methods

The experiment was conducted at Mymensingh sadar Upazila during rabi season of 2003-04. There were seven treatments (management practices) included in the experiment, such as;

T_1 = Farmers' practice (var. Tori-7, fertilizer doses- 54-60-15 kg N-P-K/ha, no weeding, irrigation and plant protection measures)

T_2 = T_1 + improved variety (BARI Sarisha 9 in place of Tori-7)

T_3 = Improved variety (BARI Sarisha 9) + Recommended fertilizers (80-30-50-20-4 kg N-P-K-S-Zn/ha)

T_4 = T_3 + Weeding cum thinning at 15 DAE

T_5 = T_4 + Irrigation (before flowering stage).

T_6 = T_5 + Plant protection measures (Insecticide/pesticide spray)

T_7 = Recommended package of production fertilizers, weeding cum thinning, irrigation (one before flowering and another at grain filling stage) and plant protection measures.

The experiment was laid out in a RCB design with 3 replications having plot size of 5 x 4 m. From sowing to harvesting intercultural operations were done as per treatments description. Full amount of P, K, S and Zn and half of N were applied as basal. Rest half was applied as top dress after 30 and 45 days of sowing. Recommended seed rate (8 kg/ha) were sown as broadcast method on 6 November 2003 and the crop was harvested on 25 January 2004. The differences among the treatment means were evaluated by least significance difference (LSD).

Results and Discussion

Plants/m^2, plant height, pods/plant, seeds/pod, grain and straw yields were significantly influenced by variety and management practices (Table 1). Treatments T_1, T_2 and T_3 were statistically identical in respect to plants/m^2 and higher than rest of the treatments. But plant height showed statistically identical to treatment T_7 and T_6 and other treatments are lower. Similar trend was followed in case of pods/plant but seeds/pod revealed similar to treatment T_6, T_7, T_4 and T_5. Grain yields were statistically identical in treatment T_6 and T_7 which were statistically higher than other treatments. These two treatments gave much higher yield than existing variety and management practices.

Table 1. Yield and yield contributing characters of mustard as influenced by different agronomic manipulation at Mymensingh sadar upazila (2003-04)

Variety	No. of plant/m^2	Plant height (cm)	No. of pods/plant	No. of seeds/pod	Grain yield (kg/ha)	Stover yield (kg/ha)
T_1	140a	71d	22e	12.3c	656e	1562f
T_2	142a	91c	36d	15.7b	788d	1757e
T_3	137a	93c	35d	15.7b	893c	1930d
T_4	88b	92c	46c	16.3ab	988c	2207c
T_5	92b	98b	49bc	16.3a	1117b	2257b
T_6	96b	103a	53ab	17.0a	1312a	2623b
T_7	84b	105a	57a	16.3ab	1395a	2728a
CV (%)	8.3	3.9	7.1	4.2	5.3	2.6

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PERFORMANCE OF DIFFERENT CHICKPEA VARIETIES

Abstract

An experiment was carried out at MLT site Kushtia sadar, Sylhet and Moulvibazar to find out the yield and suitability of chickpea variety (s) after harvest of T.Aman rice. Six BARI developed chickpea varieties (BARI Chola 2, BARI Chola 3, BARI Chola 4, BARI Chola 5, BARI Chola 6, BARI Chola 7, Annigeri and one local variety were evaluated. On an average, BARI Chola 7, BARI Chola 5 and BARI Chola 6 gave similar yield and higher than other varieties due to the maximum pods/plant and relatively bigger seed size. At Sylhet, higher seed yield was recorded from BARI Chola 3 (3 years average) but BARI Chola 8 and Annigeri also similar yield but the variety was used only one year. Similar trend was followed at Moulvibazar.

Introduction

Among the pulses grown area in Bangladesh chickpea ranked third in area and production but second in consumption priority. It covers an area of 16650 ha, producing 12225 tons of yield with a national average of 702 kg/ha (BBS-1999). About 85% of the total chickpea are grown in five greater districts namely Pabna, Rajshahi, Faridpur, Jessore and Kushtia in Aus/Jute- Fallow-Chickpea and Aman rice-chickpea cropping pattern. In Sylhet area, vast area of land remains fallowed during rabi season after harvest of Aman rice due to shortage of moisture. About 35-40% chickpea are planted in late December following Aman rice and suitable varieties for this situation are lacking. 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.

Materials and Methods

The experiment was conducted in rainfed condition at the MLT site Kushtia sadar, Sylhet and Moulvibazar during rabi season of 2003-04 at Kushtia, 2001 to 2004 at Sylhet and 2002 to 2004 at Moulvibazar. Eight chickpea varieties viz, BARI Chola 2, BARI Chola 3, BARI Chola 4, BARI Chola 5, BARI Chola 6, BARI Chola 7, BARI Chola 8 (only in Sylhet and Moulvibazar during 2003-04) Annigeri and local were tested. The trial was laid out in RCB design with four replications. The plot size was 5m x 8m. Fertilizers were applied at the rate of 20-40-20 kg at Kushtia, 20-18-17 kg at Sylhet and Moulvibazar of N-P-K/ha, respectively. The seeds were sown on 2 December 2003 at Kushtia, 25 November 2001 at Sylhet, 2-8 December during 2002 & 2003 at Sylhet and Moulvibazar. Intercultural operation and plant protection measure were done as and when required. The crop was harvested at 27 March, 2004. Necessary data were collected and analysed.

Results and Discussion

MLT site, Kushtia

Plants/m^2, plant hight, pods/plant; 100-seed wt, seed & straw yields are significantly affected by different varieties. Higher plants/m^2 was obtained from variety Annigeri which was statistically identical to BARI Chola 4. The varieties BARI Chola 7, BARI Chola 3 & BARI Chola 2 were statistically at par in the highest and higher than other varieties. The variety BARI Chola 7 & BARI Chola 5 showed higher pods/plants among the varieties. Significantly highest 100 seed wt. was recorded from BARI Chola 6 and other varieties showed much lower seed weight. The variety BARI Chola 7 gave higher seed yield which was closely followed by BARI Chola 5 & BARI Chola 6. On an average seed yield was lower in all the varieties. Similar tread was followed in case of straw yield as in seed yield.

FSRD site, Golapganj, Sylhet

Six varieties were put under trial from 2001 to 2004. Among the varieties the highest plant height was recorded from BARI Chola 3. Pods/plant was similar to BARI Chola 7, BARI Chola 2 and BARI Chola 3 and BARI Chola 6. Seed weight showed higher from BARI Chola 8 followed by BARI Chola 3. This character influences the seed yield of BARI Chola 3 and BARI Chola 8. Yield contributing characters of Annigeri were not taken but yield was found satisfactory with 1569 kg/ha (Table 2).

MLT site, Moulvibazar

Six varieties were conducted from 2002 to 2004. Among the varieties, BARI Chola 8 and BARI Chola 3 showed similar height and higher than rest of the varieties. But higher pods/plant was recorded from BARI Chola 7 followed by BARI Chola 2. BARI Chola 8 showed higher seed weight followed by BARI Chola 3. The lowest weight was recorded from BARI Chola 5 followed by BARI Chola 7. On an average of years result showed that BARI Chola 3 gave higher yield among the varieties. BARI Chola 8 and Annigeri also revealed higher yield than BARI Chola 3 but the experiment was conducted only one year with this two varieties. So, the experiment needs to be repeated with BARI Chola 3, BARI Chola 8 and Annigeri for valid conclusion.

Conclusion

From the first year result it showed that among the varieties, BARI Chola 5, BARI Chola 6, BARI Chola 7 and Annigeri performed better but yield should be more. This is 1st year trial and will be continued for the next year for confirmation at Kushtia. The varieties BARI Chola 3, BARI Chola 8 and Annigeri gave higher yield but needs trial in next year for confirmation.

Table 1. Yield and yield contributing characters of eight chickpea varieties at MLT site, Kushtia

Variety	Pl. pop (m^2)	Pl. hight (cm)	Pods/ plant	Seed/ pod	100-seed wt. (gm)	Seed yield (kg/ha)	Straw yield (kg/ha)
Local	39.75c	22.75d	14.50c	2	8.07e	515.75d	690e
BARI Chola 2	40.75c	34.90a	20.25b	2	9.75d	656.25c	825d
BARI Chola 3	38.25cd	36.13a	15.00c	2	11.43b	821.25b	925c
BARI Chola 4	49.50a	32.48b	15.00c	2	9.45d	830.00b	940bc
BARI Chola 5	44.75b	31.75b	25.00a	2	11.53b	917.50a	1025a
BARI Chola 6	37.25cd	32.15b	17.5bc	2	14.33a	906.25a	1000ab
BARI Chola 7	35.00d	36.13a	25.75a	2	10.90c	945.75a	1025a
Annigeri	51.50a	29.08c	18.00bc	2	11.78b	905.00a	975abc
CV (%)	5.5	4	12.4	-	3.2	3.5	4.3

Table 2. Maturity, plant height, yield and yield contributing characters of chickpea varieties at FSRD site, Golapganj, Sylhet during Rabi 2003-04

Variety	Maturity (Days)	Plant height (cm)	Pod/plant (no.)	100-seed wt. (g)	Seed yield (kg/ha)		
					2001-02	2002-03	2003-03
BARI Chola-2	115	36.05	36.07	13.15	856	920	1116
BARI Chola-3	122	42.91	35.23	18.10	1406	1522	1565
BARI Chola-4	116	32.01	30.37	12.67	782	766	996
BARI Chola-5	121	29.34	29.13	12.07	1010	863	926
BARI Chola-6	114	34.73	34.35	14.45	858	984	1104
BARI Chola-7	120	37.70	36.76	12.10	702	779	1016
BARI Chola-8	125	43.02	31.93	21.71	-	-	1584
Annigeri	-	-	-	-	-	1569	-
$LSD_{0.05}$	3.39	1.96	1.63	0.52	112.0	62.73	55.35

Table 3. Maturity, plant height, yield and yield contributing characters of chickpea varieties at MLT site, Moulvibazar during Rabi 2003-04

Variety	Maturity (Days)	Plant height (cm)	Pod/plant (no.)	100-seed wt. (g)	Seed yield (kg/ha)	
					2002-03	2003-04
BARI Chola-2	116	35.32	35.73	12.62	892	1055
BARI Chola-3	121	41.71	34.00	18.08	1605	1478
BARI Chola-4	117	34.32	29.38	13.32	790	936
BARI Chola-5	123	28.76	30.80	11.01	654	855
BARI Chola-6	113	36.99	34.29	14.28	1014	1048
BARI Chola-7	122	36.89	36.25	12.44	738	948
BARI Chola-8	126	41.21	33.16	20.92	-	1494
Annigeri					1516	-
$LSD_{0.05}$	3.96	4.38	3.30	2.27	32.05	55.98

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COMPARATIVE PERFORMANCE OF SOME PROMISING CHICKPEA VARIETIES/LINES

Abstract

The experiment was conducted at Ishan Gopalpur, Faridpur during rabi season 2003-04 to find out the suitable variety/line for higher yield. The result showed that significantly the highest yield (1194 kg/ha) was obtained from Special plant 7. All the lines revealed higher yield than BARI Chola 5 except Special plant 3.

Introduction

Chickpea is the 3rd number of pulse crop of Bangladesh in respect to area (99543 ha) with production of only 50771.5 tons. Few numbers of recommended varieties of chickpea are available. So, it is need to release more number of high yielding chickpea varieties. Keeping this in mind the trial was undertaken to evaluate the performance of these new lines/varieties in the farmers' field.

Materials and Methods

The experiment was carried out at Ishan Gopalpur, Faridpur during rabi season of 2002-03 and 2003-04. The experiment was laid out in RCB with 3 dispersed replications. The unit plot size was 3m x 2m with line to line 30cm in solid line. The variety/lines were; Special plant 7, Special plant 3, BCX91044-3, BCX910403, BCX91040-3 and BARI Chola 5 as check. The fertilizer doses were 20-40-20 kg N-P-K/ha with 60 kg seed/ha. The crop was sown as 11 December 2003. Two times spray were done to control insects. The crop was harvested on 30 March 2004.

Results and Discussion

The result showed that plants/m^2, pods/plant, seed weight and seed yields were significantly affected by variety/lines (Table 1). Higher plants/m^2 was recorded from Special plant 7 which was statistically identical to BARI Chola 5 and Special plant 3. Plant height and seeds/pod was not significantly influenced by variety/line. Higher pods/plant was obtained from line BCX91040-3 which was statistically at par to Special plant 7 and the lowest from Special plant 3. Significantly the highest seed weight was recorded from BARI Chola 5 and others variety/line were similar. The line Special plant 7 showed the highest seed yield among the varieties/lines. All the line showed more or less higher yield than BARI Chola 5 except Special plant 3.

The experiment should be continued for another year trial for confirmation.

Table 1. Plants/m^2, plant height, yield and yield attributes of chickpea (Ishan Gopalpur, Faridpur, 2003-04)

Variety/line	Plant pop./m^2	Plant height (cm)	No. of pods/plant	No. of seeds/pod	1000-seed weight (g)	Grain yield (kg/ha)
Special plant 7	29.3	42.7	59.2	1.60	112.7	1194a
Special plant 3	27.3	35.1	45.4	1.50	109.0	874d
BCX91044-3	24.3	40.0	49.3	1.47	108.7	1020b
BCX91043-1	25.6	42.1	55.5	1.67	113.0	1083b
BCX91040-3	23.3	39.3	62.3	1.47	109.3	1059bc
BARI Chola 5	27.6	40.9	50.9	1.47	133.3	999c
LSD (0.05)	2.41	NS	5.62	NS	7.25	66.5
CV (%)	9.4	13.2	8.5	10.4	10.6	11.4

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MULTILOCATION YIELD TRIAL OF MUNGBEAN

Abstract

An experiment was conducted at multilocation testing site Gangni Meharpur during Kharif-II season of 2003 to evaluate the performance of promising Mungbean varieties/ lines. A total of Eight (8) varieties/ lines were tested. The results of the studies revealed that there was a significant variation in grain yield among the varieties/lines. Among the varieties/lines BARI Mung-5, BMX-95006-18 and BMX-94001-10 showed similar yield and higher than other varieties/lines.

Introduction

Mungbean (Vigna radiata (L) is one of the most important pulse crops particularly in southern parts of Bangladesh where it is grown in T.Aman - Mungbean. T. Aus cropping pattern. It has good flavour, high protein content and easy digestibility. Although mungbean is an important pulse for the dietary situation of the country but its production per unit area of land has not improved. About 65-70% of the total mungbean area belongs to the southern region of Bangladesh. However the area of mungbean in Kushtia district has been increased in the recent past year. The farmer of this area is using BARI released varieties. Local cultivars of these areas are low yielding and highly susceptible to yellow mosaic virus (YMV), cercospara leaf spot (CLs) and powdery mildew (PM) disease. The farmers of this area are using BARI released varieties. The main objective of experiment is to find out the promising line as compared to existing BARI released variety.

Materials and Methods

The experiment was conducted at MLT site Gangni during Kharif-II season of 2003 under rainfed condition. The experiment was laid out in RCB design with three dispersed replications. The unit plot size was 6 rows x 4m. Seeds were sown by lines (40 x 10 cm) on 28 August, 2003. Fertilizers were applied at the rate of 20-40-20 kg/ha NPK as basal dose. One weeding was done the date of 25th October, 2003. Plant protection measure was done. Data were collected on yield and yield components. The recorded data were analyzed statistically. Different varieties/lines were harvested on 5 to 12 November 2003.

Results and Discussions

Plant height, plants/m^2, 1000-seed wt. & seed yields were significantly affected by different varieties. Three varieties/lines (BMX -94001-10, BARI Mung-5 & BMX-97001-10) showed similar height & higher than other varieties/lines. Significantly higher pods/plant was recorded from BMX-95006-18. But Seeds/pod showed higher in BARI Mung-5 which was closely followed by BMX-95006-18 & BMX-94001-10. Though pods/plant & seed weight higher in former variety but BMX99002-2 showed higher 1000-seed weight. Higher seed yield was obtained from BARI Mung 5 which was closely followed by BMX-95006-18 & BMX-54001-10.

Farmers' reaction

Farmers satisfied with the existing variety BARI Mung 5 and two lines (BMX-95006-18 & BMX-94001-10) higher yield, seed size, fine seed coat, maximum stover yield and for semi spreading mature of plants.

Conclusion

Out of eight varieties/lines, BARI Mung 5, new lines BMX-95006-18 and BMX-94001-10 showed higher yield compared to other lines. So, both the lines BMX-95006-18 & BMX-9400-10 needs to be trial for next season.

Table. Performance of Mungbean varieties at MLT site Gangni, Meharpur (Kharif-II at year of 2003)

Variety name	Plant height (cm)	Plant/ m^2	Pods/ plant	No.of seeds/ pod	1000-seed wt.(g)	Seed yield (kg/ha)	Straw yield (kg/ha)
BMX-99002-2	55.60bc	34.67a	15.22d	12.52bc	40.83a	1465.53c	2951.67
BMX-97004-10	55.85abc	35.33a	17.69d	12.17c	40.17b	1471.10bc	2868.33
BMX-94001-3	55.61bc	33.33b	14.17e	11.92c	39.05c	1361.67d	2750.00
BMX-94001-10	56.37a	33.33b	17.47b	13.25ab	39.67b	1523.67ab	3066.67
BMX-95001-7	55.50c	34.67a	16.33c	12.25c	39.67b	1488.87bc	3062.00
BMX95006-18	55.58bc	32.00c	19.37a	13.50a	40.05b	1548.33a	2910.33
BARI Mung 2	52.50d	32.33c	13.75e	12.12c	40.08b	1433.33c	2943.33
BARI Mung 5	56.15ab	33.67b	18.21b	13.52a	38.00d	1565.53a	2975.00
CV (%)	0.64	1.65	2.86	3.74	0.81	2.22	-
LSD (0.05)	0.61	0.98	0.83	0.17	0.57	57.68	-

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EFFECTS OF SEED CORMEL SIZE AND PLANT SPACING ON THE YIELD OF MUKHIKACHU

Abstract

An investigation was conducted at the Regional Agricultural Research Station, Jamalpur during the kharif season of 2003. Yield contributes such as cormel/hill and weight of cormel/hill observed the highest in spacing 60 cm x 15 cm but reduced the yield of cormels/ha due to wider spacing. The yield of cormel/ha at wider spacing was lower than closer spacing. Small seed cormels with 60 cm x 15 cm spacing gave statistically the highest yield. Considering the cost of seed and economic return, 60 cm x 15 cm spacing with small size cormel (20±5 g) appeared to be best.

Introduction

Mukhikachu *(Colocasia esculenta* L. Schott.) is a popular indigenous vegetable in Bangladesh. The crop is extensively grown in the summer season and is considered as an important vegetable, particularly in the months of September, October and November when the supply of other vegetables is scarce in the market. But till now, there has been no scientific development on the production of this crop in Bangladesh. The growers choose seed cormels and plant spacing according to their own choice. The general tendency is to select small seed cormels and a closer spacing. Double row method of planting is also in practice in some areas of the country. It is well documented that seed size and plant spacing have significant influence on the growth and yield of different crops and it is like that both the factors have similar effects on the yield of Mukhikachu. The present investigation was, therefore, undertaken with a view to finding out the optimum size of seed cormel, proper plant spacing for the production of Mukhikachu.

Materials and Methods

The experiments were conducted at the Regional Agricultural Research Station, Jamalpur in the growing season of 2003. The treatment consisted of 3 levels of seed cormel size (small, medium and large weighing 20±5 g, 30± 5g and 40±5g per seed respectively), and 4 levels of plant spacing (60 cm x 15 cm 60 cm x 30 cm, 60 cm x 45 cm and 60 cm x 60 cm). The experiment was set in factorial randomized complete block design with 3 replications. Seed cormels of Mukhikachu variety Bilashi were planted on 15 February 2003. The unit plot size was 6 m x 1.8 m. The crop received 10 tons cowdung, 140 kg urea, 100 kg triple super phosphate and 120 kg muriate of potash per hectare. Cowdung and triple superphosphate were applied during land preparation. Urea and muriate of potash were side dressed in two equal splits 40 and 90 days after planting. The crop was harvested on 28 October 2003.

Results and Discussion

Effect of cormel size: The results pertaining to the yield and yield contributing characters due to cormel size has been presented in Table 1. It indicated that plant height increased significantly with the increase of cormel size. The highest plant height was recorded when large size cormel was planted while it was shortest with smaller size cormel. The similar trend was also noticed in case of leaves/plant. But the reverse observation was found in number of sucker/hill. The highest number of sucker was found in small sized cormel while it was significantly lowest in large size cormel. But the number of cormel/hill was statistically similar in both small and large size cormel. The medium size cormel produced significantly lower number of cormel/hill. The weight of cormel/hill was found significantly the highest in small size cormel and decreased significantly with the larger size. The similar trend was also observed in yield of cormel also. However, the highest yield was recorded in small size cormel (19.56 t/ha) while it was lowest in large size cormel (17.13 t/ha).

Effect of spacing: The result indicated that the plant height increased significantly with the increase in spacing (Table 1). The shortest plant was recorded with the closer spacing while it was highest in larger spacing. The similar trend was also observed in case of number of leaves/plant. But the no. of suckers/hill was highest in closer spacing and decreased significantly with larger spacing. Similar trend was observed in case of no. of cormel/hill and weight of cormel/hill also. However, significantly the highest cormel yield was observed in closer spacing (20.79 t/ha) while it was lowest in larger spacing (13.54 t/ha).

Interaction effect: All the yield and yield contributing characters except no. of leaves/plant and no. of sucker/plant were significant due to cormel size and spacing (Table 2). Large size cormel with spacing 60 cm x 45 cm and 60 cm x 60 cm showed similar in height and higher than other treatments. Similar trend was followed in case of leaves/plant. But significantly the highest suckers/plant was recorded from wider spacing and large cormel size. Significantly the highest weight of cormel was recorded from closest spacing with small size cormel. The cormel/hill and weight of cormel contributed higher which reflected higher yield at closest spacing (60 cm x 15 cm) with small size cormel (20±5 g). Besides, the lowest yield was obtained with the larger size cormel (40±5 g) and wider spacing 60 cm x 60 cm.

Cost and return analysis

Seed cormel when used in smaller size with closer spacing required Tk. 13320/ha (Table 3) and the amount decreased gradually with the wider spacing. The same trend was exhibited in medium and large size also. But the gross return was found highest in closer spacing with small size cormel (Tk. 107960/ha). The result showed that higher yield and benefit could be obtained from closer spacing (60 cm x 15 cm) with small size cormel (20±5 g).

Conclusion

Small seed cormels (20±5 g) with 60 cm x 15 cm spacing gave the highest yield and economic return.

Table 1. Plant height, yield and yield contributing characters of Mukhikachu

Treatment	Plant height (cm)	Leaves/ plant (no.)	Suckers/ hill (no.)	Cormel/ hill (no.)	Cormel wt. /hill (g)	Yield (t/ha)
Cormel size						
Small (20±5 g)	70.75c	5.11c	8.58a	15.75a	781.67a	19.56a
Medium(30±5 g)	154.42b	5.86b	7.52b	13.75b	675.00b	18.38b
Large (40±5 g)	174.17a	7.28a	6.67c	15.42a	626.67c	17.13c
F-test	**	**	**	**	**	*
Spacing						
60cm x 15cm	112.56c	4.97c	9.56a	15.33a	765.56a	20.79a
60cm x 30cm	138.33b	5.24b	7.44c	15.67a	695.56c	17.70b
60cm x 45cm	154.67a	6.12a	8.67b	14.44b	711.11b	13.38c
60cm x 60cm	158.89a	6.67a	6.56d	12.44c	605.56d	13.54c
F	**	**	**	**	**	**
CV(%)	11.48	10.59	12.11	11.84	10.96	9.35

Figure in the column having similar letter do not significantly

Table 2. Interaction effects of cormel size and plant spacing on the yield components of Mukhikachu

Interaction		Plant height (cm)	Leaves/ plant (no.)	Suckers/ hill (no.)	Cormel/ hill (no.)	Wt. of cormels /hill (g)	Yield of cormel (t ha^{-1})
Grade	Spacing (cm)						
Small	60 x 15	79.67g	4.00g	5.33f	17.67a	860.00a	26.99a
	60 x 30	107.33f	5.07f	7.00e	13.00e	626.67ef	15.75ef
	60 x 45	109.00f	5.30f	8.00d	14.67d	646.67e	13.22g
	60 x 60	107.00f	5.87f	8.33d	16.33b	716.67c	13.54g
Medium	60 x 15	135.67e	5.03e	7.00e	13.33e	623.33f	19.99c
	60 x 30	158.00d	5.47d	7.33e	15.33bcd	673.33d	25.34b
	60 x 45	178.00c	6.13c	8.33d	16.33b	683.33d	15.09f
	60 x 60	194.00b	6.80b	10.00c	18.00a	720.00c	15.29e
Large	60 x 15	152.00d	5.67d	7.33e	13.00e	676.67d	18.39d
	60 x 30	179.67c	5.20c	8.00d	15.00cd	786.67b	15.00f
	60 x 45	207.00a	6.93a	10.67b	16.00bc	803.33b	14.84f
	60 x 60	205.67a	7.33a	12.33a	11.00f	516.67g	13.79g
F		**	*	**	**	**	**
CV (%)		11.47	10.59	12.11	11.84	10.96	9.35

Table 3. Investment due to seed cormels and return/ha as influenced by seed size and plant spacing in Mukhikachu (Bilashi)

Spacing (cm)	Seed cormel size (g/seed)		
	Small (20±5 g)	Medium (30±5 g)	Large (40±5 g)
Seed cormels required (kg ha^{-1})			
60 x 15	2220	3332	4440
60 x 30	1110	1666	2220
60 x 45	740	1110	1480
60 x 60	550	833	1108
Cost of seed cormels (Tk ha^{-1})			
60 x 15	13320	19992	26640
60 x 30	6660	9996	13320
60 x 45	4440	6660	8880
60 x 60	3324	4998	6648
Gross return from harvested cormels (Tk ha^{-1})			
60 x 15	107960	78360	73560
60 x 30	63000	101360	60000
60 x 45	52880	60360	59360
60 x 60	54160	61160	55160

@ Tk. 6.00/kg of seed cormels, @ Tk. 4.00/kg of harvested cormels

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AGRO-ECONOMIC EVALUATION OF WHEAT-JUTE-MUNGBEAN CROPPING PATTERN IN MEDIUM HIGHLAND UNDER PARTIALLY IRRIGATED CONDITION

Abstract

Wheat-Jute-Mungbean cropping pattern was tested under medium highland partially irrigated condition at the Gangni, MLT site during 2003-04. The pattern performed well both agronomically and economically by inclusion of mungbean, after Jute and before wheat (var. Potiva). The pattern was economically viable due to higher BCR and soil health could be improved with the addition of mungbean biomass.

Introduction

The farmers of the Gangni MLT site with the medium highland situation under partially irrigated condition follow their major cropping pattern Wheat (Kanchan)-Jute (O-524) Fallow and they were used traditional varieties of that crop. In this situation it is necessary to find out the alternate cropping pattern with high yielding varieties to increase profitability of production. BARI recently developed short duration high yielding Mungbean variety (BARI Mung-5) which could be successfully grown after Jute. In this context an attempt was therefore made to design a cropping patterns with high yielding varieties with wheat (Protiva)-Jute (Falguni tosha) and Mung (BARI Mung 5).

Materials and Methods

The cropping pattern Wheat-Jute-Mungbean was tested with an area of 490 Sq.m. replicated in three plots in each site across the farmers field under same land type. Data on agronomic practice, human labour cost, animal power cost, input cost were recorded from the experimental plots and farmers plots were evaluated. Agronomical and economical data were shown year-wise in Table 1-3.

Results and Discussions

Agronomic: Farmers of Gangni, MLT site follow traditional cultivation practice with low yielding variety (Kanchan for wheat, O-524 for Jute). They do not apply balanced fertilizers such as sulphur fertilizer in their field. As a result the yields were low. In improved pattern, all management were done properly with used modern variety. About 20-25% higher yield of wheat (var. Protiva) and Jute (var. Falguni tossa) was achieved than wheat (var. Kanchan) and Jute (var. O-524). Mungbean short duration variety BARI Mung-5 (73-72) days could be easily grown successfully between the crops (Jute-Wheat). Turn around time between wheat-jute, Jute-Mungbean, Mungbean-Wheat 22, 21 and 7 days.

Cost and return analysis: The gross benefit, total variable cost, gross margin and BCR of the improved patterns were higher than the farmers pattern. On an average, the gross benefit of farmer pattern (wheat-Jute) were Tk. 54620/- corresponding gross benefit of improved pattern (wheat-Jute-Mungbean) were Tk. 137911/-. Benefit cost ratio also higher in improve pattern than farmers pattern. So gross benefit, gross margin and benefit cost ratio of the improved pattern were higher than farmers pattern. From the economic point of view, it is clear that alternative improved cropping pattern was more economically profitable and higher remunerative than the farmers existing pattern.

Farmer Reaction

It was observed that the pattern Wheat-Jute-Mungbean was found highly profitable in the area due to its higher production and economic return.

Conclusion and Recommendation

It is clear that the improved cropping pattern (Wheat-Jute-Mungbean) was more economically profitable and higher remunerative than the farmer existing pattern (Wheat-Jute). This pattern could be recommended for the AEZ-11 especially in Meharpur, Choudanga and Kushtia area.

Table 1. Agro-economic performance of Improved cropping pattern as compared to farmers' pattern in medium high land under irrigated condition at MLT site Gangni, Meherpur in 2001-02

Parameters	**Farmers cropping pattern**			**Improved cropping pattern**		
	Rabi	**Kharif-I**	**Kharif-II**	**Rabi**	**Kharif-I**	**Kharif-II**
Crop	**Wheat**	**Jute**	**Fallow**	**Wheat**	**Jute**	**Mungbean**
Variety	Kanchan	0-524 (Indian)	-	Protiva	0-9897	BARI Mung-5
No of ploughing and laddering	4-5	5-6	-	4-5	5-6	2
Seed rate (kg/ha)	140	7.5	-	130	7.5	46.5
Fertilizer (N-P-K-S kg/ha)	150-22-29	50-13-33	-	90-30-20-20	50-20-58-20	20-19-29
No. of weeding	-	3	-	2	3	1
Irrigation	2	0	-	2	-	-
Insecticide application.	-	-	-	-	1	2
Sowing /Planting date(range)	4-11-00 to 19-11-00	22-4-01 25-4-01	-	4-11-00 to 19-11-00	22-4-01 to 25-4-01	13-8-01 to 20-8-01
Harvesting date(range)	5-3-01 to 14-3-01	10-8-01 17-8-01	-	5-3-01 to 14-3-01	10-8-01 to 17-8-01	19-10-01 to 28-10-01
Field duration (days)	121	115	-	121	115	66
Turn around time (day)	-	-	-	6	47	3
Grain yield (t/ha)	3.7	3.54	-	4.07	4.07	1.466
Straw yield (t/ha)	6.4	6.326	-	7.96	8.23	2.308
Gross benefit (Tk./ha)	34400	41161	-	38530	49008	41578
Whole pattern Gross Benefit	75561			129116		
TVC (Tk/ha)	13359	21110	-	16125	23847	9935
Whole pattern TVC	34505			49907		
Whole pattern G.M (Tk/ha)	41056			79209		
Whole pattern BCR	2.19			2,59		

Table 2. Agro-economic performance of Improved cropping pattern as compared to farmers' pattern in medium high land under irrigated condition at MLT site Gangni, Meherpur in 2002-03

Parameters	Farmers cropping pattern			Improved cropping pattern		
	Rabi	Kharif-I	Kharif-II	Rabi	Kharif-I	Kharif-II
Crop	Wheat	Jute	Fallow	Wheat	Jute	Mungbean
Variety	Kanchan	0-524 (Indian)	-	Protiva	Falguni tosha	BARI Mung-5
No. of ploughing and laddering	4-5	5-6	-	4-5	5-6	2
Seed rate (kg/ha)	150	7.5	-	130	7.5	40
Fertilizer (N-P-K)	-	-	-	92-32-22-20	32-22-56-19	20-20-25
No. of weeding	2	3	-	2	3	2
Irrigation	3	-	-	3	1	-
Insecticide application.	-	2-	-	-	1	2
Sowing /Planting date (range)	15-11-01 29-11-01	6-4-02 13-4-02	-	15-11-01 29-11-01	6-4-02 13-4-02	25-8-02 3-9-02
Harvesting date(range)	12-3-02 6-4-02	20-8-02 22-8-02	-	9-3-02 2-4-02	20-8-02 22-8-02	7-11-02 15-11-02
Field duration (days)	109-117	129-140	-	114-124	131-140	73-72
Turn around time	-	-	-	8-14	27-11	5-12
Grain yield (t/ha)	3.82	3.06	-	4.17	3.14	1.45
Straw yield (T/ha)	6.70	7.71	-	7.17	8.06	2.87
Gross benefit (Tk./ha)	41140	46056	-	44730	47526	49462
Whole pattern Gross Benefit	87196			141718		
TVC(Tk/ha)	15675	22650	-	15395	17775	8705
Whole pattern TVC(Tk/ha)	38325			45870		
Whole pattern G.M (Tk/ha)	48871			95848		
Whole pattern BCR	2.28			3.09		

Table 3. Agro-economic performance of Improved cropping pattern as compared to farmers pattern in medium high land under irrigated condition at MLT site Gangni, Meherpur in 2003-04

Parameter	Farmers cropping pattern			Improved cropping pattern		
	Rabi	Kharif-I	Kharif-II	Rabi	Kharif-I	Kharif-II
Crop	Wheat	Jute	Fallow	Wheat	Jute	Mungbean
Variety	Kanchan	0-524 (Indian)	-	Protiva	Falguni tosha	BARI Mung-5
No. of ploughing and laddering	4-5	5-6	-	4-5	5-6	2
Seed rate (kg/ha)	150	7.5	-	130	7.5	40
Fertilizer (N-P-K-S kg/ha)				92-32-22-20	32-22-56-19	20-20-25
No. of weeding	2	3	-	1	3	1
Irrigation				3		
Insecticide application.		2			1	2
Sowing /Planting date (range)	15-11-03 25-11-03	6-4-03	-	15-11-03	8-4-03	13-8-03
Harvesting date (range)	20-3-04	25-8-03	-	18-3-04	22-8-03	25-10-03
Field duration (days)				116	133	73
Turn around time				22	21	7
Grain yield (t/ha)	3.45	3.16		4.10	3.85	1.2
Straw yield (T/ha)	5.25	7.05	-	5.80	6.80	2.0
Gross benefit (Tk./ha)						
Whole pattern Gross Benefit	88320/-			142900/-		
Whole pattern TVC(Tk/ha)	38325/-			46970/-		
Whole pattern G.M (Tk/ha)	49325			95930/-		
BCR	2.30			3.04		

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AGRO-ECONOMIC EVALUATION OF MUSTARD-BORO- T.AMAN CROPPING PATTERN IN MEDIUM HIGHLAND UNDER IRRIGATED CONDITION

Abstract

Mustard-Boro-T.Aman cropping pattern was tested under irrigated medium highland condition at the Gangni MLT site, Meherpur during 2001-02, 2003-04. The pattern performed well both agronomically and economically by including a short duration rice variety(BR-39),in T.Aman season and with high yielding variety BR-28 in Boro season and a short duration mustard variety (BARI sharisha-9). Mustard could be successfully grown in rabi season between the crop T.Aman & boro rice. The pattern was economically viable due to higher BCR (2.18).

Introduction

The farmers of the Gangni MLT site, Meherpur used to follow Boro-T.Aman cropping pattern in the medium highland situation under irrigated condition. They could not grow rabi crops because of higher field duration of BR11. Mustard were tested last years after T.Aman rice (MV). Farmers were interested to grow BR11 in aman season for its higher yield but its field duration was high, BRRI recently developed one variety (BRRI dhan 39) which was early maturing by 98 days. & BARI recently developed one Mustard variety (BARI sarisha-9) which was also early maturing (85) and high yielding variety compare to the existing pattern with improved pattern at Gagni site.

Materials and Methods

The cropping pattern Mustard-Boro-T.Aman was tested with an area of 490 sq.m replicated in three plots across the farmers field under same land type. Data on agronomic practice, human labour cost, animal power cost, input cost were recorded from the experimental plots and farmers plots also evaluated. Agronomical and economical data were shown year-wise in Table 1-3.

Results and discussion

Agronomic: Farmers of Gangni MLT site Meherpur follow traditional cultivation practices with low yielding variety (IR-50 for Boro & BR11 for T.Aman) and do not apply balanced fertilizers such as Zinc & Boron in their field. As results the yields were low. In improved pattern 10-14% higher grain yield of Boro(BRRI dhan 28) was achieved by applying recommended rate of 110-55-45-30-4 kg N-P_2O_5-K_2O-S Zn/ha and by used modern variety. On an average, Boro (BRRI dhan 28) and T.Aman (BRRI dhan 39) required 95 days and 102 days respectively. On the other hand, IR-50 and BR-11 required 107 & 123 days respectively for field duration. So, short duration variety Mustard BARI Sarisha 9 (87 days) easily grown successfully between the crop T.Aman & Boro. Turn around time between Mustard-Boro, Boro-T.Aman and T.Aman-Mustard were 14, 63 & 5 days which was indicated the crops could be grown without disturbing the following crops.

Economic and return analysis: The gross benefit, total variable cost gross margin and BCR of the improved patterns were higher than the farmers pattern. On an average, the gross benefit of farmers pattern (IR50 and BR11) were Tk. 69043/ha and that of improved pattern Boro (BRRI dhan 28)-T.Aman (BRRI dhan 39) – Mustard (BARI Sarisha-9) were Tk. 107210. Gross benefit, gross margin & benefit cost ratio (2.17) of the improved pattern were higher than farmers' pattern. From the economic point of view, it is clear that improved cropping pattern was more economically profitable and higher remunerative than that of farmers existing pattern.

Farmer Reaction

It was observed that mustard variety BARI Sharisha-8/9, T.Aman variety BRRI dhan 28 and BRRI variety 39 was found highly profitable in the area due to its higher production & economic return. Farmers were very much impressive about higher yield and return.

Recommendation

It is clear that the improved cropping pattern (Mustard-Boro-T.Aman) was more economically profitable and higher remunerative than the farmer existing pattern. (Boro-T.Aman). This pattern could be recommended for AEZ 11 of Mehepur, Chowgacha and Kushtia area.

Table 1. Agro-economic performance of Improved cropping pattern as compared to farmers pattern under medium high land irrigated condition at MLT site Gangni, Meherpur during 2001-02

Parameters	Farmers cropping pattern			Improved cropping pattern		
	Rabi	Kharif-I	Kharif-II	Rabi	Kharif-I	Kharif-II
Crop	Fallow	Boro	T.Aman	Mustard	Boro	T.Aman
Variety	-	Ir-50	BR-11	BARI sharisha-8	BR-28	BR-39
No. of ploughing and laddering	-	3-4	3-4	4-5	3-4	3-4
Seed rate (kg/ha)	-	45	40	8	45	46
Fertilizer N-P-K-S-Zn-B	-	104-27-33-30-0	110-27-37-20-0	120-35-33-4-2	110-24-37-30-4	120-24-37-45-4
No. of weeding	-	02	02	02	03	03
Irrigation	-	continue	continue	02	continue	continue
Insecticide application.	-	03	03	02	03	03
Sowing/Planting date (range)	-	04-02-01 to 21-02-01	18-7-01 to 24-7-01	4-11-2000 to 12-11-2000	8-2-01 to 21-2-01	18-7-01 to 24-7-01
Harvesting date(range)	-	21-5-01 to 26-5-01	14-11-01 to 18-11-01	5-2-01 to 20-2-01	15-5-01 to 23-5-01	28-10-01 to 2-11-01
Field duration (days)	-	99	113	85	94	101
Turn around time(days)				10	45	10
Grain yield (t/ha)	-	3.50	4.15	1.51	4.25	4.39
Straw yield(T/ha)	-	4.00	4.46	3.21	4.72	4.78
Whole pattern gross benefit (Tk/ha)	59,897/-			93,670/-		
TVC(Tk/ha)	31,508/-			44,628/-		
G.M (Tk/ha)	28,389/-			49,042/-		
BCR	1.90			2.09		

Table 2. Agro economic performance of improved cropping pattern as compared to farmers' pattern under highland partially irritated condition at MLT site Gangni Meherpur.2002-03

Parameters	Farmers cropping pattern			Improved cropping pattern		
	Rabi	Kharif-I		Rabi	Kharif-I	
Crop	F	Boro	T.Aman	Mustard	Boro	T.Aman
Variety	-	IR-50	BR-11	BARI-9	BARI-28	BARI-39
No. of ploughing and laddering	-	3-4	3-4	4-5	3-4	3-4
Seed rate (kg/ha)	-	45	4	7.5	45	40
N-P-K-S-Zn kg/ha	-	140-65-27-26-0	140-55-45-20-0	120-80-60-40-4	110-55-45-30-0	140-55-45-20-0
No. of weeding	-	3	3	2	3	3
Irrigation	-	Continuos	1	2	Continuos	1
Insecticide application.	-	1	1	1	1	1
Sowing/Planting date (range)	-	27-1-02	9-7-02	3-11-01	28-1-02	8-602
Harvesting date(range)	-	14-5-02	10-11-02	23-1-02	8-5-02	1-10-02
Field duration (days)	-	107	123	81	100	113
Turn around time(day)	-			30	5	30
Grain yield (t/ha)	-	4.13	4.11	1.18	4.50	4.47
Straw yield(T/ha)	-	4.60	4.83	3.05	4.91	5.02
Gross benefit(Tk/ha)	75401			121748		
TVC(Tk/ha)						
Whole pattern TVC	36625			54665		
Whole pattern G.M (Tk/ha)	38776			67083		
Whole pattern BCR	2.05			2.23		

Table 3. Agro economic performance of improved cropping pattern as compared to farmers pattern under highland irrigated condition at MLT site Gangni Meherpur, 2003-04

Parameters	Farmers cropping pattern			Improved cropping pattern		
	Rabi	Kharif-I		Rabi	Kharif-I	
Crop	Fallow	Boro	T.Aman	Mustard	Boro	T.Aman
Variety	-	IR-50	BR-11	BARI-9	BRRI-28	BRRI-39
No. of ploughing and laddering	-	3-4	3-4	4-5	3-4	3-4
Seed rate (kg/ha)	-	45	4	7.5	45	40
Fertilizer N-P-K-S-ZN (kg/ha)	-	140-65-25-26	140-55-45-20	119-78-60-37-4	140-25-35-20-0	75-13-22-21-0
No. of weeding	-	3	3	2	3	3
Irrigation	-	continuos	1	2	3	2
Insecticide application.	-	1	1	1	1	1
Sowing/Planting date (range)	-	8-2-03 10-2-03	15-7-03 17-7-03	30-10-03	8-2-03	15-7-03
Harvesting date(range)	-	14-5-03	10-11-03	25-1-04	13-5-03	25-10-03
Field duration (days)	-			87	95	102
Turn around time(day)	-			5	14	63
Grain yield (t/ha)	-	4.00	3.8	1.2	4.00	3.9
Straw yield(T/ha)	-	4.60	4.83	3.03	4.9	5.08
Gross benefit(Tk/ha)	71830/-			106210		
TVC(Tk/ha)	36625/-			48665/-		
Whole pattern G.M (Tk/ha)	35205			57545/-		
Whole pattern BCR	1.96			2.18		

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EFFECT OF CULTURAL PRACTICES ON THE PERFORMANCE OF DIFFERENT CROPS IN SALINE AREA

Abstract

The experiment was conducted at Paikgacha MLT site to identify the effect of cultural practices on different crops. The result showed that the treatment wheat with straw mulch produced the significantly the highest yield (2.21 t/ha) of wheat. Similarly, maize with straw mulch produced higher yield (4.08 t/ha) but statistically identical to hand mulch. Both crops produced lowest yield without mulch. Further investigation in relation to 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. Salt accumulates as crust on the soil surface. Mulch can minimize the accumulation of salt on soil surface. For higher salinity most of the rabi crops do not survive in the area. BARI recently developed many high yielding varieties of cereals crops. To minimize the salt accumulation on soil surface maize and wheat need to be evaluated in saline area with cultural practices. The present study was therefore, undertaken to identify the suitable cultural practice of maize and wheat in saline area.

Materials and Methods

The trial was conducted at Paikgacha MLT site during rabi season 2003-2004. Two different crops (maize and wheat) were sown on 27 November 2003 at farmer's field. Three cultural practices (straw mulch, hand mulch and without mulch) were included in the study. The unit plot size was 1.5m 5 1m. Seeds were sown following RCB design with three replications. The seeds were sown as line sowing. Irrigation was given at initial stage to ensure germination. The detail particulars of materials and methods are presented in Table-1. Intercultural operations were followed as and when necessary. Wheat was harvested during the third week of March 2004 and maize was harvested during the last week of March 2004. The soil salinity level during 26 November, 11 & 26 December 2003, 10 & 25 January, 10 & 26 February, 10 & 25 March 2004 were 2.14, 1.04, 1.80, 3.96, 5.16, 6.82, 4.90, 6.14 and 3.35 mm hos/cm, respectively. Data were statistically analyzed and means were compared by LSD test.

Table 1. Variety, sowing method, spacings and fertilizer doses for wheat and maize

Name of crops	Variety	Method of sowing	Spacing	Fertilizer dose (kg/ha)				
				N	P	K	S	Zn
Wheat	Sourav	Line	20 cm	82	28	25	20	-
Maize	BARI Maize 5	Line	75525 cm	92	30	50	27	4

Results and Discussion

Wheat

Performance of wheat as affected by cultural practices has been presented in Table 2. No yield attributes except seed yield differed significantly by cultural practices. Wheat cultivated with straw mulch produced significantly highest grain yield could be due to maximum spike/m^2, longest spike, maximum grains/spike and grain weight. Wheat cultivated with no mulch produced the lowest yield could be due to minimum spike/m^2, shortest spike and minimum grain/spike.

Maize

Performance of maize as affected by cultural practices has been presented in Table 3. No yield attributes except grain/cob and grain yield differed significantly by cultural practices. Maize cultivated with straw mulch produced significantly highest grain yield could be due to maximum plant/m^2, maximum cob/plant and seed weight. Maize cultivation with no mulch produced the lowest yield could be due to minimum plant/m^2, shortest plant, minimum grain/cob and seed weight.

Farmers reaction

Farmers preferred wheat and maize for their adaptability in saline area. Farmers dislike straw mulch covering extra cost and rat infestation.

Conclusion

Wheat variety Sourav and maize variety BARI Maize-5 cultivated with straw mulch showed better adaptability in saline area. Further detail investigation in relation to management practices could be done to evaluate the performance of above mentioned crops.

Table 2. Effect of cultural practices on the yield and yield parameters of wheat at Paikgacha MLT Site during rabi season 2003-04

Cultural practices	Spike/m^2	Plant height (cm)	Spike length (cm)	Grains/spike	1000 grain wt .(g)	Grain yield (t/ha)
Straw mulch	263	91.67	11.00	31.00	32.37	2.21a
Hand mulch	252	85.67	10.67	29.00	30.80	1.96b
Without mulch	225	86.33	9.67	26.33	31.27	1.74b
CV(%)	6.96	4.93	11.51	8.11	1.95	5.18

Table 3. Effect of cultural practices on the yield and yield parameters of maize at Paikgacha MLT Site during rabi season, 2003-04

Cultural practices	Plant population/m^2	Plant height (cm)	Cob/Plant	Grain/Cob	1000 grain wt. (g)	Grain yield (t/ha)
Straw mulch	5.50	188.33	1.63	341 ab	173	4.08a
Hand mulch	5.00	187.67	1.47	351 a	172	3.90a
Without mulch	4.50	179.33	1.57	328 b	167	3.30b
CV(%)	16.83	5.78	9.70	2.33	2.04	4.41

Means followed by common letters or no letters are statistically similar at 5% level.

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SCREENING OF DIFFERENT RABI CROPS AGAINST TOLERANCE TO SOIL SALINITY IN SALINE AREA

Abstract

Different rabi crops specially vegetables were **s**creened in saline area under rainfed condition at CDSP II site, Char Majid, Noakhali during rabi season 2003-2004. Five farmer's lands having different degree of salinity (viz. S_1=4 ds/m, S_2=6 ds/m, S_3=6.5 ds/m, S_4=8.0 ds/m and S_5=9.0 ds/m) were used for the study. Among the vegetable crops batisak showed better performance in all level of soil salinity but tomato and cabbage resulted better yield in the soil having low salinity. In case of spices and oil seed crops, both the crops produce yield in the land having average soil salinity up to 6.08. With the increase of soil salinity; yields of almost all crops reduced drastically and it was not possible the plant of spices and oil seed crops tested in the study to reach up to maturity to produce yield in the soil having salinity more than 6.08ds/m.

Introduction

Out of 2.83 million hectares in the 13 districts of Bangladesh, about 0.84 million hectares are affected varying degrees of soil salinity (Karim & Iqbal, 2001). It is a production constraint common to all rainfed agriculture. From the SRDI soil report it was observed that salinity concentration vary 0-16 ds/m levels where low from May to November. During the Rabi season salinity level is highly increased here. As a result it is very difficult to grow Rabi crops. From the results in saline area it was observed that different crops response to salinity with respective varieties, so that experiment was conducted to evaluate the variability in salinity tolerance of different rabi crops in coastal area.

Materials and Methods

The experiment was conducted in farmer's field at CDSP II Site, Char Majid, Noakhali. Five farmer's field having different degrees of soil salinity (viz. S_1=3.49 ds/m, S_2=5.75 ds/m, S_3=6.08 ds/m, S_4=8.23 ds/m and S_5=9.14 ds/m) were used for the study. Detailed Salinity status of the experimental site of CDSP II at Char Majid is presented in Appendix 1. Vegetable crops namely; tomato, batisak and cabbage, spices crops viz. chilli and garlic and oil seed crop - mustard were tested in the selected farmer's field. Seedlings of different crops were raised at the seedbed. Seedlings of different crops at optimum age were transplanted in the main field having unit plot size 5m x 2m. Transplanting was done from December 15 -17, 2003. Recommended spacing and fertilizer doses were maintained depending upon the nature of crops. Weeding was done as and when necessary. Harvesting was done depending upon the crops. Data on yield of different crops were collected.

Results and Discussion

Yield of different crops against varying degree of salinity are presented in Table 1. Among different vegetable crops batisak showed better performance in all the fields resulting highest yield in S_3 (23.00 t/ha), but tomato and cabbage perform better in lower saline soil. Yield of vegetable crops under study reduce with the increase of salinity and tomato and cabbage could not grow in the soil having salinity more than 8 ds/m. Similar observation was recorded in case of spice and oil seed crops. Chilli resulted better yield in the soil having salinity up to 6 ds/m. the highest yield (0.75 t/ha) of garlic was found in the land having salinity 4 ds/m. With the increase of soil salinity; yield of garlic gradually decreased. Maximum seed yield (385.00 kg/ha) of mustard was recorded from the field with salinity 4 ds/m. With the increase of soil salinity; yields of almost all crops under study reduced drastically and it was not possible the plant of spices and oil seed crops to reach upto maturity to produce yield in the soil having salinity more than 6.50ds/m.

Recommendation

For successful cultivation of vegetable, spices and oil seed crops, soil salinity should be maintained up to 6.5 ds/m with some exception that batisak can grow well up to salinity 9 ds/m. For more conformation further research program should take including more crops/ varieties.

References

Karim, Z. and A. Iqbal(ed). 2001. Impact on land degradation in Bangladesh: Changing Scenario in Agricultural Land Use. Bangladesh Agricultural Council, Framgate, Dhaka. 95p.

Table 1. Yield performance of different rabi crops as influenced by soil salinity at CDSP II site, Char Majid, Noakhali, during 2003-2004

Soil salinity level (ds/m)	Yield (t/ha) of vegetables		
	Tomato	Batisak	Cabbage
S_1	13.18	21.79	36.53
S_2	10.53	21.00	12.00
S_3	11.00	23.00	9.79
S_4	-	15.00	10.00
S_5	-	16.06	-
	Yield (t/ha) of spices		
	Chilli	Garlic	
S1	2.27	0.75	
S2	2.30	0.70	
S3	0.97	0.63	
S4	-	-	
S5	-	-	
	Yield (kg/ha) of oil seeds		
	Mustard		
S1	385.00		
S2	133.33		
S3	156.25		
S4	-		
S5	-		

S_1 = salinity 2-5 (4), S_2 = salinity 3-8 (6), S_3 = salinity 4-9 (6.5), S_4 = salinity 5-15 (8), S_5 = salinity 5-16 (9)

Appendix 1. Salinity status of the experimental site of CDSP II at Char Majid, Noakhali

Experimental Field	Salinity (ds/m)					
	Dec./'03	Jan./'04	Feb./'04	Mar./'04	Aprl./'04	Average
Field 1	2.32	2.69	3.67	3.95	4.80	3.49
Field 3	2.20	6.21	7.64	5.00	7.69	5.75
Field 4	6.17	9.02	6.06	4.89	4.23	6.08
Field 5	7.07	7.09	15.19	5.50	6.30	8.23
Field 2	6.45	13.61	13.11	7.20	5.32	9.14
Average	4.84	7.72	9.13	5.31	5.67	

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SCREENING OF DIFFERENT OIL CROPS IN SALINE AREA DURING RABI SEASON

Abstract

The experiment was conducted as Benerpota farm, Satkhira during the Rabi season, 2002-04 to screen out the different salt tolerant varieties of different oil crops. Two year's results showed that soybean variety BARI Soybean-5, Linseed lien McGragor, Niger variety Shova and Safflower variety Saf-1 performed better at Banerpota farm. Sesame did not performed well. Further investigation in relation to 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. Amana 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 of oilseed crops. The performances of the varieties of oilseed need to be evaluated in saline area. The present study was therefore, undertaken to find out the suitable varieties of oilseeds in saline area.

Materials and Methods

The trial was conducted at Banerpota farm, Satkhira during rabi season 2002-2004. Five different crops were sown on 07 December 2003 at Benerpota farm. Four variety/line of Soybean (Galisom, Shohag, Bangladesh soybean-4 and BARI soybean-5), four variety/line of Linseed (Lin-1, Dufferin, McGragor and JL-3), four variety/line of Niger (Shova, Nawalpur, ACcc-108 and Acc-104), three varieties of Sesame (BARI Til-2, BARI Til-3 and T-6) and one variety of Safflower (Saf-1) were included in the study. The unit plot size was 2mx1m. Seeds were sown following RCB design with four replications. The seeds were sown in line sowing. One irrigation was given. The detail particulars of materials and methods are presented in Table 1. Intercultural operations were followed as and when necessary. The soil salinity level at the site during 16 Dec. 03, 21 Dec. 03, O6 Jan.04 22 Jan, 04, 07 Feb., 04, 23 Feb, 04, 08 March, 04, 24 March, 04, 07 Apr., 04 and 22 April, 04 were 1.65, 1.66, 5.20, 8.30, 12.00, 13.30, 15.10, 7.76, 3.95 and 4.00 mm hos/com, respectively.

Table 1. Materials and Methods of rabi oil crop, 2003-04

Name of crops	Method of sowing	Spacing	Fertilizer dose (kg/ha)			
			N	P	K	S
Soybean	Line	30cm	25	35	55	18
Linseed	Line	30cm	35	25	23	-
Niger	Line	30cm	35	25	25	-
Sesame	Line	30cm	50	28	23	20
Safflower	Line	40cm	45	20	25	-

Results and Discussion

Soybean

Performance of different oil crop varieties has been presented in Table 2. Plant population/m^2, plant height, pod/plant, 100 seed weight and seed yield of soybean differed significantly by variety/line. BARI soybean-5 produced highest seed yield could be due to seed weight in 2003-2004. Shohag produced lowest yield could be due minimum pod/plant and seed/pod. On an average, the highest seed yield (1231 kg/ha) was obtained from BARI soybean-5. The yield level in 2002-2003 was much higher than this year might be due to low salinity level. The soil salinity range during the crop growing season in last year was 1.74 to 3.54 mm hos/cm.

Linseed

Plant population/m^2, plant height, capsule/plant, seed/capsule and seed yield of linseed differed significantly by variety/lines. The highest seed yield produced by McGragor in 2003-04 could be due to maximum plant/m^2, capsule/plant and seed/capsule. On an average, the highest seed yield (1368 kg/ha) was obtained from McGragor. The yield level in 2002-03 was much higher than this year might be due to low salinity level.

Niger

Plant population/m^2, plant height, head/plant, seed/head, 1000 seed weight and seed yield of Niger differed significantly by variety/lines. Shova produced the highest seed yield in 2003-04 could be due to maximum seed/head and seed weight. On an average, the highest seed yield (1091 kg/ha) was obtained from Shova. The yield level in 2002-03 was much higher than this year might be due to low salinity level.

Safflower

On an average, a safflower variety Saf-1 was introduced which yielded 1730 kg/ha

Groundnut

Plant population/m2, plant height, pod/plant, seed/pod, 100 kernel weight and pod yield differed significantly by varieties. Jhinga badam produced the highest pod yield followed by BARI Badam-6. Jhinga badam produced the highest yield could be due to maximum seed/pod. Dhaka-1 produced the lowest yield could be due to minimum seed/pod and seed weight.

Conclusion

On an average of two year's results showed that Soybean variety BARI Soybean-5, linseed line McGragor, niger variety Shova and Safflower variety Saf-1 showed better adaptability in saline area. Further investigation in relation to management practices could be done to evaluate the performance of above mentioned crops.

Table 2. Days to maturity, plant height, yield and yield attributes of different oil crops tested at Banerpota farm during rabi 2003-04

Variety/line	Days to maturity	Plant pop. /m^2 (no.)	Plant height (cm)	Pod/ plant (no.)	Seed/ pod (no.)	100 seed wt. (g)	Seed yield (kg/ha)		
							2002-03	2003-04	Mean
Soybean									
Shohag	126	18.50a	51.25a	46.50c	1.93	8.67b	1560c	750b	1155
Galisom	124	12.50b	52.25a	55.50a	2.25	7.30c	1595a	775c	1185
Bangladesh soybean-4	132	20.25a	50.00a	52.75b	2.18	6.82c	1471b	825b	1148
BARI soybean-5	128	16.00ab	45.50b	53.00b	2.20	10.72a	1537ab	925a	1231
CV(%)	-	20.00	2.76	1.64	8.51	6.78	2.95	1.76	-
Linseed									
Lin-1	120	25d	80.75a	49.75d	7.75b	4.07	1483a	725b	1104
Dufferin	124	28c	73.00c	59.50b	8.75a	4.00	980c	700b	840
McGragor	116	37a	59.00d	71.00a	9.00a	3.82	1511a	1225a	1368
JL-3	124	34b	77.25b	53.25c	7.75b	3.87	1268b	700b	984
CV(%)	-	3.02	77.25b	53.25c	5.76	7.44	2.89	5.45	-

Table 2. Contd.

Variety/line	Days to maturity	Plant pop. /m^2 (no.)	Plant height (cm)	Pod/ plant (no.)	Seed/ pod (no.)	100 seed wt. (g)	Seed yield (kg/ha)		
							2002-03	2003-04	Mean
Niger									
Shova	107	25.25d	90.00a	41.25b	39.00a	4.15	1232a	950a	1091
Nawalpur	105	33.50b	72.00c	36.75c	32.50c	3.90	1125b	787b	956
Acc-104	108	34.25a	84.00b	37.00c	33.50b	3.87	1140b	937a	1038
Acc-108	108	29.50c	85.00b	46.50a	31.00d	4.10	1045c	812b	928
CV(%)	-	357	1.00	2.77	1.20	6.17	3.24	4.30	
Safflower									
Saf-1	111	21	76	68	45	30	1840	1620	1730
Groundnut									
Dhaka-1	159	17a	39ab	20a	1.85c	27.00d	1603c	1471c	1537
Basanti badam	159	11b	40a	16b	1.35d	49.00b	-	1046d	-
BARI Badam-6	159	16a	38b	15b	1.97b	50.75a	1958ab	1807b	1882
Jhinga badam	163	16a	36c	14b	2.85a	40.75c	2106a	2030a	2068
BARI Badam-5	-	-	-	-	-	-	1739bc	-	-
LS	-	*	*	*	*	*	*	*	-
CV (%)	-	7.36	2.54	7.67	3.92	2.29	7.32	2.30	-

Means followed by common letters are statistically similar at 5% level.

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PERFORMANCE OF DIFFERENT GROUNDNUT VARIETIES

Abstract

A field experiment was conducted in the farmers' field of FSRD site Atkapalia Noakhali and Laxmipur during the Rabi season of 2003-04 to evaluate the performance of some groundnut varieties in Char area. BARI badam-5 and BARI badam-6 gave higher yield than other variety at Noakhali and BARI Badam-6 showed significantly the highest yield at Laxmipur.

Introduction

Most of the farmers of the char area cultivate local variety of groundnut with traditional management practices resulting the low yield compared to HYV. ORC of BARI has already released some improved groundnut varieties on the basis of their performance in RYT. Normally the developed varieties in the farmer's field under cultivation gradually degenerate over time. So, it is necessary to replace it by new one. Therefore, released varieties were put under trial at char area of Noakhali district to evaluate their performance.

Materials and Methods

The study was conducted at FSRD site Atkapalia, Noakhali and Laxmipur during Rabi season of 2003-04. The experiment was laid out in RCB design with five replications. Three varieties DG-2, BARI badam-5 and BARI badam-6 were tested against the Dhaka-1 (local). Unit plot size was 5mx4m. Nutrient dose of 10-70-50 kg/ha of NPK, respectively were applied in the form of Urea, T.S.P. and M.P. All fertilizers were applied as basal dose during final land preparation. Seeds were sown in lines maintaining 30cm x 15cm spacing. Seed sowing was done from 18 to 26 January 2004. A few of root rot diseases were observed. Harvesting was done in last week of May 2004.

Results and Discussion

Atkapalia FSRD site

Yield and yield attributes are presented in Table 1. Highest pods/plant was found in Dhaka-1 which was statistically similar with BARI badam-5 and BARI badam-6. Significantly highest kernel weight was recorded in BARI badam-6 and lowest was found in Dhaka-1. The nut yield varied 1.76 to 2.32 t/ha among the varieties. Highest nut yield 2.32 t/ha was found from the BARI badam-5 which gave the statistical identical yield with BARI badam-6. Lowest yield was recorded from Dhaka-1 (1.76 t/ha).

Laxmipur MLT site

Days to maturity, plants/m^2, plant height, yield and yield attributes were significantly affected by variety (Table 2). Maximum number of days to maturity is required in BARI Badam 6 which was statistically identical to DG-2. Days to maturity varied within the variety is only 6 days. Significantly the highest plant height was recorded from DG-2. But significantly the highest braches/plant was obtained from BARI Badam 6. The variety Dhaka-1 gave significantly the highest yield among the variety. Significantly the highest seed weight was obtained from BARI Badam 6 and the lowest from Dhaka-1. This character influenced the nut yield where the highest yield was recorded from BARI Badam 6. The variety BARI Badam 5 and BARI Badam 6 showed similar stover yield and higher than rest of the variety.

Conclusion

BARI Badam 6 and BARI Badam 5 were found most encouraging in char land of Atkapalia, Noakhali and BARI Badam 6 at Laxmipur.

Table 1. Performance of different groundnut varieties at FSRD site, Atkapalia, Noakhali, 2003-04

Varieties	Pods/plant	100-kernel weight (g)	Pod yield (t/ha)
Dhaka-1	23.56a	34.08d	1.76c
DG-2	19.98b	44.40c	2.00b
BARI badam-5	22.04ab	45.58b	2.32a
BARI badam-6	21.80ab	51.20a	2.24a
CV(%)	9.36	0.63	7.42

Table 2. Performance of different groundnut varieties at MLT site, Laxmipur, 2003-04

Varieties	Days to maturity	Plant/m^2	Plant height (cm)	Pods/ plant	100-kernel weight (g)	Pod yield (t/ha)	Stover yield (t/ha)
Dhaka-1	125b	16.20a	40.40d	32.60a	34.00e	1.86e	2.38d
DG-2	127a	15.60ab	55.80a	23.00b	49.00c	2.50c	3.20b
BARI badam-5	122c	15.40ab	50.20b	20.60c	54.40b	2.96b	3.57a
BARI badam-6	128a	14.80b	44.00c	21.80bc	56.40a	3.11a	3.51a
Local	124b	14.80b	51.60b	20.40c	44.80d	1.97d	2.74c
CV(%)	0.54	3.51	1.70	3.50	0.84	0.87	1.68

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ON-FARM ADAPTIVE TRIAL OF ADVANCED LINES OF GROUNDNUT

Abstract

An adaptive trial was conducted in the farmers' field of MLT site, Laxmipur during the Rabi season of 2003-04 to evaluate the performance of some groundnut varieties/lines in char area. BARI Badam-6 along with an advanced line (JCGV94322) performed better yield than the local one.

Introduction

Most of the farmers of the coastal area of Laxmipur 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 recommendation as variety for cultivation. So, the present study was undertaken to evaluate the performance of some advanced lines of groundnut under farmers' condition.

Materials and Methods

The study was conducted at MLT site Laxmipur during Rabi season of 2003 -2004. The experiment was RCB design with five replications. The soil of the experimental site belongs to Ramgoti soil series and Meghna Estuarine Food Plain under AEZ 18. Unit plot size was 6m x 5m. Nutrient dose of 10-70-50 kg/ha of NPK respectively were applied in the form of Urea, T.S.P. and M.P. All fertilizers were applied as basal dose during final land preparation. Seeds were sown in lines maintaining 30 cm x 15 cm spacing. Seed sowing was done from 18th to 26th January 2004 and harvesting was done in the last week of May 2004.

Results and Discussion

Days to maturity, plants/m^2, plant height, yield and yield attributes were significantly influenced by variety/line. Days to maturity varied 4 days with lines/variety. Significantly the highest plant height was recorded from line JCGV 94322. BARI Badam 6 and line JCGV 94322 showed similar branches/plant and higher than other. Significantly the highest pods/plant was recorded from Dhaka-1 and the lowest from line JX 87015. The line JX87012 showed significantly the highest seeds/pod and others were at par. Seed weight gave higher from variety BARI Badam 6 which was statistically differ from other vareity. The nut yield was higher from BARI Badam 6 which was statistically at par to line JCGV 94322.

Conclusion

BARI Badam 6 or line JCGV94322 could be grown in char land of Laxmipur but another year trial is needed for confirmation.

Table 1. Performance of advanced groundnut varieties/lines in the coastal area of MLT site, Laxmipur during 2003-04

Variety/line	Days to maturity	Plant/m^2	Plant height (cm)	Branch/ plant (no.)	Pod/ plant	Seed /pod	100 kernel weight (g)	Nut yield (t/ha)
JX 87015	124b	24.33ab	48.00b	5.73b	18.33c	3.27a	45.00c	3.11b
ICGV94322	127ab	22.00c	54.67a	8.17a	24.33b	1.93b	51.33b	3.20ab
Dhaka-1	124b	25.00a	40.00c	6.13b	33.33a	1.85b	35.00d	1.94c
BARI badam-6	128a	22.67bc	45.00bc	8.70a	23.00b	1.98b	57.00a	3.26a
CV (%)	0.83	2.35	4.48	4.50	2.02	3.33	1.84	0.97

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ON-FARM ADAPTIVE TRIAL OF ADVANCE LINES OF GROUNDNUT

Abstract

The experiment was conducted at farmer's field at Cox's Bazar during December 2003 to April 2004 to evaluate the performance of developed and advanced lines of groundnut (JX870, 15-SLI, ICGV 94322) lines and Dhaka-1, BARI Badam-6 varieties tested with local one. The line JX87015-SLI and variety BARI Badam-6 showed the best performance.

Introduction

BARI has released a number of groundnut varieties and some advanced lines were found promising. These developed and advance lines need to disseminate among the farmers at different locations. Hence, the study was undertaken to compare these advance line with local one at Cox's Bazar in Chittagong region.

Materials and Methods

The experiment was conducted at farmers field at Cox's Bazar of Chittagong region during December 2003 to April 2004 to evaluate the performance of some varieties of groundnut under farmers condition. Two line (JX87015-SLI, ICGV 94322) and three variety (BARI Badam-6, Dhaka-1 and local) were tested. The experiment was conducted in RCB design with four dispersed replications. The groundnut varieties were sown at 18-19 December 2003. The unit plot was 50m2 with spaced 30cm x 15cm. Fertilizer dose was 12:31:43:30 kg/ha NPKS, respectively. Intercultural operations were done as and when necessary. Data on number of nut per plant, weight of nut per plant were selected randomly from 10 plants and nut yield from harvest area of $10m^2$. The crop was harvested from 15-23 April, 2004. Data were analyzed statistically & means were separated by LSD.

Results and Discussion

Yield and yield attributes of groundnut were presented in Table 1. Significantly the highest number of nut per plant was found in Dhaka-1 and the lowest number in local one. The maximum weight of nut was found in BARI Badam-6 which was closely followed by line JX87015-SLI. The highest nut yield was found in JX87015SLI which was statistically similar to BARI Badam-6. Though highest nut plant was recorded from Dhaka-1 but due to lower nut weight failed to show higher yield.

Farmers' reaction

The line JX87015-SLI and variety BARI Badam-6 could be disseminated in large scale at Cox's Bazar as those lines/variety are much higher yielder than local one.

Table 1. Nut yield and yield contributing characters of groundnut conducted at Cox's Bazar MLT site in 2003-04

Lien/Variety	Nut/plant (No.)	Nut weight/plant (g)	Nut yield (t/ha)
JX87015-SLI	45.85b	100.00a	2.99a
ICGV 94322	42.08bc	68.75b	2.41b
Dhaka-1	52.30a	75.5b	1.85c
BARI Badam-6	44.2b	107.0a	2.79ab
Local	33.55c	65.5b	1.58c
CV(%)	12.39	8.98	13.00
LSD(0.05)	9.143	11.26	0.648

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PERFORMANCE OF DIFFERENT SOYBEAN VARIETIES

Introduction

Soybean is a popular oil seed crop in Noakhali and Laxmipur districts. It is exclusively grown in Rabi season as a cash crop. But yield of soybean is low in comparison to that of other countries of the world. It has great potentiality to increase its hectare age as well as yield per unit area. In this regard Oilseed Research Centre of BARI under its varietals improvement program developed a good number of varieties. To evaluate performance of these varieties with some other varieties, which are available in BADC, MCC & farmers condition the present investigation, was undertaken.

Materials and Methods

The study were conducted at FSRD site Atkapalia, Noakhali and MLT site Laxmipur during Rabi season of 2003-2004. The experiment was laid out in RCB design with five replications at MLT site Laxmipur & six dispersed replications at FSRD site Noakhali. But due to salinity three replications were damaged in FSRD site. The soil of the experimental area belongs to Young Megna estuarine flood plain (AEZ 18f) and Meghna Estuarine Food Plain under (AEZ 18 respectively).Unit plot size was 6 m X 5m. Nutrient dose of 27-75-60 Kg/ha of NPK respectively were applied in the form of Urea, T.S.P. and M.P. All fertilizers were applied as basal dose during final land preparation. BARI soybean -4 (G-2), Bangladesh soybean -5 and BADC-1 were evaluated against the Sohag (PB-1). Seeds were sown in lines maintaining 30 cm X 6 cm spacing. Seed sowing was done from 8 to 15th January and harvesting was done in the first week of May. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTATC.

Result and discussion

Atkapalia FSRD site, Noakhali

Pods/plant, seeds/pod, 100-seed weight and seed yields were significantly influenced by variety (Table 1). Higher pods/plant was recorded from G-2 which was statistically identical to Sohag and BARI Soybean 5. The variety revealed that higher seeds/pod was recorded from G-2 but BARI Soybean 5 and Sohag showed similar seed weight and higher than other two varieties. All the yield attributes resulted higher yield in BARI Soybean 5 and other varieties were similar.

Laxmipur MLT site

Plant/m^2, pods/plant, seeds/pod, 100-seed weight and seed yields were significantly affected by the variety (Table 2). Plants/m^2 were similar among the varieties BADC-1 and G-2. The variety G-2 and BARI Soybean 5 showed similar no. of pods/plant and higher than other two varieties. But significantly the highest seeds/pod was recorded from BARI Soybean 5. Seed weight showed similar among varieties Sohag and BARI Soybean 5 and the Lowest from G-2. All the yield contributing characters influenced higher yield in BARI Soybean 5.

Farmers' reaction

Whitish seed colour and seed size and yield of both BARI Soybean-5 and Sohag highly accepted by the farmers. Due to high yielding ability of BARI soybean-5 if seeds area available farmers will cultivate more area by this variety.

Conclusion

BARI Soybean 5 is highly accepted by the farmers because of its white colour seed and high yield than the other varieties.

Table 1. Performance of different soybean varieties at FSRD site, Atkapalia, Noakhali. during 2003-04

Variety	Pod/plant	Seed/pod	100 seed weight (g)	Yield (t/ha)
BARI Soybean –5	76.43ab	2.33ab	13.43a	2.34a
Sohag	69.8ab	2.10b	13.03a	2.09b
G-2	82.07a	2.80a	9.27c	2.03b
BADC-1	62.33	2.10b	11.83b	2.12b
CV(%)	11.07	12.38	2.58	2.66

Table 2. Performance of different soybean varieties at MLT site Laxmipur during 2003-04

Variety	Plant/m^2	Pod/plant	Seed/pod	100 seed weight (g)	Seed yield (t/ha)
BARI Soybean 5	44.00b	41.20ab	2.64a	13.40a	2.40a
Sohag	40.20c	40.40b	2.06b	13.80a	2.00c
G-2	46.20a	42.40a	2.00b	6.40c	1.67d
BADC-1	45.60a	38.60c	2.12b	12.00b	2.12b
CV(%)	1.28	1.75	5.24	4.31	2.24

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ON-FARM ADAPTIVE TRIAL OF ADVANCE LINES OF SUNFLOWER IN SALINE AREA

Abstract

On-farm performance of three sunflower variety/lines namely ST-2250, Sunwheat-101 and Kironi were evaluated at Paikgacha MLT site, Khulna, No significant yield difference was observed among the variety/lines but higher seed yield (1501 kg/ha) was produced by ST-2250 followed by Kironi where Sunwheat-101 the lowest one (1387 kg/ha).

Introduction

Sunflower is an important oil crop in Bangladesh. Its cultivation has dramtically been increased during the last few years. Most of the lands in saline area remain fallow in winter season due to salinity. Recently study showed that sunflower can survive and performed better up to medium level of salinity. Recently study showed that sunflower can survive and performed better up to medium level of salinity. Recently BARI has developed few high yielding sunflower lines. After harvesting of T.Aman, the land remains fallow due to salinity. So, an experiment was undertaken to test the performance of newly released sunflower varieties/lines in saline area.

Materials and Methods

The trial was initiated at Paikgacha MLT site during Rabi season 2003-2004 with three sunflower variety/lines namely ST-2250, Sun wheat-101 and Kironi following RCB design with four replications in farmers field. The unit plot size was 2mx1m. The crop was sown on 27 November 2003 50cm x 25cm spacing. Fertilizer were applied at the rate of 88-34-80-29-3.4-1.7 kg/ha of N-P-K-S-Zn-B, respectively. All Urea, TSP, MP, Gypsum, Zincsulphate and Boric acid were applied as basal. One irrigation was given. All the intercultural operations were done as and when necessary. The crop was harvested during the second week of March, 2004. Data on yield and yield and yield attributes were collected and analyzed statistically. The soil salinity level during 26 November 03, 11 and 26 December, 03 10 and 25 January, 04, 10 and 26 February, 04, 10 and 25 March, 04 were 2.14, 1.04, 1.80, 3.96, 5.16, 6.82, 4.90, 6.14 and 3.35 mm hos/cm respectively.

Results and Discussion

No significant yield difference and yield attributes were observed among the variety/line (Table 1). The result revealed that the higher seed yield (1501 kg/ha) was obtained from ST-2250 followed by Sun wheat 101. Lowest yield (1387 kg/ha) was obtained from Sunwheat-101. The higher yield produced by ST-2250 could be due to higher number of seeds/head. The lowest seed yield produced by Sunwheat-101 could be due to minimum seed/head.

Conclusion

The result revealed that ST-2250 performed better in saline area. The experiment should be repeated another year for confirmation.

Table 1. Days to maturity, yield and yield attributes of sunflower as affected by different variety/lines at Paikgacha MLT site during rabi 2003-04

Variety/line	Days to maturity	Plant population /m^2 (no.)	Plant height (cm)	Head diameter (cm)	Seed/ head (no.)	1000 seed weight (g)	Seed yield (Kg/ha)
ST-2250	100	13	146	14.50	383	49.82	1501
Sunwheat-101	102	12	152	13.50	361	59.17	1387
Kironi	102	12	147	14.00	379	59.80	1400
LSD(0.05)	-	NS	NS	NS	NS	NS	NS
CV(%)	-	11.14	6.50	15.97	4.67	19.06	18.29

Means followed by common letters or no letters are statistically similar at 5% level.

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YIELD PERFORMANCE OF MUNGBEAN AS AFFECTED BY SALINITY IN COASTAL AREA

Abstract

The experiment was conducted at two locations, at Banerpota farm, Satkhira and at Paikgacha MLT site during rabi season, 2003-'04 to select the salt tolerant variety of mungbean. The result showed that mungbean line BM-01 performed better at Paikgacha, MLT site. No variety/line performed better at Banerpota Farm. 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 two locations, at Banerpota farm, Satkhira and Paikgacha MLT site during rabi season 2003-2004. Mungbean was sown on 22 January 2004 at Banerpota farm. On the other hand, crop was sown on 31 January 2004 at Paikgacha, Five varieties/lines of mungbean (BARI Mung-2, BARI Mung-4, BARI Mung-5, BM-01 and local) were included in the study. The unit plot size was 1.2m × 5.1m. Seeds were sown following RCB design with three replications. The seeds were sown as line sowing with spacing 30cm in solid line. Fertilizers doses were 20-16-15 kg N-P-K/ha applied as basal. Intercultural operations were followed as and when necessary. The soil salinity level Banerpota were 22Jan'04, 07Feb'04, 23Feb'04, 08Mar'04, 24Mar'04 and 07Apr'04 8.30, 12.00, 13.30, 15.10, 7.76 and 3.95 mm hos/cm, respectively. The soil salinity level during the crop growing periods at Paikgacha 25 January'04, 10 and 26 February'04, 10 and 25 March'04 and 09 April'04 were 5.16, 6.82, 4.90, 6.14, 3.35 and 4.21 mm hos/cm, respectively. Data on yield and yield attributes were collected and analyzed statistically.

Results and Discussion

Paikgacha MLT site

Performance of mungbean varieties/lines has been presented in table-1. Plant population/m^2 at harvest, plant height, pod/plant, 1000 seed weight and seed yield (kg/ha) differed significantly by variety/line. The result revealed that higher seed yield was obtained from BM-01 which was statistically identical to BARI Mung 5. The higher seed yield produced by BM-01 could be due to maximum pods/plant. The lowest yield produced by BARI mung-4 could be due to lowest seed weight. No viral disease infestation was observed in any variety except local one. Days to maturity ranged from 59 to 65 days. Pods/plant showed higher in BM-01 which was statistically at par to BARI Mung 4. Seeds/pod was not influenced by any of the variety. Significantly the highest seed weight was recorded from BARI Mung 5 but due to lower pods/plant, yield did not exceed BM-01.

Banerpota Farm

Performance of mungbean varieties at Banerpota has been presented in table-2. At the initial stage, plant population/m^2 was high. The soil test value showed salinity as high as 15.93 mm hos/cm during the crop growing period. No fruit setting was observed in BM-01 and local. The crop was died within 70 DAS.

Farmers reaction

The line BM-01 showed higher yield and could be adaptability in saline area. Farmers preferred BM-01 for resistant to viral diseases.

Conclusion

It was observed that mungbean line BM-01 showed better adaptability at Paikgacha MLT Site. On the other hand, no mungbean variety/line performed well at Banerpota. 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 Paikgacha MLT Site during rabi season, 2003-04

Variety/Line	Days to maturity	Plant pop. /m^2 at harvest	Plant height (cm)	Pod/plant	Seed/pod	1000 seed weight (g)	Seed yield (kg/ha)
BARI Mung-2	62	24.00c	33.67ab	10.57b	8.73	23.33c	520c
BARI Mung-4	62	26.33bc	36.00a	11.53ab	9.60	21.00c	511c
BARI Mung-5	59	28.33ab	31.67b	10.20bc	7.80	34.66a	680a
BM-01	62	24.00c	36.67a	12.37a	7.60	30.33b	693a
Local	65	30.00a	34.33ab	8.70c	9.66	24.00c	601b
CV(%)	-	4.84	4.56	7.56	19.02	6.20	6.05

Means followed by common letters are statistically similar at 5% level.

Table 2. Performance of mungbean variety/lines tested at Banerpota Farm, Satkhira during rabi season 2003-04

Variety/Line	Plant population/m^2				
	15 DAS	30 DAS	45 DAS	60 DAS	70 DAS
BARI Mung-2	60	5	2	-	-
BARI Mung-4	74	12	3	-	-
BARI Mung-5	53	4	2	-	-
BM-01	87	24	10	06	-
Local	91	50	22	17	-

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EFFECT OF DIFFERENT MULCHES ON POTATO CULTIVATION IN SALINE AREA

Abstract

Effect of mulch on potato cultivation in saline area under rainfed condition was studied at CDSP II site, Char Majid, Noakhali during rabi season in 2003-2004. Potato variety "Diamond" was tested with three mulch materials viz. Water hyacinth (M_1), Rice straw (M_2), Rice husk (M_3) and one control no mulch (M_0). Significant variation was found among the mulch materials on potato yield. All the mulch materials showed better yield performance in comparison with no mulch. The highest yield (8.16 t/ha) was found with rice straw mulch followed by water hyacinth (8.06 t/ha) while the lowest was resulted with no mulch (3.99 t/ha).

Introduction

Cultivation of potato is usually difficult in the coastal area due to capillary movement of salinity and insufficient soil moisture in the topsoil during rabi season. Salinity is an important determinant for soil capability and it is seen as a "modifier" which put restrictions on possible crop choices (Wilde, 2000). Application of mulch preserves soil moisture by reducing the evaporation of soil moisture and upward movement of salt and control weed infestation. The uses of water hyacinth mulch in potato has been in practice and it is established that mulching conserve soil moisture, minimize evaporation loss and enhance root growth (Allamanas *et al*., 1977; Choudhury and Prihar, 1974). Water hyacinth is not easy available in the CDSP project site. But rice straw could be used as mulch in potato cultivation. So, it is important to know the effect of different mulch materials. Hence, a study was under taken to assess the effect of mulch materials on potato cultivation in saline area.

Materials and Methods

The experiment was conducted at farmers' field under Char Development and Settlement Project - II (CDSP - II) site, Char Majid, Noakhali, during the winter season of 2003-2004. The soil was silt loam to clay under the Ramgati soil series of AEZ 18 (Young Meghna Estuarine Flood plain). Potato variety "Diamond" was tested with three mulch materials viz. Water hyacinth (M_1), Rice straw (M_2), Rice husk (M_3) and one control; no mulch (M_0). The experiment was conducted under randomized block design with five replications having unit plot size of 5m x 2m. The crop was fertilized with N-P-K (100-24-100 kg/ha). All fertilizers were applied at the final land preparation as basal. The whole potato tubers were planted within 14-20 December 2003 with 60cm x 25cm spacing. Mulches were applied immediately after planting to check the loss of soil moisture. Harvesting was done from March 7 to 21, 2004. All the data were recorded at the time of harvest and were statistically analyzed. The means were compared by Duncan's Multiple Range Test (DMRT).

Results and Discussion

Mulch materials have great influences on plant height, number of tuber/hill, tuber weight/hill and tuber yield (Table 1). The highest plant height (41.60 cm) was recorded from the plants mulched with rice straw while the lowest plant height (34.26 cm) was recorded from no mulch. Highest number of tubers produced per hill (6.42) by the plants mulched with rice straw. Tuber weight per hill was not significant but tuber yield was highly influenced by mulch materials and the highest tuber yield (8.16 t/ha) was recorded from the crop covered with rice straw mulch followed by water hyacinth (8.06 t/ha), while the lowest tuber yield was observed in no mulch (3.99 t/ha).

Recommendation

Potato can be cultivated with mulch using rice straw in the land remains fallow in rabi season immediate after harvest of T. aman. Early planting would be helpful for more yields.

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Table 1. Effect of mulch on the yield of potato at CDSP II site, Char Majid, Noakhali during the rabi season of 2003-04

Treatment	Plant height (cm)	Tuber/hill	Tuber weight/hill (g)	Tuber yield (t/ha)
M_1	40.90	4.78b	201.70	8.06a
M_2	41.60	6.42a	211.80	8.16a
M_3	37.30	5.18b	224.00	6.71ab
M_0	34.26	5.46ab	146.90	3.99b
CV (%)	11.07	13.04	23.09	24.81

Figures in column having similar letter(s) do not differ significantly.

M_1 = Water hyacinth, M_2 = Rice straw, M_3 = Rice husk & Mo = No mulch,

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SCREENING OF POTATO VARIETIES FOR COASTAL AREA

Abstract

The experiment was conducted at Multilocation Testing (MLT) Site, Kalapara, Patuakhali during rabi seasons of 2002-03 and 2003-04. A good number of varieties and genotypes as were planted to evaluate their performance in saline area. Dheera produced the highest tuber yield in both years. Heera gave 2nd highest yield (19074 kg/ha) in 2002-03 and genotype 88.163 in 2003-04 season (13593 kg/ha). In 2003-04 season, average yield of all varieties and genotypes were low due to late sowing. Rainfall in early December delayed sowing.

Introduction

Tuber Crop Research Center (TCRC) of Bangladesh Agricultural Research Institute developed some potato varieties and genotypes. These varieties and genotypes were evaluated in saline coastal area to find out suitable variety(s)/ genotype(s) for saline area.

Materials and Methods

The experiment was conducted at Multilocation Testing (MLT) Site, Kalapara, Patuakhali during rabi seasons of 2002-03 and 2003-04. A number of varieties and genotypes were conducted in both the years (Table 1). The experiment was laid out in RCB design with three replications. The experiment was sown on 3 December 2002 and 27 December 2003. The tuber was sown with 60cm x 30cm. The unit plot size was 3m x 2.8m. Irrigation was given three times at an interval of 20 days. Crops were harvested on 3 March 2003 and 18 March 2004, respectively. The salinity level at different data was sown in Table 2.

Result and Discussion

Only five varieties were put under in both the years whereas twelve varieties/genotypes in first year and eleven varieties/genotypes is second year. On an average of two year result showed that the variety Dheera gave higher yield followed by Cardinal. In 2002-03, higher yield was recorded from Dheera followed Heera. BARI TPS-1 gave only 9.40 t/ha which is less yield than the tested varieties. During 2003-04, higher yield was recorded from Dheera followed by line 88.163.

Conclusion

Among the variety Dheera variety performed better in respect of yield followed by Heera (only one year result) in coastal area of Patuakhali. TPS-364/67 did not perform well in coastal area as compared to released variety.

Table 1. Yield of potato varieties/ genotype at Kalapara , Patuakhali

Varieties/ Genotype	Tuber yield (kg/ha)		
	2002-03	2003-04	Mean
Diamont	15740b	12778b	14259
Cardinal	18333b	12000b	15167
Dheera	22222a	14463a	18343
Raja	16481b	9259cd	12870
86.140	14629c	9256cd	11943
93.316	11667cd	-	11667
94.44	13148cd	-	13148
94.42	12222de	-	12222
87.12	11667cd	-	11667
Heera	19074ab	-	19074
Provento	-	10185c	10185
Granola	-	6852ef	6852
Arinda	-	7741e	7741
88.163	-	13593ab	13593
94.319	-	6481f	6481
TPS-364/67	9815e	-	9815
BARI TPS-1	10370de	8370de	9370
CV (%)		11.7	

Table 2. Soil salinity of experimental plots at different dates

Salinity (0-15 cm depth of soil) ds/m		
Date of soil collection	2002-03	2003-04
01-12-2002	3.95	1.58
15-12-2002	4.21	2.01
30-12-2002	5.60	3.32
15-01-2003	7.50	4.55
30-01-2003	8.75	4.97
15-02-2003	11.05	6.43
01-03-2003	12.91	8.04
16-03-2003	13.88	8.91
30-03-2003	15.27	10.16

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ON-FARM EVALUATION OF BARI SWEET POTATO VARIETIES

Abstract

A field experiment was carried out at CDSP II site, Char Majid, Noakhali under rain fed condition during the Rabi season of 2003-04 to find out the suitable sweet potato variety for the coastal area. Five varieties (Kamalsunduri, Daulatpuri, BARI sweet potato-4, BARI sweet potato-5 and local) where tested Sweet potato varieties did not varies significantly in respect of root yield, but better performance was observed in case of local variety for all the parameters recorded in the study.

Introduction

Sweet potato grows well in char area of Noakhali district. Farmers of coastal areas are growing only local sweet potato variety, which are assumed to be low yielded. Recently BARI has developed some new varieties of sweet potato. A comparative test of these varieties against the existing ones is necessary to identify suitable variety for this area that is why the present study was under taken.

Materials and Methods

The experiment was conducted at CDSP II site, Char Majid, Noakhali under rain fed condition during the Rabi season of 2003-04 in the farmers' field. The experiment was laid out in RCB design with five dispersed replications. BARI developed sweet potato varieties viz. Kamalsunduri, Daulatpuri, BARI sweet potato-4 & 5 were evaluated against local variety. The unit plot size was 5m x 2m. Fertilizers were applied at the rate of 114-92-57.5 (N-P-K kg/ha) during final land preparation. Vines were planted in line with 60cm x 30cm spacing on 22 December 2003. Two weeding were done during the crop growth period. Earthling up was done at optimum time. Harvesting was done on 15-20 May in 2004. Data on yield and yield contributing characters were recorded and analyzed by computer programmed MSTATC and means were separated with Duncan's Multiple Range Test (DMRT).

Results and Discussion

Yield and yield performance of sweet potato varieties are presented in Table 1. Highest number of root per plant was found from Kamalasundari that was statistically similar to BARI SP- 5 while the minimum number of root per plant was recorded from Daulatpuri. Highest root weight per plant was found in local variety. The lowest root weight per plant was observed in BARI SP- 4, which was statistically at par with rest of the other varieties. Root yield was insignificant but local variety resulted the maximum root yield (15.47 t/ha). The lower root yield of the modern varieties of sweet potato varieties in the coastal/saline areas might be associated with soil salinity. The salinity of the experimental fields indicates that during January – February; salinity increased which might influence the vegetative phase of the crop leading to lower yield of the modern varieties. But it is assumed that the local variety was adjusted to the soil with times.

Conclusion

Local variety of sweet potato resulted higher yield and also its acceptance to the farmer is more than the others due to its higher market price and keeping quality. Among the four modern varieties developed by BARI, Kamalsundari performed better yield and it is more popular to the farmers for its attractive colour.

Table 1. Yield and yield attributes of sweet potato as influenced by different varieties at Char Majid, Noakhali during 2003-04

Variety	Root/plant	Root wt./plant (g)	Root yield (t/ha)
Kamalasundari	2.84a	243.10b	12.48
Daulatpuri	1.96b	284.30ab	12.33
BARI SP- 4	2.19b	210.97b	11.80
BARI SP-5	2.31ab	222.90b	9.87
Local	2.22b	344.60a	15.47
CV (%)	17.53	26.24	22.88

Figures in column having similar letter(s) do not differ significantly.

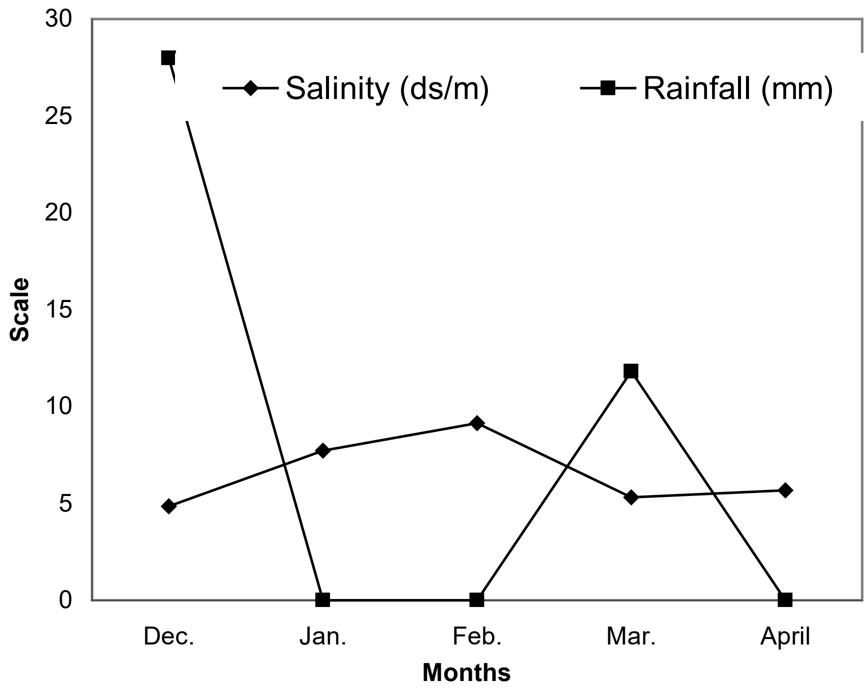

Figure 1. Relationship between monthly rainfall and soil salinity of CDSP II site at Char Majid, Noakhali

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ADAPTIVE YIELD TRIAL OF BARLEY FOR SALINE AREA

Abstract

On-Farm performance of six Barley lines/varieties namely K163, BHL01, BHL02, BHL03, BB3 and BB4 were evaluated at Paikgacha MLT site, Khulna and Kalapara, Patuakhali during the rabi season 2003-04. The line BHL02 produced the significantly highest grain yield among the lines at Khulna but BB4 showed the highest at Patuakhali.

Introduction

Barley is one of the important cereal crops of the world. In Bangladesh barley is cultivated as minor cereal. It can be grown in less fertile soil with minimum inputs. Barley is grown as food for poor people. In foreign country barley is used in a beverage industry for processing alcohol and wine. It is known that barley is a salt tolerant crop. In coastal area, vast land remains fallow due to salinity in rabi and early kharif season. Barley may be cultivated in saline area. BARI has recently developed some high yielding barley variety/lines. The experiment was undertaken to find out the performance of this variety/lines at farmers field of saline area.

Materials and Methods

The trial was conducted at Paikgacha MLT site and Kalapara, Patuakhali during Rabi season, 2003-2004 with six Barley lines/varieties namely K163, BHL01, BHL02, BHL03, BB3 and BB4 following RCB design with three replications in farmers field. The unit plot size was 1m 51m. The crop was sown on 27 November 2003 at Khulna and 13 December at Patuakhali. Line to line spacing was 30cm. Fertilizer were applied at the rate of 100-60-40 kg/ha of N, P_2O_5, and K_2O respectively. All Urea, TSP and MP were applied as basal. Irrigation was given at initial growth stage at Khulna but no irrigation at Patuakhali. All the intercultural operations were done as and when necessary. The crop was first harvested during the first week of March 2004 at Khulna and 5 April 2004 at Patuakhali. Data on yield and yield attributes were collected and analyzed statistically. The soil salinity level at Khulna during 26 November, 11 and 26 December 2003, 10 and 25 January 2004, 10 and 26 February 2004, 10 and 25 March 2004 were 2.14, 1.04, 1.80, 3.96, 5.16, 6.82, 4.90, 6.14 and 3.35 mm hos/cm, respectively whereas salinity level at Patuakhali were 2.65, 3.24, 3.68, 5.06, 5.87, 7.56, 8.22, 8.76 and 9.55 mm hos/cm on 1 & 30 December 2003, 15 & 30 January, 15 February, 1, 16 & 30 March 2004, respectively.

Results and Discussion

MLT site, Paikgacha

Spike/m^2, 1000-grain weight and grain yields were significantly influenced by variety/line. Performance of Barley lines/varieties have been presented in Table 1. The results revealed that the significantly highest grain yield (2120kg/ha) was obtained from BHL02. The lowest yield (1567kg/ha) was obtained from K163 but statistically identical for BHL4 and BB4. The highest yield produced by BHL–02 could be due to maximum spike/m^2 and longest spike. The lowest yield produced by K-163 could be due to minimum number of grain/spike.

MLT site, Kalapara, Patuakhali

Plant height, grains/spike, effective tiller/hill and grain yields were significantly influenced by variety/genotypes. The line BB3 and BB4 showed similar in height and higher than other lines. Spike length was not significantly influenced by the line. Significantly the highest grains/spike was recorded from line BB3. But effective tiller/hill was higher from BHL1 & BHL3. Significantly the highest grain yield was obtained from line BB4. The line BB3, BHL2 and BHL1 showed similar yield but lower yield than BB4.

Farmers reaction

Farmers of Khulna preferred BHL –02 for higher yield and shorter plant but dislike its threshing, winnowing and processing procedure.

Conclusion

From the study it was observed that the line BHL–02 performed better in saline area of Khulna and BB4 at Patuakhali. Production program on Barley may be undertaken in future.

Table 1. Days to maturity, plant height, yield and yield attributes of barley affected by varieties/lines at Paikgacha MLT Site during 2003-04

Variety / line	Days to maturity	Spike/m^2 (no.)	Plant height (cm)	Spike length (cm)	Grain/spike (no.)	1000 grain weight (g)	Grain yield (kg/ha)
K163	98	246bc	90.00	7.33	37	31.50bc	1567c
BHL01	94	228c	104.67	6.67	41	34.56a	1607c
BHL02	99	291a	98.67	8.00	42	30.44c	2120a
BHL03	95	270ab	105.33	7.33	37	32.37b	1880b
BB3	98	259b	90.00	7.00	47	31.60bc	1913b
BB4	95	255b	100.66	7.01	39	26.93d	1653c
CV(%)	2.25	4.98	8.82	20.00	13.21	2.25	2.67

Means followed by common letters are statistically similar at 5% level.

Table 2. Plant height, yield and yield contributing characters of barley genotypes during rabi 2003-2004 in Kalapara, Patuakhali

Variety/ Genotype	Germination (%)	Plant height (cm)	Spike length (cm)	Effective tiller/ hill (no.)	Grain /spike (no.)	Grain yield (kg/ha)
K163	85	44.9c	5.8	3.9b	30.6d	930c
BHL1	90	52.7b	5.4	5.1a	32.5cd	1170b
BHL2	90	52.6b	5.3	3.9b	36.3b	1247b
BHL3	80	54.2b	5.9	5.1a	33.9c	955c
BB3	85	62.7a	6.0	4.1b	44.0a	1249b
BB4	90	60.7a	6.1	4.1b	32.9c	1375a
CV (%)		7.21	7.88	6.05	4.3	10.2

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ADAPTIVE YIELD TRIAL OF BARLEY FOR COASTAL AREA

Abstract

On-Farm performance of eleven Barley lines/varieties namely BHL04, BHL05, BHL06, BHL07, BHL08, BHL09, BHL10, BHL11, BSHL4, BB3 and BB4 were evaluated at Paikgacha MLT site, Khulna and Kalapara, Patuakhali during the rabi season 2003-04. The line BHL11 produced higher grain yield followed by BHL10 and BHL04 at Khulna. But significantly the highest grain yield was recorded from line BB4 followed by BSHL4 at Patuakhali.

Introduction

Barley is one of the important cereals of the world. In Bangladesh barley is cultivated as minor cereal. It can be grown in less fertile soil with minimum inputs. Barley is grown as food for poor people. In foreign country barley is used in a beverage industry for processing alcohol and wine. It is known that barley is a salt tolerant crop. In coastal area, vast land remains fallow due to salinity in rabi and early kharif season. Barley may be cultivated in saline area. BARI has recently developed some high yielding barley lines. The performance of these lines needs to be evaluated in saline area at farmers field.

Materials and Methods

The trial was conducted at Paikgacha MLT site and Kalapara, Patuakhali during Rabi season, 2003-04 with eleven Barley lines/varieties namely BHL04, BHL05, BHL06, BHL07, BHL08, BHL09, BHL10, BHL11, BSHL4, BB3 and BB4. The experiment was followed RCB design with three replications in farmers field. The unit plot size was 1m x 1m at Khulna and 3m x 2m at Patuakhali. The crop was sown on 27 November at Khulna and 31 December 2003 at Patuakhali. Line to line spacing was 30cm. Fertilizer were applied at the rate of 100-60-40 kg/ha of N, P_2O_5, and K_2O respectively. All Urea, TSP and MP were applied as basal. To ensure germination irrigation was given at initial stage. All the intercultural operations were done as and when necessary. The crop was first harvested during the first week of March 2004 at Khulna and 5 April 2004 at Patuakhali. Data on yield and yield attributes were collected and analyzed statistically. The soil salinity level at Khulna during 26 November, 11 & 26 December 2003, 10 & 25 January, 10 & 26 February, 10 & 25 March 2004 were 2.14, 1.04, 1.80, 3.96, 5.16, 6.82, 4.90, 6.14 and 3.35 mm hos/cm, respectively. Whereas salinity level at Patuakhali were 2.05, 3.24, 3.68, 5.06, 5.87, 7.56, 8.22, 8.76 & 9.55 on 1, 15 & 30 December, 15 & 30 January, 15 February, 1, 16 & 30 March 2004.

Results and Discussion

MLT site, Paikgacha, Khulna

Plant height, spike/m^2 and grain yield was significantly influenced by variety/line. Performance of Barley lines/varieties have been presented in Table 1. The results revealed that higher grain yield was obtained from BHL11 which was statistically identical to BHL10. The lowest yield (1443 kg/ha) was obtained from BHL06 which was at par to BHL05 & BHL10. The highest yield produced by BHL11 could be due to maximum spike/m^2. The lowest yield produced by BHL06 could be due to the lowest grain weight. Days to maturity, plant height, length of spike and 1000-grain weight were not significantly influenced by variety/line.

MLT site, Kalapara, Patuakhali

Plant height and length of spike did not influence but grains/spike, effective tiller/hill and grain yield was significantly influenced by line (Table 2). Germination (%) varies from 45 to 88 where the highest germination was recorded from BSHL4 and the lowest from BHL10 & BHL11. The highest grains/spike was recorded from BB3 closely followed by BSHL4 and BHL10. The highest grain yield was recorded from BB4 followed by BSHL4.

Farmers reaction

Farmers of Khulna preferred BHL11 for higher yield and shortest plant but dislike its threshing, winnowing and processing procedure.

Conclusion

From the study it was revealed that the line BHL11 performed better in saline area of Khulna but BB4 showed higher yield at Patuakhali. Production program on Barley may be undertaken in future.

Table 1. Days to maturity, yield and yield attributes of barley as affected by different lines/variety at Paikgacha MLT site during 2003-04

Line/ Variety	Days to maturity	Spike/m^2 (n0.)	Plant height (cm.)	Spike length (cm)	Grains/ spike (no.)	1000 grain weight (g)	Grain yield (kg/ha)
BHL04	98	205cde	81.33cd	7.67	45	32.07	1980abc
BHL05	97	197de	91.00abc	7.33	42	32.47	1464f
BHL06	93	188de	99.00a	7.33	44	29.17	1443f
BHL07	97	188de	81.67cd	7.33	45	27.70	1757d
BHL08	101	191de	93.00ab	7.67	44	30.33	1812d
BHL09	96	184e	79.67d	8.33	42	30.60	1518f
BHL10	100	238ab	80.00d	7.33	44	31.67	2003ab
BHL11	100	253a	79.67de	7.67	45	29.73	2062a
BSHL4	100	219bcd	88.33bcd	6.67	48	30.63	1922bc
BB3	96	232abc	83.00bcd	6.00	41	30.83	1912c
BB4	100	250ab	87.33bcd	7.67	39	26.70	1666c
CV(%)	-	8.38	6.64	14.28	10.24	8.09	2.70

Means followed by common letters are statistically similar at 5% level.

Table 2. Yield and yield contributing characters of barley genotypes during rabi 2003-04 in Kalapara , Patuakhali

Variety/ Genotype	Germination (%)	Plant height (cm)	Spike length (cm)	Effective tiller/hill	Grain /spike	Grain yield (kg/ha)
BHL-4	68	47.6	5.9	3.5	27.8	747
BHL-5	60	42.2	5.6	3.7	23.0	745
BHL-6	52	51.8	5.1	4.1	26.1	476
BHL-7	48	54.0	4.6	4.1	24.0	554
BHL-8	53	46.3	5.2	3.6	25.8	480
BHL-9	58	43.3	5.1	3.3	26.5	523
BHL-10	45	37.7	4.9	3.2	28.5	443
BHL-11	45	39.0	4.3	3.2	23.9	403
BSHL-4	88	53.7	5.5	3.7	28.7	954
BB-3	57	43.9	5.3	2.9	30.7	542
BB-4	87	48.4	5.7	3.5	25.9	1010
LSD (0.5)		4.21	0.51	0.9	1.2	210
CV (%)		9.47	6.45	8.1	5.6	11.5

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LIST OF SCIENTISTS INVOLVED WITH ON-FARM RESEARCH DIVISION (2003-04)

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Dr. M Mohabbat Ullah, SSO
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Dr. S M Asaduzzaman, SSO
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M Nur Alam Mondal, SSO
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RESPONSE OF T.AMAN-CHICKPEA CROPPING PATTERN TO APPLIED PHOSPHORUS IN THE HIGH BARIND TRACT, BANGLADESH

Abstract

Residual effect of P in chickpea was evaluated applied in previous wet land rice crop (T.Aman rice) along with P and / or P + irrigation for three consecutive years (2001-2004). In 2001-02, no positive response of residual P was observed for chickpea yield and yield attributes; rather, in general P application (20 kg P ha^{-1}) under both irrigated and non-irrigated conditions gave higher grain yield though always not markedly. However, in 2002-03 (which was environmentally different from normal year) residual effect of P was observed for chickpea crop applied in previous T.Aman rice. When 20 to 60 kg P ha^{-1} was applied in T.Aman rice, it gave comparatively superior chickpea yields over the plots where no P fertilizer was applied in T.Aman rice irrespective of P or irrigation applied or not applied in chickpea. In 2003-04 residual effect of P was not observed for the plots where P was applied in T.Aman rice @ 20-60 kg ha^{-1}. However, from three years mean chickpea seed yield data it was clearly observed that when zero P was applied in T.Aman rice it produced lower chickpea seed yield in comparison to 20-60kg ha^{-1} P applied plots. Therefore at least 20 kg P ha^{-1} should be applied to T.Aman rice to get higher yield from succeeding chickpea crop. Despite that 20 kg P ha^{-1} would be applied to chickpea crop to achieve yield potential. For all the three years P application response in T.Aman rice was not significant.

Introduction

The availability of soil P/ added P is very important for root and shoot growth, as well as for partitioning of dry matter to seed (Ali, 2000, Tandon, 1987). Again availability of soil P/ added P depends on optimum soil moisture (Saraf et al., 1990, Singh and sharma, 1980, Kulthare et al., 1988). However, residual effect of P is clearly proved in Bangladesh and elsewhere (Abedin and Mukhopadhyay,1990; Tandon, 1987). Thus cropping pattern based fertilizer application can save some money. In the HBT T.Aman - Chickpea is a major pattern. If proper amount of P is applied to T.Aman rice, probably it can compensate the demand of P for chickpea. Which is important in the HBT context, because in most of the years chickpea planting in November become very difficult due to loss of soil moisture rapidly. Moisture holding capacity of HBT soil is poor due to critical organic matter contents and low infiltration of water (Ali, 2000). In such a situation if soil is opened by plowing or furrowing and exposed to sun drying for long time, soil moisture goes out quickly resulting in poor germination of seeds. Moreover, no fertilizer response was studied in the HBT for the T.Aman-Chickpea cropping pattern. So the present experiment was taken with the following objectives:

- ♦ To show the residual effect of P fertilizer on chickpea used in previous T.Aman rice
- ♦ To show the interaction between P x soil moisture on chickpea

Materials and Methods

The experiment was conducted for consecutive two years at FSRD site Chabbisnagar, High Barind Tract (HBT), Rajshahi, Bangladesh during July to March, 2001-02, 2002-03 and 2003-04. T.Aman rice variety BRRI dhan 39 was transplanted (35 days old seedlings) on July 28, 2001, July 20, 2002 and July 20, 2003, maintaining a spacing of 25cm x 15 cm following RCB design with three dispersed replications. The unit plot size was 6m x 10m. Four Phosphorus (P) fertilizer doses were tested namely, 0, 20, 40 and 60 kg P ha^{-1}. Source of P was triple super phosphate and applied as basal. The common fertilizer doses for all the treatment were N_{70} K_{40} $S_{20}Zn_1$ kg ha^{-1} applied from urea, muriate of potash, gypsum and zinc oxide respectively, applied as basal at the time of final land preparation. T.Aman rice was harvested at maturity on 29 October , 2001, 21-30 October 2002 and 30 October, 2003.

To show the residual effect of P for chickpea each rice plot was divided into four equal parts (15 m^2) and the four treatments were as follows:

1. Irrigated (one irrigation at 40 DAS) x P_0
2. Non-irrigated x P_0
3. Irrigated (one irrigation at 40 DAS) x P_{20}
4. Non-irrigated x P_{20}

Four P levels of T.Aman rice x four treatments of chickpea i.e. 16 treatments combinations were tested for chickpea crop (shown in Table 4).

Chickpea crop (BARI chola 2) was sown on 19 November 2001, 31 Oct to 3 Nov 2003 and 12 November 2003, maintaining a spacing of 40 cm x 10 cm following RCB design with three dispersed replications. Only light irrigation was applied at 40 days after sowing for irrigated treatments. Phosphorus fertilizer was applied as TSP in each furrow just before the sowing of seeds to maximize uptake (Arihara and Okada, 1991).All other common fertilizer (N_{20} K_{20} S_{15} B_1 kg ha^{-1}) was applied as basal from urea, muriate of potash, gypsum and boric acid. Chickpea was harvested at maturity on 15 March, 2002, 8 March 2003 and 14 March 2004.

For T.Aman rice and chickpea, yield attributed data were recorded at physiological maturity from 10 randomly selected plants from each plot. Yields of grain and straw were recorded from 3 m^2 area for both T.Aman rice and chickpea. Soil samples were chemically analyzed before planting of T.Aman rice and after harvest of T.Aman.

Table 1. Nutrient status of initial soil sample* (0-15 cm depth) before the transplanting of T.Aman rice, HBT, 2001

pH	Organic matter (%)	Ca	Mg	K	% Total N	P	S	B	Zn
		µg / g soil				µg / g soil			
5.7	0.82	4.72	2.05	0.26	0.07	6.17	15	0.18	1.22

*Composite sample, mean of three replications.

Table 2. Nutrient status of soil sample* after harvest of T.Aman rice (0-15 cm depth), HBT 2001

Treatment	pH	Organic matter (%)	Ca	Mg	K	% Total N	P	S	B	Zn
			µg / g soil				µg / g soil			
P_0	6.55	0.75	5.1	1.9	0.18	0.04	2.9	6.00	0.28	0.83
P_{20}	6.55	0.81	5.4	2.0	0.22	0.04	3.9	8.80	0.27	1.00
P_{40}	6.20	0.76	4.6	1.9	0.30	0.04	5.9	9.80	0.46	0.95
P_{60}	6.05	0.82	4.9	2.0	0.28	0.05	7.35	8.00	0.38	0.90

Mean of three replications

Results and Discussion

T.Aman rice: Effect of applied phosphorus (P) on T.Aman rice yield and on any one of the yield attributes were not significant for all the three years (Table 3), though status of available soil P (Olsen P) was low (Table 1). This could be due to the fact that under flooded conditions non-labile P became labile. Because in most soils there is an increase in available P after flooding, largely due to a conversion of Fe^{3+} phosphate to soluble Fe^{2+} phosphate and hydrolysis of Al phosphate. Other mechanisms resulting in increased P availability following submergence include dissolution of occluded P, hydrolysis of Fe phosphate, increased solubility of Ca phosphate in calcareous soils, and greater diffusion of P. These changes in P availability explain why the response to applied P by irrigated rice is usually less (Tisdale et al., 1997). However, soil P status (after rice harvest) was slightly increased because of application of P in T.Aman (Table 2).

Chickpea: Phosphorus that was applied in previous T.Aman rice had no effect on succeeding chickpea crop (Table 4). Rather higher grain yields were obtained from the treatments where P fertilizer and / or P + irrigation were applied except the treatments $RP_{40}I_1P_0$ and $RP_{20}I_1P_0$. As chickpea canopy growth was comparatively poor, effect of P on yield was also not always large. Ali (2000) clearly proved that P response to chickpea crop depends on good canopy growth and the uptake of P in HBT could vary from 3 kg to 15 kg ha^{-1}. Moreover, due to moisture stress conditions at later stage of the crop growth P diffusion (the major way of P anion movement from soils to root surface) was supposed to be very low. As under moisture stress the water films around the soil particles are thin and path length increases, reducing P diffusion to the roots (Tisdale et al., 1997). Despite that N and P are important for high yields when water is limiting (Tisdale et al., 1997), particularly for legumes P requirement is more (Tandon, 1987).

The above results indicate that residual effect of P in T.Aman-chickpea cropping pattern was not visible probably because of shifting of land from wet conditions to complete dry conditions. Therefore, it appears that P should be applied in chickpea irrespective of amount of P fertilizer applied in previous T.Aman rice. The results are in agreement with Ali (2000) who suggested 20 kg P ha^{-1} for chickpea production in HBT.

However, the environment of 2002-03 was largely different from pervious year. As the during the active vegetative stage of the crop temperatures of whole January was abnormally cool and foggy. Mean maximum and minimum temperatures of January, 2003 were 22.4^{O}C and 8.7^{O}C respectively. And minimum temperatures of 8-24 January were 8.4-6.6^{O}C and for two days temperatures were as low as 4.3-4.8^{O}C. Those temperatures were much below the optimal temperatures range (Khanna-Chopra and Sinha, 1987) and severely hampered the normal growth of the plants. Moreover about 18 mm rainfall at pod-filling stage and continuous foggy weather made the microenvironment of chickpea canopy moist which promoted vegetative growth at the cost of seed yield. Due to environmental differences difference was observed between P response and seed yield of 2001-02 and 2002-03.For 2002-03 in general, higher seed yield was obtained from the treatment where P was applied in T.Aman rice over the treatment where P was not applied in T.Aman rice despite the application of P in chickpea. The present results indicated that residual effect of P (applied in T.Aman rice) in succeeding chickpea crop could be visible in good rainy year, probably due to availability of non-labile soil-P because of good soil moisture. However, the fate of P applied in chickpea was not clearly understood.

In 2003-04 also no residual effect of applied P (for T.Aman rice) was observed in chickpea. But zero P applied (in T.Aman) plots had inferior chickpea seed yields in comparison to P applied plots. The results indicated that for good yield of chickpea at least 20 kg P ha^{-1} should be applied in T.Aman rice.

From the three years mean seed yields of chickpea it was observed that when P was not applied in T.Aman rice it produced inferior yields compared to P applied (20-60 kg P ha^{-1}) plots. Thus the findings suggested that at least 20 kg P ha-1 would be applied to previous T.Aman rice to obtain higher yield for succeeding chickpea crop in addition to application of 20 kg P ha^{-1} in chickpea.

Conclusions

In 2001-02 and 2003-04, residual effect of P was not observed in chickpea applied in previous T.Aman rice. In general application of 20 kg P ha^{-1} gave higher grain yield in chickpea. But for the year 2002-03 residual effect of P was observed in chickpea applied in previous T.Aman rice, irrespective of P or irrigation applied or not for chickpea. However, the year 2002-03 was environmentally different from normal year. Again in 2003-04 those chickpea plots had lower yields where P was not applied in previous T.Aman rice.

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Table 3. Yield and yield attributes of T.Aman rice (cv. BRRI dhan 39) as affected by applied phosphorus, High Barind Tract, Rajshahi, 2001-03

P levels (kg P ha^{-1})	Plant height (cm)	Effective panicle m^{-2}	Filled grains panicle^{-1}	Grain yield (t ha^{-1})			Three years mean grain yield (t ha-^{1})
				2003	2002	2001	
0	107.47a	231.25a	59.27a	2.41a	3.22a	2.92a	2.85
20	106.77a	267.50a	69.62a	2.49a	3.68a	3.16a	3.11
40	107.25a	268.75a	72.87a	2.70a	3.75a	3.38a	3.27
60	110.57a	272.75b	71.30a	2.90a	3.76a	3.63a	3.43
CV (%)	6.9	10.0	13.2	11.2	11.5	7.8	-

Same letter in a column do not differ significantly at 5 % level by DMRT.

Table 4. Effect of residual phosphorus (applied in T.Aman rice), applied P and irrigation on the performance of chickpea (BARI Chola 2), High Barind Tract, Bangladesh, 2001-04

Treatment	Plant height (cm)	Pods/plant (No)	100-seed wt. (g)	Seed yield (t ha^{-1})			Mean of three years seed yield (t ha^{-1})
				2003-04	2002-03	2001-02	
RP60I0P0	37.40a	41.53a	11.09a	0.97c	0.99ab	0.90cd	0.95
RP60I0P20	37.86a	42.68a	11.50a	1.17ab	1.03ab	1.12a-d	1.11
RP60I1P0	37.06a	42.66a	11.90a	1.17ab	1.17a	0.86cd	1.06
RP60I1P20	37.86a	38.66a	12.20a	1.11b	1.25a	1.42a	1.26
RP40I0P0	35.33a	44.44a	11.34a	1.19a	1.09ab	0.80bcd	1.03
RP40I0P20	36.86ab	44.93a	11.54a	1.19a	1.20a	0.93bcd	1.11
RP40I1P0	35.33a	36.13a	11.90a	0.97c	1.23a	1.09a-d	1.09
RP40I1P20	33.93ab	43.89a	12.10a	1.19a	1.30a	1.41a	1.30
RP20I0P0	36.36abc	35.58a	11.68a	0.93c	0.95ab	0.80d	0.89
RP20I0P20	36.46a	35.67a	11.94a	0.97c	1.06ab	1.02cd	1.02
RP20I1P0	36.13a	46.52a	11.65a	1.24a	0.97ab	1.21abc	1.14
RP20I1P20	37.40a	46.98a	11.63a	1.25a	1.08ab	1.26ab	1.20
RP0I0P0	31.06bc	41.66a	10.56a	0.97c	0.68b	0.82d	0.82
RP0I0P20	37.16a	40.99a	11.10a	0.97c	0.69b	1.07a-d	0.91
RP0I1P0	29.73c	31.93a	10.55a	0.73d	0.67b	0.90cd	0.76
RP0I1P20	34.00abc	33.88a	10.88a	0.77d	0.67b	1.12a-d	0.85
CV (%)	7.4	13.65	3.2	7.5	23.2	17.5	-

Same letter in a column do not differ significantly at 5 % level by DMRT.
RP = Phosphorus applied in previous T.Aman rice
I_0 = Non-irrigated, I_1 = One irrigation at 40 DAS
All P in kg P ha^{-1}

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PERFORMANCE OF FIVE DROUGHT TOLERANT AND WILT RESISTANT CHICKPEA GENOTYPES UNDER HIGH BARIND CONDITIONS

Abstract

Five drought and wilt tolerant chickpea genotypes along with three other widely cultivated cultivars were tested at Chabbisnagar FSRD site, in the High Barind Tract, Rajshahi during November 2003 to March 2004. No symptom of wilt was observed on any cultivar. Among the genotypes only ICCV 94927-3 had the high yield potential due to its higher number of pods per plat and heavier 100-seed weight. Thus with Annigeri only ICCV 94927-3 was comparable.

Introduction

High Barind Tract (HBT) area is characterized by low and erratic rainfall having low soil moisture in post-rainy season along with highly compact soil (Ali, 2000). Thus the area needs deep rooting genotypes with high yield, i. e. cultivars with drought tolerant characteristics. Also often wilt is a constraint for chickpea production in the HBT. In the mean time the two deep rooting genotypes namely, ICC 4958 and Annigeri is already adapted to the HBT situations (Ali, 2000). Recently ICRISAT has developed drought tolerant and wilt resistant elite genotypes (personal communication, L. Krishnamurthy) through the crossing between ICC 4958 and Annigeri. Therefore, among the developed progenies five promising genotypes along with widely cultivated BARI released chickpea varieties and Annigeri were tested.

Materials and Methods

The non-replicated (as available seed was small amount) experiment was conducted at Chabbisnagar FSRD site, HBT, Rajshahi during November, 2003 to March, 2004. The tested eight genotypes were; ICCV 94916-4, ICCV 94916-8, ICCV 94920-3, ICCV 94924-2, ICCV 94924-3, Annigeri, BARI chola 5 and BARI chola 2.The unit plot size was 2 m x 7 m. At the time of final land preparation different fertilizers were applied @ N_{20} P_{20} K_{20} S_{10} B_1 kg ha^{-1}. Seeds were shown on 12 November 2003, maintaining a spacing of 40 cm x 10 cm. The chickpea fields were kept weed and pod borer free. All the genotypes were harvested on 14, March 2004. Data on yield attributes were recorded from 10 randomly selected plant and yields were recorded from whole plot (as area was small).

Results and Discussion

As the initial soil moisture was poor resulting in poor germination of two genotypes. Among the genotypes ICCV 94924-3 and Annigeri produced higher and promising seed yields (Table 1). Thus among the tested cultivars only ICCV 94924-3 showed promising yield potential due to its higher number of pods/plant and heavier seed weight. No symptom of wilt was observed on any cultivars. Thus the genotypes would be tested over the years and locations (depend on seed quantity) to show its response to year and location variations. The experiment will be continued for the next year.

Table 1. Yield and yield attributes of eight different chickpea genotypes at High Barind Tract, Rajshahi, 2003-04

Genotype	Plant population/ m^2 (no)	Plant height (cm)	Branche s /plant (no)	Pods/pl ant (no)	Grains/ pod (no)	100-seed wt (g)	Seed yield (kg/ha)	Straw yield (kg/ha)
ICCV 94916-4	*	46.7	2.6	27.6	1.0	31.0	155	204
ICCV 94916-8	*	43.2	2.6	40.6	1.2	31.0	114	171
ICCV 94920-3	39.2	55.9	2.4	49.0	1.6	25.5	1221	1400
ICCV 94924-2	50.5	46.4	2.4	65.4	1.8	25.0	2126	2159
ICCV 94924-3	49.3	47.8	2.4	58.2	1.6	25.0	2641	2001
Annigeri	48.0	50.2	2.4	59.8	1.8	15.6	2640	2560
BARIchola 5	50.7	58.0	2.4	55.8	1.6	11.5	1246	2468
BARIchola 2	48.2	58.0	3.2	65.3	1.8	12.3	1823	2179

* = Germination poor

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ADVANCED YIELD TRIAL OF CHICKPEA

Abstract

A field experiment was carried out in farmer's field at 'F-8RD site, Chabbishnagar. Rajshahi during rabi 2003-04 to evaluate the performance of promising chickpea lines against BGM and wilt disease over location. Nine advanced line of chickpea viz. BCX-91010-1, ICCV-98939, ICCV-98936, ICCV-94916-8, ICCX-5100206-2, ICCV-95138, ICCV-97004, BCX910109-3, ICCV-96020 and two checks (BARl Chola-5 & ICCL 87322) were tested at the farmers field. The entry ICCV-97004, ICCV-98936 and BCX 9601093-3 and ICCV-98936 showed similar seed yield and higher than other variety/line. Among the lines ICCV-98936 took less time than other varieties/line tested.

Introduction

Chickpea *(Cieer arietinum L)* is the third largest pulse crop in Bangladesh (BBS, 1997). It is one of the best grain legumes for human and animal consumption. It contributes about 20 percent of the total pulses (BB8, 1992). It is normally cultivated in the winter season on conserved soil moisture. Its average yield in Bangladesh is far below the yield level achieved by many other chickpea growing countries (BARC, 1975). The low yield of chickpea might be attributed to the lack of high yielding and disease resistance varieties, inadequate fertilizer use and inappropriate cultural practices. Under Barind stress situation it can be successfully grown after harvesting of short duration T.Aman rice. But wilt is a major problem of chickpea production in Bangladesh. Considering these views, this present trail was initiated with 'the objective to select lines against BGM and wilt in Barind area.

Materials & Methods

The trial was conducted at FRSD site, Chabbishnagar Rajshahi during Rabi 2003-04. The experiment was laid out in a randomized block design with three replications. The unit plot size was 6 rows x 4 m. The seeds were sown in 40 cm row spacing with continuous sowing. Eleven advanced lines/ varieties viz. BCX-91010-1, ICCV-98939, ICCV-98936, ICCV-94916-8, ICCX-5100206-2, ICCV-95138, ICCV 97004, BZX 910109-3, ICCV 96020, BARI Chola-5, ICCL 87322 were included in the study. Seeds were sown on 29 November 2002. The seed rate was maintained 50 kg/ha. The land was fertilized at the rate of 20-40-20 N, P20S, K2O kg/ha in the form of urea, TSP and MP respectively. All fertilizers were applied as basal during t he final land preparation. The crops were harvested on 26 March 2003. The seed yield and other related data were recorded and analyzed statistically.

Results and Discussion

The data on yield and yield components of eleven lines/varieties of chickpea are presented in Table 1. All yield components and yields were statistically significant. Days to flowering ranged from 78 to 82. The days to flowering differed to different lines. The entry ICCV 94916-8, ICCX 9100206-2 and BCX 910109-3 took maximum (82) and line ICCL 87322 (78) took the minimum number of days to flowering. Days to maturity ranged from 166 to 126. The entry ICCV 95138 and ICCV 96020 took the maximum (126) and entry BCX-91010-1 (116) took the minimum number of days for maturity. The highest percentage of .mortality was observed in the line ICCV 94916-8 (4.56%) and lowest in ICCV 96020 (0%). The plant height was maximum in line ICCL 87322 being 80.47 cm and lowest from line ICCX-9100206-2 (49 cm). The pods/plant ranged from 38.67 to 66.2. The highest number of pods/plant was obtained from line ICCV-97004 (66.20) and lowest from ICCL-87322 (38.67). The 1000 seed weight (g) ranged from 263.0 to 133.1. The highest 1000 seed weight was obtained from line ICCV-94916-8 (263.0 g) and lowest from ICCV-98939 (133.1 g). A significant variation was observed in seed yield/ha. Among eleven lines/variety, the lines ICCV-97004 and ICCV 98936 showed similar seed yield and higher than other entry/line. The existing variety BARI Chola 5 showed lower yield than the above two lines. On the basis of mortality and yield performance, four entries ICCV-97004, ICCV-98936, BCX-910109-3 and ICCV-989339 may be selected for further evaluation in the next year.

Farmers' reaction

Famers are very much interested to cultivate the Chickpea lines ICCV-97004, ICCV-98936, BCX-910109-3 and BARI Chola 5 due to its low mortality and high yield potentiality. Another year trial is needed for its confirmation.

Table 1. Performance of some advance lines of chickpea at FSRD Site, Chabbishnagar, Rajshahi during 2003-04

Entries	Days to flowering	Days to maturity	Plant pop./ m^2	Mortality (%)	Plant height (cm)	Pods/ plant (no.)	Grains/ pod	1000-seed wt.(g)	Seed yield (t/ha)	Straw yield (t/ha)
BCX910101	79	116	29	1.47	56.40	49.27	1.400	155.0	1.08	2.48
ICCV98939	80	118	31	0.85	54.40	50.67	1.333	133.1	1.43	2.05
ICCV98936	81	120	34	1.45	55.40	54.33	1.467	139.3	1.51	2.29
ICCV949168	82	119	25	4.56	66.80	49.27	1.400	263.0	1.15	2.04
ICCX91002062	82	122	32	1.37	49.00	45.43	1.333	122.7	1.22	2.25
ICCV95138	81	126	31	0.44	61.73	46.00	1.330	243.3	1.39	1.91
ICCV97004	79	125	32	0.11	61.27	66.20	1.400	254.3	1.55	2.17
BCX9101093	82	124	23	1.77	57.27	48.60	1.333	225.7	1.46	2.12
ICCV96020	81	126	24	0.00	60.07	43.87	1.333	254.7	1.36	2.25
BARIChola5	79	122	31	0.16	59.73	55.87	1.467	136.3	1.31	2.20
ICCL87322	78	121	28	1.56	80.47	38.67	1.267	164.3	0.94	2.14
LSD (0.05)	4.81	4.62	4.05	0.37	9.11	7.90	0.18	21.23	0.15	0.33
CV (%)	3.5	2.06	8.28	17.60	8.86	9.11	7.98	6.59	6.44	8.82

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STUDY ON THE SEED ENRICHMENT OF MUSTARD WITH BORON TO MINIMIZE BORON DEFICIENCY IN THE SOIL

Abstract

The study was conducted at FSRD site, Chabbishnagar, Rajshahi during rabi season 2002-03 & 2003-04 and FSRD site, Narikeli, Jamalpur 2003-04 with the objective to get boron enriched seeds which can be grown in boron deficient soil without boron application. The experiment involved 5 levels of boron viz. 3 levels of foliar spray @ 50, 100 and 200 mg/litre, soil application @ 1.00 kg/ha and control. At Rajshahi, on an average highest seed yield was obtained from foliar spray of boron @ 2.00 mg/litre followed soil application @ 1 kg/ha of boron. Similar trend was followed at Jamalpur.

Introduction

Mustard is one of the major oil seed crops in Bangladesh. Bangladesh imported mustard seeds (broken or not) 100890 metric tons with about Tk. 127 core in the year 1997 (Anon, 1998). But seed yield is very low compared to other mustard growing countries of the world. The seed yield of mustard is greatly influenced by boron particularly where soil is deficient. The soil analysis revealed that the soil of High Barind area constrains trace amount (0.14-0.33 mg/g soil) of boron and Jamalpur soil contain (0.05-0.27 mg/g soil) of Boron. Mehrotra *et al*. (1977) observed that the seed yield increase ranging from 16 to 69% to boron application. Sterility in Mustard is an important constraint for low yield due to boron deficiency. Experimental reports suggest that application of boron has significant effect in reducing sterility. Boron is essential for bearing fruits. Farmers generally do not use boron in the field. Due to deficiency of Boron plant growth is stunted and leaves become curling. Foliar application of Boron is beneficial for quick recovery of the crop and to reduce the sterility in mustard with this view in mind, the experiment was undertaken to get Boron enriched seeds of mustard which can be grown in boron deficient soils without boron application.

Materials and Methods

The trial was conducted at FSRD site, Chabbishnagar, Rajshahi during rabi season in 2002-203 & 2003-2004 and Narikeli, Jamalpur during 2003-04. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 5m x 4m. The seeds were sown in 30cm row spacing with continuous sowing. The variety was BARI Sarisha-8. The seeds were sown on November 07, 2002 & November 16, 2003 at Rajshahi and 12-15 November 2003 at Jamalpur. The seed rate was maintained 8 kg/ha. Nitrogen, phosphorus, potassium and sulphur were applied as basal during final land preparation at the rate of 120-35-60-30 kg per hectare in the form of Urea, Triple super phosphate, Murate of potash and Zypsum, respectively. The treatment combinations of the study were:

T_1= Foliar spray of Boron @ 50 ppm i.e. 50mg/litre
T_2= Foliar spray of Boron @ 100 ppm i.e. 100mg/litre
T_3= Foliar spray of Boron @ 200 ppm i.e. 200 mg/litre
T_4= Soil application of Boron @ 1.00 kg/ha
T_5= Control

Spray was done 30-50, days before initiation of flowering. The crops were harvested on February 8, 2002 and February 17, 2004 at Rajshahi and 10-12 February, 04 at Jamalpur.

Data were collected on different yield components and yield, analyzed statistically and the differences between treatment means were evaluated by least significant difference of test.

Result and Discussion

Chabbishnagar, Rajshahi

Yield and yield attributes were significantly affected except plant/m^2 & plant height (Table 1). Treatment T_1, T_2, T_3 & T_4 were statistically identical in respect of effective siliqua/plant & higher than T_5 which showed lowest siliqua/plant. More sterile siliqua/plant was observed in treatment T_5 followed by T_4, T_1 & T_2. Higher seed/siliqua was recorded from treatment T_3 followed by T_2 and lowest from T_5. Seed weight was not significant influenced by the treatment. Higher seed yield was recorded from treatment T_3 which was statistically identical to T_2 and T_1 whereas lowest yield from treatment T_5. But in 2002-03 showed higher yield from treatment T_3 followed by T_4. On an average higher seed yield was recorded from foliar spray of boron @ 200 ppm.

Narikeli, FSR site, Jamalpur

Effective pod/plant, sterile pods/plant, seed/pod, 1000-seed weight and seed yield were significantly affected by the treatment (Table 2). Plant height & plant/m^2 were not statistically identical. Treatment T_3 showed higher effective pods/plant but statistically at par to T_4 treatment. But significantly highest sterile pod/plant was recorded from control (T_5). Seeds/pod showed similar seed/pod in treatment T_3, T_4 & T_2 and higher than T_5. Seed weight did not influence among the treatment T_4, T_3, T_2 and T_1 but lowest from T_5 treatment. Higher seed yield was obtained from treatment T_3 which was statically identical to treatment T_4.

Conclusion

From the above study it revealed that Boron was essential for mustard cultivation and it could be applied either to spray 200 mg/litre as foliar application or to apply full dose of @ 1.0 kg/ha as basal. The experiment needs to be continued for further confirmation at Jamalpur.

Table 1. Effect of boron application on the yield and yield contributing characters of mustard at Rajshahi during 2003-04

Treatment	Plant height (cm)	Plant population /m^2 (no.)	Effective siliqua/plant (No.)	Sterile siliqua/ plant(no.)	Seed/ siliqua (no.)	1000 weed wt. (g)	Seed yield (t/ha	
							2003-04	2002-03
T_1	96.15	81.10	55.20a	3.68a	20.05b	2.91	1.95ab	1.03c
T_2	96.85	72.38	55.90a	2.93ab	22.05ab	3.01	1.97ab	1.17bc
T_3	96.45	82.30	59.20a	1.93b	24.53a	3.10	2.06a	1.52a
T_4	92.15	81.55	55.63a	3.85a	19.98b	2.85	1.76b	1.42ab
T_5	86.65	79.95	42.63b	4.20a	15.98c	2.69	0.94c	0.96c
CV(%)	5.92	6.72	8.81	6.67	10.48	9.41	8.91	16.13
LSD(0.05)	NS	NS	8.94	1.36	3.31	NS	0.24	0.304

Table 2. Plant height, plant/m^2, yield and yield attributes of mustard (Narikeli, Jamalpur 2003-04)

Treatment	Plant height (cm)	Plant /m$_2$ (no.)	Effective pods/plant	Sterile pods/ plant (no.)	Seed/ pods(no.)	1000 weed wt. (g)	Seed yield (t/ha
T_1	99.2	64.3	57b	17b	19bc	3.60ab	1267b
T_2	101.6	67.2	62b	13c	20ab	3.70a	1377b
T_3	99.8	67.9	83a	10d	22a	3.90a	1707a
T_4	102.8	66.3	70ab	12cd	22a	4.00a	1640a
T_5	99.3	60.2	60b	21a	16c	3.20b	1017c
CV(%)	NS	11.20	7.12	6.15	5.55	6.23	9.25

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INTERCROPPING CARROT WITH HYBRID MAIZE AT DIFFERENT PLANTING SYSTEMS AT HILLY AREAS IN BANDARBAN

Abstract

An experiment of inter-cropping carrot with hybrid maize at different planting system was carried out at Bandarban sadar areas during rabi season 2003-04 with view to identify the suitable planting system and find out the economic return from the system. It revealed that gross margin was found highest Tk. 54037 ha^{-1} for treatment T_3 (Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows carrot (30cm x 10 cm) due to higher gross margin from maize and it was lowest Tk. 26193 ha^{-1} for treatment T_2 (Maize normal row (75 cm x 25 cm) + 2 rows carrot (30 cm x 10 cm) due to negative gross margin from carrot. The benefit cost ratio was highest 2.38 for T_1 sole maize and it was lowest 2.48 for T_2.

Introduction

Hybrid maize is newly introduced crop in Bangladesh. Due to the establishment of poultry industry its demand is increasing day by day. Maize is a long duration and wide spaced crop. In the inter-row space another short duration crop can be intercropped for better utilization of natural resources as well as maximizing total productivity of unit area. Carrot is a protein rich high value cash crop. It is a quick growing short stature crop; it may be intercropped with maize due to its different growth habit for getting maximum economic benefit.

In Bandarban district about 355 acres of land are covered by maize cultivation with very lower yield only 1.5 t/ha (BBS, 1999). Now-a-days mini poultry industry has been developed in hilly areas. So, the demand of maize as poultry or dairy feed is increasing day by day. Due to the very lower yield of existing local maize variety, farmers are deprived from higher benefit. So, it is necessary to introduce hybrid maize for higher yield and high economic return as well as better utilization of land for maximum outlay. Farmers would be getting better economic return for maize-carrot intercropping system in hilly areas.

Objectives

- To find out the suitable planting system of carrot intercropped with maize;
- To estimate the cost and economic return of maize carrot intercropping system.

Materials and Methods

An experiment on inter-cropping carrot with maize at different planting systems was conducted during rabi season 2003-04 at Bandarban sadar areas in hill district Bandarban. The soil was brown loam and slightly acidic to strongly acidic, soils pH ranges 4.5-6.5. Land type was high land. Organic matter was low and N was very low, P- medium, K- medium, S- medium, Zn- very low and Boron was very low (SRDI Thana Nirdeshika, Bandarban). The site represents the area of AEZ- 29. The treatments are T_1 = Sole maize (75cm x 25cm), T_2 = Maize normal row (75 cm x 25 cm) + 2 rows carrot (30 cm x 10 cm) & T_3 = Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows carrot (30 cm x 10 cm). The experiment was set up in RCB with 3 replications. The crop was sown on 10 November 2003. The unit plot size was 4m x 4.5m. The variety of maize and carrot was pacific 984 and enoura-Japan. The fertilizer dose was 250-12-120-40 kg N-P_2O_5-K_2O-S/ha. The $^1/_3$ rd and other fertilizers were given as basal. The rest of N as top dressed on 30 and 60 DAS in maize row only. Three irrigations were given on 33, 64 and 86 DAS. The maize was harvested on 5 April 2004 and carrot on 28 March 2004.

Results and Discussion

Yield and yield contributes of carrot

Root length, root diameter and weight of 10 roots were not significantly influenced by different treatment but plants/m^2 was statistically different. Significantly highest yield was recorded from treatment T_3 (Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows carrot (30cm x 10 cm). Between the two treatment lowest yield was obtained from treatment T_2 (Maize normal row (75 cm x 25 cm) + 2 rows carrot (30 cm x 10 cm) due to less number of plants/m^2 (Table 1). The yield of carrot of was not satisfactory level. Lower yield of carrot was obtained due to improper management by the farmer as a new crop in Bandarban.

Yield and yield contributes of maize

Significantly highest yield was recorded from treatment T_3 (Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows carrot (30cm x 10 cm) due to higher plants /m^2. Among the treatment lowest yield was obtained from treatment T_2 (Maize normal row (75 cm x 25 cm) + 2 rows carrot (30 cm x 10 cm) due to obtained lower plants/m^2 (Table 2).

Cost benefit analysis

Highest total **gross return** (Tk.103230 ha^{-1}) was obtained from treatment T_3 was followed by treatment T_1 (Tk.89500 ha^{-1}). The former treatment higher due to higher gross return from maize and carrot late treatment showed higher from maize only. Among the treatment higher gross margin was obtained Tk.54037ha^{-1} for treatment T_3 and it was lowest Tk. 26197 for T_2. Considering the benefit cost ratio, the highest was found 2.38 for T_1 sole maize than other treatment due to negative return of carrot (Table 3). The cost of cultivation was different among the crop. In case of carrot, only seed, sowing and harvesting cost was considered due to inter-cropping with maize. But in case of maize, all cost had been considered except land rent. Among the treatment total cost of cultivation was estimated Tk.49193ha^{-1} for T_2 and T_3 while it was Tk.37537 ha^{-1} for T_1 sole maize. The highest gross margin (Tk.54037 ha^{-1}) was obtained from treatment T_3 due to higher gross margin (Tk. 59463 ha^{-1}) from maize. Among the treatment the lowest gross margin (Tk26197 ha^{-1}) was recorded from treatment T_2 due to lower gross margin from maize and high negative return from carrot.

Considering the Benefit cost ratio the highest was found 2.38 for T_1 and it was also highest among the treatment and lowest BCR was found 1.53 from T_2 due to negative return from carrot.

Field observation

- After sowing of carrot it was observed that the germination percentage was very low below 40 percent
- Farmers were not aware practiced for carrot cultivation, so proper training is needed
- No disease was found in hybrid maize.

Farmer's reaction

- Farmers are interested to cultivate hybrid maize due to better yield and excellent big size of cob and it's demand of local market is high, for example, one cob are sale 3-5 taka in local market;
- Carrot is a new crop in Bandarban and it's management practice was unknown to the farmers.

Table 1. Plant height, yield and yield contributing character of carrot in maize-carrot intercropping system at hilly areas in Bandarban, 2003-04

Treatment	Plants/m^2	Root length (cm)	Root diameter (cm)	Wt. of 10- root (g)	Root yield (kg/ha)
T_2	8.3b	4.32	8.85	490	539
T_3	10.5a	4.45	9.05	498	623
LSD(0.05)	1.12	NS	NS	NS	NS

Table 2. Plant/m^2, yield and yield contributing character of maize (Pacific-984) in maize-carrot inter-cropping system at hilly areas in Bandarban, 2003-04

Treatment	Plant/m^2	No. of cob/plant	Length of cob (cm)	No. of grain/cob	Wt. of 1000 grain (g)	Grain yield (ton/ha)
T_1	4.21b	0.95	18.25	525a	370a	8.95b
T_2	4.00b	0.89	17.30	452b	350b	7.00c
T_3	5.88a	1.03	19.47	545a	380a	9.70a
LSD(0.05)	0.30	NS	NS	0.35	0.15	0.20

Table 3. Per hectare costs and economic return of maize-carrot intercropping at different planting system at hilly areas in Bandarban, 2003-04

Treat ment	Gross return (Tk/ha)			*Total cost of cultivation (Tk/ha)			Gross margin (Tk/ha)			Benefit Cost Ratio (BCR)		
	carrot (a)	maize (b)	total (a+b)	carrot (a)	maize (b)	total (a+b)	carrot (a)	maize (b)	total (a+b)	carrot (a)	maize (b)	total (a+b)
T_1	-	89500	89500	-	37537	37537	-	51963	51963	-	2.38	2.38
T_2	5390	70000	75390	11656	37537	49193	-6266	32463	26197	-0.33	1.86	1.53
T_3	6230	97000	103230	11656	37537	49193	-5426	59463	54037	-0.61	2.58	1.97

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INTER-CROPPING OF HYBRID MAIZE WITH BUSHBEAN AT DIFFERENT FERTILIZER LEVELS IN BANDARBAN

Abstract

An experiment of inter-cropping hybrid maize with bushbean at different fertilizer level was carried out at Bandarban sadar areas during rabi season 2003-04. It revealed that gross margin was found highest Tk.101152ha^{-1} for treatment T_5 (Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows of bush bean (30 cm x 10 cm) +250-120-120-40 kg N, P_2O_5, K_2O and S/ha) and it was lowest Tk. 59463 ha^{-1} for treatment T_1 for sole maize with (75 cm x 25 cm) + 250-120-120-40 kg N, P_2O_5, K_2O and S/ha (recommended dose). The gross margin increased by 45 percent due to inter-cropping system. The benefit cost ratio was highest 3.02 for T_5 and it was lowest 2.48 for T_1.

Introduction

Hybrid maize becomes importance in Bangladesh due to its higher yield potentiality and favorable agro-climate condition for its cultivation. It requires high amount of chemical fertilizers for exploiting its maximum yield potentiality. On the contrary, bush bean being a leguminous crop needs lower fertilizer dose for its cultivation. Maize-bush bean is a competent inter-cropping system because of their different photosynthetic pathway, growth duration, root systems and requirement of growth resources. Growing of bush bean in association with hybrid maize may reduce fertilizer requirement for the system as bush bean can fix atmospheric N_2 and subsequently release it to the soil. More over, after harvesting of green pods, incorporation of green biomass of bush bean may improve soil health in the long run. The nutrient management of intercropping is somewhat different from of the sole cropping and the success of intercropping depends on the proper nutrient management to obtain maximum productivity.

In Bandarban district about 355 acres of land are covered by maize cultivation with very lower yield only 1.5 ton/ha (BBS, 1999). Now a days mini poultry industry has been developed in hilly areas. So, the demand of maize as poultry or dairy feed is increasing day by day. Due to the very low yield of existing local maize variety, farmers were deprived from higher benefit.

Due to the limited area of land in hill district an inter-cropping system might be more profitable than single cropping. So it is necessary to introduce hybrid maize at farmer's level for higher yield and high economic return. A suitable inter-cropping system should be developed for better economic return as well as better utilization of land.

Objectives

- To find out the optimum fertilizer dose for higher productivity for intercropping hybrid maize with Bushbean
- To analyze the cost and return of hybrid maize-bush bean inter-cropping system at different fertilizer levels
- To creates impact of hybrid maize inter-cropping fertilizer dose.

Materials and Methods

An experiment on inter-cropping of hybrid maize with bush bean at different fertilizer levels was conducted during rabi season 2003-04 at Bandarban sadar areas in hill district Bandarban. The soil was brown loam and slightly acidic to strongly acidic, soils pH ranges 4.5 -6.5. Land type was high land. Organic matter was low and N was very low, P- medium, K- medium, S- medium, Zn- very low and Boron was very low (SRDI Thana Nirdeshika, Bandarban). The site represents the area of AEZ-

29. The treatments are, T_1 = Sole maize (75 cm x 25 cm) + 250-120-120-40 kg N, P_2O_5, K_2O and S/ha (recommended dose), T_2 = Maize normal planting (75 cm x 25 cm) + 2 rows of bush bean (30 cm x 10 cm) + 200-80-80-30 kg N, P2O5, K_2O and S/ha, T_3 = Maize normal planting + 2 rows of bush bean (30 cm x 10 cm) + 250-120-120-40 kg N, P_2O_5, K_2O and S/ha, T_4 = Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows of bush bean (30 cm x 10 cm) + 200-80-80-30 kg N, P_2O_5, K_2O and S/ha, T_5 = Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows of bush bean (30 cm x 10 cm) +250-120-120-40 kg N, P_2O_5, K_2O and S/ha. The experiment was laid out RCB degin with 3 replications. The unit plot size was 4.0 x 4.5 m. The maize and bushbean variety was pacific 984 and BARI Jharseem 1. The experiment was sown on 19 November 2003. The bushbean was harvested 3 times on 13, 20 and 27 January 2004 and maize on 5-12 April 2004. At the time of flowering leaf bettle was attack in bushbean and control by Symbush.

The yield contributing character data were recorded from ten randomly selected plants. Yield data was recorded per plot and convert per hectare yield. Data were analysis statistically by LSD test and cost return analysis was also done.

Results and Discussion

Yield and yield contributes of bushbean

Plants/m^2, pods/plants and weight of green pods were not significantly influenced by different treatment but green pods of yield was statistically different. Significantly highest yield was recorded from treatment T_3 (Maize normal planting + 2 rows of bush bean (30 cm x 10 cm) + 250-120-120-40 kg N, P_2O_5, K_2O and S/ha). Among the treatment lowest yield was obtained from treatment T_4 (Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows of bush bean (30 cm x 10 cm) + 200-80-80-30 kg N, P_2O_5, K_2O and S/ha) due to lower dose of fertilizer and less number of green pods per plants(Table1).

Yield and yield contributes of maize

Number of cob/plants was not significantly influenced by different treatment, but plant/m^2, length of cob, no. of grain/cob and wt. of 1000 grain weight was statistically different. Significantly highest yield was recorded from treatment T_5 Maize paired row (37.5 cm/150cm/37.5cm) + 4 rows of bush bean (30 cm x 10 cm) +250-120-120-40 kg N, P_2O_5, K_2O and S/ha. Among the treatment lowest yield was obtained from treatment T_2 (Maize normal planting (75 cm x 25 cm) + 2 rows of bush bean (30 cm x 10 cm) + 200-80-80-30 kg N, P2O5, K_2O and S/ha) due to lower dose of fertilizer and less number of plants/m2 and grain /cob as well as length of cob was lower than other treatment (Table 2).

Cost benefit analysis

Highest total gross return (Tk. 102900 ha^{-1}) was obtained from treatment T_5 was followed by treatment T_3 (Tk. 86100 ha^{-1}). The former treatment higher due to higher gross return from maize and late treatment showed higher from bushbean. All the treatment showed higher gross return than sole crop (Tk. 99400 ha^{-1}) (Table 3). The cost of cultivation was different among the crop. In case of bush bean, only seed, sowing and harvesting cost was considered due to intercropping with maize. But in case of maize, all cost had been considered except land rent. Among the treatment total cost of cultivation varied due to different fertilizer dose and it was Tk. 49948ha^{-1} for T_1, T_3 and T_5 while Tk.45133 ha^{-1} for T_3 and T_5. The highest gross margin (Tk. 101152 ha^{-1}) was obtained from treatment T_5 due to higher gross margin (Tk. 62963 ha^{-1}) from maize. Among the treatment the lowest gross margin (Tk. 59463 ha^{-1}) was recorded from treatment T_1 (Sole maize) .

Considering the Benefit cost ratio the highest was found 3.02 for T5 and lowest 2.48 for T1 and it was also lowest among the treatment.

It is evident from cost benefit analysis inter-cropping system was more profitable than sole crop. Per hectare gross margin increased by 41 percent than sole crop due to intercropping system and it was happened in treatment T5 with higher fertilizer dose.

Farmer's reactions

Farmers are interested to cultivate hybrid maize due to better yield and excellent big size of cob, its demand of local market is very high, for example, one cob sold 3-5 taka in local market. But BARI Jharseem-1 is a new crop in Bandarban, some farmers showed negative attitude to take as vegetable crop. Farmer's preferred inter-cropping system due to earn of additional benefit from additional crop as earliest time.

Table 1. Yield and yield contributing character of BARI Jharsheem 1 in maize-bushbean inter-cropping system at hilly areas in Bandarban, 2003-04

Treatment	Plant/m^2	No. of pod /plant	Wt. of 50 green pods (gm)	Green pods yield (t/ha)
T_2	18.0	11.4	230	4.08c
T_3	18.9	11.0	250	5.60a
T_4	17.3	9.4	240	2.91d
T_5	18.15	12.4	260	4.82b
LSD (0.05)	NS	NS	NS	0.35

Table 2. Yield and yield contributing character of maize (pacific-984) in maize-bushbean inter-cropping system at hilly areas in Bandarban, 2003-04

Treatment	Plant/ m^2	No. of cob/plant	Length of cob (cm)	No. of grain/cob	Wt. of 1000 grain (g)	Grain yield (ton/ha)
T_1	5.01	1.03	19.83	532	373a	9.94a
T_2	4.33	1.00	17.70	512	330b	7.31c
T_3	4.88	1.01	19.07	524	337b	8.61b
T_4	5.00	1.00	18.18	505	327b	8.25b
T_5	5.12	1.02	20.66	539	373a	10.29a
LSD (0.05)	NS	NS	NS	NS	15.0	0.39

Table 3. Per hectare costs and return of maize-bush bean intercropping system at different fertilizer level at hilly areas in Bandarban, 2003-04

Treatment	Gross return (Tk/ha)	*Cost of cultivation (Tk/ha)	Gross margin (Tk/ha)	Benefit Cost Ratio (BCR)
T_1	99400	39937	59463	2.48
T_2	113900	45133	68767	2.52
T_3	142100	49948	92152	2.84
T_4	111600	45133	66467	2.47
T_5	151100	49948	101152	3.02

*Cost item was included in bush bean seed, sowing and harvesting cost only but in case of maize land preparation, fertilizer, seed, sowing, weeding,irrigation, intercultural operation, insecticide and harvesting cost.

Note: Sales price of Bushbean @Tk.10/kg and grain of maize @Tk10/kg in local market.

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AN ADAPTIVE TRIAL OF DIFFERENT VARIETIES OF POTATO AT HILLY AREAS IN BANDARBAN

Abstract

An adaptive trial of different 4 varieties of potato viz.: Diamant, Raja, Arinda and local one as Check was carried out at Bandarban Sadar areas during rabi season,2003-2004 with view observed the yield performance of the variety for hilly areas. Among these variety Arinda produced highest yield of 22.16 ton/ha,followed by Raja 21.93 ton/ha where lowest yield was found 11.616ton/ha from local variety (Dohajari).The yield of Arida was 48 percent higher than local one. The gross margin was found highest as Tk. 95490 per hectare for Arinda and was 71 percent higher than local. Benefit Cost Ratio was highest 2.60 for Arinda, followed by Raja was 2.57. The trial revealed that among the four varieties, Arinda was more profitable variety and Raja was also the same but Raja has less demand in local market due to it's red colour. Unavailability of HYV potato seed in local market was the major problem and lack of technical know-how on improved management practiced of potato cultivation was the another constraint.

Introduction

Potato is widely cultivated throughout the year. It is an important vegetable crop in this area. But the area of this crop is limited due to abundant of hill. In Bandarban district about 2308 acres of land under potato cultivation with national average yield 13.8 t/ha (BBS, 1999). Maximum farmers are cultivated local variety called Dohajhari variety which has poor yield. So, It has an opportunity to increase per hectare yield of potato by introducing high yielding variety and applying scientific management to the farmer's level. So, an adaptive trial of different varieties of potato is undertaken with following objectives:

- To observe the yield performance of different varieties of potato at hilly areas in Bandarban district.
- To estimate the profitability of different varieties of potato cultivation at hilly areas in Bandarban.

Materials and Method

An adaptive trial of different varieties of potato was carried out at hilly areas in Bandarban Sadar during 2003-2004.Four varieties of potato were evaluated at farmers field in Bandarban Sadar areas to study the yield performance of potato cultivation in Hilly region. TCRC of BARI supplied three varieties of potato (Diamant, Raja and Arinda) and one check local variety of potato (Dohajari). All varieties were planted on 3-7 December 2003 in 11.2m x 7.8m plot size maintaining 40cm x 25cm spacing. The design was RCBD with 3 replications. Fertilizers were used at the rate of Urea- 250, TSP- 150, MP- 250 and Gypsum- 120kg/ha. Different intercultural operation i.e. irrigation, weeding, Top dressing and spraying etc. were done as and when necessary. The tuber was harvested on 18 - 25 February, 2003. 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

Plants/hill, tuber/hill, weight of tuber/hill and tuber yield were significantly affected by variety (Table 1). Significantly the highest plants/hill was recorded from local variety. Similar trend was followed in case of tuber/hill but weight of tubers/hill were similar among the three varieties except local one. The higher yield was obtained from Arinda followed by Raja and the lowest from local one. The highest yield was recorded from treatment Arinda due to highest weight of tuber/hill. The yield of Arinda was 48 percent higher than local one. The yield of diamont was also lower due to low seed quality.

Cost benefit analysis

Highest gross return (Tk.155120 ha^{-1}) was obtained from variety Arinda, followed by Raja (Tk.153551 ha^{-1}). Among the variety higher gross margin was obtained Tk.95490ha^{-1} for Arinda followed by Tk. 93880 for Raja and it was lowest Tk. 35497 for local one. The gross margin of Arinda increased by 71 percent than local. Considering the benefit cost ratio, the highest was found 2.60 for Arinda and lowest was 1.77 for local due to lower yield of Arinda. The cost of cultivation was different between HYV and local variety due to the price of seed varied. In case of HYV variety, the total cost of cultivation was estimated Tk.59630/ha while it was Tk.45773 for local variety. The highest gross margin (Tk.95490 ha^{-1}) was obtained from Arinda due to highest yield of tuber, followed byTk.93880/ha for Raja. Among the treatment the lowest gross margin (Tk35497 ha^{-1}) was recorded from local one due to received lower yield (Table 2). Considering the Benefit cost ratio the highest was found 2.60 for Arinda, followed by 2.57 for Raja and it was lowest 1.77 for local one.

Field observation

- At the initial stage, the *Agrotis ipsilon*(Hufnagel) locally called Khatui paka was attack which control by spraying Darsban
- At the maturity stage of tuber, late blight disease was severely attack on 01Feb-5March fogy weather and cloudy day
- Dithen M-45 and Ridomil gold was sprayed for preventing the disease but sprayed was delayed;
- Yield could be increased if timely control insect and diseases.

Farmer's Reaction

Farmers are very much interested to cultivate high yielding variety of potato but seed is not available there.

Conclusion

Potato could be cultivated within November than farmers will get additional benefit. Potato seeds supplied should be ensured by the respective department in earliest time to the farmer level. Farmer's training program on modern potato cultivation practice should be organized with the emphasis of unskilled hilly people. The experiment should be repeated next year for confirmation.

Table1. Plant height, yield and yield contributing character of potato varieties at farmer's field at Bandarban Sadar areas in Bandarban Hill district, 2003-04

Variety	Plant height (cm)	No. of plants/hill	No. of Tuber/hill	Weight of Tuber/hill (gm)	Yield (t/ha)
Diamant	36.3	2.25c	5.5b	195a	16.19b
Raja	33.0	3.35b	5.6b	212a	21.93a
Arinda	33.8	2.56c	4.3b	215a	22.16a
Local (Check)	39.8	5.0a	16.0a	114b	11.61c
LSD (0.05)	NS	0.20	5.2	60.5	3.25

Table 2. Cost and return of potato cultivation at farmer's field in Bandarban Hill distric2003-04

Variety	Gross return (TK/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	Benefit Cost Ratio
Diamant	113330	59630	53700	1.90
Raja	153551	59630	93880	2.57
Arinda	155120	59630	95490 (71%)	2.60
Local (Check)	81270	45773	35497	1.77

Note: Seed cost of potato @Tk.20/kg for HYV and Tk.15/kg for local one, Sales price of potato Tk 7.00 /kg.

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ON-FARM TRIAL OF BARI CHICKPEA VARIETIES AT HILLY AREAS IN BANDARBAN

Abstract

An on-farm trial of BARI Chickpea varieties was carried out at Bandarban Sadar areas during rabi season 2003-04 with view to find out the yield performance of chickpea varieties at farmers field. The trial revealed that among the varieties, the highest seed yield was found 1.85 t/ha from BARI chola-5 and lowest yield was 1.25ton/ha for BARI chola-3. The highest gross margin was estimated as Tk 26290/ha for BARI Chola-5 and it was the lowest Tk. 112900/ha for BARI Chola-3 and considering the profitability the highest Benefit Cost Ratio was found 2.32 for BARI chola-5 and the lowest 1.56 for BARI chola-3. Attack of pod borer was the major production constraint in chickpea.

Introduction

Chickpea (*Cicer arietinum* L) is the third most important pulse crop in Bangladesh in respect of area and production with and average yield of 765 kg/ha.Chickpea yield is probably the most unstable among the pulse grown in Bangladesh due to the extreme sensitivity to micro-environment conditions(Musa and Kar,1995).It contributes about 20 percent of the total pulses (BBS,1992). The area and the productivity of chickpea are not encouraging due to lack of suitable varieties/cultivars. In Bandarban district, about 515 acres of land are covered by different pulse crop (BBS.1999). Chickpea is one of the new crops in Bandarban. The area of pulse crop is limited due to hilly areas. In spite of this, it has an opportunity to grow chickpea at farmer's level in plain areas around the hills. In hilly areas, farmers are interested to grow new economic crops but they did not get suitable variety of those crops. In this regard, this type of trial has been undertaken with the specific objectives.

- to find out the yield performance of different varieties of chickpea and
- to estimate the cost and return of different varieties of chickpea at farmer's level of hilly areas.

Materials and Method

An on-farm trial of different four varieties of chickpea was carried out at hilly areas in Bandarban Sadar during Rabi season, 2003-2004. Four varieties of chickpea (BARI Chola-2, BARI Chola-3, BAR Chola-5 and BARI Chola-6) were evaluated at farmer's field in Bandarban Sadar areas to study the yield performance of chickpea cultivation in hill region. Pulse division of BARI, Gazipur, supplied four varieties of chickpea. All variety was planted on 23-27 November 2003 in 4m x 2.5m plot size maintaining 40cm x 10cm spacing. The design was RCBD with 3 replications. Fertilizers (Urea- 43, TSP- 44, MP- 33, Gypsum- 55 and Boric Acid 6 kg/ha) were used. Different intercultural operation i,e. irrigation, weeding and spraying etc. were done as and when necessary.The harvesting period was on 20 March,2003. 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

Pods/plant, seed weight and seed yield were significantly influenced by the variety (Table 1) but plants/m^2 and plant height were insignificant. Pods/plant was statistically identical in between variety BARI Chola 5 and BARI Chola 2 which was higher than rest of the variety. But weight of seeds was similar between BARI Chola 2 and BARI Chola 6. Significantly the highest seed yield was recorded from BARI Chola 5 due to highest number of plant/m^2 and number of pod /plant. Among the variety lowest yield was obtained from BARI Chola- 3 due to lowest number of plant /m^2 and number of pod /plant.

Cost benefit analysis

Highest gross return (Tk.46250 ha^{-1}) was obtained from BARI Chola-5 due to higher seed yield, followed by BARI Chola-6 (Tk.39000 ha^{-1}). The cost of cultivation was identical among the variety which was Tk.19960/ha. Among the variety higher gross margin was obtained Tk.26290ha^{-1} for BARI Chola 5 followed by Tk. 19040for BARI Chola-6 and it was lowest Tk. 11290 for BARI Chola-3. Considering the Benefit cost ratio the highest was found 2.32 from BARI Chola-5, followed by 1.95 for BARI Chola-6. Among the variety it was found lowest 1.56 for BARI Chola-3 (Table 2).

Field observation

- At the maturity stage, the *pod borer insect* was attack continuously;
- Symbose was sprayed for controlling the insect.

Farmer's reaction

- Farmers are interested to cultivate high yielding variety of chickpea due to better yield performance of chickpea in their field;
- Some farmer's are showed interest to grow chickpea in large portion of their land in next year.

Conclusion

Chickpea is one another new crop in hilly areas. Due to the limited land, it might be possible to cultivate chickpea with improved management practices. The experiment should be continued in next year for confirmation.

Table 1. Plant/m^2, yield and yield contributing character of different chickpea varieties at hilly areas in Bandarban, 2003-04

Variety	Plant/m^2	Plant height (cm)	Days to flowering	No. of pod/plant	Wt. of 1000 seed (gm)	Seed yield (ton/ha)
BARI Chola-2	28.5	45	60-67	40.15a	127.5a	1.35c
BARI Chola-3	26.0	52	60-67	34.80c	117.5b	1.25c
BARI Chola-5	31.5	49	60-67	42.80a	112.0b	1.85a
BARI Chola-6	29.6	55	60-67	37.90b	122.5a	1.56b
LSD (0.05)	NS	NS	-	2.90	7.5	0.18

Table 2. Cost and return of different chickpea varieties at hilly areas in Bandarban, 2003-04

Variety	Gross return (Tk/ha)	Total cost of cultivation (Tk/ha)	Gross margin (Tk/ha)	Benefit Cost Ratio
BARI Chola-2	33750	19960	13790	1.69
BARI Chola-3	31250	19960	11290	1.56
BARI Chola-5	46250	19960	26290	2.32
BARI Chola-6	39000	19960	19040	1.95

Seed cost @Tk.30/kg
The market price of chickpea was accounted as Tk 25 per kg.

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ON-FARM TRIAL OF BARI STEM AMARANTH VARIETY AT HILLY AREAS IN BANDARBAN

Abstract

An on-farm trial of BARI stem amaranth variety was carried out at Bandarban Sadar areas during Kharif-1 season 2004 with view to find out the yield performance of the variety at farmers field. The trial revealed that among the varieties, the highest green yield was found 39.55 ton/ha from BARI stem amaranth variety(Labony) and lowest yield was found 31.12ton/ha from local one(Sarupa).The highest gross margin was estimated as Tk 131511/ha for BARI stem amaranth variety and it was lowest Tk. 97795/ha for local one. Considering the profitability, the highest Benefit Cost Ratio was found 5.92 for BARI stem amaranth variety and it was lowest 4.66 for local check. Unavailability of seed (labony) in local market was the major constraint. Attack of leaf beetle was the another production problem.

Introduction

BARI developed one high yielding stem amaranth variety which needs to popularize among the farmers. In Bandarban district about 130 acres of land covered by stem amaranth called danta with 4.2 ton per hectare yield (BBS, 1999). But the developed variety of BARI stem amaranth (Labony) on-station yield was estimated as 40-45 ton/ha. So, it is necessary to popularize and disseminate the BARI high yielding stem amaranth, variety at farmer's level for getting maximum yield and income. In this context, an on-farm trial has been undertaken with the following objectives:

- To evaluate the yield performance of stem amaranth variety under farmer's field;
- To estimate the cost and economic return of stem amaranth variety cultivation;
- To popularize and disseminate the BARI high yielding stem amaranth variety at hilly areas in Bandarban.

Materials and Method

An on-farm trial of stem amaranth variety was carried out during Kharif-I season, 2004 at hilly areas in Bandarban. Two varieties of stem amaranth i.e. BARI stem amaranth-1 (Labony) and one local (Sarupa) as check of stem amaranth were evaluated at farmers field in Bandarban Sadar areas. All varieties were planted on 08-18 March, 2004 in 6m x 2m plot size (two beds constitute one plot) maintaining 30cm x 15cm spacing. The design was RCBD with 5 dispersed replications. Fertilizer were used at the rate of Urea- 200, TSP- 100, MP- 150kg and cowdung 10 ton ha^{-1}.The entire quantity of cowdung, TSP and Gypsum, half of urea and MP were applied during final land preparation. The rest of urea and MP were applied as top dressing in 2 equal splits plot at 20 and 30 days after sowing. Different intercultural operation i,e. irrigation, weeding and spraying etc. were done as and when necessary. The harvesting started from 27 April continued 16 May, 2004 respectively. 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

The highest yield 39.55 ton/ha was recorded from BARI stem amaranth (Labony) due to highest weight of per plant and stem weight. The lowest yield was obtained from local one due to low yield attributes (Table1).

Cost benefit analysis

Highest **gross return** (Tk. 158200ha^{-1}) was obtained from BARI stem amaranth (Labony) due to higher green yield and lowest gross return Tk. 124480 ha^{-1} for local variety. The cost of cultivation was identical among the variety which was Tk. 26689/ha. Among the variety higher gross margin was obtained Tk. 131511ha^{-1} for BARI stem amaranth (Labony) and it was lowest Tk. 97795 for local check. Considering the Benefit cost ratio the highest was found 5.92 from BARI stem amaranth (Labony and it was lowest 4.66 for local check (Table 2).

Field observation

- o At the vegetative stage, the *leaf beetle* was attack continuously;
- o Sabicron (instead of Nogos) was sprayed for controlling the insect.

Farmer's reaction

- o Farmers preferred labony than local one due to its softness and less fibers as well as big size of green stem
- o They are agreed to cultivate stem amaranth variety labony due to high yield and early maturity and easy way of cultivation;

Conclusion

In Bandarban Sadar areas maximum plain land (around or near the hill foot slop) was quite remained fellow. It might be possible to cultivate stem amaranth during fellow period i.e. Kharif-1 season. As because the variety of labony was short duration crop (50-60 days), so it has an ample opportunity to introduce BARI stem amaranth variety at farmers level. In order to draw a valid recommendation, this experiment should be continued in next year.

Table 1. Yield and yield contributing character of Stem amaranth variety cultivation at hilly areas in Bandarban

Variety	Plant/m^2	Days to 1st & last harvest	Plant height (cm)	Total weight/ plant (gm)	Stem weight (gm)	Green yield (kg/ha)
Labony	14	52 - 61	82.26	282.50	193.25	39.55
Local	15	52 - 61	77.15	207.50	142.50	31.12

Table 2. Per hectare costs and return of Stem amaranth cultivation at hilly areas in Bandarban during Khrif -I season, 2004

Variety	Gross return (Tk/ha)	Total cost of cultivation (Tk/ha)	Gross margin (Tk/ha)	BCR
Labony	158200	26689	131511	5.92
Local	124480	26689	97795	4.66

Seed cost @ Tk.200/kg,
Green yield sales @ Tk. 4/kg in local market.

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FEASIBILITY STUDY OF POINTED GOURD AT HILLY AREAS IN BANDARBAN

Introduction

Pointed gourd, a high yielding vegetables, usually grown in north-western 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 overdone 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, the crop should be introduced at farmer's level. In this context, an experiment has been under taken with the following objectives:

- To observed the yield performance of pointed gourd
- To quantify the cost benefit analysis of pointed gourd and compared to other vegetables at hilly areas in Bandarban;
- To know the farmers feed back of pointed gourd cultivation in their field.

Materials and Method

A feasibility study of pointed gourd was conducted at Bandarban Sadar areas during 2003-2004 in farmer's field. The experiment was set up RCB with 3 dispersed replications. Two varieties (PG 025 and Rajbari) with three supports (S_1= Bamboo macha, S_2 = with trail net made of rope & S_3 = straw mulch) were used. The bed size was 4.5m x 1.5m where pit to pit distance 1.5m. No. of pot/bed was 3 and plant/pit one. The ratio male and female was 1: 8. Fertilizer application per pit was used Cowdung - 5 kg during pit preparation (22 t/ha), TSP - 50 gm during pit preparation (222 kg/ha) and MP - 40 gm(20+10+10): 20 gm in pit preparation, 10 gm in after 15 days and 10 gm in after 30 days (178 kg/ha). Urea was applied as 70 gm (0+25+25+20): 25 gm after 15 days, 25 gm after 30 days and 20 gm after 45 days (311kg/ha). The crop was planted on 31 October to 1 November 2003 and harvested on 28 March 2004.Yield data was recorded from per bed and converted to per hectare. The yield was harvested in each 7 days interval and data was recorded by monitoring technique in each harvesting day. Irrigation, top dressing, weeding and spraying was done as necessary.

Results and Discussion

The result of yield was partial because the fruit harvesting would be continued till October, 2004. By this time eleven times of harvest was completed up to 14 May 2004.

The highest fruit yield was obtained 11.36 ton/ha from the variety of PG025 with maintaining the support of bamboo macha. Yield was highest due to highest number of fruit per bed (139.4) and highest weight (55gm) of individual fruit, followed by 5.69 ton/ha with maintaining trail net. In case of variety Rajbari, fruit yield was found 1.59ton/ha comprising 30.57 numbers of fruit per bed and 35gm weight of individual fruit (Table 1). The age of crop is now 6 month and it would be continue till October 2004.

Cost benefit analysis

Bamboo support with variety PG 025 showed higher gross return, gross margin and BCR (2.68) and as compared to trellis net of the same variety.

Field observation

- No disease was found yet, but fruit fly was attack and poison trap was used for controlling it

Farmers reaction

- Farmers are highly interested to grow it due to attractive colour and big size of fruit of PG025 variety as well as excellent bearing of fruit.

Table 1. Yield and contributing character of pointed gourd cultivation at hilly areas in Bandarban, 2003-04 (Partial result, only 11 times harvest)

Treatment	Support system					
	Bamboo macha (S_1)			With trail net(S_2)		
	no. of fruit/ bed (4.5mx1.5m)	Individual fruit wt. (gm)	Yield of fruit (ton/ha)	no. of fruit/ bed (4.5mx1.5m)	Individual fruit wt. (gm)	Yield of fruit (ton/ha)
PG025	139.4	55	11.36	69.8	55	5.69
Rajbari	65.14	35	3.38	30.57	35	1.59

Table 2. Cost and return of pointed gourd cultivation at hilly areas in Bandarban (Partial result)

Treatment	Cost/return (Tk/ha)					
	Bamboo macha (S_1)			With trail net(S_2)		
	Gross return	Gross margin	BCR	Gross return	Gross margin	BCR
PG025	227200	142556	2.68	113800	38480	1.51
Rajbari	67600	-17044	-0.79	31800	-43520	-0.42

Total cost of cultivation, *In case of bamboo macha = Tk.84644/ha and for net as support =Tk.75320/ha, Sales price of pointed gourd in local market @Tk.20/kg. No. of vine per hactare: 2430.*

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BREAD WHEAT ADAPTIVE LINE TRIALS AT FARMER'S FIELD CONDITION

Abstract

The experiment was conducted in medium high land at FSRD site, Tangail, Pabna, Rangpur, Jamalpur and MLT site Jessore and Mymensingh during rabi 2003-04 to assess the yield performance of bread wheat lines in different agro-climatic zones under farmer's field condition. It was observed that the higher grain yield was recorded from BAW1008 in all most sites except Comilla where BAW 1006 showed similar yield to Shatabdi & BAW 1008. But Chowgacha & Jhenaidah both the line showed higher yield than variety.

Introduction

Wheat (*Triticum aestivum*) is the second most important cereal crop next to rice, cultivated during rabi season in Bangladesh. The area and production of wheat were markedly increased from 1975-1985 and after that area and production started declining. This declining was probably associated with yield, higher production cost, decreasing soil fertility, low market price during the harvest price. Wheat Research Center of BARI has developed a good number of wheat lines/varieties and also some technologies to eliminate those constrain. The Wheat Research Center (WRC) conducted several on station trials with newly released bread wheat lines which need to be tested and compared with widely cultivated standard varieties at on farm level. The experiment was undertaken to assess the yield performance of bread wheat lines/variety and determines their potentiality.

Materials and Methods

The experiment was undertaken at the farmers' field of Tangail, Comilla, Pabna, Mymensingh, Rangpur, Jessore and Jamalpur during rabi 2003-04. Two advanced bread wheat lines were, BAW1006 and BAW1008 compared with released variety and Kanchan in medium high land under irrigated condition. The experiment was laid out in a randomized block design with three replications. The unit plot size was 4m x 5m. The land was fertilized with 220 kg urea, 132 kg TSP, 68 kg MP, and 117 kg gypsum/ha. Two-third of urea and all amount of fertilizer were applied at final land preparation. Seeds were sown on 2 Dec., 10 December 30 Nov. 21-23 Nov., 25-30 Nov.2003, 22 Nov- 22 Nov. 03 and 29-30 Nov. 03 at Tangail, Comilla, Pabna, Rangpur, Jessore, Jamalpur and Rangpur, respectively. The crop was sown with 120 kg seed/ha at a spacing 20 cm in solid line. One irrigation was applied at 23 days after sowing (DAS) followed by rest urea as top dress. One hand weeding was done at 27 days after sowing. The crop was harvested on 18-22 March at Tangail, 28 March at Comilla, 22-26 March, Pabna, 15-17 March at Jessore, 17-22 March at Jamalpur 2004 and 15-16 March 2004 at Rangpur, respectively. All necessary data were collected and analyzed statistically.

Result and Discussion

Palima, Tangail

Days to maturity, plant height, yield and yield attributes were significantly influenced by different variety/line. Grains/spike was significantly influenced by different variety/line. Number of grain/spike was obtained lowest from Kanchan which was significant difference among variety/line. Bold grain size showed in line BAW1008 which was significantly different from other lines/variety. Higher grain yield was obtained from lineBAW1008, which was at par to Shatabdi. The line BAW1008 showed 21% higher grain yield than Kanchan. The higher grain yield was achieved due to higher number of spikes/m^2 and grain weight.

Chandina, Comilla

Grain, straw yields and 1000-grain weights were significantly influenced by different variety/lines (Table 2). The line BAW1008 showed significantly highest grain weight closely followed by BAW1006. Grain yield was not significantly influenced by variety except Kanchan. Among the lines, BAW1006 revealed slightly higher yield with shortest maturity days (98) as compared to other variety. Straw yield also higher than BAW1006 followed by Shatabdi.

Puspara, Pabna

Plant height, grains/spike, 1000-grain weight and grain yields were significantly influenced by variety/line. Significantly highest grains/spike was obtained from BAW1008. Grain weights among the lines/variety were statistically identical except Kanchan. Grain yield was not significantly influenced by variety/lines except Kanchan which showed lowest grain yield (Table 3a).

At Sujanagar, plant height, grains/spike, 1000-grain weight and grain yields were significantly affected by variety/line. The line BAW-1006 and BAW-1008 showed similar grains/spike. Significantly highest grain weight was recorded from BAW-1008. Higher grain yield was obtained from BAW1008 which was statistically identical to Shatabdi and BAW1006 (Table 3b).

Nilphamari and Polashbari, Rangpur

At Nilphamari, the result revealed that there was significant difference in respect of all the characters studied except plant height, spikes/m^2 and days to maturity (Table 4a). Significantly higher 1000-grain weight was recorded from BAW1008. There was significant difference in respect of grain yield among the advance lines and released varieties, numerically the highest yield (4.75 t/ha) was obtained from BAW1008 which was followed by Shatabdi (Table 4a).

At Polashbari, filled grain/spike, 1000-grain wt. and grain yields were significantly influenced by variety/line. The line BAW1008 showed higher no. of grains/spike but statistically at par to Shatabdi. Significantly highest grain wt. was recorded from BAW1008. Similar trend was followed in case of grain yield. The line BAW1008 showed 9% higher grain yield than Kanchan. Straw yield showed higher from BAW1008 which was statistically identical to Shatabdi and Kanchan (4b).

Mymensingh Sadar

Plant height grain/spike, 1000-grain weight, grain yield, spikes/m^2 were not significantly influenced by line/variety. Grains/spike showed significantly highest in BAW1008. Grain wt. not significantly influence by variety expect Kanchan. Higher grain yield was obtained from BAW1008 which was not significantly different from other variety/line except Kanchan. Straw yields were not significantly influenced by variety (Table 5).

Jhanidah MLT site

Grain yield and yield attributes were significantly influenced by variety/lines. Plant height was not significantly influenced by variety/line. The variety Shatabdi and Kanchan showed similar spike/m^2 and lowest from BAW1006. The variety Shatabdi, BAW 1006 and BAW1008 produced similar grain/spike whereas Kanchan gave lowest grains/spike. Significantly highest grain weight was recorded from BAW1008. Higher grain yield was obtained from BAW1008 which was statistically identical to Shatabdi and BAW1006 and lowest from Kanchan. Straw yield did not influence by line/variety (Table 6).

Chowgacha MLT site, Jessore

Plant height, grain, straw yields and yield attributes were significantly affected by variety/line. Highest plant height was recorded from Kanchan which was identical to BAW1008. The higher spikes/m^2 was obtained from BAW1008 which was statistical identical to Kanchan. Grains/spikes showed statistically highest from BAW 1008. Significantly highest grain weight was recorded from BAW1008. The line BAW 1008 showed significantly highest grain yeild than Shatabdi. Among the variety/line, Kanchan showed the lowest grain yield (Table 7).

Melandah MLT site, Jamalpur

Plant height plant/m^2, straw yield, grain yield and yield attributes were significantly influenced by variety/line (Table 8a). Significantly highest spikes/m^2 was obtained from Shatabdi and lowest from Kanchan. But longest spike was recorded from BAW1008 and Shatabi & BAW1008 were similar.

The line Shatabdi and BAW1008 were superior in grains/spike than other variety/lines. Grain weights were similar in BAW1008 and Shatabdi. Similar trend was obtained from grain yield but significantly highest straw yield from Shatabdi. The variety Kanchan showed lower grain yield than other variety /line due to less no. of spikes/m^2 and grain weight and grains/spike. Higher grain yield was obtained from BAW1008 due to higher length of spike, grain/spike, 1000-grain weight but very close yield to Shatabdi.

Sherpur MLT site

Plant height plant/m^2, straw yield, grain yield and yield contributing characters were significantly influenced by variety and line (Table 8b). The line BAW1006 and Shatabdi showed highest no. of spikes/m^2 than other variety. The lowest spike/m2 was obtained from Kanchan. Significantly highest grain/spike was obtained From BAW1008 and lowest from Kanchan. Shatabdi & BAW1008 showed similar grain weight and high than other variety/line. Higher grain yield was recorded from BAW1008 which was statistically identical to Shatabdi. The variety BAW 1008 showed higher grain yield due to more no. of spikes/m^2, grains/spike and 1000-grain weight. But straw yield showed significantly highest from Shatabdi.

Farmers' reaction

Famers were much impressed with the wheat line BAW1008 for its high yield, bold and white colour of seed.

Table 1. Yield and yield contributing characters of newly released wheat lines/varieties (FSRD site, Palima, Tangail during 2003-04)

Varieties /Lines	Days to maturity	Plant height (cm)	Spike length (cm)	No. of spike/ m^2	No. of grain/spike	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	110b	105.1a	10.63a	296c	37d	33.56d	2.43c
Shatabdi	113a	109.9b	9.76b	284d	41b	40.97c	3.20ab
BAW1006	106c	106.7a	11.0a	315b	39c	46.43b	3.11b
BAW1008	106c	97.2c	11.07a	385a	49a	51.6a	3.40a
CV%	0.68	0.98	2.17	0.66	1.59	1.87	3.92

Table 2. Yield and yield attributes of bread wheat variety/lines at Debiduar, Comilla, rabi 2003-04

Variety/line	Maturity (days)	Plant height (cm)	Spikes/ m^2	Grains spike	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Kanchan	101	100a	354	37	24.60c	1.71b	3.30b
Shatabdi	104	99ab	359	42	36.67b	3.06a	4.17a
BAW-1006	98	98b	372	45	38.80ab	3.26a	4.44a
BAW-1008	101	94c	287	44	40.93a	2.91a	2.66b
LSD (0.05)	NS	2.01	NS	NS	3.25	0.63	0.84
CV (%)	_	1.19	12.57	11.23	5.32	13.25	13.33

Table 3a. Performance of yield and yield contributing characters of Wheat varieties at MLT site, Puspapara, Pabna during 2003-04

Treatment	Days to maturity	Plant height	No. of grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	116	100.07b	35b	46.74c	3.93ab
Shatabdi	120	101.97ab	44	52.41	4.09ab
BAW-1006	114	96.70c	36b	52.77b	3.48b
BAW-1008	117	103.57a	46a	52.41b	4.53a
CV (%)	-	1.4	7.4	1.7	11.8

Table 3b. Performance of yield and yield contributing characters of Wheat varieties at MLT site, Sujanagar, Pabna during 2003-04

Treatment	Days to maturity	Plant height	No. of grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	109	92.83d	44b	46.30c	3.15b
Shatabdi	114	95.73c	47b	51.97b	3.49ab
BAW-1006	109	104.13a	46b	52.33b	3.20ab
BAW-1008	110	97.47b	51ab	54.23a	3.59a
CV (%)	-	0.40	4.20	1.10	8.60

Table 4a. Yield and yield contributing characters of different advance lines/varieties of wheat at Nilphamari MLT site of OFRD, Rangpur during rabi 2003-04

Treatment	Days to maturity	Plant height (cm)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	108	105	308	41a	39.2b	4.10ab
Shatabdi	109	101	312	43a	41.3b	4.59ab
BAW-1006	108	107	309	33b	42.5b	3.84b
BAW-1008	106	107	309	44a	49.0a	4.75a
CV (%)	4.7	5.9	3.9	6.8	5.5	8.7

Table 4b. Yield and yield contributing characters of different advance lines/varieties of wheat at Polashbari MLT site of OFRD, Rangpur during rabi 2003-04

Treatment	Days to maturity	Plant height (cm)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	108	109	310	40b	42.3c	3.90ab
Shatabdi	109	102	308	43a	44.8bc	4.22ab
BAW-1006	107	108	297	32c	46.0b	3.66b
BAW-1008	109	105	306	44a	50.5a	4.50a
CV (%)	3.0	5.1	3.2	3.5	3.3	7.8

Table 5. Yield and yield contributing characters of different advance lines/varieties of wheat at Mymensingh Sadar during rabi 2003-04

Treatment	Plant height (cm)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Kanchan	93c	300	37b	45b	2.95b	5.49
Shatabdi	98b	298	35b	50a	3.48ab	5.80
BAW-1006	97b	286	36b	53a	3.59ab	5.99
BAW-1008	103a	264	40a	53a	3.63a	5.28
CV (%)	1.40	13.3	3.4	4.1	9.80	10.60

Table 6. Performance of wheat varieties/lines at Jheniadah MLT site, during rabi 2003-04

Treatment	Plant height (cm)	Spike length (no.)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)	Days to maturity
Kanchan	80.40	8.93c	314a	37b	41.06c	3.0b	5.87	111
Shatabdi	83.67	9.86b	315a	42a	40.20c	3.17b	5.97	110
BAW-1006	80.23	10.13ab	253c	40ab	45.96b	3.37a	6.45	109
BAW-1008	80.93	10.6a	267b	42a	50.60a	3.12ab	6.56	108

Table 7. Performance of wheat varieties/lines at Chowgacha, MLT site during rabi 2003-04

Treatment	Days to maturity	Plant height (cm)	Spike length (no.)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)
Kanchan	111	90.35a	9.50c	368a	41b	40.4c	3.06c
Shatabdi	113	85.50bc	9.77bc	334b	43b	44.7b	3.82b
BAW-1006	113	81.33c	10.30b	318b	40b	45.3b	4.01ab
BAW-1008	110	87.26ab	11.47a	385a	47a	52.5a	4.05a

Table 8a. Yield and yield contributing characters of Wheat at MLT site, Melandah during 2003-04

Treatment	Plant height (cm)	Spike length (no.)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Kanchan	98.47a	8.0c	320c	31c	42.67c	2.98c	5.80b
Shatabdi	92.07b	8.88b	368a	38a	53.20a	3.80ab	6.28a
BAW-1006	89.77c	8.47b	348b	36b	52.67b	3.51b	5.20c
BAW-1008	88.87c	11.77a	345b	39a	54.33a	4.02a	5.07c
CV (%)	8.91	11.46	10.51	9.43	11.24	12.53	11.64

Table 8b. Yield and yield contributing characters of Wheat at MLT site, Sherpur during 2003-04

Treatment	Plant height (cm)	Spike length (no.)	Spike/m^2 (no.)	Grains/ Spike (no.)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Kanchan	101.53a	8.70c	319c	32c	38.67c	2.88c	5.45b
Shatabdi	97.34b	9.56b	3999a	36b	52.33a	3.50ab	5.8a
BAW-1006	96.09b	9.269b	396a	34b	50.17b	3.23b	5.01c
BAW-1008	90.01c	10.83a	388b	41a	53.33a	3.93a	4.85c
CV (%)	9.63	12.07	10.39	9.62	8.13	-	-

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PERFORMANCE OF WHEAT THROUGH POWER SEEDER COMPARE TO TRADITIONAL METHOD

Introduction

Wheat (*Triticum aestvum*) is the second major cereal crop next to rice, cultivated during rabi season in Bangladesh. It has to compete with other important winter crops like pulses, oil seeds and vegetables. Due to higher cost of production of wheat it can not compete with above mentioned crops. Production cost of wheat, ploughing cost is major. CIMMYT developed a power seeder, which is able to furrow, line sowing and leveling of soil at a time. It reduce seed rate (20%), $^{1}/_{3}$rd production cost and yield increased (20-30%) of wheat over traditional broadcast method. Therefore, collaboration with CIMMYT and BARI conducted a production program of wheat to see the comparative performance in between mechanical and traditional method.

Materials and Methods

A cultivation program was conducted at Goyanghat of Sylhet, Puspapara of Pabna and Narikeli of Jamalpur during 2003-04 to compare the traditional practice of wheat production with mechanical method. Before starting the program a motivational meeting was organized for successful implementation of the program. Thirteen cooperator farmers for seeder and four for traditional methods were selected in same land categories. Wheat variety Shatabdi was sown through power seeder and Kanchan was sown in traditional broadcast method. The crop was fertilized at the rate of 55-22-15-12 kg N-P-K-S/ha at Sylhet and 100-36-25-22-2-0.5 kg N-P-K-S-Zn-B/ha at Pabna. The seeds were sown on 4-10 December 2003 at Sylhet, 5-10 December 2003 at Pabna and 7-11 Dec. 03 at Jamalpur. Intercultural operation and plant protection measures were done as and when required. Crop was harvested on 18-25 March 2004 at Sylhet, 20-25 March 2004 at Pabna and 2-4 April 2004 at Narikeli.

Results and Discussion

Goyanghat, Sylhet

The highest grain yield (2.52 t/ha) was obtained from mechanical seeding which was 9% higher than traditional broadcast (2.39 t/ha) method. Economic point of view, higher gross return, gross margin and benefit cost ratio (3.03) were obtained from mechanical seeding. So, higher profit could be possible compare to traditional production method.

Puspapara, Pabna

Higher grain yield (3.10 t/ha) was obtained from mechanical seeding which was 45% higher than conventional broadcast (2.38 t/ha) method. Similarly, higher gross return (Tk. 39197/ha), gross margin (Tk. 26397/ha) and benefit cost ratio (3.06) were obtained from mechanical seeding.

Narikeli, Jamalpur

The higher grain yield was obtained from power tiller operated seeder which was 19% higher grain yield than the traditional method. The gross return, gross margin and BCR (2-19) also were obtained higher from mechanical seeding.

Conclusion

Wheat seeding through mechanical seeder was an improved method for wheat cultivation. Moreover, the method was easy, profitable, minimized the turn around time, sowing timely and even population. So, the program can be recommended for large-scale extension at farmers' field.

Farmers' reaction

Farmers showed very much positive response with new mechanical seeder. They expressed their satisfaction with less production cost and recover the turn around time. They also opined that the price of seeder is too high. Some problem with the uneven seeding was found due to problem in dropping seed which need easy adjustment process.

Table 1. Comparative performance of Wheat in between power seeder and traditional production method (Goyanghat, Sylhet, 2003-04)

Method	No. of monitored farmers	Area covered (ha)	Grain yield (t/ha)	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Seeding with power seeder	13	2.0	2.52	25200	8290	16910	3.03
Traditional broadcast method	4	0.5	2.39	23900	9490	14410	2.51

Table 2. Comparative performance of Wheat in between power seeder and traditional production method (Puspapara, Pabna, 2004-05)

Method	No. of monitored farmers	Area covered (ha)	Grain yield (t/ha)	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Seeding with power seeder	3	1	4.30	51075	12800	38275	3.99
Traditional broadcast method	3	1	2.38	28325	14100	14225	2.01

Table 3. Comparative performance of Wheat in between power seeder and traditional production method (Narikeli, Jamalpur, 2004-05)

Method	No. of monitored farmers	Area covered (ha)	Grain yield (t/ha)	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Seeding with power seeder	6	1.50	3.85	36845	16795	23900	2.19
Traditional broadcast method	6	1.50	3.26	31365	18560	16065	1.69

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FIELD PERFORMANCE EVALUATION OF POWER TILLER OPERATED FLUTED TYPE SEEDER IN MLT SITE, FARIDPUR

Introduction

Line sowing of jute, wheat, paddy, pulses and oilseeds contributes to higher yield and involve less cost. Still the farmers of Bangladesh are practicing traditional broadcast method of sowing for those crops. To take the full advantages of the sowing, a weeder of good performance is also very important which can reduce weeding cost significantly. Considering all these, BARI has developed a fluted type power tiller operated multicrop seeder and a upland weeder. The seeder has been tested for sowing wheat, paddy and mungbean at BARI experimental plot, Joydebpur, Gazipur. The performance of the seeder is satisfactory. Now it needs to be tested in farmers field at different soil type and field condition.

Materials and Methods

The experiment was conducted at Ishan Gopalpur, Faridpur during 2003-04. The design was BCB with 3 dispersed replications. The unit plot size was 15m x 10m. Spacing between line to line 20cm in solid line with 120 kg seed/ha. Fertilizer dose was 200-160-50-100-7.5 kg Urea-TSP-MP-Gypsum-Boric acid/ha. The variety was Protiva. The crop was sown on 6 December 2003. The treatments were T_1= only BARI seeder/Chinese Seeder, T_2= One ploughing by power tiller + BARI Seeder/Chinese Seeder & T_3 = Farmers practice. Three irrigations were given. The crops were harvested on 23 March 2004.

Expt. 1. Field performance evaluation of wheat by power tiller operated fluted type BARI developed seeder

Results

Higher plants/m^2 was obtained from treatment T_2 which was followed by T_1 and T_3. Similar trend was followed in case of spike/m^2. Plant height was almost similar in all the treatments. Similar trend was followed in grains/spike and 100-grain wt. Higher grain yield almost about 15 & 8% were obtained from T_2 & T_1 than T_3 (FP).

Table 1. Plant/m^2 yield & yield attributes of wheat (Faridpur, 2003-04).

Treatment	Plant height (cm)	Plant population/ m^2 (no.)	No. of spike/m^2	Grain/s pike	1000 wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
T_1= (Seeds sown by BARI seeder	96.2	188	299	39	36.1	2.8	5.3
T_2= One ploughing by power tiller + BARI seeder	96.8	196	329	37	35.6	3.0	5.8
T_3=Farmers practice	95.3	167	269	39	35.3	2.6	4.9
CV (%)	8.4	9.2	12.4	6.3	7.9	10.5	13.6

Expt. 2. Field performance of wheat by power tiller operative fluted type Chinese seeder

Plant height was almost similar in all the treatment. Plant population/m^2 was higher in treatment T_1 and lowest from farmer practice. But spikes/m^2 was also highest from treatment T_1 and other two treatments were similar. Grain/spike almost similar in treatment T_1 and T_2 whereas slightly lower from treatment T_3. Grain weight did not influence the treatments. Grain yield was almost similar in treatment T_2 and T_1 which was 11 and 9% higher than FP. Straw yields were not significantly influenced by different practice.

Table 2. Plant /m^2 yield & yield attribute of wheat (Faridpur, 2003-04)

Treatment	Plant height (cm)	Plant populatio n/m^2 (no.)	No. of spike/m^2	Grain/s pike	1000 wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
T_1= (Seeds sown by Chinese seeder	89.4	198.7	280	41	38.8	3.12	5.4
T_2= One ploughing by power tiller + Chinese seeder	90.5	150.0	266	41	38.9	3.16	5.5
T_3=Farmers practice	90.4	118.7	261	37	38.7	2.82	5.3
CV (%)	8.6	13.4	14.5	7.3	7.4	8.6	12.3

Farmers' reaction

Farmers were very much impressive to see the performance of BARI seeder & Chinese seeder.

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ON-FARM ADAPTIVE TRIAL OF ADVANCED LINES OF RAPESEED (*Brassica napus)*

Abstract

The experiment was conducted at farmer's field near RARS, Rahmatpur, Barisal, Jamalpur, Chatmohar, Pabna, Fatikchari, Chittagong & Chowgacha, Jessore during rabi 2002-2004 to evaluate the performance of two *Brassica napus* lines (Nap-179 and Nap-198) along with a variety (BARI Sarisha-8) as check. The line Nap-179 produced the higher grain yield with bolder size in all the sites except Chowgacha where significantly highest yield from BARI Sarisha-8.

Introduction

Mustard is one of the important edible oil crops in Bangladesh. It tops the list in respect of area and production among the oil crops grown in the country. Mustard covers about 3.40 lakh hectares of land and produced about 2.46 lakh tons of seeds every year. It's per hectare yield is about 740 kg (Mondal, 2001). In Bangladesh two species of *Brassica,* viz. *Brassica campestris* and *Brassica juncia* are mainly grown for oil purpose. But yield potential of *Brassica napus* is higher than the other two species. Bangladesh Agricultural Research Institute has already released two varieties of *Brassica napus* and developed another two lines named Nap-179 and Nap-198. Now it is necessary to test the lines in different region under farmers' condition. So, the present study has been undertaken to evaluate the yield performance of the lines and to know the farmers' reactions about the new lines.

Materials and Methods

The experiment was conducted at farmers' field near RARS, Rahmatpur, Barisal, FSRD, Jamaalpur, Chatmohar, MLT site, Pabna, Fatikchari, Chittagong and Chowgacha, Jessore during rabi, 2003-2004. The trial was laid out in RCB design with four replications. Unit plot size was $5x4m^2$. Two *napas* line viz. Nap-196 and Nap-179 along with BARI Sarisha-8 were tested in the study. Fertilizers were applied at the rate of 135-35-45-30 kg NPKS kg/ha. Entire quantities of P,K,S along with 50% N were applied at the time of final land preparation. The rest N was applied as topdressing at 21 days after sowing. The seeds were sown maintaining 30cm line to line spacing on 20 November at Barind, 9-14 November, Jamalpur, 7 November, Pabna, 8-17 December, Chittagong and 6 November, Jessore. Thinning was done keeping 5cm plant to plant distance. All the plots were weeded twice at 20 and 40 days after seeding. Insecticide was applied twice to control aphids. The crops were harvested during 06 March, 2004 at Barisal, 22 February to 9 March at Chittagong. Yield and yield contributing parameters were recorded from 10 randomly selected plants in each plot avoiding border effect. The collected data were analyzed statistically.

Results and discussion

Rahmatpur, Barisal

The yield and yield contributing parameters of the tested mustard genotypes are presented in table-1. There was no significant difference in plant height and plant/m2 among the genotypes/variety. Branching habit of Nap-179 was significantly higher than Nap-198 and BARI Sarisha-8. Pod bearing was significant higher in Nap-198 than other two line/variety. Number of seed per pod was higher in Nap-179 than the other two genotype/variety. The line Nap-198 and Nap-179 produced bolder size grain than BARI Sarisha-8. Grain yield of Nap-179 was significant higher than BARI Sarisha-8 and Nap-198. It was observed that production of unfilled pods was increased with increasing temperature. Severe shattering of mature pods was found in all the genotypes. These may be the cause of lower yield than their potentiality.

Narikeli FSRD site, Jamalpur

Maturity, pods/plant and seed yields were significantly influenced by line/variety. But plant height, plant/m2, seed/pod and 1000-seed weight were statistically identical. BARI Sarisha-8 showed higher pods/plant which was statistically identical to Nap-198. But higher seed yield was recorded from Nap

198 which was statistically at par to BARI Sarisha-8. BARI Sarisha-8 took 2 days less time than both the line (Table 2).

Chatmohar, Pabna

Plant height, pods/plant and seed yields were significantly influenced by variety/line. Days to maturity, plant/m^2, seeds/pod and 1000-seed weight were not significantly influenced by the treatment. BARI Sarisha-8 showed higher plant height which was statistically identical to Nap-198. Significantly highest pods/plant was obtained from Nap-198 which reflected the seed yield of Nap-198. The line Nap-198 showed significantly highest yield and 48% higher yield than BARI Sarisha-8 (Table 3).

Fatickchari, MLT site

Variety/line significantly influenced plant/m^2, plant height, pods/plant, seeds/pod and seed yield (Table 4). Significantly higher plant height and plants/m^2 were recorded from Nap-198. Similar trend was followed in case of pods/plant. Both the line showed similar seeds/pod. Significantly highest seed yield was recorded from Nap-198 due to more no. of pods/plant and seeds/pod.

Chowgacha, MLT site

Plant height, seeds/pod, 1000-seed weight and grain yields were significantly influenced by variety/line. Plant/m^2, branch/plant, pods/plant & straw yields were statistically similar in respect of variety/line (Table 5). The line Nap-198 and BARI Sarisha-8 showed similar in height & higher than Nap-179. Significantly highest seeds/pod were recorded from Nap-198 but highest seed yield was obtained from BARI Sarisha-8. Both the line failed to show higher yield than existing variety BARI Sarisha-8.

Farmers' Reaction

From Barisal it is reported that a huge number of unfilled pods in the upper part of the plants and sever shattering of pods in all the genotypes discourage the farmers' to store the seeds for further use. But they opined that grain size of the lines is bolder than their local variety and also higher yield in Nap 198 in all the site except Jessore.

The experiment should continue another year in all sites for confirmation.

Table 1. Yield and yield contributing characters of mustard varieties at Rahmatpur, Barisal, 2003-04

Treatment	Plant height (cm)	Plant/ m^2	Days to 80% maturity	Crop duration (day)	Branch/ plant	Pod / plant	Seed/ pod	1000 grain wt. (gm)	Grain yield (t/ha)
Nap-198	87.75	74	101a	96a	4.95b	76a	14.05ab	3.51a	1012b
Nap-179	93.75	78	95b	93b	5.00a	60b	14.68a	3.35a	1235a
BARI Sarisha-8	82.50	69	94b	94ab	3.70c	52c	13.15b	3.28b	828c
CV(%)	10.79	5.06	0.49	1.0	6.04	8.42	5.33	2.38	6.56

Table 2. Plant height, plant/m^2, yield & yield attributes of rape seed mustard (Narikeli, Jamalpur 2003-04)

Line/variety	Plant height (cm)	Maturity (days)	Plant/m^2	Pod/plan t	Seed/ pod	1000- seed wt. (g)	Seed yield (kg/ha)
Nap-179	98.9	92a	76.6	47b	20	4.00	1705b
Nap-198	92.5	92a	72.0	69ab	19	4.0	1892a
BARI Sarisha-8	88.9	90b	75.6	78a	20	3.70	1789ab
CV(%)	8.77	8.52	8.92	9.14	6.94	4.88	5.54

Table 3. Plant characters, yield and yield contributing characters of tested lines/varieties (Chatmohar, Pabna 2003-04)

Treatment	Days to 80% Maturity	Plant population m^2 (no.)	Plant height (cm)	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	1000- seeds wt. (g)	Seed yield^{-1} (t/ha)
BARI Sarisha-8	82.25	36.00	90.00a	35.50b	19.00	3.20	0.87c
Nap-179	82.25	36.00	87.00b	37.25b	21.00	3.23	1.07b
Nap-198	83.00	35.75	88.50ab	61.50a	23.25	3.15	1.65a
CV(%)	1.00	2.70	1.60	6.30	13.00	2.20	3.50

Table 4. Yield and yield attributes of rape seed lines and variety at Fatickchari MLT site, Chittagong in 2003-04.

Variety/line	Plants/m^2 (no.)	Plant height (cm)	Pod/plant (No.)	Seed/pod (No.)	1000 seed wt. (g)	Seed yield (Kg/ha)
Nap-179	136b	89.13b	70.35c	23.98a	3.17	1230c
Nap-198	161a	100.42a	108.30	25.90A	3.28	1850a
BARI Sarisha-8	143b	87.69b	91.18b	23.17b	3.18	1445b
CV%	5.02	4.32	8.01	4.74	5.10	7.64
LSD (0.05)	12.75	6.911	12.47	1.99	NS	105.0

Table 5. Performance of yellow seeded advanced lines of rape seed at MLT site, Chowgacha, Jessore during rabi 2003-04.

Entries	Plant Pop/m^2 (no.)	Plant height (cm)	Branches/ plant (no.)	No. of pods/ plant	No. of seeds/ pod	1000- seed wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Nap-179	26.50	94.78b	4.93	180	26b	3.65b	1.68b	3.97
Nap-198	25.50	99.85a	4.95	182	26b	3.90a	1.71b	4.09
BARI Sarisha-8	25.25	98.53a	4.98	194	28a	3.75b	1.81a	4.10
CV(%)	3.10	1.02	3.25	3.89	3.18	1.98	1.74	2.76

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ON-FARM ADAPTABILITY TRIAL OF LINES OF TURNIP RAPE (*Brassica campestris)*

Abstract

The experiment was conducted in medium high land at FSRD site of BARI, Palima, Jessore, Tangail, Pabna, Chittagong, Jamalpur and Manikganj during rabi 2003-04 to evaluate the performance of advanced promising variety/lines of turnip rape mustard under farmer's field condition. Among the tested variety/lines OTBC-1097 gave the significant higher grain yield at Pabna & Tangail. The variety BARI-9 and OTBC-2193 gave the statistically similar grain yield. At Manikganj two lines showed similar yield and higher than BARI Sarisha 9. The results showed that BARI Sarisha-9 was 5-9 days earlier than two lines. At Jamalpur variety/line did not influence the seed yield.

Introduction

Bangladesh have 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 yield potential of local varieties and its poor management practices. Oil Seed Research Centre (ORC) of BARI has developed some advanced promising varieties/lines of rape-mustard which possess the high yield and less diseases susceptible and high oil content (44%). Hence, the study was undertaken to evaluate the performance of advanced lines under farmer's field condition will be released as variety.

Materials and Methods

The trial was conducted at FSRD site, Palima, Tangail, Kashinathpur MLT site Pabna, Bagerpara, Jessore, Fatickchari, Chittagong, Jamalpur and Manikganj during rabi 2003-2004 in farmer's field. The design of the experiment was RCBD with three replications. Tested variety/lines were BARI Sarisha-9, OTBC-2193 and OTBS 1097 (yellow). Plot size was 6m x 4m. The seed rate was 7 kg/ha. Seeds were sown on 6th November, 2003 at Tangail, 8 November, 2003 at Pabna, 15 November at Jessore, 8-11 November Fatickchari, Chittagong, 9-14 November 2003, at Jamalpur and 19-20 November 2003 at Manikganj. Fertilizer doses were 120-34-45-29-4-2kg NPKSZnB/ha. The spacing was 30cmx5m. All fertilizers were applied as basal except urea. Urea was applied as top dress on 20 and 45 days after sowing (DAS), respectively followed by crop. One weeding cum thinning was done on 18 DAS. The crops were harvested variety wise during 24-28 January, 2004 at Tangail, 2-8 Feb. at Pabna, 12 Feb., at Jessore, 22 Feb. to 9 March 04 at Chittagong, 5-9 Feb. 04 at Jamalpur and 12-14 February 2004 at Mainkganj. The data on different plant characters and yield components were collected from 10 plants selected at random in each plot and yield was recorded plot wise. Data were analyzed statistically using MSTATC package.

Results and discussions

FSRD site, Pabna, Tangail

Plant height, days to maturity, yield and yield attributes were significantly influenced by different lines/variety. The result showed that BARI Sarisha-9 was 05 days earlier than OTBC 2193 and 02 days earlier than OTBC 1097. No significant variation was observed in plant population/m2. The result showed that significant highest plant height was observed from OTBC 2193 where as shorter plant height was shown in variety BARI Sarisha-9 which was statistically similar to OTBC 1097. The line OTBC 2193 showed significantly the highest number of branch/plant. The significant highest length of pod was obtained from the line OTBC 1097. There was no significant difference among the variety/line but the higher number of pod/plant was recorded from the variety BARI Sarisha-9. The line OTBC 1097 showed the highest number of seeds/pod, which was significantly different from other variety/line. The tested lines and variety revealed statistically similar 1000 grain weight. The line OTBC 1097 showed statistically significant higher grain yield and BARI Sarisha-9 and OTBC 2193 showed statistically similar grain yield which were lower than former one.

Kashinatpur, MLT site, Pabna

Plant/m^2, plant height, yield and yield attribute were significantly influenced by different line/variety. The OTBC 2193 and BARI Sarisha-9 were statically similar height & higher than OTBC 1097. Significantly highest pods/plant was obtained from BARI Sarisha-9 and lowest from OTBC 1097 but OTBC 1097 but OTBC 1097 showed significantly highest seed/pod and others two treatments were similar. Similar trend was followed in case of 1000-seed weight. Significantly highest seed yield was recorded from OTBC 1097 and lowest from OTBC-2193. The line OTBC 1097 showed 17% higher seed yield than BARI Sarisha-9.

Bagherpara, Jessore

Plant height, pod/plant and seeds/pods were significantly influenced by line/variety. Plant/m^2, branches/plant 1000-seed weight and seed yield were not significantly influenced by variety/line. Significantly highest pod/plant was recorded from OTBC 1097. Similar trend was followed in case of seeds/pod. The line OTBC-2193 and OTBC 1097 showed similar yield and higher yield than BARI Sarisha-9.

Fatickchari, MLT Chittagong

Plant/m^2, pod/plant, seed/pod and seed yield were significantly influenced by variety/line. But plant height and 1000-seed weight were not significantly influenced by the treatment. Significantly highest plant/m^2 was obtained from line OTBC2193. But pod/plant between OTBC 2193 and BARI Sarisha-9 showed similar & higher than OTBC 1097. The two lines revealed similar number seed/pod and higher than BARI Sarisha-9. Significantly highest seed yield was obtained from line OTBS 2193 which was 7.4% higher than BARI Sarisha-9.

Narikeli FSRD site, Jamalpur

Plant height, maturity, pods/plant seed/pod were significantly affected by variety/line. Significantly highest plant height was recorded from OTBC 2193. Plants/m^2, 1000-seed weight and seed yield were statistically identical. Significantly highest pod/plant was obtained from OTBC 2193 and other two treatments were similar. The two advance lines did not exceed the yield of BARI Sarisha-9.

Manikganj

Plant height, branches/plant and seed yields were significantly influenced by variety (Table 6). Branches/plant, plants/m^2, pods/plant seeds/pod and 1000-seed weight were statistically identical. The line OTBC 2193 and BARI Sarisha 9 were statistically at par and higher than OTBC 1097. The BARI Sarisha 9 took 5 days less than the other varieties/line. The lines OTBC 1097 and OTBC 2193 showed similar yield and higher than BARI Sarisha 9.

Farmer's reaction

Farmers expressed their satisfaction with high yield of line OTBC 1097. They also satisfied with uniform maturity but BARI Sarisha-9 had the advantage of earliness.

Conclusion

One year result showed that line OTBC 1097 showed higher yield at Tangail and Pabna but OTBC 2193 at Fatickchari, Chittagong. But two lines showed similar yield at Jessore. In all the three sites, both the line showed higher yield than BARI Sarisha-9 but at Jamalpur two advanced line did not influence the yield over BARI Sarisha-9. The experiment needs to be continued another year for confirmation.

Table 1. Plant characters, yield and yield contributing characters of Turnip rape varieties at FSRD site, Palima, Tangial during 2003-04

Variety/line	Days to maturity	Plant height (cm)	Pop. /m^2	No. of branch /plant	Length of pod (cm)	No. of pod/ plant	No. of seeds/ pod	1000 seed wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
OTBC2193	85.50a	1096a	90.55	5.20a	4.80b	83.90a	15.10c	3.05	1.21b	3.57
OTVC1097	83.00b	97.00b	87.47	4.40b	5.15a	78.60a	29.65a	3.05	1.75a	3.30
BARI Sarisha 9	80.25c	93.60b	89.72	4.65b	4.85b	85.95a	18.30b	2.90	1.37b	4.12
CV(%)	1.01	2.58	3.19	3.06	2.87	11.17	7.86	5.77	13.46	17.06

Table 2. Plant characters, yield and yield contributing character of Turnip Rape Seed (Kashinathpur, Pabna)

Treatment	80% maturity	Plant Pop.\ m^2 (no.)	Plant height (cm)	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	1000-seed wt. (g)	Seed yield^{-1} (g)
OTBC1097	90	56.88b	95.48b	61.00c	26.49a	4.00a	1.95a
OTBC 2193	86	63.63ab	112.95a	86.75b	12.46b	3.25b	1.38b
BARI Sarisha 9	84	70.13a	108.45a	98.28a	12.61b	3.13b	1.62b
CV(%)	-	10.60	5.60	6.60	8.30	4.30	8.7

Table 3. Plant height, plant/m^2, yield and yield contributing characters of turnip rape, Chowgacha, Jessore during rabi 2003-04

Variety/line	Plant height (cm)	Plant pop. /m^2 (no.)	Branches/ plant (no.)	Pods/plant (no.)	Seeds/ pod (no.)	1000- grain wt. (g)	Seed yield (t/ha)
OTBC2193	105.75	86.75	6.70	124.25	17.25	3.55	2.37
ITBC1097	83.25	81.00	6.50	71.75	30.50	3.62	2.36
BARI Sarisha-9	107.00	66.50	7.25	161.25	16.50	3.55	2.14
CV (%)	11.36	18.36	6.00	11.58	7.26	7.02	9.36
LSD (0.05)	19.39	NS	NS	23.85	2.69	NS	NS

Table 4. Plant/m^2 yield and yield attributes of turnip rape lines and variety at Fatickchari MLT site in 2003-04

Variety/line	Plant pop. /m^2 (no.)	Plant height (cm)	Pod/plant (no.)	Seed / pod (no.)	1000 Seed wt. (g)	Seed yield (kg/ha)
OTBC1097	122b	84.65	60.22b	23.42a	2.83	1275b
OTBC2193	138a	85.95	89.47a	22.90a	2.70	1355a
BARI Sarisha-9	125 b	87.6	81.28a	18.17b	2.72	1000b
CV(%)	6.72	6.28	9.98	7.48	3.95	7.6
LSD (0.05)	14.95	NS	13.30	2.77	NS	169.7

Table 5. Plant height, maturity, yield and yield attributes of turnip rape seed (Narikeli, Jamalpur 2003-04)

Variety/line	Plant height (cm)	Plant /m^2 (no.)	Maturity (days)	Pods/plant (no.)	Seeds/ pod (no.)	1000- grain wt. (g)	Seed yield (t/ha)
OTBC2193	91.7b	76.7	79b	58c	29a	4.10	1455
ITBC1097	103.7a	79.6	83a	143a	17b	4.00	1392
BARI Sarisha-9	94.2b	83.0	81ab	100b	15b	4.10	1465
CV (%)	8.15	12.56	6.82	12.08	13.77	5.28	NS

Table 6. Plant height, yield and yield contributing character of yellow seeded mustard at MLT site, Manikganj, 2003-04

Variety/line	Days to maturity	Plant height (cm)	Pop. /m^2	No. of branch /plant	No. of pod/ plant	No. of seeds/ pod	1000 seed wt. (g)	Seed yield (t/ha)
OTBC2193	62	0.93a	59.5	10.25	56.5	9.0	3.22	1.04ab
OTBC1097	86	0.79b	56.0	7.25	43.5	23.0	3.00a	1.14a
BARI Sarisha 9	81	0.88a	49.0	8.75	41.5	9.0	3.17	0.92b
CV(%)	-	4.52	16.3	23.48	21.51	18.58	6.59	7.05

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ON-FARM ADAPTABILITY TRIAL OF YELLOW SEEDED ADVANCED LINES OF MUSTARD (*Brassica juncea)*

Abstract

The experiment was conducted in medium high land at FSRD site of BARI, Palima Tangail, Jessore, Pabna, Patuakhali, Jamalpur and Manikganj during rabi 2003-2004 to evaluate the performance of advanced promising lines of yellow seeded mustard under farmer's field condition. Among the tested variety/lines BJ-11 gave higher grain yield in all the sites except Patuakhali. Where BJ-66 gaves significantly higher yield. At Jamalpur both the line/variety showed similar yield.

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 yield potential of local varieties and its poor management practices. Oil Seed Research Centre (ORC) of BARI has developed some advanced promising lines of yellow seeded mustard which possess the high yield and less diseases susceptible and high oil content. Hence, the study was undertaken to evaluate the performance of advanced lines under farmer's field condition will be released as variety.

Materials and Methods

The trial was conducted at FSRD site, Palima, Tangail, Jessore, Pabna, Patuakhali, Jamalpur and Manikganj during rabi 2003-04 in farmer's field. The design of the experiment was RCBD with three replications. Tested variety was Daulat as a check and two advanced lines were BJ-11 (Y) and BJ-66 (Y). Plot size was 6mx4m. The seed rate was 7 kg/ha. Seeds were sown on 7th November, 2003 at Tangail, 7-10 November, Pabna, 22-30 November Patuakhali and 9-14, November, 03 at Jamalpur and 19-20 November 2003 at Manikganj. Fertilizer doses were 260, 170, 90, 160, 5 and 10 kg/ha of Urea, TSP, MP, Gypsum, Zinc oxide and boric acid respectively. All fertilizers were applied as basal except urea. Urea was applied as top dress on 20 and 45 days after sowing (DAS), respectively. One weeding cum thinning was done on 18 DAS. The crops were harvested variety wise during 1st week of February, 2004 at Tangail, 22-25 February, Pabna, 22-23 February, Patuakhali, 5-9 February at Jamalpur and 26-27 February 2004 at Manikganj. The data on different plant characters and yield components were collected from 10 plants selected at random in each plot and yield was recorded plot wise. Data were analyzed statistically using MSTATC package.

Results and Discussions

Palima, Tangail

Plant height, days to maturity, yield and yield attributes were significantly influenced by different liens/variety. The result showed that BJ-11(Y) and BJ-66(Y) were 05 days earlier than Daulat. No significant variation was observed in plant population/m2. The result showed that significant highest plant height (1.59 m) was observed in BJ-11(Y)) whereas shorter plant height was shown in variety Daulat. Number of pod/plant was insignificant among the lines, but the higher number of pod/plant was recorded from the Bj-66(Y). The same trend was also observed in number of seeds/pod. The tested lines and variety revealed statistically similar results in case of 1000 grain weight and stover yield. Statistically significant grain yield (1.51 t/ha) was obtained from the line BJ-11(Y) and Daulat gave the lowest (1.31 t/ha). Stover yield did not influence by variety/line.

Chatmohor, MLT site, Pabna

General performance of the crops was poor at later stage due to severe cold during late December to 1st week of January, 2004. The maturity days showed 3 days earlier in BARI Sarisha-9 than other two lines. Plants/m^2, seed/pod and seed yields were not significantly influenced by variety/line. Pods/plant showed higher from BJ-66 but statistically at par to BJ-11 and higher than Daulat. Significantly highest 1000-seed weight was recorded from Daulat & lowest from BJ-66.

Chowgacha MLT site, Jessore

Plant height, pod/plant, seed/pod, 1000-seed weight was grain yields were significantly influenced by variety/line. Plant/m^2, branches/plant, seed/pod and straw yield were statistically at par. Plant height showed similar in Daulat and BJ-66 but higher than BJ-11. Similar trend was followed in pods/plant. But BJ-11 and Daulat revealed similar in seed weight & higher than BJ-66. Similar trend was noticed in case of grain yield. Two advanced line did not exceed the yield of BARI Sarisha-9.

Lebukhali, Patuakhali FSRD site

Plant/m^2 was not significantly influenced by variety/line but plant height, yield attributes & seed yields were significantly influenced by the treatment (Table 3). Significantly highest plant height was recorded from BJ-66 & other two varieties/lines were similar. Similar trend was followed in case of pods/plant. But significantly highest seed/pod was recorded from BJ-66. Seed yield was also significantly highest from BJ-66 due to more number of pod/plant & 1000-seed weight.

Narikeli, Jamalpur, FSRD site

Plant highest, plant/m^2, seeds/pod and seed yields were not significantly influenced by variety/line (Table 4). Significantly highest pod/plant was recorded from Daulat and other two lines/varieties were statistically at par. Both the lines were statistically identical in 1000-seed weight. Seed yield were not significantly influenced by line/variety. Slightly higher yield was recorded from BJ-11 and 7 to 8 days less time required maturing in both the line than Daulat.

Manikganj MLT site

Plant height and plants/m2 were significantly influenced by variety/line whereas other characters were insignificant (Table 1). The line BJ-11 showed 2 days earlier than other variety/line. Plants/m^2 was similar in BJ66 and Daulat whereas lower plants were obtained from BJ11. Both the line showed similar height and higher than Daulat. Seed yields were statistically similar but slightly higher in line BJ-11 than other varieties/line.

Farmer's reaction

Some leaf spots are found in BJ-11 line in late stage at Pabna site. Farmers were shown keen interest about new line but need move investigation before releasing the variety.

The experiments should be repeated in another year in all sites.

Table 1. Yield and yield contributing characters of yellow seeded advanced lines/varieties of mustard at FSRD site, Palima, Tangail during 2003-04

Variety/line	Days to maturity	Plant height (m)	Pop. /m^2	No. of pod/plant	No. of seeds/ pod	1000 grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
Daulat	95	1.39c	80.75	182.9b	13.35b	2.37	1.31c	5.37
BJ-66(Y)	90	1.46b	84.00	187.4a	14.75a	2.50	1.40b	5.50
BJ-11(Y)	90	1.59a	88.25	186.4a	14.25a	2.45	1.51a	5.37
LSD (0.05)	-	0.05	13.83	2.96	0.70	0.48	0.05	1.74

Table 2. Plant characters, plant/m2 yield and yield contributing character of yellow seeded mustard (Chatmohar, Paba, 2003-04)

Variety/ line	Flowering (days)	Maturity (days)	Plant pop. plot^{-1} (no)	Plant height (cm)	Pods plant^{-1} (no.)	Seeds pod-^{1} (No.)	1000-seed wt. (g)	Seed yield^{-1} (t/ha)
BJ-11	44.00a	93a	30.75	175.5a	139ab	11.75	2.73b	0.75
BJ-66	44.25a	93a	30.50	174.25a	144a	13.00	2.60c	0.78
Daulat	40.25b	90b	30.75	159.50b	132b	13.25	2.95a	0.82
CV(%)	3.90	0.90	3.40	2.70	4.4	9.60	1.8	6.10

Table 3. Plant/m^2, yield and yield contributing characters of mustard varieties/lines at MLT site, Chowgacha, Jessore during rabi 2003-04

Variety/line	Plant pop. /m^2 (no.)	Plant hegith (cm)	Branches/ plant (no.)	No. of pods/plant	No. of seeds/ pod	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BJ-11	23.25	161.15b	5.45	461.06b	14.85	2.63a	1.39a	4.49
BJ-66	24.50	168.90a	5.43	510.28a	15.70	2.35b	1.27b	4.55
Daulat	24.00	173.50a	5.47	514.16a	15.18	2.63a	1.36a	4.53
LSD(0.05)	NS	5.58	NS	27.85	NS	0.09	0.08	NS
CV(%)	2.51	1.92	1.96	3.25	2.82	2.18	3.65	2.7

Table 4. Plant/m^2 yield and yield contributing characters of yellow seeded mustard variety/line (Lebukhali, Patuakhali 2003-04)

Variety/line	Plant Pop. / m^2	Plant height (cm)	Pods/plant	Seeds/pod	1000 seed weight (gm)	Yield (Kg/ha)
Daulat	55.5	138.5b	55.25b	12.00a	2.7b	1003b
BJ-66	54.5	144.5a	57.00a	11.25b	3.5a	1165a
BJ-11	56.5	136.5b	54.75b	11.25b	2.9b	1017b
CV (%)	10.50	7.65	5.06	4.50	4.44	9.08

Table 5. Maturity, plant height, yield & yield attributes of yellow seeded mustard variety/line (Narikeli, Jamalpur, 2003-04)

Variety/line	Maturity (days)	Plant/m^2	Plant height (cm)	Pod/plant	Seed/pod	1000-seed wt. (g)	Seed yield (kg/ha)
BJ11	94b	72.3	128.8	97b	13	3.1ab	1808
BJ-66	93b	73.3	132.2	111b	12	3.2a	1778
Daulat	101a	70.0	126.9	166a	13	2.9b	1750
CV(%)	3.60	8.28	6.92	7.95	NS	4.14	6.28

Table 6. Maturity, plant height, yield & yield attributes of yellow seeded mustard variety/line (Manikganj, 2003-04)

Variety/line	Maturity (days)	Plant/m^2	Plant height (cm)	Pod/plant	Seed/pod	1000-seed wt. (g)	Seed yield (kg/ha)
BJ11	97	44.25b	1.33a	81.75	10.5	2.39	1.21
BJ-66	99	53.25a	1.35a	80.00	10.5	2.34	1.16
Daulat	99	51.00ab	1.27b	78.25	9.5	2.47	1.03
CV(%)	-	10.07	2.93	11.17	13.91	5.37	9.21

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ON-FARM ADAPTIVE TRIALOF ADVANCED LINES OF GROUNDNUT

Abstract

The experiment was conducted at farmers' filed at Katiadi MLT site, Kishoregonj during December 2003 to May, 2003 to evaluate to the performance of developed and advanced lines and local (JX-87015SL, ICGV-94322, BARI Badam 6 and Dhaka-1) were tested. The variety BARI Badam 6 significantly the highest yield pod yields among the varieties/lines.

Introduction

Ground nut (*Arachis hypogaea*) is an important oilseed crop. In Bangladesh, it occupies third place in respect of area and production. At present, in rabi and kharif seasons a total of 36 thousand hectare of land is under groundnut cultivation. Groundnut seed contains 48-52% oil and 24-26% protein. Groundnut is mainly consumed as roasted nut and as a confectionery item. Oilseed Research Centre, BARI has released a number of groundnut varieties and advanced line. These developed and advance lines need to be disseminating among the farmers field to evaluate the performance of these varieties and lines. Hence, the study was undertaken to compare the lines with existing variety.

Materials and Methods

The experiment was conducted at farmers field under Katiadi MLT site, Kishoregonj during December 2003 to May 2004 to evaluate the performance of some varieties/line (JX--87015SL$_1$ ICGV-94322, BARI Badam 6, Dhaka-1) of groundnut under farmer's condition were tested. The experiment was conducted in RCB design with four dispersed replications. The groundnut varieties were sown at 8-9 December 2003 and harvested 6-28 May 2004. The unit plot size was 6m x 5m with spacing 30 cm x l0 cm. Seed rate was 100 kg/ha. Fertilizer dose was 12-32-43-54-1 kg/ha of NPKSB, respectively and applied as basal. Intercultural operation such as irrigation, weeding and earth up were and plant protection measures were done properly. Slightly incidence of disease and insect attack was found in experimental plot. The crop was harvested variety wise on 2-28 May, 2004. The data of yield components were collected from 10 plants selected at random in each plot and pod yield was recorded plot wise. The collected data were analyzed statistically and means were separated with LSD test.

Results and Discussion

Yield and yield attributes of groundnut varieties were presented in Table 1. The result showed that plant height, pod/plant, kernel/pod, 100-kernel wt., shelling percentage and pod yield were significantly different in groundnut varieties/line (Table 1). The highest plant height and kernel/pod was recorded from JX-87015 SL which was statistically different from other varieties. Local variety (Dhaka-1) showed significantly the highest pods/plant which was statistically different from other varieties/line. Significantly the highest 100-kernel weight and pod yields were recorded from variety BARI Badam-6 which was statistically different from other varieties. Significantly highest pod yield (4.01 t ha^{-1}) was obtained from BARI Badam-6. BARI Badam-6 gave the highest pod yield due to higher 100-kernel weight. The highest gross return (Tk. 120444 ha^{-1}) and benefit cost ratio (2.60) was recorded from BARI Badam-6.

Farmer's reaction

Farmer's of MLT site, Katiadi opined that there was incidence of insect and diseases in the new varieties. They also opined that the yield of BARI Badam-6 was higher than other variety. Farmers preferred ICGB-94322 due to its taste and pod size and colour.

Table 1. Performance of yield and yield contributing characters varieties and advanced lines of groundnut at Katiadi MLT site, Kishoregonj, 2003-04

Variety/line	Days to maturity	Plant height (cm)	Pod/plant (no.)	Kernel/pod (no.)	100-kernel wt. (g)	Shelling %	Pod yield (t/ha)
JX-87015SL	170a	74.70a	17.27c	3.03a	31.67c	68b	2.71d
ICGV-94322	159b	48.70c	19.20bc	1.87c	38.00b	75a	2.98c
Dhaka-1	144c	55.13b	25.87a	1.93c	29.00d	77a	3.28b
BARI Badam-6	159b	53.17bc	21.60b	2.43b	41.67a	75a	4.01a
LSD (0.05)	2.13	5.35	2.70	0.25	2.18	4.15	0.096
CV (%)	0.68	4.62	6.44	5.43	3.12	2.81	2.06

Figures in a column having similar letter (s) do/does not differ significantly at 5% level of significance.

Table 2. Cost and return analysis of groundnut varieties and lines developed by BARI tested at MLT site, Katiadi during 2003-04

Variety	Gross return (Tk ha^{-1})	Total Variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
JX-87015SL$_1$	81375	46345	35030	1.76
ICGV-94322	89444	46345	43099	1.93
Dhaka-1	98430	46345	52085	2.12
BARI Badam-6	120444	46345	74099	2.60

Price:	Tk./kg
Groundnut (pod)	30.00

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ON-FARM ADAPTIVE TRIAL OF INTERCROPPING GROUNDNUT WITH GARLIC AND ONION

Abstract

An experiment was conducted at Kashinatpur MLT site of Pabna during radi season of 2003-04 to verify the performance of onion and garlic as intercrop with groundnut. The garlic intercropped with two rows produced the highest return of Tk. 121500 with the highest land equivalent, ratio (LER) of 1.97. All the intercropped system earned higher return and LER than sole crop (groundnut).

Introduction

Groundnut is a long duration slow growing crop especially in rabi season. It is grown with wide row spacing, which allows long term fallowing of interspaced. 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 avertive and met the diversified farmers' needs. Thus an experiment was designed with the objectives to find out the performance of garlic and onion as intercrops with ground nut.

Materials and Methods

The experiment was conducted at MLT site Kashinathpur, Pabna during rabi season of 2003-04. The experiment was laid out in RCB design with three replications. The unit plot size was 3.6 m x 4.0 m. There was five treatments viz. T_1= Mono culture groundnut (324 plant groundnut), T_2= Groundnut iwth two rows of onion (324 plants of groundnut and 440 plant of onion), T_3= Groundnut with two rows of garlic (360 plants of groundnut), T_4= Groundnut with one row of garlic (24 plant of Groundnut and 44 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 x 15 cm in T_1, T_2 and T_4 whereas 40 cm x 10 cm in T_3 and T_5. Onion and garlic spacing was in single rows in T_2 and T_4. Between two rows of groundnut two rows of onion and two rows of garlic were planted maintaining 15cm x 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, garlic and seedlings of onion were sown/transplant on 20 & 23 November 2003 and 8 January 2004, respectively and harvested on 16 May, 22 March and 11 April 2004, respectively. Some onion seedlings were damaged and were transplanted on 3 February 2004. Plant characters were recorded and analyzed statistically.

Results and Discussion

The results revealed that the highest groundnut yield was obtained from sole crop which was statistically identical with T_3, T_4 and T_5. T_2 gave the lowest yield of groundnut. The highest return (Tk. 1215000) was recorded from T_5 and the lowest from T_1. LER was also higher in T_5. Double rows of onion and garlic in between two rows of groundnut gave higher LER than single row system. Two rows of onion and two rows of garlic gave the higher yield of onion and garlic than one rows of every crop. Yield of groundnut with tow rows of onion or garlic was higher than one rows of onion or garlic might be due to higher plant population of groundnut.

Tow rows of garlic in between the two rows of groundnut is found more profitable. The experiment needs to be continue for another year for confirmation.

Farmers reaction

Farmers opined that two rows of garlic in between two rows of groundnut was more suitable combination due to moderate yield of groundnut with additional and higher yield of garlic. They also opined that if they can plant onion bulb directly instead of onion seedling then it might be more profitable.

Table 1. Yield of groundnut, onion and garlic in different intercropping system (Kashinathpur, Pabna 2003-04)

Combination	Yield (t/ha)			Gross return (Tk./ha)	LER
	Groundnut	Onion	Garlic		
T_1	3.09a	-	-	61800	1.00
T_2	2.58b	1.32	-	64440	1.09
T_3	2.74ab	2.13	-	70360	1.14
T_4	2.78ab	-	3.30	105100	1.70
T_5	2.91ab	-	4.22	121500	1.97
CV (%)	6.3	-	-	-	-

Price = Tk./kg
Groundnut= 20.00

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ON-FARM ADAPTIVE TRIAL OF ADVANCED LINES OF SUNFLOWER

Abstract

The experiment was conducted at farmers' field near RARS, Rahmatpur, Barisal, FSRD Palima, MLT site Patuakhali and MLT site Jessore during rabi 2003-04 to evaluate the performance of two sunflower lines (ST-2250 and Sunwheat-101) along with a variety (Kironi) as check. Sunwheat-101 produced the highest grain yield at Barisal and Patuakhali but at Jessore higher yield was recorded from Kironi. Yield of ST-2250 was higher at Pabna and Faridpur.

Introduction

Sunflower (*Helianthus annuus* L.) is cultivated as an oil crop in different countries of the world. It occupies 1795 acres of land with total production of 555 tons (BBS, 2000). Sunflower oil is good quality edible oil. Seeds contain 42-45% of oil and 55% linoelic acid. There is a wide scope of growing sunflower in Bangladesh and it is cultivated in the district of Rajshahi, Jessore, Kustia, Natore, Pabna, Dinajpur and Tangail. To accelerate sunflower cultivation Oil Seed Research Centre (ORC), BARI already released a high yielding composite variety (Kironi). Another two lines of sunflower named ST-2250 and Sunwheat-101 has been developed by ORC, BARI. Now, it is necessary to test the lines in different region under farmers' condition. So, the present study was undertaken to evaluate the yield performance of the lines and to know the farmers reaction about the new lines.

Materials and Method

The experiment was conducted at farmers field, Rahmatpur, Barisal, Pabna, Patuakhali and Jessore during rabi, 2003-04. The soil of the experimental plot was silty clay loam. The trial was laid out in RCB design with four replications. Unit plot size was 4x4m2. Two sunflower lines viz ST-2250 and Sunwheat-101 along with a variety (Kironi) as check was tested in the experiment. Seeds were sown 15 December 2003 at Barisal, 13 December at Pabna, 7-8 January at Patuakhali, 19 November at Jessore. Plant spacing was 50x25cm. Fertilizers were applied at the rate of 90-35-80-30 kg NPKS kg/ha. Entire quantities of P, K,S along with 50% N were applied at the time of final land preparation. The rest N was applied as topdressing in equal split at 25 and 45 days after sowing. Thinning of excess seedling was done at 15 days after emergence. All the plots were weeded twice at 20 and 40 days after seeding. Two-flood irrigation was done at growing stage and at the time of flowering. The crops were harvested on 06 April, 2004 at Barisal, 25 March 2004 at Pabna, 15 April, Patuakhali, 6 March at Jessore. Yield and yield contributing parameters were recorded from 10 randomly selected plants in each plot avoiding border effect. The collected data were analyzed statistically.

Results and Discussion

Rahmatpur, Barisal

The data on yield and yield contributing characters are presented in table 1. The results of the study revealed that significant differences were found in plant height, filled and unfilled grain/head as well as per hectare grain production. The check variety Kironi produced the tallest plants (166cm). The plants of other two lines were smaller than Kironi. The line ST-2250 produced somewhat larger size head (16cm diameter) but head diameter of sunwheat-101 was smaller (14.57cm) than Kironi (15.63cm). Sunwheat-101 produced maximum filled grains (615), which contribute to higher yield (1787 kg/ha). Unfilled seeds were found maximum (126) in ST-2250 and minimum in sunwheat-101 (69). Grain yield of St-2250 (1743 kg/ha) was also higher than Kironi (1656 kg/ha)

ARS, Pabna

Only plant height was significantly influenced by line/variety. But days to maturity, plants/m^2 and seed yield were not significantly affected by the treatment (Table 2). Plant height between ST-2250 and Kironi were statistically similar. Seed yield was very close to each other.

Lebukhali, Patuakhali

The results showed that seeds/head and seed yields were significantly influenced by the treatment (Table 3). Plants/m^2, head diameter and ton weight were not significantly influenced by the treatment. Significantly highest seed/head was recorded from sunwheat-101 which contributed higher yield. The line Sunwheat showed 9% higher yield than existing variety Kironi.

Bagerpara, FSR site, Jessore

Dia/head, filled grain/head, 1000-seed weight, yield/plan & yields were significantly affected by variety./line (Table 4). Significantly highest filled grains/head was recorded from Kironi-2 where unfilled grain/head from ST-2250. Significantly highest 1000 seed weight was recorded from Kironi-2. Similarly higher yield plant & yield was obtained from Kironi due to more no. of filled grains/head, 1000-seed weight and yield/plant.

Ishan Gopalpur, Faridpur

Plant height, 1000-grain weight and seed yield were significantly influenced by variety/line. Significantly highest plant height was recorded from sunwehat-101 and other two varieties/lines were identical. Seed weight showed highest from ST-2200 which was significantly different from ST-2250. The line ST-2250 showed significantly highest seed yield from ST-2250 and lowest from Kironi (Table 5).

Farmers reaction

Farmers opined that they are satisfied with yield of ST-2250 and sunwheat-101. But birds attacked was a major problem at the time of grain filling stage, which decrease the yield as well as increases the cost of production. Marketing is not a problem at Barisal. Farmers' stored the seeds for future use.

Conclusion

Sunwheat-101 produced the highest grain yield at Barisal and Patuakhali but at Jessore higher yield was recorded from Kironi. Yield of ST-2250 was higher at Pabna and Faridpur. The experiment was conducted only one year so another year trial is needed for confirmation.

Table 1. Plant height, yield and yield components of different sunflower genotypes tested in the experiment at Rahmatpur, Barisal

Treatment	Plant height (cm)	Head dia (cm)	Filled seed/ head (no.)	Unfilled seed/head (no.)	Seed wt. /head (g)	1000 grain wt. (g)	Grain yield/ plot (kg)	Grain yield (kg/ha)
ST-2250	142c	16.00	595a	126a	32.88	65.29	2.79	1743b
Sunwheat-101	144b	14.57	627a	69c	36.63	63.31	2.86	1787a
Kironi	166a	15.63	575b	92b	36.13	63.48	2.63	1656c
CV(%)	0.52	1.25	3.14	59.43	13.61	10.95	1.04	0.48

Table 2. Plant characters, yield and yield contribution character of sunflower lines/varieties (ARS, Pabna, 2003-04)

Line/variety	Days to flowering	Days to maturity	Plant/m^2	Plant height at harvest	Head diameter (cm)	Seed yield (t/ha)
ST-2250	71	103	7.85	141.45ab	14.90	1.65
Sunwheat-01	71	103	7.79	136.13b	13.92	1.61
Kironi-2	71	103	9.83	144.18a	14.00	1.63
CV(%)	1.6	0.6	1.1	3.2	5.3	7.5

Table 3. Plant/m^2, yield and yield attributes of sunflower (Lebukhali, Patuakhali, 2003-04)

Variety/line	Plants/m^2	Head diameter (cm)	Seed/head	1000 seed weight (g)	Seed yield (kg/ha)
Sunwheat 101	764	9.9	320a	63.50	1545a
ST-2250	7.60	10.2	310b	61.75	1434b
Kironi	7.60	9.5	294c	63.70	1421b
CV(%)	3.95	6.5	5.55	4.75	8.65

Table 4. Plant/m^2, plant height, yield and yield contributing characters of sunflower varieties/lines at FSR site Bagherpara, Jessore during 2003-04.

Variety/line	Plant height (cm)	Plant popu. (no.)	Dia/ head (cm)	Filled grain/ head (no)	Unfill grain/ head (no.)	1000 grain weight (g)	Yield/ plant(g)	Yield (t/ha)
ST-2250	160.25	46.00	17.68	699	227	78.25	60.27	1.54
Kironi-2	166.25	45.75	19.43	949	261	93.50	87.21	2.12
Sunwheat 101	151.00	47.00	18.52	776	287	83.50	62.47	1.87
CV(%)	7.21	3.73	1.51	3.49	34.81	2.62	19.06	10.98
LSD(0.05)	NS	NS	0.48	48.77	NS	3.85	23.08	0.35

Table 5. Plant/m^2, plant height, yield and yield attributes of sunflower (Ishasn Gopalpur, Faridpur, 2003-04)

Variety/line	Initial plants/m^2	Final plant/m^2	Plant height (cm)	Head diameter (cm)	1000 grain wt. (g)	Seed yield (kg/ha)
Kironi	8.35	6.20	139b	15.25	73.5b	1384c
ST-2250	8.25	6.16	140b	16.50	88.5a	1584a
Sunflower-101	8.48	6.15	145a	15.50	76.5b	1463b

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ON-FARM ADAPTIVE TRIAL OF EARLY ADVANCED LINE OF NIGER

Abstract

The experiment was conducted at ARS, Pabna, MLT, Narail, FSRD, Jamalpur & Faridpur during rabi season 2003-04 to evaluate the performance of advance lines of Niger at different locations. Two advanced lines Acc-107 and Acc-11002 were tested with check variety. The variety Shova showed higher yield in all three sites except Faridpur where Acc-107 showed significantly higher yield.

Introduction

Niger is a minor oil seed crop of Bangladesh. But it is good edible oil. It contains about 38-42% oil, 50% essential fatty acid and inoelic acid and 20-25% protein. It occupies 91925 acres of land with a production of 22005 tons (BBS 2000). It can be grown in the char and marginal land in Bangladesh. BARI developed variety/lines have potentiality to increase its production which needed multilocation testing for adaptability. Hence the trial was undertaken to evaluate the performance of advanced lines with existing variety.

Materials and Methods

The experiment was conducted at ARS, Pabna, Jessore, Jamalpur and Faridpur during rabi season 2003-04. Two advance lines Acc-107 and Acc-11002 and variety Shova Jamalpur (as check) were included in the study. The experiment was laid out in RCB design with four replications. The unit plot size was 5x4m. The land was fertilized with 34, 24 and 25 kg^{-1} N, P and K, respective. The entire amount of TSP, MP and 3rd of Urea were used as basal. Rest 2/3rd of urea was applied as top dress at 30 and 50 days after sowing. Seeds were sown on 5 December 2003 at Pabna, 27 November at Jessore and 12-16 November at Jamalpur, 12 November 2003 at Faridpur. The crop was sown at a spacing 40 x 30cm. Weeding were done at 15, 30 and 50 days after sowing. Two irrigations were applied at 30 and 50 days after sowing. The crop was harvested on 28 March, 2004 at Pabna, 8-15 March, 2004 at Jamalpur and 24 February to 8 March, 2004 at Faridpur. Yield and yield contributing characters were recorded and analyzed statistically.

Results and Discussion

ARS, Pabna

Days to flowering, plant height, yield and yield attributes were significantly influenced by variety/line. Plant/m^2, head/plant and seed/head were statistically identical (Table 1). Higher plant height was recorded from Acc-107 which was statistically at par to Shova and lowest from Acc-11002. Seed yield between Acc-107 and Shova were statistically identical & higher than Acc-11002. But over all yield was poor because this crop is new in that area. The experiment may be tried for next the year.

Narail, MLT site

Plant height, branches/plant, head/plant, seed/head, 1000-seed weight and seed yield were significantly influenced by variety/line (Table 2). Significantly highest plant height was recorded from Shova & other two varieties/lines were at par. Significantly highest branches/plant was observed from Acc-107 but head/plant was recorded from Shova which was statistically identical to Jamalpur. Shova showed significantly highest seed/head. Similar trend was followed in case of 100-seed weight. As a result, significantly highest yield was recorded from Shova. So, the two lines failed to show higher yield than existing Shova variety.

IshanGopalpur, Faridpur

Variety/line significantly influenced days to maturity, plant height, no. of head/plant & seed yield (Table 3). The variety Nowalpur showed 13-14 days earlier than other variety/line. The plant height were similar to Acc-107 and Shova which were higher than Nowalpur. But Nowalpur and Acc-102 showed similar head/plant & higher than Shova. Seeds/head and 1000-seed weight were statistically identical. But significantly highest grain yield was recorded from variety Acc-107 which was 15-22% higher than Nowalpur & Shova.

Narikeli, FSRD, Jamalpur

Only plant height was significantly influenced by variety/line and other characters were insignificant. The variety Shova and Acc-102 showed similar in height and higher than Acc-11002. Seed yield of existing variety Shova were statistically identical to two tons. It revealed that two lines failed to show higher yield than Shova.

Conclusion

Yield is satisfactory in advance lines/Shova in Faridpur and Jamalpur but yield is very low at Pabna and Jamalpur but farmers faced problem of extraction and use of oil.

Table 1. Plant characters, yield and yield contributing character of advanced niger lines (ARS, Pabna, 2003-04)

Vaiety/line	Day to 50% flowering	Day to maturity	Plant height at harvest (cm)	Plants m^2 (no.)	Heads plant^{-1} (no.)	Seeds heed^{-1} (no.)	Seed yield ha^{-1} (t)
Acc-11002	74.75c	112	85.75b	29.25	45.85	29.95	0.34b
Acc-107	78.75b	114	97.90a	30.75	47.95	23.80	0.41a
Shova	80.75a	114	94.05a	28.75	50.30	30.65	0.45a
CV(%)	0.6	0.3	3.7	4.6	13.4	5.2	5.8

Table 2. Plant height, plant/m2, yield & yield attribute of advanced lines of niger (Narikeli, FSRD site 2003-04)

Line/Variety	Plant height (cm)	Plant/m^2	Branches/ plant	Head/plant	Seed/head	1000-seed weight (g)	Seed yield (kg/ha)
Nowalpur	85.28b	41.25	3.88b	36.a	33b	3.58b	658.75b
Acc-107	89.93b	39.50	5.60a	31b	33b	3.50b	650.00b
Shova	101.83a	40.75	4.43b	39a	35a	4.40a	696.25a
LSD(0.5)	5.74	NS	0.63	4.11	1.43	0.26	34.87
CV(%)	3.59	11.70	7.36	6.65	2.48	3.87	3.02

Table 3. Plant characters, yield and yield attributes of niger (IshanGopalpur, Faridpur, 2003-04)

Variety/line	Days to maturity	Plant pop. /m^2 (no.)	Plant height (cm)	No. of heads/ plant	No. Seed/ Head	1000 seed weight (g)	Seed yield (Kg/ha)
Nawalpur	103b	24	118b	62a	12	5.8	1010b
Acc-107	116a	27	146a	67a	13	5.4	1286a
Shova	117a	25	142a	55b	12	5.6	1096b

Table 4. Plant characters, yield and yield attributes of Niger (Narikeli, Jamalpur, 2003-04)

Line/Variety	Plant height (cm)	Plant/m^2	Pod/plant	Seed/pod	1000-seed weight (g)	Seed yield (kg/ha)
Acc-11002	94.3b	46.0	35	33	3.4	1153
Acc-107	118.1a	46.30	44	37	3.4	1196
Shova	128.8a	48.0	45	42	3.5	1207
CV(%)	5.02	6.74	11.06	9.61	5.02	9.34

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ADAPTABILITY TRIAL OF NEWLY RELEASED POTATO VARIETIES

Abstract

An adaptability trial of newly released potato varieties Raja and Arinda along with Multa, Cardinal, Diamant and Heera was tested at farmers' field at MLT site Sunamgonj during rabi 2003-04. Arinda gave the highest yield (28.7 t/ha) due to higher tuber weight/plant. Cardinal produced the second highest yield (23.7 t/ha). Heera gave the lower yield (16.8 t/ha).

Introduction

Potato is one of the important vegetables as well as cash crop in Bangladesh. The yield of potato in Bangladesh is low compared to other countries of the world. In Sunamgonj district, farmers are using mainly local variety, some farmers cultivated Diamont variety. Tuber Crop Research Center (TCRC) of BARI has developed a good number of high yielding varieties. The newly released varieties of potato need on-farm trial to evaluate their performance. Keeping the views in mind the experiment was undertaken to evaluate the performance of recently developed potato varieties developed by BARI.

Materials and Methods

The experiment was conducted at MLT site Sunamgonj during rabi 2003-2004. Six varieties were used viz. Multa, Raja, Arinda, Heera, Cardinal & Diamant. The unit plot size was 8m × 5m. RCB design was followed with three replications. The fertilizer was applied @ 95-20-56-8 N, P, K, S kg/ha, respectively and cowdung was used as 5 t/ha. Seeds were sown on 7 December 2003. The crop was irrigated twice. Dithane M-45 was applied against late blight disease. Earthing up and other intercultural operations were done properly. Potato was harvested from 5 to 7 March 2004.

Results and Discussion

The result showed that weight of tuber/plant and yield were significantly influenced by different varieties but number of tuber/plant was not significant. The variety Arinda produced the highest tuber weight/plant (0.62 kg) which was significantly differed from other varieties. Cardinal gave the second highest per plant yield which was followed by Diamant and Multa. Consequently the variety Arinda gave the highest yield (28.7 t/ha) followed by Cardinal (23.7 t/ha). The red skinned variety Raja produced 19.2 t/ha tuber yield.

Farmers' reaction

A field day was observed at the farmers field. Farmers opined that among the six varieties the yield performance of Arinda was excellent. The variety Raja showed positive response due to its red colour skinned as well as comparatively higher yield. Farmers are agreed to cultivate Arinda and Raja in the next year if seeds are available.

Conclusion

The variety Arinda showed higher tuber yield among the varieties. The experiment should be repeated in the next year for confirmation.

Table 1. Yield and yield contributing characters of six potato varieties at MLT site Sunamgonj during rabi 2003-04

Variety	Tuber/plant (no.)	Wt. of tuber/plant (kg)	Tuber yield (t/ha)
Multa	7.3	0.41	20.2
Cardinal	6.1	0.48	23.7
Raja	7.0	0.38	19.0
Diamont	7.7	0.44	21.7
Heera	6.5	0.32	16.8
Arinda	8.7	0.62	28.7
$LSD_{0.05}$	NS	0.11	6.31

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ON-FARM PERFORMANCE OF PROMISING SWEET POTATO VARIETY DEVELOPED BY BARI

Abstract

On-farm performance of sweet potato viz BARI Sweet Potato-4, BARI Sweet Potato-5, Kalomegh and Lalkothi were evaluated against the farmers local variety at MLT, Melandah, Magura, Cox's bazar, Bogra, Kishoreganj and Patuakhali during the rabi season of 2003-04. The result showed that BARI Sweet Potato 5, Kalomegh and Lalkothi produced highest tuber yield. On the other hand, the performance of local variety was poor which yielded lower yield than the other varieties.

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. Farmers are using local variety, which is low yielded, and contain less carotene. Bangladesh Agricultural Research Institute (BARI) has developed two sweet potato varieties viz. BARI sweet potato-4 (SP-4), BARI sweet potato 5 (SP-5), Kalomegh, Lalkothi which has high yield ability and also contain high amount of carotene. These varieties need on-farm trial to evaluate their performance and also to get feed back from the farmers. Keeping the views in mind the experiment was under taken to evaluate their performance of recently developed sweet potato varieties developed by BARI and to get feed back from the farmers

Materials and Methods

The on farm validation trial of sweet potato were conducted at Jamalpur, Magura, Cox's bazar, Bogra, Kishoreganj and Patuakhali during rabi season of 2003-04. Three varieties viz. BARI Sweet Potato-4, BARI Sweet Potato-5, Kalomegh, Lalkothi and the local were tested in the farmers field. The vine was planted at the spacing 60 x 30 cm. The plot size was 6m x 9m per variety at each farmer's field. The crop was fertilized with 70-25-85 kg/ha N-P-K and 8 t/ha cow dung respectively. Half of urea and all others fertilizer were used at final land preparation. Remaining part of N fertilizer was top dressed in two equal splits 15 and 35 DAT. The vines were planted on 12 November at Jamalpur, 30 November at Cox's bazar, 17-19 November at Bogra, 9 November at Kishoreganj and 8-20 December, 2003 at Patuakhali. One weeding was done during the period of 15-30 DAT. There was no incidence of disease and pest attack. The crop was harvested on 1-5 May at Jamalpur, 7 April at Bogra, 21-23 April at Cox's bazar, 3-6 April at Bogra, 21 March at Kishoreganj and 20-25 April, 2004 at Patuakhali, respectively. The data were taken as per schedule and analysed statistically and means were separated as per DMRT/LSD test.

Results and Discussion

MLT site, Melandah, Jamalpur

Vine length, branches/plant, tuber/plant, weight of tuber/plant and tuber yields were significantly influenced by variety (Table 1). Significantly the highest length of vine was recorded from local. Similar trend was followed in case of branches/plant. All the variety showed similar tuber/plant and significantly higher than local. Similar trend was followed in case of weight of tuber. Though Lalkothi gave higher yield but statistically identical to Kalomegh and BARI SP 5. The lowest yield was obtained from local variety. All the varieties showed three times higher yield than local one. Cost and benefit analysis showed that the highest return was recorded from Lalkothi followed by Kalomeg and much benefit than local one.

MLT site, Magura

Tubers/plant, weight of tuber/plant, yield/plot and yield (t/ha) were significantly affected by variety (Table 2). Significantly the highest tuber/plant was recorded from Kalomeg and others variety were statistically identical. The variety BARI SP 4 and Kalomeg were statistically similar in weight of tuber. Similar trend was followed in case of yield/plot and yield (t/ha). The variety Kalomeg revealed higher yield due to weight of tuber and tubers/plant.

MLT site, Cox's bazar

Tuber/plant, tuber weight/plot and tuber yield was significantly influenced by variety (Table 3). The variety BARI SP 5 showed significantly the highest tuber/plant. But higher tuber/plot was recorded from Kamalasunduri which was statistically identical to BARI SP 4. The variety Kamalasunduri showed similar yield to BARI SP 4 and the lowest yield from local followed by Tripti.

MLT site, Gabtali, Bogra

Vine length, tuber/plant and weight of vine were significantly influenced by variety (Table 4). Significantly the highest vine length was recorded form BARI SP 5 and the lowest from local but statistically identical to Kalomeg. There is no difference in tuber/plant between Kalomegh, lalkothi and BARI SP 4 but difference form BARI SP 5 and local. Significantly the highest weight was recorded from Lalkothi and the lowest from local. The highest gross return was obtained from Lalkothi followed by Kalomegh. Similar trend was followed in case of BCR. The newly developed variety lakkothi or kalomegh gave higher yield as well as higher benefit than the existing variety and local one.

MLT site, Katiadi, Kishoreganj

Tuber/plant, tuber weight/plant and tuber yield was significantly influenced by variety (Table 5). Higher tuber/plant was recorded from BARI SP 4 followed by Lalkothi and BARI SP 5. There was significant difference between variety in respect of tuber weight/plant except local one. But significantly the highest tuber yield was recorded from local. It is noted that higher gross return as well as gross margin and BCR was recorded from local one. Besides, price of local sweet potato is higher than BARI verities.

FSRD site, Lebukhali, Patuakhali

Tuber/plant was almost similar among the varieties but tuber weight/plant and root yield were significantly different in variety. Higher tuber weight was recorded from BARI SP 5 followed by Lalkothi, Kalomegh and BARI SP 4 and the lowest from local one (Table 6). The variety Lalkothi and BARI SP 4 showed similar yield and much higher than local one.

Farmers' reaction

- ⇒ BARI SP-4 & 5 varieties are less sweet than local and Daulatpuri.
- ⇒ BARI SP-4 gets cracked on boiling
- ⇒ BARI SP-4 & 5 are less tolerant to water stagnancy.
- ⇒ All BARI varieties get very soft on boiling which do not preferred by farmers.

Table 1. Effect of different varieties on yield and yield components and cost and return analysis of sweet potato at Melandah, 2003-04

Variety	Vine length (cm)	Branches/ plant (no.)	Tuber/ plant (no.)	Wt. of tuber/ plant (kg)	Tuber yield (t/ha)	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR
BARI SP-4	95.90c	7.50c	4.25a	451.0a	24.71b	61775	9635	52140	6.41
BARI SP-5	137.6b	12.30b	3.97a	490.5a	25.90a	64750	9635	55115	6.72
Kalomegh	89.40c	8.15c	4.21a	502.6a	27.60a	69000	9635	59365	7.16
Lalkothi	108.8c	7.01c	4.27a	512.1a	28.54a	71350	96354	61715	7.41
Local	163.2a	18.40a	2.56b	123.5b	7.80c	23400	9635	13765	2.43
CV (%)	9.97	14.58	11.89	11.08	10.92	-	-	-	-

Figure in a column having similar letters do not differ significantly

Price: (Tk/kg)
BARI SP 4 = 2.5, BARI SP 5 = 2.50, Kalomegh = 2.50, Lalkothi = 2.50 & Local = 3.00

Table 2. Performance of sweet potato tested at MLT site,, Magura during 2003-04

Variety	Tubers/plant (no.)	WT of Tuber/ plant (g)	Yield/plot (kg)	Yield (t/ha)
BARI SP-4	4.4b	920a	448a	37.33a
BARI SP-5	4.8b	780b	398b	33.17b
Lalkothi	5.0b	810b	414b	34.50b
Kalmegh	6.4a	930a	469a	39.08a
Local	4.6b	360c	208c	17.33c
LSD (0.05)	1.1	90.0	21.6	1.85

Table 3. Performance of sweet potato tested at MLT site, Cox's bazar during 2003-04

Variety	Tubers/plant (no.)	WT of Tuber/ plant (g)	Yield (t/ha)
BARI SP-4	3.35b	1.10ab	23.23ab
BARI SP-5	3.95a	1.05b	21.55bc
Kamalasunduri	3.08bc	1.27a	24.64a
Tripti	2.88bc	0.85c	19.49cd
Local	2.58c	0.62d	17.70d
CV (%)	11.48	11.84	8.12
LSD (0.05)	0.56	0.17	2.67

Table 4. Yield, yield attributes and Cost-benefit analysis of different sweet potato varieties at MLT site Gabtali, Bogra during 2003-04

Variety	Vine length (cm)	Tuber/ plant (no)	Weight of vine (t/ha)	Tuber yield (t/ha)	GR (Tk./ha)	TVC (Tk./ha)	BCR
Local	86.37c	4.43b	56.08c	16.5e	66000	26009	2.54
BARI-SP-5	180.5a	3.42c	59.83bc	21.04d	63120	26009	2.43
BARI-SP-4	104.3b	5.18a	60.35b	33.0c	99000	26009	3.81
Kalomegh	93.48c	5.37a	36.37d	36.63b	109890	26009	4.22
Lalkothi	105.0b	5.77a	91.24a	39.98a	119940	26009	4.61
CV(%)	7.22	10.45	5.77	5.47	-	-	-
LSD (0.05)	9.9	0.60	4.22	1.94	-	-	-

Table 5. Yield, yield attributes, cost and return analysis of of sweet potato varieties at MLT site, Katiadi, Kishoreganj during rabi 2003-04

Variety	Tuber/plant (no.)	Tuber wt./ plant (g)	Tuber yield (tha^{-1})	Gross return ($Tkha^{-1}$)	TVC ($Tkha^{-1}$)	Gross margin ($Tkha^{-1}$)	BCR
BARI SP-4	5.03a	603a	14.70b	29400	11799	17601	2.49
BARI SP-5	4.23ab	467ab	10.17c	20340	11799	8541	1.72
Lalkothi	4.40ab	493a	11.37bc	22740	11799	10941	1.92
Kalmegh	3.93b	532a	13.60b	27200	11799	15401	2.31
Local	3.53b	360b	17.70a	53100	8300	44800	6.40
CV (%)	13.56	12.28	8.85	-	-	-	-

Table 6. Yield contributing characters of some sweet potato varieties during Lebukhali, Patuakhali 2003-04

Variety	Tuber/plant	Tuber weight. (gm)	Root yield (t/ha)
BARI SP-4	6	145	52
BARI SP-5	5	150	45
Lalkothi	6	148	53
Kalmegh	5	146	44
Local	5	85	22

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STUDY ON THE LATE PLANTING POTENTIAL OF TOMATO VARIETIES IN THE RABI SEASON

Abstract

An experiment was conducted at Regional Agricultural Research Station farm, Jessore during 2003-04 to observe the effect of planting date and variety on the yield of late planting tomato. Five planting date (Dec. 01 & 16, Jan. 01 & 16 and Feb. 01) were used as main factor and four tomato varieties viz. BARI Tomato 4, BARI Tomato 5, BARI Tomato 6 and BARI Tomato 12 were used as sub factor. Yield and yield contributing characters were influenced significantly due to difference sowing dates and varieties. Significantly the highest yield (48.47 t/ha) was obtained from 01 Dec. sowing. The variety BARI Tomato 4 and BARI Tomato 5 showed statistically identical yield. Interaction effect of planting date and variety influenced the yield and yield contributing characters significantly. The highest yield (57.07 t/ha) was obtained from 16 Dec. sowing with variety BARI Tomato 5 which was statistically identical to 1 Dec. sowing with variety BARI Tomato 4. The yield of different varieties decreased gradually up to final planting date in all the varieties.

Introduction

Gradual increase in the price of tomato after the period of seasonal abundance offers an opportunity of growing tomato late in the season to harness the benefit of high market price. Either growing a long duration variety that gives a good yield toward the end of the growing season or planting suitable varieties as late crop might be useful. For satisfactory production, such varieties should have high temperature tolerance. However, suitable varieties have not yet been bread for such condition in Bangladesh. In this situation it might be worth while to study the late sowing/planting potential of existing varieties and select better ones for late planting in different agro-ecological region of the country. Therefore, the study was undertaken to find out the suitable tomato for late rabi season when tomato demand and price are high in the market.

Materials and Methods

The experiment was conducted at Regional Agricultural Research Station, Jessore during rabi season 2003-04. The experiment was laid out in a split plot design with 3 replications. Planting dates were assigned in the main plot and varieties in the subplot. Five planting dates viz. Dec. 01 & 16, Jan. 01 & 16 and Feb. 01 were used as main plot. Four tomato varieties viz. BARI Tomato 4, BARI Tomato 5, BARI Tomato 6 and BARI Tomato 12 were used as sub plot. The unit plot size was 3 m x 4 m. Tomato seedlings were planted in maintaining the spacing 60 cm x 50 cm. Fertilizer were used at the rate of 100-75-125-150-7.5-10000 kg N-P_2O_5-K_2O-Gypsum-Boric acid-cowdung/ha. Half of P_2O_5, K_2O & cowdung and full dose of –Gypsum & Boric acid were applied dung the final land preparation. The remaining 50% cowdung and P_2O_5 were used during pit preparation prior to planting. The rest N and K_2O were applied in two equal installments at 21 and 35 DAT. Thirty days old seedling were planted as per treatment. Irrigation, weeding, plant protection and other intercultural operation were done as and when necessary. Harvesting continued from 11 March to 22 April 2003 depending on the planting date and maturity of different varieties. Data were collected and analyzed statistically.

Results and Discussion

Effect of planting date: From the Table 1, it was revealed that yield and yield contributing characters were varied significantly due to planting date. Significantly the highest plant height was recorded from 1 Dec. sowing. There was trend to decrease plant height with the advance of date of planting. Similar trend was followed in case of fruits/cluster and fruits/plant. This two characters contributed to higher yield/plant as well as yield (kg/ha).

Effect of variety: Result presented in the Table 2 showed that fruit/cluster, fruit/plant, yield/plant and yield (t/ha) varied significantly due to variety. The variety BARI Tomato 12 showed significantly the highest plant height among the varieties. Fruits/cluster between BARI Tomato 4, 5 and 6 were statistically identical and higher than BARI Tomato 12. But fruits/plant showed identical in BARI Tomato 4 & 5 which was higher than BARI Tomato 6 & 12. Similar trend was followed in case of yield/plant, fruits/plant and yield/plant which contributed higher yield of BARI Tomato 4 and BARI Tomato 5.

Interaction between date of planting and variety: Results of table 3 shows that yield and yield contributing characters differ significantly due to the interaction between variety and plant date. Dec. 1 planting with variety BARI Tomato 5 produced the highest yield (57.07 t/ha) which was statistically identical to same date of variety BARI Tomato 4. The yield decreased gradually up to the final date of planting in 2003-04. But yield was low in 2002-03 where higher yield was recorded from Dec. 16 planting with BARI Tomato 5 followed by BARI Tomato 4. On an average, higher yield was recorded from Dec. 01 planting with BARI Tomato 5 followed by BARI Tomato 4.

Conclusion

Though the yield of BARI Tomato 5 and BARI Tomato 4 were very much lower at last planting comparing with the first and second planting but it may be cultivated as late planting variety considering the demand and high market price.

Table 1. Effect of date on the yield and yield components of late planting tomato at RARS, Jessore during 2003-04

Planting date	Plant height (cm)	Fruit/cluster (no.)	Fruits/plant (no.)	Yield/plant (kg)	Yield (t/ha)
Dec. 01	99.52a	7.63a	46.47a	1.91a	48.70a
Dec. 16	93.85b	6.31d	33.80b	1.62b	39.60b
Jan. 01	87.38c	7.40a	25.34c	1.23c	24.63c
Jan. 16	68.21d	5.86c	15.58d	0.54d	11.46d
Feb. 01	69.48d	6.63b	9.50e	0.32e	7.23e
CV (%)	5.47	6.80	25.23	12.63	10.56

Table 2. Effect of variety on the yield and yield components of late planting tomato at RARS, Jessore during 2003-04

Variety	Plant height (cm)	Fruit/cluster (no.)	Fruits/plant (no.)	Yield/plant (kg)	Yield (t/ha)
BARI Tomato 4	63.34c	7.01a	35.62a	1.23a	29.47a
BARI Tomato 5	63.43c	6.77a	37.68a	1.33a	30.82a
BARI Tomato 6	100.72b	6.91a	18.20b	1.02b	24.21b
BARI Tomato 12	107.25a	6.37b	13.05c	0.91c	20.79c
CV (%)	5.47	6.80	25.23	12.63	10.56

Table 7. Interaction effect of planting date and variety on the yield and yield components of late planting tomato at RARS, Jessore during 2002-03

Planting time	Variety	Plant height (cm)	Fruits/ cluster (no.)	Fruits/ plant (no.)	Yield/ plant (g)	Average fruit weight (g)	Yield (t/ha)	
							2003-04	2002-03
Dec. 01	BARI Tomato 4	74.93fg	7.93	64.73a	2.17b	33.50	55.91a	20.24bc
	BARI Tomato 5	76.73fg	7.40	71.57a	2.41a	33.70	57.07a	20.56bc
	BARI Tomato 6	118.20b	7.97	29.03def	1.68c	57.90	43.02cd	14.04e
	BARI Tomato 12	128.20a	7.23	20.53efg	1.41d	68.80	38.79d	19.79cd
Dec. 16	BARI Tomato 4	69.32gh	6.40	44.40bc	1.69c	37.95	44.60bc	23.51ab
	BARI Tomato 5	69.07bc	6.67	47.13b	1.97b	41.86	48.69b	24.18a
	BARI Tomato 6	111.07bc	6.38	24.57d-g	1.37d	55.70	32.42e	16.49de
	BARI Tomato 12	125.97a	5.80	19.10fgh	1.42d	74.37	32.69e	17.44cde
Jan. 01	BARI Tomato 4	65.30h	7.73	34.33cd	1.42d	41.20	26.57f	5.23fgh
	BARI Tomato 5	64.10h	7.60	32.83de	1.21de	36.70	24.39f	6.15f
	BARI Tomato 6	105.43c	7.63	19.47fg	1.22de	62.69	25.43f	5.83fg
	BARI Tomato 12	113.70b	6.63	14.72ghi	1.08e	73.31	22.14f	5.05fgh
Jan. 16	BARI Tomato 4	54.33i	5.90	22.13efg	0.58f	26.11	13.47g	2.79fgh
	BARI Tomato 5	52.10i	5.53	21.00efg	0.60d	28.47	12.71g	3.23fgh
	BARI Tomato 6	87.13de	6.17	12.40ghi	0.57fg	40.04	13.82g	3.37fgh
	BARI Tomato 12	79.27ef	5.83	6.80hi	0.40fgh	59.26	5.82i	2.86fgh
Feb. 01	BARI Tomato 4	52.83i	7.10	12.50ghi	0.32gh	25.20	6.80hi	1.71h
	BARI Tomato 5	54.20i	6.63	15.87ghi	0.43fgh	27.11	11.25gh	1.94gh
	BARI Tomato 6	81.77def	6.40	5.53i	0.26h	47.19	6.37i	1.63h
	BARI Tomato 12	89.13d	6.37	4.10i	0.25h	58.78	4.51i	1.50h
	CV (%)	5.47	6.80	25.23			20.76	12.63
	F-test	**	NS	**			**	**

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ON-FARM TRIAL OF TOMATO VARIETIES

Abstract

The trial was conducted at Pabna, Jamalpur and Magura with two BARI released tomato varieties BARI Tomato 3 and BARI Tomato 9 with BARI Tomato 2 as check to see their yield performance. Check variety (BARI Tomato-2) gave higher yield (77.90 t ha^{-1}) due to its higher fruit weight $plant^{-1}$ (1.56 kg).

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one of the most common and popular vegetable in Bangladesh. It occupies 36080 acres of land with an annual production of 99690 tons (BBS, 2000). It is rich in vitamins and minerals and widely cultivated in the world as well as in Bangladesh. The yield potential of tomato is much higher than that is achieved by farmers. It may be attributed to the lack of improve variety and proper management practices. Varietal development is a continuous process. Normally the developed varieties under cultivation in farmer's field gradually degenerate over time. So, it is necessary to provide several alternatives to replace in desired cases. The Horticulture Research Centre, BARI has developed many varieties which needed wide range testing across the country. Therefore, released varieties were be put under trial to observe the performance of newly developed tomato varieties at farmer's field

Materials and Methods

The trial was conducted at farmer's field at FSRD site, Goyeshpur, Pabna, FSRD site Narikeli, Jamalpur and MLT site Magura during rabi season 2003-04. BARI Tomato 3 and BARI Tomato9 and BARI Tomato 2 at Pabna and local check at other two sites were tested with 4 farmers. The unit plot size was 4.8m x 1m with 60cm x 40cm plant spacing. Twenty seven days old seedlings were transplanted on 10 November at Pabna, 13-15 November at Jamalpur and 3 December 2003 at Magura. Manures and fertilizers were applied at the rate of 10 tons, 252, 90 and 130 kg CD, N, P, K ha^{-1}. Half of $cowdung^{-}$ and full TSP were applied during final land preparation. The remaining cowdung was applied during pit preparation. Urea and MP were top-dressed in two equal installments at 21 and 35 days after transplanting. The crop was kept weed free and was sprayed with regent at seedling stage in 12 days intervals when required. The crops were harvested from 21 January to 14 February 2004 at Jamalpur and 8 March to 10 April 2004 at Magura.

Results and Discussion

FSRD site Goyeshpur, Pabna

No. of fruits/plant, weight of fruits/plant and fruits yields were significantly influenced by variety. Significantly the highest fruit/plant was recorded from BARI Tomato 9 and other two varieties were similar. But weight of fruits/plant was recorded from BARI Tomato 2 and the lowest from BARI Tomato 9. The weight of fruits/plant had influenced the fruit yield (Table 1).

FSRD site Narikeli, Jamalpur

The result revealed that fruits/plant, weight of fruit/plant and yield were significantly influenced by variety (Table 2). BARI Tomato showed higher no. of fruits/plant which was statistically at par to BARI Tomato 2 and the lowest from local one. But significantly the highest fruit/plant was recorded from BARI Tomato 3. Fruits/plant and weight of fruit/plan had significantly influenced the fruit/yield so BARI Tomato 2 gave higher yield though statistical identical to BARI Tomato 2. The lowest yield from local due to lower no. of fruits/plant and weight of fruit/plant.

MLT site Magura

Plant height, fruits/plant and fruit yield were significantly affected by variety (Table 3). Significantly the highest plant height was recorded from local one and other two varieties were similar. But fruits/plant was showed the highest from BARI Tomato 9. Weight of fruit/plant did not influence by any of the variety. Significantly the highest fruit yield was recorded from BARI Tomato 3 and the lowest from local one.

Farmers reaction

Farmers were satisfied with the production of BARI varieties. At Pabna reported that BARI Tomato 9 was more susceptible to virus than BARI Tomato 2 and BARI Tomato 3.

Table 1. Yield and yield contributing parameters of different tomato varieties at FSRD site, Goyeshpur of OFRD site, Pabna during 2003-04

Variety	No. of fruits plant^{-1}	Weight of fruit plant^{-1} (kg)	Yield (t ha^{-1})
BARI Tomato 2	48.40	1.56	77.90
BARI Tomato 3	41.60	1.38	68.95
BARI Tomato 9	89.00	1.21	60.40

Table 2. Yield and yield attributes of Tomato varieties at Narikeli, Jamalpur during 2003-04

Variety	No. of fruits plant^{-1}	Weight of fruit plant^{-1} (kg)	Yield (t ha^{-1})
BARI Tomato 2	16.7ab	1.37b	44.80a
BARI Tomato 3	21.4a	1.75a	56.27a
Local	11.7b	0.74c	22.80b
CV (%)	8.59	5.95	10.63

Table 2. Plant height, yield and yield attributes of Tomato varieties at Magura during 2003-04

Variety	Plant height (cm)	No. of fruits plant^{-1}	Weight of fruit plant^{-1} (kg)	Yield (t ha^{-1})
BARI Tomato 2	96.88b	28.18b	2.21	59.11a
BARI Tomato 9	89.63b	41.00a	2.00	52.60b
Local	105.38a	24.23b	2.13	50.25b

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ADAPTIVE TRIAL OF CHERRY TOMATO VARIETIES

Abstract

The experiment was conducted at Regional Agricultural Research Station, Jessore during 2003-2004 to evaluate the performance of BARI tomato varieties. Three BARI tomato varieties viz. BARI Tomato 1, BARI Tomato 2 and BARI Tomato 11 (cherry) were tested. The highest yield was obtained from BARI Tomato 2 which was identical with BARI Tomato 1. The lowest yield was produced by BARI Tomato 11. The higher yield produced by the varieties for higher yield contributing characters.

Introduction

Cherry tomato varieties have recently been introduced in Bangladesh. These are very rich source of carotene as well as vitamin C and can play a vital role in improving the nutrition of vast rural masses. However, the recently introduced varieties have not been evaluated in the diverse agro-ecological regions of the country and farmer's acceptances of the varieties have not been evaluated. Therefore, the study was undertaken to evaluate the performance of available varieties at RARS, Jessore.

Materials and Methods

The experiment was conducted at RARS, Jessore during rabi season 2003-04. It was laid out in RCB design with 3 replications. Three varieties from BARI viz. BARI Tomato 1, BARI Tomato 2 and BARI Tomato 11 were tested. The unit plot size was 3m x 3m. Lands were ploughed well and 30 day old seedling were transplanted on 9 December, 2002 maintaining 60 x 50cm spacing. Cowdung 10 t/ha and 100-75-125-150-7.5 kg/ha N-P_2O_5-K_2O-Gypsum-Boric acid were applied. Half of the cowdung, P_2O_5-K_2O and total amount of Gypsum, Boric acid were applied during the final land preparation. The remaining 50% cowdung and P2O5 were used during pit preparation prior to planting. The rest N and K2O were applied in two equal installments at 21 and 35 DAT. Irrigation were done thrice and weeding once as per necessity. Plant protection measures and other intercultural operation were done as and when necessary. Harvesting started on 25 February, 2004 and finished on 7 April, 2004. Data on yield and yield component were taken carefully and analyzed statistically.

Results and Discussion

Plant height, fruits/cluster, fruits/plant, yield/plant and fruit yields were significantly affected by variety (Table 1). Significantly the highest plant height was recorded from cherry and the lowest from BARI Tomato 2. But cherry tomato showed significantly the highest fruits/cluster and other two varieties were similar but lower than the former one. Similar trend was followed in case of fruits/plant but yield/plant revealed similar yield in both the varieties and higher than cherry tomato. The BARI Tomato 2 showed higher yield but statistically identical to BARI Tomato 1. Similar trend was followed in 2002-03 but yield was low due to virus infestation.

Conclusion

The BARI Tomato 1 showed higher yield closely followed by BARI Tomato 2 whereas much lower yield and cherry tomato.

Table 1. Yield and yield components of cherry tomato varieties at RARS, Jessore during 2003-04

Treatments	Plant height (cm)	Fruits/ cluster (no)	Fruits/plant (no)	Yield/ plant	Yield (t/ha)	
					2003-04	2002-03
BARI Tomato 1	104.80b	5.37b	24b	1.79a	49.22a	19.34a
BARI Tomato 2	80.27c	4.83b	27b	2.00a	52.82a	16.76ab
Cherry	134.87a	13.37a	172a	1.15b	27.92b	16.08
CV %	2.89	5.08	20.29	9.48	12.76	-
LSD	6.998	0.904	34.24	0.35	12.53	-

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ON-FARM TRIAL OF EARLY BRINJAL VARIETY

Introduction

Variety development is a continuous process. Normally the developed varieties in the farmer's field under cultivation gradually degenerate over time. So, it is necessary to replace it by new one. Therefore newly released varieties needs to be put under trial at different locations for their adaptability and acceptability at farmer's level. BARI has already developed early varieties-Kazla, Nayantara and one advanced line ISD-006. The trial was conducted at farm level at Farming System Research and Development site, Narikeli, Jamalpur during rabi 2003-04 to observe the performance of brinjal varieties in the farmer's field.

Materials and Methods

The trial was conducted at Farming System Research and Development site, Narikeli, Jamalpur during rabi 2003-2004. Two brinjal varieties viz. Kazla, Nayantara and one advanced line ISD-006 were transplanted from 4-6 November, 2003 at different farmer's field. The plot size was 20m x 10m. The trial was set in six dispersed farmers' field. Fertilizer was used at the rate of 375, 150, 250 kg/ha and 10 t/ha of Urea, TSP, MP and cow dung, respectively. The entire amount of cow dung, TSP and half urea and MP were used at final land preparation. The rest of urea and MP were top dressed at 20 and 30 days after sowing. The fruits were harvested from January 12 and continued up to April 25, 2004.

Results and Discussion

The result obtained from the study indicated that the highest plant was obtained from ISD 006 which was significantly different from other two varieties. Kazla and Nayantara produced similar plant height among which Kazla produced the shortest plant. But the number of fruits/plant was recorded significantly the highest from Kazla and the lowest from ISD 006. Higher yield was obtained from Kazla which was statistically similar to Nayantara. The ISD 006 produced the lowest yield (29.9 t/ha) among the variety.

Farmer's reaction

Kazla and Nayantara were blakish in colour and preferred by the farmers.

Table 1. Plant height, yield and yield attributes of brinjal varieties in the farmer's field at FSRD site, Narikeli, Jamalpur, 2003-04

Treatment	Plant height (cm)	Fruits/plant (no.)	Fruit length (cm)	Yield (t/ha)
Kazla	73.2b	43.3a	10.5	52.9a
Nayantara	75.9b	20.0b	13.1	43.7ab
ISD-006	86.0a	9.3b	9.3	29.9b
CV(%)	9.24	13.55	12.25	15.96

Figure in the column having similar/no letter(s) do not differ significantly

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ON-FARM TRIAL OF BARI HYACINTH BEAN VARIETY (BARI Seem 1)

Introduction

Country bean is one of the important vegetable in Bangladesh. It has to complete 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 Seem-1. To popularize the variety with recommended practices for large scale production, a development program on BARI Seem-1 was undertaken at the Farming Systems Research and Development Site, Narikeli and Multilocation Testing Sites, Melandah and Sherpur during the rabi season of 2003-2004.

Materials and Methods

The development program was conducted at the Farming Systems Research and Development Site, Narikeli and Multilocation Testing Site, Melandah and Sherpur during the rabi season of 2003-2004. Seeds of BARI Seem-1 were supplied to farmers and were sown on August 19-27, 2003 in pit with a spacing of 2.5m x 2.5m. The size of pit was 45 x 45 x 45 cm. The crop was fertilized with recommended fertilizer dose of 50-150-50-10000 kg/ha of 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. Intercultural operation was done as and when necessary. Crop was harvested during November, 2003 and continued up to March, 2004.

Results and Discussion

The result of the development program was presented in Table 1. The average yield was 13.56 t/ha. The new variety was higher yielder than local one.

Farmers' reaction

Farmers were able to get better price for early harvesting and heavy bearing and good demand in the market Farmers expressed their satisfaction for softness and tasty. No virus infestation was observed.

Recommendation: BARI Seem-1 is recommended for large scale extension at farmers field.

Table 1. Performance of BARI Seem 1 in farmers field during 2003-04

Co-operator farmer (no.)	Area covered (m^2)	Yield (t/ha)
25	1500	13.56

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ON-FARM TRIAL OF EARLY GARDEN PEA VARIETIES

Abstract

An on-farm trial of early garden pea variety BARI Motorshuti 3 was conducted at Tangail, Jamalpur, Pabna, Faridpur, Magura and Sylhet during rabi 2003-04 to observe the performance of newly developed garden pea variety at farmers fields. The variety BARI Motorshuti-3 gave the highest yield at all the sites except Tangail where BARI Motorshuti 1 showed the highest yield. The farmers' variety took only 55-60 days to mature. At Sylhet only BARI Motoshuti-3 was put under trial with reasonable yield and benefit.

Introduction

Garden pea is very popular for its various cooking purposes. According to fulfill the demand BARI-developed their varieties; early garden pea is one of the latest developed variety. So it is necessary to trial of that variety on the farmer's field's condition for adaptability and acceptability at farmers' level.

Materials and Methods

The trial was conducted at Tangail Jamalpur, Pabna, Faridpur, Magura and Sylhet during rabi 2003-04. The six varieties (BARI-Motorshuti 1, BARI-Motorshuti 2, BARI-Motorshuti 3, IPSA Motorshuti 1, IPSA Motorshuti 2 and IPSA Motorshuti 3 were used in this trial. The unit plot size was 6 x 4 m^2 with plant spacing 20 x15cm^2. The crops were sown on 16 November 2003 at Jamalpur & Pabna, 6 February 2004 at Pabna and 15 January 2004 to 8 February 2004 at Faridpur. Two seeds were used for each hill. The fertilizers were applied at the rate of 10 t/ha cowdung and 150-150-100 kg/ha of urea, TSP and MP respectively. The entire quantity of cowdung, TSP and half of urea and MP were applied during land preparation. The rest of urea and MP were applied as topdressed after 20 and 30 days after sowing. Intercultural operation such as weeding was done 2 times and irrigation was applied only one time. The plant protection measure was taken as and when necessary. The garden pea was harvested at maturity stage. The crop was harvested on 15-21 January at Jamalpur, January to 6 February at Pabna and 15 January to 8 February at Faridpur. The yield and yield attributing characteristics of garden pea varieties were collected and analyzed statistically using MSTATC package.

Result and Discussion

FSRD site, Palima, Tangail

The yield and yield contributing characters of garden pea varieties were presented in Table 1. The yield and yield contributes were significantly influenced by different varieties. Days to maturity are an important for the garden pea varieties. Maximum days to maturity (112 days) was required for the variety BARI-Motorshuti 1, where as minimum days (43) were recorded for IPSA-Motorshuti-3. Except these two varieties other four varieties required same days (57) to maturity. Significantly the highest plant height was recorded from IPSA Motorshuti 3 and the lowest from IPSA Motorshuti 1. Branches/plant was also significantly the highest from IPSA Motorshuti 3 but the highest pods/plant were recorded from BARI Motorshuti 1. Similar trend was followed in case of length of pod. Due to higher no. of pods/plant and length of pods contributed the highest yield in BARI Motorshuti 1 though it took longer time to mature. IPSA Motorshuti 3 less yield than BARI Motorshuti 1 but it takes only 43 days to mature.

FSRD site, Narikeli, Jamalpur

Only one variety was included in the trial. The pod yield is 6.70 t/ha.

FSRD site, Goyeshpur, Pabna

BARI Motorshuti took less time than the other two varieties. Higher plant/m^2 was recorded from BARI Motorshuti 3 followed by local one and the lowest from BARI Motorshuti 1. But the highest pods/plant was obtained from local one and the lowest from BARI Motorshuti 3. Similar trend was followed in case of seeds/pod. The highest pod yield was recorded from BARI Motorshuti 3 which took only 52 days to mature (Table 3).

FSRD site, Ishan Gopalpur, Faridpur

Among the variety BARI Motorshuti took less time than other two varieties (Table 4). Plants/m^2 was almost similar among the variety. But plant height was the highest form local variety followed by BARI Motorshuti 1. Higher pods/plants were recorded from local but seeds/pod was not so much difference. BARI Motorshuti 3 showed higher weight of seeds followed by BARI Motorshuti 1 and much less weight in case of local one. This character influences the pod yield where the highest yield was recorded from BARI Motorshuti1 with the lowest time to mature (66 days).

MLT site, Magura

Local variety showed higher plant height than other two varieties (Table 5). Plants/m^2 was very low in all the variety. Higher pods/plant was recorded from BARI Motorshuti 1 and the lowest from local one. Similar trend was followed in case of seeds/pod. But 1000-seed weight showed the highest from BARI Motorshuti 3 and much lower in local one. This character influenced much in pod yield as result BARI Motorshuti 3 revealed higher pod yield. Average pod yield is very low due to low population.

FSRD site, Golapganj, Sylhet and MLT site, Sunamganj

The first harvest starts after 52-54 DAS and continued up to 64-65 DAS. Total no. of harvested pods/plant ranged from 8-10 at FSRD site and MLT site it was 11-14. The highest pod yield (8.6 t/ha) was found at MLT site Sunamganj and at FSRD site the yield was 6.2 t/ha. In both the locations the BCR indicated that BARI Motorshuti-3 was highly profitable.

Farmers reaction

Farmers were very encouraged to see the performance of BARI Motorshuti 3 which could be harvested within 55-60 days.

Conclusion

In all the sites BARI Motorshuti performance better in respect of yield and early to mature.

Table 1. Days to maturity, plant height, yield and yield contributing characters of garden pea varieties at FSRD site, Palima, Tangail during 2003-04

Variety	Days to maturity	Plant height (cm)	Branches/ plant	No. of pods /plant	Length of pods (cm)	Yield (t/ha)
BARI Motorshuti 1	112.0a	105.0b	1.06bc	13.80a	8.03a	11.99a
BARI Motorshuti 2	57.00c	45.33d	1.33bc	4.60c	7.00bc	5.77c
BARI Motorshuti 3	57.00c	43.67d	0.86bc	4.33c	7.06bc	4.07d
IPSA Motorshuti 1	57.00c	31.37e	1.46b	5.20c	6.36c	4.51cd
IPSA Motorshuti 2	57.00c	54.53c	0.80c	4.33c	7.20b	4.42cd
IPSA Motorshuti 3	43.00b	173.7a	3.00a	11.53b	6.46c	7.85b
LSD (0.05)	0.05	9.017	0.63	1.69	0.72	1.39

Table 2. Plant/m^2, pods/m^2 and pod yield of garden pea at Narikeli, Jamalpur during 2003-04

Variety	Plants/m^2	Pods/m^2	Pod yield (t/ha)
BARI Motorshuti 3	30.3	180.8	6.70

Table 3. Days to maturity, plant height, yield and yield contributing characters of garden pea varieties at FSRD site, Goyeshpur, Pabna during 2003-04

Variety	Days to maturity	Plants/m^2	No. of pods /plant	Seeds/plant (no.)	Yield (t/ha)
BARI Motorshuti 1	78	22.66	13.3	5.5	5.09
BARI Motorshuti 3	52	48.75	9.6	4.8	9.50
Local (Check)	82	39.37	26.7	6.5	6.37

Table 4. Days to maturity, plant height, yield and yield contributing characters of garden pea varieties at FSRD site, Ishan Gopalpur, Faridpur during 2003-04

Variety	Days to maturity	Plant pop./ m^2	Plant height (cm)	No. of pods /plant	No. of seeds/ pod	1000-seed wt. (g)	Yield (t/ha)
BARI Motorshuti 1	99	30	72	12	5.0	450	4.10
BARI Motorshuti 3	66	32	41	15	4.5	502	6.84
Local	93	35	86	16	5.0	101	2.91

Table 5. Plant height, yield and yield contributing characters of garden pea varieties at MLT site, Magura during 2003-04

Variety	Plant /m^2	Plant ht (cm)	Pods/plant (no.)	Sees/ pod (no.)	1000 gr. wt. (g)	Yield (t/ha)
BARI Motorshuti 1	7.03	59.23	13.89	7.3	194.88	1.99
BARI Motorshuti 3	8.65	51.95	11.93	5.73	276.40	1.71
Local	8.64	65.05	8.45	4.13	57.00	0.46

Table 6. Days to harvest yield and economic performance of BARI Motorshuti-3 at FSRD site Golapganj, Sylhet and MLT site Sunamganj, rabi 2003-04

Location	Days to 1st harvest	Days to last harvest	Harvested pods/plant (no.)	Marketable pod yield (t/ha)	Gross Return (Tk/ha)	TVC (Tk/ha)	Gross Margin (Tk/ha)	BCR
FSRD site Golapganj	54	65	8-10	6.2	74400	10850	63550	6.85
MLT site Sunamganj	52	64	11-14	8.6	86000	10200	75800	8.43

Motorshuti: Tk.12/kg at Sylhet and Tk.10/kg at Sunamganj

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ON-FARM TRIAL OF CAULIFLOWER VARIETY AT FARMERS' FIELD

Abstract

The experiment was conducted in medium high land at FSRD site, Palima, Tangail under the AEZ-8 during rabi 2003-2004 to observe the performance of high yielding cauliflower variety named Rupa compared with local variety (Paushali).

Introduction

Cauliflower is one of the most important winter vegetables. Farmers need high yielding variety for their maximum economic benefit. Accordingly BARI has developed high yielding cauliflower variety (Rupa) which needs to popularize among the farmers through on-farm trial.

Materials and Methods

The experiment was undertaken in medium highland under irrigated condition at farmer's field of FSRD site, Palima, Tangail during rabi 2003-2004. The poushali local variety was used as a cheek. The experiment was laid out in RCBD with six different farmer's field (each farmers plot treated as one replication). The plot size was 4.5 x 1.0 m^2 and plant spacing 60 cm x 45 cm. The land was fertilized with 240-150-220 kg/ha of urea, TSP and MP respectively and 10 t/ha of cowdung. Total amount of cowdung, TSP and 50 % of MP were applied during land preparation. The entire urea, and rest of MP were applied 3 equal installments at 15, 30 and 45 days after transplanting. Approximately the 39 days old seedlings were transplanted in 1st week of November/03.The harvesting was stated from 28^{th} December /03 which continued up to 8^{th} January/04. The collected data were compiled and arranged tabular form for presentation.

Result and Discussion

Among the two varieties, Rupa showed slightly higher yield than Pushail due to higher no. of outer leaves, total plant weight and weight of curd/plant (Table 1).

Farmers' reactions

➲ The farmers were interested to cultivate variety Rupa for its high yield and market demand.

Table 1. Yield and yield attributes of Rupa and check variety Pushali at FSRD site, Palima, Tangail during 2003-04

Variety	No. of outer leaves/plant	Total plant wt. (kg)	Curd wt. /plant (kg)	Marketable curd yield (t/ha)
Pushali	18.53	1.191	0.418	21.72
Rupa	19.68	1.201	0.437	22.50

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ON-FARM TRIAL OF RADISH VARIETIES

Abstract

The study was carried out at FSRD site Goyeshpur, Pabna, Ishan Gopalpur, Faridpur and MLT site, Magura during rabi season 2003-04 to observe the performance of newly developed radish varieties at farmer's field under different agro ecological zone. The highest root yield was obtained from Tasakisan at Pabna, Druti from Faridpur and Pinky from Magura.

Introduction

Radish (*Raphanus sativus*) is a most common and popular winter vegetable widely grown in Bangladesh. It occupies 54490 acres of land with a total annual production of 200840 tons. In Bangladesh average, yield of the crop is poor (3.69t ha^{-1}) compared to other radish growing countries (BBS, 2000). The reason behind this lower yield is the lack of high yielding variety of radish, Horticulture research centre of BARI has developed some high yielding radish varieties which needed multi-locations testing for wider adaptability. Therefore, the study was undertaken to observe the performance of newly developed radish varieties at different farmer's field.

Materials and Methods

The experiment was conducted at FSRD site Goyeshpur, Pabna, Ishan Gopalpur, Faridpur and Magura during rabi season 2003-04. The radish variety Druti and Pinky was included in the study with Tasakisan as check. The experiment was laid out in RCB design with four dispersed replications. The unit plot size was 10m x 5m. The crop was sown with spacing 30 cm x 30 cm. The land was fertilized with Cowdung, N, P, K and S at the rate of 10 t, 127 kg, 155kg, 31 and 133 kg ha^{-1} respectively. The entire amount of cowdung, P and half of N and K fertilizers were applied during final land preparation. The rest half of N and K were used as top dress after 20 and 30 days of sowing. The seeds were sown on 19 October 2003 at Pabna, 2 to 8 November at Faridpur and 3-6 November at Magura. The crop was harvested on 20 December 2003 to 7 January 2004 at Pabna and 11-15 January 2004 at Magura.

Results and Discussion

FSRD site Goyeshpur, Pabna

Maximum root length was obtained from Tasakisan (Table 1) which was significantly different from Druti and Pinky. Root diameter was found maximum in Druti which was similar with Tasakisan while the minimum was recorded from Pinky. The highest root yield per plant was recorded from Tasakisan which was at par with Durti. The highest root yield per hectare was obtained from Tasakisan, which was statistically identical to Druti while the lowest was recorded from Pinky.

Ishan Gopalpur, Faridpur

Plant/m^2 was very close in respect of different variety. Higher root length was recorded from local one (Table 2). BARI Mula 2 showed higher root weight/plant than the other two varieties. On an average, higher root yield was obtained from BARI Mula 2 (Pinky) and the lowest from Tasakisan.

Magura

Maximum root length was recorded for Pinky followed by Druti and the lowest from local one. Root breadth was similar to Pinky and Druti whereas lower breadth from local. The root weight also showed similar trend. The highest root yield was recorded from Pinky and the lowest from local one. All the yield attributes contributed higher yield in variety Pinky (Table 3).

Farmer's reaction

Variety Druty can be harvested within short time. Market price is moderate but root crack was found with the advance of harvest time. Pinky was smaller in size. It could be kept for longest days in the field at consumable condition having pungent smell. Market price was high with Pinky. Tasakisan is very good in all aspect.

Table 1. Yield and yield contributing characters of different variety of Radish (Pabna, 2003-04)

Variety	Root length (cm)	Root diameter (cm)	Root wt./ plant (kg)	Root yield/p lot (kg)	Root yield (t/ha)
BARI Mula 2 (Druti)	20.56b	5.44a	0.43a	237.58a	48.16a
BARI Mula 3 (Pinky)	20.15b	4.01b	0.26b	154.82b	31.91b
Tasakisan (check)	25.30a	5.26a	0.49a	257.46a	54.24a
CV (%)	7.8	9.3	18.0	12.7	11.5

Table 2. Plant/m^2, yield and yield attributes of different varieties of Radish (Ishan Gopalpur, Faridpur, 2002 to 2004

Variety	No. of plants/m^2	Root length (cm)	Root diameter (cm)	Root wt/plant (kg)	Root yield (t/ha)	
					2002-03	2003-04
BARI Mula 2 (Druti)	18	16	4.0	328	89.4	59.04
BARI Mula 3 (Pinky)	17	14	4.5	282	67.2	47.94
Tasakisan (check)	16	18	3.8	290	-	46.40

Table 3. Yield and yield contributing characters of radish varieties tested at MLT site Magura during 2003-04

Variety	Root length (cm)	Root breadth (cm)	Root wt (g)	Root wt/plot (kg)	Root wt. (t/ha)
Pinky	20.05	17.60	399	803	40.13
Druty	18.60	17.10	309	675	34.00
Local	13.89	13.89	221	203	10.12

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ON-FARM ADAPTIVE TRIAL OF BARLEY

Abstract

On-Farm performance of six Barley lines/varieties namely K163, BHL01, BHL02, BHL03, BB3 and BB4 were evaluated at Chowgacha, Jessore during the rabi season 2003-04. The line K163 and BHL03 produced the significantly highest grain yield among the lines.

Introduction

Barley (*Hordeum vulgare* L.) is the world's fourth important cereal after wheat, maize and rice. It is cultivated successfully in a wider range of climate than any other cereal. Hence barley has an importance to cultivate in marginal land where other cereals can not grow successfully. So, the present study was undertaken to evaluate the advanced lines in the farmer's field in order to release a new variety.

Materials and Methods

The experiment was conducted with four advance lines viz. BHL-01, BHL-02, BHL-03 and K-163 with BARI Barley-4 as local check variety at MLT site Chowgacha, Jessore during rabi 2003-04. The design was randomized complete block with three replications. Seeds of different entries were sown on 24 November, 2003. The unit plot size was 10m x 10m maintaining a spacing of 25cm between rows. Fertilizers were applied @ of 100-60-40 kg/ha N, P and K in the form of urea, triple super phosphate and muriate of potash respectively. Total amount of TSP, MP and half of urea was used as basal dose and rest half of urea in two equal splits after 1st and 2nd irrigation, respectively. Inter cultural operations were done as and when necessary. Data on days to 50% heading and maturity, plant height, plant population, spike length, number of grains per spike, 1000-grain weight, grain yield/plant, grain yield t/ha were recorded and analyzed statistically and means were separated by DMRT.

Results and Discussion

The performances of different characters are shown in Table 1. Significant differences were observed among the entries in respect of grain yield, plant population, plant height, 1000-grain weight and dry weight of straw. Higher plant/m2 was recorded from line BHL02 which was statistically identical to BB4 and BHL01 and local from BHL03. The line BB4 and BHL03 showed similar in height and higher than other lines. Length of spike, grains/spike were significantly influenced by different lines. Significantly the highest grain weight was recorded from line BHL03 and the lowest from BB4. Higher grain yield was produced from line K163 but statistically identical to BHL03. The line BHL03 and BHL02 showed similar straw weight and higher than other lines. Though the highest yield was recorded from K163 but the lowest straw yield was obtained from the line.

Conclusion: The line K163 and BHL03 showed similar yield but higher than other lines studied.

Table 1. Plant/m^2, plant height, yield and yield contributing characters of barley at MLT site, Chowgacha, Jessore during rabi 2003-04

Entries	Plant Pop./m^2	Plant height (cm)	Length of spike (cm)	Grain/spike	1000- gr. wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BHL-01	366.67ab	87.23c	8.97	47	32.97d	2.61bc	5.94c
BHL-02	381.67a	93.40b	8.77	47	37.67b	2.63b	7.06a
BHL-03	344.67c	99.47a	8.77	48	39.13a	2.70ab	7.17a
K-163	361.33b	81.67d	8.47	47	35.57c	2.75a	5.44d
BB-4	375.67ab	100.57a	8.90	46	28.10e	2.53c	6.39b
CV (%)	2.16	1.75	2.76	2.14	0.49	1.74	3.27
F-test	**	**	NS	NS	**	**	**

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ON-FARM VERIFICATION TRIAL OF QUALITY PROTEIN MAIZE ACROSS LOCATIONS

Introduction

Maize grain is one of the major feed of poultry birds. However as the available hybrid maize cultivars have low protein content, particularly low in lysine and triptophene. The poultry farm owners fortified the feed with costly artificial lysine and triptophane .But the recently developed quality protein maize (QPM) is rich in protein, especially it contains higher amount of lysine and triptophene than existing hybrid maize. At present farmers of different parts of the country grow hybrid maize (such as Pacific 11) with an average yield of 5.75 t ha^{-1}. Therefore, the trial was undertaken to verify the performance of QPM in comparison to commercial hybrid maize (Pacific 11) at different AEZ of Bangladesh.

Materials and Methods

Locations 10: Rangpur (AEZ-3), Pabna (AEZ-12), Bogra (AEZ-25), Manikganj (AEZ-7), Comilla (AEZ-19), Jamalpur (AEZ-8 & 9), Tangail (AEZ-8), Kushtia (AEZ-11), Jessore (AEZ 11) and Mymensingh (AEZ- 9). The experiment was sown from 23 November 2003 to 11 January 2004 across the country.

Fertilizer and other management: As recommended by BARI and CIMMYT (2003)
Fertilizer rate (kg ha^{-1}): N-156, P-55, K-138, S-3, B-1, Cowdung/compost-5000
Fertilizer application method: $^1/_3$rd of N and all other fertilizer and cowdung were applied as basal, rest half N $^1/_3$ was applied at 8-10 leaves stage and rest $^1/_3$ N at tasseling stage.

Results

Quality protein maize (QPM) cv. HQ 2000 was evaluated in comparison to commercial hybrid (Pacific 11) across ten (10) locations. On an average, over the location result showed that plant height, cobs/plant, grain/cob, 1000-seed weight were higher in Pacific 11 than the HQ 2000. The yield attributes were contributed higher grain yield in Pacific 11 (Table 1). Field duration were almost same both the variety/line. Higher gross return and gross margin showed in Pacific 11 due to higher yield but cost of cultivation is same. Benefit cost ratio was very close to each variety/line (Table 2).

Table 1. Grain yield and yield attributes of quality protein maize (HQ2000) and commercial hybrid (Pacific11) maize across 10 locations and 22 farmers, 2003-04

Variety	Plant height (cm)	Cobs/ 7.5m^2 (no)	Grains/ cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	199.65	33.69	420.15	325.91	8.36	148
Pacific 11	211.46	45.08	429.87	354.63	9.11	147
T-test (.05 with 9 df	-	-	-	-	NS	-

Table 2. Comparative economic performance of quality protein maize and commercial hybrid across 9 locations and 19 farmers, 2003-04

Variety	Gross return (Tk/ha)	Total cost (Tk/ha)	Gross margin (Tk/ha)	Benefit cost ratio (BCR)
HQ 2000	68640	22861	45779	3.00
Pacific 11	74000	22861	51139	3.23

Price (Tk./kg): QPM grain: 7.50, Pacific 11 grain: 8.00 & Maize straw: 0.50

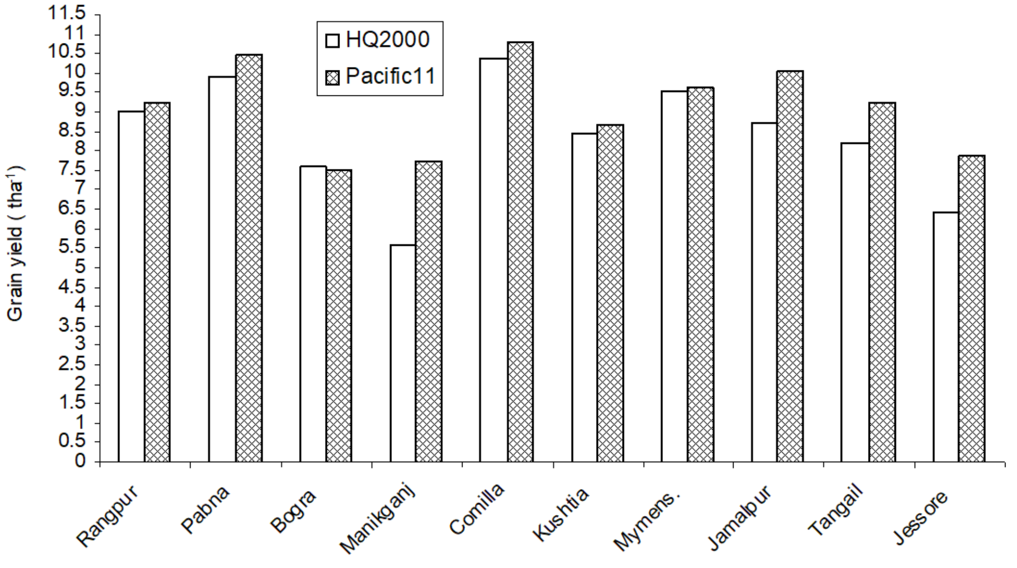

Fig. Grain yeild of Quality proten maize (HQ 2000) and Pacific11 across locations, 2003-04.

Farmers' feedback about QPM

- Ants ate the seeds in some locations after seeding
- Seedling vigor was less in comparison to Pacific 11
- Seed size is smaller than Pacific 11
- Market price was about 0.50 Taka / kg less than Pacific 11

Researchers' opinion

- Only properly treated seeds should be sown
- Grain yield of HQ2000 was almost equal to Pacific 11 in some location.
- More trial across locations over the years should be done before recommendation for farmers
- However, block production of QPM linking appropriate market should be explored

Appendices

Grain yield and yield attributes of quality protein maize (HQ2000) and commercial hybrid (Pacific11) maize, 2003-04

Rangpur,

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	200.10	50.83	434.33	325.91	8.99	146
Pacific 11	210.40	40.16	465.00	354.63	9.23	145

DS: 24-29 Nov, 2003

Pabna

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	173	37.36	-	-	9.89	160
Pacific 11	179	42.08	-	-	10.44	157

DS: 23-24 Nov, 2003

Bogra

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	183.1	40	-	294.33	7.6	147
Pacific 11	188.33	41	-	299..33	7.5	147

DS: 6-8 Dec, 2003

Manikganj

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	226	48	-	-	5.56	146
Pacific 11	243	58.5	-	-	7.71	146

DS: 25 Nov., 2003

Comilla

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	-	47.66	-	380.84	10.39	135
Pacific 11	-	46.00	-	390.23	10.8	133

DS: 5-11 Janu., 2004

Kushtia

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	183.6	44	545	355.0	8.43	148
Pacific 11	205	49	558	367.3	8.66	150

DS: 3-13 Dec, 2003

Jessore

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	203.6	39.97	483.03	284	6.42	139
Pacific 11	222.63	44.80	493.53	343	7.86	137

DS: 25 Nov to 13 Dec, 2003

Jamalpur

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	204.15	38.55	503	373.65	8.71	150
Pacific 11	221.9	40.95	471	408.8	10.05	150

DS: 12- 14 Dec, 2003

Mymensingh

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	243	39	487	347	9.50	144
Pacific 11	230	43	494	387	9.62	144

DS: 11 Dec, 2003

Tangail

Line/variety	Plant height (cm)	Cobs/7.5m^2 (no)	Grains/cob (no)	1000-seed weight (cm)	Grain yield (t/ha)	Field duration (days)
HQ2000	184.75	40.5	480	260.1	8.18	139
Pacific 11	213.00	43	497	310.7	9.26	136

DS: 1 Jan, 2004

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ADAPTIVE TRIAL OF HYBRID MAIZE LINES AT PABNA AND RANGPUR

The experiment was conducted at ARS, Pabna and ARS, Rangpur during 2003-04. The experiment was set up in RCBD with 3 replications. There were five advanced lines (GO-05001, GO-05002, GO-05003, GO-05004 & HG 2000) and one commercial variety (Pacific 11) which is currently used by the farmers. The experiment was sown on 15 December and 25 November 2003 and harvested ranges 139-146 days at Pabna and Rangpur. Fertilizers were used as per recommendation for hybrid maize. Three to four irrigations were given at different steps.

ARS, Pabna: Grain yield and yield attributes were significantly influenced by line/variety (Table 1). Significantly the highest leaf length and breadth was recorded from line GO-5002. Ear height was similar to Pacific 11 and HQ 2000. They were higher than other lines. Significantly the highest grain yield was recorded from Pacific 11. All the lines failed to show higher yield than Pacific 11. Similar trend was followed in case of straw yield.

ARS, Rangpur: Grain yield and yield attributes were significantly influenced by line/variety (Table 2). Plants/m^2 was significantly identical among the variety/line. Significantly the highest cobs/plant was recorded from Pacific 11 but seed weight was higher from GO-05001 but statistically identical to GO-05003 and NK-46. Though higher grain yield was recorded from GO-05001 but husk covered less (82%) than all the lines.

From one year result showed that Pacific 11 out yielded all the lines under the trials at Pabna but at Rangpur 3 less were found promising (GO-05001, GO-05003 & NK-46) and higher grain yield than Pacific 11. The trials should be continued for another year for confirmation.

Table 1. Yield and yield attributes of hybrid maize lines, ARS, Pabna (AEZ-12), 2003-04

Maize line	Days to 50% tasseling	Days to silking	Days to maturity	Plant height (cm)	Leaf length (cm)	Leaf breadth	Ear height (cm)	Grain yield (t/ha)	Stover yield (t/ha)
GO-05001	93c	99c	140a	210.55ab	72.25ab	7.46b	58.85e	8.96b	7.98c
GO-05002	95abc	101bc	139b	213.28ab	82.35a	9.08a	63.88bc	8.20c	8.36bc
GO-05003	96ab	105ab	139b	206.78ab	78.80ab	8.17b	67.68bc	8.16bc	8.22bc
GO-05004	97a	109a	146ab	200.78b	71.30b	7.68b	67.73bc	8.09c	6.89d
HG 2000	94bc	100bc	140ab	220.00a	76.55ab	8.21b	69.23ab	8.33bc	8.54b
Pacific 11	95bc	101bc	141a	215.68ab	78.90ab	9.01a	77.10a	10.46a	9.56a
CV (%)	1.5	3.0	0.6	4.3	8.1	6.3	8.5	5.0	3.5

Date of sowing: 15 December, 2003

Table 2. Yield and yield attributes of hybrid maize lines, ARS, Rangpur (AEZ-3), 2003-04

Maize cultivars	Plant height (cm)	Ear height (cm)	Plants/ m^2 (no.)	Days to maturity (days)	Cobs/ plant (no.)	1000-seed wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)	Stem and root lodging (%)	Dry rot infestation (%)	Cob covered with husk (%)
GO-05001	219.1b	90.5b	6.48	145c	1.10b	457.0a	12.19a	13.46a	4.1	99.9	81.7
GO-05002	218.6b	85.6b	6.57	148abc	1.03b	396.7b	11.80ab	12.76ab	6.1	83.3	96.7
GO-05003	206.8b	95.7b	6.40	150ab	1.13b	376.3bc	11.95a	12.85ab	6.2	35.0	97.0
GO-05004	205.3b	91.4b	6.35	146bc	1.03b	344.0d	10.76bc	11.38b	5.7	61.7	99.9
Pacific 11	210.8b	96.9b	6.43	151a	1.20b	365.7cd	10.72bc	12.00ab	4.3	20.0	84.3
NK-46	225.3ab	96.3b	6.57	151a	1.03b	382.0bc	11.97a	13.57a	5.4	28.3	99.9
HG 2000	241.8a	117.9a	6.35	149abc	1.50a	316.0e	10.54c	14.02a	7.2	11.7	99.9
CV (%)	5.1	9.6	4.0	1.8	6.9	3.9	5.4	9.3	-	-	-

Same letter in a column do not differ significantly at 5 % level of DMRT, Date of sowing: 25 November, 2003

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SUBPROJECT: CROPPING PATTERN BASED FERTILIZER MANAGEMENT

DEVELOPMENT OF FERTILIZER RECOMMENDATION FOR DIFFERENT CROPPING PATTERNS AND ENVIRONMENTS

Abstract

The experiment was conducted during 2000-03 at 7 (seven) locations, 2001-03 at one location and 2002-03 rest of the locations covering the major AEZs of the country to develop a cropping pattern based fertilizer recommendation for dominant cropping patterns under different AEZ. A total of 14 (fourteen) dominant cropping patterns across the country were tested against six different fertilizer management packages (soil test based fertilizer dose for MYG & HYG, IPNS for HYG, FRG '97, farmers practice and absolute control). In general, higher yield as well as gross margin was recorded from STB fertilizer dose for HYG (T_2) and IPNS (T_3) treatment over the locations. But marginal benefit cost ratio (MBCR) over control was higher in AEZ based fertilizer recommendation (FRG '97) and as well in STB fertilizer dose for MYG & HYG. In IPNS treatment due to cost of organic manure MBCR was less compared with other treatments. At some locations the experiment was completed for three cycles and recommendation were made and considering yield, economic return and long term soil fertility management were suggested for different cropping patterns.

Introduction

Soil fertility is a dynamic property which varies with crops, cropping intensity and input use. More than 50% of our cultivated soil contain organic matter below the critical level (1.5%). Annual depletion of plant nutrients in the intensively cropped area ranges from 180 to more than 250 kg/ha. High and medium highland comprising 60% of total cultivated land which is in most cases deficient in essential nutrients such as 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 did not use any organic fertilizers. Scarcity of fuel led them to use cowdung and crop residues as domestic fuel. Farmers usually use of fertilizers on single crop basis without considering the whole cropping pattern. But some of the nutrients by now knew to have considerable residual effect on the succeeding crops. BARC developed a national fertilizer recommendation guide '97 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 under different agro-ecological conditions.

Objectives

- To find out a cropping pattern based fertilizer recommendation for dominant cropping patterns
- To determine the economic use of fertilizer in promising pattern

Materials and Methods

The experiment was conducted at 7 locations during 2000-03, one location 2001-03 and 22 locations during 2002-03 under different AEZs on different cropping patterns. A total of 14 dominant cropping patterns were tested at 30 different locations. The experiment was laid out in RCB design with six dispersed replications. The following six fertilizer management packages were tested-

T_1 (ED1)	=	Estimated mineral fertilizer dose for moderate yield goal
T_2 (ED2)	=	Estimated mineral fertilizer dose for high yield goal
T_3 (IPNS)	=	Integrated Nutrient Management for HYG
T_4 (FRG '97)	=	Fertilizer dose from BARC Fertilizer Recommendation Guide'97
T_5 (FP)	=	Farmers' practice
T_6 (Control)	=	Absolute control

The treatment concept was to compare the soil test based (STB) mineral fertilizer dose for High Yield Goal (HYG), Moderate Yield Goal (MYG), the high yield goal integrated with organic manure with current BARC's Fertilizer Recommendation Guide '97 as well as the farmers prevailing practices. Details of the site characteristics and crop management 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	Location
1.	Mustard-Boro-T.Aman	Netrakona, Phulpur and Gabtali
2.	Wheat-Jute-T.Aman	Sherpur and Palima
3.	Boro-T.Aman	Joypurhat, Feni, Ishan Gopalpur, Sujanagar and Kolaroa,
4.	Potato-Jute-T.Aman	Narikeli and Melandah
5.	Groundnut-T.Aman	Atkapalia, Laxmipur and Natore
6.	Potato-T.Aman	Barind and Paba
7.	Potato-Boro-T.Aman	Syedpur
8.	Potato-T.Aus-T.Aman	Katiadi and Kishoreganj
9.	Boro-T.Aus-T.Aman	Chandina
10.	T.Aus-T.Aman	Golapganj, Moulvibazar and Jhalokati
11.	Mungbean-T.Aus-T.Aman	Bhola
12.	Mustard-Boro	Mymensingh and Kaliakoir
13.	Chilli - T.Aman	Lebukhali and Hathazari
14.	Maize - T.Aman	Goyeshpur

Fertilizer dose (kg/ha) of different cropping patterns tested in different locations

Netrakona

Treatment	Mustard (N-P-K-S-Zn-B-CD)	Boro rice	T.Aman rice
T_1	68-24-38-26	98-23-67-17	68-17-49-10
T_2	95-31-55-32	168-33-94-23	92-21-62-13
T_3	65-21-25-32-10 t/ha CD	168-33-94-23	92-21-62-13
T_4	70-15-25-15	120-18-20-5	60-8-30-4
T_5	48-13-13-0	133-12-15-11	85-0-0-0
T_6	0-0-0-0-0-0-0	0-0-0-0-0-0-0	0-0-0-0-0-0-0

Phulpur, Mymensingh

Treatment	Mustard (N-P-K-S-Zn-B-CD)	Boro rice	T.Aman rice
T_1	84-25-39-26	90-15-68-17	66-11-48-11
T_2	118-31-56-32	126-22-95-24	84-13-61-14
T_3	88-21-26-32	126-22-95-24	84-13-61-14
T_4	70-15-25-15	100-12-40-7	60-8-30-4
T_5	55-20-20-0	113-18-31-0	82-0-0-0
T_6	0-0-0-0-0-0-0	0-0-0-0-0-0-0	0-0-0-0-0-0-0

Gabtali, Bogra

Treatment	Mustard (N-P-K-S-Zn-B-Oilcake)	Boro rice	T.Aman rice
T_1	65-28-29-14-1-0.5-0	94-20-47-11-1.3-0	65-15-33-7-1-0
T_2	88-37-42-17-1.5-0.5-0	132-29-66-16-2-0	88-17-42-9-1.5-0
T_3	68-30-37-17-1.5-0.5-400	112-22-61-16-2-0-400	68-10-37-9-1.5-0-400
T_4	65-15-30-15-1-1-0	100-15-40-10-1-0	65-5-30-3-0
T_5	52-15-27-14--0-0	69-12-26-7-0-0	52-10-26-0-0
T_6	0-0-0-0-0-0-0	0-0-0-0-0-0-0	0-0-0-0-0-0-0

Sherpur

Treatment	Wheat (N-P-K-S-Zn-MOC)	Jute (N-P-K-S)	T.Aman (N-P-K-S)
T_1	100-20-50-17-1-0	80-15-50-10	70-10-40-7
T_2	125-30-75-27-1.5-0	120-20-80-20	100-15-50-10
T_3	75-10-50-27-1.5-500	90-10-70-20	75-7-44-10
T_4	80-17-40-12-1.0-0	30-4-15-20	70-8-25-4
T_5	30-22-28-0-0-0	30-25-31-12	58-3-31-0
T_6	0-0-0-0-0-0	0-0-0-0	0-0-0-0

Palima, Tangail

Treatments	Wheat (N-P-K-S-Zn-CD)	Jute (N-P-K-S)	T.Aman (N-P-K-S)
T_1	109-30-73-18-0.2	81-10-42-8	71-19-39-9
T_2	125-41-75-36-0.5	113-13-60-11	97-12-40-6
T_3	110-21-50-36-0.5-5t/ha CD	113-13-60-11	97-12-40-6
T_4	60-15-25-8-1	55-7-25-5-1	40-6-15-2
T_5	55-12-15-0-0	58-21-31-0	58-3-31-0
T_6	0-0-0-0	0-0-0-0	0-0-0-0

Joypurhat, Bogra

Treatments	Boro (N-P-K-S-Zn)	T.Aman (N-P-K-S-Zn)
T_1	97-25-60-17-105-0	67-11-42-6-0
T_2	136-35-83-23-2.0	91-14-54-8-0
T_3	121-30-68-23-2.0-CD 5 t/ha	76-9-44-8-0- CD 5 t/ha
T_4	110-25-65-15-1	75-12-40-5-0
T_5	87-26-40-3-1.0	71-10-23-0-0
T_6	0-0-0-0-0	0-0-0-0-0

Feni, Noakhali

Treatment	Boro (N-P-K-S-Zn-B-CD)	T.Aman
T_1	130-33-86-20-1.5-0	90-12-60-12-1
T_2	183-47-120-28-2-0	122-14-77-16-1.5
T_3	168-42-105-28-2-0 + CD 5t/ha	122-14-77-16-1.5
T_4	95-20-40-10-1	65-7-25-4-0
T_5	85-20-60-0	76-16-30-0
T_6	0-0-0-0-0-0	0-0-0-0-0

Ishan Gopalpur, Faridpur

Treatment	Boro (N-P-K-S-Zn-CD)	T.Aman (N-P-K-S)
T_1	64-18-25-10-1.5-0	44-9-4-3
T_2	90-25-30-14-2-0	60-10-4.5-4
T_3	75-20-15-40-2-5 t/ha	60-10-4.5-4
T_4	90-20-25-10-1.5-0	60-4-12-2
T_5	100-29-37-12-4-0	85-30-20-20
T_6	0-0-0-0-0-0	0-0-0-0

Sujanagar, Pabna

Treatment	Boro (N-P-K-S-Zn-B-CD)	T.Aman
T_1	94-27-20-16-0.29-1.0-0	64-13-15-5-0.2-1
T_2	133-38-20-22-0.38-1.0-0	87-16-15-7-0.3-1
T_3	108-18-3-22-0.38-+5000	87-16-15-7-0.3-1
T_4	100-20-35-10-1.5-0	70-8-20-4-0
T_5	93-29-35-0-0-0	113-21-29-15-0
T_6	0-0-0-0-0-0	0-0-0-0-0

Kalaroa, Khulna

Treatment	Boro (N-P-K-S-Zn)	T.Aman (N-P-K-S-Zn)
T_1	100-23-22-13-20	68-10-15-8
T_2	140-33-30-18-2.5	92-13-20-11
T_3	130-27-20-18-2.5+10 t/ha CD	92-13-20-11
T_4	100-20-35-10-1.5	70-6-20-4
T_5	138-30-37-0-2.7	135-30-37.5-0-5.4
T_6	0-0-0-0-0	0-0-0-0-0

Narikeli, Jamalpur

Treatment	Potato (N-P-K-S-Zn-MOC)	Jute (N-P-K-S)	T.Aman (N-P-K-S)
T_1	110-20-75-10-2-0	80-6-40-2	80-7-40-8
T_2	150-30-125-15-3-0	120-8-60-3	100-8-50-12
T_3	130-20-100-15-3-500	120-8-60-3	100-8-50-12
T_4	90-15-50-10-1-0	40-7-20-3	60-8-30-4
T_5	120-20-80-0-0-0	30-5-30-0	60-12-30-0
T_6	0-0-0-0-0-0	0-0-0-0	0-0-0-0

Melandah, Jamalpur

Treatment	Potato (N-P-K-S-Zn-B-CD)	Jute (N-P-K-S)	T.Aman (N-P-K-S)
T_1	90-20-70-7-1-0	70-8-40-5	65-8-30-3
T_2	130-30-100-11-1.5-0	100-10-50-7	90-10-35-4
T_3	100-20-70-11-1.5-10 t/ha CD	100-10-50-7	90-10-35-4
T_4	90-15-50-10-1-0	40-7-20-3	60-8-30-4
T_5	95-40-65-15-2.5-6 t/ha CD	45-2-0-0	90-7-10-0
T_6	0-0-0-0-0	0-0-0-0-0	0-0-0-0-0

Atkapalia, Noakhali

Treatment	Groundnut (N-P-K-S)	T.Aman (N-P-K-S)
T_1	21-33-24-0-0	66-12-22-0-1
T_2	30-43-34-0-0	90-14-29-0-1.5
T_3	15-38-19-0-0 + CD 5 t/ha	90-14-29-0-1.5
T_4	20-20-25-12-1	65-7-25-4-0
T_5	6-24-0-0-0	38-16-0-0 + CD 1.25 t/ha
T_6	0-0-0-0-0	0-0-0-0

Laxmipur, Noakhali

Treatment	Groundnut (N-P-K-S)	T.Aman (N-P-K-S)
T_1	20-30-10-0	60-12-14
T_2	30-40-15-0	80-15-23
T_3	18-35-10-0+ CD 5 t/ha	80-15-16
T_4	20-20-25-12	65-7-25-4
T_5	6-24-0-0	36-6-0-0
T_6	0	0

Natore, Rajshahi

Treatments	Groundnut (N-P-K-S-Zn-B)	T.Aman (N-P-K-S)
T_1	21-24-20-8-1.5-0	62-7-16-3
T_2	30-30-29-10-2.5-0	85-9-20-4
T_3	15-25-14-10-2.5 -0+ CD 5 t/ha	85-9-20-4
T_4	21-24-20-8-0-0	70-6-20-4
T_5	6-17-21-2-0-0	97-47-32-0
T_6	0-0-0-0-0-0	0-0-0-0

Barind, Rajshahi

Treatments	Potato (N-P-K-S-Zn-B)	T.Aman (N-P-K-S)
T_1	106-22-37-8-2.5-0.8	74-9-16-6
T_2	147-32-54-18-4-1.0	100-11-20-8
T_3	138-27-48-18-4-1.0 + Cd 10 t/ha	100-11-20-8
T_4	161-30-132-18-2.5-1.0	75-12-40-5
T_5	207-70-210-18-2-1.0	62-13-16-8
T_6	0-0-0-0-0-0	0-0-0-0

Paba, Rajshahi

Treatments	Potato (N-P-K-S-Zn-B)	T.Aman (N-P-K-S)
T_1	90-36-48-0-0-0	62-0-10-0
T_2	126-48-66-0-0-0	85-0-15-0
T_3	94-22-30-0-0 + CD 10 t/ha	85-0-15-0
T_4	100-48-48-8	70-6-20-4
T_5	172-119-186-22	62-25-15-8
T_6	0-0-0-0-0-0	0-0-0-0

Syedpur, Rangpur

Treatment	Potato (N-P-K-S-Mg-Zn-B-CD)	Boro (N-P-K-S)	T.Aman (N-P-K-S)
T_1	95-17-98-12-10-2-1-0	95-7-51-8	65-5-36-5
T_2	135-25-140-17-15-3-1.5-0	135-10-71-11-	90-7-46-7
T_3	105-15-110-17-15-3-1.5-10000	135-10-71-11	90-7-46-7
T_4	100-20-50-8-0-1-0-0	100-10-20-5	65-7-20-3
T_5	110-48-160-20-0-4-1-7500	69-0-0-0	97-18-28-0
T_6	0-0-0-0-0-0-0-0	0-0-0-0	0-0-0-0

Katiadi, Kishoreganj

Treatment	Potato (N-P-K-S-Zn-B-CD)	T.Aus (N-P-K-S)	T.Aman (N-P-K-S)
T_1	96-23-66-12-0	66- 8 – 21 – 05	66 –8 – 21 –05
T_2	135-32-107-17-0	90 - 9 – 29 – 6	90 – 9 – 29 – 6
T_3	120-27-92-17-5000	90 - 9 – 29 – 6	90 – 9 – 29 – 6
T_4	90-15-50-10 -0	60 – 08 – 30 – 04	60 – 08 – 30 – 04
T_5	124-51-150- 0-10000	50 – 10 – 17 – 0	52 – 14 – 25 – 02
T_6	0-0-0-0-0	0-0-0-0-0	0-0-0-0-0

Kishoreganj sadar

Treatment	Potato (N-P-K-S-Zn-B-CD)	T.Aus (N-P-K-S)	T.Aman (N-P-K-S)
T_1	90 – 20 – 69 – 11 – 0	61 – 7 – 24 – 05	61 – 7 – 24 – 05
T_2	120 – 29 – 98 – 16 – 0	84 – 8 – 31 – 6	84 – 8 – 31 – 6
T_3	111 – 24 – 83 – 16 – 5000	84 – 8 – 31 – 6	84 – 8 – 31 – 6
T_4	90 – 15 – 50 – 10 – 0	60 – 8 – 30 – 04	60 – 8 – 30 – 04
T_5	152 – 45 – 75 – 0 – 11000	50 – 0 – 0 – 0	96 – 16 – 24 – 0
T_6	0-0-0-0-0	0-0-0-0-0	0-0-0-0-0

Chandina, Comilla

Treatment	Boro (N-P-K-S-Zn)	T.Aus (N-P-K-S)	T.Aman (N-P-K-S)
T_1	83-13-48-12	57-5-33-4	57-5-33-4
T_2	117-18-67-16	78-6-43-5	78-6-43-5
T_3	102-13-52-16-5t/ha CD)	78-6-43-5	78-6-43-5
T_4	95-20-40-10	65-7-25-4	65-7-25-4
T_5	120-60-100	110-25-44	110-25-44
T_6	0-0-0-0	0-0-0-0	0-0-0-0

Golapganj, Sylhet

Treatment	T.Aus (N-P-K-S-Zn-B-CD)	T.Aman
T_1	68-17-41-4.8-0	68-9-41-2.4-0
T_2	93-21-53-6.4-0	93-11-53-3.2-0
T_3	78-16-38-6.4-0+CD (5 t/ha)	93-11-53-3.2-0
T_4	40-8-20-4-1	40-4-20-2-0
T_5	54-12-22-0-0	54-12-22-0-0
T_6	0-0-0-0-0-0	0-0-0-0-0

Moulvibajar, Sylhet

Treatment	T.Aus (N-P-K-S-Zn-B-CD)	T.Aman
T_1	66-14-32-3.6-0	66-7-32-1.8-0
T_2	90-16-41-4.8-0	90-8-41-2.4-0
T_3	75-11-26-4.8-0+CD (5 t/ha)	90-8-41-2.4-0
T_4	40-8-20-4-1	40-4-20-2-0
T_5	64-10-17-0-0	64-10-17-0-0
T_6	0-0-0-0-0-0	0-0-0-0-0

Jhalokati, Barisal

Treatment	T.Aus (N-P-K-Zn)	T.Aman (N-P-K-Zn)
T_1	60-15-0-0.5	66-5-0-0
T_2	80-16-0-1	96-7.5-0-0
T_3*	70-6-0-1	96-7.5-0-0
T_4	50-5-35-2	44-7.5-35-0
T_5	40-8-0-0	40-8-0-0
T_6	0-0-0-0	0-0-0-0

*3 t/ha CD were applied in T_3 treatment

Bhola, Barisal

Treatment	Mungbean (N-P-K-S)	T.Aus (N-P-K-S)	T.Aman (N-P-K-S)
T_1	20-10-8-1	54-6-20-1	74-7-20-3
T_2	25-15-8-1.5	77-7.5-20-3	100-8-20-4
T_3*	10-10-8-1.5	77-7.5-20-3	100-8-20-4
T_4	12-8-8-6	35-4-20-2	30-3-20-2
T_5	0-0-0-0	40-8-35-0	40-8-35-0
T_6	0-0-0-0	0-0-0-0	0-0-0-0

*3 t/ha CD were applied in T_3 treatment

Mymensingh

Treatment	Mustard (N-P-K-S-Zn-B-CD)	Boro (N-P-K-S-Zn-CD)
T_1	86-26-44-26-0.5	93-13-33-7
T_2	120-34-64-32-1	130-19-45-9
T_3	90-24-34-32-1-1o t/ha CD	130-19-45-9
T_4	70-15-25-15	100-12-50-7
T_5	54-60-15-0	115-8-14-4
T_6	0-0-0-0	0-0-0-0

Kaliakoir, Gazipur

Treatment	Mustard (N-P-K-S-Zn-B-CD)	Boro (N-P-K-S-Zn-CD)
T_1	67-22-25-16-1-0.5	98-13-45-5-1
T_2	99-28-36-19-2-0.5	138-19-63-7-1.5
T_3	84-23-21-19-2-0.5 + CD 5 t/ha	138-19-63-7-1.5
T_4	60-15-10-10-0-0-0	100-15-35-6-1
T_5	145-50-32-0-0-0	115-35-26-7-0
T_6	0-0-0-0	0-0-0-0

Lebukhali, Patuakhali

Treatment	Chilli (N-P-K-S)	T.Aman (N-P-K)
T_1	95-81-76	46-15-25
T_2	123-105-98	65-19-35
T_3	93-95-68 + CD 10 t/ha	65-19-35
T_4	65-40-50	30-3-15
T_5	60-25-0	60-0-0
T_6	0-0-0	0-0-0

Hathazari, Chittagong

Treatment	Chilli (N-P-K-S-B)	T.Aman (N-P-K)
T_1	106-17-106-18-1	71-5-32-5
T_2	138-22-138-23-1	97-5-41-6
T_3	108-3-117-23-1-3 t/ha PM	97-5-41-6
T_4	100-40-70-15	45-4-20-3
T_5	93-57-82-0	43-23-0-0
T_6	0-0-0	0-0-0

Goyeshpur, Pabna

Treatments	Maize (N-P-K-S-Zn-B)	T.Aman (N-P-K-S-Zn)
T_1	139-45-58-24-5.5-0.6	61-11-18-4
T_2	181-59-76-31-5.5-0.7	84-13-23-6
T_3	115-41-53-18-5.5-0.7-5 t/ha PM	84-13-23-6
T_4	260-55-114-34-5.5-0.8	70-6-20-4
T_5	173-38-94-27-5	75-16-29-4
T_6	0-0-0-0-0	0-0-0-0-0

Results and Discussion

CP : Mustard-Boro-T.Aman
Year : 2002-03

Netrakona, Mymensingh (AEZ 9)

No significant yield difference in seed yield of Mustard was observed among the treatments except with Farmers' practice (T_5) and no fertilizer (T_6) treatment. Different levels of nutrient dose failed produce significant difference in Mustard yield. Farmers' usually apply lower amount of NPK and they do not apply any S fertilizer, therefore yield is very low. The lowest seed yield (353 kg/ha) was obtained from control treatment (T_6). More or less similar trend was observed in stover yield also. In Boro rice the highest grain yield was recorded from T_3 that was also identical to T_2 and T_4. STB fertilizer dose for MYG (T_1) produced significantly lower yield against FRG '97 (T_4). Similarly, in T.Aman rice the highest grain yield was recorded from T_3 which was statistically identical to T_2. Almost similar trend was found in straw yield of rice crops.

From the cost and return analysis it was found that the highest gross margin was obtained from T_2 followed by T_3. But marginal benefit cost ratio (MBCR) over control was higher in T_4 and T_5 due to less fertilization cost in comparison to other fertilizer packages. However, gross return as well as gross margin was higher in T_2 and T_3 but due to higher fertilization cost MBCR was less.

Table 1. Yield, cost and return analysis of Mustard -Boro-T.Aman cropping pattern as influenced by different fertilizer packages at Netrakona, Mymensingh during 2002-03

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR	TVC	GM	MBCR
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman				
T_1	630a	5.52c	3.58c	1382bc	6.38b	5.04a-c	89041	10438	78603	3.58
T_2	720a	6.26ab	4.08a	1760ab	6.96a	5.64a	101170	14439	91756	3.43
T_3	800a	6.38a	3.96ab	2010a	7.03a	5.56ab	102830	15234	87596	3.36
T_4	650a	5.98ab	3.73bc	1820ab	6.75ab	5.06bc	94505	9258	85247	4.63
T_5	280b	5.87bc	3.21c	990c	6.68ab	4.63c	81455	6066	75389	4.91
T_6	58c	3.33d	2.75d	353d	3.53c	3.29d	51622	0	51622	-

Phulpur, Mymensingh (AEZ 9)

Mustard was not possible to establish due to heavy rainfall in November. Therefore, the experiment was started with Boro rice. The highest grain yield in Boro rice was recorded from STB fertilizer dose for HYG (T_2) that was also identical to IPNS (T_3). Response of Boro rice to higher nutrient level was observed to some extent. But in T.Aman rice no significant difference in grain yield was observed among the treatments except with Farmers' practice (T_5) and no fertilizer treatment (T_6). However the soil was deficit in NPK and S but response of higher level of fertilizers was not evident. In case of straw significantly higher yield was obtained from T_2, T_3 and T_5 in Boro rice. In T.Aman rice T_2 and T_3 gave significantly higher yield.

From the cost and return analysis it was found that the highest gross return as well as gross margin obtained from T_2 followed by T_3. Similarly MBCR was also higher in T_2 but due to additional cost for cowdung gave the lowest MBCR in T_3.

Table 2. Yield, cost and return analysis of Mustard -Boro-T.Aman cropping pattern as influenced by different fertilizer packages at Phulpur, Mymensingh during 2002-03

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR	TVC	GM	MBCR
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman				
T_1	-	4.76cd	4.43a	-	4.86b	6.74b	76940	5868	71072	3.15
T_2	-	5.43a	4.55a	-	5.23a	7.41a	83445	7908	75537	3.16
T_3	-	5.12ab	4.41a	-	5.28a	7.24a	79940	10775	69165	1.99
T_4	-	4.40d	4.17ab	-	4.54b	6.62bc	71940	5262	66678	2.56
T_5	-	4.96bc	3.90b	-	5.54a	6.38c	74360	4477	69883	3.55
T_6	-	3.49e	3.42c	-	4.09c	5.76d	58460	0	58460	---

Gabtali, Bogra (AEZ 25)

Higher seed yield of Mustard was recorded from STB fertilizer dose for HYG (T_2) followed by IPNS (T_3). Fertilizer dose for MYG both STB and FRG '97 (T_1 and T_4) gave similar yield. Farmers dose (T_5) also produced identical yield with T_4. Almost similar trend was observed in stover yield. Similar trend was followed in boro rice. Fertilizer doses for MYG (STB & FRG '97) produced similar yield. Almost similar result was found in straw yield. But in T.Aman rice significantly the highest grain yield was recorded from T_2. In case of straw higher yield was obtained in T_2 followed by T_3 and T_4.

Cost and return analysis showed that highest gross return as well as gross margin was obtained from T_2 followed by T_3. MBCR was almost similar and the value is more than 3 in all the treatments except T_3. Due to higher fertilization cost the value was lowest in T_3.

Table 3. Yield, cost and return analysis of Mustard -Boro-T.Aman cropping pattern as affected by fertilizer levels at Gabtali, Bogra during 2002-03

Treat.	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman				
T_1	0.61b	5.03b	1.84bc	2.55b	5.65b	2.76bc	63610	10894	52716	3.02
T_2	1.01a	5.66a	2.31a	2.91a	5.94a	3.29a	79440	14763	64677	3.30
T_3	1.00a	5.53a	2.01b	2.88a	5.82ab	3.20ab	76400	18738	57662	2.44
T_4	0.59bc	4.95b	1.70cd	2.50b	5.31c	2.94ab	61650	8402	53248	3.69
T_5	0.540 c	4.25c	1.52de	2.39b	5.1c	2.81bc	54650	6557	48093	3.66
T_6	0.238d	2.23d	1.31e	0.30	2.67d	2.42c	30615	0	30615	-

Price (Tk./kg): Urea = 5.5, TSP= 14.5, MP= 9.5, Gypsum= 3 & Zinc Sulphate= 50

Output Cost: Mustard = 20, Boro Rice = 6.5 & Straw = 0.5, T.Aman Rice = 6.5 & Straw = 0.5.

CP : Wheat-Jute-T.Aman
Year : 2002-03

Sherpur, Jamalpur (AEZ 9)

Grain yield of Wheat did not vary significantly among the treatments T_1, T_2 & T_3 except T_4, T_5 and T_6. Response of wheat to higher level of nutrients was not evident. Farmers' practice produced identical yield with FRG '97. Similar trend was observed in straw yield. In Jute, the higher fibre yield was recorded from T_3 followed by T_3, T_4 and T_1. Jute stick yield was significantly higher in T_2. In T.Aman rice almost similar trend was found in grain yield as well as in straw yield where higher grain yield was recorded from T_2 followed by T_1 & T_3.

From Cost and return analysis it was found that the highest gross margin was calculated from STB fertilizer dose for HYG (T_2) followed by T_1. Regarding MBCR the highest value was obtained from T_4 (FRG '97) due to less fertilization cost. Increase the fertilization cost reduces the MBCR and therefore, MBCR was less in T_1 and T_2. The lowest MBCR was obtained in IPNS.

Table 4. Yield, cost and return analysis of Wheat-Jute-T.Aman cropping pattern as affected by different fertilizer packages at Sherpur, Jamalpur during 2002-03

Treat.	Grain/fibre yield (t/ha)			Stover/stick/ straw yield (t/ha)			GR (Tk/ha)	TVC (Tk/ha)	GM (Tk/ha)	MBCR
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman				
T_1	3.14a	2.69a	4.64a	4.34ab	3.59b	5.15a	91045	12609	78436	5.14
T_2	3.18a	3.08a	4.78a	4.21b	4.28a	5.47a	98435	15129	83306	4.77
T_3	3.41a	2.91a	4.61a	4.60a	3.78b	5.39a	90936	17970	72966	3.60
T_4	2.70b	2.88a	4.31b	3.59c	3.82b	4.87b	85380	8824	76556	6.70
T_5	2.83b	2.04b	4.16b	3.69c	3.13c	4.46b	78905	9079	69826	5.79
T_6	0.68c	1.01c	1.31c	1.06d	1.41d	2.61c	26285	0	26285	-

Output (kg/Tk):Wheat =7.00, T.Aman rice = 7.00, Jute (fibre)= 6.25, Jute stick = 0.75, Rice straw = 0.75, Wheat straw = 0.50
Inputs (kg/Tk):Urea= 5.60, TSP = 12.40, MP = 9.40, Gypsum = 4.00, Zinc sulphate = 25.00, Mustard oil cake = 10.00

Palima, Tangail (AEZ 8)

Higher grain yield of Wheat was obtained from T_3 (IPNS) which was statistically identical to T_2 and T_1. Response of wheat to higher level of nutrients was observed to some extent. Similar trend was observed in straw yield. In Jute, significantly higher fibre yield was recorded from IPNS (T_3). STB fertilizer dose for MYG (T_1) produced significantly higher yield over FRG '97 (T_4). The highest stick yield was obtained from T_3 that was also similar to T_2 and T_1. Similarly in T.Aman rice significantly higher grain yield was recorded from T_3. No significant yield difference was observed in T_2, T_1 and T_4. The highest straw yield was obtained from T_1 that was similar to T_2 and T_3.

From Cost and return analysis it was found that the highest gross return as well as gross margin was calculated from IPNS based fertilizer dose (T_3) followed by T_2. Regarding MBCR the highest value was obtained from T_4 (FRG '97) due to less fertilization cost followed by FP (T_5). Increase the fertilization cost reduces the MBCR and therefore, MBCR was less in T_1, T_2 and T_3.

Table 5. Yield, cost and return analysis of Wheat-Jute-T.Aman cropping pattern as influenced by different fertilizer packages at Palima, Tangail during 2002-03

Treat.	Grain yield (t/ha)			Stover/stick/ straw yield(t/ha)			GR	VC	GM	MBCR
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	(Tk/ha)	(Tk/ha)	(Tk/ha)	
T_1	2.89ab	2.58c	3.51b	3.77ab	5.45ab	4.01a	89705	11285	78420	4.28
T_2	3.05a	2.89b	3.64b	3.91a	5.59ab	3.91a	95195	12455	82740	4.32
T_3	3.30a	3.19a	4.12a	4.01a	5.91a	3.77ab	103770	13942	89828	4.47
T_4	2.83b	2.39d	3.55b	2.91c	5.20b	3.12bc	86200	5695	80505	7.87
T_5	2.29c	2.25e	3.27c	3.12bc	4.65c	2.91c	77280	5960	71320	6.02
T_6	1.31d	1.06f	1.62d	2.64c	2.67d	2.64c	41355	0	41355	-

Price of inputs (Tk./ka): Urea = 6, TSP= 12, MP = 10, Gypsum= 5, Zinc sulphate= 35 and Cow dung = 0.50
Price of output (Tk./ha): Grain (wheat) = 7.50, grain (rice) =7, Fibre =.9, Straw= 0.05 and stick = 3

CP : Boro -T.Aman
Year : 2000-01 to 2002-03

Joypurhat, Bogra (AEZ 25)

Average of three years results showed that higher and identical grain yield was recorded from IPNS (T_3) and STB fertilizer dose for HYG (T_2). Similar yield was also obtained in STB fertilizer dose (T_1) and FRG '97 (T_4) which was higher than Farmers' practice (T_5). The lowest yield was recorded from no fertilizer treatment (T_6). The trend was same over the years. Almost similar result was found in straw yield. Effect of organic manure applied in IPNS (T_3) was not evident. In T.Aman rice the trend was same and higher grain yield was recorded from T_3 and T_2 in 2001-02 but other years and mean showed that significantly the highest grain yield was recorded from T_3. Response of cowdung on the yield of T.Aman rice was observed to some extent. More or less similar trend was found in straw yield.

Cost and return analysis showed that higher gross return as well as gross margin was recorded from T_3 followed by T_2. MBCR over control was the highest in T_3 but closely followed by other treatments. However, in T_3 cowdung @10 t/ha was applied but fertilization cost did not increase as the price of cowdung was very chief. Based on three years of experimentation IPNS based fertilizer dose could be recommended for the cropping pattern for higher yield and economic return as well as for sustainable soil fertility.

Table 6. Yield of crops as influenced by different fertilizer packages in Boro-T.Aman cropping pattern at Joypurhat, Bogra during 2000-01 to 2002-03

Treatment	2000-01		2001-02		2002-03		Mean	
	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman
				Grain yield (t/ha.)				
T_1	4.31e	4.04c	4.39de	4.15c	5.32b	3.79c	4.673b	3.99c
T_2	5.24bc	4.82b	5.24bc	4.67ab	5.78a	4.18b	5.422a	4.56b
T_3	5.35b	5.00a	5.26bc	4.79a	5.85a	4.47a	5.487a	4.75a
T_4	4.30e	4.24c	4.35e	4.18c	5.10c	3.81c	4.581b	4.07c
T_5	3.75f	3.68d	3.83f	3.47d	4.58d	3.08d	4.052c	3.41d
T_6	2.78g	2.39e	2.73g	2.13e	2.71g	1.9e	2.737d	2.14e
				Straw yield (t/ha.)				
T_1	8.51d	8.62de	8.76cd	8.85c-e	6.20j	4.63ij	7.825c	7.37d
T_2	8.84c	9.57ab	9.99a	9.21bc	6.95i	5.42gh	8.591b	8.07b
T_3	9.13b	10.06a	10.01a	9.81a	7.28h	5.85g	8.808a	8.57a
T_4	7.95f	8.79c-e	8.98bc	9.14b-d	6.08j	5.13hi	7.730c	7.69c
T_5	7.68g	8.49ef	8.23e	8.04f	5.50k	4.18j	7.136d	6.90e
T_6	5.68k	5.79g	6.16j	5.37gh	3.77i	3.11k	5.202e	4.75f

Table 7. Cost and return analysis of Boro -T.Aman cropping pattern as influenced by different fertilizer packages at Joypurhat, Bogra during 2000-01 to 2002-03 (Average)

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	63907	7255	56652	2.76
T_2	73214	9873	63341	2.70
T_3	75335	9803	65532	2.95
T_4	63942	7478	56464	2.65
T_5	55521	5949	49572	2.17
T_6	36662	0	36662	-

* Variable Cost = Fertilizer Cost only

Input cost (Tk./kg): Urea= 5.5, TSP= 14.5, MP= 9.5, Gypsum= 3. $ZnSO_4$= 50 &Cowdung= 150.
Output price (Tk./kg): T.Aman rice= 6.50, Boro rice= 6.50, Rice straw= 0.50 (In both cases).

Feni, Noakhali (AEZ 18)

Grain yield of Boro rice was significantly the highest in T_3. Effect of cowdung on the yield of Boro rice was evident. Similarly, in T.Aman rice significantly the highest grain yield was obtained from T_3. Response to higher levels of nutrients and organic manure to both the rice crops was observed. Similar result was found in case of straw yield of Boro and T.Aman rice. STB fertilizer dose for MYG produced significantly higher yield over FRG '97 in all the crops.

Cost and return analysis showed that the highest gross margin was recorded from T_3 followed by T_2. But MBCR was the highest in FRG '97 (T_4) due to less fertilization cost. However, yield as well as gross margin was higher in IPNS treatment (T_3) but due to higher fertilization cost MBCR was the lowest.

Table 8. Yield, cost and return analysis of Boro -T.Aman rice cropping pattern as affected by fertilizer levels at Feni, Noakhali during 2002-03

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Boro	T.Aman	Boro	T.Aman				
T_1	5.30c	5.16c	5.10c	4.96c	91140	10352	80788	4.44
T_2	5.68b	5.45b	5.47b	5.25b	97095	14137	82958	3.68
T_3	5.86a	5.75a	5.65a	5.55a	101415	15755	85660	3.57
T_4	4.63d	4.88d	4.43d	4.68d	82590	5947	77003	6.36
T_5	3.95e	4.15e	3.75e	3.95e	69900	6639	63261	3.73
T_6	2.60f	2.74f	2.40f	2.55f	45135	0	45135	-

Inputs price (Tk./kg): Urea= 6.00, TSP= 15.00, MP= 10.00, Gypsum= 5.00, Zinc sulphate = 40.00
Output price (Tk./kg): Grain = 7.50 & Straw = 1.50 (* Variable Cost = Fertilizer Cost only)

Ishan Gopalpur, Faridpur (AEZ 12)

Average of three years results showed that the highest grain yield of Boro rice was obtained in IPNS based fertilizer dose (T_3). Other fertilizer doses produced almost similar yield and only differed with no fertilizer treatment. Results over the years did not vary appreciably and significantly the highest grain yield was obtained in T_3 in all the years. Effect of cowdung applied in IPNS (T_3) treatment on the grain yield of Boro rice was evident. In case of straw the trend was almost same but results were varied over the years. In T.Aman rice almost similar result was observed but higher grain yield was recorded from T_3 followed by T_2. However, grain yield varied slightly over the years. During 2000-01 and 2002-03, significantly higher yield was recorded from T_3. But in 2001-02, grain yield did not differ significantly among the treatments except with T_1 and T_6. More or less similar result was observed in straw yield.

Cost and return analysis of three years average showed that the highest gross return as well as gross margin was obtained from T_3. MBCR over control was highest in T_4 due to less fertilization cost. Treatment T_3 and T_2 also gave higher and satisfactory MBCR, however it was little bit less due to higher fertilizer cost. In Farmers' practice fertilization cost was highest and therefore, MBCR was the lowest. Based on three years of study IPNS based fertilizer dose could be recommended for the cropping pattern at Faridpur for higher yield, economic return as well as for sustainable crop production.

Table 9. Yield of crops as influenced by different fertilizer packages in Boro-T.Aman cropping pattern at Ishan Gopalpur, Faridpur during 2000-01 to 2002-03

Treatment	2000–01		2001–02		2002–03		Mean	
	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman
Grain yield (t/ha.)								
T_1	5.13b	3.67bc	5.48c	3.77bc	5.41c	3.94c	5.34	3.79
T_2	5.42b	4.07b	5.74bc	3.98ab	5.65b	4.20b	5.60	4.08
T_3	6.18a	4.20a	6.56a	4.13a	6.62a	4.32a	6.45	4.21
T_4	5.33b	3.93bc	6.00b	3.78a	5.73b	3.98c	5.69	3.90
T_5	5.20b	3.81c	5.89bc	3.46a	5.68b	3.74d	5.59	3.67
T_6	2.87c	2.57d	2.84d	2.41c	2.64d	2.39e	2.78	2.45
Straw yield (t/ha.)								
T_1	6.60c	5.01b	6.95c	4.72b	5.80e	4.10c	6.45	4.61
T_2	6.85b	5.21a	7.27bc	4.82ab	5.87d	5.50a	6.66	4.84
T_3	7.68a	5.16ab	7.81a	4.89a	6.70b	4.55b	7.40	4.86
T_4	6.90b	5.00b	7.54ab	4.79ab	5.80c	4.20c	6.75	4.66
T_5	6.75b	4.57c	7.42ab	4.49c	5.95a	4.00d	6.70	4.35
T_6	4.05d	3.80d	3.67d	3.45d	3.58f	3.70e	3.76	3.65

Table 10. Cost and return analysis of Boro -T.Aman cropping pattern as influenced by different fertilizer packages at Ishan Gopalpur, Faridpur during 2000-01 to 2002-03 (Average)

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	66073	4423	63003	5.96
T_2	71243	5338	65839	5.91
T_3	77463	6847	70617	5.51
T_4	70108	4898	65210	6.21
T_5	67597	8336	59259	3.31
T_6	39675	0	39675	-

* Variable Cost = Fertilizer Cost only

Input price (Tk./kg): Urea = 6.50, TSP = 11.00, MP = 9.00, Gypsum = 3.00 & Cowdung = 0.40

Output price (Tk./kg): Boro rice = 7.00, T.Aman rice= 6.50 & Rice straw = 0.50

Sujanagar, Pabna (AEZ 11)

No significant yield difference was observed among the treatments except with control. Effect of higher levels of fertilizer was not evident and farmers' practice also gave similar yield. However soil nutrient status was low to very low but effect of fertilizer was not reflected in the grain yield of Boro rice. In case of straw, higher yield was recorded from T_3 which was identical to T_2. In T.Aman rice almost similar trend was found in grain yield. Yield was differed only with Farmers' practice (T_5) and no fertilizer treatment (T_6). But significantly higher straw yield was obtained in T_3. But other treatments did not vary significantly except with control (T_6).

From cost and return analysis it was found that the highest gross return as well as gross margin was obtained from IPNS (T_3) treatment followed by STB fertilizer dose for HYG (T_2) & FRG'97 (T_4). But MBCR was the highest in T_4 due to less fertilization cost. MBCR was also satisfactory in T_2 and T_3.

Table 11. Yield, cost and return analysis of Boro -T.Aman rice cropping pattern as affected by fertilizer levels at Sujanagar, Pabna during 2002-03

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Boro	T.Aman	Boro	T.Aman				
T_1	4.61a	3.39ab	6.32b	5.00b	62508	6510	55998	3.97
T_2	5.00a	4.00a	6.55ab	5.06b	69805	7880	61925	4.03
T_3	5.22a	4.25a	7.72a	5.98a	74203	8657	65546	4.09
T_4	4.62a	4.05a	6.23b	5.01b	67323	6428	61895	5.85
T_5	4.88a	3.58b	6.45b	5.08b	65880	7406	58474	3.82
T_6	1.40b	2.26c	3.37c	4.56c	30150	0	30150	-

* Variable Cost = Fertilizer Cost only

Kolaroa, Khulna (AEZ 13)

During 2000-01 grain yield of Boro rice did not vary significantly among the treatments except with control treatment but in 2001-02 significantly higher yield was recorded from IPNS treatment (T_3) which was identical to STB fertilizer dose for HYG (T_2). Similarly during 2002-03 the highest yield was obtained in T_3 that was similar to Farmers' practice (T_5). Average of three years data also showed that the highest grain yield was recorded from IPNS (T_3) based fertilizer dose followed by FP (T_5). Farmers' dose is very close to recommended fertilizer dose for HYG and that's why the yield was quite good. Fertilizer doses for MYG (STB & FRG '97) produced similar yield. More or less similar trend was found in straw yield. Initial soil nutrient status data showed that the soil is deficit in NP and S and therefore, a positive effect of higher levels of nutrients was apparent on rice. However, the trend was slightly varied over the years. In T.Aman rice, grain yield did not vary appreciably among the different treatments. Higher and similar yield was recorded from treatment T_2, T_3 and T_5. Fertilizer doses for MYG T_2 and T_4 also produced similar yield. The trend did not vary markedly over the years. Almost similar trend was observed in straw yield.

Cost and return analysis from average of three years data showed that highest gross return was obtained from T_3 closely followed by T_5 and T_2. But the highest gross margin was recorded from T_2. Due to higher fertilization cost in IPNS treatment gross margin was less and MBCR was the lowest. As the fertilizer cost is less in T_4 the MBCR was the highest. Based on three years of study STB fertilizer dose for HYG and IPNS based fertilizer dose could be recommended for the cropping pattern in terms of yield and economic return as well as for sustainable soil fertility.

Table 12. Yield of crops as influenced by different fertilizer packages in Boro-T.Aman cropping pattern at Kolaroa, Khulna during 2000-01 to 2002-03

Treatment	2000-01		2001-02		2002-03		Mean	
	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman	Boro	T.Aman
Grain yield (t/ha.)								
T_1	5.16a	4.40a	5.37b	3.90cd	4.62c	4.33b	5.05	4.21
T_2	5.95a	4.77a	5.87ab	4.70ab	4.93bc	4.85ab	5.58	4.77
T_3	5.72a	4.45a	6.37a	4.90ab	5.88a	5.07a	5.99	4.81
T_4	5.15a	4.40a	5.37b	4.30bc	5.12bc	4.57ab	5.21	4.42
T_5	5.70a	4.37a	5.75b	5.10a	5.50ab	5.14a	5.65	4.87
T_6	3.85b	2.95b	3.37c	3.37d	3.38d	3.27c	3.53	3.19
Straw yield (t/ha.)								
T_1	4.75b	4.95a	5.50a	4.50bc	5.50b	5.33b	5.25	4.92
T_2	5.81a	5.15a	6.12a	5.20b	5.75b	5.47ab	5.89	5.27
T_3	5.69a	4.82a	6.52a	5.15b	6.50a	6.05a	6.23	5.34
T_4	4.81b	4.90a	6.12a	5.20b	6.00ab	5.67ab	5.64	5.25
T_5	5.10b	4.70a	6.25a	6.10a	6.50a	6.05a	5.95	5.61
T_6	3.37c	3.65b	3.75b	6.12c	4.00c	4.02c	3.70	4.59

Table 13. Cost and return analysis of Boro -T.Aman cropping pattern as influenced by different fertilizer packages at Kolaroa, Khulna during 2000-01 to 2002-03 (Average)

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	66823	6810	62013	2.66
T_2	74663	9463	65200	2.74
T_3	77845	14201	63644	2.06
T_4	69705	6615	63090	3.14
T_5	75971	12282	63689	2.21
T_6	48686	0	48686	-

Variable Cost = Fertilizer Cost only
Price (Tk/kg)= Urea = 6.00, TSP= 14.00, MP= 10.00, Gypsum= 4.00, $ZnSO_4$= 80.00, Cow dung=0.50, Rice grain= 7.00, Rice straw= 0.50

CP : Potato-Jute-T.Aman
Year : 2002-03

Narikeli, Jamalpur (AEZ 9)

Tuber yield of Potato did not vary significantly among the treatments except with no fertilizer treatment. Effect of higher levels of fertilizers as well as organic manure on the yield of Potato was not evident. However, the highest yield was obtained in STB fertilizer dose for MYG (T_1). In Jute higher and identical fibre yield was recorded from T_1, T_2 and T_3. Fibre yield did not vary significantly in STB fertilizer doses for MYG and HYG. Almost similar trend was found in stick yield of Jute. In T.Aman rice higher grain yield was recorded from STB fertilizer dose for HYG (T_2) followed by IPNS (T_3). Effect of higher doses of nutrients was observed in T.Aman rice. Fertilizer dose for MYG (STB & FRG '97) produced identical yield with Farmers practice. Similar result was obtained in straw yield. In all cases the lowest yield was obtained from no fertilizer (T_6).

From the cost and return analysis it was found that the highest gross margin was obtained from T_1 followed by T_3. But marginal benefit cost ratio (MBCR) over control was highest in T_4 due to low fertilization cost in comparison to other fertilizer packages. With the increase of fertilization cost decreases the MBCR and the lowest figure were obtained from IPNS (T_3) due to the additional cost of mustard oil cake (MOC). Considering yield as well as economic return STB fertilizer dose for MYG was found superior over other fertilizer packages.

Table 14. Yield, cost and return analysis of Potato-Jute-T.Aman cropping pattern as affected by different fertilizer packages at Narikeli, Jamalpur during 2002-03

Treat.	Tuber/fibre/grain yield (t/ha)			Stick/straw yield (t/ha)		GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Potato	Jute	T.Aman	Jute	T.Aman				
T_1	33.4a	2.42a	3.12b	3.63a	3.28b	180070	9432	170638	8.9
T_2	31.0a	2.47a	3.87a	3.67a	4.03a	176455	13289	163166	6.0
T_3	32.4a	2.50a	3.92a	3.75a	4.12a	182930	18817	164113	4.6
T_4	30.1a	2.20b	3.25b	3.47ab	3.48b	166040	6891	159149	10.1
T_5	29.7a	2.02c	3.03b	3.27b	3.28b	161080	8165	152945	7.9
T_6	18.4b	1.12d	1.50c	2.23c	1.82c	96120	0	96120	-

Output (Tk/kg): Potato= 4.00, T.Aman rice = 7.00, Jute (fibre)= 8.00, Jute stick = 1.00, Rice straw = 0.50
Inputs (Tk/kg):Urea= 6, TSP= 14, MP= 10, Gypsum= 3, Zinc sulphate= 25, Mustard oil cake=10

Melandah, Jamalpur (AEZ 9)

Significantly the highest tuber yield of Potato was recorded from IPNS (T_3). Effect of cowdung applied in T_3 was observed on the yield of Potato. However, STB fertilizer dose for HYG (T_2) and FRG'97 (T_4) produced similar yield. STB fertilizer dose for MYG (T_1) produced significantly lower yield than T_3, T_2 and T_4. In Jute higher and identical fibre yield was recorded from T_2 and T_4. However, treatment T_3 and T_1 was similar but fibre yield was significantly higher in T_6. Almost similar trend was found in stick yield of Jute. In T.Aman rice significantly higher grain yield was recorded from STB fertilizer dose for HYG (T_2). However, nutrient dose was same in T_2 and T_3 but reason for lower yield in T_3 was not clear. FRG '97 (T_4) gave similar yield with farmers practice (T_5). In straw yield no significant difference was observed in T_1, T_2 and T_3, however grain yield was varied significantly. In all cases the lowest yield was obtained from no fertilizer (T_6).

From the cost and return analysis it was found that the highest gross margin was obtained from T_2 closely followed by T_3. But marginal benefit cost ratio (MBCR) over control was higher in T_1 and T_4 due to lower fertilization cost. In IPNS treatment the MBCR was lowest due to the additional cost of cowdung applied in Potato. Considering yield as well as economic return STB fertilizer dose for HYG (T_2) was found superior over other fertilizer packages.

Table 15. Yield, cost and return analysis of Potato-Jute-T.Aman cropping pattern as affected by different fertilizer packages at Melandah, Jamalpur during 2002-03

Treat.	Tuber/fibre/grain yield (t/ha)			Stick/ straw yield (t/ha)		GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Potato	Jute	T.Aman	Jute	T.Aman				
T_1	30.03c	2.45b	4.71b	3.59b	6.15a	179355	10002	169353	13.31
T_2	35.59b	2.99a	5.17a	4.39a	6.71a	210215	13615	196600	12.04
T_3	37.68a	2.62b	4.85b	3.78b	6.39a	212605	18113	194492	9.19
T_4	34.76b	2.88a	4.43c	3.96ab	5.87b	199985	11253	188732	13.67
T_5	27.63d	2.04c	4.19c	3.28c	5.46b	162180	12485	149695	9.29
T_6	6.18e	1.21d	1.13d	2.91d	1.96c	46200	0	46200	-

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

CP : Groundnut-T.Aman
Year : 2002-03

Atkapalia, Noakhali (AEZ 18)

The highest nut yield of Ground nut was recorded from IPNS treatment (T_3) which was statistically identical to STB fertilizer dose for HYG (T_2) and FRG'97 (T_4). However groundnut is a legume crop but response to cowdung was observed to some extent. Almost similar trend was found in T.Aman also. The highest grain yield was obtained from T_3 which was also similar to T_2 and T_4. Fertilizer dose based on FRG '97 also produced higher and satisfactory yield. Almost same trend was observed in stover and straw yield of Ground nut and T.Aman rice, respectively.

Cost and return analysis showed that higher gross return as well as gross margin was obtained from T_3 followed by T_2 and T_4. The highest MBCR was obtained from T_4. Present fertilizer recommendation (FRG '97) was found superior in terms of yield and return.

Table 16. Effect of different nutrient packages on agro-economics performance of Groundnut-T.Aman cropping pattern at Atkapalia, Noakhali during 2002-03

Treatment	Nut/Grain yield (t/ha)		Stover/Straw yield(t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
	Groundnut	T.Aman	Groundnut	T.Aman				
T_1	2.15bc	3.83b	15.46	4.98bc	65955	5403	60552	2.26
T_2	2.42ab	4.02ab	15.79	5.22b	71670	7083	64587	2.53
T_3	2.49a	4.44a	17.21	5.76a	76410	8732	67678	2.60
T_4	2.28ab	3.97ab	16.50	5.16b	69135	4621	64514	3.33
T_5	1.95cd	3.59bc	16.15	4.67c	60845	4043	56802	1.76
T_6	1.72d	3.17c	15.31	4.17d	53745	0	53745	-

Price of inputs (Tk./kg): Urea =6.00, TSP= 14.00, MP= 10.00, Gypsum= 5.00, Zinc sulphate= 50.00
Price of outputs (Tk./kg): Groundnut = 15.00, Stover =0.25, Grain =7.50 & Straw =1.00

Laxmipur, Noakhali (AEZ 18)

Nut yield of Groundnut varied significantly among the different nutrient packages and higher nut yield was recorded from T_3 followed by T_2. Fertilizer dose for MYG both STB and FRG '97 (T_1 and T_4) gave identical yield. Response of Groundnut to higher level of nutrients was evident. In T.Aman rice more or less similar trend was observed and similarly higher yield was recorded from T_3 and T_2. Almost similar result was found in stover and straw yield of Groundnut and T.Aman rice, respectively.

Cost and return analysis showed that higher gross return as well as gross margin was obtained from T_3 and T_2. But MBCR was highest in farmers' practice due to very low fertilization cost. However yield as well as gross margin was higher in T_3 but due to additional fertilization cost for cowdung MBCR was the lowest over control.

Table 17. Effect of different nutrient packages on agro-economics performance of Groundnut-T.Aman cropping pattern at Laxmipur, Noakhali during 2002-03

Treatment	Nut/grain yield (t/ha)		Stover/straw yield (t/ha)		Gross return (Tk/ha)	Variable cost Tk/ha	Gross margin (Tk/ha)	MBCR (Over control)
	Groundnut	T.Aman	Groundnut	T.Aman				
T_1	2.59b	4.53b	2.63b	5.41b	81157	4856	76301	7.64
T_2	2.87a	5.13a	3.24a	6.43a	91330	6483	84847	7.30
T_3	2.93a	5.17a	3.26a	6.66a	92785	8115	84670	6.01
T_4	2.38b	4.34c	3.08a	5.11b	76300	4804	71496	6.72
T_5	2.06c	3.56d	2.35b	4.18c	64148	2427	61721	8.29
T_6	1.41d	2.47e	1.53c	2.74d	44033	0	44033	-

Input price (Tk./kg): Urea = 6.50, TSP= 14.00, MP= 10.00, Gypsum= 5.00, Zinc sulphate = 60.00
Output price (Tk./kg): Groundnut = 14.00, Stover= 0.25, Grain = 8.00, Straw= 1.00

Natore, Rajshahi (AEZ 11)

Nut yield of Groundnut did not vary markedly among the different nutrient packages. However, higher yield was recorded from IPNS (T_3) which was statistically identical to others except T_1 and T_6. In T.Aman rice grain yield did not vary significantly among the different nutrient packages except with no fertilizer treatment (T_6). However farmers usually apply a high dose of NPK in T.Aman rice even higher than recommended rate but yield was lower compared with recommended fertilizer dose. Initial soil nutrient status showed that the soil is deficit with S and Zn but farmers' did not apply any S and Zn fertilizer which might be responsible for lower yield. Similarly straw yield of T.Aman rice did not differ significantly except with control treatment.

Cost and return analysis showed that higher gross return and gross margin was recorded from T_3. But the highest MBCR was found in T_4 due to less fertilization cost. IPNS based fertilizer dose (T_3) also gave higher and satisfactory MBCR.

Table 18. Effect of different nutrient packages on agro-economics performance of Groundnut-T.Aman cropping pattern at Natore, Rajshahi during 2002-03

Treatment	Nut/grain yield (t/ha)		Stover/straw yield (t/ha)		Gross return (Tk./ha)	Variable cost (Tk./ha)	Gross margin (Tk./ha)	MBCR (Over control)
	Groundnut	T.Aman	Groundnut	T.Aman				
T_1	1.76b	4.28a	-	4.96a	72140	5023	67117	6.27
T_2	1.83ab	4.53a	-	5.24a	73160	6648	66512	4.89
T_3	2.06a	4.67a	-	5.36a	79800	6196	73604	6.32
T_4	1.84ab	4.61a	-	5.20a	75200	4910	70290	7.04
T_5	1.85ab	4.84a	-	5.81a	77830	7865	69965	4.73
T_6	1.08c	2.33b	-	2.55b	40630	0	40630	-

CP : Potato-T.Aman
Year : 2002- 03

Barind, Rajshahi (AEZ 26)

Tuber yield of Potato significantly differ among different treatments. Identical yield was recorded from different treatments except with STB fertilizer dose for MYG (T_1) and no fertilizer (T_6) treatment. However, higher yield was obtained in Farmers' practice (T_5) followed by FRG'97 (T_4). Farmers' usually apply a very high dose of fertilizer in Potato. Similarly, fertilizer recommendation for Potato in FRG'97 particularly N and K was much higher than STB fertilizer recommendation. Soil was also deficient in NP and S. Therefore, effect of higher doses of fertilizers on the yield of Potato was observed. In T.Aman rice higher grain yield was recorded from T_2 which was identical to T_3. Other fertilizer doses also gave identical yield and only differed with control. More or less similar trend was observed in straw yield of T.Aman rice. Yield of crops varied mainly due to difference in N fertilizer doses. Treatment comprising higher dose of N gave higher yield.

Cost and return analysis results showed that the highest gross return as well as gross margin was recorded from T_5 followed by T_4. But the highest MBCR was obtained from T_4. Due to higher fertilization cost MBCR was slightly less in T_5. However, MBCR did not vary markedly in different fertilizer packages.

Table 19. Yield, cost and return analysis of Potato-T.Aman rice cropping pattern as affected by fertilizer levels at Chabbishnagar, Barind, Rajshahi during 2002-03

Treatment	Tuber/grain yield (t/ha)		Straw yield (t/ha)	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Potato	T.Aman	T.Aman				
T_1	14.8b	3.07b	4.67ab	85940	11620	74320	2.84
T_2	20.2a	3.46a	5.47a	110490	15526	94964	3.71
T_3	19.2ab	3.26ab	5.25ab	104870	15491	89379	3.35
T_4	22.1a	3.11b	5.23ab	115400	15981	99419	3.91
T_5	23.7a	3.12b	4.39bc	121030	21390	99640	3.18
T_6	8.18c	2.31c	4.03c	52920	0	52920	-

* Variable Cost = Fertilizer Cost only

Price (k./kg) = Urea =6.00, TSP= 13.00, MP= 9.00, Gypsum= 4.00, Boric acid= 110.00, $ZnSO_4$= 30.0, Cowdung= 0.05, Rice grain= 7.00, Rice straw= 1.00, Tuber= 4.00

Paba, Rajshahi (AEZ 11)

Tuber yield of Potato varied significantly among the different nutrient packages. Higher yield was obtained in IPNS (T_3) followed by FRG'97 (T_4) and Farmers' practice (T_5). STB fertilizer doses for MYG and HYG (T_1 and T_2) gave similar yield. Traditionally the farmers' apply a very high dose of NPK in Potato. Similarly, fertilizer recommendation for Potato in FRG'97 particularly N and K was much higher than STB fertilizer recommendation. Initial soil status also showed that the soil was rich in nutrient contents and only deficit in nitrogen. But STB fertilizer dose failed to produce higher yield and the reasons are not clear. However, effect of cowdung on Potato was observed as applied in T_3. In T.Aman rice no significant yield difference was found except with farmers' practice (T_5) and no fertilizer (T_6) treatment. Almost similar trend was observed in straw yield.

Cost and return analysis results showed that the highest gross return as well as gross margin was recorded from T_4 followed by T_3. But MBCR was the highest in T_3. Cowdung was very cheap in that area and therefore, fertilization cost was less in T_3 compared with T_4 and T_5. Due to over fertilization cost the MBCR was the lowest in Farmers' practice (T_5).

Table 20. Yield, cost and return analysis of Potato-T.Aman rice cropping pattern as influenced by different fertilizer packages at Paba, Rajshahi during 2002-03

Treatment	Tuber/grain yield (t/ha)		Straw yield (t/ha)	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Potato	T.Aman	T.Aman				
T_1	24.75b	3.13a	3.63a	177170	6300	170870	5.66
T_2	26.39b	3.33a	3.94a	188920	8596	180324	5.51
T_3	29.00a	3.16a	3.82a	203100	6390	196710	9.64
T_4	29.10a	3.44a	3.98a	206100	8581	197519	7.53
T_5	28.50a	2.61b	4.18a	196060	20414	175646	2.67
T_6	20.42 c	2.01c	2.90b	141500	0	141500	-

* Variable Cost = Fertilizer Cost only

Price (Tk./kg): Potato=6.00, Rice = 8.00, Straw= 1.00, Urea= 6.00, TSP= 16.00, MP= 12.00, Gypsum = 5.00 and Cowdung= 100 Tk/ton.

CP : Potato-Boro-T.Aman rice
Location : Syedpur, Rangpur (AEZ 3)
Year : 2002-03

The highest tuber yield of Potato was recorded from Farmers' practice (T_5) that was also similar to IPNS (T_3). Farmers' generally apply a higher dose of fertilizers along with micronutrients (Zn and B) and organic manure in Potato which might be contributed to higher yield. Two MYG fertilizer doses (STB & FRG '97) also produced identical yield. But in Boro and T.Aman rice higher grain yield was recorded from STB fertilizer dose for HYG (T_2) and IPNS treatment (T_3). Fertilizer doses for MYG (STB & FRG '97) and Farmers' practice produced identical yield. In case of straw higher and identical grain yield was found in T_2, T_3 and T_1. Similar trend was also observed in T.Aman rice. In all the cases the control treatment gave the lowest grain and straw yield in both the rice crops.

Cost and return analysis showed that higher gross return as well as gross margin was calculated from T_3 followed by Farmers' practice (T_5). But MBCR was higher T_5 followed by T_1 and T_3.

Table 21. Yield, cost and return analysis of Potato-Boro-T.Aman cropping pattern as affected by fertilizer levels at Syedpur FSRD site, Rangpur during 2002-03

Treat	Tuber/grain yield (t/ha)			Straw yield (t/ha)		GR	VC	GM	MBCR
	Potato	Boro	T.Aman	Boro	T.Aman				
T_1	23.15c	4.23b	4.32b	5.56abc	5.81ab	166685	83821	82864	6.52
T_2	26.07b	4.62a	4.87a	6.09a	6.17a	186330	88987	97343	5.77
T_3	27.46ab	4.86a	5.18a	5.82ab	6.41a	196275	899905	106370	6.01
T_4	22.81c	4.22b	4.21b	5.12c	5.32b	163900	875999	76301	4.95
T_5	29.12a	4.01b	4.27b	5.31bc	5.44b	188095	86092	102003	6.93
T_6	10.42d	1.93c	2.18c	3.13d	2.97c	77610	70160	7450	-

Means followed by the same letter(s) in a column are not significantly different at 5% level by DMRT.

CP : Potato-T.Aus-T.Aman
Year : 2002-03

Katiadi, Kishoreganj (AEZ 9)

Tuber yield of Potato influenced significantly by different fertilizer packages. Higher yield was recorded from Farmers' practice (T_5) which is statistically identical to IPNS based fertilizer dose (T_3). Generally farmers' apply higher amount of P and K along with cowdung. A positive effect of organic fertilizer was observed. However, same amount of nutrients were applied in T_2 and T_3 but yield was differed significantly. Higher yield obtained in T_3 might be due to the effect of cowdung. Fertilizer doses for MYG (STB and FRG '97) also produced similar yield.

In T.Aus rice, higher yield was obtained from IPNS (T_3) but it was statistically identical to T_2. But straw yield of T.Aus rice did not differ significantly among the fertilizer packages except T_6. In T.Aman rice, higher grain yield was recorded from T_3 which was identical to T_2 and T_1. Almost similar trend was observed in straw yield.

From cost and return analysis it was found that the highest gross return as well as gross margin was calculated from IPNS treatment (T_3) followed by T_5. But MBCR was highest in T_4 due to less fertilization cost followed by T_3. Considering yield and economic return IPNS based fertilizer dose was found superior for this cropping pattern.

Table 22. Yield, cost and return analysis of Potato-T.Aus-T.Aman cropping pattern as affected by different fertilizer packages at Katiadi during 2002-03

Treat.	Tuber/grain yield (t/ha)			Straw yield (t/ha)		GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Potato	T.Aus	T.Aman	T.Aus	T.Aman				
T_1	9.37c	2.70b	3.18ab	3.97a	4.10b	111075	7892	103183	7.55
T_2	11.96b	2.98ab	3.50ab	4.09a	4.70a	132055	11050	121005	7.29
T_3	16.96a	3.13a	3.66a	4.72a	4.70a	165250	12758	152492	8.91
T_4	11.78b	2.63b	2.92c	3.90a	3.86b	122630	7208	115422	9.87
T_5	20.13a	2.60b	2.96bc	3.86a	3.74b	163580	13964	149616	8.02
T_6	3.80d	1.57c	1.47d	2.29b	2.18c	51520	0	51520	-

Kishoreganj

Significantly higher tuber yield of Potato was obtained from IPNS based fertilizer dose (T_3). Generally farmers' apply higher amount of P and K along with cowdung. A positive effect of organic fertilizer was observed. However, same amount of nutrients were applied in T_2 and T_3 but yield was differed significantly. STB fertilizer dose for HYG (T_2) and FRG'97 (T_4) produced identical yield and it was significantly higher than STB fertilizer dose for MYG (T_1).Fertilizer doses for MYG (STB and FRG '97) also produced similar yield.

In T.Aus rice, grain yield did not vary significantly among the different fertilizer doses except with FP and control treatment. However grain yield was highest in IPNS (T_3) treatment. Higher straw yield of T.Aus rice was obtained from T_5 followed by T_3. In T.Aman rice, higher grain yield was recorded from T_3 and T_2 which was also similar to T_1. Almost similar result was found in straw yield.

From cost and return analysis it was found that the highest gross return as well as gross margin was calculated from IPNS treatment (T_3) followed by farmers' fertilizer dose (T_5). MBCR was also higher in T_4 followed by T_3. Considering yield and economic return IPNS based fertilizer dose was found superior for this cropping pattern.

Table 23. Yield, cost and return analysis of Potato-T.Aus-T.Aman cropping pattern as affected by different fertilizer packages at Kishoreganj during 2002-03

Treat.	Tuber/grain yield (t/ha)			Straw yield (t/ha)		GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Potato	T.Aus	T.Aman	T.Aus	T.Aman				
T_1	9.61c	2.63ab	3.15ab	9.61c	2.63ab	112040	8220	103820	6.69
T_2	12.05b	2.86ab	3.55a	12.05b	2.86ab	130585	11483	119102	6.41
T_3	18.54a	2.92a	3.59a	18.54a	2.92a	171370	13173	158197	8.68
T_4	11.16b	2.51ab	2.99c	11.16b	2.51ab	116705	6737	109968	8.86
T_5	18.76a	2.46b	2.28c	18.76a	2.46b	160725	15128	145597	6.85
T_6	4.59d	1.51c	1.49d	4.59d	1.51c	57010	0	57010	-

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

CP : Boro -T.Aus-T.Aman rice
Location : Chandina, Comilla (AEZ 19)
Year : 2002-03

No significant yield difference was observed in grain yield of Boro rice among the different fertilizer packages except with FRG'97 (T_4) and control (T_6). However, higher yield was recorded from IPNS treatment (T_3) that was statistically identical T_2, T_1 and Farmers' practice (T_5). Similarly, no significant difference was observed in straw yield also. In T.Aus rice significantly the highest grain yield was obtained from T_3. However, nutrient dose was similar to T_2 but yield was significantly higher in T_3. Treatment T_2, T_4 and T_5 also gave identical yield. No significant difference was found in straw yield except T_6. In T.Aman rice no significant yield difference was observed among the different fertilizer packages except with no fertilizer treatment. Similar result was obtained in straw yield.

Cost and return analysis showed that higher gross return as well as gross margin was calculated from T_3 followed by T_2. MBCR over control was almost same in all the treatments except with Farmers' practice (T_5). Farmers of that area used higher dose of fertilizers in rice that increase fertilization cost and reduce MBCR.

Table 24. Yield, cost and return analysis of Boro- T.Aus- T.Aman cropping pattern as influenced by different fertilizer packages at Chandina, Comilla during 2002-03

Treat	Grain yield (t/ha)			Straw yield (t/ha)			GR	VC	GM	MBCR
	Boro	T.Aus	T.Aman	Boro	T.Aus	T.Aman				
T_1	5.96ab	3.82c	3.55a	6.59a	4.72b	4.22a	108840	6698	102142	4.06
T_2	6.35ab	4.49b	3.85a	6.81a	5.11ab	4.24a	118990	8999	109991	4.15
T_3	6.38a	5.28a	3.68a	6.93a	5.44ab	4.38a	123000	9785	112465	4.23
T_4	5.89b	4.52b	3.25a	6.49a	4.89ab	4.24a	111240	7368	103872	4.02
T_5	5.92ab	4.69b	3.18a	6.80a	5.45a	4.33a	113110	15634	97476	2.01
T_6	4.68c	2.77d	2.52b	5.38b	3.57c	2.88b	81620	0	81620	-

- Variable Cost = Fertilizer cost only.

Price (Tk./kg): Rice = 7.00, Rice straw=1.00, Urea =6.00, TSP=14.00, MP= 9.00, Gypsum= 4.00 & Cowdung 0.35

CP : T.Aus -T.Aman
Year : 2000-01 to 2002-03

Golapganj and Moulvibazar, Sylhet (AEZ 20)

Average of three years data showed that higher grain yield of T.Aus rice was recorded from T_2 followed by T_3. FRG '97 (T_4) and Farmers practice (T_5) also gave similar yield. Treatments T_3 and T_2 gave higher and identical yield during 2001-02 and 2002-03 but during 2000-01 T_3, T_2 and T_1 produced similar yield. Almost similar result was obtained in straw yield. In T.Aman rice, similar trend was observed in grain as well as straw yield. Higher and identical yield was recorded from treatment T_2 and T_3 followed by T_1. STB fertilizer dose for MYG (T_1) produced significantly higher yield over FRG '97 in both the rice crops. Initial soil status showed that soil is deficient in NPK and therefore, a good response of rice crops was observed to higher level of nutrients.

Cost and return analysis from average of three years data showed that highest gross return as well as gross margin was obtained from T_2 followed by T_3. But the highest MBCR over control was recorded from T_1 followed by T_2 due to less fertilization cost. In T_3 MBCR was the lowest due to additional cost of cowdung.

At Moulvibazar MLT site similar result was observed like FSRD site Golapganj, Sylhet. Treatment T_3 and T_2 gave higher and identical yield over other treatments. Result was more or less same over the years. Regarding cost and return analysis the highest gross return and gross margin was found in T_2

followed by T_3. However, MBCR was higher in T_1 followed by T_2. Based on three years of study STB fertilizer dose for HYG and IPNS based fertilizer dose could be recommended for the cropping pattern at Sylhet and Moulvibazar in terms of yield and economic return as well as for sustainable soil fertility.

Table 25. Yield of crops as influenced by different fertilizer packages in T.Aus -T.Aman cropping pattern at Sylhet during 2000-01 to 2002-03

Treatment	2000-01		2001-02		2002-03		Mean	
	T.Aus	T.Aman	T.Aus	T.Aman	T.Aus	T.Aman	T.Aus	T.Aman
Grain yield (t/ha.)								
T_1	5.08	4.35	4.81	4.98	4.75	4.94	4.76	4.76
T_2	5.40	4.85	5.17	5.32	5.13	5.27	5.15	5.15
T_3	5.30	4.60	5.15	5.30	5.16	5.29	5.06	5.06
T_4	3.45	3.15	3.25	3.48	4.36	3.88	3.50	3.50
T_5	3.76	3.34	3.43	3.69	4.17	4.02	3.68	3.68
T_6	2.80	1.95	2.67	2.76	2.52	2.68	2.46	2.46
LSD (0.05)	0.57	0.55	0.23	0.20	0.24	0.24	-	-
Straw yield (t/ha.)								
T_1	6.15	5.48	5.87	6.23	5.76	6.16	5.93	5.96
T_2	6.64	6.16	6.31	6.81	6.25	6.74	6.41	6.58
T_3	6.41	5.89	6.26	6.70	6.22	6.79	6.29	6.45
T_4	4.96	4.74	4.45	5.08	4.82	5.42	4.74	5.08
T_5	5.49	4.79	4.82	5.24	5.14	5.59	5.15	5.21
T_6	3.36	2.47	3.23	3.53	3.17	3.42	3.25	3.14
LSD (0.05)	0.54	0.58	0.40	0.35	0.22	0.20	-	-

Table 26. Cost and return analysis of T.Aus-T.Aman cropping pattern as influenced by different fertilizer packages at Golapganj, Sylhet during 2000-01 to 2002-03 (Average)

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	76866	4907	71959	7.33
T_2	83021	6338	76683	6.64
T_3	81978	8136	73842	5.05
T_4	58372	2825	55547	6.18
T_5	60798	3533	57265	5.63
T_6	40923	0	40923	-

Table 27. Yield of crops as influenced by different fertilizer packages in T.Aus -T.Aman cropping pattern at Moulvibazar during 2000-01 to 2002-03

Treatment	2000 –'01		2001 –'02		2002 –'03		Mean	
	T.Aus	T.Aman	T.Aus	T.Aman	T.Aus	T.Aman	T.Aus	T.Aman
Grain yield (t/ha.)								
T_1	4.93	4.52	4.98	4.30	4.93	4.24	4.95	4.35
T_2	5.24	5.04	5.19	4361	5.12	4.53	5.18	4.73
T_3	5.09	4.83	5.17	4.56	5.16	4.56	5.14	4.65
T_4	3.34	3.42	3.47	3.20	3.96	3.79	3.59	3.47
T_5	3.75	3.55	3.45	3.39	3.87	3.74	3.69	3.56
T_6	2.72	2.04	2.84	2.43	2.79	2.36	2.78	2.28
LSD(0.05)	0.55	0.55	0.23	0.21	0.25	0.27	-	-
Straw yield (t/ha.)								
T_1	5.96	5.70	5.98	5.33	5.87	5.22	5.94	5.42
T_2	6.44	6.38	6.36	5.79	6.21	5.68	6.34	5.97
T_3	6.21	6.16	6.23	5.79	6.14	5.70	6.18	5.85
T_4	4.81	4.98	4.89	4.86	5.27	4.74	4.99	4.86
T_5	5.33	5.01	4.93	4.88	5.21	4.79	5.16	4.89
T_6	3.26	2.56	3.38	3.06	3.29	2.98	3.31	2.87
LSD(0.05)	0.48	0.47	0.20	0.26	0.37	0.25	-	-

Table 28. Cost and return analysis of T.Aus-T.Aman cropping pattern as influenced by different fertilizer packages at Moulvibazar during 2000-01 to 2002-03 (Average)

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	73878	4205	69673	8.03
T_2	79030	5321	73709	7.31
T_3	77925	7114	70811	5.31
T_4	57565	2825	54740	6.17
T_5	59039	3355	55685	5.64
T_6	40127	0	40127	-

Jhalokati, Barisal (AEZ 13)

Average of three years results showed that the highest grain yield of T.Aus rice was obtained in IPNS based fertilizer dose (T_3). Fertilizer dose for MYG both STB and FRG'97 (T_1 and T_4) also produced almost similar yield. However, the results were slightly varied over the years. During 2001 and 2002, higher yield was obtained in T_3. But in 2003, significantly higher and identical yield was recorded from T_3 and T_2. Response of cowdung on the yield of T.Aus rice was observed to some extent. In T.Aman rice almost similar result was observed and higher grain yield was recorded from T_3 followed by T_2. However grain yield varied slightly over the years and similar trend was found as observed in T.Aus rice.

Cost and return analysis of three years average showed that the highest gross return as well as gross margin was obtained from T_3 followed by T_2. Due to higher yield the return is higher. MBCR over control was highest in T4 due to less fertilization cost. Treatment T_3 and T_2 also gave satisfactory MBCR, however it was little bit less due to higher fertilizer cost. Based on three years of study STB fertilizer dose for HYG could be recommended for the cropping pattern at Jhalokati and Barisal for higher yield, economic return but for sustainable soil health and yield, IPNS could be recommended.

Table 29. Effect of different nutrient management packages on the yield of crops in T.Aus-T.Aman cropping pattern at Jhalokati, Barisal during2001-2003

Treatments	Grain yield (t/ha)							
	2001		2002		2003		Mean	
	T.Aus	T.Aman	T.Aus	T.Aman	T.Aus	T.Aman	T.Aus	T.Aman
T_1	2.93c	4.02c	3.52b	3.53bc	3.79b	4.20b	3.56	3.90
T_2	3.14b	4.88b	3.46b	3.63b	4.17ab	4.58ab	3.85	4.56
T_3	3.25a	5.00a	4.11a	4.32a	4.52a	4.85a	4.27	4.72
T_4	2.88c	4.17c	3.44b	3.76b	3.57b	4.08b	3.70	4.32
T_5	2.78d	4.10c	2.93c	3.12cd	3.68b	3.83c	3.32	3.72
T_6	2.14e	3.15d	2.70c	2.68d	2.65c	2.86d	2.55	2.89
CV(%)	1.41	1.62	6.84	7.33	7.32	7.65	-	-

Table 30. Cost and return analysis of T.Aus-T.Aman cropping pattern at Jhalokati, Barisal during 2001-2003 (Average)

Treatments	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
T_1	47423	4096	43327	2.98
T_2	52626	5102	47525	3.43
T_3	56823	6560	50263	3.29
T_4	47803	2421	45382	5.21
T_5	44563	3099	41464	3.02
T_6	35256	0	35257	

* Variable Cost = Fertilizer Cost only

Price (Tk./ka): T.Aus rice=6, T.Aman= 7, Urea= 7, T.S.P= 15, MP= 9, Gypsum= 4.50, Zinc oxide= 50, CD= 0.50

CP : Mungbean-T.Aus-T.Aman
Location : Bhola, Barisal (AEZ 13)
Year : 2000-01 t0 2002-03

Average of three years results showed that the highest seed yield of Mungbean was obtained in IPNS based fertilizer dose (T_3) followed by STB fertilizer dose for HYG (T_2). Fertilizer dose for MYG both STB and FRG'97 (T_1 and T_4) also produced similar yield. Farmers' usually do not apply any fertilizer in Mungbean. Therefore, yield obtained in Farmers' dose is very low and close to control (T_6). However, the results were slightly varied over the years. During 2000-01, no significant yield difference was observed among the different fertilizer packages except with Farmers' practice and no fertilizer treatment (T_5 and T_6). But in 2001-02 and 2002-03, significantly higher yield was recorded from IPNS (T_3) treatment. In T.Aus rice, grain yield did not vary markedly among the treatments except with T_5 and T_6. However the highest yield was found in T_3 followed by T_2. Results over the year varied slightly but the treatment T_3 and T_2 produced higher yield in all the years. In T.Aman rice similar result was observed and higher grain yield was recorded from T_3 and T_2. However grain yield varied slightly over the years. During 2000-01, the highest yield was obtained in T_3 which was identical to T_4. But in 2001-02, higher and identical yield was produced by T_3 and T_1 and in 2002-03 the highest yield was recorded from T_3 which was similar to T_2. STB fertilizer dose for MYG (T_1) gave higher yield over FRG'97 (T_4) in both the rice crops.

Cost and return analysis of three years average showed that the highest gross return as well as gross margin was obtained from T_3 followed by T_2. Due to higher yield the return is higher. MBCR over control was slightly higher in T_4 due to less fertilization cost. Treatment T_3 and T_2 also gave higher and satisfactory MBCR. Based on three years of study IPNS based fertilizer dose and STB fertilizer dose for HYG could be recommended for the cropping pattern at Bhola and Barisal for higher yield, economic return as well as for sustainable crop production.

Table 31. Yield of Mungbean-T.Aus-T.Aman cropping pattern as influenced by different fertilizer packages at Bhola, Barisal during 2000-01 to 2002-03

Treatment	Grain yield {Mungbean (kg/ha), Rice (t/ha)}					
	2000-01			2001-02		
	Mungbean	T.Aus	T.Aman	Mungbean	T.Aus	T.Aman
T_1	942ab	3.12b	4.33b	766.67b	3.07ab	4.04ab
T_2	1023a	3.34a	4.36b	833.33b	3.17ab	4.43a
T_3	1048a	3.46a	4.75a	924.33a	3.39a	3.89b
T_4	973a	2.98cd	3.83ab	815.67b	3.28ab	3.70b
T_5	736b	2.52c	3.31c	663.33c	2.79b	3.67b
T_6	762b	2.15d	2.79d	669.67c	2.23c	2.77c
CV(%)	11.94	2.79	3.59	4.54	10.01	7.88

Table 31. Contd.

Treatment	Grain yield {Mungbean (kg/ha), Rice (t/ha)}					
	2002-03			Mean		
	Mungbean	T.Aus	T.Aman	Mungbean	T.Aus	T.Aman
T_1	1122c	3.59bc	3.95cd	943.55	3.26	4.11
T_2	1293b	3.80b	4.85ab	1049.77	3.44	4.55
T_3	1512a	4.13a	5.05a	1161.44	3.66	4.56
T_4	984d	3.36cd	4.39bc	924.22	3.21	3.97
T_5	826e	3.09d	3.86cd	741.78	2.80	3.61
T_6	527f	2.51e	3.36d	653.00	2.30	2.97
CV(%)	2.66	3.39	5.49	-	-	-

Table 32. Cost and return analysis of Mungbean-T.Aus-T.Aman cropping pattern at Bhola, Barisal during 2000-01 to 2002-03 (Average)

Treatments	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
T_1	69882	4463	65219	4.84
T_2	77208	5720	71489	5.04
T_3	82483	6782	75701	5.02
T_4	69264	3677	65588	5.75
T_5	58758	2362	56397	4.58
T_6	48427	0	48427	-

* Variable Cost = Fertilizer cost only.

Price (Tk./kg): Urea= 7.00, TSP= 15.00, MP= 9.00, Gypsum= 4.50, CD= 0.50, Mungbean= 20.00, T.Aus= 6.00, T.Aman= 7.00

CP : Mustard-Boro
Year : 2002-03

Mymensingh (AEZ 9)

Significantly higher seed yield of Mustard was obtained from IPNS (T_3). Other treatments gave identical yield differed only with STB fertilizer dose for MYG (T_1) and no fertilizer (T_6) treatment. Treatment T_1 produced significantly lower yield than the FRG '97 (T_4). Similar result was found in stover yield. In Boro rice, higher grain yield was recorded from T_3 that was statistically identical to T_2. Farmers' practice (T_5) produced significantly higher yield over T_1 and T_4. However, fertilizer dose for MYG both STB and FRG '97 (T_1 and T_4) gave identical yield. In case of straw similar yield was obtained from T_2, T_3 and T_5 and higher than other treatments.

From cost and return analysis it was found that the highest gross return as well as gross margin was obtained from IPNS treatment (T_3) followed by T_2. But MBCR was higher in T_4, T_5 and T_2. Due to additional cost of cowdung MBCR was the lowest in T_3.

Table 33. Yield, cost and return analysis of Mustard-Boro cropping pattern as influenced by different fertilizer packages at Mymensingh during 2002-03

Treatment	Grain yield		Straw yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Mustard (kg/ha)	Boro (t/ha)	Mustard (kg/ha)	Boro (t/ha)				
T_1	842c	4.47c	2122c	4.74c	53646	8103	45543	1.53
T_2	1008b	5.50ab	2534b	5.92a	65507	11289	54218	2.15
T_3	1163a	5.86a	2905a	5.94a	71483	15889	55594	1.90
T_4	1006b	4.84c	2545b	5.64b	60363	6609	53754	2.89
T_5	1043b	5.27b	2600b	5.80a	60435	7918	53826	2.42
T_6	408d	4.06d	962d	4.38d	41231	0	41231	---

* Variable Cost = Fertilizer Cost only

Kaliakoir (AEZ 28)

Average of two years results showed that higher seed yield of Mustard was recorded from IPNS (T_3) followed STB fertilizer dose for HYG (T_2). Fertilizer dose for MYG both STB and FRG'97 (T1 and T4) gave similar yield which was lower than Farmers' practice (T_5). Farmers' usually apply higher dose of NPK than recommended dose. However, they do not apply S fertilizer in Mustard. Results over the year varied slightly and it was found that during 2002-03 significantly higher seed yield was recorded from T_3 and T_2 but in 2003-04 the same treatments gave higher yield but it was also identical to Farmers' dose (T_5). Almost similar trend was found in stover yield. In Boro rice the highest grain yield was obtained from T_3 followed by T_2. Treatment T_1 and T_4 gave similar yield but lower than T_5. Almost similar trend was observed over the years and higher yield was recorded from T_3. Straw yield also followed the same trend. Response of crops to higher level of fertilizers was evident to some extent.

From cost and return analysis it was found that the highest gross return as well as gross margin was obtained from IPNS treatment (T_3) followed by T_2. The highest MBCR was calculated from FRG '97 (T_4) due to less fertilizer cost. However, additional cost of cowdung increase the fertilization cost in treatment T_3 (IPNS) but still the MBCR is satisfactory. MBCR was the lowest in Farmers practice (T_5) due to highest fertilizer cost. Based on two years of study IPNS based fertilizer dose could be recommended for the cropping pattern at Kaliakoir for higher yield and economic return as well as for sustainable soil fertility.

Table 34. Yield, cost and return analysis of Mustard-Boro cropping pattern as affected by fertilizer levels at Kaliakoir

Treatment	Seed/grain yield (t/ha)					
	2002-03		2003-04		Mean	
	Mustard	Boro	Mustard	Boro	Mustard	Boro
T_1	0.623b	6.28b	0.768b	5.16d	0.70	5.72
T_2	0.772a	6.48b	0.949a	6.30b	0.86	6.39
T_3	0.807a	6.77a	0.970a	7.05a	0.89	6.91
T_4	0.595bc	6.35b	0.760b	5.12d	0.68	5.74
T_5	0.580c	6.46b	0.938a	5.79c	0.76	6.13
T_6	0.227d	3.26c	0.253c	3.22c	0.24	3.24
	Stover/straw yield (t/ha)					
T_1	1.5b	8.2b	1.84b	6.45c	1.67	7.33
T_2	1.8a	8.5ab	2.18ab	7.88b	2.00	8.19
T_3	1.8a	8.9a	2.08ab	8.81a	1.94	8.86
T_4	1.4b	8.1b	1.90b	6.40c	1.65	7.25
T_5	1.4b	8.0b	2.34a	7.64b	1.87	7.82
T_6	0.70c	6.7c	0.83c	5.03d	0.78	5.87

Table 35. Cost and return analysis of Mustard-Boro cropping pattern as influenced by different fertilizer packages at Kaliakoir, Gazipur during 2002-03 to 2003-04 (Average)

Treatment	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (Over control)
T_1	60151	7521	52630	3.62
T_2	68468	10102	58366	3.52
T_3	73275	11757	61518	3.44
T_4	59926	5579	57647	4.85
T_5	64643	12182	52461	2.61
T_6	32888	0	32888	-

Variable Cost = Fertilizer Cost only

CP : Chilli -T.Aman
Year : 2002-03

Lebukhali, Patuakhali (AEZ 13)

Fruit yield of Chilli varied significantly among the different nutrient packages. Higher fruit yield was recorded from T_2 followed by T_3. Farmers' practice (T_5) gave similar yield with FRG'97 (T_4). Response of higher levels of nutrients was observed in Chilli. In T.Aman rice almost similar trend was found and the highest grain yield was obtained from T_3 which was identical to T_2. Fertilizer doses for MYG both STB and FRG'97 also gave identical yield.

From the cost and return analysis it was found that the highest gross return as well as gross margin was obtained from T_2. But MBCR was higher in T_4 followed by T_5 due to less fertilization cost. The lowest MBCR was obtained in T_3 due to additional cost of cowdung.

Table 36. Yield, cost and return analysis of Chilli-T.Aman rice cropping pattern as affected by fertilizer levels at Lebukhali, Patuakhali during 2002-03

Treatment	Fruit/Grain yield (t/ha)		Straw yield (t/ha)	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Chilli	T.Aman	T.Aman				
T_1	1.24b	3.90c	4.65	70889	11131	59758	2.06
T_2	1.43a	4.11ab	4.80	78813	16408	62405	1.88
T_3	1.39a	4.26a	4.86	78568	19656	58912	1.56
T_4	1.09c	3.87c	4.59	65212	5755	59457	3.01
T_5	1.00c	3.31d	4.23	58086	3435	54651	2.96
T_6	0.86d	2.53e	4.26	47908	0	47908	-

* Variable Cost = Fertilizer Cost only

Hathazari, Chittagong (AEZ 23)

Fruit yield of Chilli varied significantly among the different nutrient packages. Higher fruit yield was recorded from T_3 followed by T_2. Similar yield was obtained from fertilizer dose for MYG both STB and FRG'97 (T_1 and T_4) along with Farmers' dose (T_5). Response of higher levels of nutrients was observed in Chilli to some extent. In T.Aman rice almost similar trend was found and the higher grain yield was obtained from T_2 which was statistically identical to T_3. Similar result was also found in straw yield.

From the cost and return analysis it was found that the highest gross return as well as gross margin was obtained from T_2 followed by T_3. Similarly the highest MBCR was also obtained in T_2 followed by FRG '97.

Table 37. Yield, cost and return analysis of Chilli-T.Aman rice cropping pattern as affected by fertilizer levels at Hathazari, Chittagong during 2002-03

Treatment	Fruit/Grain yield (t/ha)		Straw yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Chilli	T.Aman	Chilli	T.Aman				
T_1	880b	4.39bc	-	4.89b	124843	12957	111886	4.18
T_2	1176a	5.13a	-	5.93a	160923	15004	145919	6.01
T_3	1055a	5.05ab	-	5.65a	147913	14342	133571	5.38
T_4	788b	4.14c	-	4.59b	113518	7168	106350	5.97
T_5	895b	3.89c	-	4.54b	122405	12450	109955	4.15
T_6	455c	2.81d	-	3.31c	70708	0	70708	-

* Variable Cost = Fertilizer Cost only

CP : Maize-T.Aman
Location : Goyeshpur, Pabna (AEZ 11)
Year : 2002-03

Grain yield of Maize did not vary significantly among the treatments except with no fertilizer treatment (T_6) but higher grain yield was obtained from T_4. Even Farmers' practice also produced similar yield. Effect of higher levels of nutrients as well as organic manure was not observed in Maize. However, the soil was deficient in NPKS. Similar trend was found in stover yield. In T.Aman rice similar result was observed both in grain and straw. Yield did not differ significantly among the treatments except with control.

Cost and return analysis showed that the highest gross return and gross margin was obtained in FRG '97 (T_4) followed by T_2 and T_5. MBCR over control did not vary markedly, However, the highest MBCR was found in T_2.

Table 38. Yield, cost and return influenced by different fertilizer levels in the cropping pattern Maize-T.Aman at Goyeshpur, Pabna during 2002-03

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Maize	T.Aman	Maize	T.Aman				
T_1	6.91ab	3.09a	7.24ab	4.00a	78710	5855	72855	2.70
T_2	7.82a	3.30a	8.00ab	4.10a	87190	7275	79915	3.34
T_3	7.08ab	3.74a	7.58ab	4.39a	85465	7827	77638	2.88
T_4	8.59a	3.14a	8.63a	4.18a	91655	11198	80457	2.56
T_5	7.72a	3.64a	7.17ab	4.28a	88885	9296	79589	2.80
T_6	5.54b	2.40b	6.66b	3.15b	62885	0	62885	-

Input price (Tk./kg): Urea= 6.00, TSP= 14.00, MP= 8.00, Gypsum= 3.00, ZnO=40.00 & Borax = 40.00
Output price (Tk./kg): Maize grain = 7.00, T.Aman grain = 8.00 & Stover/Straw= 0.50

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			
Mymensingh (9)	MHL	I	5.8	1.80	0.10(L)	0.18 (M)	2.15 (VL)	14.28 (VL.)	2.64 (VH)	0.18 (L)
Phulpur (9)	MHL	I	5.8	1.41	0.11 (L)	0.048 (VL)	11.74 (L)	6.52 (VL)	2.41 (H)	0.14 (VL)
Netrokona (9)	MHL	I	6.4	1.63	0.087 (VL)	0.051 (VL)	4.98 (VL)	6.95 (VL)	2.84 (VH)	0.15 (VL)
Hathazari (23)	MHL	I	5.35	1.15	0.07 (VL)	0.07 (L)	23.8 (Opt)	8.0 (L)	-	-
Narikeli (9)	MHL	I	5.8	1.0	0.06 (VL)	0.08 (VL)	8.15 (L)	12.72 (L)	0.67 (L)	1.39 (VH)
Melandah (9)	MHL	I	4.7-5.2	0.75-1.28	0.06-0.10 (L)	0.18-0.76 (M)	7.99-11.32 (L)	7.69-10.9 (L)	1.84-5.1 (M)	0.05-0.29 (L)
Sherpur (9)	MHL	I	5.5	0.55-1.31	0.025-0.11 (VL)	0.06-0.15 (VL)	4.2-11.5 (L)	6.66-15.5 (L)	0.28-0.79 (VL)	0.61-2.75 (VH)
Katiadi (9)	MHL	I	6.85	0.66	0.092 (L)	0.15 (L)	6.23 (VL)	8.85 (L)	-	-
Kishoreganj (9)	MHL	I	6.75	0.88	0.11 (L)	0.14 (L)	8.6 (L)	9.55 (L)	-	-
Lebukhali (13)	MHL	R	5.3	1.44	0.08 (VL)	0.28 (Opt)	4.4 (VL)	33.46(Opt)	0.34(VL)	-
Paba (11)	MHL	I	8.2	1.53	0.11 (L)	0.25 (H)	32.0 (VH)	78.1 (VH)	1.35 (M)	0.66 (M)
Natore (11)	MHL	R	8.3	-	0.10 (L)	0.20 (O)	8.43 (L)	26.71 (L)	0.61 (L)	-
Barind (25)	MHL	I	5.6	1.04	0.06 (VL0	0.19 (M)	3.05 (VL)	4.83 (L)	2.30 (M)	0.33 (L)
Atkapalia (18)	MHL	R	7.2	1.66	0.091 (L)	0.18 (M)	2.0 (VL)	25.8 (O)	0.62 (L)	0.15 (L)
Feni (18)	MHL	I	6.78	1.54	0.08 (VL)	0.052 (VL)	1.40 (VL)	8.81 (VL)	0.52 (L)	0.25 (L)
Laxmipur (18)	MHL	R	6.6	2.12	0.12 (L)	0.19 (M)	1.5 (VL)	31.3 (VH)	0.85 (L)	0.47 (O)
Syedpur (3)	MHL	I	5.8	2.1	0.09 (L)	0.045 (VL)	11.65 (L)	8.52 (L)	10.64 (L)	0.24 (L)
Goyeshpur (11)	MHL	I	8.28	2.29	0.11 (L)	0.17 (L)	5.47 (VL)	10.82 (L)	-	0.29 (L)
Sujanagar (11)	MHL	I	8.4	-	0.11 (L)	0.39 (VH)	1.25 (VL)	7.52 (VL)	1.23 (M)	0.27 (L)
Ishan Gopalpur (12)	MHL	I	7.5	-	0.18 (M)	0.42 (VH)	9.03 (L)	18.0 (M)	-	-
Golapganj (20)	MHL	R	5.20	1.70	0.08 (VL)	0.05 (VL)	3.25 (VL)	22.5 (M)	0.73 (L)	0.36 (M)
Moulvibazar (20)	MHL	R	4.74	1.95	0.09 (VL)	0.17 (M)	9.56 (L)	22.3 (M)	3.30 (VH)	0.58 (O)
Bhola (13)	MHL	R	7.1	-	0.57 (VL)	0.50 (VH)	8.8 (L)	27.2 (O)	1.59 (O)	0.48 (O)
Jhalokati (13)	MHL	R	6.5	-	0.12 (L)	0.39 (VH)	7.6 (L)	50.3 (VH)	0.93 (M)	-
Kolaroa (11)	MHL	I	8.1	1.88	0.09 (L)	0.22 (M)	4.80 (VL)	13.2 (L)	0.51 (L)	-
Joypurhat (25)	MHL	I	5.8	1.93	0.09 (L)	0.076 (L)	3.42 (VL)	7.35 (VL)	-	0.12 (VL)
Gabtali (25)	MHL	I	5.9	1.85	0.09 (L)	0.125 (VL)	6.67 (L)	16.2 (M)	0.76 (L)	0.22 (L)
Kaliakoir (28)	MLL	I	6.12	1.59	0.084 (VL)	0.16 (L)	6.63 (VL)	15.33 (M)	0.84 (L)	0.23 (L0

Appendix table 2. Crop management practices

Site	Cropping pattern	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Netrokona	Mustard	BARI Sarisha 9	10	2nd week of Nov	1st week of Feb
	Boro	BRRI Dhan 29	40	2nd week of Feb	Last week of May
	T.Aman	BRRI Dhan 32	40	4th week of July	1st week of Nov
Phulpur	Mustard	-	-	-	-
	Boro	BRRI Dhan 28	40	1st week of Feb	1st week of May
	T.Aman	BRRI Dhan 32	40	Last week of July	2nd week of Nov
Mymensingh	Mustard	BARI Sarisha 9	10	2nd week of Nov	4th week of Jan.
	Boro	BRRI Dhan 28	40	1st week of Feb	1st week of May
Gabtali	Mustard	BARI Sarisha 9	08	1st week of Nov	Last week of Jan.
	Boro	BRRI Dhan 28	50	1st week of Feb	1st week of May
	T.Aman	BRRI Dhan 39	50	4th week of July	1st week of Nov.
Narikeli	Potato	Cardinal	2000	3rd week of Nov	2nd week of Feb
	Jute	O-9897	8	3rd week of March	3rd week of May
	T.Aman	BRRI Dhan 33	40	1st week of Aug.	Last week of Oct.
Melandah	Potato	Cardinal	2000	3rd week of Nov	1st week of March
	Jute	O-9897	8	3rd week of March.	2nd week of July
	T.Aman	BRRI Dhan 33	50	3rd week of July	Last week of Oct.
Sherpur	Wheat	Kanchan	100	4th week of Nov..	4th week of March
	Jute	O-9897	8	2nd week of April	4th week of July
	T.Aman	BRRI Dhan 33	50	3rd week of Aug	1st week of Nov
Kishoregonj	Potato	Diamont	1500	3rd week of Nov.	1st week of March
	T.Aus	BR 26	50	2nd week of May	Last week of July
	T.Aman	BRRI Dhan 32	50	2nd week of Aug	2nd week of Nov
Katiadi	Potato	Diamont	1500	3rd week of Nov.	1st week of March
	T.Aus	BR 26	50	2nd week of May	Last week of July
	T.Aman	BRRI Dhan 32	50	2nd week of Aug	2nd week of Nov
Lebukhali	Chilli	Local	-	3rd week of Jan.	2nd week of May
	T.Aman	BR-23	40	1st week of Sept.	3rd week of Dec
Melandaha	Mustard	Tori 7	6	3rd week of Nov.	1st week of Feb.
	Boro	BRRI Dhan 29	40	2nd week of Feb.	Last week of May
	T.Aman	BRRI Dhan 33	40	3rd week of July	1st week of Nov.
Ishan Gopalpur	Boro	BRRI Dhan 29	40	4th week of Jan.	3rd week of May
	T.Aman	BRRI Dhan 39	40	Last week of July	2nd week of Nov
Joypurhat	Boro	BRRI Dhan 29	40	1st week of Feb.	3rd week of May
	T.Aman	BR 11	40	4th week of July	3rd week of Nov.
Hathazari	Chilli	Local	600g	3rd week of Dec.	2nd week of April
	T.Aman	BRRI Dhan 30	35	Last week of July	4th week of Nov
Syedpur	Potato	Cardinal	1500	1st week of Dec.	2nd week of Feb.
	Boro	BRRI Dhan 28	40	1st week of March	1st week of July
	T.Aman	BR 11	40	2nd week of July	3rd week of Nov.
Feni	Boro	BRRI Dhan 29	40	1st week of Feb.	Last week of May
	T.Aman	BR 11	40	3rd week of July	3rd week of Nov
Paba	Potato	Cardinal	1800	Last week of Nov.	Last week of March
	T.Aman	BRRI Dhan 39	40	3rd week of July	3rd week of Nov.
Natore	G.nut	DG-1	-	4th week of Jan.	3rd week of May
	T.Aman	BR 11	40	2nd week of July	3rd week of Nov.
Barind	Potato	Cardinal	1800	4th week of Dec.	2nd week of March
	T.Aman	BRRI Dhan 39	40	3rd week of July	4th week of Oct.
Atkapalia	G.nut	Dhaka-1	-	1st week of Jan.	3rd week of May
	T.Aman	BRRI Dhan 32	40	Last week of July	3rd week of Nov.
Laxmipur	G.nut	DG-2	-	4th week of Jan.	Last week of May
	T.Aman	BRRI Dhan 32	40	3rd week of July	3rd week of Nov.
Goyeshpur	Maize	Pacific-11	150	3rd week of Dec.	3rd week of May
	T.Aman	BRRI Dhan 39	50	4th week of July	1st week of Nov
Sujanagar	Boro	BRRI Dhan 29	120	3rd week of Feb.	1st week of June
	T.Aman	BRRI Dhan 39	40	3rd week of July	Last week of Oct

Appendix table 2. Contd.

Site	Cropping pattern	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Chandina	Boro	BRRI Dhan 29	40	3rd week of Jan.	3rd week of May
	T.Aus	BR 20	40	Last week of May	Last week of Aug.
	T.Aman	BRRI Dhan 39	40	1st week of Sept.	4th week of Nov.
Bhola	M.bean	BARI M.bean-5	60	1st week of Feb	Mid April
	T.Aus	BR-14	40	3rd week of May	3rd week of Aug.
	T.Aman	BR-23	40	Last week of Aug.	2nd week of Dec.
Jhalokati	T.Aus	Kazla	40	3rd week of May	3rd week of Aug.
	T.Aman	BR-23	40	Last week of Aug.	2nd week ofDec.
Kolaroa	Boro	BRRI Dhan 28	40	3rd week of Jan.	Last week of April
	T.Aman	BRRI Dhan 30	40	1st week of Aug.	4th week of Nov.
Golapganj	T.Aus	BR 26	30	1st week of June	Mid. Aug.
	T.Aman	BRRI Dhan 32	30	1st week of Sept.	Last week of Nov.
Moulvibazar	T.Aus	BR 26	30	1st week of June	Mid. Aug.
	T.Aman	BRRI Dhan 32	30	1st week of Sept.	Last week of Nov.
Kaliakoir	Mustard	Tori-7	8	3rd week of Nov	1st week of Feb.
	Boro	BRRI Dhan 29	40	2nd week of Feb.	3rd week of May

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EFFECTS OF RICE STRAW ON THE PERFORMANCE OF BORO-FALLOW-T.AMAN RICE SYSTEM

Abstract

An on-farm experiment was conducted at three different locations viz. Comilla, Shahrasti (Chandpur) and Kolaroa (Khulna) during 1999-2000 to 2002-03 to evaluate the effect of Boro rice straw in corporation on the yield of T.Aman rice in Boro-T.Aman rice cropping system. Boro rice was grown with recommended fertilizer and it was harvested at different height to remain straw in the soil as per treatment. In T.Aman rice, ⅓rd and ⅔rd Boro rice straw was incorporated to the soil along with full doses as well as reduced doses of inorganic fertilizers for MYG. Inorganic fertilizers of recommended dose for MYG and HYG and farmers' practice were also included to compare. Results showed that grain yield of T.Aman rice did not vary appreciably among the treatments at Comilla. However, the highest yield was obtained in T_2 where $^2/_3{}^{rd}$ rice straw was incorporated along with recommended fertilizer dose for MYG (RF_2). No significant result was also found in Shahrasti. But at Kolaroa, T_2 produced higher yield along with T_5 and T_7. Incorporation of $^2/_3{}^{rd}$ rice straw along with RF_2 gave similar yield with recommended fertilizer dose for HYG (RF1). Treatment T_2 performed better in terms of yield as well as economic benefit irrespective of locations.

Introduction

Boro-T.Aman rice system is a predominant cropping pattern in Bangladesh under irrigated medium high to medium low land condition. Due to continuous practice of rice based cropping system the production seems to have reached in a stagnant position in spite of using more and more fertilizers. Use of organic matters like cowdung and farmyard manure is decreasing because of utilization as fuel materials. Further, continuous cultivation of HYV rice over the years is exhausting the soil nutrients. Thus, organic matter content and soil fertility is decreasing day by day. Recycling of organic matter is essential for maintaining soil fertility. Establishment of dhaincha or any other green manuring crop is very difficult because of heavy rainfall in the month of May. As such, alternative strategy might be incorporation of rice straw. Boro rice straw may be used as an alternate source of organic matter and may stabilize the yield of the crops under Boro-Fallow-T.Aman rice system.

Generally, Boro rice is harvested in the month of May and particularly in medium low land due to high rainfall and flash flood water where farmers are forced to harvest the crop at the top remaining the straw. Thus the Boro rice straw can be utilized as organic residue to the succeeding T.Aman rice. Therefore, the complementary use of rice straw with mineral fertilizer will help to increase use efficiency of applied fertilizers and maintaining soil fertility. With this view in mind the experiment was under taken to compare rice straw and inorganic fertilizer effects with conventional practice of chemical fertilizers application on Boro-T.Aman rice system.

Materials and Methods

The experiment was initiated from Boro season of 1999-2000 and continued in 2002-03. It was conducted at 3 different locations Comilla, Shahrasti and Kolaroa. Seven different treatment combinations were tested with 6 dispersed replications. The plot was divided into 7 (seven) sub-plot. The size of each unit plot was 10 m x 10 m.

In Boro rice recommended dose of fertilizers were applied in all the plots. Irrigation and other intercultural operations were done as and when necessary. Boro rice straw was harvested leaving$1/3^{rd}$ and $^2/_3{}^{rd}$ straw in the soil. Yield and yield contributing characters of Boro rice were recorded as per requirement. Rice straw of Boro was incorporated into the soil by ploughing. In T.Aman rice, fertilizers were applied as per following treatments combinations. Seven treatments were as follows:

T_1= $\frac{1}{3}$ Boro rice straw ($\frac{2}{3}$ should be harvested from top) incorporation then T.Aman with RF_2
T_2= $\frac{2}{3}$ Boro rice straw ($\frac{1}{3}$ should be harvested from top) incorporation then T.Aman with RF_2
T_3= T_2 + T.Aman with 65-6-20-4 kg NPKSZn/ha.
T_4= T_3 + T.Aman with 50-6-20-4 kg NPKSZn/ha.
T_5= Recommended fertilizer for high yield goal (RF_1)
T_6= Recommended fertilizer for moderate yield goal (RF_2)
T_7= Farmers practices (Harvesting).

Note: RF_1 = 90-8-26-5-2 kg/ha of NPKSZn
RF_2 = 70-6-20-4 kg/ha of NPKS
FP (Comilla): 90-37-32 kg/ha of NPK
FP (Kolaroa): 135-30-38-0-5 kg/ha of NPKSZn

Irrigation and other intercultural operations were done as and when necessary. Yield and yield contributing characters were recorded as per requirement and were statistically analyzed. Soil characteristics and different crop management practices followed in different sites are given in appendix I.

Results and discussion

Location : Comilla
Year of conduction: 1999-2000 to 2002-03

Boro

The performance of Boro rice presented in Table 1. Average of four years results showed that grain yield of Boro rice did not vary significantly. First year (1999-2000) the experiment was initiated with recommended fertilizer and therefore, yield was same. But in next three years, the crop was grown with recommended fertilizer dose and rice straw incorporation. Therefore, yield was slightly differed over the years, however, yield was insignificant. Grain yield was little bit higher in T_3 and T_4 where rice straw was incorporated along with inorganic fertilizer. The trend was almost same in 2^{nd}, 3^{rd} and 4^{th} year. More or less similar result was observed in straw yield.

T.Aman

The experiment was conducted in four consecutive years and average results showed that grain yield did not vary appreciably among the different treatments except with T_6 and T_7. In T_6 and T_7, T.Aman was grown only with inorganic fertilizers for MYG and Farmers' practice, respectively. Effect of Boro rice straw incorporation on the yield of T.Aman rice was observed to some extent. Rice straw incorporation along with full dose of recommended fertilizer dose as well as reduced amount of recommended fertilizer dose gave similar yield. Incorporation of one third as well as two third also gave similar yield. Yield over the years did not vary significantly except in 2000-01. During 2000-01 grain yield differed significantly only with Farmers' practice (T_7). However, the highest grain yield was recorded from treatment T_2 where two third Boro rice straws were incorporated along with recommended fertilizer dose. Similarly, in case of straw, yield did not vary markedly among the treatments. Yield was also insignificant over the years.

The average of four years results revealed that the highest gross return as well as gross margin was obtained from T_2 closely followed by T_3. Economic return did not very appreciably among the treatments except with T_6 and T_7. However, the lowest gross margin was obtained from Farmers' practice (T_7).

Conclusion

From the four years results it is clear that incorporation of Boro rice straw has some positive effect on the yield of T.Aman rice. Two third ($^{2}/_{3}^{rd}$) as well as $^{1}/_{3}$rd Boro rice straw could be incorporated along with full dose of recommended fertilizer dose (MYG) in T.Aman rice for higher yield and economic return. Grain yield of Boro rice also increased slightly due to straw incorporation. Incorporation of rice straw will improve soil physical and chemical properties and thereby improve soil fertility as well. However, post soil analysis data was not yet available. Therefore, it can be concluded that after harvest of Boro rice straw should be incorporated in soil and then grown T.Aman rice with recommended fertilizer for higher yield, profit and for sustainable crop production.

Table 1. Effect of boro rice straw on the yield of Boro rice in the Boro-T.Aman rice systems during 1999-2000 to 2002-03 at Comilla

Treatment	Grain yield (t/ha)				
	1999-00	2000-01	2001-02	2002-03	Mean
95-20-40-10	5.15	6.47	6.92	6.68	6.35
95-20-40-10	5.15	6.37	6.74	7.70	6.49
95-20-40-10	5.15	6.87	6.52	7.80	6.58
95-20-40-10	5.15	6.67	6.98	6.86	6.41
95-20-40-10	5.15	6.23	6.58	6.68	6.16
95-20-40-10	5.15	6.30	6.78	6.06	6.07
95-20-40-10	5.15	6.30	6.53	6.59	6.14
	Straw yield (t/ha)				
95-20-40-10	6.9	8.4	8.41	7.31	7.75
95-20-40-10	6.9	8.3	8.22	8.25	7.92
95-20-40-10	6.9	8.8	7.88	8.18	7.94
95-20-40-10	6.9	8.5	8.53	7.23	7.79
95-20-40-10	6.9	8.1	8.04	7.40	7.61
95-20-40-10	6.9	8.2	8.12	6.87	7.52
95-20-40-10	6.9	8.2	7.86	7.22	7.54

Table 2. Effect of boro rice straw on the yield of T.Aman rice in the Boro-T.Aman rice systems during 1999-2000 to 2002-2003 at Comilla

Treatment	Grain yield (t/ha)				
	1999-00	2000-01	2001-02	2002-03	Mean
T_1	4.52a	5.38a	5.70	4.67	5.07
T_2	4.65a	5.48a	5.98	5.72	5.46
T_3	4.45a	5.38a	5.65	5.56	5.26
T_4	4.42a	5.18ab	5.75	4.82	5.04
T_5	4.29ab	5.30a	5.56	4.98	5.03
T_6	4.06ab	4.63b	5.44	4.89	4.75
T_7	4.30ab	5.00ab	5.17	5.17	4.91
	Straw yield (t/ha)				
T_1	4.49	6.71	8.11	6.0	6.33
T_2	5.35	5.13	6.97	6.8	6.06
T_3	5.27	6.76	7.49	7.2	6.68
T_4	5.58	5.49	8.05	6.3	6.35
T_5	4.96	6.62	7.78	5.9	6.31
T_6	5.75	5.78	7.62	6.4	6.39
T_7	5.40	6.25	7.24	6.7	6.40

Table 3. Cost and return analysis as influenced by boro rice straw incorporation in Boro-T.Aman rice system at Comilla during 1999-2000 and 2002-03 (Average)

Treatment	Gross return (Tk./ha)	Variable cost (Tk./ha)	Gross margin (Tk./ha)
T_1	94020	11179	82841
T_2	97630	12184	85446
T_3	97500	13002	84498
T_4	94290	13397	80893
T_5	92250	10532	81718
T_6	89650	9865	79785
T_7	91290	12541	78749

Price: Rice grain @ Tk. 7.00 /kg, Rice straw @ Tk. 1.00 /kg
Urea @ Tk. 6.00 /kg, T.S.P @ Tk.15.00 /kg, M P @ Tk.9.00 /kg, Gypsum @ Tk.4.00 /kg,

Location : Shahrasti, Comilla
Year of conduction: 2002-03

The experiment initiated with Boro rice grown with recommended fertilizer dose. As the fertilizer dose was same, therefore, yield was also same in all the plots. On an average 5.41 and 6.34 t/ha of grain and straw yield was recorded, respectively. After harvesting Boro rice treatments were imposed in T.Aman rice with different amount of rice straw incorporation along with inorganic fertilizers. Results showed that no significant difference in grain yield of T.Aman rice was found among the different treatments. Effect of rice straw incorporation on the yield of T.Aman rice was not observed at all. Similar trend was found in straw yield also. Different growth and yield contributing characters were insignificant among the treatments. However, it was the 1st year experiment and the experiment will be repeated for another two years.

Table 4. Yield and yield contributing characters of T.Aman under Boro - T.Aman cropping pattern at Shahrasti, Chandpur during 2002-03

Treatment	Plant height (cm)	Effective Tiller/hill	Panicle length (cm)	Grain/ panicle	Straw wt. (t/ha)	Yield (t/ha)
T_1=54-19-21-4.5+ $^1/_3$rd RS	85.8	14.0	20.2	144.0	6.2	4.56
T_2=54-19-21-4.5+ $^2/_3$rd RS	85.6	14.2	20.0	145.8	6.4	4.11
T_3=65-22-25-20-+ $^1/_3$rd RS	86.4	13.8	20.0	144.6	6.5	4.79
T_4=50-18-16-20+ $^2/_3$rd RS	85.6	13.8	20.0	147.2	6.4	4.12
T_5=74-23-27-6.3	86.2	14.8	20.4	142.2	6.6	4.14
T_6=54-19-21-4.5	85.4	14.2	21.0	145.6	6.7	4.17
T_7=90-37-32	87.4	14.8	21.0	150.8	6.9	4.34
LSD	NS	NS	NS	NS	NS	NS
CV (%)	11.32	4.03	2.36	2.57	11.18	3.64

Location : Kolaroa
Year of conduction: 2001-02 to 2002-03

In the 1st year Boro rice was grown with recommended fertilizers. Grain yield was same in all the plots as the treatment was similar. On an average 5.4 and 6.34 t/ha of grain and straw yield was obtained, respectively. Similarly, in the 2nd year (2002-03) no significant difference in yield was found. Effect of straw incorporation on the yield of Boro rice was not evident. However the highest yield was recorded from T_2 where $^2/_3$rd Boro rice straw was incorporated along with recommended fertilizer dose.

After harvesting of Boro rice, different amount of straw was incorporated along with inorganic fertilizer in T.Aman rice. On an average 1.88 and 3.6 t/ha of straw (dry wt. basis) was incorporated as

$^{1}/_{3}$rd and $^{2}/_{3}$rd, respectively (Table 1). The effect of rice straw on the yield of T.Aman has been shown in Table 5. During the year 2002-03, no significant difference in yield was observed except with T_5 where recommended fertilizer dose for MYG was applied. Effect of rice straw on the yield of T.Aman rice was not evident. However, yield was little bit higher in T_5 and T_7 due to higher fertilizer dose. But in 2001-02, grain yield varied significantly among the treatments. Significantly higher yield was obtained from T_2, T_5 and T_7. Average of two years results also showed that higher yield was obtained from T_2, T_5 and T_7. Two third rice straw incorporated along with recommended fertilizer dose for MYG produced similar yield with recommended fertilizer dose for HYG. Effect of rice straw in T.Aman rice was observed to some extent.

Cost and return analysis showed that the highest gross margin was obtained in T_2 followed by T_5. Similarly, treatment T_2 and T_5 produced higher BCR. From the two years of experimentation it was found that incorporation of rice straw ($^{2}/_{3}$rd) along with recommended fertilizer dose for MYG performed better in terms of yield and economic benefits. However the experiment will be continued for next year for sound recommendation.

Table 5. Performance of Boro rice under Boro - T.Aman cropping pattern at Kalaroa MLT site during 2001-02 to 2002-03

Treatment	Grain yield (t/ha)			Straw yield (t/ha)		
	2001-02	2002-03	Mean	2001-02	2002-03	Mean
T_1	5.25	5.13	5.19	5.50	5.81	5.66
T_2	5.52	5.56	5.54	6.13	6.31	6.22
T_3	5.26	5.31	5.29	5.63	6.13	5.88
T_4	5.42	5.25	5.34	6.38	6.00	6.19
T_5	5.50	5.25	5.38	6.50	5.88	6.19
T_6	5.52	5.37	5.45	6.60	5.75	6.18
T_7	5.31	5.19	5.25	6.50	5.94	6.22
Average	5.40	5.29	5.34	6.18	5.97	6.07

Table 6. Effect of Boro rice straw and fertilizer on yield and yield attributes of T.Aman rice under Boro – T.Aman cropping pattern at Kalaroa MLT site, 2002-03

Treatment	Grain yield (t/ha)			Straw yield (t/ha)		
	01-02	02-03	Mean	01-02	02-03	Mean
T_1 = $^{1}/_{3}$ boro rice straw + 70-6-20-4-0kg/ha NPKSZn	4.17b	4.62ab	4.39	4.72a	5.25bc	4.98
T_2 = $^{2}/_{3}$ boro rice straw + 70-6-20-4-0 kg/ha NPKSZn	4.77a	4.88ab	4.82	5.12a	5.67ab	5.39
T_3 = $^{1}/_{3}$ boro rice straw + 65-22-25-20-5 kg/ha NPKSZn	4.02b	4.27ab	4.14	4.72a	4.42d	4.57
T_4 = $^{2}/_{3}$ boro rice straw + 50-18-16-20-5 kg/ha NPKSZn	4.27b	4.42ab	4.34	4.77a	4.92cd	4.84
T_5 = HYG (RF_1) 91-7.8-26-5.2-0 kg/ha NPKSZn	4.82a	4.90a	4.86	5.15a	6.02a	5.58
T_6 = MYG (RF_2) 70-6-20-4-0 kg/ha NPKSZn	4.02b	4.20b	4.11	4.55a	5.07c	4.81
T_7 = (FP) 135-30-37.5-0-5.4 kg/ha NPKSZn	4.97a	4.97a	4.97	5.22a	6.00a	5.61
CV (%)	5.23	9.20	-	9.33	6.48	-

Table 8. Cost and return analysis of the cropping pattern Boro- T.Aman rice system at Kalaroa during 2002-03

Treatment	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	32655	9950	22705	3.28
T_2	34555	10900	26555	3.17
T_3	29965	12620	17345	2.37
T_4	31190	12810	18380	2.43
T_5	34990	9970	25020	3.50
T_6	29835	9460	20375	3.15
T_7	35305	13560	21745	2.60

Price (Tk/kg): Urea= 6, Gypsum= 4, TSP= 14, MP= 10, $ZnSO_4$= 80, Rice grain= 7, Rice straw= 0.50

Appendix tables

Table 1. Crop management practices

Site	Crop	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Comilla	Boro	BRRI Dhan 29	40	1st week of Feb	2nd week of May
	T.Aman	BRRI Dhan 33 & BRRI Dhan 32	40	2nd week of Aug	3rd week of Nov
Shahrasti	Boro	BRRI Dhan 29	4040	1st week of Feb	3rd week of May
	T.Aman	BRRI Dhan 33		3rd week of Aug	2nd week of Nov
Kolaroa	Boro	BRRI Dhan 28	40	3rd week of Jan.	Last week of April
	T.Aman	BRRI Dhan 30	40	1st week of Aug.	Last week of Nov.

Table 2. Initial soil analysis results of Kalaroa MLT site

Nutrient	Soil test value	Soil test interpretation
pH	8.1	Slightly alkaline
Organic matter (%)	1.88	Medium
EC (mmhos/cm)	0.66	Non saline
Total N (%)	0.092	Low
Available P (ppm)	4.80	Very low
K (meq./100g)	0.22	Medium
S (ppm)	13.21	Low
Zn (ppm)	0.51	Low

Table 3. Yield and yield contributing characters of Boro under Boro - T.Aman cropping pattern at Comilla sadar, during 1999-2000

Treatment	Plant height (cm)	Tiller\ Hill	Panicle/ hill	Grain/ Panicle	Length of panicle (cm)	panicle/ m^2	1000 Grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15
T3=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15
T4=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15
T5=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15
T6=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15
T7=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15
T8=95-20-40-10	90.83	16.7	13.43	159.55	21	311.25	23.65	6.9	5.15

Table 4. Yield and yield contributing characters of T.Aman under Boro - T.Aman cropping pattern at Comilla sadar, during 1999-2000

Treatment	Plant height (cm)	Tiller /hill	Panicle/ hill	Grain/ Panicle	Length of panicle (cm)	Panicle/ m^2	1000 Grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=54-19-21-4.5+1/3rd RS	100.2	12.65	10.80	121	21.43	308.03	22.15	4.49	4.52a
T3=54-19-21-4.5+/3rd RS	71.6	13.80	12.48	108	20.40	312.55	21.98	5.35	4.65a
T4=65-22-25-20-+1/3rd RS	96.5	13.50	12.58	125	21.95	325.68	22.5	5.27	4.45a
T5=50-18-16-20+2/3rd RS	99.5	13.05	12.53	126	21.83	308.68	22.45	5.58	4.42a
T6=74-23-27-6.3	98.4	13.30	12.08	126	21.10	321.03	23.54	4.96	4.29ab
T7=54-19-21-4.5	98.2	12.38	10.98	121	21.38	278.00	23.77	5.75	4.06ab
T8=90-37-32	98.0	12.35	11.88	110	21.43	319.95	23.65	5.40	4.30ab
Sx	*	ns	ns	**	*	*	ns	*	*
CV(%)	5.2	4.2	0.5	2.1	4.5	12.9	2.5	7.2	6.5

Table 5. Yield and yield contributing characters of Boro under Boro - T.Aman cropping pattern at Comilla sadar, during 2000-01

Treatment	Plant height (cm)	Tiller\ hill	Panicle/ hill	Grain/ Panicle	Length of panicle (cm)	panicle/m ^{2}	1000 Grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=95-20-40-10	103.62	9.90	9.3	154.15	28.30	312.50	23.9	8.4	6.47
T3=95-20-40-10	104.53	10.10	9.6	161.85	29.35	306.40	24.1	8.3	6.37
T4=95-20-40-10	103.26	9.50	9.1	157.10	29.20	298.98	23.9	8.8	6.87
T5=95-20-40-10	104.88	10.30	9.8	153.40	28.30	305.20	23.4	8.5	6.67
T6=95-20-40-10	101.10	10.15	9.6	161.30	28.85	299.30	23.6	8.1	6.23
T7=95-20-40-10	103.63	10.50	9.8	153.85	29.70	301.40	23.7	8.2	6.30
T8=95-20-40-10	102.15	10.10	9.7	153.40	27.30	305.20	23.9	8.2	6.30
CV(%)	3.5	2.4	1.4	9.4	3.1	6.9	1.5	2.5	3.7

Table 6. Yield and yield contributing characters of T.Aman under Boro - T.Aman cropping pattern at Comilla sadar, during 2000-01

Treatment	Plant height (cm)	Tiller \hill	Panicle/ hill	Grain/ Panicle	Length of panicle (cm)	1000 Grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=54-19-21-4.5+1/3rd RS	86.06	12.93	11.75	87.70	22.85	23.10	6.71	5.38a
T3=54-19-21-4.5+2/3rd RS	85.48	10.98	11.15	101.08	21.80	23.60	5.13	5.48a
T4=65-22-25-20-+1/3rd RS	91.53	10.98	10.13	100.18	21.95	22.45	6.76	5.38a
T5=50-18-16-20+2/3rd RS	80.10	12.03	10.68	89.68	19.60	22.98	5.49	5.18ab
T6=74-23-27-6.3	88.78	13.35	12.53	107.30	22.38	23.65	6.62	5.30a
T7=54-19-21-4.5	81.80	12.63	12.90	81.13	19.75	23.40	5.78	4.63b
T8=90-37-32	89.40	11.70	10.95	94.20	22.75	23.65	6.25	5.00ab
CV(%)	4.6	5.1	2.1	11.3	2.5	2.6	3.1	4.8

Table 7. Yield and yield contributing characters of Boro under Boro-T.Aman cropping pattern at Comilla sadar, during 2001-02

Treatment	Plant height (cm)	Effective tiller/ hill	Length of panicle (cm)	Grain/ Panicle	1000- Grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=95-20-40-10	78.37	15.10	22.25	100.42	23.20	8.41	6.92
T3=95-20-40-10	78.30	15.55	22.57	101.35	23.35	8.22	6.74
T4=95-20-40-10	79.17	14.85	22.57	102.67	23.52	7.88	6.52
T5=95-20-40-10	80.23	14.98	22.02	97.17	23.32	8.53	6.98
T6=95-20-40-10	80.03	15.56	22.77	98.20	23.15	8.04	6.58
T7=95-20-40-10	79.35	14.32	22.70	102.60	23.25	8.12	6.78
T8=95-20-40-10	80.32	14.02	22.50	102.05	23.52	7.86	6.53
LSD	NS	NS	NS	NS	NS	NS	NS
CV%	10.52	13.86	6.75	9.37	7.25	12.14	10.11

Table 8. Yield and yield contributing characters of T.Aman under Boro - T.Aman cropping pattern at Comilla sadar, during 2001-02

Treatment	Plant height (cm)	Effective tiller/hill	Panicle length (cm)	Grain/ panicle	1000-grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=54-19-21-4.5+ ^{1}/3rd RS	101.17	11.75	22.54	161.27	21.88	8.11	5.70
T3=54-19-21-4.5+ ^{2}/3rd SR	99.40	12.72	22.65	159.75	22.13	6.97	5.98
T4=65-22-25-20-+ ^{1}/3rd RS	102.12	12.70	22.32	168.63	22.22	7.49	5.65
T5=50-18-16-20+ ^{2}/3rd RS	103.20	12.22	23.34	166.72	22.21	8.05	5.75
T6=74-23-27-6.3	99.17	12.50	22.48	165.84	22.35	7.78	5.56
T7=54-19-21-4.5	101.20	11.57	23.36	167.75	22.37	7.62	5.44
T8=90-37-32	100.80	12.22	23.25	158.45	22.78	7.24	5.17
LSD	NS	NS	NS	NS	NS	NS	NS
CV(%)	8.88	13.13	11.48	14.55	7.61	10.88	12.9

Table 9. Yield and yield contributing characters of Boro under Boro - T.Aman cropping pattern at Comilla sadar, during 2002-03

Treatment	Plant height (cm)	Effective Tiller/hill	Panicle length (cm)	Grain/ panicle	1000-grain wt. (g)	Straw yield (t/ha)	Yield (t/ha)
T2=95-20-40-10	85.2	16.4	25.0	107.2	22.4	7.31	6.68
T3=95-20-40-10	84.9	15.2	26.2	116.6	23.4	8.25	7.70
T4=95-20-40-10	90.0	17.2	24.8	115.4	21.8	8.18	7.80
T5=95-20-40-10	89.0	18.4	26.6	112.4	22.0	7.23	6.86
T6=95-20-40-10	84.2	16.8	25.8	120.6	22.4	7.40	6.68
T7=95-20-40-10	84.2	18.2	25.2	111.4	22.2	6.87	6.06
LSD	NS	NS	NS	NS	NS	NS	NS
CV%	6.45	11.24	5.56	9.58	5.37	10.45	8.53

Table 10. Yield and yield contributing characters of T.Aman under Boro - T.Aman cropping pattern at Comilla sadar, during 2002-03

Treatment	Plant height (cm)	Effective Tiller/ hill	Panicle length (cm)	Grain/ panicle	1000-grain wt.(g)	Straw wt. (t/ha)	Yield (t/ha)
T2=54-19-21-4.5+ ^{2}/3rd SR	100	11.8	20.6	133	18.6	6.0	4.67
T3=65-22-25-20-+ ^{1}/3rd RS	101	13.4	20.5	134	18.1	6.8	5.72
T4=50-18-16-20+ ^{2}/3rd RS	102	13.2	21.4	135	19.0	7.2	5.56
T5=74-23-27-6.3	103	12.2	21.3	137	19.2	6.3	4.82
T6=54-19-21-4.5	99	10.6	20.6	130	14.6	5.9	4.98
T7=90-37-32	101	12.4	21.1	140	18.0	6.4	4.89
LSD	NS	NS	NS	NS	NS	NS	NS
CV%	7.32	10.55	5.45	9.26	2.30	10.59	12.43

Table 11. Effect of Boro rice straw and fertilizer on yield and yield attributes of T.Aman rice under Boro-T.Aman cropping pattern at Kalaroa MLT site, 2001-002

Treatment	Plant height (cm)	Tiller/hill (no.)	Panicle length (cm)	Grain/ Panicle (no.)	1000 grain weight (g)
T_1	114.00c	12.17	23.45	112.72b	24.50
T_2	116.45bc	12.75	24.20	117.75ab	25.25
T_3	117.82abc	12.67	24.40	113.32b	25.75
T_4	120.92abc	12.62	24.65	124.62a	26.50
T_5	124.30a	12.02	23.90	117.50ab	25.75
T_6	121.52ab	12.80	23.72	126.05a	25.50
T_7	124.72a	12.67	25.90	123.98a	25.75
CV (%)	3.60	6.38	7.10	5.28	6.13

Table 12. Amount of Boro rice straw incorporated into the soil before T.Aman transplanting under Boro-T.Aman cropping pattern at Kalaroa MLT site during 2002-03

Treatment	Before T.Aman transplanting
	Boro rice straw incorporated (t/ha)
T_1	1.86
T_2	3.60
T_3	1.90
T_4	3.61
T_5	1.09
T_6	1.09
T_7	1.09
Average	2.03

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IMPROVEMENT OF SOIL FERTILITY THROUGH INTEGRATED FERTILIZER MANAGEMENT IN MUNGBEAN-T.AUS-T.AMAN CROPPING PATTERN

Abstract

The experiment was conducted at Lebukhali FSRD site of OFRD, BARI, Patuakhali during 2002-03 to evaluate the effect of different nutrient management packages on soil fertility and productivity of Mungbean-T.Aus-T.Aman cropping pattern. Four different nutrient management packages (crop residues + CD @ 10 t/ha + estimated inorganic fertilizers, crop residues + CD @ 5 t/ha + estimated inorganic fertilizers, crop residues + estimated inorganic fertilizers and only inorganic fertilizers at recommended rate) along with Farmers' practice and no fertilizer treatment were tested. Grain yield of crops varied significantly among the different nutrient packages. Significantly higher grain yield in Mungbean was obtained in IPNS with crop residues + CD @ 10 t/ha (T_1). In T.Aus and T.Aman rice all the three IPNS based treatments (T_1, T_2 and T_3) gave higher and identical yield over other treatments. Regarding cost and return analysis, the highest gross margin was calculated from T_1 closely followed by T_2 and T_3. But the highest MBCR was found in T_3 due to less fertilization cost.

Introduction

Soil of tidal Ganges Floodplain (AEZ-13) is non-calcareous and silty clay to heavy clay in texture, slightly acidic in dry season to slightly alkaline in wet season (p^H 5.5-7.4). Generally fertility is poor, soil organic matter content is about 1% and native soil nitrogen and phosphorus content is low to very low. Drainage is very poor. Drying of soil results in very hard consistence difficult to plough for rabi crop cultivation with weak draft animal as available in the locality and type is medium high land to medium low land flooded twice daily usually from May to October. T.Aus, T.Aman and rabi crops (area coverage 25%) like Mungbean, Khesari, Cowpea, Chili are main crops. Farmers use very low amount of inorganic fertilizer. It is necessary to study the long term effect of integrated fertilizer management practices on major cropping pattern for sustaining soil fertility, crop productivity and for improvement of soil health. With this point of view Mungbean-T.Aus-T.Aman cropping pattern was selected as brown mungbean plant is a good source of organic matter that can be easily incorporated in soil without any extra cost. Farmers usually did not apply any organic manure in their traditional cultivation practice. Integrated nutrient management with organic and inorganic fertilizers will be very useful to improve and maintain soil fertility for sustainable crop production. Keeping this view in mind the experiment was designed with following objectives-

- To increase crop productivity.
- To improve soil health.
- To improve soil physical condition.

Materials and Methods

The experiment was initiated under rainfed condition at FSRD site, Lebukhali, Patuakhali in rabi season of 2002-03, with Mungbean in Mungbean-T.Aus-T.Aman cropping pattern. Six treatments of fertilizer management with 5 dispersed replications were set up in RCB design. Treatments are given in table 1. Seeds of BARI Mung-2 were sown at the rate of 30 kg/ha in line with a spacing of 30 cm. Seeds were sown on 6 February 2003. Crop was infested by pod borer at ripening stage. Insecticide, Malathion was sprayed 2 times at 7 days interval. Pods were harvested two times first on April15-20, and finally on 3-6 May 2003. After then plants were incorporated in soil at the time of land preparation before T.Aus. For T.Aus fertilizer dose was estimated by deducting the amount of nutrient element that was added by mungbean plants. In the same way straw of T.Aus was incorporated in the soil during land preparation for T.Aman and fertilizer dose for T.Aman was estimated by deducting the amount of nutrient element that was added by T.Aus straw. Fertilizer doses were estimated on the basis of FRG '97 recommendation. Variety of T.Aus and T.Aman was BRRI dhan 27 and BRRI dhan 23, respectively. At the beginning of the experiment soil sample was collected for chemical analysis and sent to SRDI regional laboratory, Khulna. Data was collected from plants sample.

Table 1. Treatments for fertilizer management

Treatment	Estimated chemical fertilizer								
	Mungbean			T.Aus			T.Aman		
	N	P	K	N	P	K	N	P	K
T_1= Crop residues + Cowdung (10 t/ha) + Estimated chemical fertilizer	0	0	0	20	4	20	12	2	0
T_2= Crop residues+ Cowdung (5 t/ha) + Estimated chemical fertilizer	0	3	0	20	4	20	12	2	0
T_3= Crop residues+ Estimated chemical fertilizer	12	8	8	20	4	20	12	2	0
T_4= Recommended fertilizer dose (FRG '97)	12	8	8	35	4	20	30	3	20
T_5= Farmers' practice (Mungbean: CD 3 t/ha)	0	0	0	60	0	0	40	0	0
T_6= Control	0	0	0	0	0	0	0	0	0

To estimate the requirement of chemical fertilizer following information was followed.
Cowdung : 3-1-3 kg N-P-K per ton for following crop.
Crop residues (Mungbean) : 6 kg N per ton dry biomass to succeeding T.Aus.
Crop residues (T.Aus) : 2-0.5-8 kg N-P-K per ton dry biomass to succeeding T.Aman

Results and discussion

Grain yield of Mungbean varied significantly among the treatments. Significantly higher yield was recorded from T_1 where crop residues of Mungbean (1st year) + CD @ 10 t/ha along with estimated fertilizer was applied. Second highest yield was obtained in T_2 where 5 t/ha of cowdung was applied instead of 10 t/ha. Effect of organic manure was observed in Mungbean to some extent. Recommended fertilizer dose, FRG '97 (T_4) gave identical yield with T_5 where crop residues + estimated inorganic fertilizer were applied. Farmers usually do not apply any inorganic fertilizer in Mungbean, therefore, yield was similar in Farmers' practice (T_5) and no fertilizer treatment (T_6). In T.Aus rice, higher yield was recorded from T_1 that was identical to T_2 and T_3. The IPNS based treatments (T_1, T_2 and T_3) gave higher yield over inorganic fertilizer (T_4). Almost similar trend was observed in T.Aman rice. Significantly higher yield was recorded from IPNS based treatments. Farmers' apply only nitrogenous fertilizer in T.Aus and T.Aman @ 40 and 60 kg/ha, respectively. They did not apply any PKS fertilizers; therefore, yield was lower than other fertilizer doses.

Regarding cost and return analysis, the highest gross return as well as gross margin was obtained from treatment T_1 closely followed by T_2 and T_3. But the highest MBCR over control was found in T_3. Incorporation of crop residues of Mungbean and T.Aus could reduce the inorganic fertilizer and thereby reduced cost of production. From the result it is clear that IPNS based fertilizer dose produced higher yield and economic return. Effect of cowdung as well as crop residues was evident.

Table 2. Yield and economics of Mungbean-T.Aus-T.Aman cropping pattern as affected by different fertilizer doses at Lebukhali, Patuakhali during 2002-03

Treat.	Grain yield (kg/ha)			Straw yield (kg/ha)			Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR over control
	M. bean	T.Aus	T.Aman	M. bean	T.Aus	T.Aman				
T_1	1195a	4310a	4698a	2564	4534	4758	92206	6270	85936	7.75
T_2	1123b	4290a	4541a	2541	4592	4620	88971	3995	84976	11.35
T_3	1032c	4153ab	4470a	2308	4354	4602	85104	2180	82924	19.02
T_4	965c	3940b	3979b	2325	4230	4365	78513	3087	75426	11.30
T_5	654d	2578c	2570c	1935	3338	3466	51770	1302	50468	6.25
T_6	586d	2110d	2080d	2031	2870	2850	43628	0	43628	-
CV (%)	6.43	7.4	9.27	-	-	-	-	-	-	-

Input (Tk./kg): Urea= 6, TSP= 15, MP= 10, Mungbean seed= 40, T.Aus seed =15, T.Aman seed = 15
Output (Tk./kg): Mungbean= 20, T.Aus rice= 5, T.Aman rice= 6, Rice straw = 0.50

Appendix tables

Table 1. Effect of different nutrient management packages on yield and yield contributing characters in Mungbean under CP Mungbean-T.Aus-T.Aman during 2002-03 at SRD site, Lebukhali, Patuakhali.

Treatment	Plant pop./ m^2	Plant height (cm)	Pods/ plant	Seeds/ pod	1000 grain wt. (gm)	Grain yield (kg/ha)	Stover yield (kg/ha)
T_1	31.4	50.8	14.6a	8.6a	30.4ab	1195a	2564
T_2	30.6	51.4	14.4a	8.4a	30.6a	1123b	2541
T_3	30.2	49.8	13.8b	8.4a	30.4ab	1032c	2308
T_4	30.8	49.8	13.4b	8.4a	30.4ab	965c	2325
T_5	27.0	48.2	12.0c	7.0b	30.0c	654d	1935
T_6	30.0	48.2	12.4c	7.0b	30.2b	586d	2031
CV(%)			3.65	5.4	2.2	6.43	

Table 2. Effect of different nutrient management packages on yield and yield contributing characters of T.Aus under CP Mungbean-T.Aus-T.Aman during Kharif-2003 at FSRD site, Lebukhali, Patuakhali.

Treatments	Panicle/m^2	Grain /Panicle	1000-grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	161a	94a	28.9a	4310a	4534
T_2	159ab	96a	28.7a	4290a	4592
T_3	157b	95a	28.7a	4153ab	4354
T_4	158ab	93a	28.6a	3940b	4230
T_5	133c	84b	27.5b	2578c	3338
T_6	128d	74c	27.2b	2110d	2870
CV(%)	6.05	7.43	2.63	7.4	

Table 3. Effect of different nutrient management packages on yield and yield contributing characters of T.Aman under CP Mungbean-T.Aus-T.Aman during Kharif-2003 at FSRD site, Lebukhali, Patuakhali.

Treatment	Pan/m^2	Filled grain/panicle	Unfilled grain/panicle	1000-grain wt. (gm)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	236a	79.0a	13	27.5a	4698a	4758
T_2	232a	77.6a	11	27.0b	4541a	4620
T_3	229a	76.5a	13	27.2ab	4470a	4602
T_4	219b	69.6b	12	27.5a	3979b	4365
T_5	188c	54.8c	15	26.8c	2570c	3466
T_6	176c	46.4d	17	26.2d	2080d	2850
CV(%)	4.77	4.59	1.52	9.27		

Table 4. Two years' yield of different crops under CP Mungbean-T.Aus-T.Aman at FSRD site, Lebukhali, Patuakhali

Treatments	Yield (kg/ha) in 2001-02 season			Yield (kg/ha) in 2002-03 season		
	Mungbean	T.Aus	T.Aman	Mungbean	T.Aus	T.Aman
T_1	1224 a	4121ab	4565a	1195a	4310a	4698a
T_2	1211 a	4146a	4581a	1123b	4290a	4541a
T_3	1196 a	4026ab	4630a	1032c	4153ab	4470a
T_4	1183 a	4067ab	4505a	965c	3940b	3979b
T_5	1080 b	3205c	3150b	654d	2578c	2570c
T_6	760 c	2662d	2580c	586d	2110d	2080d
CV(%)	8.6	6.31	12.27	6.43	7.4	9.27

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SUBPROJECT: 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 13 different locations across the country with 9 dominant cropping patterns during 2000-01 to 2002-03 to find out an optimum fertilizer dose for the crops grown in different cropping pattern & response of crops to NPKS. Four different levels of NPKS, viz. 0, MYG, HYG and HYG x 1.3 were tested. Results showed that a marked response on the yield of crops to N was evident irrespective of locations. Even in some locations the response was linear. A considerable response to P was also observed in most of the locations, particularly in P deficient soils. But response to K and S was not clear in some of the locations. From the yield data a response curve was drawn and optimum fertilizer dose for the crops were find out.

Introduction

Crops grown in different cropping patterns and environment responded differently to mineral fertilizer nutrients. The nature of response may vary over time. In the past, most of the fertilizer recommendations were individual crop basis. But there some residual effects of some nutrient elements particularly PKS and Zn are found in the succeeding crops. In Bangladesh different crops are grown in different cropping patterns under different agro-climatic condition. Recently BARC developed a national fertilizer recommendation guide '97 with fertilizer recommendation for different crops based on AEZ that needs to further update and verified for different dominant cropping patterns at different environments. Therefore, it is very important to verify and update the present recommendation of BARC FRG '97 for major crops under different agro-ecological condition.

Objective

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

Materials and Methods

The experiment on seven dominant cropping patterns was conducted during 2000-01 to 2002-03 at different locations under different AEZs to determine optimum and economic dose of fertilizer nutrients for major crops grown in different environments. A total of 9 dominant cropping patterns at 13 locations were tested. 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 NPK and S for different crops grown in different cropping patterns were tested all over the country. 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

Sl. No.	Cropping pattern	Locations
1.	Mustard-Boro-T.Aman	Narikeli
2.	Wheat-Jute-T.Aman	Sherpur
3.	Potato-Jute-T.Aman	Melandah
4.	Boro-T.Aus-T.Aman	Chandina
5.	Boro-T.Aman	Kolaroa, , Feni, Ishan Gopalpur
6.	Chickpea-T.Aman	Barind
7.	Chilli-T.Aman	Lebukhali, Hathazari
8.	Groundnut-T.Aman	Atkapalia
9.	Mustard-Boro	Mymensingh, Kaliakoir

Results and Discussion

Cropping pattern : **Mustard -Boro - T.Aman**
Location : **Narikeli, Jamalpur (AEZ 9)**
Year of establishment : **2002-03**

Mustard: Response of Mustard to nitrogen was observed to some extent. Grain yield increased markedly up to 60 kg/ha of N and then tended to decline. But response to P, K and S was not evident. However, seed yield increased slowly up to 20, 36 and 20 kg/ha of P, K and S, respectively.

Boro: Grain yield of Boro rice increased markedly with the increase of N and the highest yield was recorded from 130 kg/ha of N and then tended to decrease. But no considerable response was observed to P, K and S. Grain yield of T.Aman rice was increased slightly up to 12, 60 and 20 kg/ha of P, K and S, respectively.

T.Aman: Almost similar trend was found in T.Aman rice like Boro. Grain yield of T.Aman rice increased sharply up to 60 kg/ha of N. Yield also showed to increase up to 80 kg/ha but the rate of increment was slow. P, K and S again failed to show considerable response towards the yield of T.Aman rice.

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

Crop	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Mustard	62	10	21	17	60	9	19	13
Boro	134	18	56	18	106	14	39	11
T.Aman	80	16	52	6	69	14	12	6

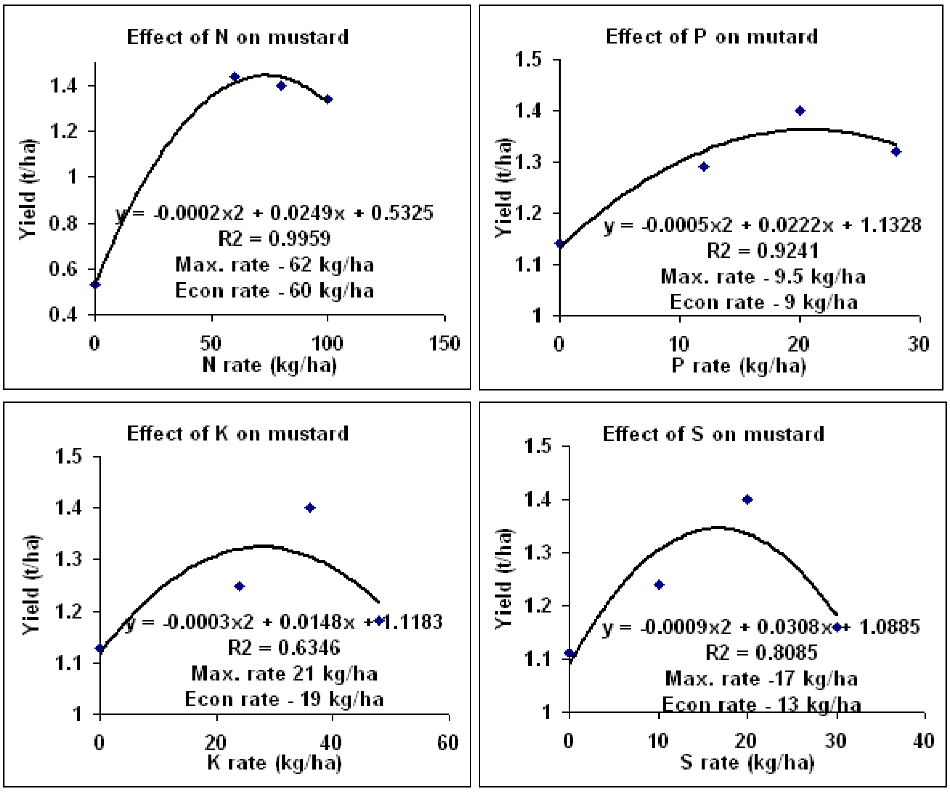

Figure 1. Response of NPKS on Mustard of Mustard-Boro-T.Aman cropping pattern at FSRD site, Narikeli, Jamalpur during 2003

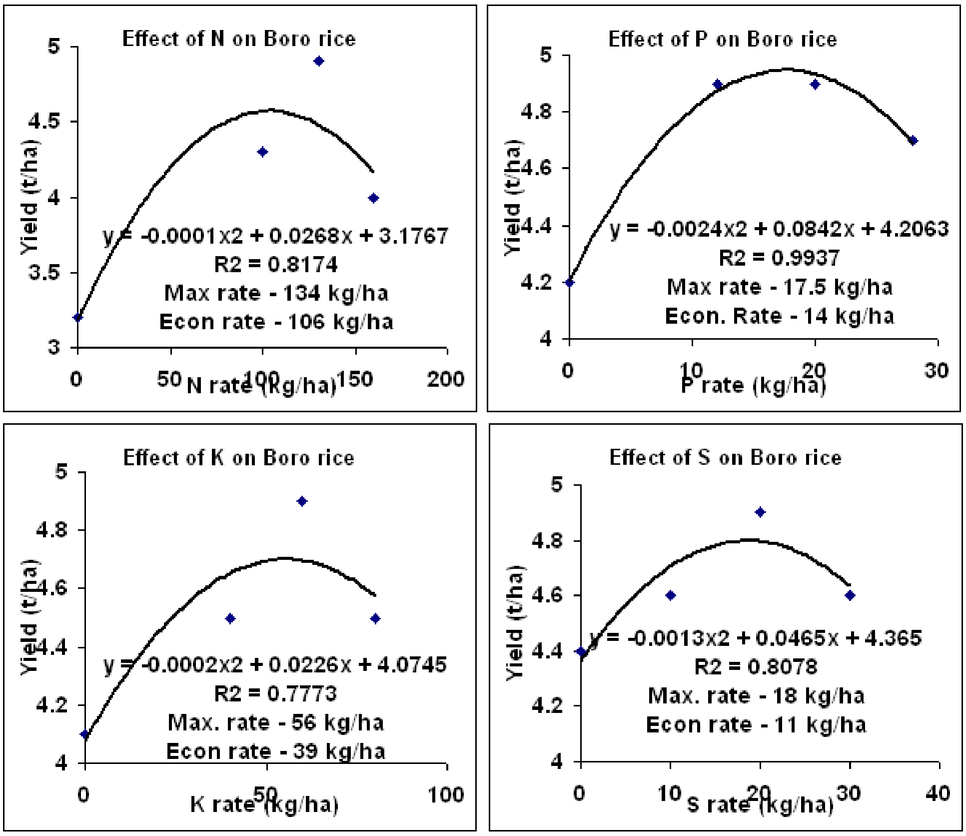

Figure 2. Response of NPKS on Boro of Mustard-Boro-T.Aman cropping pattern at FSRD site, Narikeli, Jamalpur during 2003

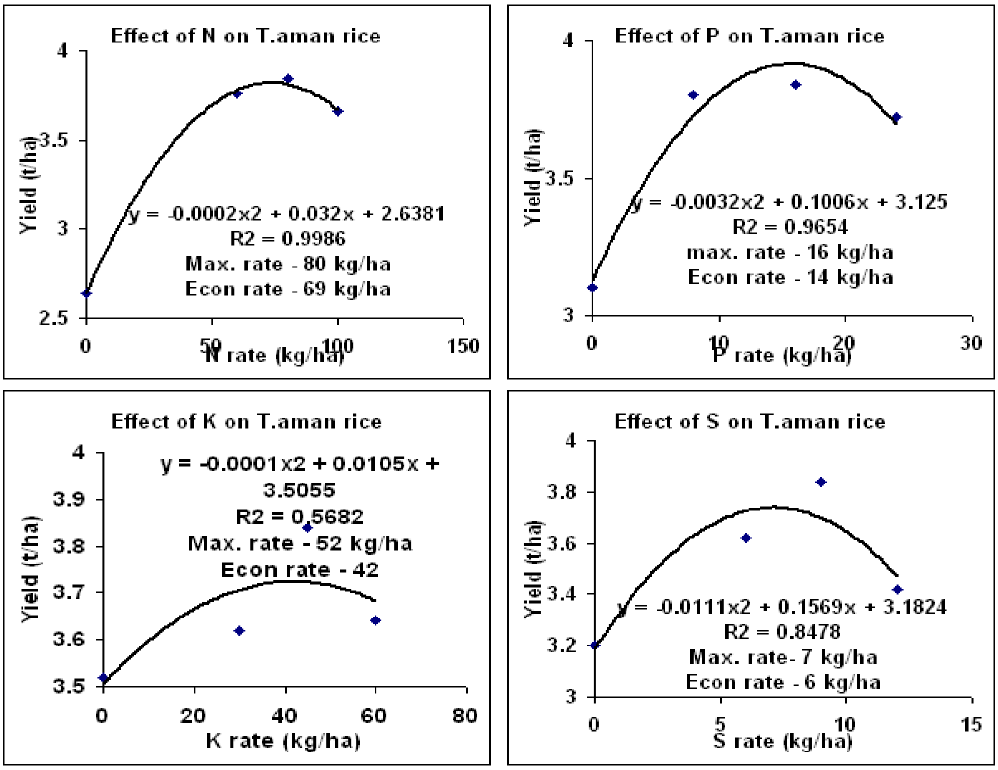

Figure 3. Response of NPKS on T.Aman of Mustard-Boro-T.Aman cropping pattern at FSRD site, Narikeli, Jamalpur during 2003

Table 1. Effects of different levels of fertilizer nutrients on the yield of crops in Mustard-Boro - T.Aman cropping pattern at Narikeli, Jamalpur, 2002-03

Nutrient levels (kg/ha)			Grain yield (t/ha)		
Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
N levels					
0	0	0	0.53	3.2	2.64
60	100	60	1.44	4.3	3.76
80	130	80	1.40	4.9	3.84
100	160	100	1.34	4.4	3.66
P levels					
0	0	0	1.14	4.2	3.10
12	12	8	1.29	4.9	3.80
20	20	16	1.40	4.9	3.84
28	28	24	1.32	4.7	3.72
K levels					
0	0	0	1.13	4.1	3.52
24	40	30	1.25	4.5	3.62
36	60	45	1.40	4.9	3.84
48	80	60	1.18	4.5	3.64
S levels					
0	0	0	1.11	4.4	3.20
10	10	6	1.24	4.6	3.62
20	20	9	1.40	4.9	3.84
35	30	12	1.16	4.6	3.42

Cropping pattern : Wheat-Jute- T.Aman
Location : Sherpur MLT site, Jamalpur (AEZ 9)
Year of establishment : 2002-03

Wheat: Grain yield of wheat increased markedly with the increase of N levels and the highest yield was obtained from 135 kg/ha of N and then tended to decline. Similarly, P, K and S showed a positive response to some extent towards the yield of Wheat. Grain yield increased up to 30, 75 and 25 kg/ha of P, K and S, respectively. However, the rate of increment was higher up to 20, 50 and 15 kg/ha of P, K and S, respectively.

Jute: Fibre yield of Jute increased markedly with the increase of N and the highest yield was recorded from 120 kg/ha and then tended to decrease. Almost similar trend was found in case of P, K and S. Fibre yield increased appreciably up to 20, 80 and 18 kg/ha, respectively.

T.Aman: Grain yield of T.Aman rice increased with the increase of N levels up to 100 kg/ha of N and then tended to decrease. However rate of increment was higher up to 70 kg/ha of N. Similarly, P, K and S showed a positive response towards the yield of T.Aman rice. Grain yield increased up to 15, 50 and 10 kg/ha of P, K and S, respectively. But the rate of increment was higher at 10, 40 and 7 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	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Wheat	148	30	76	26	142	26	73	25
Jute	127	22	86	20	116	20	80	18
T.Aman	108	16	54	11	100	15	49	9

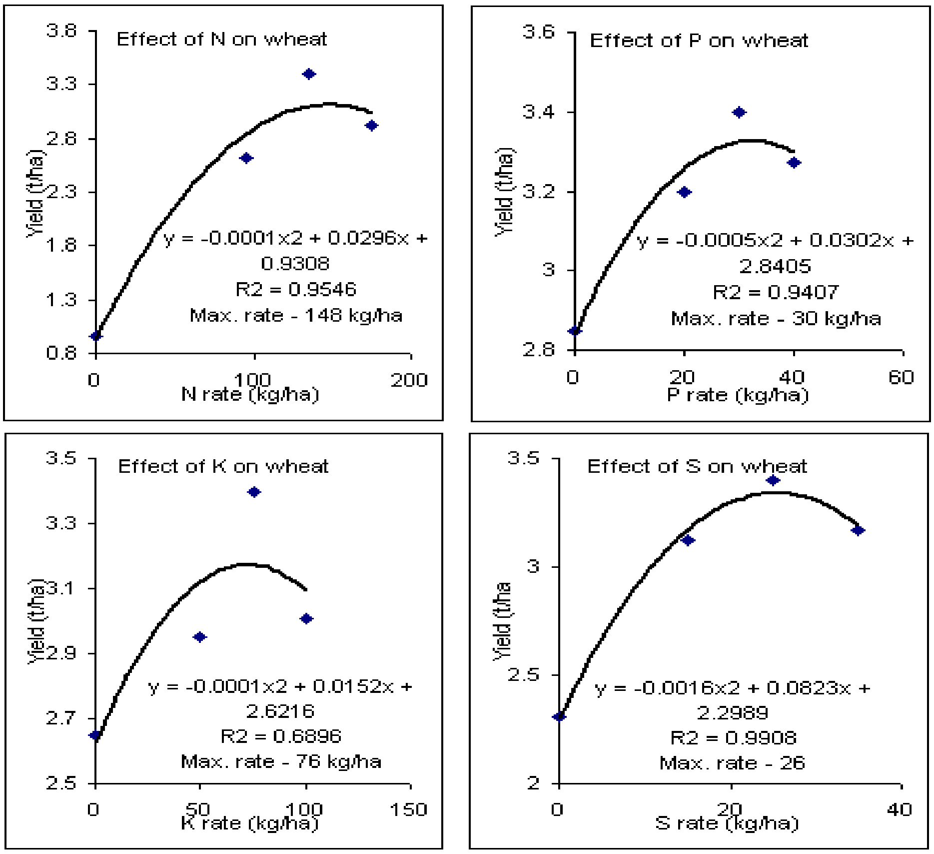

Figure 4. Response of NPKS on Wheat of Wheat-Jute-T.Aman cropping pattern at MLT site, Sherpur during 2002-03

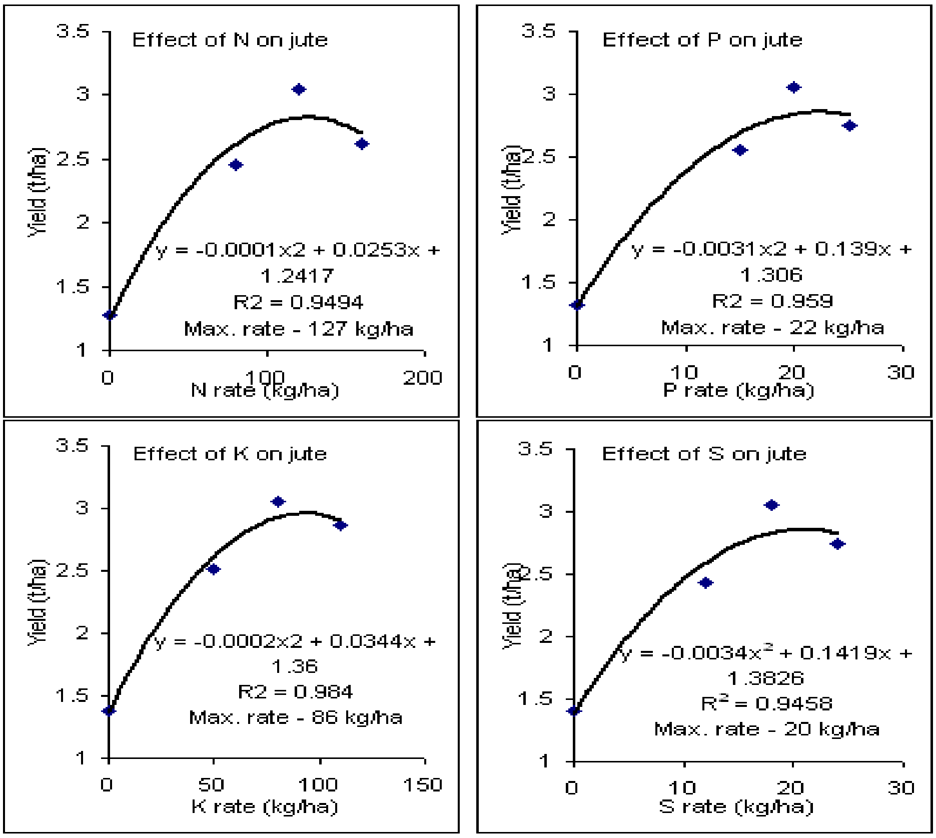

Figure 5. Response of NPKS on Jute of Wheat-Jute-T.Aman cropping pattern at MLT site, Sherpur during 2002-03

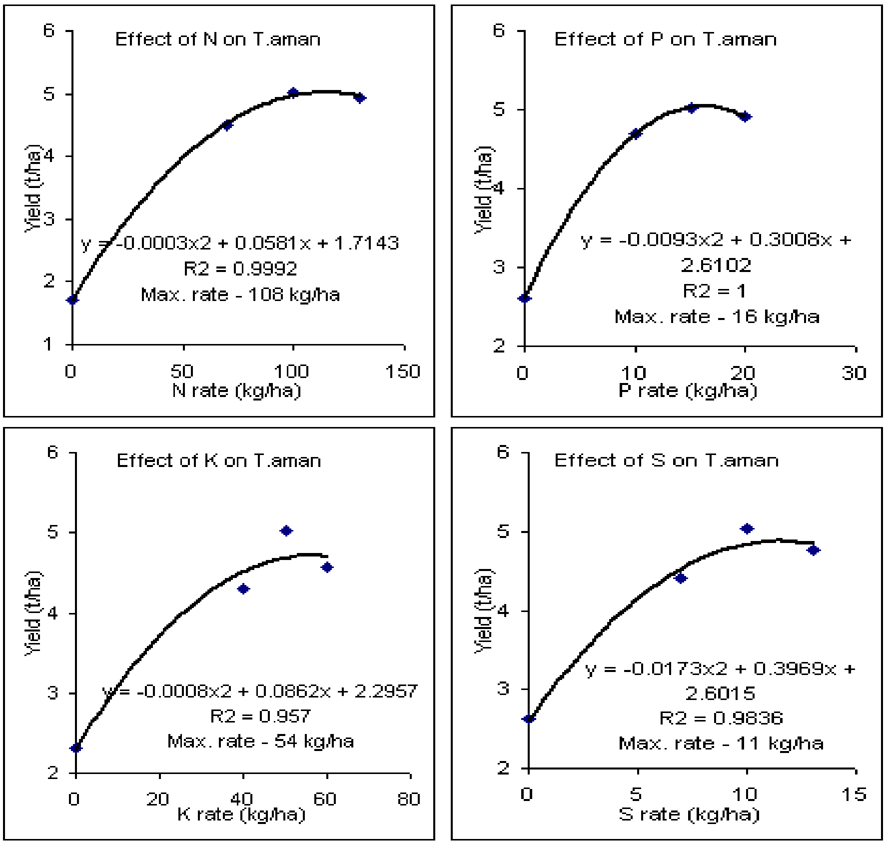

Figure 6. Response of NPKS on Wheat of Wheat-Jute-T.Aman cropping pattern at MLT site, Sherpur during 2002-03

Table 2. Effects of different levels of fertilizer nutrients on the yield of crops in Wheat-Jute -T.Aman cropping pattern at Sherpur MLT site, Jamalpur, 2002-03

Nutrient levels (kg/ha)			Grain yield (t/ha)		
Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
N levels					
0	0	0	0.96	1.27	1.72
95	80	70	2.62	2.45	4.49
135	120	100	3.40	3.05	5.03
175	160	130	2.92	2.62	4.93
P levels					
0	0	0	2.85	1.32	2.61
20	15	10	3.20	2.55	4.69
30	20	15	3.40	3.05	5.03
40	25	20	3.27	2.75	4.91
K levels					
0	0	0	2.65	1.38	2.31
50	50	40	2.95	2.52	4.30
75	80	50	3.40	3.05	5.03
100	110	60	3.01	2.86	4.56
S levels					
0	0	0	2.31	1.41	2.62
15	12	7	3.12	2.49	4.40
25	18	10	3.40	3.05	5.03
35	24	13	3.17	2.74	4.77

Cropping pattern : **Potato -Jute - T.Aman**
Location : **Melandah, Jamalpur (AEZ 9)**
Year of establishment : **2002-03**

Potato: A considerable response of Potato to nitrogen was observed. Tuber yield of Potato increased markedly with the increase of nitrogen up to 130 kg/ha of N. After that level tended to decrease. Similarly, P, K and S showed a positive response to some extent towards the yield of Potato. Tuber yield increased up to 30, 100 and 10 kg/ha of P, K and S, respectively.

Jute: Fibre yield of Jute increased markedly with the increase of N and the highest yield was recorded from 100 kg/ha and then tended to decrease. Almost similar trend was found in case of P, K and S. Fiber yield increased appreciably up to 12, 55 and 7 kg/ha of P, K and S, respectively.

T.Aman: Grain yield of T.Aman rice increased with the increase of N levels up to 90 kg/ha of N and then tended to decrease. Similarly, P, K and S showed a positive response towards the yield of T.Aman rice. Grain yield increased up to 10, 40 and 4 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	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Potato	141	33	112	12	132	30	97	10
Jute	132	14	59	8	114	11	46	7
T.Aman	103	11	43	4	92	9	38	4

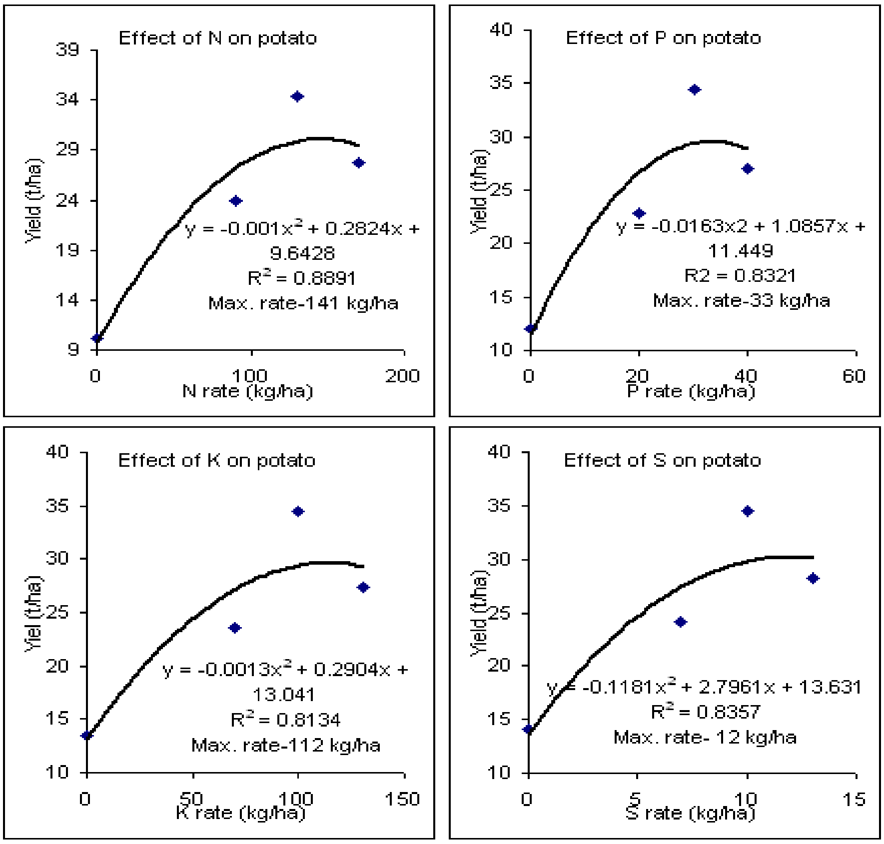

Figure 7. Response of NPKS on Potato of Potato-Jute-T.Aman cropping pattern at MLT site, Melandah during 2002-03

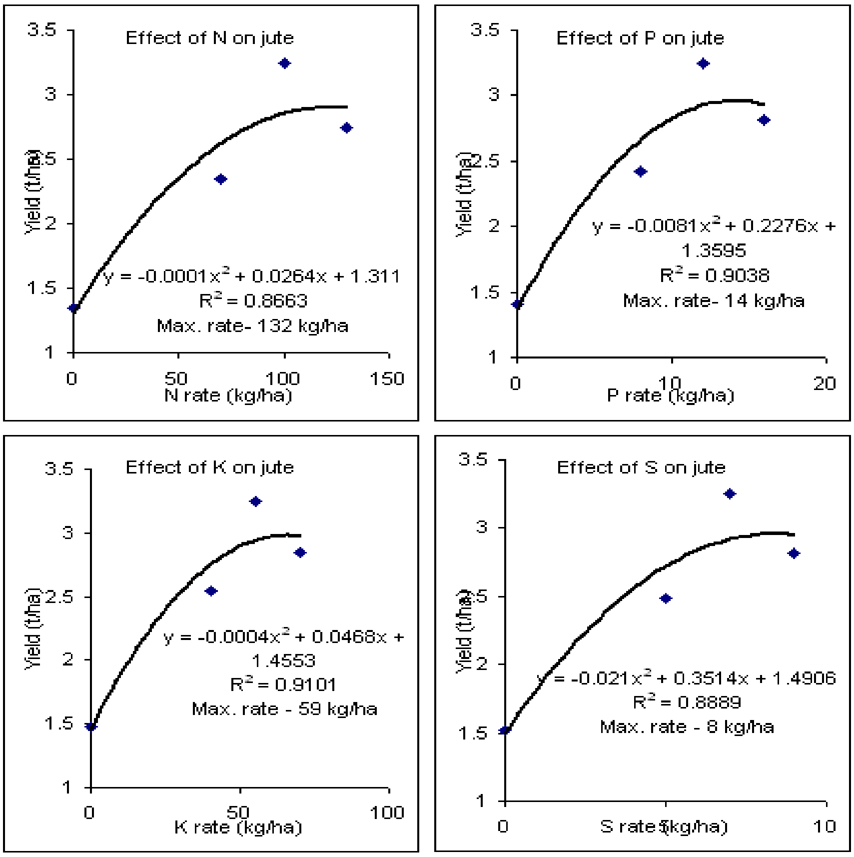

Figure 8. Response of NPKS on Jute of Potato-Jute-T.Aman cropping pattern at MLT site, Melandah during 2002-03

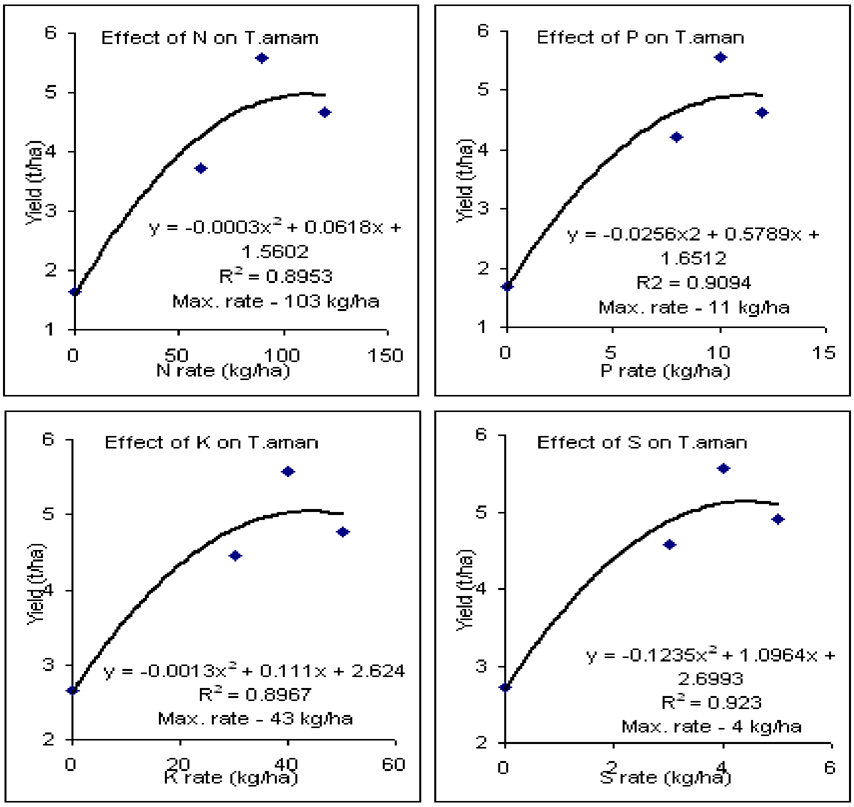

Figure 9. Response of NPKS on T.Aman of Potato-Jute-T.Aman cropping pattern at MLT site, Melandah during 2002-03

Table 3. Effects of different levels of fertilizer nutrients on the yield of crops in Wheat-Jute -T.Aman cropping pattern at Sherpur MLT site, Jamalpur, 2002-03

Nutrient levels (kg/ha)			Grain yield (t/ha)		
Potato	Jute	T.Aman	Potato	Jute	T.Aman
N levels					
0	0	0	10.12	1.35	1.65
90	70	60	23.86	2.34	3.72
130	100	90	34.43	3.25	5.57
170	130	120	27.71	2.74	4.67
P levels					
0	0	0	12.08	1.40	1.68
20	8	8	22.87	2.42	4.21
30	12	10	34.43	3.25	5.57
40	16	12	26.96	2.81	4.62
K levels					
0	0	0	13.54	1.48	2.66
70	40	30	23.54	2.54	4.45
100	55	40	34.43	3.25	5.57
130	70	50	27.39	2.85	4.78
S levels					
0	0	0	14.09	1.52	2.73
7	5	3	24.10	2.49	4.57
10	7	4	34.43	3.25	5.57
15	9	5	28.24	2.82	4.91

Cropping pattern : Boro-T.Aus- T.Aman
Location : Chandina, Comilla (AEZ 19)
Year of establishment : 2002-03

Boro: Grain yield of Boro rice increased markedly with the increase of N levels up to 80 kg/ha of N. After that level yield also increased up to 120 kg/ha of N but the rate of increment was comparatively slow. But response of Boro rice to P, K and S was not evident. However, grain yield increased slowly up to 23, 80 and 20 kg/ha of P, K and S, respectively.

T.Aus: A considerable response of T.Aus rice to nitrogen was found. Grain yield increased up to 80 kg/ha of N and there after tended to decrease. But no considerable response to P, K and S was observed at all.

T.Aman: In T.Aman rice, almost similar trend was observed like T.Aus rice. Response to nitrogen was observed only. Grain yield increased appreciably up to 80 kg/ha of N. P, K and S failed to produce significant response towards the grain yield of T.Aman rice.

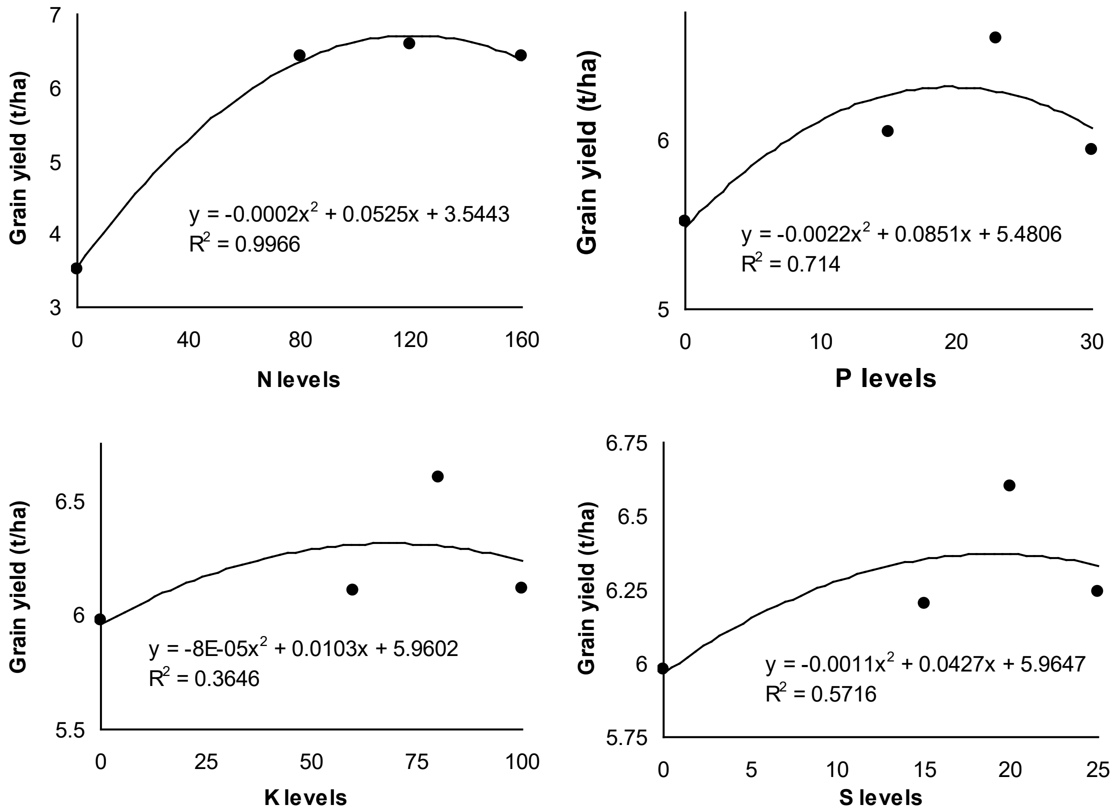

Figure 10. Response of Boro to NPKS grown in Boro-T.Aus- T.Aman cropping pattern during 2002-03 at Chandina, Comilla

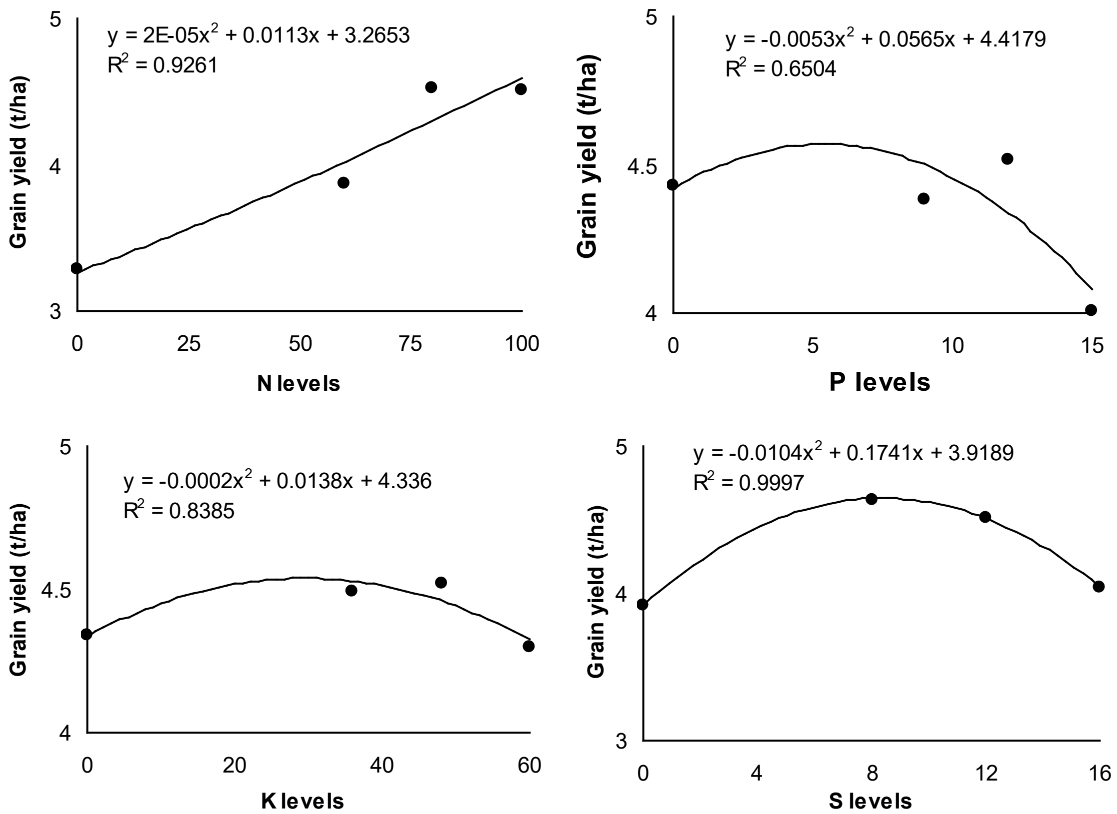

Figure 11. Response of T.Aus to NPKS grown in Boro-T.Aus- T.Aman cropping pattern during 2002-03 at Chandina, Comilla

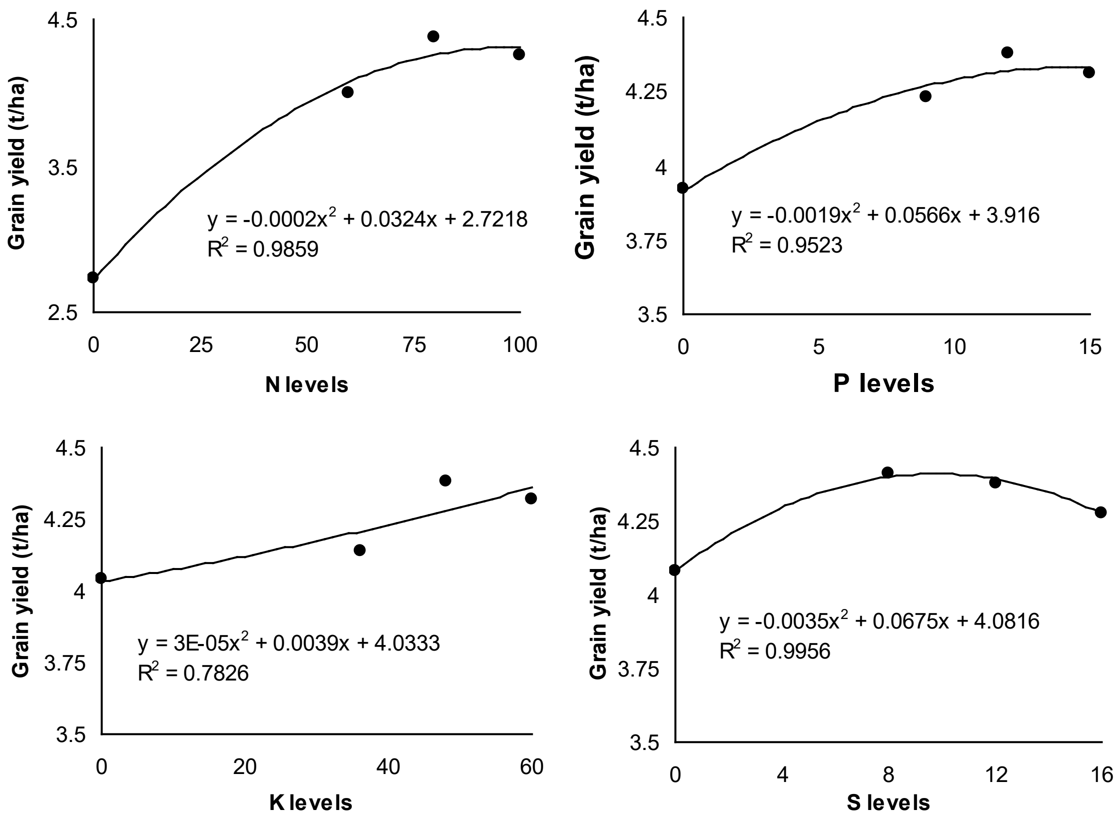

Figure 12. Response of T.Aman to NPKS grown in Boro-T.Aus-T.Aman cropping pattern during 2002-03 at Chandina, Comilla

Table 4. Effects of different levels of fertilizer nutrients on the yield of crops in Boro-T.Aus -T.Aman cropping pattern at Chandina, Comilla, 2002-03

Nutrient levels (kg/ha)			Grain yield (t/ha)		
Boro	T.Aus	T.Aman	Boro	T.Aus	T.Aman
N levels					
0	0	0	3.53	3.28	2.73
80	60	60	6.44	3.87	3.99
120	80	80	6.60	4.52	4.38
160	100	100	6.42	4.51	4.26
P levels					
0	0	0	5.52	4.43	3.92
15	9	9	6.04	4.38	4.23
23	12	12	6.60	4.52	4.38
30	15	15	5.94	4.01	4.31
K levels					
0	0	0	5.98	4.34	4.04
60	36	36	6.11	4.49	4.14
80	48	48	6.60	4.52	4.38
100	60	60	6.12	4.30	4.32
S levels					
0	0	0	5.98	3.92	4.08
15	8	8	6.20	4.64	4.41
20	12	12	6.60	4.52	4.38
25	16	16	6.24	4.04	4.28

Cropping pattern : Boro- T.Aman
Location : Kolaroa MLT site, Khulna
Year of establishment : 2000-01 to 2002-03

Boro: Average of three tears data showed a positive response of Boro rice to nitrogen. Grain yield increased sharply with the increase of nitrogen level up to 140 kg /ha of N and after that level started to decrease. More or less similar trend was observed over the years. Similarly, in case of P grain yield increased up to 35 kg/ha of P and then tended to decrease. Almost similar trend was found in case of K and S. Grain yield increased up to 30 and 20 kg/ha of K and S, respectively. However, response to P, K and S was not very distinct as observed in nitrogen.

T.Aman: In T.Aman rice, almost similar trend that was observed in Boro rice was found. Grain yield of T.Aman rice increased sharply up to the application of 65 kg/ha of N and then slowly increased up to 95 kg/ha. After that level yield was started to decrease. Response of T.Aman rice to PKS was also observed to some extent. Yield increased up to the application of 15, 15 and 10 kg/ha of PKS, respectively. After that level yield also increased but very slowly.

From the average data a response curve was drawn and quadratic relationship was observed. From that response curve the optimum doses of the nutrients for different crops were calculated.

From the response curve the optimum doses of the nutrients for different crops were calculated.

Crop	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Boro	145	30	22	18	130	27	19	17
T.Aman	92	19	16	13	90	16	15	12

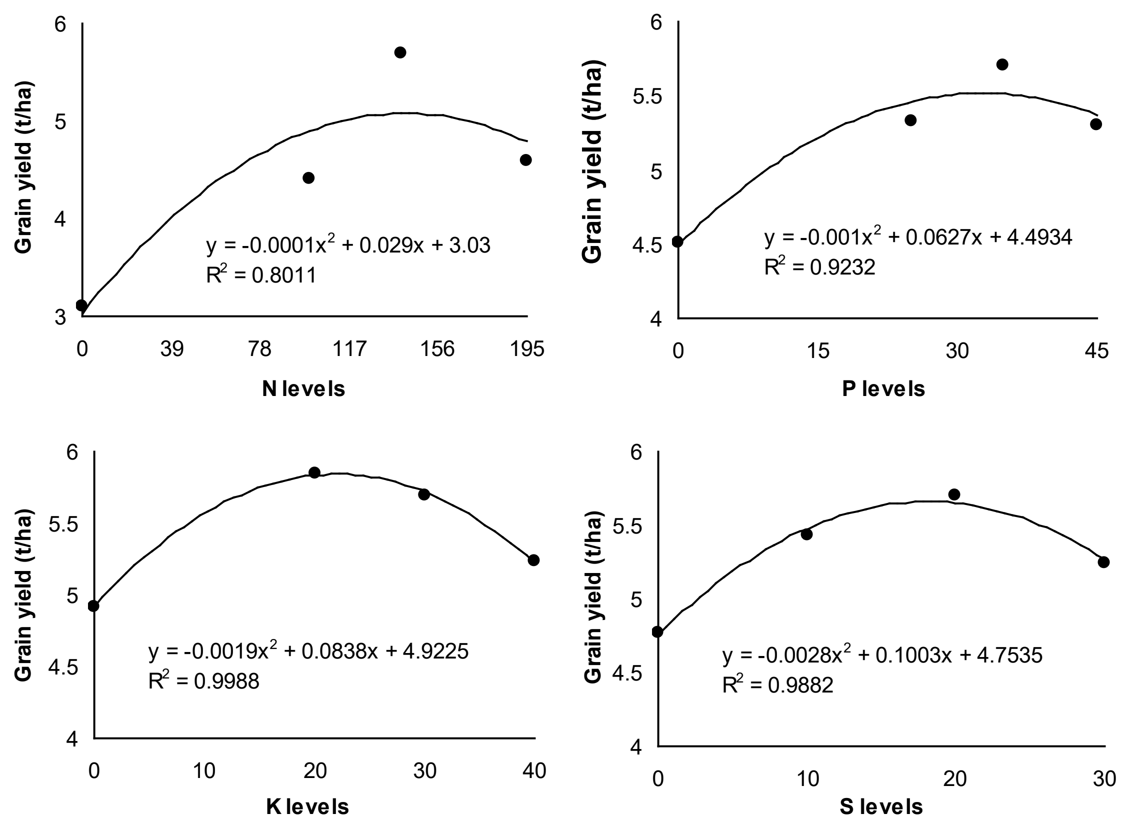

Figure 13. Response of Boro to NPKS grown in Boro- T.Aman cropping pattern during 2001-03 at Kolaroa, Khulna

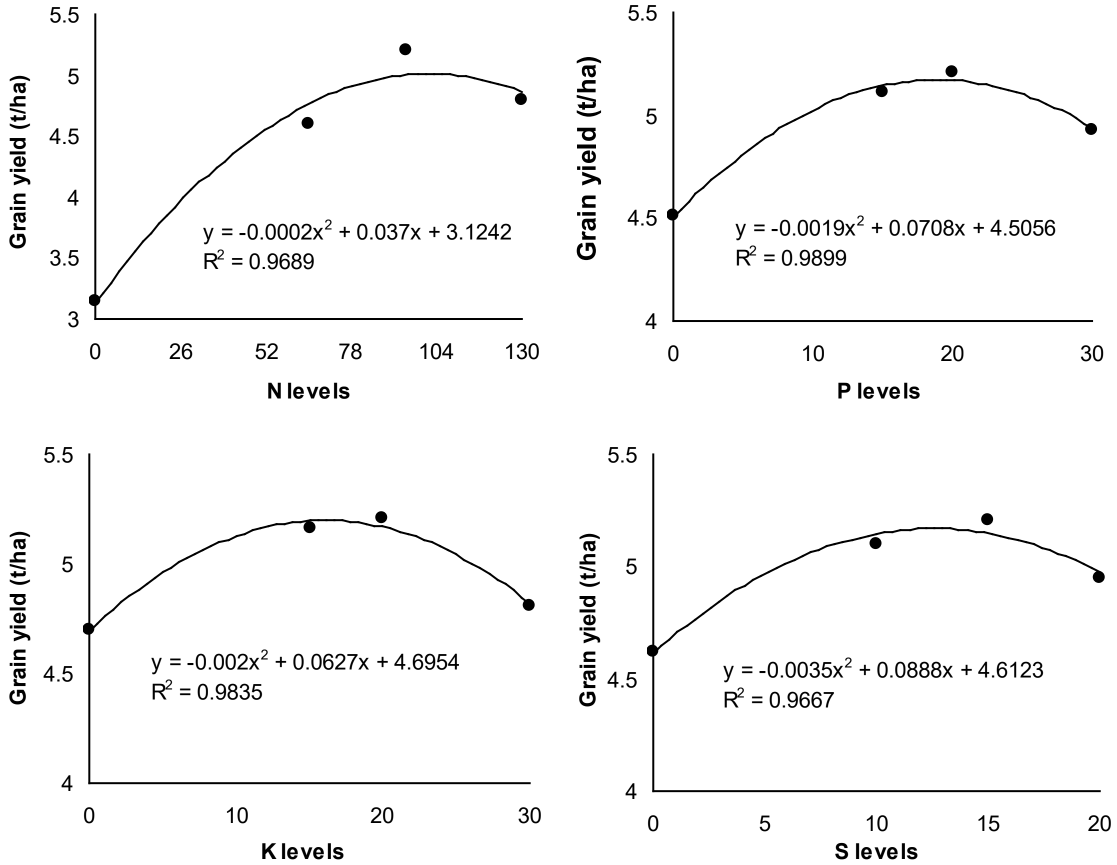

Figure 14. Response of T.Aman to NPKS grown in Boro- T.Aman cropping pattern during 2001-03 at Kolaroa, Khulna

Table 5. Effects of different levels of fertilizer nutrients on the yield of Boro rice in Boro-T.Aman cropping pattern at Kolaroa MLT site, Khulna, 2001-2003

Fertilizer levels (kg/ha)	Grain yield (t/ha)			
	2001	2002	2003	Mean
N (Levels)				
0	3.51	3.00	2.79	3.10
100	5.41	4.51	3.29	4.40
140	5.90	5.75	5.45	5.70
195	5.50	4.80	3.50	4.60
P (Levels)				
0	4.70	4.70	4.13	4.51
25	5.50	5.51	4.98	5.33
35	5.90	5.75	5.45	5.70
45	5.61	5.40	4.89	5.30
K (Levels)				
0	5.85	5.11	3.82	4.92
20	6.11	5.92	5.52	5.85
30	5.90	5.75	5.45	5.70
40	5.60	5.30	4.79	5.23
S (Levels)				
0	5.16	4.92	4.23	4.77
10	5.63	5.51	5.15	5.43
20	5.90	5.75	5.45	5.70
30	5.75	5.52	4.48	5.25

Table 6. Effects of different levels of fertilizer nutrients on the yield of T.Aman rice in Boro-T.Aman cropping pattern at Kolaroa MLT site, Khulna, 2001-2003

Fertilizer levels (kg/ha)	Grain yield (t/ha)			
	2001	2002	2003	Mean
N (Levels)				
0	3.90	3.21	2.34	3.15
65	5.40	4.70	3.70	4.60
95	6.21	5.25	4.17	5.21
130	5.51	4.91	3.98	4.80
P (Levels)				
0	4.95	4.67	3.91	4.51
15	5.63	5.15	4.55	5.11
20	6.21	5.25	4.17	5.21
30	5.50	5.10	4.19	4.93
K (Levels)				
0	5.85	4.85	3.40	4.70
15	6.25	5.18	4.05	5.16
20	6.21	5.25	4.17	5.21
30	6.00	5.00	3.49	4.81
S (Levels)				
0	5.60	4.71	3.55	4.62
10	6.00	5.00	4.30	5.10
15	6.21	5.25	4.17	5.21
20	6.13	5.07	3.65	4.95

Location : Feni, Noakhali
Year of establishment : 2002-03

Boro: A positive response of Boro rice was observed to nitrogen. Grain yield was increased with the increase of N levels sharply up to 130 kg/ha of N and after that level rate of increment was slow. However yield increased up to 180 kg/ha of N and then tended to decrease. Similarly, in case of P response was found to some extent. Grain yield increased appreciably up to 30 kg/ha of P and there after the increment was very slow. In case of K and S no considerable response towards yield was found at all.

T.Aman: Similar trend was found like Boro rice. Grain yield increased with the increase of N and the highest yield was obtained from 120 kg/ha of N. However, the rate of increment was higher up to 90 kg/ha. In case of P, K and S a positive response was also observed and grain yield increased up to the application of 30 kg/ha, 80 kg/ha and 16 kg/ha of P, K and S, respectively. But the rate of increment was higher up to the application of 24, 60 and 12 kg/ha of P, K and S, respectively. A response curve was drawn from the yield data and a quadratic type of relationship was found.

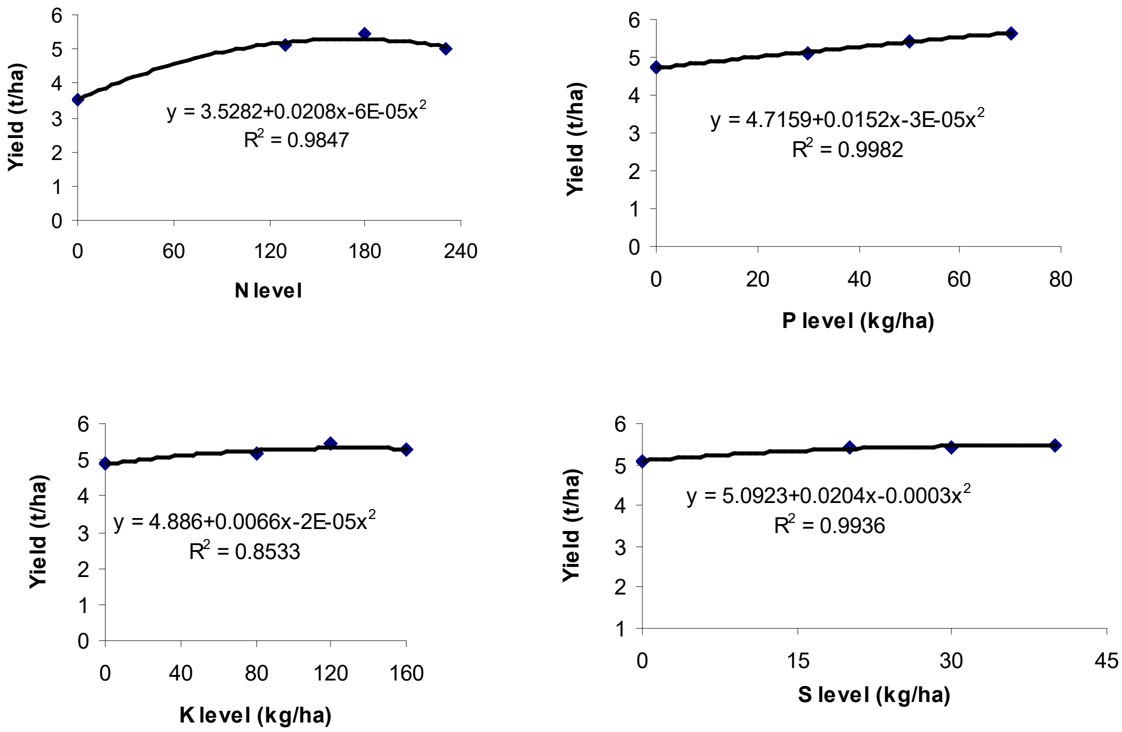

Figure 15. Response of Boro to NPKS grown in Boro-T.Aman cropping pattern during 2002-03 at Feni

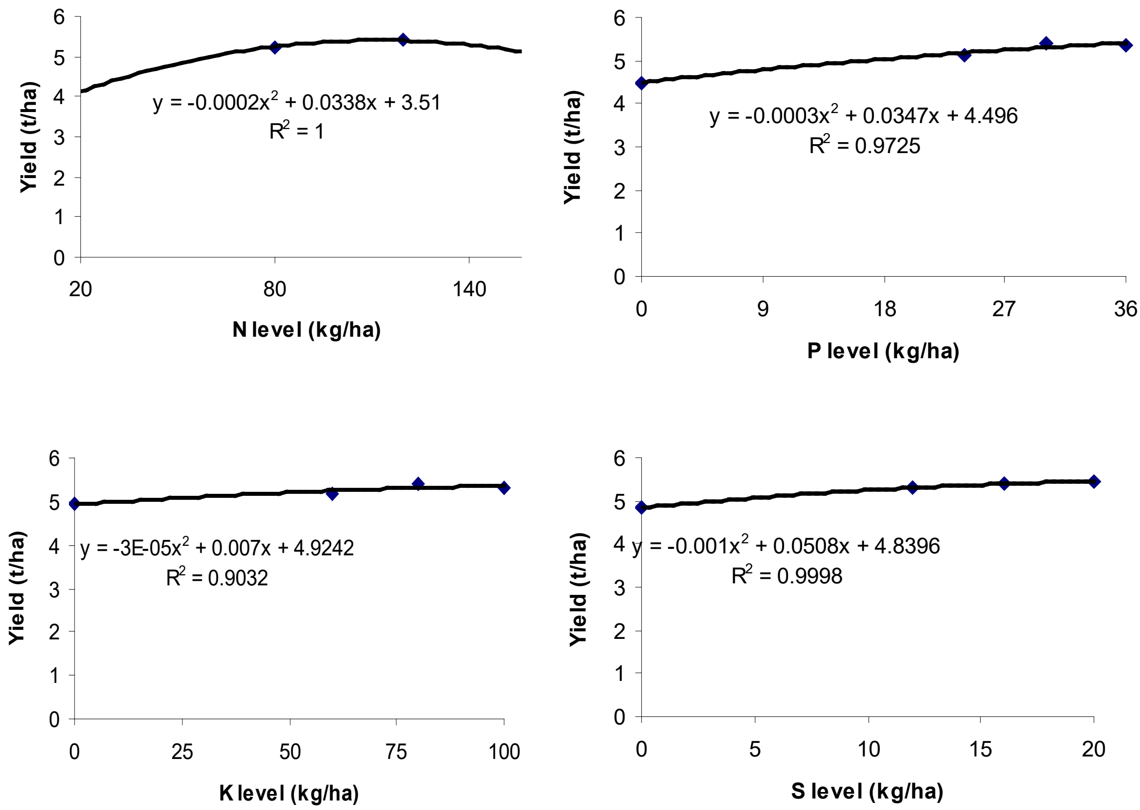

Figure 16. Response of T.Aman to NPKS grown in Boro-T.Aman cropping pattern during 2002-03 at Feni

Table 7. Effects of different levels of fertilizer nutrients on the yield of crops in Boro-T.Aman rice cropping pattern at Feni, Noakhali, 2002-03

Nutrient levels (kg/ha)		Grain yield (t/ha)	
Boro	T.Aman	Boro	T.Aman
N levels			
0	0	3.54	3.5
130	90	5.10	5.25
180	120	5.43	5.40
230	150	5.02	5.07
P levels			
0	0	4.72	4.5
30	24	5.13	5.12
50	30	5.43	5.40
70	36	5.24	5.37
K levels			
0	0	4.9	4.93
80	60	5.17	5.19
120	80	5.43	5.40
160	100	5.26	5.32
S levels			
0	0	5.09	4.84
20	12	5.40	5.30
30	16	5.43	5.40
40	20	5.46	5.45

Location : Ishan Gopalpur, Faridpur
Year of establishment : 2000-01 to 2002-03

Boro: Average of three years data showed that a considerable response of Boro rice to nitrogen was evident. Grain yield of increased markedly up to 90 kg/ha of N and thereafter tended to decrease. Trend was almost same over the years. Similarly, in case of P, K and S a positive response was found and yield increased up to 24, 30 and 16 kg/ha of P, K and S, respectively. However the trend of increase was not very sharp as observed in nitrogen.

T.Aman: Similar trend was found in T.Aman like Boro rice. Grain yield increased sharply with the increase of N up to 60 kg/ha. In case of P and S a considerable response was also observed and grain yield increased up to the application of 16 and 10 kg/ha of P and S, respectively. But the trend was not very sharp like nitrogen. Almost similar trend was found over the years.

From the average data a response curve was drawn and the response was quadratic in nature. From the response curve the optimum doses of the nutrients for different crops were calculated.

Crop	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Boro	105	29	32	17	101	26	31	16
T.Aman	66	14	16	10	62	12	16	9

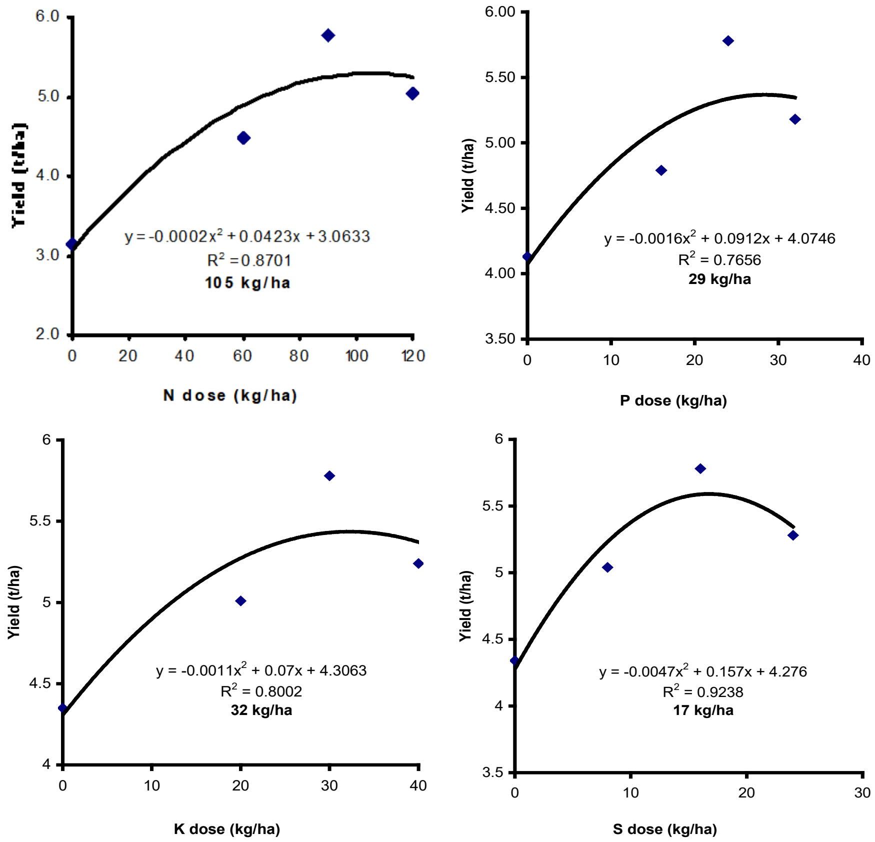

Figure 17. Response of Boro to NPKS grown in Boro-T.Aman cropping pattern during 2001-03 at Ishan Gopalpur, Faridpur

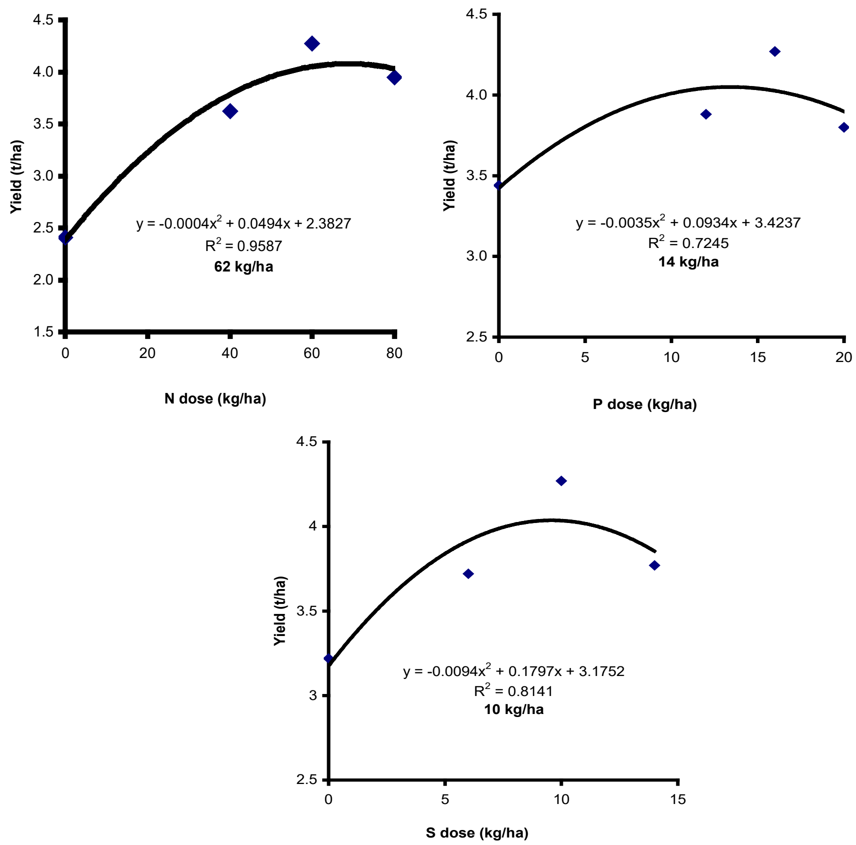

Figure 18. Response of T.Aman to NPKS grown in Boro-T.Aman cropping pattern during 2001-03 at Ishan Gopalpur, Faridpur

Table 8. Effect of different levels of fertilizer nutrients on the yield of boro in Boro-T.Aman cropping pattern at FSRD site, Ishan Gopalpur, Faridpur during 2000-01 to 2002-03

Fertilizer level (kg/ha)	Grain Yield (t/ha)			
	2000-01	2001-02	2002-03	Mean
N level				
0	4.02	2.48	2.89	3.13
60	4.58	4.75	4.11	4.48
90	5.98	6.24	5.10	5.78
120	5.18	5.35	4.62	5.05
P level				
0	4.12	4.32	3.95	4.13
16	4.82	5.45	4.10	4.79
24	5.98	6.24	5.10	5.78
32	5.32	5.76	4.45	5.18
K level				
0	4.28	4.46	4.30	4.35
20	4.98	5.58	4.46	5.01
30	5.98	6.24	5.10	5.78
40	5.42	5.83	4.48	5.24
S level				
0	4.52	4.37	4.13	4.34
8	5.03	5.31	4.78	5.04
16	5.98	6.24	5.10	5.78
24	5.54	5.63	4.67	5.28

Table 9. Effect of different levels of fertilizer nutrients on the yield of T.Aman in Boro-T.Aman cropping pattern at FSRD site, Ishan Gopalpur, Faridpur during 2000-01 to 2002-03

Fertilizer level	Grain Yield (t/ha)			
	2000-01	2001-02	2002-03	Mean
N level				
0	2.55	2.33	2.35	2.41
40	4.15	3.75	2.96	3.62
60	4.70	4.56	3.55	4.27
80	4.53	4.16	3.16	3.95
P level				
0	3.92	3.53	2.82	3.44
12	4.44	4.31	2.90	3.88
16	4.70	4.56	3.55	4.27
20	4.46	3.96	2.97	3.80
S level				
0	3.63	3.80	3.24	3.22
6	4.19	4.22	3.74	3.72
10	4.70	4.56	3.55	4.27
14	4.31	4.13	2.86	3.77

Location : Barind, Rajshahi
Cropping pattern : Chickpea -T.Aman rice
Year of establishment : 2002-03

Chickpea: Nitrogen was not included in Chickpea for response study. But response of Chickpea to P, K and S was not observed at all. Seed yield did not increase appreciably due to increase of P, K and S level.

T.Aman: Response of T.Aman to nitrogen was observed. Grain yield increased markedly with the increase of N level up to 100 kg/ha of N. Then yield tended to decline. But response to other nutrient elements P, K and S was not evident. Grain yield did not increase appreciably due to increase of nutrient doses. The experiment should be repeated for another year carefully for giving sound recommendation.

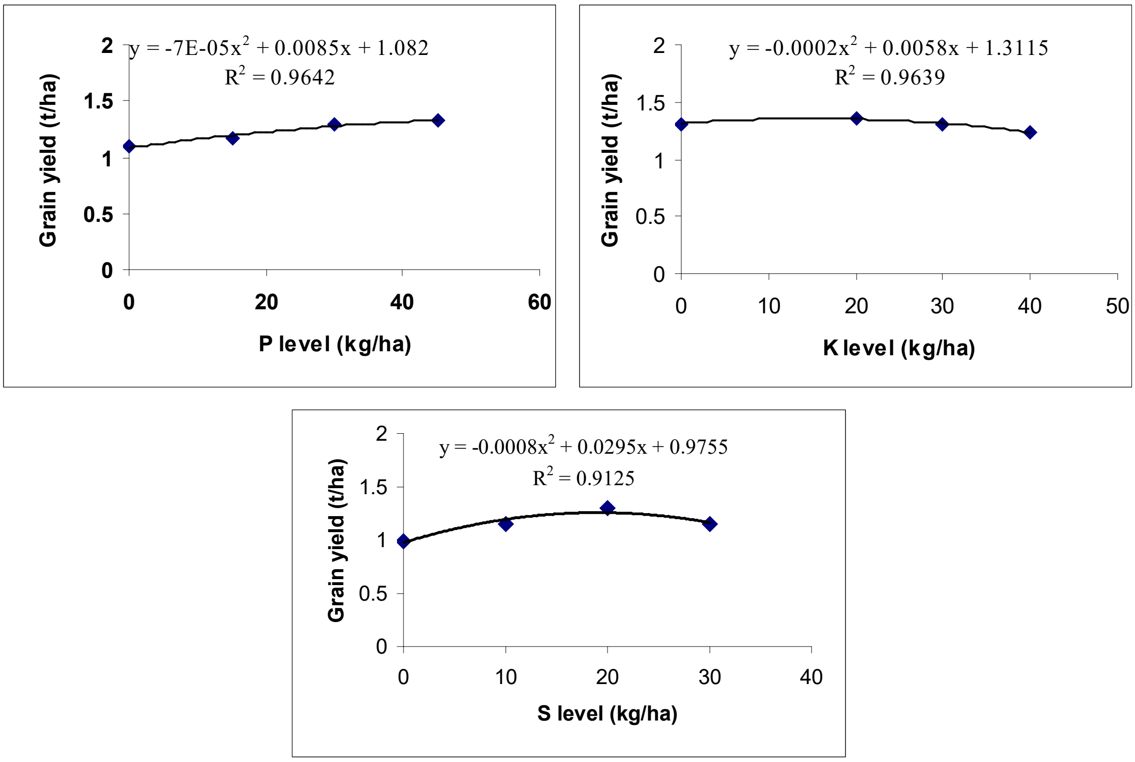

Figure 19. Response of Chickpea to added P, K and S in Chickpea-T.Aman cropping pattern at FSRD Site, Chabbishnagor, Rajshahi during 2002-03

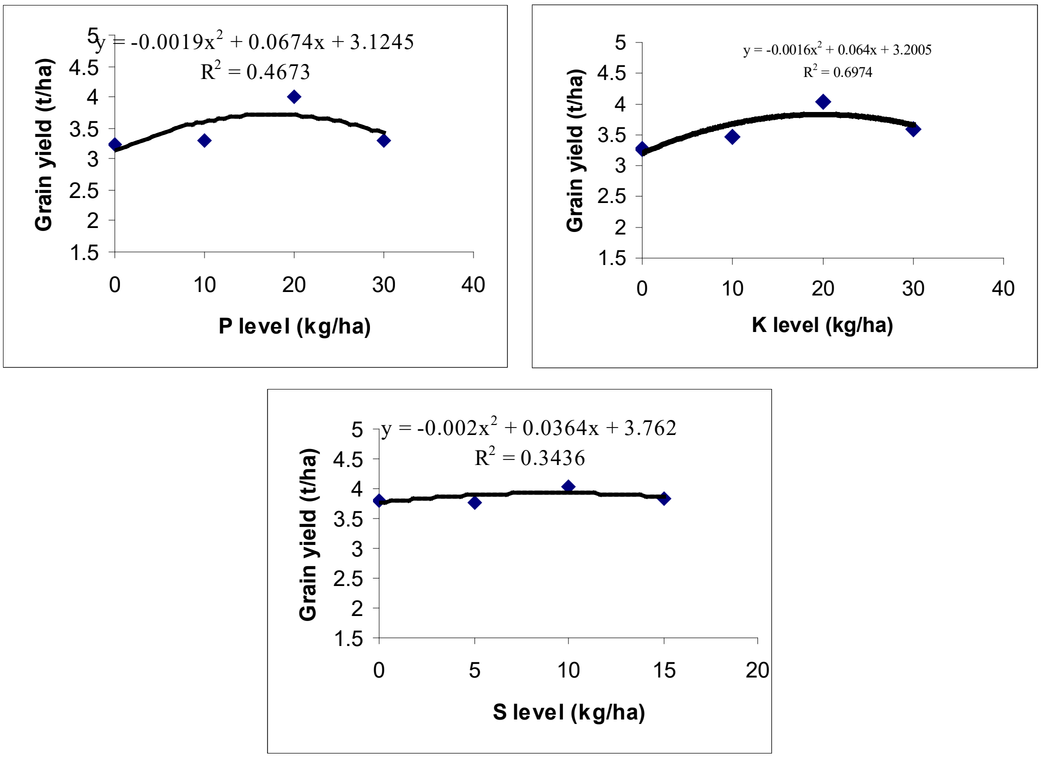

Figure 20. Response of T.Aman to added P, K and S in Chickpea-T.Aman cropping pattern at FSRD Site, Chabbishnagor, Rajshahi during 2002-03

Table 10. Effects of different levels of fertilizer nutrients on the yield of crops in Chickpea-T.Aman cropping pattern at Barind, Rajshahi, 2002-03

Nutrient levels (kg/ha)		Grain yield (t/ha)	
Chickpea	T.Aman	Chickpea	T.Aman
N levels			
-	0	-	1.62
-	50	-	2.98
-	100	-	4.40
-	150	-	3.75
P levels			
0	0	1.09	3.37
15	10	1.17	3.40
30	20	1.30	3.95
45	30	1.32	3.35
K levels			
0	0	1.31	3.39
20	10	1.36	3.60
30	20	1.30	3.95
40	30	1.24	3.62
S levels			
0	0	1.15	4.15
10	5	1.15	3.84
20	10	1.30	3.95
30	15	1.15	3.92

Cropping pattern : Chilli-T.Aman rice
Year of establishment : 2002-03

Lebukhali, Patuakhali

Chilli: A positive response of Chilli to different nutrients was observed. Fruit yield increased with the increase of nitrogen linearly. The highest yield was recorded from the highest level of nitrogen. Similarly, fruit yield increased linearly with the increase of P level. Response to K was not evident at all. Therefore, it is not possible to find out the optimum doses of NPK for Chilli.

T.Aman: Response of T.Aman to nitrogen was not observed. However, the highest yield was found in 60 kg/ha of N. Almost similar trend was found in case of P and K. The trend was not consistent. The experiment should be repeated for another year carefully for giving sound recommendation.

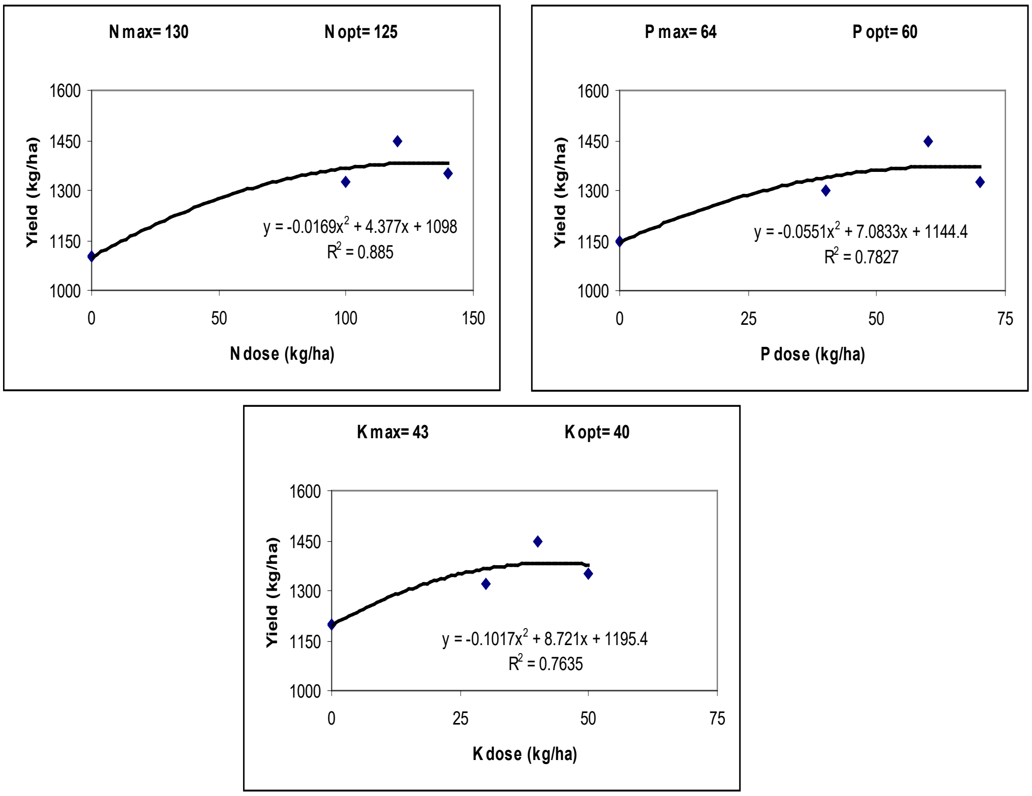

Figure 21. Response of Chilli to added N, P and K in Chilli-T.Aman cropping pattern at FSRD Site, Lebukhali, Patuakhali during 2002-03

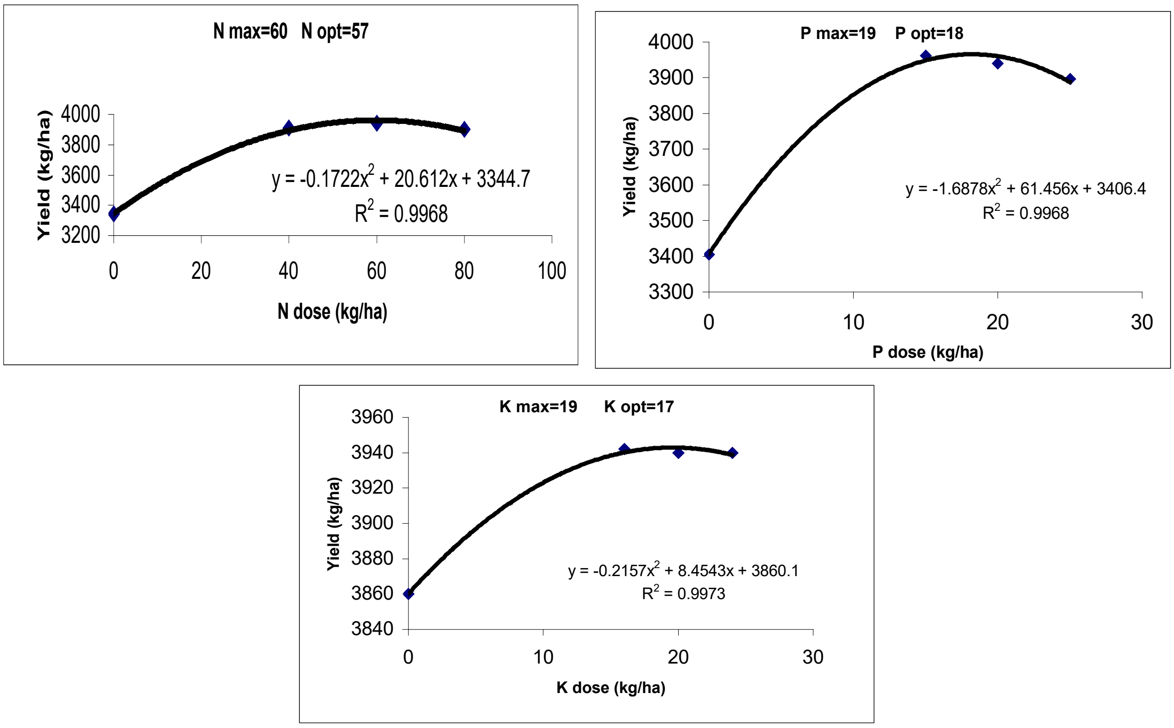

Figure 22. Response of T.Aman to added N, P and K in Chilli-T.Aman cropping pattern at FSRD Site, Lebukhali, Patuakhali during 2002-03

Table 11. Effects of different levels of fertilizer nutrients on the yield of crops in Chilli-T.Aman cropping pattern at Lebukhali, Patuakhali, 2002-03

Nutrient levels (kg/ha)		Grain yield	
Chilli	T.Aman	Chilli (kg/ha)	T.Aman (t/ha)
N levels			
0	0	800	4.22
80	40	888	4.25
110	60	1000	4.38
140	80	1250	4.12
P levels			
0	0	625	3.70
75	15	950	3.70
100	20	1000	4.38
125	25	1613	4.23
K levels			
0	0	763	3.98
60	20	1000	3.98
90	30	1000	4.38
120	40	1263	3.68

Hathazari, Chittagong

Chilli: A positive response of Chilli to different nutrients was observed. Fruit yield increased with the increase of nitrogen significantly up to 120 kg/ha of N. Fruit yield tended to decrease after that level. From the initial soil status it was found that P status is optimum, therefore, response to P was not studied. A considerable response of Chilli to K and S was also observed. Fruit yield increased significantly up to 110 and 20 kg/ha of K and S, respectively.

T.Aman: Almost similar trend was found in T.Aman rice. Response of N, K and S was observed towards the grain yield of T.Aman rice. Yield increased significantly up to 80, 40 and 10 kg/ha of N, K and S, respectively.

A response curve was drawn from the data and the relationship was quadratic in nature. From the response curve optimum doses of fertilizers for the crops grown in Chilli-T.Aman cropping pattern at Hathazari was found out.

Crop	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Chilli	142	-	116	20	140	-	115	20
T.Aman	124	-	43	10	106	-	40	5

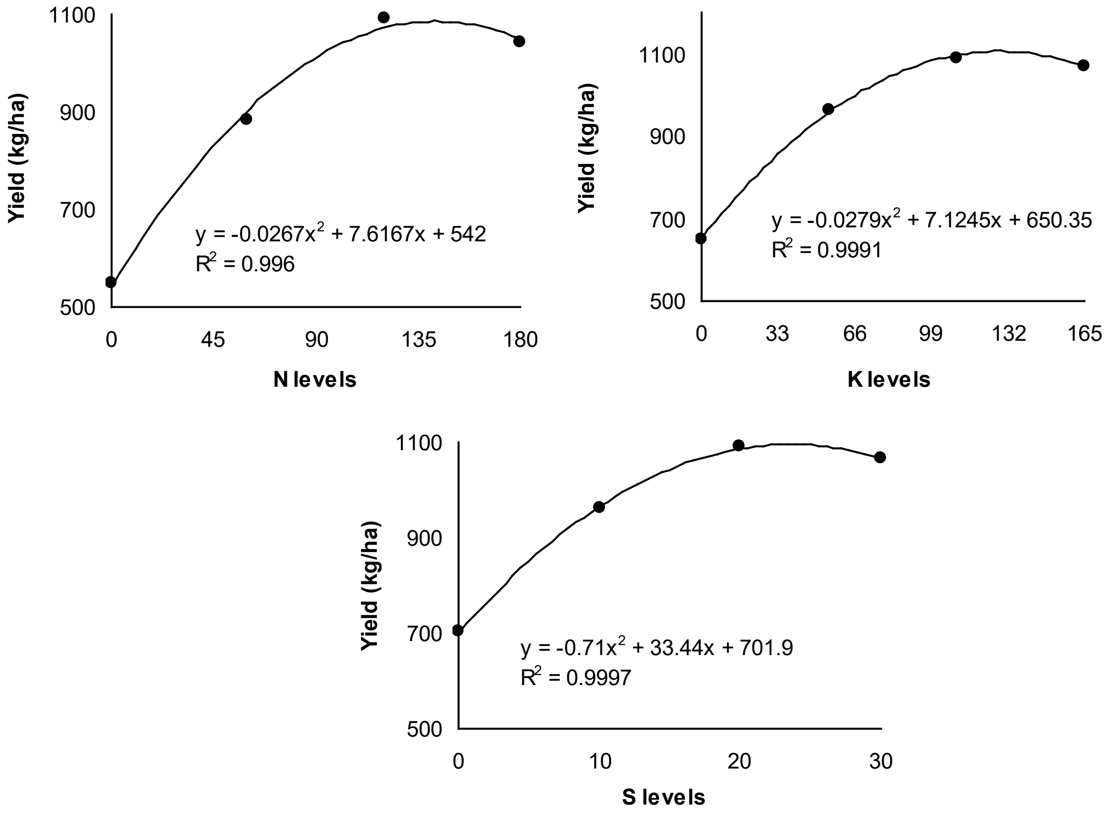

Figure 23. Response of Chilli to added N, K and S in Chilli-T.Aman cropping pattern at Hathazari, Chittagong during 2002-03

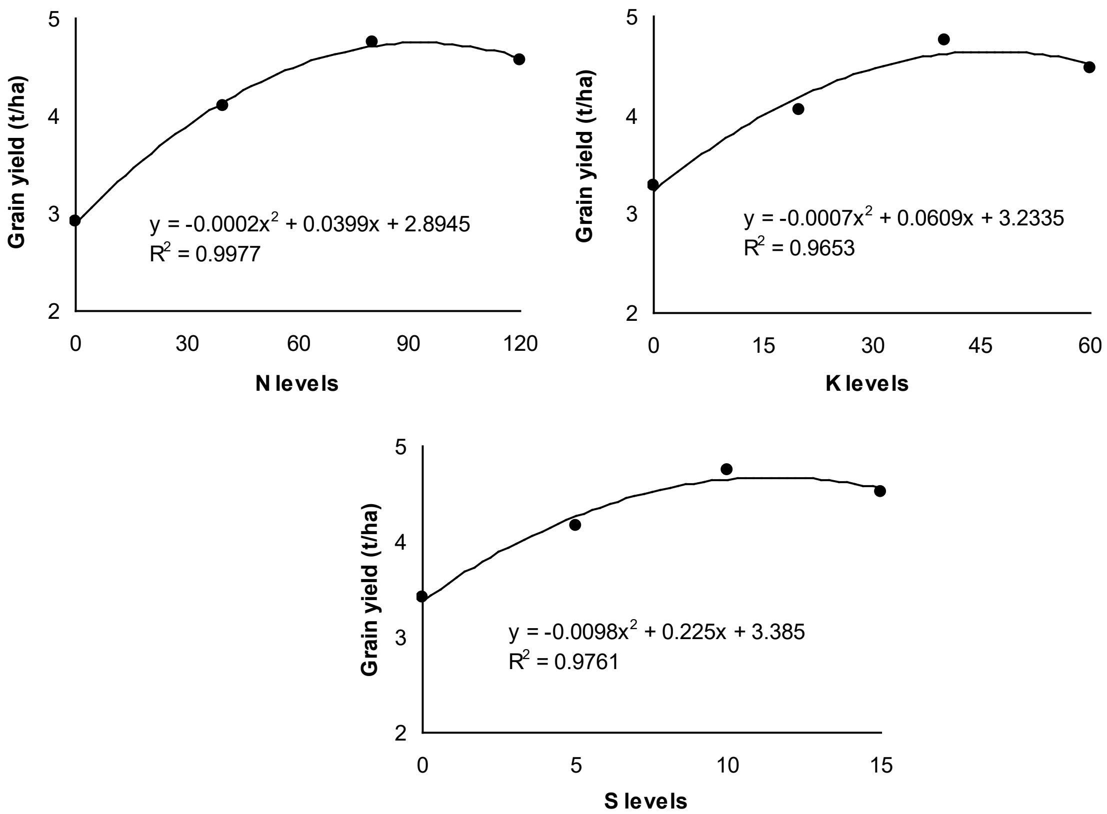

Figure 24. Response of T.Aman to added N, K and S in Chilli-T.Aman cropping pattern at Hathazari, Chittagong during 2002-03

Table 12. Effects of different levels of fertilizer nutrients on the yield of crops in Chilli-T.Aman cropping pattern at Hathazari, Chittagong, 2002-03

Nutrient levels (kg/ha)		Grain yield	
Chilli	T.Aman	Chilli (kg/ha)	T.Aman (t/ha)
N levels			
0	0	548d	2.91c
60	40	885c	4.10b
120	80	1090a	4.76a
180	120	1043b	4.58a
K levels			
0	0	648c	3.28d
55	20	965b	4.05c
110	40	1090a	4.76a
165	60	1070a	4.48b
S levels			
0	0	703d	3.42d
10	5	962c	4.16c
20	10	1090a	4.76a
30	15	1065b	4.52b

Cropping pattern : Groundnut-T.Aman
Location : Atkapalia, Noakhali
Year of establishment : 2002-03

Groundnut: Response of nitrogen towards the nut yield of groundnut was not evident. As the groundnut is a leguminous crop, therefore, response to N was not found. However, seed yield increased up to 20 kg/ha of N. Similarly, in case of P response towards yield was observed to some extent and yield increased up to 30 kg/ha of P. But no considerable response was found in case of K.

T.Aman: Response of T.Aman rice to N was not evident. However, grain yield increased with a very slow rate and the trend was linear. Response of T.Aman rice to P was observed to some extent and yield increased up to 12 kg/ha of P. But response of T.Aman rice to K was not found.

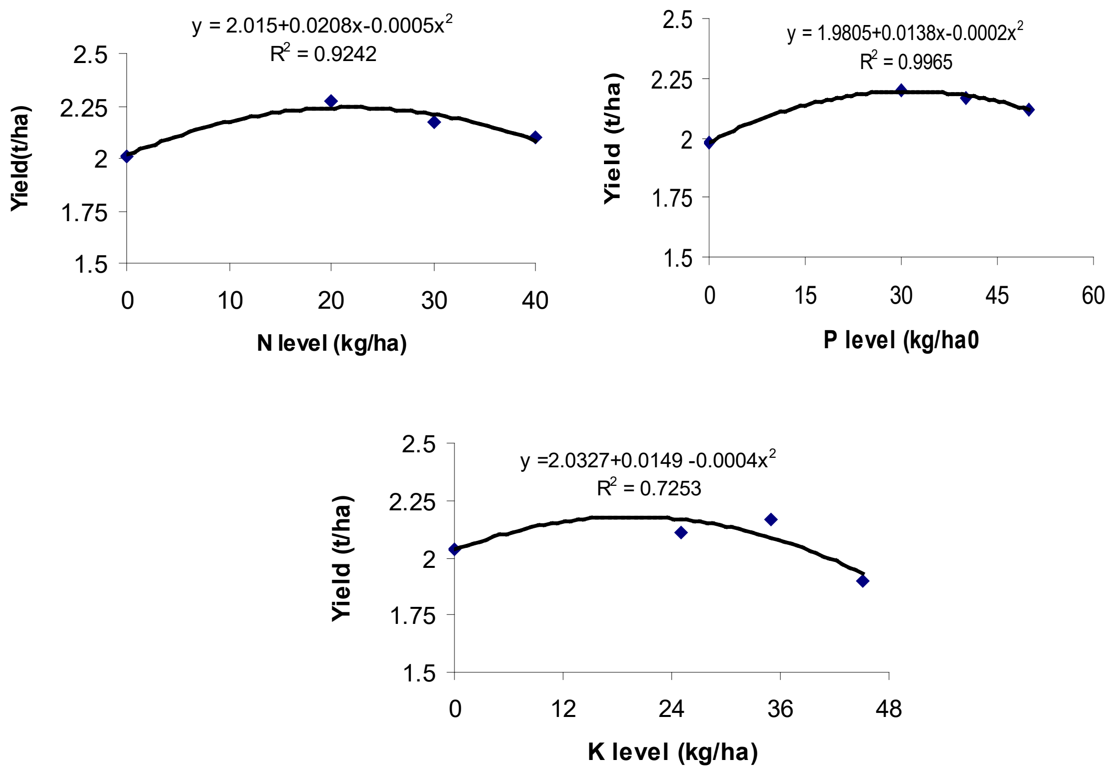

Figure 25. Response of Groundnut to added N, K and S in Ground-T.Aman cropping pattern at Atkapalia, Noakhali during 2002-03

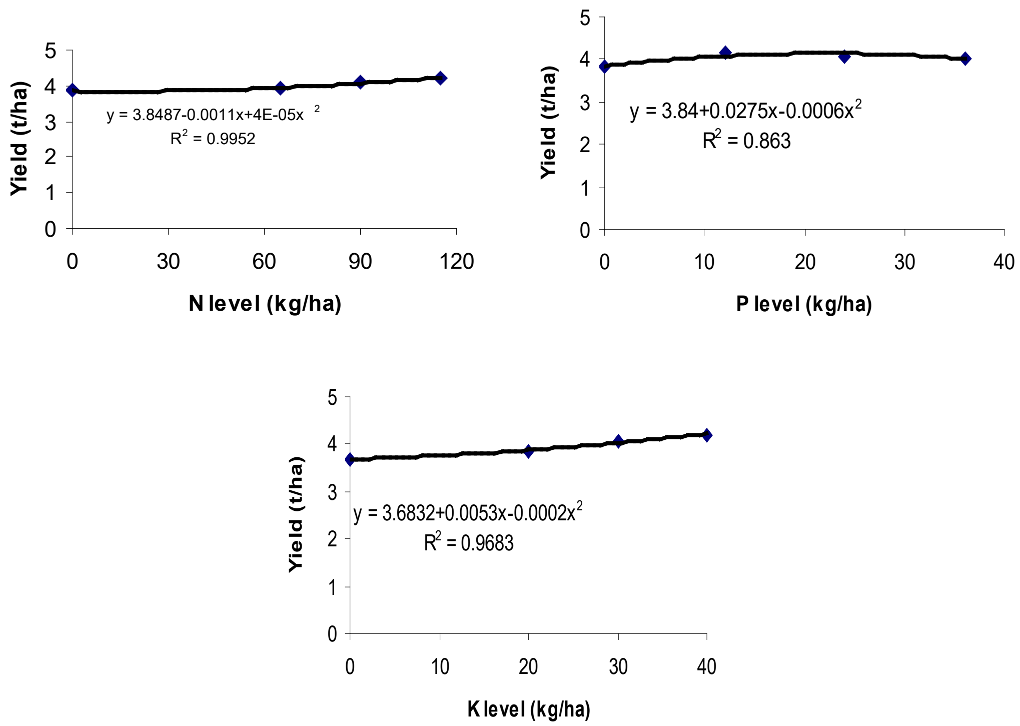

Figure 26. Response of T.Aman to added N, K and S in Ground-T.Aman cropping pattern at Atkapalia, Noakhali during 2002-03

Table 13. Effects of different levels of fertilizer nutrients on the yield crops in Groundnut-T.Aman cropping pattern at Atkapalia, Noakhali during 2002-03

Nutrient levels (kg/ha)		Grain yield (t/ha)	
Groundnut	T.Aman	Groundnut	T.Aman
N levels			
0	0	2.01	3.85
20	65	2.27	3.93
30	90	2.17	4.08
40	115	2.10	4.23
P levels			
0	0	1.98	3.82
30	12	2.20	4.14
40	24	2.17	4.08
50	36	2.12	4.04
K levels			
0	0	2.04	3.69
25	20	2.11	3.83
35	30	2.17	4.08
45	40	1.90	4.20

Cropping pattern : Mustard-Boro
Location : Mymensingh
Year of establishment : 2003-04

Mustard: Response of Mustard to nitrogen was observed to some extent. Seed yield increased appreciably with the increase of nitrogen up to 120 kg/ha and there after started to decline. In case of P, K and S response towards yield was found. However, seed yield did not increase markedly from 0 to next higher level of P, K and S. Yield increased significantly from 2nd level to next higher level and the highest yield was found in 34, 64 and 32 kg/ha of P, K and S, respectively.

Boro: Response of Boro rice to nitrogen was also observed. Grain yield increased markedly up to 130 kg/ha of N and there after tended to decrease. However, yield obtained from 0 nitrogen was much higher (4.72 t/ha). Response of P, K and S was also observed to some extent. But the rate of increment was not very high. However, grain yield increased up to 39, 45 and 18 kg/ha of P, K and S, respectively.

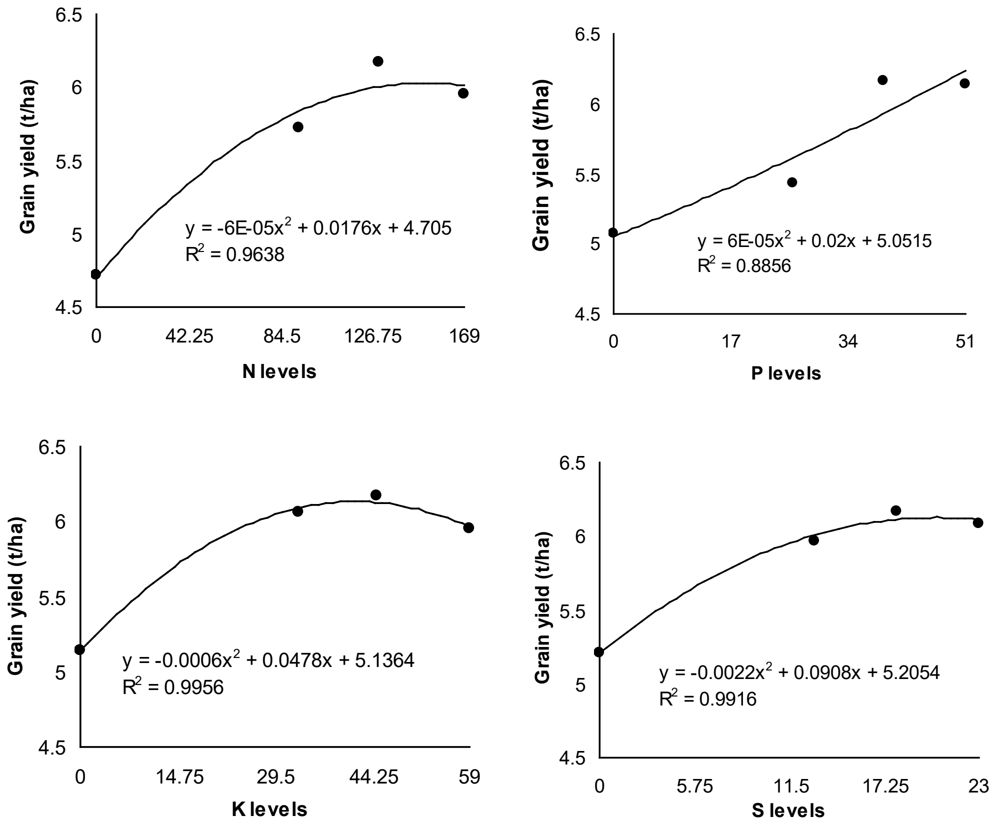

Figure 27. Response of Mustard to NPKS grown in Mustard-Boro cropping pattern at Mymensingh during 2002-03

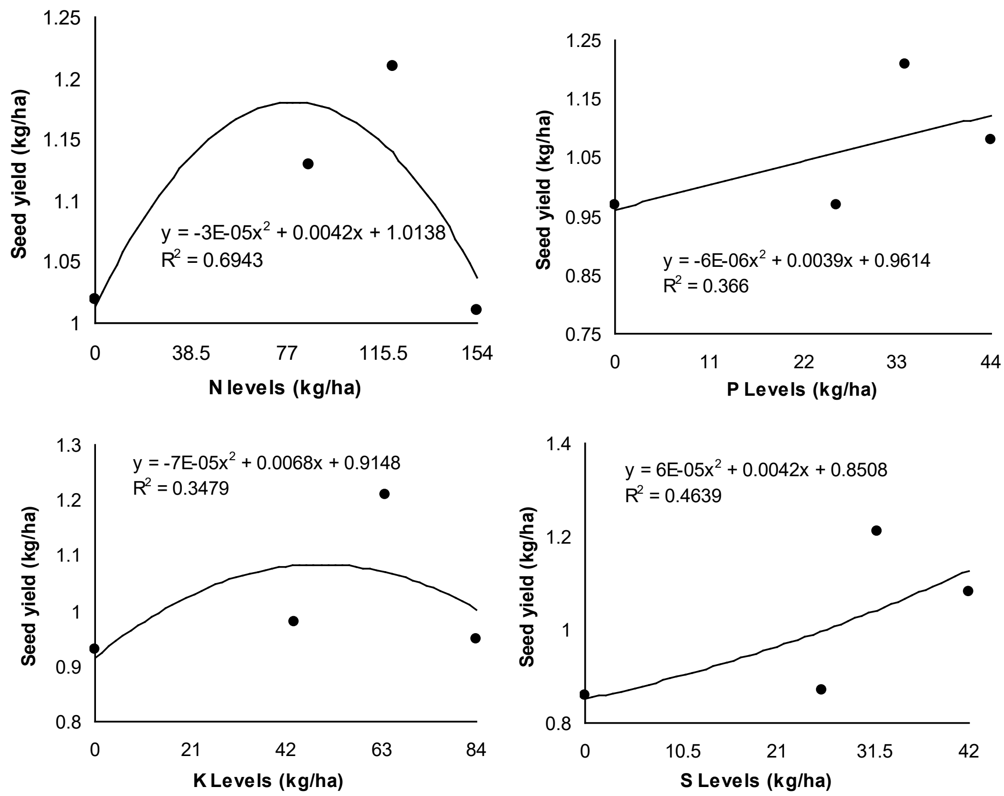

Figure 28. Response of T.Aman to NPKS grown in Mustard-Boro cropping pattern at Mymensingh during 2002-03

Table 14. Effects of different levels of fertilizer nutrients on the yield crops in Mustard-Boro cropping pattern at Mymensingh during 2002-03

Nutrient levels (kg/ha)		Grain yield (t/ha)	
Mustard	Boro	Mustard	Boro
N levels			
0	0	1.02	4.72
86	93	1.13	5.72
120	130	1.21	6.17
154	169	1.01	5.95
P levels			
0	0	0.97	5.08
26	26	0.97	5.44
34	39	1.21	6.17
44	51	1.08	6.14
K levels			
0	0	0.93	5.14
44	33	0.98	6.06
64	45	1.21	6.17
84	59	0.95	5.95
S levels			
0	0	0.86	5.21
26	13	0.87	5.97
32	18	1.21	6.17
42	23	1.08	6.09

Cropping pattern : Mustard-Boro
Location : Kaliakoir, Gazipur
Year of establishment : 2003-04

Mustard: Response of Mustard to nitrogen was observed to some extent. Seed yield increased with the increase of nitrogen linearly and the highest yield was recorded from the highest level of nitrogen (135 kg/ha). Therefore it is not possible to find out the optimum dose of nitrogen for mustard. Response was also observed to P and K. Seed yield of Mustard increased up to 30 and 50 kg/ha of P and K, respectively. But the rate of increment was not very distinct.

Boro: Response of Boro rice to nitrogen was also observed. Similar trend was found in Boro rice like Mustard. Grain yield increased linearly with the increase of nitrogen. P and K also showed some response towards the yield. Grain yield increased up to 30 and 50 kg/ha of P and S, respectively.

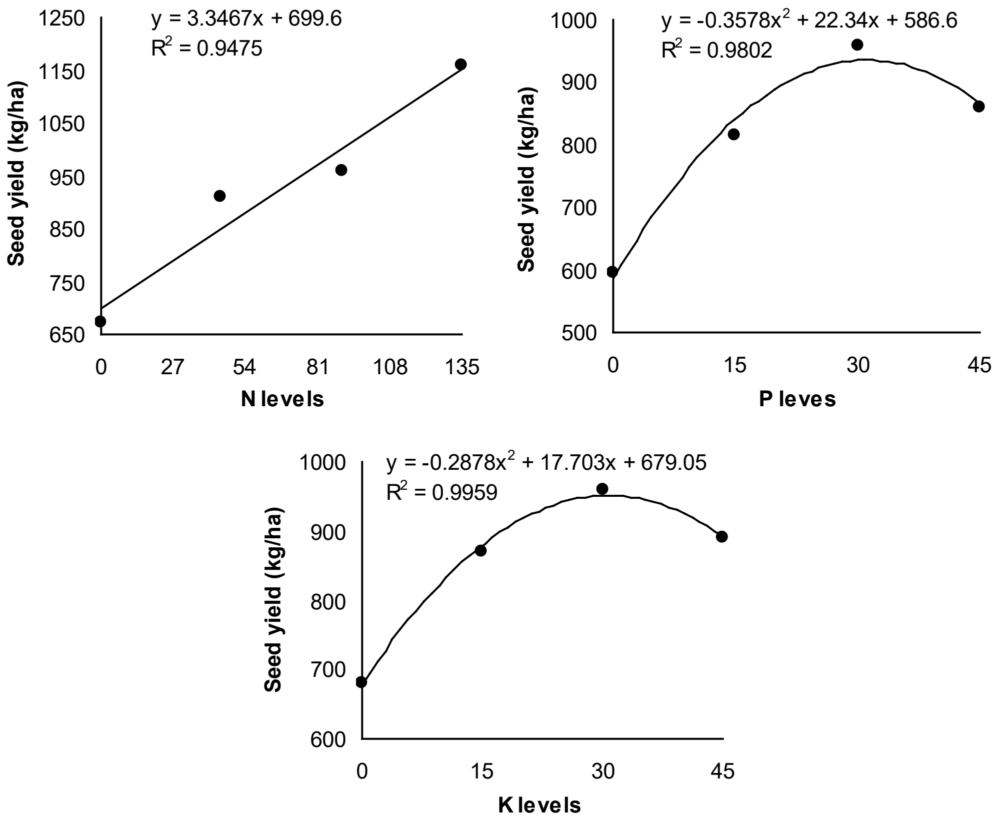

Figure 29. Response of Mustard to NPK grown in Mustard-Boro cropping pattern at Kaliakoir, Gazipur during 2002-03

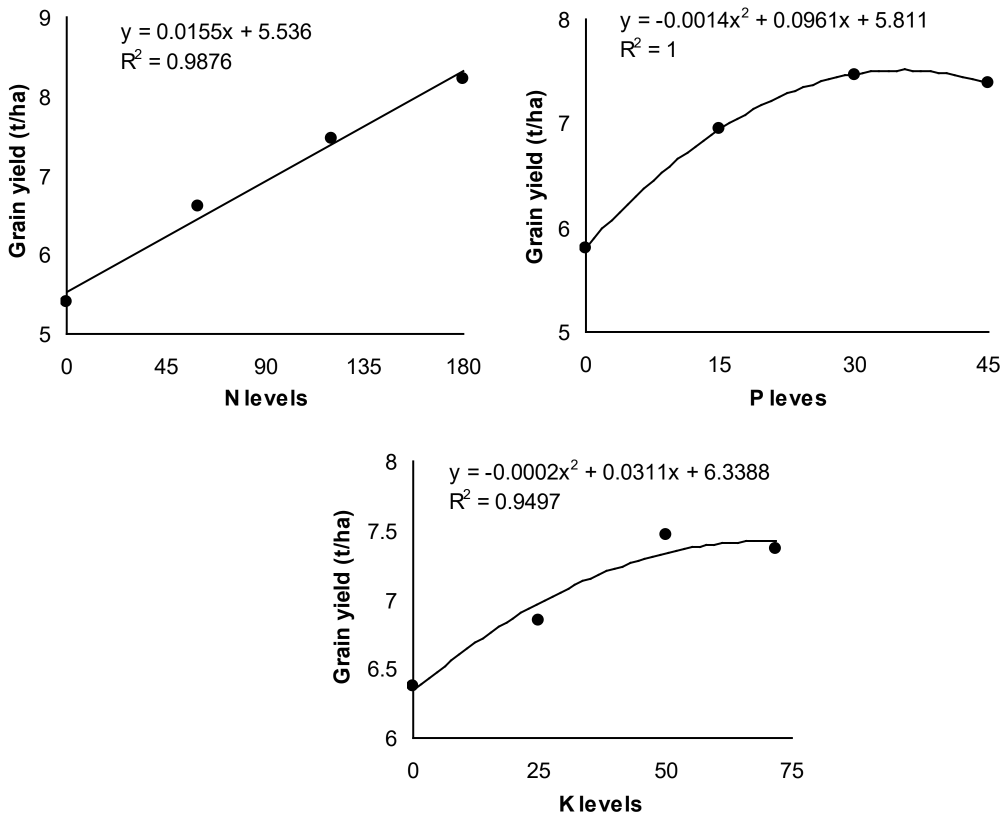

Figure 30. Response of Boro to NPK grown in Mustard-Boro cropping pattern at Kaliakoir, Gazipur during 2002-03

Table 15. Effects of different levels of fertilizer nutrients on the yield crops in Mustard-Boro cropping pattern at Kaliakoir during 2002-03

Nutrient levels (kg/ha)		Grain yield (t/ha)	
Mustard	Boro	Mustard	Boro
N levels			
0	0	0.672	5.41
45	60	0.912	6.62
90	120	0.960	7.47
135	180	1.158	8.23
P levels			
0	0	0.595	5.81
15	15	0.816	6.95
30	30	0.960	7.47
45	45	0.859	7.39
K levels			
0	0	0.682	6.38
15	25	0.871	6.85
30	50	0.960	7.47
45	75	0.890	7.37

Appendices

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			
Narikeli (9)	MHL	I	5.6-6.15	1.0	0.05 (VL)	0.08 (VL)	8.15 (L)	12.7 (L)	0.67 (L)	1.39 (VH)
Melandah (9)	MHL	I	5.2-5.9	0.75-1.38	0.05-0.10 (L)	0.06-0.76 (M)	4.75-11.3 (L)	5.08-10.9 (L)	0.78-5.1 (M)	0.05-0.29 (L)
Sherpur (9)	MHL	I	5.0-6.2	0.55-1.31	0.025-0.101 (L)	0.06-0.15 (VL)	4.2-11.5 (L)	6.6-15.5 (L)	0.28-0.79 (VL)	0.61-2.75 (VH)
Lebukhali (13)	MHL	R	5.3	1.44	0.08 (VL)	0.28 (Opt)	4.4 (VL)	33.46(Opt)	0.34(VL)	-
Barind (26)	MHL	I	5.7	1.12	0.07 (VL)	0.26 (M)	6.17 (VL)	15.0 (L)	1.22 (M)	0.18 (L)
Atkapalia (18)	MHL	R	7.06	1.41	0.03	0.23	5.7	65.2	0.66	-
Hathazari (23)	MHL	I	5.00	1.23	0.08 (VL)	0.10 (VL)	30.0 (Opt.))	11.8(L)	-	-
Ishan Gopalpur (12)	MHL	I	7.5	-	0.18 (M)	0.42 (VH)	9.03 (L)	18.0 (L)	-	-
Kolaroa (11)	MHL	I	8.1	1.88	0.09 (L)	0.22 (M)	4.80 (VL)	13.2 (L)	0.51 (L)	-
Mymensingh (9)										
Kaliakoir (28)	MLL	I	6.03	1.62	0.086 (VL)	0.20 (M)	6.25 (VL)	22.8 (Opt.)	0.98 (M)	0.24 (L)

Appendix table 2. Crop management practices

Site	Cropping pattern	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Narikeli	Mustard	Tori-7	08	3rd week of Nov	2nd week of Jan
	Boro	BRRI Dhan 28	40	3rd week of Feb	3rd week of May
	T.Aman	BRRI Dhan 33	40	1st week of Aug.	Last week of Oct.
Melandah	Potato	Cardinal	2000	4th week of Nov	4th week of March
	Jute	O-9897	8	3rd week of March	4th week of July
	T.Aman	BRRI Dhan 33	50	1st week of Aug.	Last week of Oct.
Sherpur	Wheat	Kanchan	120	4th week of Nov.	Last week of March
	Jute	O-9897	8	3rd week of April	Last week of July
	T.Aman	BRRI Dhan 33	50	Last week of Aug	Last week of Oct.
Lebukhali	Chilli	Local	-	3rd week of Jan.	2nd week of May
	T.Aman	BR-23	40	1st week of Sept.	3rd week of Dec
Hathazari	Chilli	Local	600g	3rd week of Dec.	2nd week of April
	T.Aman	BRRI Dhan 30	35	Last week of July	4th week of Nov
Barind	Wheat	Kanchan	120	2nd week of Nov	Last week of March
	T.Aman	BRRI Dhan 39	40	3rd week of July	Last week of Oct.
Atkapalia	G.nut	Dhaka-1	-	1st week of Jan.	3rd week of May
	T.Aman	BRRI Dhan 32	40	2nd week of Aug.	3rd week of Nov.
Feni	Boro	BRRI Dhan 29	40	1st week of Feb.	Last week of May
	T.Aman	BR 11	40	Last week of July	3rd week of Nov
Kolaroa	Boro	BRRI Dhan 28	40	4th week of Jan.	Last week of April
	T.Aman	BRRI Dhan 30	40	1st week of Aug.	Last week of Nov.
Chandina	Boro	BRRI Dhan 29	40	3rd week of Jan.	3rd week of May
	T.Aus	BR 20	40	Last week of May	Last week of Aug.
	T.Aman	BRRI Dhan 39	40	1st week of Sept.	4th week of Nov.
Ishan Gopalpur	Boro	BRRI Dhan 29	40	3rd week of Jan.	3rd week of May
	T.Aman	BRRI Dhan 32	40	Last week of July	2nd week of Nov.
Kaliakoir	Mustard-	Tori-7 (Imp.)	8	3rd week of Nov.	1st week of Feb.
	Boro	BRRI Dhan 29	40	2nd week of Feb.	3rd week of May
Mymensingh	Mustard	BARI Sarisha 9	8	1st week of Nov.	Last week of Jan.
	Boro	BRRI Dhan 29	40	2nd week of Feb.	3rd week of May

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EFFECTS OF DIFFERENT LEVELS OF MAGNESIUM ON THE PERFORMANCE OF POTATO AND TOMATO AT RANGPUR

Abstract

The experiment was conducted at FSRD site, Syedpur, Rangpur during Rabi season of 2002-03 and 2003-04. Five different levels of magnesium varied from crop to crop were tested against Potato and Tomato to find out the optimum and economic dose of Mg for the crops grown in magnesium deficient area of grater Rangpur. Average of two years results revealed that a positive response of crops to magnesium was evident. Yield of Potato increased significantly with the increase of Mg level up to 10 kg/ha. After that, the yield tended to decrease slowly. However, yield was identical to 15 and 20 kg/ha of Mg. Similarly, In Tomato response to Mg was observed. Fruit yield increased significantly up to 16 kg/ha. Almost similar trend was observed over the years. From the average data a response curve was drawn for Potato and Tomato. The response was quadratic in nature and from the equation Mg dose that maximized yield as well as profit was find out for Potato and Tomato at grater Rangpur under AEZ 3.

Introduction

Magnesium is one of the essential secondary nutrient elements for crop production. It is an important constituent of chlorophyll and therefore, essential for photosynthesis. It also promotes uptake and translocation of phosphorus. Generally, magnesium does not need to apply in the soil as its status in soil is optimum. But recently its deficiency was reported in medium highland soil of grater Rangpur under Tista Flood Plain (AEZ 3). Initial soil nutrient status also showed that Mg content of that area is low (0.14 meq/100 g of soil) and below the critical level (0.8meq/100 g of soil). The deficiency was observed in different crops particularly in rabi crops like Potato, Tomato and other vegetables crops and Maize. Potato, Tomato and Maize is widely grown in Rangpur and area under those crops is expanding over the years. Magnesium recommendation for different crops is not yet available in our country even not mentioned in the national fertilizer recommendation guide (FRG'97). Therefore, it is very important to find out the optimum dose of Mg for different crops for successful crop production. Keeping this view in mind the experiment was undertaken to find out the optimum dose of Mg for Potato and Tomato for magnesium deficient area of AEZ # 3.

Materials and Methods

The experiment was conducted at FSRD site, Syedpur during Rabi 2002-03 and 2003-04 to find out the optimum dose of Mg for Potato and Tomato. Five levels of Mg varied from crop to crop were tested against the crops. The trial was conducted in randomized complete block design with 6 dispersed replications. Initial soil samples were also collected from experimental plots and analyzed in SRDI laboratory, Rajshahi. The results of soil analysis are given in appendix table 1 &2. The unit plot size was 5 m × 3 m. Details of the crop and fertilizer managements are given in appendix table 3. At maturity crops were harvested and necessary data were collected and analyzed statistically.

Different levels of magnesium were tested in different crops

Crop	Mg levels (kg/ha)				
Potato	0	5	10	15	20
Tomato	0	8	16	24	32

Results and Discussion

Crop: Potato

Response of Potato to Mg was observed. Average of two years results showed that tuber yield of Potato increased markedly with the increase of Mg level up to 10 kg/ha. Tuber yield showed to decline after that level slowly. Similar trend was found over the years. Tuber yield increased significantly up to 10 kg/ha of Mg. However, the yield was identical to 15 and 20 kg/ha of Mg. Initial soil status showed that Mg status of the soil was medium. But response towards the yield of Potato was evident.

A response curve was drawn with average yield data of Potato obtained against different levels of Mg. The response was quadratic in nature and from the equation the Mg dose that maximized yield as well as profit was find out and it was 13kg Mg ha^{-1} and 12 Kg ha^{-1}, respectively.

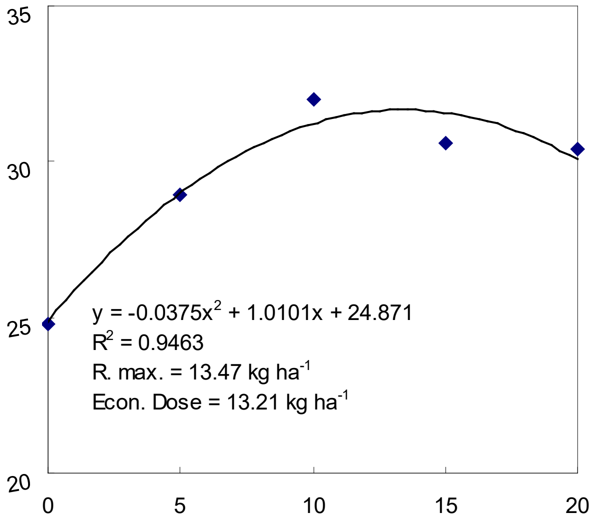

Figure 1. Response of Potato to added Magnesium at FSRD site, Syedpur, Rangpur (average yield of 2002-03 and 2003-04)

Table 1. Effects of different levels of Mg on the tuber yield of Potato at Syedpur FSRD site, Rangpur during 2002-2003 and 2003-04

Levels of Mg (kg ha^{-1})	Tuber yield (t/ha)		
	2002-03	2003-04	Mean of 2 years
0	25.33c	24.20c	24.77
5	29.55b	28.31b	28.93
10	32.33a	31.63a	31.98
15	30.95ab	30.26ab	30.61
20	30.75ab	30.07ab	30.41
CV (%)	*6.2*	*8.6*	-

Means followed by the same letter (s) in a column are not significantly different at 5% level by DMRT

Tomato

Average of two years results revealed that fruit yield of Tomato increased significantly with the increase of Mg level up to 16 kg/ha. There after yield tended to decline slowly. As the initial Mg status of the soil was low, therefore, response of Tomato to added Mg was observed. Similar results were obtained over the years. Fruit yield increased significantly up to 16 kg/ha of Mg. Yield did not increase further, however, it was identical to 24 and 32 kg/ha of Mg.

A response curve was drawn with average yield data of Tomato obtained against different levels of Mg. The response was quadratic in nature and from the equation the Mg dose that maximized yield as well as profit was find out and it was 23kg Mg ha^{-1} and 22 Kg ha^{-1}, respectively.

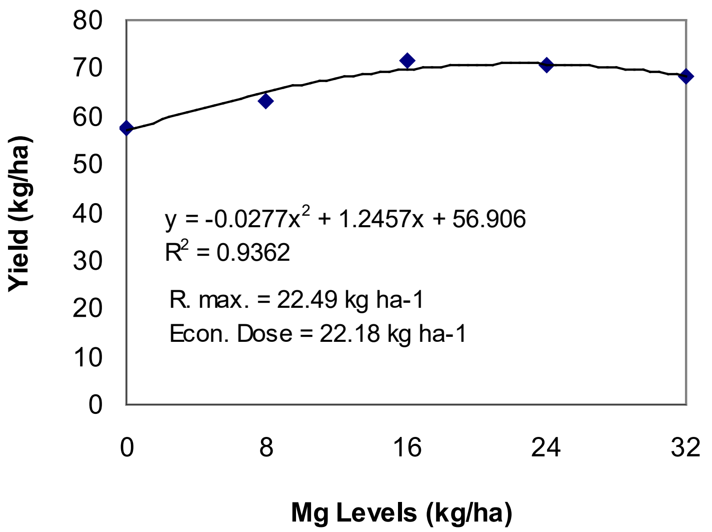

Figure 2. Response of tomato to added Magnesium at FSRD site, Syedpur, Rangpur (average yield of 2002-03 and 2003-04)

Table 2. Effects of different levels of Mg on the marketable fruit yield of Tomato at Syedpur FSRD site, Rangpur during 2002-03 and 2003-04

Levels of Mg ($kg\ ha^{-1}$)	Marketable fruit yield (t/ha)		
	2002-03	2003-04	Mean
0	56.09c	59.20b	57.65
8	61.52b	64.46b	62.99
16	70.59a	72.63a	71.61
24	68.97a	71.97a	70.47
32	66.46a	70.10a	68.28
CV (%)	*6.3*	*6.7*	-

Appendix table 1. Initial soil status of the experimental plots of Potato

SL.	Soil Characteristic	Status	SL.	Soil Characteristic	Status
1.	pH	5.37	6.	P (Micro gram g^{-1} soil)	38.95 (VH)
2.	OM (%)	2.17	7.	S (Micro gram g^{-1} soil)	13.12 (L)
3.	Mg (m eq/100g soil)	0.82 (M)	8.	Zn (Micro gram g^{-1} soil)	0.55 (L)
4.	K (m eq/100g soil)	0.42 (H)	9.	B (Micro gram g^{-1} soil)	0.29 (L)
5.	N (%)	0.11 (L)			

Appendix table 2. Initial soil status of the experimental plots of Tomato

SL.	Soil Characteristic	Status	SL.	Soil Characteristic	Status
1.	pH	6.22	6.	P (Micro gram g^{-1} soil)	53.11 (VH)
2.	OM (%)	1.68	7.	S (Micro gram g^{-1} soil)	14.58 (L)
3.	Mg (m eq/100g soil)	0.46 (L)	8.	Zn (Micro gram g^{-1} soil)	0.58 (L)
4.	K (m eq/100g soil)	0.49 (VH)	9.	B (Micro gram g^{-1} soil)	0.25 (L)
5.	N (%)	0.11 (L)			

Appendix table 3. Crop management and fertilization

Crop Management

Crop	Variety	Spacing (cm)	Planting time	Harvesting time	Irrig. (no.)	Pesticide use
Potato	Cardinal	60 cm x 25 cm	1st week of Dec.	1st week of Feb.	3	-
Tomato	Ratan	60 cm x 45 cm	4th week of Nov.	1st week of April	3	-

Fertilization

Crop	Fertilizer rate (NPKSZn in kg/ha)	Application (Method & time)
Potato	Mg: 0-5-10-15-20 NPKSZnB: 160-15-50-27-1-1.8 + CD @ 7.5 t/ha	In Potato, all PKS Mg Zn B and ½ of urea and cowdung were applied as basal and rest half of urea was side dressed at 30 DAP.
Tomato	Mg: 0-8-16-24-32 NPKSZnB: 160-15-50-27-1-1.8 + CD @ 5 t/ha	All P, S, Mg, Zn, B and cowdung was applied as basal. But N and K was applied in 2 equal splits at 15 and 35 DAP.

Appendix table 4. Effects of different levels of Mg on the yield attributes of potato at Syedpur FSRD site, Rangpur during 2002-03 and 2003-04

Levels of Mg (kg ha^{-1})	Plant height (cm)	Shoot Hill^{-1} (No.)	Tuber. Plant^{-1} (No.)	Tuber wt. Hill^{-1} (g.)
		Year 1 : Rabi 2002-03		
0	78	3.59	10.4	420c
5	81	3.62	10.8	479b
10	79	3.82	10.9	530a
15	79	3.72	10.8	505ab
20	80	3.77	10.5	499ab
CV (%)	3.2	5.8	5.6	5.9
		Year 2 : Rabi 200-04		
0	79.3	3.6	9.6	406 c
5	81.3	3.6	10.2	452b
10	79.2	3.7	10.7	508a
15	82.4	3.8	9.9	488ab
20	79.8	3.8	10.1	486ab
CV (%)	4.5	4.5	5.9	6.1

Appendix table 5. Effects of different levels of Mg on the yield attributes of tomato at Syedpur FSRD site, Rangpur during 2002-03 and 2003-04

Levels of Mg (kg ha^{-1})	Plant height (cm)	Fruit Plant^{-1} (No.)	Fruit wt. Plant^{-1} (kg.)
	Year 1 : Rabi 2002-03		
0	74	27.5	1.69c
8	74	27.7	1.88bc
16	76	28.4	2.12a
24	75	28.4	2.04a
32	76	27.9	1.98ab
CV (%)	3.5	8.4	9.3
	Year 2 : Rabi 2003-04		
0	76.2	29.5	1.80c
8	78.0	29.9	1.98b
16	75.6	30.4	2.25a
24	77.6	30.4	2.13ab
32	77.3	30.3	2.10ab
CV (%)	4.3	7.0	6.8

Means followed by the same letter (s) in a column are not significantly different at 5% level by DMRT.

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SUBPROJECT: VERIFICATION OF FERTILIZER MANAGEMENT PRACTICES

EFFECT OF UREA SUPER GRANULE (USG) AS A SOURCE OF NITROGENOUS FERTILIZER ON UPLAND VEGETABLES AND FRUITS

Abstract

The experiment was conducted at Narsinghdi, Tangail, Pabna and Rangpur during 2002-03 and 2003-04 to evaluate the effect of Urea Super Granule (USG) on upland vegetables and fruits crops. Different vegetables crops viz. cabbage, cauliflower and fruits crops viz. banana were included in the trial. Recommended dose of USG, 10% and 20% less of recommended USG were tested along with recommended dose of prilled Urea and Farmers' practice. At Norshingdi recommended dose of prilled urea in ring placement was included as another treatment. Results revealed that yield of crops increased significantly due to application of USG over prilled urea across the locations. In most cases, 10-20% less of N as USG also produced identical yield with recommended dose of prilled urea. But at Norshingdi, recommended dose of USG and recommended dose of prilled urea in ring placement produced higher and identical yield. About 10-20% nitrogen could be saved by using USG instead of prilled urea. Regarding economics, the higher returns were also obtained from recommended dose of N as USG treatments.

Introduction

Nitrogen is the most deficient nutrient element in Bangladesh soil. In general, farmers' of the country apply at least nitrogenous fertilizer to their crops for better yield. There are different types of nitrogenous fertilizers are now available in the market. Recently, Urea super Granule (USG) has become available in the market and used in wetland rice as well as upland crops. It is said that USG is more efficient than prilled urea in supplying N to crops as it is minimize loss by leaching and volatilization. USG is mostly used by farmers in boro rice and it is reported that 20-30% nitrogen could be saved by using USG compared to prilled urea. During the last couple of years farmers' in some parts of the country using USG in upland vegetables and fruit crops like brinjal, cabbage, cauliflower, tomato, papaya and banana. However, there is no recommendation of USG on upland crops are so far available and research findings in this regard are very scanty. Environment in wetland rice is quite different from upland condition and efficiency of USG on upland crops are yet to be ascertained. In this context the experiment was designed with the following objectives-

i) To find out the efficiency of USG on upland vegetables and fruits.
ii) To determine the optimum and economic dose of USG for upland crops.

Materials and Methods

The experiment was conducted at farmers' field of Shibpur, Narsinghdi, FSRD site Palima and MLT site Modhupur, Tangail, FSRD site Goyeshpur, Pabna and FSRD site Syedpur, Rangpur. The experiment was started with Cabbage and brinjal at Tangail during rabi season of 2000-01 and in 2002-03 extended in some new sites with new crops. Different vegetables viz. Cabbage, Cauliflower, Tomato, Potato and fruit crops viz. Papaya and Banana were included in the trial. Details about site characteristics and soils, crop management and fertilization are provided in appendix Table 1 and 2, respectively. The experiment was laid out in RCB design with 6 dispersed replications. Unit plot size was varied from 40 m^2 to 80 m^2. There were five treatments viz. (T_1) Recommended dose of N as prilled urea; (T_2) Recommended dose of N as USG; (T_3) 10% less N than recommended dose as USG; (T_4) 20% less N than recommended dose as USG and (T_5) Farmers' practice. But at Norshingdi recommended dose of prilled urea in ring placement was included as another treatment. Other nutrient elements PKSZn were applied in recommended rate. Yield attributes were collected from 10 randomly selected plants and yield was harvested from 10 m^2 area. All the data were analyzed statistically. Market price of the crop at harvest was recorded to calculate economics.

Results and Discussion

Crop: Cabbage

Shibpur, Narsinghdi

Higher head yield was obtained from treatment T_3 that was statistically identical to T_2 and T_1 in 2002-03 and T_3 & T_2 in 2003-04. USG with 10 to 20% < recom. N (T_4 and T_5) produced statistically similar head yield to recommended N (T_1) in 2002-03 or higher dose of N (T_6) where prilled urea was applied as broadcast. Cost and benefit analysis showed that T_3 produced highest average gross return, gross margin and ultimately higher BCR (6.14). Prilled urea as ring method found better than broadcast but produced lower BCR than USG. So, N could be applied in recommended dose either as USG or as prilled urea in ring placement for growing cabbage at Narsingdi area.

Table 1. Yield and yield attributes of cabbage as affected by different sources of N at Shibpur MLT site, Narsingdi during rabi 2003-04

Treatment	Head pericycle (cm)		Head weight with outer leaves (kg)		Head weight without outer leaves (kg)		Marketable head yield (t/ha)		
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	Mean
T_1	62.15a	50.53b	2.82bc	2.23b	2.21bc	1.66b	78.94bc	56.60b	67.77
T_2	62.40a	50.93ab	2.89ab	2.43a	2.28ab	1.72ab	83.01ab	59.96a	71.49
T_3	62.60a	52.10a	2.98a	2.38a	2.38a	1.83a	84.88a	61.55a	73.22
T_4	58.55b	50.23b	2.78cd	2.21b	2.16c	1.65b	77.24c	55.03b	66.14
T_5	58.70b	49.90b	2.70d	2.17b	2.11c	1.62b	75.36c	54.99b	65.18
T_6	58.60b	50.67b	2.74cd	2.30ab	2.13c	1.69b	76.82c	55.94b	66.38
$LSd_{.05}$	3.4	1.17	2.6	0.15	3.3	0.23	3.4	3.33	-

Table 2. Average cost and return of cabbage as affected by different sources of N at Shibpur MLT site, Narsingdi, rabi 2003-04

Treatment	Gross return (Tk/ha)	Total cost of production (Tk/ha)	Gross margin (Tk/ha)	Benefit-cost Ratio
T_1	338850	59368	279482	5.70
T_2	357450	59618	297832	5.99
T_3	366100	59618	306482	6.14
T_4	330700	59417	271283	5.57
T_5	325900	59278	266622	5.49
T_6	331900	59860	272040	5.54

Market price of cauliflower = Tk.5.00/kg head

Syedpur, Rangpur

Head yield and yield attributes were significantly influenced by the treatments (Table 3). Treatments T_2 & T_3 showed similar yield attributes and higher than other treatments which also reflected the head yield. Similar trend was followed in 2003-04. Higher gross return, gross margin, BCR and MBCR were obtained from T_2.

On the basis of the results, it was observed that Urea Super Granule had positive impact on cabbage cultivation. On an average 10-20% N might be saved as USG compare to prilled urea. Hence, N at the rate of 133-155 kg ha^{-1} from USG may be recommended to cultivate cabbage (var. Atlas-70) in the irrigated highland of AEZ # 3.

Table 3. Effect of USG on yield contributing characters of cabbage at Syedpur FSRD site, OFRD, BARI, Rangpur during 2002-2003 and 2003-04

Treatment	Plant height (cm)	Outer leaf/plant (no.)	Head diameter (cm)	Head length (cm)	Head wt. with leaves (kg)	Head wt. without leaves (kg)	Head yield (t/ha)
2002-03							
T_1	22.9ab	7.08	23.3bc	14.2b	2.85ab	2.46ab	66.23ab
T_2	23.4a	7.28	24.6a	15.4a	3.09a	2.69a	72.28a
T_3	22.8ab	7.33	23.9ab	14.8ab	2.97ab	2.57ab	69.30ab
T_4	22.4b	7.22	22.9c	14.0b	2.71b	2.36b	63.55b
T_5	22.4b	6.97	22.6c	13.8b	2.62b	2.35b	63.67b
CV(%)	2.7	4.4	3.5	6.0	8.7	9.6	7.0
2003-04							
T_1	23.8ab	6.8	23.8ab	14.6b	2.93b	2.56bc	69.52ab
T_2	24.6a	7.1	25.1a	15.8a	3.24a	2.85a	75.80a
T_3	24.7a	7.3	24.5ab	15.1ab	3.01ab	2.73ab	73.35ab
T_4	23.4b	6.7	23.4b	14.3b	2.90b	2.45c	67.65b
T_5	23.6b	6.6	23.1b	14.2b	2.81b	2.44c	68.05b
CV(%)	3.4	7.8	6.9	6.0	6.6	7.7	7.0

Table 4. Cost and return of cabbage as affected by USG application at Syedpur FSRD site, OFRD, BARI, Rangpur during 2002-03 and 2003-04

Treatment	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR	MBCR
T_1	161409	68719	92690	2.35	-
T_2	176065	70467	105598	2.50	8.34
T_3	169650	70171	99479	2.42	5.68
T_4	156056	69876	86180	2.23	- 4.63
T_5	156691	71106	85585	2.20	- 1.98

Crop: Cauliflower

Shibpur, Narsinghdi

In both the years, T_3 and T_2 produced identically higher yield of cauliflower. T_4 produced statistically similar yield to T_1 and T_6 indicates efficiency of USG over prilled urea. Higher average yield of cauliflower (24.24 t/ha) was obtained from recommended dose of N applied as USG (T_3) which was followed by T_2. Cost and benefit analysis showed that T_3 provided higher average gross return, gross margin and ultimately higher BCR (2.89) which were very close to T_2. Again, ring placement (T_2) found better than broadcast of prilled urea (T_1) with respect to yield and return.

Table 5. Yield and yield attributes of cauliflower as affected by USG application at Shibpur MLT site, Narsingdi during rabi 2002-03 & 2003-04

Treatment	Curd pericycle (cm)		Curd weight with outer leaves (kg)		Curd weight without outer leaves (kg)		Marketable curd yield (t/ha)		
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	Mean
T_1	52.90bc	48.53ab	1.54c	1.40a	0.82b	0.74bc	23.51b	21.15b	22.33
T_2	53.25b	48.17ab	1.61b	1.41a	0.87a	0.80ab	24.96a	22.99a	23.98
T_3	54.20a	49.07a	1.69a	1.43a	0.87a	0.83a	25.31a	23.16a	24.24
T_4	53.20b	48.07ab	1.49c	1.34ab	0.78b	0.72c	22.93bc	20.36bc	21.65
T_5	52.35c	46.83b	1.36d	1.26b	0.72c	0.70c	21.09d	19.42c	20.26
T_6	52.80bc	47.20ab	1.50c	1.38a	0.80b	0.71c	22.33cd	19.82bc	21.08
$LSd_{.05}$	1.0	1.98	2.7	0.09	2.8	0.05	3.4	1.57	-

Table 6. Average cost and return of cauliflower as affected by USG application at Shibpur MLT site, Narsingdi, rabi 2002-03 & 2003-04

Treatment	Gross return (Tk/ha)	Total cost of production (Tk/ha)	Gross margin (Tk/ha)	Benefit-cost ratio
T_1	139563	52289	87274	2.67
T_2	149875	52464	97411	2.86
T_3	151500	52464	99036	2.89
T_4	135313	52150	83163	2.59
T_5	126625	51985	74640	2.44
T_6	131750	54658	77092	2.41

Average market price of cauliflower = Tk. 6.25/kg

Goyeshpur, Pabna

The result showed that higher curd yield (43.44 t ha^{-1}) was obtained from 100% USG which was statistically at par to other treatments except farmers practice (Table 7). All other characters were also statistically identical. This was probably because of very close nutrient management. Curd yield of second year (2003-04) was less than previous year which might be due to late planting and short duration of winter. After completion of 2 years experimentation, the average result showed that USG as recommended dose of prilled urea (T_2) treatment gave higher curd yield (54.55 t ha-1) but was very clear to T_3. Higher gross return and gross margin was recorded from T_2 followed by T_3. But higher MBCR was recorded from 20% less USG used. It was due to lower cost of fertilizer.

Gross margin of second year were very close in all treatments in both in years (Table 3) but the height MBCR was recorded from 20 % less used of USG in both the year (Table 3).It was due to lower cost of fertilizer with comparable yield.

Table 7. Effect of different nitrogen sources on the curd yield (t/ha) of cauliflower at FSRD site, Goyeshpur, Pabna during 2003-04

Treatment	50% curd initiation (day)	Plant height (cm)	Whole plant wt. (kg)	Marketable weight (kg)	Curd length (cm)	Curd breath (cm)	Curd yield ha^{-1} (t)
T_1	63	49.40	1.69	1.11	12.91	16.46	40.17
T_2	63	49.42	1.81	1.20	13.22	16.81	43.44
T_3	63	49.71	1.86	1.19	13.02	16.48	43.43
T_4	62	50.05	1.76	1.12	12.73	16.45	41.15
T_5	63	49.27	1.58	1.02	12.71	16.25	37.46
CV (%)	-	3.7	10.5	10.1	3.0	3.8	10.2

Table 8. Effect of different nitrogen sources on the curd yield (t/ha) of cauliflower at FSRD site, Goyeshpur, Pabna during 2002-03 to 2003-04

Treatment	2002-03	2003-04	Mean
T_1	60.74	40.17	50.46
T_2	65.65	43.44	54.55
T_3	64.72	43.43	54.08
T_4	63.52	41.15	52.34
T_5	57.41	37.46	47.44
CV (%)	12.3	10.2	-

Table 9. Cost and return analysis of different sources of nitrogen on the cauliflower at FSRD site, Goyeshpur, Pabna (average)

Treatment	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	MBCR
T_1	272360	43931	228429	66.72
T_2	294445	44141	250304	84.08
T_3	292090	43931	248159	147.91
T_4	282250	43722	238528	460.76
T_5	255905	43688	212217	-

Fruit: Banana

Modhurpur, Tangail

Results revealed that maximum number of suckers per plant (7.86) was obtained from T_1 which was statistically different from other treatments. The highest number of leaves per plant was recorded from the treatment T_2 which was statistically identical to T_1 and T_3. Highest number of banana/bunch was obtained from farmer's dose. The significant variation was not found in case of Banana length. The highest weight of bunch (22.70 kg) was measured in farmer's dose, which was statistically higher than other treatments. Remarkable variation was not found among the treatments in case of number of flowered plant/80 m^2 and weight of Banana .Statistically similar yield was found in the treatments T_2 and T_3, which was followed by others treatments except T_4. From the Table 11, it was found that the highest net return (Tk. 80275/ha was given by USG (20 % < Rec.) dose followed by USG (10% < Rec.) Tk. 79,300/ha and the highest BCR (1.40) was obtained from USG (20 % < Rec.) dose and the negative BCR was found from farmer's dose due to application at higher dose of fertilizers.

Table 10. Effect of USG and prilled urea on yield and yield contributing characters of Banana at MLT site, Modhupur, Tangail during 2003-04

Treatment	No. of Sucker/ plant	No. of leaves /plant	No. of Banana / bunch	Length of Banana	Wt. of bunch (kg)	No. of Flowered/ 80 m^2	Wt. of Banana (g)	Yield (t/ha)
T_1	7.86a	17.07ab	117.7ab	18.27	19.00c	17.00b	156.7	45.54ab
T_2	5.33b	17.60a	114.7b	17.40	20.90b	19.67a	159.3	48.72a
T_3	6.13b	17.00ab	115.9ab	18.00	20.47b	18.67ab	160.3	48.58a
T_4	6.20b	16.33b	115.6ab	17.80	17.53d	19.00a	158.0	42.30b
T_5	6.13b	16.63b	127.3a	14.33	22.70a	19.00a	161.3	46.28ab
LSD(0.05)	1.47	0.922	11.86	4.15	1.23	1.78	15.25	4.31

Table 11. Cost and return analysis of USG on Banana cultivation

Treatment	Price/bunch	Gross margin (Tk./ha)	TVC (Tk./ha)	Net return (Tk./ha)	BCR
T_1	60	1,30,625	54,800	75,825	1.38
T_2	65	1,37,500	59,050	78,450	1.32
T_3	65	1,37,500	58,200	79,300	1.36
T_4	65	1,37,500	57,225	80,275	1.40
T_5	70	1,16,825	1,33,800	- 16,975	-0.13

Number of applied USG balls per plant on the basis of soil analysis value

USG (nos) $T_2 = 650$ $T_3 = 585$ $T_4 = 520$ @ 1.0 g/USG

Syedpur, Rangpur

The results revealed that USG had significant positive effect on the yield of banana as compare to normal prilled urea. The recommended dose of USG (143 kg N ha^{-1}) gave higher yield (55.64 t ha^{-1}) and it was statistically identical to the yield obtained using 90 % of recommended from USG. The yields obtained using 80% & 90% of recommended N from USG; cent percent recommended N from prilled urea and farmer's dose were 49.96, 52.98, 49.63 and 48.82 t ha^{-1}, respectively. These yields also were statistically identical. These results indicate that 10-20% N could be saved by using USG instead of prilled urea. The economic analysis also showed that the higher return also obtained from USG as a source of N application for banana cultivation.

Table 12. Effect of USG on yield and yield contributing characters of banana at Syedpur FSRD site, OFRD, BARI, Rangpur during 2002-03

Treatment	Plant height (cm)	No. of hand/ bunch	No. of finger/hand (no.)	Length of finger (cm)	Diameter of finger (cm)	Weight of bunch/plant (kg)	Yield (t/ha)
T1	298	8.8	15.6ab	21.0	12.0	23.28b	49.63b
T2	313	8.9	16.4a	21.5	12.8	25.96a	55.64a
T3	302	8.8	16.0a	21.6	12.4	24.39ab	52.98ab
T4	301	8.7	14.5bc	22.0	12.1	23.77ab	49.96b
T5	309	8.4	13.43c	21.0	12.1	22.77b	48.82b
CV (%)	7.8	3.9	6.9	2.8	4.9	7.8	7.6

Table 13. Cost and return of banana as affected by USG application at Syedpur FSRD site, OFRD, BARI, Rangpur during 2002-03

Treatment	Gross return (Tk/ha)	Total variable cost (Tk/ha)	Gross margin (Tk/ha)	BCR	MBCR	MRR (%)
T_1	146634	57085	89549	2.57	-	-
T_2	164391	58676	105715	2.80	11.16	1136
T_3	156532	58040	98492	2.70	10.36	1301
T_4	147609	57403	90206	2.57	3.07	207
T_5	144241	78930	65311	1.83	- 0.11	- 199

Initial nutrient status of soil, 2002-03

Crop: Cabbage

Shibpur

Sample	pH	OM %	Ca	Mg	K	Total	P	S	Cu	Fe	Mn	Zn	B
			meq/100ml			N %	µg / ml						
Mean	5.2	0.99	3.4	0.68	.29	.052	23	17	3.8	321	15.0	4.4	0.35
Critical level			2.0	0.8	0.2		14	14	1.0	10.0	5.0	2.0	0.20

Syedpur, Rangpur

SL.	Soil Characteristic	Status	SL.	Soil Characteristic	Status
1.	pH	5.40	6.	P (Micro gram g^{-1} soil)	66.49 (VH)
2.	OM (%)	1.60	7.	S (Micro gram g^{-1} soil)	8.26 (L)
3.	Mg (meq/100g soil)	0.56 (L)	8.	Zn (Micro gram g^{-1} soil)	1.06 (M)
4.	K (meq/100g soil)	2.85 (H)	9.	B (Micro gram g^{-1} soil)	0.35 (M)
5.	N (%)	0.088 (VL)			

Crop: Cauliflower

Shibpur

Sample	pH	OM %	Ca	Mg	K	Total N	P	S	Cu	Fe	Mn	Zn	B
			Meq/100ml			%	µg / ml						
Mean	5.1	0.82	2.3	0.50	.30	.043	41	11	8.5	431	22.0	4.8	0.28
Critical level			2.0	0.8	0.2		14	14	1.0	10.0	5.0	2.0	0.20

Goyeshpur, Pabna

Sample	pH	K	Total N (%)	P	S	B	Zn
		meq/100g soil		microgram/100g soil			
Sample-1	8.5	0.26	0.07	6	5.0	0.60	0.42
Critical limit	Alkaline	Medium	VL	VL	VL	Optimum	Optimum

Fruit: Banana

Syedpur, Rangpur

SL.	Soil Characteristic	Status	SL.	Soil Characteristic	Status
1.	pH	5.26	6.	P (Micro gram g^{-1} soil)	64.49 (VH)
2.	OM (%)	-	7.	S (Micro gram g^{-1} soil)	11.49 (L)
3.	Mg (meq/100g soil)	0.52 (L)	8.	Zn (Micro gram g^{-1} soil)	1.33 (M)
4.	K (meq/100g soil)	0.37 (H)	9.	B (Micro gram g^{-1} soil)	0.52 (Opt.)
5.	N (%)	0.075 (VL)			

Appendix table 2. Crop management and fertilization

Crop Management

Site	Crop	Variety	Spacing (cm)	Planting time	Harvesting time	Irrig. (No.)	Pesticide use
Shibpur	Cabbage	Atlas-70	60 cm x 45 cm	Last week of Nov.	28 Jan-2 Feb.	3	Dursban Dithane M-45
	Cauliflower	Agrahayani	60 cm x 60 cm	Last week of Nov.	1st wk. of Feb.	3	Dursban Dithane M-45
Modhupur	Banana	Amrit sagar	2m x 2m	Mid Jan.	Mid. Nov.	2	Dimecrone
Syedpur	Cabbage		60cm x60 cm	10 Nov.			
	Banana		2m x 2m	5-7 Oct.			
Goyeshpur	Cauliflower	Snow white	60cm x 45 cm	Last wk of Nov.	2-29 Feb.	3	Dursban

Fertilization

Site	Crop	Fertilizer rate (NPKSZn in kg/ha)	Application (Method & time)
Shibpur	Cabbage Cauliflower	RF = 138-24-60-20 + CD @4t/ha FP = 173-38-62 + CD @4t/ha RF = 100-26-67-20 + CD @4t/ha FP = 173-44-42 + CD @4t/ha	All PKS and CD were applied during final land preparation and prilled urea was top dressed in 3 equal splits at 20, 50, 65 DAT and 15, 30, 45 DAT for Cabbage and Cauliflower, respectively. USG was applied at 15 and 20 DAT for Cabbage and Cauliflower, respectively, as ring method 4 inches apart from each plant and 3 inches deep in soil.
Modhupur	Banana	RF = 0.65-0.40-0.30-4.0 kg/plant FP = 0.75-1.0-1.0-5.0-1.5 kg/plant	For treatment T1, 50 % cow dung during land preparation, 50 % cow dung and 50 % TSP during pit preparation, 25 % urea, 50 % TSP , 50 % MP apply 60 DAP. Fifty per cent Urea, 50 % MP applied at 135 DAP. Rest 25 % Urea applied at flowering stage. For T2, T3 and T4 Same as T1 except Urea (USG).The USG was applied in 3 equal splits at 60, 135 DAP and before flowering. For T5 same as T1.But mustard oil cake was applied in 3 equal splits at 60, 135DAP and before flowering followed by ring method.
Syedpur	Cabbage	RF = 172-7-24-38-0.5-10+ CD @6t/ha FP = 164-40-124-32-2-1 + CD @7.5t/ha	All PKS and CD were applied during final land preparation and prilled urea was top dressed in 3 equal splits at 20, 50, 65 DAT. USG was applied as ring method at 15 DAT.
	Banana	RF= 143-0-0-10-4-0 g + CD 6 kg/plant FP = 105-60-200-0 g + CD 3.5 +MOC .025 kg/plant	All amounts of fertilizer except TSP and MP were applied during final land preparation. Fifty percent Cowdung and 50 % TSP were applied during pit preparation. Twenty five percent Urea, 50% TSP and 50% MP was applied at 60 DAP. Rest 50% MP and 50% urea were applied at 135 DAP and rest 25% urea was applied at flowering stage. USG and MOC were applied as ring method at three equal splits at 60, 135 DAP and before flowering stage.
Goyeshpur	Cauliflower	RF =158- 54-45-33 kg/ha of NPKS FP = 60 kg N/ha	Entire amount of TSP, MP, Gypsum and Borax were applied as basal. Prilled urea was applied in two installments at 15 and 35 DAP. USG was applied at 20 DAP in 3-4 inches apart from plant and 2-3 inches depth of soil.

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EFFECT OF DIFFERENT TIME AND DEPTH OF USG APPLICATION ON THE GROWTH AND YIELD OF CABBAGE, CAULIFLOWER AND TOMATO

Abstract

The experiment was conducted at FSRD site, Palima, Tangail during 2003-04 to evaluate the effect of time and depth of USG placement on the performance of cabbage and cauliflower production. The treatments were 3 levels of depth and 4 levels of Urea Super Granule (USG) application at different days of interval. The effect of time on different yield contributing characters of cabbage, cauliflower and tomato were found significant. It was found that the higher head, curd and fruit yields were obtained from the combination of D_2T_2, i.e. 8 cm depth and 10 days after transplant (DAT) of USG application followed by 4 cm depth and 10 DAT. Similar trends were observed for weight of head with outer leaves, pericycle, head diameter, head weight, head yield of cabbage, curd of cauliflower, individual fruit weight, number of fruit/plant and fruit yield of tomato, respectively. The results revealed that optimum depth x time was 8 cm x10 DAT for maximizing the growth and yield of cabbage, cauliflower and tomato production in Tangail region.

Introduction

Nitrogen is the most deficient nutrient element in Bangladesh soil, in general, farmers of the country apply at least nitrogenous fertilizer to their crops for better yield. There are different types of nitrogenous fertilizers available in the market. Recently, Urea Super Granule (USG) has become available in the market and used in wetland rice as well as upland crops. It is believed that USG is more efficient than prilled urea in supplying N to crops as it is minimize loss by leaching and volatilization. USG is mostly used by farmers in boro rice and it is reported that 20-30 % nitrogen could be saved by using USG compared to prilled urea. During the last couple of years farmers in some parts of the country using USG in upland vegetables and fruit crops like brinjal, cabbage, cauliflower, tomato, papaya and banana. However, there is no recommendation of USG on upland crops, so far research findings in this regard are very scanty. Environment in wetland rice is quite different from upland condition and efficiency of USG in upland crops are yet to be ascertained. Recently OFRD, BARI, Tangail has established from their research that10-20 % less then recommended USG application was economically profitable in comparison to prilled urea in different vegetables such as potato, tomato, cabbage, cauliflower and brinjal. Most of the farmers apply USG in different times and depth in different vegetables. As a result applied N is not properly utilized for the growth and yield of vegetables. Proper time and placement depth of USG is the most important factor for the efficient use of N, maximum growth and yield of vegetables. In the context the experiment was designed with the following objectives-

i. To find out the optimum time and depth placement of USG
ii. To increase of N use efficiency and profitability of the farmers

Materials and Methods

The experiment was conducted at FSRD site, Palima, Tangail during 2003-2004 and in the medium highland under AEZ-8. The experiment consists of 3 levels of depth and 4 levels of time of USG application followed by split plot design with 6 replications. Treatments were as depth of placement (03) i.e., 04, 08 and 12 cm (D_1 = 04 cm, D_2 = 08 cm, D_3 = 12 cm) and time of application (04) i.e., 0, 10, 15 and 20 DAT (T_1= 0 DAT, T_2= 10 DAT, T_3=15 DAP, T_4= 20 DAT).The unit plot size was 4mx5m. Before conducting the field experiment soil samples were collected from each plot and its chemical analysis was done. Details about initial nutritional status of soils, crop management and fertilization are provided in appendix tables A, B and C. All fertilizers were applied on the basis of soil analysis value as per recommendation (FRG, BARC, 1997) during the final land preparation except USG. The USG was applied at 0,10 , 15 and 20 DAT as ring method 8 cm apart from plant stalk in different depth which were mentioned in appendix table E. The necessary crop management practices were done as an when necessary (appendix table-D). The data on different plant characters and yield components were collected from the sample of 10 plants selected at random in each plot and yield was recorded plot wise. Data were analyzed statistically using MSTATC package.

Results and Discussion

Cabbage

Head yield: The effect of depth and placement time of USG was found significant on yield and yield attributes (Table 3). The highest plant height was recorded from D_2T_2 treatment followed by D_1T_2. Number of outer leaves/plant was affected by the different time of USG application and depth. The maximum number of outer leaves/plant was recorded from the treatment combination D_2T_1 followed by D_1T_4. The lowest outer leaves/plant were produced by the treatment combination D_1T_3 .The highest head diameter was obtained from D_1T_2 which was followed by D_2T_2 . The lowest head diameter was recorded from the treatment combination D_1T_1. In case of pericycle of head, it was observed that the higher pericycle of head was obtained from D_1T_2 which was statistically similar to D_2T_2 , followed by D_2T_1 . The lowest pericycle of head was found in D_2T_4. The highest head yield (74.98t/ha) was obtained from D_2T_2 treatment combination which was followed by D_1T_2.

Table 1. Main effect of different depth of USG on the growth, yield and yield attributes of cabbage, 2003-04

Depth (cm)	Plant height (cm)	Number of outer leaves /plant(no.)	Head diameter (cm)	Pericycle of head(cm)	Head yield with outer leaves (t/ha)	Head yield (t/ha)
$D_{1(4)}$	21.03	12.27	21.20	70.85	80.03	66.04
$D_{2\ (8)}$	21.87	12.52	21.33	70.46	81.54	66.45
$D_{3\ (12)}$	20.82	12.4	21.30	70.63	81.19	61.56
LSD(0.05)	1.16	1.29	0.574	1.33	1.26	4.91
CV (%)	3.22	4.92	3.99	4.03	8.37	10.68

Table 2. Main effect of placement of time on the growth, yield and yield attributes of cabbage, 2003-04

Time of placement (Days)	Plant height (cm)	Number of outer leaves /plant (no.)	Head diameter (cm)	Pericycle of head (cm)	Head weight with outer leaves (t/ha)	Head yield (t/ha)
$T_{1(0)}$	21.42	12.66	21.15	71.33	82.70	67.90
$T_{2(10)}$	22.31	11.98	22.35	73.00	86.40	71.92
$T_{3\ (15)}$	20.69	12.12	21.06	69.40	79.53	62.22
$T_{4(20)}$	20.53	12.75	20.57	68.86	75.06	56.69
LSD(0.05)	0.67	0.60	0.84	1.45	6.70	6.84
CV (%)	3.22	4.92	3.99	4.03	8.37	10.68

Table 3. Interaction effects of Depth and Time on the growth, yield and yield attributes of Cabbage, 2003-04

Depth (cm) x Time(day)	Plant height (cm)	No. of outer leaves/plant	Head diameter (cm)	Pericycle of head (cm)	Head weight with outer leaves (t/ha)	Head yield (t/ha)
4 x 0	21.13	12.35	19.77	70.42	81.03	66.36
4 x 10	22.00	11.84	22.55	74.00	87.02	74.18
4 x 15	20.67	11.77	20.93	68.88	76.80	63.17
4 x 20	20.33	13.11	21.55	70.09	72.44	59.73
8 x 0	21.87	13.35	21.75	71.95	84.74	69.47
8 x 10	23.07	12.00	22.53	73.48	89.84	74.92
8 x 15	21.27	12.27	21.18	69.29	80.39	64.51
8 x 20	21.27	12.47	19.87	67.13	74.03	57.66
12 x 0	21.27	12.27	21.91	71.62	82.33	67.88
12 x 10	21.87	12.11	21.95	71.51	82.33	66.66
12 x 15	20.13	12.33	21.07	70.04	81.39	58.99
12 x 20	20.00	12.67	20.29	69.35	78.73	52.70
LSD(0.05)	1.17	1.04	1.47	2.51	11.62	11.85
CV (%)	3.22	4.92	3.99	4.03	9.04	4.92

Cauliflower

Curd yield: Curd yield was significantly influenced by different time of USG application. The highest yield (33.17 t/ha) was obtained from 10 DAT, which was significantly different from those obtained with others times of application. The lowest yield (28.63 t/ha) was obtained from the treatment T_4 where USG was placed at 20 DAT. The curd yield was not significantly influenced on different depth of placement of USG .Interaction effects was significant on different time of USG application and depth on yield .The significantly highest curd yield was produced by the 10 DAT with 8 cm depth of placement (Table 6).

The effect of USG application time was marked on yield and yield contributing characters of cabbage and cauliflower. It appeared that USG application time at 10 DAT might be optimum for maximizing the head and curd yield of cabbage and cauliflower with 8 cm depth of placement.

Table 4. Main effect of different depth of USG on the growth, yield and yield attributes of cauliflower, 2003-04

Depth (cm)	Plant height (cm)	No. of outer leaves	Curd wt. (kg/plant)	Curd yield with outer leaves (t/ha)	Curd yield (t/ha)
$D_{1(0)}$	55.95	19.82	0.43	48.64	30.86
$D_{2(08)}$	56.00	19.80	0.44	49.65	31.76
$D_{3(12)}$	56.33	19.57	0.42	48.73	29.59
LSD(0.05)	1.22	1.02	0.05	1.52	1.22
CV (%)	1.33	3.22	3.80	2.31	3.12

Table 5. Main effect of placement of time on the growth, yield and yield attributes of cauliflower, 2003-04

Time of placement (days)	Plant height (cm)	No. of outer leaves/plant (no.)	Individual curd weight (kg)	Curd yield with outer leaves (t/ha)	Curd yield (t/ha)
$T_{1\ (0)}$	56.44	19.67	0.44	50.82	31.81
$T_{2\ (10)}$	57.51	19.87	0.48	50.70	33.17
$T_{3\ (15)}$	55.18	19.89	0.41	47.69	29.21
$T_{4\ (20)}$	55.24	19.49	0.38	46.82	28.63
LSD(0.05)	0.73	0.63	0.03	1.32	0.94
CV (%)	1.33	3.22	3.80	2.31	3.12

Table 6. Interaction effects of Depth and Time of USG placement on the growth, yield and yield attributes of cauliflower, 2003-04

Depth (cm) x Time (day)	Plant height (cm)	No. of outer leaves/plant	Individual curd weight (kg)	Curd yield with outer leaves (t/ha)	Curd yield (t/ha)
4 x 0	55.80	20.20	0.45	50.49	32.59
4 x 10	56.80	20.07	0.49	51.60	33.45
4 x 15	56.07	20.00	0.40	46.66	29.13
4 x 20	55.13	20.00	0.38	45.80	28.39
8 x 0	56.60	19.80	0.47	50.86	32.96
8 x 10	57.53	19.80	0.51	51.85	33.95
8 x 15	54.67	19.67	0.42	48.26	29.34
8 x 20	55.20	19.60	0.39	47.65	28.63
12 x 0	56.93	19.47	0.41	51.11	29.87
12 x 10	58.20	19.47	0.46	48.64	32.10
12 x 15	54.80	19.33	0.41	48.14	29.13
12 x 20	55.40	19.33	0.39	47.03	28.88
LSD(0.05)	1.28	1.09	0.05	2.29	1.64
CV (%)	1.33	3.22	3.80	2.31	3.12

Tomato

Yield: Fruit yield was significantly influenced by depth and time of USG application. The highest yield (84.43 t/ha) was produced by 10 days after USG application which was significantly different from those obtain with others time of application. The lowest yield (66.72 t/ha) was obtained from 20 DAT of USG application (Table 8). The yield was also significantly influenced with depth of USG placement. The maximum yield was obtained from D_1 treatment i.e. 4 cm depth of USG , which was statistically identical to 8 cm depth where as the lowest yield was recorded in 12 cm depth. Fruit yield was also significantly influenced by the interaction of depth and time of application of USG. Significantly higher yield was obtained from 8cm depth and 10 days after transplant (DAT) which was statistically identical with 4 cm depth and 10DAT treatment. So, 10 days after transplant and 8 cm depth of USG placement is the best time for higher yield of tomato.

Table 7. Main effect of different depth of USG on the growth, yield and yield attributes of tomato, 2003-04

Depth (cm)	Plant height (cm)	No. of fruits /plant	Wt. of fruit (kg/plant)	Individual fruit weight (kg)	Fruit yield (t/ha)
$D_{1(0)}$	78.78	24.64	1.90	76.83	76.13
$D_{2(08)}$	79.73	25.39	1.96	77.33	76.05
$D_{3(12)}$	80.18	24.68	1.73	69.92	69.14
LSD(0.05)	2.38	0.71	0.55	3.17	4.49
CV (%)	3.06	1.91	3.19	2.72	5.97

Table 8. Main effect of placement of time on the growth, yield and yield attributes of tomato, 2003-04

Time of placement (days)	Plant height (cm)	No. of fruits /plant	Wt. of fruit (kg/plant	Individual fruit weight (g)	Fruit yield (t/ha)
$T_{1\ (0)}$	79.40	24.55	1.69	69.33	67.90
$T_{2\ (10)}$	80.30	26.79	2.16	80.89	84.43
$T_{3\ (15)}$	81.18	25.37	1.90	74.89	76.04
$T_{4\ (20)}$	77.38	22.89	1.68	73.67	66.72
LSD(0.05)	2.41	0.47	0.14	2.01	4.36
CV (%)	3.06	1.91	3.19	2.72	5.97

Table 9. Interaction effects of Depth and Time of USG placement on the growth, yield and yield attributes of cauliflower, 2003-04

Depth (cm) x Time (day)	Plant height (cm)	No. of fruits /plant	Wt. of fruit (kg/plant	Individual fruit weight (kg)	Fruit yield (t/ha)
4 x 0	78.93	24.33	1.71	70.00	68.35
4 x 10	79.40	26.55	2.14	81.67	85.91
4 x 15	80.93	25.22	1.95	76.33	78.13
4 x 20	75.87	22.44	1.79	79.33	72.14
8 x 0	81.93	24.77	1.80	73.67	72.11
8 x 10	78.80	27.55	2.44	89.00	91.15
8 x 15	81.07	26.00	1.90	74.00	76.17
8 x 20	77.13	23.22	1.68	72.67	64.75
12 x 0	77.33	24.55	1.58	64.33	63.24
12 x 10	82.70	26.27	1.91	72.00	76.23
12 x 15	81.53	24.89	1.84	74.33	73.82
12 x 20	79.13	22.99	1.58	69.00	63.26
LSD(0.05)	4.18	0.81	1.02	3.48	7.55
CV (%)	3.06	1.91	3.19	2.72	5.97

Appendix table A. Initial Soil test values of experimental plots of cabbage

Soil texture	%			K	µg/g soil			
	pH	OM	Total N	(meq /100g soil)	P	S	B	Zn
Sandy clay loam	5.8 S. acidic	1.72 Medium	0.15 Low	0.10 Low	5.20 Very low	13 low	0.188 Low	7.534 High

Appendix table B. Initial soil test values of the experimental plots of cauliflower

Soil texture	pH	%		µg / g soil				K
		OM	Total N	P	S	B	Zn	meq /100 g soil
Sandy clay loam	5.9	1.75 Medium	0.061 Very low	5.22 Very low	14 Low	0.190 Low	8.00 Very high	0.12 Low

Appendix table C. Initial soil test values of the experimental plots of tomato

Soil texture	PH	OM (%)	N (%) (Total)	P (µg/g)	K (meq/100g)	S (µg/g)	B (µg/g)	Zn (µg/g)
Sandy clay loam	6.14 Sl. acidic	1.72 Medium	0.09 V. low	21.23 Medium	0.09 Very Low	9.05 Low	1.58 Very high	1.26 Medium

Appendix table D. Crop management

Crop	Variety	Spacing	Planting time	Harvesting time	Irrigation (no.)	Weeding (no.)	Pesticide
Cabbage	Atlas-70	60cm x 60cm	22, October/04	Last week of December	01	3	Dithane M-45
Cauliflower	Milkway	60cm x 60 cm	22,October/04	2nd week of January	01	4	Acrobat MZ
Tomato	BARI tomato-8	60cm x 40cm	25,October/04	2nd week of February	01	02	Dithane M-45,

Appendix Table E. Fertilization

Crop	Fertilizer rate (kg/ha) N-P-K-S + CD	Application Method
Cabbage	152-56-162-13 + 3000	10 balls of USG (1 g/ball) was applied as ring method 8cm apart from the plant at 0, 10, 15 and 20 DAT in 3 levels of depth viz. 04 cm, 08 cm and 12 cm
Cauliflower	97-50-80-10 + 3000	8 balls of USG (1 g/ball) was applied as ring method 8 cm apart from the plant at 0, 10, 15 and 20 DAT in 3 levels of depth viz. 04 cm, 08 cm and 12 cm
Tomato	155 -21-163-37	8 balls of USG (1 g/ball) was applied as ring method 8 cm apart from the plant at 0, 10, 15 and 20DAT in 3 levels of depth viz.04 cm, 08 cm and 12 cm

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EFFECT OF VARIETY AND NITROGEN FERTILIZER MANAGEMENT ON THE YIELD OF OKRA AT SHIBPUR MLT SITE, NARSINGDI

Abstract

An experiment was carried out at farmers' field of Shibpur MLT site, Narsingdi during kharif 2003 to find suitable variety of okra and efficient management of N for its profitable cultivation. The experiment was laid out in Spilt plot design with 4 dispersed replication. Two okra varieties namely, BARI Dheros-1 and local were assigned to main plots and sub-plots received six treatments with N source viz. N_1) Recommended dose of N as prilled urea (broadcast), N_2) Recom. dose of N as prilled urea (ring placement), N_3) 10%<Reco. dose of prilled urea (ring placement), N_4) Recom. dose of N as USG; N_5) 10%<Recom. dose of N as USG and; N_6) Farmers' dose. There was no significant difference between the two varieties but N management significantly affected yield and yield attributes. Interaction of variety and N management was also significant. Variety BARI Dheros-1 with recommended dose of N as USG produced significantly higher yield (30.06 t/ha) which was statistically similar to recommended dose of N applied as prilled urea in ring placement with same variety. Cost benefit analysis showed that variety BARI Dheros-1 with recommended dose of N as USG provided highest benefit-cost ratio.

Introduction

Narsingdi district is well known for growing vegetables and fruits. It has diversified land type belonging to AEZ-9. About 10 thousand hectares of land of the district is under vegetable cultivation and rabi vegetables are grown in 6000 hectares of land (source: DAE, Narsingdi). Okra is one of the major kharif crops grown in this area. But, in the recent years farmers are not getting better yield of okra. The variety and/or nutrient management might be the probable causes for lower yield. Besides, local variety is very much susceptible to YMV disease. There is a need to replace the local variety with a YMV resistant variety. Again, it has been observed that they do not grow same vegetables in the same land every year. Thus farmers have to apply fertilizers individual crop basis though type and amount of fertilizers varies widely for particular crop. Nitrogen is highly deficient in most of the soils in Bangladesh and also in Narsingdi. So farmers should apply at least N to each crop. Nitrogen management alone can increase yield of a crop substantially but use of higher dose of N is harmful to environment. So, there was a need to verify whether variety or N management is responsible for lower yield of okra. The present study was thus designed to achieve the following objectives.

i. To find out appropriate variety of okra
ii. To determine efficient management of N for profitable production of okra

Materials and Methods

The experiment was conducted at farmers' field of Shibpur Multi Location Testing (MLT) site, Narsingdi during kharif 2003. The land was medium high with sandy loam soil belonging to AEZ 9. The experiment was laid out in Spilt Plot design with 4 dispersed replications. Size of unit plot was 4m x 3m. Two okra varieties (BARI Dheros1 and local) were assigned to main plots whereas sub-plots received six N management treatments viz. N_1) Recommended dose of N as prilled urea (broadcast), N_2) Recom. dose of N as prilled urea (ring placement), N_3) 10% <Recom. dose of N as prilled urea (ring placement), N_4) Recom. dose od N as USG; N_5) 10%<Recom. N as USG and; N_6) Farmers' management. The recommended fertilizer dose for okra as calculated based on soil test value (IPNS perspective) was 138-24-60-12-16-4000 kg N-P-K-Mg-S-CD/ha and farmers' dose 173-38-62-5000 kg N-P-K-CD/ha. All of Cow dung (CD), P, K, Mg and S were applied at the time of final land preparation. Prilled urea (broadcast) was applied as top dress in three equal splits at 21, 35 and 55 DAS. In case of prilled urea (ring method), placements were done twice at 21 and 35 DAS in rings

made 17.5 - 25 cm apart from each plant and 12.5 cm deep in the soil. USG was applied once at 21 DAS at 17.5- 25.cm apart from each plant and dibbled 12.5 cm deep in the soil. Seeds were sown during 24-29 March 2003. Weeding was done at 15, 35 and 55 DAS. Pesticide was applied as per recommendation at 30 and 60 Das. The crop was harvested during 15 May to 7 July 2003. Yield attributes were collected from 5 randomly selected plants and analyzed statistically. Market price of the crop was recorded at each harvest to calculate economics.

Results and Discussions

Effect of Variety: There was no significant difference between two varieties of okra under study with respect to yield and yield attributes. But higher number of fruits/plant and weight of individual fruit and fruit yield/plant was obtained from BARI Dheros-1 (Table 1).

Effect of nitrogen management: All of the yield attributes were significantly affected by nitrogen management treatments except plant population/plot. Significantly tallest plant was obtained from N_4. The treatments N_1, N_2 and N_6 produced identical and medium where lower plant height was recorded from N_3 followed by N_5. Branches/plant was recorded higher from treatment N_4 but statistically identical to N_1 and N_2. The highest fruits/plant was obtained from treatment N_4 which was statistically different from other treatments. Treatments N_4, N_2 and N_1 showed similar fruit length and higher than other treatments. But higher individual fruit weight was obtained fro N_4 followed by N_2. Statistically highest fruit yield/plant was recorded from N_4 whereas N_3 & N_5 showed similar and lowest fruit yield/plant. Highest fruit yield was obtained from recommended dose of N as USG (T_4) which might be due to higher no. of branches/plant, fruits/plant, individual fruit wt. and fruit yield/plant.

Interaction between variety and fertilizer: Plant height, plant population, yield and yield attributes were significantly influenced by interaction of variety and nitrogen management. Significantly highest plant height was obtained from V_1N_4 and the same treatment produced significantly highest number of fruits/plant. Individual fruit weight was higher from treatment V_1N_2 but statistically at par to V_1N_4. Similar trend was followed incase of fruit yield/plant. Thus V_1N_4 gave the highest fruit yield (30.06 t/ha) which was statistically similar to V_1N_2. Local variety failed to produce higher yield than BARI Dheros-1 and also yield attributes were lower in local variety irrespective of N-management.

Economic Performance:

The highest gross return was obtained from variety BARI Dheros-1 with recommended dose of fertilizer of N as USG (V_2N_4). The same variety with recommended dose of N as PU (V_1S_2) produced second highest gross return. Local variety failed to produce higher gross return than BARI Dheros-1 in all treatments. Similar trend was followed incase of gross margin. Though higher cost was involved in local variety of farmers' management due to use of higher dose of fertilizers but failed to show higher return. The variety BARI Dheros-1 with recommended dose of N as USG showed higher benefit-cost ratio than all other treatments. But, recommended dose of N as prilled urea (ring placement) with same variety followed the second highest BCR.

Farmer's Reaction

Farmers preferred variety BARI Dheros-1 as it gave higher yield than local variety. Besides, plants of variety BARI Dheros-1 were less susceptible to YMV disease.

Conclusion

One year result showed that the okra variety BARI Dheros-1 performed better than Local. Variety BARI Dheros-1 produced significantly higher yield and benefit-cost ratio. USG or prilled urea (ring placement) showed more benefit than broadcast prilled urea with respect to yield and BCR

Table 1. Effect of variety on the yield and yield attributes of okra at Shibpur MLTsite, Narsingdi during kharif 2003

Treatment	Plant pop^n./12 m^2	Plant height (cm)	Branches/ plant (No.)	Fruits/ plant (No.)	Length of fruit (cm)	Individual fruit wt. (g)	Fruit yield/ plant (g)	Yield (t/ha)
V_1	71	1.73	2.6	25	13.9	17.7	444	26.25
V_2	71	1.67	2.4	22	13.0	16.2	354	20.95
LSD $_{(.05)}$	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Effect of N management on the yield and yield attributes of okra at Shibpur MLT site, Narsingdi during kharif 2003

Treatment	Pop^n (12 m^2)	Plant height (cm)	Branches /plant (No.)	Fruits /plant (No.)	Fruit length (cm)	Individual fruit wt. (g)	Fruit yield/ plant (kg)	Fruit Yield (t/ha)
N_1	71	1.72b	2.6ab	23cd	13.8a	17.2b	396c	23.33c
N_2	71	1.71b	2.6ab	24b	13.9a	18.3a	435b	25.56b
N_3	71	1.60c	2.3c	22cd	13.2b	16.4c	363d	21.87d
N_4	71	1.82a	2.7a	25a	14.1a	18.1a	464a	27.38a
N_5	72	1.63c	2.3c	22d	12.7c	15.6d	350d	20.58e
N_6	71	1.71b	2.5b	23bc	13.2b	16.7c	388c	23.03c
LSD $_{(.05)}$	0.79	0.06	.012	1.15	0.05	0.55	20.99	1.36

Table 3. Interaction between variety and N management on the yield and yield attributes of okra at Shibpur MLT site, Narsingdi during kharif 2003

Treatment	Population (12 m^2)	Plant height (cm)	Branches/ plant (No.)	Fruits/ plant (No.)	Fruit length (cm)	Individual fruit wt. (g)	Fruit yield/ plant (kg)	Fruit yield (t/ha)
V_1N_1	71.0ab	1.74bcd	2.6ab	24.2cd	14.6a	18.22b	443b	26.14b
V_1N_2	71.3ab	1.74bcd	2.6cd	25.5b	14.1ab	19.29a	486a	28.79a
V_1N_3	71.3ab	1.63fgh	2.4cd	23.4d	13.8b	17.16c	398cd	24.19c
V_1N_4	71.0ab	1.86a	2.8a	27.0a	14.6a	18.86a	513a	30.06a
V_1N_5	70.5b	1.64fg	2.6ab	23.6d	13.0cde	16.36d	388cd	22.49d
V_1N_6	71.5ab	1.76bc	2.6ab	24.9bc	13.6bcd	17.44c	439b	26.07b
V_2N_1	71.8a	1.71cdf	2.5bc	21.2ef	12.9def	16.15de	349e	20.52e
V_2N_2	70.5b	1.69def	2.5bc	22.1f	13.7bc	17.38c	384d	22.31d
V_2N_3	71.5ab	1.57h	2.3d	21.4ef	12.6ef	15.61e	328ef	19.54ef
V_2N_4	71.0ab	1.79b	2.6ab	23.8cd	13.7bcd	17.28c	416bc	24.71bc
V_2N_5	72.0a	1.62g	2.3d	20.1f	12.3f	14.91f	312f	18.68f
V_2N_6	71.0ab	1.67efg	2.4cd	21.1ef	12.8ef	15.93de	337ef	19.97ef
LSD $_{(.05)}$	1.12	0.07	0.18	1.15	0.71	0.55	29.69	1.92

Table 4. Economics of okra as affected by variety and N management at Shibpur MLT site, Narsingdi during kharif 2003

Treatment	Gross return (Tk/ha)	TVC (Tk/ha)	Gross Margin (Tk/ha)	Benefit-Cost Ratio
V_1N_1	78420	8839	69581	8.87
V_1N_2	86370	8839	77531	9.77
V_1N_3	72570	8764	63806	8.28
V_1N_4	90180	8839	81341	10.20
V_1N_5	67470	8764	58706	7.69
V_1N_6	78210	11229	66931	6.93
V_2N_1	61560	8839	55721	6.96
V_2N_2	66930	8839	58091	7.57
V_2N_3	58620	8764	49856	6.69
V_2N_4	74130	8839	65291	8.39
V_2N_5	56010	8764	47276	6.39
V_2N_6	59910	11229	68601	5.31

Market price of Okra = Tk 3.00/kg

EFFECT OF VARIETY AND NITROGEN FERTILIZER MANAGEMENT ON THE YIELD OF TOMATO AT NARSINGDI

Abstract

An experiment was carried out at farmers' field of Shibpur MLT site, Narsingdi during two consecutive rabi season of 2002-03 & 2003-04 to select appropriate variety of tomato and also determine efficient management of nitrogen for growing tomato. Two tomato varieties BARI Tomato-2 (Ratan) and BARI Tomato-8 (Shila) were assigned to main plots and sub-plots received six treatments with N management viz. S_1) Recommended dose of N as prilled urea (broadcast), S_2) Recom. dose of N as prilled urea (ring placement), S_3) 10%<Recom. dose of prilled urea (ring placement), S_4) Recom. dose of N as USG; S_5) 10%< Recom. dose of N as USG and; S_6) Farmers' dose. The variety Shila gave significantly highest yield than Ratan. Nitrogen management treatments significantly affected yield and yield attributes of tomato irrespective of variety. Higher yield was obtained from the variety Shila with recommended dose of N as USG which was statistically similar to recommended dose of N applied as prilled urea in ring placement with same variety. Cost and return analysis showed that variety Shila with recommended dose of N as USG provided highest benefit-cost ratio.

Introduction

Narsingdi district is well known for growing vegetables and fruits. It has diversified land type belonging to AEZ-9. About 10 thousand hectares of land of the district is under vegetable cultivation and rabi vegetables are grown in 6000 hectares of land (source: DAE, Narsingdi). Farmers grow vegetables in medium high land having cropping pattern Jute-Fallow-Vegetable. But farmers do not grow same vegetables in the same land every year. Farmers apply fertilizers to individual crop but type and amount of nutrient varies for particular crop. This may affect crop yield and soil health as well. Particularly farmers use higher dose of N which is harmful to environment. Tomato is one of the major winter crops grown here. A production programme was conducted on BARI released tomato varieties BARI Tomato-2 and BARI Tomato-3 during 1996-97. Both the varieties gave remarkably higher yield than the local variety and farmers accepted those varieties. But in the recent years farmers are not getting potential yield of tomato. So, there was a need to check whether variety or nutrient management is responsible for lower yield of tomato. The present study was thus designed to achieve the following objectives.

Objectives:

iii. To select appropriate variety of tomato
iv. To determine efficient management of N for profitable production of Tomato

Materials and Methods

The experiment was conducted at farmers' field of Shibpur Multi Location Testing (MLT) site, Narsingdi in two consecutive rabi season of 2002-03 & 2003-04. The land was medium high with sandy loam soil belonging to AEZ 9. The initial soil fertility status (Table-1) was determined by collecting soil samples from each replication and analyzed in the SSD laboratory, BARI, Gazipur. The experiment was laid out in Spilt Plot Design with 4 dispersed replications. The unit plot size was 4m x 3m. Two tomato varieties viz. V_1= BARI Tomato 2 (Ratan) and V_2= BARI Tomato 8 (Shila) were assigned to main plots whereas sub-plots received six N management treatments viz. S_1) Recommended dose of N as prilled urea (broadcast), S_2) Recom. dose of N as prilled urea (ring placement), S_3) 10% <Recom. dose of N as prilled urea (ring placement), S_4) Recom. dose od N as USG; S_5) 10%<Recom. N as USG and; S_6) Farmers' management. About 30-day old seedlings were planted at 60 cm x 40 cm. On last week of October in the 1st year, while 2nd week of November in the 2nd year. The recommended fertilizer dose for Tomato as calculated based on soil test value (IPNS

perspective) was 175-20-22-12-30-2-5000 kg N-P-K-Mg-S-B-CD/ha and farmers' dose 81-42-45-5000 kg N-P-K-CD/ha. All of Cow dung (CD), P, K, Mg, S and B were applied at the time of final land preparation. Prilled urea (broadcast) was applied as top dress in two equal splits at 15 and 35 DAT. In case of prilled urea (ring method), placements were done twice at 15 and 35 DAT in rings made 17.5 - 25 cm apart from each plant and 7.5 cm deep in the soil. USG was applied once at 15 DAT at 17.5- 25.cm apart from each plant and dibbled 12.5 cm deep in the soil. Two irrigation were applied following top dress of N. Pescticides like Dithane M-45, Rovral and Ridomil were applied as per recommendation. Earthing up was done about 1 month after transplanting. The crop was harvested during February to March of the following year. Yield attributes were collected from 5 randomly selected plants and analyzed statistically. Market price of the crop was recorded at each harvest to calculate cost and return.

Results and Discussions

Analysis of soil samples showed that soil pH is close to neutral and organic matter content of soil is moderate. Soil was very low in N but P and K content was medium. Mg, S and B were at or below critical level.

Effect of Variety: All the characters except fruits/clusters were significantly affected by variety in both the years. The variety Shila showed significantly highest plant height. Significantly highest yield was obtained from Shila due to higher number of fruit clusters/plant and the highest individual fruit weight and fruit yield /plant.

Effect of nitrogen management: Plant height, yield and all yield attributes were significantly affected by nitrogen management treatments. Treatments S_2 and S_4 were statistically identical in respect of plant height in both years and produced significantly higher plant height than other treatments except S_1 in the 1st year (Table 2). Fruit clusters per plant were statistically identical. Significantly highest individual fruit wt. and fruit yield/plant were recorded from S_4 which were statistically identical to S_2. Highest fruit yield was obtained from treatment S_4 (recommended dose of N as USG) which was statistically similar to treatment S_2 (recommended dose of N as prilled urea with ring placement) due to higher fruit wt. and fruit yield/plant. Farmers' management produced lowest yield as most of the yield attributes performed lowest in this treatment which might be due to use of lower dose of nitrogen.

Interaction between variety and fertilizer: Each of the yield attributes and fruit yield along with plant height was significantly influenced by variety and nitrogen management interaction. The variety Shila produced higher plant height with recommended dose of USG (S_4) which was statistically similar to S_2 and S_1. Higher number of fruit clusters/plant was obtained from treatments V_1S_2, V_1S_4, V_2S_2 and V_2S_4. The variety Shila showed higher no. of cluster/plant in all nitrogen management treatment than variety Ratan. Higher individual fruit weight and fruit yield/plant showed in variety Shila with recommended dose of N as USG (S_4) that was at par to S_2 in same variety. In both the years, variety Shila gave higher fruit yield with recommended dose of N as USG (S_4) and statistically identical yield of the same variety with recommended dose of N as prilled urea with ring placement (S_2). In case of variety Shila, recommended dose of N as USG produced 8.5% higher yield than recommended dose of N as prilled urea (broadcast) which is currently used. The farmer's dose showed 27% less yield than recommended dose of N as USG with same variety. Reduction of N (10%) as USG or prilled urea (ring placement) reduced yield than recommended dose of N.

Cost and Return Analysis

Variety Shila produced higher economic return than Ratan in all fertilizer treatments in both the years. Highest gross return and gross margin was obtained from variety Shila with recommended dose of nitrogen as USG (V_2S_4) which was close to V_2S_2.. However, the variety Shila with recommended dose of N as USG showed higher benefit-cost ratio closely followed by recommended dose of N as prilled urea (ring placement) with same variety.

Farmer's Reaction

Farmers preferred variety Shila as it gave higher yield than Ratan. The other reasons they mentioned that plants of variety Shila was more strong and stout and more resistant to diseases. But the germination percentage of Shila was to some extent lower compared to Ratan.

Conclusion

Two years result showed that the tomato variety Shila performed better than Ratan. Again, Shila produced higher yield and benefit cost ratio with recommended dose of N as USG or recommended dose of N as prilled urea (ring placement).

Table 1. Effect of variety on the yield and yield attributes of Tomato at Shibpur MLT site, Narsingdi during rabi 2002-03 & 2003-04

Treat ment	Plant height (cm)		Fruit cluster /plant (no.)		Fruits/ clusters (no.)		Individual fruit wt. (g)		Fruit yield/ plant (kg)		Fruit yield (t/ha)		
	Y-1	Y-2	Y-1	Y2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Mean
Ratan	61.3	71.5	7.1	9.5	2.9	3.3	70.5	68.3	1.77	1.99	62.39	69.61	64.50
Shila	83.9	90.1	9.4	9.6	2.6	3.2	78.5	73.1	1.96	2.24	70.36	78.09	74.23
$LSD_{.05}$	11.6		1.6		ns		ns		ns		6.20		

Y-1= Year 2002-03; Y-2= Year 2003-04

Table 2. Effect of N management on the yield and yield attributes of Tomato at Shibpur MLT site, Narsingdi during rabi 2002-03 & 2003-04

Treat-ment	Plant height (cm)		Cluster/ plant (no.)		Fruits/ clusters (no.)		Individual fruit wt. (g)		Fruit yield/ plant (kg)		Fruit yield (t/ha)		
	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Mean
S_1	74.5	81.6	8.7	9.6	2.9	3.2	77.0	70.39	1.92	2.09	68.65	74.63	71.64
S_2	74.4	84.0	8.6	9.8	2.9	3.3	80.6	76.74	2.01	2.32	71.17	78.94	74.74
S_3	71.9	78.9	8.3	9.4	2.8	3.2	72.5	67.74	1.81	1.99	64.73	71.87	68.30
S_4	74.7	84.8	8.4	9.9	2.8	3.4	82.9	78.61	2.07	2.41	73.31	80.98	77.15
S_5	71.0	79.1	7.9	9.5	2.7	3.2	69.1	66.35	1.73	2.10	62.35	72.33	67.34
S_6	69.3	76.4	7.7	9.2	2.6	3.2	65.0	64.46	1.63	1.80	57.90	65.61	61.76
$LSD_{.05}$	1.37	2.15	0.3	0.2	NS	NS	2.41	1.83	0.06	0.09	3.31	2.33	

Table 3. Interaction between variety and N management on the yield and yield attributes of Tomato at Shibpur MLT site, Narsingdi during rabi 2002-03 & 2003-04

Treat-ment	Plant height (cm)		Fruit cluster/ plant (no.)		Fruits/ clusters (no.)		Individual fruit wt. (g)		Fruit yield/ plant (kg)		Fruit yield (t/ha)		
	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Mean
V_1S_1	62	72	7.5	9.5	3.15	3.3	73.5	67.3	1.82	2.0	65.23	70.56	67.89
V_1S_2	62	75	7.5	9.7	3.20	3.3	70.8	72.5	1.91	2.1	66.73	74.94	70.84
V_1S_3	61	69	7.1	9.3	3.00	3.2	67.5	66.1	1.68	1.8	59.06	67.68	63.37
V_1S_4	63	75	7.3	9.9	2.90	3.5	78.8	74.8	1.97	2.2	68.05	76.21	72.13
V_1S_5	60	69	6.8	9.4	2.85	3.3	65.3	65.3	1.65	2.0	59.99	68.03	64.01
V_1S_6	59	68	6.6	9.2	2.75	3.2	61.5	63.7	1.57	1.7	54.93	62.73	58.83
V_2S_1	87	91	9.8	9.7	2.80	3.2	80.5	73.5	2.02	2.2	72.76	78.70	75.73
V_2S_2	87	93	9.8	9.8	2.70	3.3	84.5	80.9	2.11	2.5	75.60	82.94	79.27
V_2S_3	88	88	9.5	9.5	2.63	3.1	77.5	69.4	1.94	2.1	70.30	76.06	73.18
V_2S_4	86	94	9.5	9.9	2.63	3.4	87.0	82.4	2.18	2.6	78.56	85.75	82.16
V_2S_5	82	89	9.1	9.5	2.50	3.2	73.0	67.4	1.81	2.2	64.70	76.63	70.67
V_2S_6	79	85	8.8	9.2	2.4	3.1	68.5	65.2	1.69	1.9	60.87	68.50	64.69
$LSD_{(.05)}$	1.2	1.9	0.3	0.12	0.12	0.1	2.95	2.58	0.07	0.1	4.06	3.29	
CV(%)	1.0	1.7	3.9	2.84	2.90	2.8	2.70	2.53	2.60	4.2	4.20	3.08	

Table 4. Average cost and return of tomato as affected by variety and N management at Shibpur MLT site, Narsingdi during rabi 2002-03 & 2003-04

Treatment	Gross return (Tk/ha)	Total Variable Cost (Tk/ha)	Gross Margin (Tk/ha)	Benefit-Cost Ratio
V_1S_1	566203	78285	487918	7.23
V_1S_2	590806	78460	512346	7.53
V_1S_3	528506	78195	450311	6.76
V_1S_4	601564	78460	523104	7.67
V_1S_5	533843	78195	455648	6.83
V_1S_6	490642	78639	412003	6.24
V_2S_1	631588	78285	553303	8.07
V_2S_2	661112	78460	582652	8.43
V_2S_3	610321	78195	532126	7.81
V_2S_4	685214	78460	606754	8.73
V_2S_5	589388	78195	511193	7.54
V_2S_6	539515	78639	460876	6.86

Average price of tomato = Tk 8.34/kg

Appendix table 1. Analytical data of initial soil sample 2002-03

Sample	pH	OM %	Ca	Mg	K	Total N %	P	S	Cu	Fe	Mn	Zn	B
			meq/100ml				µg / ml						
1.	5.5	1.12	3.9	.80	.28	.059	10	15	3.0	248	7.8	3.4	0.20
2.	5.8	1.26	3.5	.68	.30	.067	18	11	5.2	287	18.6	6.0	0.22
Mean	5.7	1.19	3.7	0.74	.29	.063	19	13	4.1	268	13.2	4.7	0.21
Critical level			2.0	0.8	0.2		14	14	1.0	10.0	5.0	2.0	0.20

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EFFECT OF PLANT SPACING AND FERTILIZER ON THE YIELD OF POTATO AT MUNSHIGANJ

Abstract

The experiment was conducted at Munshiganj during the Rabi season of 2003-04 to evaluate the effect of different fertilizer packages with different spacing on the yield and to find out the optimum and economic dose fertilizer and plant spacing for Potato at Munshiganj. The experiment was laid out in split plot design with plant spacing in main plot and fertilizer doses in sub plots with six dispersed replications. STB fertilizer dose for MYG and HYG and IPNS for MYG and HYG along with farmers' practice and no fertilizer were tested against recommended (60 x 20 cm) and farmers' spacing (30 x 15 cm). Results revealed that significantly higher tuber yield of Potato was recorded from farmers' spacing due to higher plant population. But weight of tuber/plant was higher in recommended spacing. Among the fertilizer packages, IPNS for HYG (T4) produced higher yield, however, it was identical to farmers' dose (T5). Interaction effect of spacing and fertilizer dose was insignificant. But the highest tuber yield was recorded from IPNS for HYG with farmers' spacing. Regarding cost and return analysis the highest gross margin was found in the same combination. Generally, higher MBCR was found in recommended spacing irrespective of fertilizer doses. Due to higher seed and fertilizer cost gross margin as well as MBCR was the lowest in farmers' fertilizer dose with farmers' spacing.

Introduction

Munshiganj is one of the leading Potato growing areas in Bangladesh. Farmers' grow Potato as a cash crop and usually applied a very high dose of chemical fertilizers. Previous survey reveals that the farmers' of Munshiganj applied 400-250-400 kg/ha of NPK in Potato which is extremely higher than present national recommendation. Previous research works showed that 120-10-40 kg/ha of NPK along with CD @ 10 t/ha produced similar yield with farmers' dose. Excessive and continuous use of chemical fertilizers is also detrimental for soil health and environment. The farmers' did not apply any organic fertilizer in Potato, however, a response of cowdung was found in previous study. Due to unavailability of cowdung as organic manure other sources of organic manure could be explore. Poultry manure is now available because of rapid expansion of poultry farm in greater Dhaka. Application of organic manure will improve soil fertility for sustainable crop production and reduce undesirable effects in soil as a consequence of high dose of chemical fertilizers.

Optimum plant population is also very important factor for higher yield of Potato. Farmers' of Munshiganj usually grow Potato in closer spacing. Average plant spacing followed by farmers' is 30 x 10 cm against recommended spacing of 60 cm x 20 cm. Therefore, plant population is much higher in farmers' practice. Farmers' belief that higher plant population and higher fertilizer dose is responsible for higher yield. Therefore, recommended and farmers' spacing needs to be verified against different fertilizer packages for higher yield and profit.

Objectives

1. To evaluate the effect of different fertilizer packages with different spacing on the yield of Potato
2. To find out the optimum and economic dose fertilizer and plant spacing for Potato

Materials and Methods

The experiment was carried out at farmers' field of Munshiganj MLT site to evaluate the effect of different fertilizer packages with different spacing on the yield of potato during rabi 2003-04. The experiment was laid out in split-plot design with six dispersed replication. Two plant spacings- i. Recommended spacing (60cm x 20cm) and ii. Farmers spacing (30cm x 15cm) was given in the main plot. Six different fertilizer packages- STB fertilizer dose for MYG (T_1) and HYG (T_2), IPNS based fertilizer for MYG (T_3) and HYG (T_4), Farmers dose (T_5) and no fertilizer (T_6) was given in the sub-plot. Seed rate was 1250 and 2700 kg/ha for recommended spacing and farmers spacing, respectively. Intercultural operations were done as and when necessary. Potato variety `Diamont' was grown on 1st week of December 2003 and harvested on 2nd week of March 2004.

Treatment (Fertilizer dose (kg/ha) for Potato)

Treatment	N	P	K	S
T_1 = Soil test based fertilizer dose for MYG	95	10	40	10
T_2= Soil test based fertilizer dose for HYG	135	15	60	15
T_3= IPNS based fertilizer dose for MYG	70	0	24	10+ 2.5 t/ha PM
T_4= IPNS based fertilizer dose for HYG	110	0	45	15 + 2.5 t/ha PM
T_5= Farmers dose (Avg. of 25-30 farmers)	370	150	350	0
T_6 = No fertilizer	0	0	0	0

PM (Well decomposed poultry manure) applied one week before planting.

Results and discussion

Effect of plant spacing: Effect of plant spacing on the yield of Potato is given in Table 1. Results showed that the farmers' spacing produced significantly higher tuber yield of Potato over recommended spacing. In farmers' spacing the plant population was 22.22 plants/m^2 which was about 2 and half times higher than plant population of recommended spacing (8.33 plants/m^2). Higher yield obtained in farmers' spacing is due to higher plant population. Weight of tuber/plant also varied significantly. But the trend was just reverse to tuber yield. Significantly higher tuber wt./plant was recorded from recommended spacing. Tuber weight/plant increased with the increase of plant spacing. However, wt. of tuber/plant was higher in recommended spacing but due to higher plant population tuber yield/ha was higher in farmers' spacing.

Effect of fertilizer: Effect of different fertilizer packages on the yield of Potato is shown in Table 2. Tuber yield varied significantly among the treatments. Higher yield of Potato was obtained in IPNS based fertilizer dose for HYG (T_4) that was also identical to Farmers practice (T_5). A considerable response of poultry manure applied in IPNS treatments (T_3 and T_4) was evident. Tuber yield increased appreciably in IPNS treatments over STB inorganic fertilizer dose for MYG and HYG (T_1 and T_2). On an average 2.2 t/ha higher yield was recorded from IPNS over only inorganic fertilizers. Farmers' of Munshiganj traditionally apply a very high dose of inorganic fertilizers in Potato. But the yield was not higher than STB recommended fertilizer.

Spacing x fertilizer interaction: Effect of spacing x fertilizer interaction on the tuber yield of Potato is given in Table 3. However, the interaction was insignificant but the highest tuber yield (35.4 t/ha) was recorded from IPNS for HYG at farmers spacing followed by Farmers' dose at Farmers' spacing. Generally, all the fertilizer packages produced higher yield at farmers' spacing over recommended spacing mainly due to population effect. The lowest yield (14.0 t/ha) was obtained from no fertilizer treatment with recommended spacing.

Cost and return analysis

Cost and return analysis was done from spacing x fertilizer interaction. The highest gross return as well as gross margin was obtained from IPNS for HYG with Farmers' spacing due to higher yield. Variable cost (seed and fertilizer) was the highest in Farmers' fertilizer dose with farmers' spacing. Farmers usually apply a very high dose of inorganic fertilizer in Potato with a very close spacing that increased the variable cost. However, the second higher gross margin was obtained from IPNS for HYG with recommended spacing and STB fertilizer dose for HYG with Farmers' spacing. Due to higher seed and fertilization cost gross margin was the lowest in Farmers' dose with farmers, spacing.

MBCR is generally much higher in recommended spacing irrespective of fertilizer doses. The highest MBCR over no fertilizer with recommended spacing was found in IPNS for MYG with recommended spacing. With Farmers' spacing the highest MBCR was obtained from IPNS for HYG.

Conclusion

From the above result that IPNS based fertilizer for HYG gave higher yield as well as gross margin irrespective of plant spacing. The experiment was completed for 1st year and it will be verified for another 2 years with some modification for sound recommendation.

Table 1. Effect of plant spacing on the yield of Potato at Munshiganj during 2003-04

Spacing (cm)	Wt. of tuber /plant (g)	Tuber yield (t/ha)	Plant pop./m^2	Plant pop./ha
Recom. (60 x 20)	349 a	22.9b	8.33	83300
Farmers (30 x 15)	274 b	30.3a	22.22	222200

Table 2. Effect of different fertilizer doses on the yield of Potato at Munshiganj during 2003-04

Treatment	Tuber yield (t/ha)
T_1 = Soil test based fertilizer dose for MYG	26.2c
T_2= Soil test based fertilizer dose for HYG	28.2b
T_3= IPNS based fertilizer dose for MYG	27.9bc
T_4= IPNS based fertilizer dose for HYG	30.9a
T_5= Farmers dose (Avg. of 25-30 farmers)	28.9ab
T_6 = No fertilizer	17.7d

Table 3. Cost & return analysis of Potato affected by spacing and fertilizer doses at Munshiganj during 2003-04

Treatment	Variable cost (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	MBCR
S1xT_1	25485	117000	91514	15.7
S1xT_2	26880	125500	98620	12.7
S1xT_3	26622	125000	98378	13.3
S1xT_4	27660	131500	103840	11.9
S1xT_5	44860	118500	73640	2.17
S1xT_6	22500	70000	47500	-
S2xT_1	51585	144500	92915	2.56
S2xT_2	52980	156000	103020	2.82
S2xT_3	52722	153500	100778	2.76
S2xT_4	53760	177000	123240	3.42
S2xT_5	70960	170000	99040	2.06
S2xT_6	48600	107000	58400	1.41

Variable cost = Seed + fertilizer cost.
MBCR was done over control with recommended spacing.

Appendix table 1. Initial soil status of the experimental plots of Potato at Munshiganj

SL.	Soil Characteristic	Status	SL.	Soil Characteristic	Status
1.	pH	4.3	7.	P (Micro gram g^{-1} soil)	16.3 (M)
2.	OC (%)	1.09	8.	S (Micro gram g^{-1} soil)	31.8 (H)
3.	Ex. Mg (m eq/100g soil)	1.84 (H)	9.	Zn (Micro gram g^{-1} soil)	3.15 (VH)
4.	K (m eq/100g soil)	0.15 (L)			
5.	Ex. Ca (m eq/100g soil)	4.73 (Opt.)			
6.	Total N (%)	0.11 (L)			

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EFFECT OF DIFFERENT NUTRIENT MANAGEMENT PACKAGES ON THE YIELD OF CABBAGE AND TOMATO

Abstract

The experiment was conducted at MLT site Kendua, Netrakona, during rabi 2003-04 to evaluate the proper nutrient management packages for cabbage production and determine the economic dose of fertilizer for cabbage under irrigated condition. The cabbage variety atlas-70 was tested against six different fertilizer management packages (soil test based fertilizer dose for MYG & HYG, IPNS for HYG, BARI Rec. dose, Crop removal and farmers practice). Higher head yield (95.14 t ha^{-1}) as well as gross margin (121801 Tk. ha^{-1}) was recorded from BARI Recommended dose. But marginal benefit cost ratio (MBCR) was higher (8.57) in STB based fertilizer dose for MYG (T_1) due to less fertilizer cost involvement.

Introduction

The importance of cabbage (*Brassica oleracea* var. capitata Lin.) and Tomato as vegetables due to supply of adequate vitamins, carbohydrates and minerals is well known. It is one of the most important winter vegetables and is grown throughout Bangladesh. Cabbage and tomato are intensively grown under irrigated Medium High Land of Kendua MLT site, Netrakona. But a recent field survey and soil test data reveals that yield of cabbage and tomato is lower than expected yield which might be due to imbalance use of inorganic fertilizer, less use of organic manure and lack of using modern crop varieties.

A judicious integration use of macro and micro-nutrients along with organic manure may not only help to maintain soil fertility but may also increase crop productivity. Therefore, keeping all these in mind the present study was carried out to find out the proper nutrient management packages for cabbage and tomato and to determine the economic dose of fertilizer for cabbage and tomato under irrigated medium high land at Kendua, Netrakona under AEZ 9.

Materials and Methods

The experiment was conducted under irrigated condition during the period from November 2003 to February 2004 at Kendua MLT site, Netrakona. The soil of the experimental field belongs to the Agro-ecological region Old Brahmaputra Floodplain (AEZ 9). The surface soil was loamy to clayey in texture. The pH of soil is 6.3 with OM 1.66%, total N 0.10, available P (10.76), exchangeable K (0.12) and available S (9.69) which show that all the nutrients area low. The experiment was laid out in RCB design with six dispersed replications. The unit plot size was 5m × 8m. Six different fertilizer packages were tested and the details of the treatments are i) T_1= Estimated mineral fertilizer dose for moderate yield goal (MYG), ii) T_2 = Estimated mineral fertilizer dose for high yield goal (HYG), iii) T_3 = Integrated nutrient management for high yield goal, iv) T_4 = BARI recommended dose, v) T_5 = Nutrients rate based on crop removal for high yield & T_6 = Farmer's practice (FP).

Nutrient rate kg ha^{-1}

Cabbage					Tomato				
CD	N	P	K	S	CD	N	P	K	S
-	131	26	102	25	-	119	27	114	20
-	191	36	145	36	-	170	38	157	29
8000	167	28	121	36	6000	152	32	139	29
8000	150	44	138	0	10000	254	88	125	0
-	414	28	466	89	-	126	18	183	17
8000	99	39	80	11	6000	90	35	69	16

The entire amount of cowdung P, S 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 10-15, 25-30 and heading time of cabbage and two splits for tomato and 21 and 35 DAT as ring method. The cabbage variety atlas-70 and tomato variety ratan were tested. The thirty days old seedling of cabbage were transplanted on 24-30 November 2003 and harvested 19-29 February 2004, respectively whereas tomato seedling transplanted on 25-30 December 2003 and harvested on 18 February to 27 March 2004. One seedling was transplanted at a spacing 60 cm × 45cm for both the crops. Irrigation was given six time which supplied 4.8 cm available water in 6 decimal plot. Intercultural operations such as weeding, irrigation and pest control were done in order to maintain the normal crop growth. Data on yield and yield attributes along with other parameters were collected properly and subjected to statistical analysis and means were compared by DMRT and economic analysis was done.

Result and Discussion

Cabbage

The effect of different nutrient management packages on the head yield of cabbage is presented in table1. Head pericycle was found statistically identical in all the treatments except farmers practice (T_6). Soil test based (STB) fertilizer dose for high yield goal (T_2) produced 10% larger head pericycle than farmers practice. Plant height and whole plant weight were insignificant among the treatments. Marketable head weight/plant was statistically significant (Table 1). Head yield with outer leaves showed similar yield in all the treatments except soil test based fertilizer dose for medium yield goal level (T_1). Similar trend was followed in case of head yield. Soil test based fertilizer dose for medium yield goal (T_1) treatment gave the lowest head yield. Whole plant weight, marketable head weight/plant and head yield with outer leaves was inferior which might be due to use less amount of chemical fertilizers. The higher marketable head yield was produced by T_1, T_3, T_5, T_2 and T_6. The marketable head yield reduction over head yield with outer leaves in manure used treatment ranges from 7-9% but higher dose of chemical fertilizer used treatments without manure marketable yield reduction ranges from 11-17%.

Cost and return analysis: The cost and return analysis of cabbage has been presented in Table 2. The highest gross return and gross margin was calculated from T4 followed by T_3. The variable cost (Tk.18397 ha^{-1}) was highest in T_5 due to crop removal basis fertilizer dose was very high in cabbage. The second highest figure (Tk.11395 ha^{-1}) was found in T_4 followed by T_3 (Tk.11102 ha^{-1}) due to the cost of cowdung involved in these treatments. Due to higher fertilization cost, the gross margin (Tk.106497 ha^{-1}) was less in T_5 than other treatments.

Tomato

The effect of different nutrient management packages on the yield of Tomato is presented in table1. Plant height, fruits/plant, yield/plant and yield/ha were significantly influenced by different fertilizer treatments. Plant height showed similar in all the treatment except T_1 which showed lower plant height. But fruits/plant also showed similar in all the treatment except T_6. Yield /plant gave higher from treatment T_4 but statistically identical to T_3 and T_5. Higher yield was obtained from treatment T_4 which was statistically identical to T_5 and T_3. The lowest yield was recorded from T_6 due to lower fruits/plant and yield/plant.

Cost and return: The cost and return analysis of tomato has been presented in Table 2. The highest gross return (Tk.148760 ha^{-1}) was calculated from T_4 which was very close to T_3 (Tk.142760 ha^{-1}). The total variable cost (Tk.16172 ha^{-1}) was highest in T_4 followed by T_3 (Tk.10355 ha^{-1}) due to higher fertilizer dose and cost of cowdung involved in these treatments.

Conclusion

Based on one year study revealed that BARI recommended dose was superior to other treatments in respect of yield and gross return of cabbage. But for tomato treatments T_5 (IPNS) is superior to different nutrient management packages. The experiment needs to be repeated another years for final recommendation.

Table 1. Effect of different nutrient management packages on plant characters, yield and yield attributes of cabbage at MLT site Kendua

Treatment	Plant height (cm)	Head pericycle (cm)	Whole plant wt. (kg)	Marketable head weight (kg)	Head yield With outer Leaf (tha^{-1})	Marketable head yield (tha^{-1})
T_1	20.60	66.18ab	2.27	1.98b	71.10b	62.92b
T_2	21.08	69.37a	2.82	2.57a	93.67a	85.85a
T_3	20.88	67.82ab	3.13	2.74a	99.89a	92.15a
T_4	20.50	66.83ab	3.22	2.85a	102.99a	95.14a
T_5	20.75	67.26ab	3.32	2.72a	107.88a	89.21a
T_6	20.80	62.95b	2.77	2.55a	92.52a	84.50a
CV (%)	2.81	5.82	9.29	13.92	8.10	16.92

Figures in a column means followed by same letter(s) are not different significantly at 5% level by DMRT

Table 2. Cost and return analysis of different nutrients management packages in cabbage at Kendua MLT site during 2002-03

Treatment	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	MBCR Over T_6
T_1	88088	5887	82201	8.57
T_2	120190	8463	111727	-1.80
T_3	129010	11102	117908	6.73
T_4	133196	11395	121801	7.91
T_5	124894	18397	106497	0.74
T_6	118300	9511	108789	-

Table 3. Effect of different nutrient management packages on yield of tomato at MLT site Kendua during 2003-04

Treatment	Plant height (cm)	Fruits/plant (no.)	Yield/plant (kg)	Yield (tha^{-1})
T_1	75.58b	22a	1.67c	60.50b
T_2	78.18ab	23a	1.83b	61.95b
T_3	81.30a	24a	1.91ab	71.38a
T_4	81.98a	24a	2.02a	74.38a
T_5	85.23a	24a	1.96ab	62.08b
T_6	82.18a	19b	1.65c	55.10c
CV (%)	4.59	6.33	6.13	5.55

Figures in a column means followed by same letter(s) are not different significantly at 5% level by DMRT

Table 2. Cost and return analysis of different nutrients management packages in tomato at Kendua MLT site during 2003-04

Treatment	Gross return (Tk. ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})
T_1	121000	5920	115080
T_2	123900	8915	114985
T_3	142760	10355	132405
T_4	148760	16172	132588
T_5	124160	6776	117384
T_6	110200	7322	102878

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EFFECT OF INORGANIC AND ORGANIC FERTILIZERS ON THE YIELD OF SUMMER ONION

Abstract

An experiment was conducted at Shibpur MLT sites, Narsingdi during 2004 kharif season to determine the optimum dose of inorganic and organic fertilizer on the yield of summer onion. The experiment was laid out in RCBD with three replications. Summer onion variety BARI Piaj 2 was used as test crop. Four different inorganic and organic fertilizers doses along with no fertilizer treatments were employed for the experiment. The highest bulb yield (23.54 t/ha) was obtained from fertilizer combination 120-43-100-40 kg N-P-K-S/ha along with 5 t/ha cowdung, which was 213% higher than control.

Introduction

Onion (*Allium cepa*. L) is one of the major important spices in Bangladesh. It stands second in respect of area and production in Bangladesh. Bangladesh produces only 1.31 lakhs metric tons of onion as against the total requirement of 4.50 thousand MT per year on an area of 33.26 thousand hectares of land (BBS, 2001). So, there is an acute shortage of onion in relation to its requirement. The high demand of onion can be meet up by increasing area as per hectare yield. This can be done by many ways of which the most important are the judicious application of fertilizer and introduction of summer onion varieties. In Bangladesh, onion is mainly grown in the Rabi season (winter). Usually, onion is not cultivated during Kharif (summer) season in the country. Recently BARI has released two summer onion varieties for growing in kharif season. There is a significant response of onion to inorganic and organic fertilizer (Nasreen and Hossain, 2000; Ullah, 2002). Although, the weather conditions seem to be congenial for the proper growth of summer onion but research work of summer onion is very scarce in Bangladesh. It is therefore, necessary to explore the possibilities of growing this crop in farmers' field in order to raise its yield through inorganic and organic fertilization. The study was undertaken to find out optimum dose of fertilizer for summer onion.

Materials and Methods

The experiment was conducted at MLT site, Shibpur, Narsingdi during February to May, 2004. Before starting the experiment a composite soil sample was collected and analyzed. The experiment was laid out in Randomized complete block design with three replications. The unit plot size was 2mx2m. Five treatments of the experiment were:

i. T_1= 120-43-100-40 kg N-P-K-S/ha + 5 t/ha cowdung
ii. T_2= 90-54-75-20 kg N-P-K-S/ha + 5 t/ha cowdung
iii. T_3= Poultry manure 3 t/ha + Required amount from inorganic fertilizer
iv. T_4 = Cowdung 5 t/ha + Required amount from inorganic fertilizer
v. T_5 = Absolute control

Forty days old seedlings of summer onion variety BARI Piaj 2 were transplanted on 24 February, 2004 with 15x 10cm spacing. All fertilizer except urea and muriate of potash were applied as per treatment at final land preparation. Urea was applied in three installment at 10, 28, 42 DAT and muriate of Potash was applied in two installments at 10 and 42 DAT. The crop was irrigated three times at 10, 32 and 45 DAT. The crop was harvested on 24th May, 2004. Necessary data were collected and analyzed statistically.

Results and Discussion

Plant height, bulb length, single bulb weight and yields were significantly affected by fertilizer treatments. The treatments T_1, T_3 and T_4 were statistically identical in respect of plant height, bulb length and single bulb weight. The higher plant height was obtained from T_1 which was statistically identical to T_4 & T_3 whereas the lowest height from T_5. There was no significant difference in bulb length in between T_1, T_2, T_3 and T_4. The maximum individual bulb weight (59.13 g) was recorded in T_1 which was statically identical with T_2, T_3 and T_4. The minimum bulb weight (27.21 g) was recorded in T_5 treatment. The total bulb yield of summer onion varied significantly due to fertilizer application (Table 1). Higher bulb yield (23.54 t/ha) was recorded in T_1 but statistically identical to T_2, T_3, T_4 and T_5. The lowest bulb yield (7.50 t/ha) was recorded from unfertilized control plot.

Conclusion

One season result showed that the summer onion variety BARI Piaj 2 gave more than 6 (six) times higher yield than national average. For confirmation the experiment should be repeated next season.

Table 1. Effect of inorganic and organic fertilizer on the yield and yield attributes of summer onion

Treatment	Plant height (cm)	Bulb length (cm)	Single bulb weight (g)	Yield (t/ha)
T_1	43.33a	2.69a	59.13a	23.54a
T_2	41.00b	2.51a	57.63a	21.16a
T_3	41.33ab	2.48a	53.16a	19.53a
T_4	41.66ab	2.57a	54.11a	19.71a
T_5	28.00c	1.69b	27.21b	7.50b
CV(%)	2.73	6.12	6.93	8.78

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EFFECT OF BORON ON YIELD OF SOME SHORT DURATION MUSTARD

Abstract

A field experiment was conducted at Mymensingh Sadar Upazila during rabi season of 2003-04 to evaluate the effect of boron on the yield and yield of mustard and identify a most suitable dose of boron as well as suitable mustard variety under Old Brahmaputra Floodplain soils of Bangladesh (AEZ 9). Three short duration varieties of BARI released mustard varieties viz. Improved Tori-7, BARI Sharisha 9 and BARI Sharisha 12 with five doses of boron such as 0, 0.5. 1.0, 1.5, and 2.0 kg boron ha^{-1} were tested. Application of boron significantly influenced plant height, siliqua per plant, seeds per siliqua, seed yield and stover yield of mustard. The result showed that Tori-7 responded with 1.5 kg B/ha, BARI Sarisha 9 with 0.5 kg and BARI Sarisha 12 with 1 kg B/ha which is sufficient to increase yield.

Introduction

Mustard is the principal oleaginous crop of Bangladesh. It covers 58.6% of the total oilseed area and produces 52.2% of the total oilseed production in the country. The average yield of mustard per unit area in Bangladesh is very low compared with other mustard producing countries. In Phulpur and Netrakona under Mymensingh greater district, organic matter and boron content of the soil is poor for which results poor yield of mustard. This is mainly due to less pod as well as siliqua formation. The application of Boron in conjugation with Sulphur caused 42% increased seed yield of mustard. The present investigation was, therefore, undertaken to evaluate the effect of boron on the yield and yield performance of mustard and to find out the suitable boron fertilizer dose for mustard in Old Brahmaputra Floodplain soil.

Materials and Methods

The experiment was conducted at Mymensingh sadar during rabi season of 2003-04. The experiment was laid out in randomized complete block design with 3 replications. The factorial RCB design was followed where three varieties (Improved Tori-7, BARI Sharisha-9, & BARI Sharisha-12) and five Boron doses (0, 0.5, 1.0, 1.5, 2.0 kg B ha^{-1}) were combined. Initial soil samples were collected and analyzed for chemical characteristics of soil (Appendix 1). The plot received NPKS fertilizer as a blanket dose. Based on soil test report the plot were fertilized by the application of 100, 20, 50, and 20 kg N, P, K, and S, ha^{-1} for both location. Boric acid (ALPHA BORON) was used as the source of boron. Full amount of P, K, S, and B and half of N were applied as basal. Rest half was applied as top dress after 30 and 45 days of sowing. Recommended seed rate (8 kg ha^{-1}) were sown as broadcast method on November 06, 2003. The crop was harvested on January 24, 2004. The differences among the treatment means were evaluated by least significant difference (LSD).

Results and Discussion

Effect of variety: The yield components of mustard as influenced by different varieties were statistically significant including seed and stover yield. On the other hand, number of plants per unit area was not significant. The variety BARI Sarisha 9 and BARI Sarisha 12 showed similar yield and higher than Tori-7. All the yields attributes contributed higher yield of BARI Sarisha 9 and BARI Sarisha 12 (Table 1).

Effect of Boron: Table 1 show that the number of pods per plant, number of seed per pod and seed yield was responded significantly by the application of Boron fertilizers. It is observed that all boron applied treatment significantly gave maximum number of pods per plant. The highest numbers of pods were observed from 1.5 kg B/ha (47) which were statistically similar with other boron applied treatments but it was differed only from without boron. The same trend was also found in case of seeds per pod. The maximum number of pods (14.2) were recorded from 1.0 and 1.5 kg B/ha and it was statistically similar with 0.5 kg B/ha plot. The seed yield statistically significant among the treatments. The higher seed yield was recorded from 1.5 kg B/ha and it was at par with 2.0 and 1.0 kg Boron. The yield of without boron plot was only 868 kg/ha.

Interaction between Variety and Boron: The interaction effect of Boron and variety was statistically significant in plants/m^2, plant height, yield and yield attributes (Table 1). The result showed that among the varieties responded Boron differently. The variety Tori-7 showed higher yield with 1.5 kg B/ha and different from other treatments. But variety BARI Sarisha 9 revealed similar yield from 0.5 to 1.5 kg B/ha and BARI Sarisha 12 gave similar statistical yield to Boron 1.0 to 1.5 kg/ha (Table 1).

Cost and return analysis

The cost and return analysis shows that the application of 1.5 and 2.0 kg B/ha were undominated and discarded from economic study. The MRR (%) of 0.5 kg and 1.0 kg B/ha (845 % and 762 % respectively). The maximum gross margin (Tk. 23598/ha) was recorded from 1.5 kg B/ha (Table 3). The cost and return analysis shows that the application of 1.0 and 2.0 kg B/ha were undominated and discarded from economic study. The maximum gross margin (Tk. 23598/ha) was recorded from 1.5 kg B/ha (Table 3).

Table 1. Yield and yield parameters of some short duration mustard varieties as influenced by various doses of boron fertilizer at Mymensingh Sadar upazila (2003-04)

Variety	No. of Plant m^{-2}	Plant height (cm)	No. of Pod Plant^{-2}	No. of Seed Pod^{-1}	Grain Yield (kg ha^{-1})		Stover Yield (kg ha^{-1})
					2003-04	2002-03	
Variety							
Tori-7	128a	93b	44b	12.6b	982b	1097	2249b
BARI Sarisha 9	129a	95a	47a	14.1a	1101a	1080	2495a
BARI Sarisha 12	126a	96a	44a	13.9a	1060a	1035	2440a
Boron doses (kg ha^{-1})							
0	120b	92c	42b	12.1c	868c	887c	2268c
0.5	128a	94b	45ab	14.2a	1005b	1078b	2347bc
1.0	132a	95ab	45ab	14.2a	1129a	1078b	2456a
1.5	130a	96a	47a	13.8ab	1147a	1189a	2478a
2.0	128a	95ab	46a	13.6b	1091a	1122ab	2419ab
Variety x Boron doses (kg ha^{-1})							
T_7 x 0.0	114d	90f	42bc	11.0f	808e	1017cd	2114f
T_7 x 0.5	124c	93e	45a-c	13.2c-e	894e	1017cd	2196ef
T_7 x 1.0	132a-c	94de	44a-c	13.2c-e	1052bc	1117a-c	2332c-e
T_7 x 1.5	132a-c	94de	46ab	12.9de	1088a-c	1217a	2308de
T_7 x 2.0	137a	94de	45a-c	12.8e	1070bc	1117a-c	2296de
S_9 x 0.0	125c	93e	45a-c	12.6e	916de	900de	2411b-d
S_9 x 0.5	135ab	94de	48a	14.9a	1104a-c	1133a-c	2450a-d
S_9 x 1.0	136a	96b-d	45a-c	14.6ab	1140ab	1033b-d	2492a-c
S_9 x 1.5	128a-c	96bc	48a	14.6ab	1194a	1200ab	2590a
S_9 x 2.0	123cd	97ab	47a	14.1a-c	1152ab	1133ac	2534ab
S_{12} x 0.0	123cd	94c-e	40c	12.6e	879e	743 e	2299de
S_{12} x 0.5	125bc	96b-d	42bc	14.5ab	1016cd	1083a-c	2394b-d
S_{12} x 1.0	128a-c	96b-d	45ab	14.7ab	1194a	1083a-c	2546ab
S_{12} x 1.5	130a-c	98a	47a	13.9b-d	1160ab	1150a-c	2536ab
S_{12} x 2.0	123cd	96b-d	45ab	13.9b-d	1052bc	1117a-c	2426a-d
CV (%)	6.1	1.8	8.6	5.7	7.9	10.2	5.3

Figures in a column having same letter(s) do not differ significantly

Table 3. Cost and return analysis of different doses of Boron on yield of Mustard at Mymensingh Sadar Upazila (2003-04)

Boron doses (kg ha^{-1})	Gross return (Tk ha^{-1})	Cost of Boron (Tk ha^{-1})	Gross margin over Boron (Tk ha^{-1})	Marginal gross margin (Tk ha^{-1})
0	18589	0	18589	-
0.5	21777	304	21472	2883
1.0	23178	609	23559	2240
1.5	24511	913	23598	77
2.0	23272	1218	22054	-

Appendix Table 1. Initial status of soil samples

Samples	pH	OM (%)	Total N (%)	P (ppm)	K (meq 100^{-1} g Soil)	S (ppm)	Zn (ppm)	B (ppm)
Soil test values	6.1	1.34	0.08	4.56	0.16	9.52	2.2	0.13
Interpretation	-	-	Low	Very low	Medium	Very low	High	Low

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EFFECT OF DIFFERENT LEVELS OF BORON ON THE PERFORMANCE OF PAPAYA

Abstract

The experiment was conducted at MLT site Modhupur, Tangail during two consecutive years of 2002-2003 and 2003-04 to evaluate the response of boron application on papaya (cv. Shahi).The experiment involved seven boron levels viz. 0.0, 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 kg per ha from boric acid. The higher fruit yield 61.44 t/ha in 2002-03 and 47.78 t/ha was obtained from treatment T_5 i.e. 2 kg B/ha. On an average of two years, the fruit yield 54.61 t/ha was obtained with the application of 2 kg B/ha along with a blanket dose of 0.54, 0.45, 0.45, 0.24, 0.15 and 16 kg/plant of Urea, TSP, MP, Gypsump, Zincsulphate and cow dung, respectively.

Introduction

Papaya (*Carica papaya* L.) is nutritional and rich quick growing fruit in Bangladesh. It can be eating as fruit and also used as vegetables. Bangladesh produces 39,000 tons of papaya from an area of about five thousand hectares of land having an average yield of 7.80 t/ha (BBS, 1998), which is the lowest among the papaya growing countries of the world. This is due to the poor management practices and imbalanced fertilization of the crop. Both macro-and micro- nutrients have an important role on the production of papaya (Lokhande and Moghe, 1991). Papaya is intensively grown in Modhupur Tract under AEZ 28. Boron deficiency has an effect on papaya production. Soil test value indicated that boron is very low (0.06 ppm) in Modhupur tract. Due to boron deficiency papaya was deformed in shape and size. But farmers do not use boron fertilizer for papaya cultivation. As a result farmers are not getting full benefit from papaya cultivation. It is known that boron is the important factor for attractive shape, size and quality for papaya, which can be also increased yield, quality and production of papaya. Hence, the study was undertaken with the objectives to observe the response of papaya to added boron and to find out the optimum dose of boron for papaya cultivation.

Materials and Methods

The trial was carried out in Multilocation Testing site, Modhupur, Tangail during two consecutive years of 2002-03 and 2003-04 to evaluate the response of boron on papaya (cv. Shahi). Before conducting the field experiment soil samples were collected from experimental plot and its chemical analysis was done. Data indicate that pH of the soil sample was acidic (5.0), organic matter content was low (1.12), total N (%) was low (0.10), P was very high (74.63 µg/g), K was medium (0.19 meq/ 100 g) and B was very low (0.06 µg/g) in appendix table 1. The experiment was laid out in a randomized complete block design having seven treatments replicated in 4 times. Boron levels were 0.0, 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 kg/ha applied from boric acid. A blanket dose of 622-221-562-110-136 NPKSZn kg/ha was also applied (Technology Hand Book, BARI, 2002). Full dose of TSP was applied during the final land preparation. One half of potassium and full dose of boron mixed well with soil applied in pit.One half of urea and one fourth of potassium were applied around the young plant and covered with soil at two months after planting. The remaining nitrogen and potassium were applied around the young plant and covered with soil at four months after planting. Each plot measured 10 m x 8 m with 1 m drain between plots. Two month old seedlings were transplanted in March with a spacing of 3 m x 2m in between rows plants in both the years. Four weeding, two irrigations, and three times earthing up were done during the crop growth. Borthomixture and Dithane M-45 (0.2%) were sprayed three times as preventive and plant protection measures for root rot and pests. Harvesting started from 2nd week of November and continued upto March. Data on number of fruits /plant, percent of normal and deformed fruits per plant, fruit size and weight, yield per hectare were recorded and were analysed statistically. Duncan`s Multiple Range Test (DMRT) was used to determine the significant differences among the treatments.

Results and Discussions

Yield and yield contributing characters of papaya significantly influenced by boron treatments are sown in table 1. All the studied characters were significantly influenced by the application of boron. In 2002-03, it was observed that the tallest plant was obtained from T_5, though superior to other treatments but did not differ significantly except control. The smallest plant height was obtained from control. But in 2003-04, it was found that plant height was no significant variation among the treatment. The number of fruits/plant showed significant variation among the treatments in both the years. In 2002-03, the higher number of fruits/plant was recorded in T_5 treatments which was statistically significant different from others treatments. The rest of the treatments gave the statistically identical number of fruits/plant except control. But in 2003-04, the treatment T_3 gave the higher number of fruits/plant followed by T_2. The lowest number of fruits/plant was obtained from the treatment T_7 where boron level was 3.00 kg/ha.The normal fruit percentage /plant was significantly highest from the treatment T_5 followed by T_4 (Table 2).The treatment T_4 and T_6 gave the statistically identical normal fruit. The lowest percentage of normal fruit was recorded from the control treatment .The lowest percent of deformed fruit/plant was obtained from the T_5 treatments where boron level was 2 kg/ha (Table 2).The deformed percentage fruit was decrease gradually with the increase of boron level up to 2 kg/ha and then gradually increase with the increasing of boron level, its may be due to over dose of boron.

Individual fruit weight was significantly influenced by different levels of boron application in both the years. In 2003-04, the higher individual fruit weight was obtained from the treatment T_5 which was identical to T_3 and T_4 but significant different from other treatments (Table 2). But in the year 2002-03, it was observed that the highest fruit weight was obtained with the treatment T_5 which was statistically significant different from $T_{1,}$ T_2 and T_3 but identical with T_4, T_6 and T_7 (Table 1). The lowest fruit weight was obtained from control in both the year. Weight of individual fruit increased with the increased of boron level up to 2 kg/ha and then gradually decreased with the increase of boron level.

The yield of fruit was influenced by the application of boron fertilization. In 2003-04, it was observed that the highest yield was obtained from the treatment T_5 which was significant difference among the treatments. The treatment T_4 and T_6 gave the statistical identical fruit yield (Table 2). But in 2002-03, the higher fruit yield was obtained from treatment T_5 i.e. 2 kg B/ha which was statistically identical to T_4 and T_6 (Table 1). The lowest yield was obtained from control plot in both the year. On an average of two years, the result showed that, the higher yield (54.61 t/ha) was obtained from the treatment T_5, where boron dose was 2 kg /ha.

From the study, it could be concluded that boron level 2.0 kg/ha along with a blanket dose of 622-221-562-110-136 kg NPKSZn/ha may be optimum for the production of papaya (cv. shahi) in Modhupur,Tangail.

Farmers' Reaction

> Farmers' should be motivate to apply boron for papaya production
> Uniform shape and sized of papaya was found better in case of boron application.

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Table 1. Plant height, yield and yield contributing characters of papaya (cv. Shahi) as influenced by different levels of boron at MLT site, Modhupur, Tangail, 2002-03

Boron levels (kg/ha)	Plant height (cm)	Fruits /plant (no.)	Length of fruit (cm)	Breath of fruit (cm)	Individual fruit weight (kg)	Fruit yield (t/ha)
T_1 (0.00)	180.6b	16.38c	16.33d	35.33c	0.91d	40.81d
T_2 (0.05)	182.2ab	19.38b	17.07cd	35.90c	0.99c	48.58c
T_3 (1.0)	183.7ab	20.23b	18.48bc	37.28bc	1.06b	53.70bc
T_4 (1.5)	183.4ab	21.08b	19.58ab	38.83ab	1.09ab	56.92ab
T_5 (2.0)	185.7a	23.08a	20.52a	40.58a	1.13a	61.44a
T_6 (2.5)	184.0ab	20.45b	19.05ab	39.25ab	1.10ab	55.97ab
T_7 (3.0)	181.9ab	19.38b	18.13bc	38.1b	1.07ab	52.44bc
CV (%)	1.50	5.92	5.30	3.74	3.88	7.03

Means followed by same letter is not significantly different at 5% level by DMRT

Table 2. Plant height, yield and yield contributing characters of papaya (cv. Shahi) as influenced by different levels of boron at MLT site, Modhupur, Tangail, 2003-04

Boron levels (kg/ha)	Plant height (cm)	Fruits/plant (no.)	Per cent of normal fruit/plant	Percent of deformed fruit/plant	Individual Fruit weight (kg)	Fruit yield (t/ha)
T_1 (0.00)	172.9	27.43ab	26.00e	74.00a	0.60c	36.75d
T_2 (0.05)	172.6	28.39a	50.25d	49.25b	0.62c	38.35d
T_3 (1.0)	174.2	28.62a	64.75c	35.00c	0.71ab	41.98bc
T_4 (1.5)	173.4	28.03ab	72.75b	27.25d	0.74ab	43.65b
T_5 (2.0)	173.4	27.60ab	83.00a	17.00e	0.78a	47.78a
T_6 (2.5)	173.9	25.54bc	69.25b	26.25d	0.69b	43.22b
T_7 (3.0)	172.9	23.61c	63.25c	36.75c	0.62c	39.65cd
CV (%)	1.16	5.57	4.71	11.73	6.90	4.67

Means followed by same letter is not significantly different at 5% level by DMRT

Table 3. Effect of different levels of boron on the fruit yield of papaya cv. Shahi for the year of 2002-04 at MLT site, Modhupur, Tangail

Boron levels(kg/ha)	Fruit yield (t/ha)		Average yield of two years (t/ha)
	2002-03	2003-04	
T_1 (0.00)	40.81d	36.75d	38.78
T_2 (0.05)	48.58c	38.35d	43.46
T_3 (1.0)	53.70bc	41.98bc	47.84
T_4 (1.5)	56.92ab	43.65b	50.28
T_5 (2.0)	61.44a	47.78a	54.61
T_6 (2.5)	55.97ab	43.22b	49.59
T_7 (3.0)	52.44bc	39.65cd	46.04
CV (%)	7.03	4.67	--

Means followed by same letter is not significantly different at 5% level by DMRT

Appendix table: Initial soil test values of the experimental plots

Parameters	P^H	OM (%)	Total N (%)	P(µg /g)	K (meq/100g)	S (µg g)	Zn (µg /g)	B (µg /g)
Value	5.0 Acidic	1.12 Low	0.10 Low	74.63 Very high	0.19 Medium	36 High	1.52 Optimum	0.06 Very low

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EFFECT OF BORON AND MOLYBDENUM APPLICATION ON MUNGBEAN

Abstract

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during 2003. Nine treatment excluding control (without fertilizer) were constructed with B and Mo each @ 1 and 2 kg/ha, respectively, together with recommended fertilizer doses and were applied in mungbean to assess their effects. Application of 2 kg B/ha in combination with 2 kg Mo/ha resulted in the highest nodules/plant. Yield and yield components significantly responded to different treatments. The treatment of 2 kg B/ha with 1 kg Mo/ha increased yield of 96.63%, over recommended fertilizer doses. As regards economic return, the combined treatment of 2 kg B/ha with 1 kg Mo/ha was found beneficial than the other treatments.

Introduction

Mungbean (*Vigna mungo* L. Wilczek) is native to India-Burma areas of Southeast Asia and is mainly grown in semi-arid to low lands of tropical and sub-tropical regions. In Bangladesh its contribution is only 5% to the total pulse production. The benefits of inoculation in legumes for increasing biological nitrogen fixation efficiency are well established. Field studies revealed that deficiency of B causes considerable reduction of growth and nodulation and Mo is required for increasing nodulation and yield in mungbean. In Bangladesh, hardly any attempt has so far been made on the application of B and Mo in mungbean for bringing about the improvement of nodulation and yield in relation to economic return, Therefore, keeping these facts in view, the present investigation was made.

Materials and Methods

The investigation was carried out at Regional Agricultural Research Station, Jamalpur during the Kharif-1 of 2003. The soil of the experimental field was clay loam with 1.00% organic matter having 6.35. The total N=.06%, available P, S, B is 8.15, 12.72, 0.17 ppm and exchangeable K is 0.08% respectively. The experiment was laid out in a randomised complete block design replicated three times. The unit plot was 4m x 5m.

The micronutrients, such as B and Mo each @ 1 and 2 kg/ha along with recommended fertilizers (20, 18, 25 and 10 kg/ha of N, P, K and S) and a control (without fertilizer) were taken into consideration to constitute ten treatments (Table 1). All the plots received recommended fertilizers except the control. B as boric acid and Mo as sodium molybdate were applied as per treatments. The variety was BARI Mung-5 and seeds were sown in rows 30 cm x 5 cm spacing on the 3rd February and harvested on 15th May 2003. Agronomic practices and plant protection measures were taken whenever necessary. Yield, yield contributes and cost-benefit analysis was recorded treatments.

Results and Discussion

Root growth and nodulation: The results revealed that significant effects of different treatments for all the root parameters were found (Table 1). The ranges of root length were 17.50 to 26.51 cm. Individually or in combination B and Mo proved their superiority in increasing root length over control and recommended fertilizers. Application of Mo @ 1 kg/ha either singly or in combination with B @ 1 or 2 kg/ha appreciably increased root length than the others. The maximum nodulated roots/plant were recorded from the combination treatments of 2 kg with 2 kg Mo/ha, whereas the maximum nodule less roots/plant were recorded from the single treatment of 1 kg B/ha. The maximum nodules/plant of 20.50 was recorded when B and Mo applied together each @ 2 kg/ha. Overall the combined treatments were more effective for nodulation than the other treatments.

Yield and yield components: Yield and yield components viz., plant height, branches/plant, seeds/pod, 1000-seed weight and yield/ha significantly responded to different treatments (Table 2). When B and Mo were applied in addition to recommended fertilizers either singly or in combination initiated early flowering have got larger period pod formation leading to increase in yield/ha. Addition of 1 kg Mo/ha with 1 or 2 kg B/ha was found to be more effective for increasing plant height. The combined treatments were more favourable for branches/plant than the others. The combined application of 2 kg B/ha with 1 kg Mo/ha gave the highest pods/plant. Seeds/pod did not markedly but significantly responded to different treatments. The ranges of 1000-seed weight were 19.57 to 26.76. Yield increased significantly due to the improvement of pods/plant and 1000-seed weight. However, amongst the treatments, application of Mo @ 1 kg/ha as a single as well as in combination with 1 or 2 kg B/ha were more effective for increasing yield. However, result showed that the combined treatments were better for increasing yield in mungbean and application of 2 kg B/ha with 1 kg Mo/ha obtained the highest yield.

Cost and return analysis

The economics of different treatments on yield/ha showed that maximum net returns of Tk 43146 was obtained from in the combined treatments of 2 kg B/ha with 1 kg Mo/ha, and it was followed by the combined treatment of 1 kg B/ha with 1 kg Mo/ha, whereas the minimum net returns was obtained from control (Table 3). Besides, amongst the micronutrient treatments, 2 kg Mo/ha when applied as single gave the least net returns and from the estimation of benefit over control, it is also appeared that 2 kg Mo/ha was not economically beneficial. The results indicated that highest cost of 2 kg Mo/ha did not compensate by higher net returns.

Conclusion

From the study it may be concluded that in addition to recommended fertilizers, 1 kg Mo/ha either singly or in combination with 1 or 2 kg B/ha may be applied in mungbean for attaining higher yield and net returns.

Table 1. Response of root growth and nodulation to B and Mo in mungbean during 2003

Treatment (kg/ha)	Root length (cm)	Nodulated roots/plant (no)	Nodule less roots/plant (no)	Nodules/ plant (no)	Nodules dry wt/plant (gm)
Control	17.50d	4.75e	12.15b	5.47e	0.0019c
Recommended fertilizer	18.79d	4.98de	11.10bc	7.53de	0.0213a
$B_{1.0}$	20.46bcd	6.08cde	14.37a	8.08cde	0.0232a
$B_{2.0}$	21.17bcd	7.85ab	9.27cd	10.31cd	0.0216a
$Mo_{1.0}$	24.19ab	6.68bc	6.00e	11.43c	0.0120b
$Mo_{2.0}$	24.42ab	6.25cd	5.95e	11.20c	0.0140b
$B_{1.0}$+$Mo_{1.0}$	24.94ab	7.55abc	6.97de	15.70b	0.0162b
$B_{1.0}$+$Mo_{2.0}$	22.51abc	7.42abc	8.17de	17.90ab	0.0280a
$B_{2.0}$+$Mo_{1.0}$	26.51a	7.49abc	8.63d	19.30a	0.0260a
$B_{2.0}$+ $Mo_{2.0}$	21.01bcd	8.86a	7.07de	20.50a	0.0281a
CV (%)	7.72	8.58	10.24	10.47	9.50

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

Table 2. Effects of B and Mo on yield and yield components in mungbean during 2003

Treatment (kg/ha)	Plant height (cm)	Plant/m^2 (no)	Branches/ plant (no)	Pods/plant (no)	Seeds/ pod (no)	1000-seed wt (gm)	Yield (kg/ha)
Control	19.43c	30d	6.31b	20.81 d	9.47c	19.57cd	724e
Recom. fertilizer	25.60b	38c	7.05b	23.17cd	10.87bc	23.16abc	890de
$B_{1.0}$	26.85b	42abc	8.05ab	23.71cd	11.19bc	26.76a	1018cde
$B_{2.0}$	26.14b	40bc	8.18ab	25.14c	11.00bc	22.45bcd	1104cd
$Mo_{1.0}$	25.45b	41abc	8.98ab	27.11bc	11.50bc	19.27d	1326bc
$Mo_{2.0}$	26.87b	45ab	8.28ab	25.11c	12.21ab	21.46bcd	1400bc
$B_{1.0}$+$Mo_{1.0}$	35.64a	40bc	11.15a	30.74ab	14.23a	22.64bcd	1522ab
$B_{1.0}$+$Mo_{2.0}$	27.53b	40bc	8.78ab	27.01bc	12.03ab	23.52ab	1500ab
$B_{2.0}$+$Mo_{1.0}$	34.39a	44abc	10.25ab	32.77a	12.41ab	24.40ab	1750a
$B_{2.0}$+ $Mo_{2.0}$	28.57b	47a	9.28ab	29.41ab	12.52ab	25.34ab	1505ab
CV (%)	8.14	12.28	10.98	11.75	8.08	6.17	9.98

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

Table 3. Economics of different treatments on yield/ha in mungbean during 2003

Treatment (kg/ha)	Gross return (Tk/ha)	Variable cost (Tk/ha)	Net return (Tk/ha)	Benefit over control (Tk/ha)
Control	21720	0	21720	-
Recom. fertilizer	26700	2846	23854	2134
$B_{1.0}$	30540	3246	27244	5524
$B_{2.0}$	33120	3746	29374	7654
$Mo_{1.0}$	39780	8454	31326	9606
$Mo_{2.0}$	42000	14062	27938	6218
$B_{1.0}$+$Mo_{1.0}$	45660	8904	36756	15036
$B_{1.0}$+$Mo_{2.0}$	45000	14512	30488	8768
$B_{2.0}$+$Mo_{1.0}$	525000	9354	43146	21426
$B_{2.0}$+ $Mo_{2.0}$	45150	14962	30188	8468

Crops and input price (Tk /kg):

Mungbean	=	30.00
Urea	=	6.00
TSP	=	15.00
MP	=	14.00
Gypsum	=	4.00
Boric acid	=	90.00
Sodium molybdate	=	2200.00

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RESPONSE OF CHICKPEA VARIETIES TO PHOSPHORUS AND MOLYBDENUM IN SURMA-KUSYIARA FLOODPLAIN SOIL

Abstract

The effect of molybdenum (Mo) and phosphorus (P) on the yield of three chickpea varieties was studied at FSRD site, Golapganj, Sylhet during rabi 2003-04. Five different fertilizer doses along with or without Mo and P, and three chickpea varieties- BARI Chola 2, BARI Chola 3 and BARI Chola 5 were used. Mo (0.5 kg/ha) and P (20 kg/ha) along with blanket doses of N, K, S and B gave the highest yield but only P along with blanket doses had no significant effect. Among the varieties BARI Chola 3 gave the highest yield.

Introduction

Recently chickpea is performing well in the fallow area of Sylhet region. These soils are characterized by a low pH, with crops frequently showing nutrient deficiency symptoms. Inadequate nodulation of legumes on acid soils can be associated with low-plant available molybdenum (Barrow, 1973) and also phosphorus (Gupta and Singh, 1982). In that situation chickpea growth and yield will probably be hampered due to Mo deficiency. Therefore, an experiment was undertaken to investigate the effect of Mo on different chickpea varieties along with P.

Materials and Methods

An experiment was conducted under rainfed condition at FSRD site Golapganj, Sylhet during rabi 2003-04. A description of the initial physical and chemical properties of the experimental plots is presented in Table 1.

Table 1**.** Physical and chemical properties of the experimental soil profile used for chickpea.

Properties	Depth of soil layers (cm)								
	0-15			15-30			30-45		
	*F_1	F_2	F_3	F_1	F_2	F_3	F_1	F_2	F_3
Soil P^H	5.90	5.30	5.10	6.10	5.50	-	6.20	5.60	-
N (Total N %)	0.10	0.10	0.09	0.11	0.11	-	0.08	0.11	-
P (ppm)	7.20	11.00	6.00	4.00	13.00	-	2.00	16.00	-
K (meq/100g soil)	0.14	0.12	0.09	0.15	0.10	-	0.11	0.09	-
S (meq/100g soil)	12.10	39.00	19.00	7.80	40.00	-	0.08	23.00	-
B (ppm)	0.27	0.22	0.18	-	-	-	-	-	-

*F- Farmer

Experiment was laid out in factorial RCB design with 3 dispersed replications. The unit plot size was 3m × 4m. There were 5 fertilizer doses: F_1- absolute control, F_2- blanket doses of fertilizers for N, K, S and B at the rate of 15, 20, 15 and 1 kg/ha, respectively, F_3- Mo (500g/ha) + F_2, F_4- Mo (500g/ha) + P_{20} (kg P/ha) + F_2, F5- P_{20} (kg P/ha) + F_2 and three varieties viz. V_1- BARI Chola-2, V_2- BARI Chola-3 and V_3- BARI Chola-5.

Molybdenum and Boron were used as an ammonium hepta molybdate tetra hydrate [$(NH_4)_6 Mo_7O_{24}.4H_2O$] and boric acid. N, K, S and B were applied at the time of final land preparation. Mo and P were applied in the furrow before sowing of seed. The seeds were sown on 29 November and 5 December, 2003. Spacing was 40cm × 10cm. The rainfall occurred during October 2003 was 238.1 mm and during crop growing period (November-March) was 54.6 mm (Fig1). Pod borer was minimized by spraying of insecticides and also by hand picking of larvae. The crop was harvested last week of March, 2004.

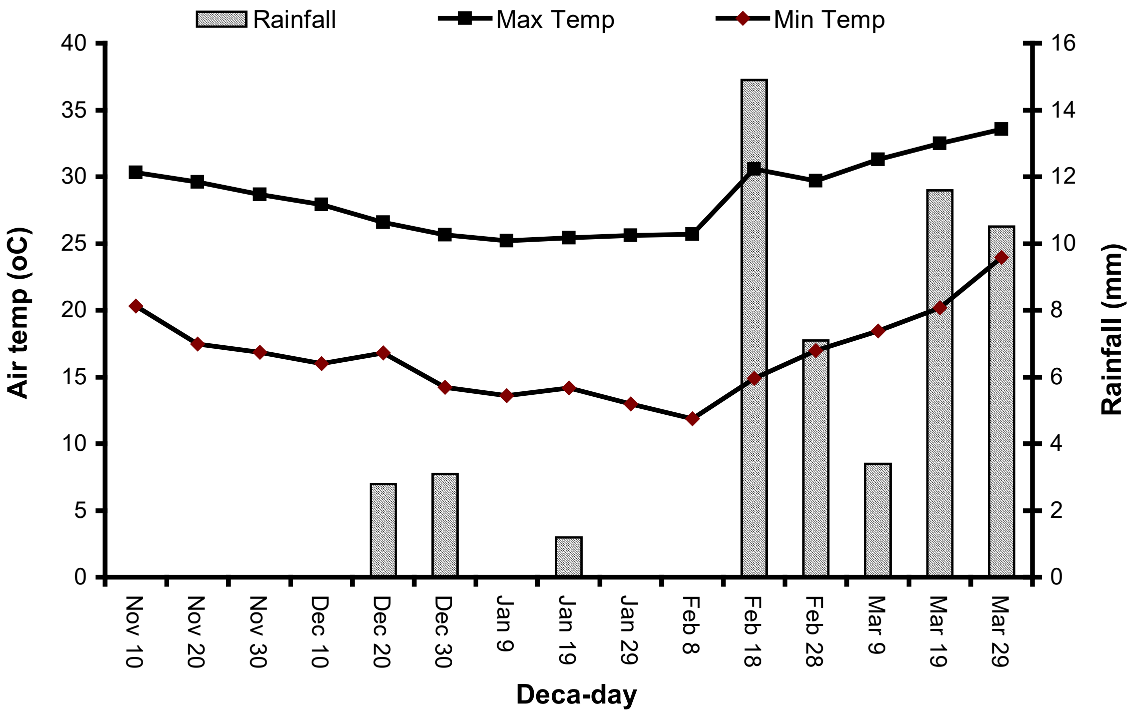

Fig. 1. Deca-day air temperature and total rainfall during chickpea growing period

Results and Discussion

The yield contributing characters of chickpea varieties as responded to Mo and P along with a blanket dose of fertilizers were presented in Table1. The application of Mo and P along with blanket fertilizers enhanced number of pod/plant and bigger seed size which was at par to application of P along with blanket fertilizers. Among the varieties, BARI Chola-3 gave the highest pod bearer and maximum seed size. Application Mo and P with blanket dose of N, K, S and B coupled with the variety BARI Chola-3 gave the highest seed yield (1554 kg/ha).

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Table 2. Effect of molybdenum and phosphorus on pod/plant, 100-seed weight and seed yield of chickpea varieties at FSRD site, Golapganj, Sylhet during 2003-04

Fertilizer dose	Variety			
	BARI Chola-2	BARI Chola-3	BARI Chola-5	Mean
Pod/plant (No.)				
F_1= Absolute control	27.13	25.30	21.07	24.50
$F_2 = N_{15}K_{20}S_{15}B_1$	28.16	27.06	24.16	26.47
F_3 = Mo + F_2	31.06	30.43	29.10	30.20
F_4 = Mo + P + F_2	36.06	34.16	32.13	34.12
F_5 = P + F_2	33.20	31.13	31.17	31.83
Mean	31.13	29.62	27.53	
$LSD_{0.05}$	For variety- 3.48, for fertilizer dose- 4.49, for interaction- NS			
100 – Seed wt. (g)				
F_1= Absolute control	12.24	17.15	11.36	13.58
$F_2 = N_{15}K_{20}S_{15}B_1$	12.90	17.80	11.57	14.09
F_3 = Mo + F_2	12.92	17.76	11.65	14.11
F_4 = Mo + P + F_2	13.46	18.40	12.15	14.67
F_5 = P + F_2	13.39	18.42	12.10	14.64
Mean	12.94	17.91	11.77	
$LSD_{0.05}$	For variety- 0.04, for fertilizer dose- 0.06, for interaction- 0.10			
Seed yield (kg/ha)				
F_1= Absolute control	947	1180	705	944
$F_2 = N_{15}K_{20}S_{15}B_1$	1024	1276	809	1036
F_3 = Mo + F_2	1077	1364	940	1126
F_4 = Mo + P + F_2	1269	1554	1082	1301
F_5 = P + F_2	1195	1480	1044	1239
Mean	1102	1370	916	
$LSD_{0.05}$	For variety- 110.3, for fertilizer dose- 142.40, for interaction- NS			

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HOMESTEAD AGROFORESTRY AT BANDARBAN HILLY AREAS: AN ECONOMIC ANALYSIS

Abstract

The study was carried out at Bandarban sadar areas in hill district Bandarban during January-March 2004 with a view to identify the homestead utilization pattern, profitability of major fruit and timber tree species through investment analysis, distribution of homestead trees and decision making process as well as constraint of homestead plantation. Data were collected from 36 homestead agroforestry practicing households. The sample farmers were selected by using purposive sampling technique. The investment analysis revealed that the longer term investment on fruit and timber tree species was profitable. The analysis showed that BCRs were greater than one, NPVs were positive and IRRs were more than 30%. Technical know-how of growing tree, good quality of seed/ seedling, lack of cash money and attack of pest and diseases were the major constraint for homestead agroforestry production. It may be concluded that production of fruit and timber tree species is highly profitable if modern inputs and production technology can be made available to farmers in time.

Key words: *Agroforestry, Homestead, Utilization, Profitability, Bandarban*

Introduction

In Bangladesh, homestead agroforestry plays a vital role in providing fuel wood, fodder, fruit and timber. It is estimated that about 61 to 70 percent of saw logs and 90 percent of fuel wood and bamboo's come from homestead forests. Most of the native fruits, country vegetables, fuel wood and timber come from the homestead, home yard and marginal lands attached to or near by homesteads. Through homestead agroforestry, the production of various types of fruits, vegetable, spices, fodder, forage, fuel wood and timber can be increased considerably (Haque, 1994).

According to Mondol (1992), although fruit crops cover only 1.75 percent area of all crops under cultivation, its contribution to total is about 6.4 percent and its share to total value of crops is about 7.8 percent. However, the average contribution of fruits to GDP is around 2.04 percent. The gross income from fruit crops is about 4.7 times higher than that of other crops.

Homestead having even a small size of land area is planted with few number of trees and it supply us fruits, fuel, timber and fodder etc. Trees grown in the homesteads are very essential from economic and ecological standpoints. But this important resource is declining at an alarming rate. It is, therefore, essential to grow more trees to meet the increasing demand and to maintain ecological stability. A country should have at least 25 percent of the total area under forest for maintaining ecological balance. But in Bangladesh, it is only 6.5 percent. Serious imbalance has already been created in the ecosystem, causing a number of meteorological and health hazards. Agroforestry is an important tool to solve this acute problem of food, fuel, fodder, soil fertility and ecology. Well-planned and well-managed agroforestry can play a great role in improving homestead production in Bangladesh.

The potentials of homestead plantations and agroforestry systems for meeting fuel wood and other needs of rural people have not been fully explored. Due to traditional management practices, low levels of inputs and technical know-how, productivity from these sources is not being fully realized. Besides these, there are several other socio-cultural problems inhibiting development and expansion of these systems.

It is observed that in the hilly areas most of the homestead area was remained under utilized or unutilized. Thus there seems have a tremendous potential for improved or better utilization of that area. Because of the shortage of land, homestead agroforestry is one important option for bridging the gap between demand and supply of agricultural product.

The present study makes an effort to explore relative profitability and economic justification of different crops based on farm level data. It may be useful for both micro and macro level policy and planning. Farmer's may use the results of the study in making decisions. They may be above to allocate their resources accordingly. The study could help the policy makers to get some ideas for judicious planning for homestead agroforestry development in Bandarban

The specific objectives of the study are:

i) to identify the homestead utilization pattern, distribution of homestead trees and decision making process for homestead plantation;
ii) to evaluate the relative profitability of major homestead trees through investment analysis;
iii) to identify the major constraints of homestead plantation and
iv) to develop a guide line for better utilization of homestead area and their products.

Materials and Methods

The study was conducted mainly two villages i.e. Balaghata and Mushlimpara in Bandarban sadar areas during January – March 2004.In total thirty six sample household were selected for data collection where 18 for tribal groups and another 18 for Bengali groups. Both of the groups were heterogeneous. All sample homesteads were selected by applying purposive random sampling technique. All kinds of information were collected in detail with the help of pre-tested survey schedule and face to face interview was followed. The collected data were tabulated, summarized and analyzed. Simple statistical tools were used for analysis.

In order to evaluate the profitability and productivity of selected fruit and timber trees, investment (financial) analysis were carried out considering the timing of benefit and costs throughout the rotation period of specific trees. Three discounted measures as suggested by Gittinger (1982) for project appraisal were used in the study:

1) Benefit Cost Ratio (BCR) = $\sum_{t=1}^{n} [B_t/(1+i)^t]/ [C_t/(1+i)^t]$

2) Net Present Value (NPV) = $\sum_{t=1}^{n} [B_t - C_t] /(1+i)^t$

3) Internal Rate of Return (IRR) = $\sum_{t=1}^{n} [B_t - C_t] /(1+i)^t = 0$

Where, Bt = Benefit in each year t
Ct = Cost in each year,
t = 1, 2,........,n,
n= number of years,
i = interest (discount) rate (assuming 0.08).

The BCR is relative measure, which is used to compare benefit per unit of cost. The NPV is an absolute measure, which estimates the net worth of trees. The IRR is defined as the average earning power of an investment over the rotation period of the perennial fruit and timber.

In investment analysis, total cost and total return per tree were calculated on the basis of assumption and information gathered from sample farmers. The total cost of fruit trees and timber is included seed/sapling, manure/fertilizer/pesticides, material cost and labour cost on the basis of per tree. All fruit trees and timber were estimated for 25 years rotation and guava was estimated 15 years. Secondary and primary information was used to estimate the fruit and timber yield (at harvest) of different species. The fuel wood yield was estimated on the basis of farmers' practice on branch/leaf pruning in different species. So, these are crude estimates based on information gathered from key informants and secondary sources.

Results and Discussion

Homestead utilization pattern

The homestead utilization pattern under different farm categories has been presented in table 1. In case of all farm categories, the largest portion of the homestead was occupied by trees and bushes. The area devoted to vegetable production was 16.75 and 108.8 sq. meter for tribal and Bengali farmers, respectively. The area occupied by trees and bushes was smaller in tribal homestead due to small size of homestead than that in the Bengali. The area of vegetable garden was also larger compared to tribal homestead. Most of the farms were found to have more open yard/space for the purpose of threshing and drying of crops.

Trees grown in the homesteads and species selection criteria for homestead plantation

Thirteen different tree species were identified in the homestead. The distribution of species was influenced by macro and micro-environmental factors of the homestead and the needs and choices of the family. Farmers were found to prefer fruit trees as they could get both fruit timber and fuel from the trees.

The highest average number of fruit trees was banana (11-14 per household) which was also found in Base line Survey in Bandarban, 2002, conducted by OFRD, BARI, Bandarban and timber tree was Gammer-4-11, Mahogonj-4-5 per household). It was found that 33% household contained banana and 31% household contained Gammer in Bengali. In the study area, there were grown in different types of vegetables in homestead areas i,e. Dherosh, Lau, Seem, Chilli, Brinjal, Radish, Stem amaranth, tomato, red amaranth and Bittergourdetc(Table 2).

Profitability of major fruit and timber tree species

In order to evaluate the profitability of major fruit and timber tree species, investment analysis was applied considering the timing of benefits and costs throughout the routable period of specific trees.

The results of financial analysis of different fruit trees and timber tree species were presented in table 3. It was revealed that all fruit and timber trees were found profitable because of high benefit cost ratio (BCR), net present value (NPV) and internal rate of return (IRR) and more or less same result was found in the previous relative study at Char area of Noakhali (Uddin *et. al.*, 2003). The average BCR, NPV and IRR for all species under study was found 47, Tk.3073 and 48% respectively. Among the fruit trees, Jackfruit was highly profitable which BCR were 7.80, NPV was Tk.2630.00 and IRR was 66% implying that return from investment in fruit trees would be more than the opportunity cost of capital, at least in the formal capital market. It was also revealed that among the timber trees, Segun was highly profitable which produced BCR, NPV and IRR of 155, Tk.10111.00 and 73% respectively (Table 4). Investment (Financial) analysis of fruit and timber trees showed that BCRs were greater than one, NPVs were positive and IRR were more than 30 percent, indicates that longer term investment on fruit and timber trees is profitable.

Decision making of homestead agroforestry by the family members

The family members were asked to express their views on their participation in the decision making on homestead agroforestry activities. For decision making, it was observed that women of the tribal family and men in the Bangali family were dominant for providing decision in homestead agroforestry activities. About 93 percent male farmers of tribal family provide decision on input collection and money handling and 93% wife in put selection as well as fertilizer application. It was also observed that wife of both tribal and Bangali families played significant role in decision making (tribal-98% and bangali- 93%) on planting or sowing of sapling or seeds in homestead (Table 4).

Constraints/Limiting factors of planting new trees in the homestead

The need for growing more trees is felt by almost all farmers. But various physical, technical and socioeconomic constraints limit their desires. Lack of technical know-how, lack of good seed/seedling was the most common constraints of growing trees which was reported by 93% farmers. Though the Bengali farmers had a larger homestead area, about 33% of them reported scarcity of space for tree planting, as they required an open space for different household works like drying of crops and cloths, thereby of crop residues etc. Lack of irrigation was another problem due to maximum homestead was situated on high land or hill slope which was reported by 80 percent of farmers. Lack of cash money for purchasing fertilizer and unavailability of fertilizer due to long distance to market from their house was another problem and it was reported by 90 and 93 percent farmers, respectively (Table 5).

Conclusion

There is a great opportunities and prospects for improvement of the existing traditionally managed homesteads. Majority of the homestead were found under utilized with limited fruit trees and vegetables. No scientific management practices have been identified to improve the homestead productivity. Replacement of the less productive trees/shrubs with a number of multipurpose tree species such as *Mangifera indica, Artocarpus heterophllus, Cocos nucifera, Psidium guajava, Lichi chinensis, Citrus spp*. etc. in the homesteads which may fulfill the basic requirements of fuel, food/fruit, timber and fodder for the farmers. It can serve as a source of cash income. Similarly, planting of quick-growing nitrogen fixing tree species like *Acacia nilotica, Dalbergia sissoo*, etc. will help the farmers to overcome fuel wood and timber crisis and maintain the fertility and productivity of the homestead. Proper management practices such as pruning, pollarding, bending, etc. may enhance total dry matter, flower and fruit production.

Recommendations

The policy recommendation constitute important guide lines for developing homestead agroforestry recommendation based on the finding of the study are presented below:

i. Extension workers and farmers should be trained with improved management practice of trees particularly for homestead plantation.

ii. A special plan for optimal utilization of homestead area to be designed.

iii. Seeds/seedlings/sapling of proven/economic species should be available to the farmers.

iv. Finally, well-planned and well-managed agroforestry can play a great role in improving homestead in the study area as well as in Bangladesh.

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Table 1. Homestead utilization pattern in different farm categories at Bandarban sadar

Farm category	Av. homestead size (m^2)	Area of homestead under different used (m^2)						
		Housing	Cattle shed	Pond/ ditches	Tree & bushes	Thresh/ drying floor	Vegetables garden	Other/ Fallow
Tribal	155	35.07	6.17	19.20	54.10	7.23	16.75	2.63
Bangali	431.56	40.92	15.54	-	172.21	35.94	108.8	70.00

Source: Field Survey 2004

Table 2. Major tree species and vegetables grown in the homestead at Bandarban

Sl. no	Species	Av. number of per household		% household contained	
		Tribal	Bangali	Tribal	Bangali
A.	**Fruit trees:**				
	Mango	4.0	4.78	10	15
	Jack fruit	4.23	3.22	10	10
	Litchi	2.6	2.33	6	7
	Coconut	4.18	6.00	10	19
	Betel nut	8.24	-	20	-
	Guava	2.66	3.4	6	11
	Banana	14	10.5	**34**	**33**
	Palmyra plum	1.0	1.5	2	5
B.	**Timber trees:**				
	Cotton tree	1.0	-	5	-
	Segun	2.83	4.36	15	12
	Mehagoni	5.33	4.00	**28**	11
	Gammer	3.64	11.4	**19**	**31**
	Jaam	2.22	4.00	12	11
	Korai	2.0	6.25	11	**17**
C.	**Vegetables:**	**Area(Sq. meter)**			
	Dherosh	6.68	3.25	26	3
	Lau	1.17	1.23	5	1
	Seem	1.68	5.00	7	4
	Chilli	2.75	30.00	11	23
	Brinjal	2.51	13.33	10	10
	Radish	2.51	8.0	10	6
	Stem amaranth	1.90	15.00	8	11
	Tomato	2.42	12.0	10	9
	Redamarnth	2.2	4.30	9	3
	Bittergourd	0.58	20.00	2	15

Source: Field Survey 2004

Table 3. Investment analysis of fruit and timber trees at Bandarban sadar areas

Sl. no	Species	Av. cost and return (Tk./tree)					
		TC (Tk.)	TR (Tk.)	NB (Tk.)	BCR	NPV (Tk.)	IRR (%)
A. Horticultural species							
1	Mango	87	281	194	3.2	758	35
2	Jackfruit	89	695	606	7.8	2630	66
3	Coconut	83	397	314	4.7	1241	38
4	Betelnut	32	119	87	3.7	810	34
5	Guava	56	177	121	3.1	657	32
6	Litchi	91	438	347	4.8	1488	48
7	Palmyra plum	36	397	361	11.0	1857	50
	Average	68	358	290	6.0	1349	43
B. Timber species							
8	Mehagoni	39	2630	2591	67.0	3091	48
9	Segun	57	8854	8797	155.0	10111	73
10	Jaam	25	920	895	36.8	1462	35
11	Gammer	33	1622	1589	48.0	2689	38
12	Korai	26	3340	3314	127.0	6633	64
	Average	36	3473	3437	87.0	4797	52
	All	52	1916	1864	97.0	3073	48

Source: Field survey

Note: TC= Total cost(Tk./tree), TR= total return(Tk./tree) and NB= Net benefit(Tk./tree)

Table 4. Decision making for planting fruit trees, timber trees and vegetables on homestead by family members

Activities	Percent of decision making by family members									
	Farmers own		Wife		Parents		Children		Relatives	
	T	B	T	B	T	B	T	B	T	B
Selection of sapling/seeds	60	87	73	20	25	-	7.0	-	-	-
Plot selection	53	60	93	40	10	-	15	-	-	-
Sapling/seed collection	60	93	60	7.0	6.0	-	7.0	-	12	11
Planting/sowing	53	67	98	93	27	13	26	27	1.0	3.0
Inputs collection	93	98	33	33	-	7.0	13	7.0	-	-
Fertilizer apply	60	93	93	20	-	7.0	20	6.0	-	-
Pruning	87	80	-	26	-	-	60	20	-	-
Product sales	27	93	87	6.0	-	20	60	20	-	7.0
Money handling	93	13	80	-	-	-	-	-	-	-

T = Tribal, B = Bangali

Table 5. Constraints of planting new trees on the homesteads in different farm categories

Sl. no.	Problems/constraints	Percent of respondent by farm categories		
		Tribal	Bengali	All groups
1	Insufficient space for new plantation	27	33	30
2	Lack of irrigation	93	67	80
3	Lack of good quality seed/sapling	93	93	93
4	Attack of pest and diseases	67	67	67
5	Lack of cash money	93	87	90
6	Unavailability of fertilizer and insecticides	93	93	93
7	Ownership problem in homestead	20	7.0	14
8	Lack of technical know-how for improving homestead	93	93	93

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PRODUCTION, UTILIZATION AND MARKETING OF BANANA IN BANDARBAN HILLY AREAS

Abstract

The study was conducted at Bandarban sadar Thana in Chittagong Hill Tract area, Bandarban during January to March 2004 with a view to estimate cost, return and profitability of banana production as well as marketing cost, marketing margin and seasonal price of banana. In total 80 sample were selected of them 45 were farmer, 10 were faria, 13 were wholesalers and 12 were retailers. Data were collected from different categories of farmers of banana growers and marketing functionaries. It was revealed that average the highest yield was found 1832 bunches (18.32 t/ha) for small farmers. The highest gross return (Tk. 155736/ha) was obtained from small farm categories. The highest production cost (Tk. 19651/ha) was found from medium farmers while the lowest was Tk. 13383/ha from large farmers. The highest gross margin was estimated Tk. 136817/ha for small farmers and it was the lowest Tk. 92450/ha for large farmer. The highest BCR was found 8.2 for small farmer and 7.0 for medium farmer. Total marketing cost per 100 bunches was found higher for wholesaler Tk. 1942 and it was lowest for faria Tk. 933. The special price was estimated per 100 banana was Tk. 69 for wholesaler and Tk. 93 for retailer. Price of banana was lower in rainy season due to mass production of banana while it was higher in winter season for lower supply. Black spot on banana, buncy top virus, diseases and technical know-how of improved banana production were the main constraints to banana growers. Higher marketing tolls and lack of government facilities for running the banana marketing were the major marketing constraints. The government agencies should keep attention to solve the banana production and marketing problems for higher economic return as well as better utilization of natural resources in Bandarban hilly areas.

Introduction

Banana is one of the major horticultural crops in hill district Bandarban. About 1206 hectares of hilly land covered by banana cultivation and total production was estimated as 22360 metric tons in 1998-99 where per hectare yield was 18.5 ton (BBS, 1999). The most of the banana come form Jhum and small gardens in the Chittagong Hill Tracts (CHT) region. Banana production in the CHT has been increasing with the integration of different into the Jhum cycle. But over 90 percent of banana grown in the Jhum is of poor quality indigenous varieties. Recently some organized commercial gardening is gaining popularly in Khagrachari and Bandarban districts. Ninety percent of the banana cultivation is of local and indigenous variety, mostly Champa and Bangla. Market value of these varieties is low and the keeping quality poor. Abundant banana production in the CHT (over 3250000 tones annually) can profitably be brewed to banana beer. After meeting local consumption the beer can be exported outside the country (Mutsaers, 2000).

Nearly half of the organized (non Jhum) banana plantation in Khagrachari, Bandarban and Rangamati districts is offered to pre-harvest contracters. The contractors could be local representatives of the Chittagong buyers or their travelling representatives. The contractor examines the crop and offers a price for the garden to the owner. The owner continues to look after the garden up to harvest time. Harvesting generally continues throughout the year with some degree of variation in production.

Those who have not or could not offer their orchards to contractors take the fruits in the nearby Hat after harvest and offer for sale to local buyers, who almost invariably represent a Chittagong trader. The harvested produce is assembled in major centers in growing areas, sorted, graded and transported for further trade in Chittagong or other centers. Banana bunches are not packed at all and are dumped in to the truck as such. A considerable portion of the fruit is damaged physically and loses quality at the time of loading. Further damage is done while on journey.

Chittagong cartel is extremely concerned about the ruling prices. If a lot is about to be auctioned in Chittagong fruit market (Fringee Bazar) at prices considered low by the cartel, it is invariably bought by the cartel and shipped out to a further destination, thus ensuring that the Chittagong price does not fall below the desired level. Over the entire season, the prices in the rest of the major markets get adjusted to Chittagong levels.

The growers of CHT region made some attempts to market banana by themselves. But they were, however considerably handicapped by not having an access to market intelligence at various wholesale center . As a result , they ended up following the lead given by Chittagong cartel group . So, the banana growers in the hilly region utterly helpless; prices offered to them at the farm were not sufficient even to cover the cost of harvesting and carrying the fruit.

Banana production and marketing assume an important place in the agricultural development of Bangladesh. Despite the vast utility of banana, its marketing system in hill region is plagued with several inadequacies. So there is need for detail study on banana production and marketing. In this context the present study was conducted with the following objectives:

Objectives

i. to estimate the cost and returns of banana production and utilization of banana under different farm categories at hilly areas in Bandarban;
ii. to identify the existing marketing channels;
iii. to estimate the marketing costs, margins, spatial and seasonal price variation of banana;
iv. to identify the problems faced by the farmers and markets participants and also to recommend suggestions for solution of these problems.

Methodology

Area description

***Location and area extent*:** The site is lies between 21°55' and 22°22' North latitudes and between 92°08' and 92°19' East longitudes. The site represents the area of AEZ 29. The area of sadar Upazila was estimated 49490 ha. Where single cropped area was 2632 ha, doubled cropped area was 1101 ha, triple cropped area was 240 ha, net cropped area was 3976 ha and current fallow land was 214.60 ha.(DAE, 2002). The cropping intensity of this area was 146.58% in 1998-99 (BBS, 1999).

Climate: In the study area the climate is sub-topical monsoon. Hot and humid rainy season alternates with dry and cool winter. Annual rainfall ranges 1760-2890 mm. About 87% of the rainfall is occurred during the months of May to October. Monthly maximum and minimum mean temperatures ranges from 27 to36°C and 16 to 27°°C (SRDI, 2002).

Soils: The soil is mainly reddish brown loam and strongly acidic. The valley soil contains acid loam and clay subject to seasonal flooding. It is mainly used for rice cultivation. But the steep slopes with red hill soil make most of the area unsuitable for the crops (BBS, 2000). Soil pH ranges from 4.5 to 6.0. Ten soil series identified in this region (SRDI, 1992).

Sampling and data

The study was confined to Bandarban district of Bangladesh which contributes significantly to the total production of banana. On the basis of higher concentration of banana production, Bandarban Sadar thana was selected for the survey. Two local markets namely Bandarban sadar and Balaghata bazar were a part of total population. The participants involved in banana production and marketing in the study area were farmer, faria, wholesaler and retailer. The selected total sample included 45 farmers (small-20, medium-15 and largr-10), 10 Farias, 13 wholesalers and 12 retailers. Data were collected during the months of January to March 2004.

Analytical Procedure

The data collected from different categories of farmers i, e. owner of banana garden and different marketing functionaries were analyzed to estimate cost, return and profitability of banana production as well as marketing cost, marketing margin and seasonal price variation of banana. The simple statistical procedure was used for analysis.

Procedure for cost and return analysis of banana production

The cost and return function may be expressed as:

$$PC = \Sigma\, pixi$$
$$TPC = PC + m$$
$$TR = \Sigma\, riqi$$

Where, PC = production cost

pi = price of i -th input factor
xi = amount of i -th cost
TPC = total production cost
m = interest on operating capital
TR = total revenue
ri = price i-th product
qi = amount of i -th product

if TR is greater than TPC, the farm receives a positive net return and TR is less than TPC, the farm incurs a negative net returns.

Interpretations of the profit and loss and the rate of return situation of the cost and return analysis would be made:

$$TVC = TPP.\ py \text{ or } Y.py$$

where, TVP = Total value product; TPP = Total physical product; py = price and y = Yield.

Results and Analysis

Cost and return of banana production

Table 1 presents the cost and return of banana production at hilly areas in Bandarban under different farm categories. It revealed that the average yield of banana was found 1566 bunches ha^{-1} for all category of farmer. Considering the farm category, the highest yield was obtained 1832 bunches ha^{-1} for small farmer and it was lowest 1245 bunches ha^{-1} for large farmer followed by 1621 bunches ha^{-1} for medium farmer.

The average gross return was found Tk.133118 ha^{-1} for all farmers. The highest gross return was estimated as Tk.155736 ha^{-1} for small farmers and it was lowest Tk.105832 ha^{-1} for large farmer (Table 1).

The average production cost was found as Tk.17317 ha^{-1} for all farmers and it was highest as Tk 19651 ha^{-1} for medium farmers and lowest Tk. 13383 ha^{-1} for large farmer. Cost items were included as cost of shacker, cost of land preparation, cost of planting and cost of harvesting. Farmers were not habited to apply fertilizer in their banana garden due to lack of cash money and technical know-how. So, no fertilizer cost was included. Farmers did not maintain intercultural operation as because shortage of knowledge and inhibited. As a result the intercultural operation cost was also not included.

The average gross margin was found Tk.115800 ha^{-1} for all farmers. The highest gross margin was estimated Tk. 36817 ha^{-1} for small farmer and it was lowest Tk. 92450 ha^{-1} for large farmer (Table 1). The average benefit cost ratio was found Tk. 7.7 for all farmers and it was highest 8.2 for small farmer and lowest 7.0 for medium farmer (Table 1).

Utilization of banana

The utilization pattern was identified as own consumption, sales, distribution and wastage. It revealed that out of total banana production, 92.76 percent were sold, 3.5 percent for own consumption, 2 percent for distribution to their relatives and neighbor and 1.66 percent was wastage (Table 2).

Marketing of banana

Marketing of banana at hilly areas is an important issue for our national scenario. For details analysis of marketing the following particulars needed to be discussed:

Market Participants

Different types of intermediaries involved in banana marketing in the study were as faria, wholesaler and retailer. A brief description of them is given below:

Farmer: Marketing channel of banana started from the banana-growing farmers. They were classified into three groups' namely small, medium and large farmers. The socio-economic condition of the three groups of farmers varied. The small farmers owned below 2.5 acres of land, medium farmers, 2.5-5.0 acres and large farmers owned above 5 acres of land. The modes of selling of these groups were different.

Faria: They were the small traders who had no fixed establishment and staff. They purchased banana from the farmers at the farm gate or in the local market and sold them to wholesalers and partly to retailers. They also dealt in other agricultural commodities. They did their business independently with self finance.

Wholesaler: They were relatively large traders having fixed establishment in the market and had also permanent staff. They purchased the large portion of banana from farmers or faria. Generally, the large share of their purchase was sold to Chittagong market and a small amount to retailer at Keranihatt, Shatkania, Chittagong which only 22 km from Bandarban town.

Retailer: They were the last link in the channel of banana marketing. In the study area, they had small permanent or temporary shops located at Bandarban Bazar, Bandarban. They purchased banana from wholesaler, Faria and farmer and sold it to the ultimate consumer. Most of them were also involved in trading of commodities like pulses, oil or different types of necessary things.

Marketing Channels of Banana

In the study area the following marketing channels were identified:

Channels

1. Farmer → Faria → Wholesaler → Retailer → Consumer
2. Farmer → Wholesaler → Retailer → Consumer
3. Farmer → Faria → Retailer → Consumer
4. Farmer → Wholesaler → Traders → Consumer

Marketing Function of Banana

Marketing function may be defined as major specialized activities performed in the accomplishing the marketing process (Kohls and Uhl, 1980). Some of the common functions involved in banana marketing are buying, selling, transportation, storage, market information and pricing. The sellers were found to possess low bargaining power as compared to buyers of banana. Rickshaw, van and boat were the common means of transportation for farmers. Maximum faria sold banana on the spot. Retailer were used Rickshaw as transportation and wholesaler were used jeep or truck. Green banana leaves were used for storage of banana. Sources of market information were poor i,e. personal visit to market and fellow farmers.

Marketing Costs

Marketing costs represent the cost of performing various marketing functions needed to transfer a commodity from the place of production to the ultimate consumer. Marketing cost incurred by the various market participants is discussed in turn. Table 3 presents that the banana marketing costs for different categories of farmer- small, medium and large farmers were Tk 1540, Tk.1596 and Tk.1624 respectively with average being about Tk. 1586 per 100 bunches of banana. Table 4 shows the costs incurred by different types of intermediaries. The total marketing cost per 100 bunches was higher for wholesaler Tk. 1941 who sold banana in Chittagong market and it was lowest for Faria Tk. 932 who sold the banana on the spot and retailer sold it to their ultimate consumer.

Marketing margins

In this study, gross marketing margin of each intermediary was estimated by deducting the purchase price of banana from the sale price while the net margin/profit component was estimated by deducting the marketing cost from the gross marketing margin. Table 5 presents the marketing margin of different banana intermediaries in Bandarban. The gross margin of banana per 100 bunches were Tk. 1979, Tk.3452 and Tk. 5895 for Farias, wholesalers and retailers respectively whereas the highest net margin was found as Tk. 4395 for retailer and his profit making was relatively better than other.

Spatial and seasonal price variation of banana

It was observed that the spatial price of banana was varied in the study area. It was estimated that the farm gate price of per 100 bananas was Tk.53 where it was Tk.69 for wholesaler and Tk.93 for retailer.

On the other hand, the seasonal price of banana was also differed due to different demand of banana in different seasons. It was observed that, the price of per 100 bananas was accounted as Tk. 100 in summer season while it was Tk. 75 in rainy season and Tk.125 for winter season. It revealed that in winter season, the price of banana was high due to low production and limited supply of banana. In rainy season price of banana was lower than other season due to high production and mass supply of banana in market. On the other hand, the price of banana was also high due to high demand of banana. The month wise price variation of banana was also observed. The price of per 100 bananas was estimated as Tk. 93, Tk. 125, Tk. 150, Tk. 80, Tk. 80, Tk. 75, Tk. 70, Tk. 69, Tk. 80, Tk. 90, Tk. 100 and Tk. 125 respectively (Table 6).

Problems of banana production faced by the farmer

Black spot on the banana due to fruit beetle was the acute problem faced by about 88 percent of the farmers. About 64 percent farmers faced by diseases of bunchy top in their banana garden and 55 percent were Sigatoka diseases. Due to the lack of cash money farmers did not apply fertilizer in their banana garden which opined 31 percent of farmers. About 67 percent farmers claimed that they had no technical knowledge for better management practices of banana garden (Table 7).

Problems of banana marketing

As regards banana marketing, the banana growing farmers and intermediaries were found to have been facing a number of interrelated problems which might cause the main barier to rapid diffusion and adoption of banana marketing. Table 8 shows the marketing problems faced by the farmer. Dominance of intermediaries was the second most important problem faced by 73 percent of the farmers. Received higher market tolls were the first problem claimed at 92 percent of the farmers. Local administration may be solved it. About 58 percent farmers opined that they received low price of banana during rainy season for mass production at this stage government could be intervened for collecting banana with give price support to the farmers.

Table 9 shows the problems reported by the banana intermediaries. About 65 percent of all intermediaries reported that shortage of operating capital was their problem for run their business. Damage due to absence of storage facilities indicated as problem by 83 percent of intermediaries. About 72 percent reported that they had to paid high marketing cost and 89 percent of the intermediaries claimed that government did not give any marketing facilities.

Conclusion and Recommendations

From the above discussion it might be concluded that, the banana growers did not used fertilizer due to lack of cash money and unknown to the effect of fertilizer on banana production in the study area. To overcome this problem, this type of program may be introduced at farmer's level. Black spot on the banana, bunchy top virus and Sigatoka diseases was prevalent but farmers did not know how to over come this problem. Unknown to the technical know-how was another production constraint. To over come this, such type of training program should be organized at farms level. If would be possibly organized, farmers will be benefited as well as banana production would be surplus. It was observed in banana garden that, the good quality product was only 20 percent due to local variety or improper management. So, high yielding variety with improved management packages may be introduced at farm level.

In case of marketing, farmers received very lower price due to dominance of intermediaries and long distance (3-8 km) to their sales market from banana garden. As a result they are bound to sale it, though the price was very low. To overcome this, sales centre should be established near to the garden by the formation of co-operative system. Lack of storage facility and collection of different types of tolls (Union tax, Purashaba tax and market tax etc.) was the major marketing constraint. To over come this, local government should give attention.

Due attention should be paid to solve the banana production and marketing problems for higher economic return as well as better utilization of natural resources in Bandarban hilly areas.

Table 1. Cost and returns of Banana production at hilly areas in Bandarban

Items	Categories of farmer			
	Small (n=20)	Medium (n=15)	Large (n =10)	All farmer (n=45)
A. Yield of banana (no.of bunches/ha)	1832	1621	1245	1566
B. Farm gate price (Tk/bunches)	85	85	85	85
C. Gross return (Tk/ha)	155736	137785	105833	133118
D. Production cost (Tk/ ha):	-	-	-	-
Cost of Sacker @ Tk. 4/ shaker	4277	38560	3135	3757
a. Cost of land preparation	5806	6943	4631	5793
b. Cost of planting	4043	3059	2494	3198
c. Cost of harvesting	4792	5790	3123	4568
E. Total cost of production (Tk/ha)	18918	19651	13383	17317
F. Gross margin (Tk/ha)	136817	118134	92450	115800
G. Benefit cost ratio (C/E) (Undiscounted)	8.2	7.0	7.9	7.7
E. Production cost (Tk/bunches) B/A	10.32	12.12	10.75	11.06

Table 2. Utilization pattern of banana under different farm categories

Category of farmer	Utilization pattern of banana (%)			
	Own consumption	Sales	Distribution	wastage
Small	7.0	86.30	4.2	3.0
Medium	2.0	96.0	1.0	1.0
Large	2.0	96.0	1.0	1.0
All farmer	3.5	92.76	2.0	1.66

Table 3. Marketing cost (Tk. per 100 bunches)of banana incurred by farmers

Cost items	Categories of farmers			
	Small	Medium	Large	All farmer
Transportation	519 (34)	508 (32)	485 (30)	505 (32)
Wages	204 (13)	223 (14)	208 (13)	212 (13)
Wastage	258 (17)	245 (15)	265 (16)	256 (16)
Market tolls	229 (15)	222 (14)	230 (14)	227 (14)
Personal expenses	330 (21)	398 (25)	433 (27)	3867 (24)
Total	1540 (100)	1596 (100)	1624 (100)	1586 (100)

Source: Field survey 2004.

Table 4. Marketing costs (Tk. per 100 bunches) of banana incurred by different intermediaries

Cost items	Faria	Wholesaler	Retailer
Transportation	131 (14.09)	421 (21.70)	275 (18.33)
Loading and unloading	-	298 (15.34)	167 (11.15)
Market tolls	307 (32.91)	301 (15.50)	300 (20.00)
Wages	197 (21.18)	306 (15.77)	200 (13.33)
Wastage	121 (13.01)	246 (12.69)	253 (16.92)
Storage	-	125 (6.48)	102 (6.84)
Personal expenses	175 (18.78)	242. (12.48)	201 (13.40)
Total	932 (100)	1941 (100)	1499 (100)

Source: Field survey 2004.
Figures in parentheses indicate percentage of total marketing cost.

Table 5. Marketing margin (Tk. per 100 bunches) of intermediaries at Bandarban

Particulars	Faria	Wholesaler	Retailer
Purchase price (1)	8220	11962	7354
Sale price (2)	10200	15414	13250
Gross Margin (3 = 2-1)	1979	3452	5895
Marketing cost (4)	932	1941	1499
Net margin (5 = 3-4)	1047	1510	4395

Source: Field survey 2004.
Figures in parentheses indicate percentage of total marketing cost.

Table 6. Seasonal price variation of Banana at Bandarban

Month	Price of per 100 bananas (Tk.)	Month	Price of per 100 bananas (Tk.)
January	93	July	70
February	125	August	69
March	150	September	80
April	80	October	90
May	80	November	100
June	75	December	125

Table 7. Problems faced by the farmer in banana production at Bandarban

Problems	Responses of different farmers (in percentages)			
	Small	Medium	Large	All farmer
1. Black spot on the banana due to fruit beetle	89	92	83	88
2. Prevalent of bunchy top virus diseases	67	58	66	64
3. Attack of Sigatoka diseases of banana	56	50	59	55
4. Unable to fertilizer apply due to lack of cash money	44	23	25	31
5. Lack of technical know-how an improved management of banana production	76	67	59	67

Source: Field survey 2004.

Table 8. Problems faced by the banana-producing farmer in marketing at Bandarban

Problems	Responses of different farmers (in percentages)			
	Small	Medium	Large	All farmer
Dominance of intermediaries	87	75	58	73
Higher market tolls	96	93	89	92
Poor communication and transport facilities	43	31	25	33
Inadequate market demand	39	18	28	25
Low price of banana in rainy season	68	59	48	58

Source: Field survey 2004.

Table 9. Problems faced by the intermediaries in banana marketing at Bandarban

Problems	Responses of different intermediaries (in percentages)			
	Faria	Wholesaler	Retailer	All intermediaries
Shortage of operating capital	68	73	53	65
Poor communication and transport facility	12	45	11	23
Absence of storage facilities	-	92	75	83
Lack of adequate market information	56	48	53	53
High marketing cost	72	77	68	72
Lack of govt. facilities in marketing	88	94	85	89

Source: Field survey 2004.

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YIELD GAP ANALYSIS OF WHEAT UNDER DIFFERENT MANAGEMENT SITUATION AT MLT SITE, POLASHBARI, RANGPUR

Abstract

The study was conducted at MLT site, Polashbari under Rangpur district to estimate the yield and benefit gap under different management practices of Wheat (Var. Kanchan) cultivation during April-May 2004. A total of 40 plots of 40 farmers were selected randomly to collect primary data, of them 20 farmers were under Better Practiced Farmers plots (BPFP) and the rest were Average Practiced Farmers Plots(APFP). It was observed that BPFP gave higher yield (2.56 t ha^{-1}) than the average practiced farmers plots (APFP) (1.87 t ha^{-1}). The yield gap between BPFP and APFP was found 688 kg ha^{-1} (27%) and that of benefit gap (gross margin) was found Tk. 9801 ha^{-1} (25%). It was estimated that TSP, gypsum and borax played statistically significant role in yield gap between BPFP and APFP. The study suggested that the difference in yield and benefit could be minimized at farm level to increase the use of TSP, borax and decrease the use of gypsum fertilizer in the APFP.

Introduction

Wheat is the second cereal crop in Bangladesh. It can play a vital role in food requirement in the national perspective. Production area of Wheat is increasing day by day but the yield of Wheat does not increase in the same rate. The national average yield of Wheat was 2.27 t/ha in 1997-98 and 2.19 t/ha in 1998-99 (BBS, 1999). In the farmers fields the production efficiency of Wheat, like other crops is not satisfactory in the country. Varietal performance varied significantly from research station to farmers' field. Because the factors of production, both quality and quantity, are not maintained properly in the farmers' level. Amount and quality of different inputs used, sowing or planting time, intercultural operations etc. varied from research station to farmers' practice and also varied among the farmers cultivating Wheat. These might be the causes of such yield differences. In Bangladesh, most of the farmers cultivate Kanchan variety of Wheat with traditional management practices resulting low average yield. The farmers do not follow the recommended practices. But there are some farmers whose management is better compared to the average farmers and thus they obtain better yield. In order to increase the production of Wheat to its maximum possible extent at farm level, it is necessary to identify the factors behind this yield gaps. The study is, therefore, designed to estimate the yield and benefit differences of Wheat under different management practices and to identify the factors behind yield differences of Wheat under different management practices.

Methodology

The study was conducted at MLT site, Polashbari under Rangpur district to estimate the yield and benefit gap under different management practices of Wheat (Var. Kanchan) cultivation during April-May 2004. The farmers' management practices were classified into two groups. The first group consists of better-practiced 50 percent farmers (better practiced farmers' plot-BPFP) who got comparatively higher yield and the rest 50 percent were the average practiced farmers' plots (APFP). A total of 40 plots of 40 farmers were selected randomly to collect primary data, of them 20 farmers were under Better Practiced Farmers plots (BPFP) and the rest were Average Practiced Farmers Plots(APFP). Data were collected through survey method by using a pre-tested schedule. The collected data were edited and analyzed statistically and presented in a tabular form.

A Cobb-Douglas production function was selected to quantify the relative contribution of different production factors to the yield gap between BPFP and APFP for being easy on logarithmic transformation. The function becomes a simple linear one and the co-efficient of the production factors are the elasticity of production.

The Cobb- Douglas functional form of the multiple regressions is as follows:

$$Y = a\, X_i\, U_i$$

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7\, U_i$$

Where,

Y = Yield gap between better practiced farmers plot (BPFP) and average practiced farmers plot (APFP) (Kg/ha)

X_1= Difference in Urea (kg/ha)

X_2= Difference in TSP (kg/ha)

X_3= Difference in MP (kg/ha)

X_4= Difference in Gypsum (kg/ha)

X_5= Difference in Zinc oxide (kg/ha)

X_6= Difference in Borax (kg/ha)

X_7 = Difference in Human labor (Tk/ha)

a = Constant or intercept, b_1, b_2, b_3, ----,b_7 = Co efficient of respective variables and

U_i= Disturbance term.

Limitations

Qualitative production factors, such as no. of irrigation, date and time of different cultural operations might have a great impact on the variation to the yield gap, but these factors could not be included in the model.

Results and Discussion

Agronomic practices and technology employed

It was observed that there were differences in agronomic practices as well as input use levels between BPFP and APFP. Better practiced plots received more amount of chemical fertilizer 199-118-68-74-5-4 kg Urea-TSP-MP-Gypsum- Zinc oxide -Borax ha^{-1} respectively than that of average practiced plots 167-96-62-64-0-0 kg Urea-TSP-MP-Gypsum- Zinc oxide -Borax ha^{-1} respectively (Table-1). Sowing period also differed. Farmers did not use fertilizer rationally and it might be due to lack of proper knowledge and cash. Better practiced farmers were found to use more amounts of chemical fertilizers and this might be caused higher yield. It was observed that BPFP produced higher yield (2.56 t/ha) than that of APFP (1.87 t/ha). The yield gap was 688 kg/ha. It was found that farmers applied less amount of fertilizer except urea and MP (199-118-68-74-5-4 kg Urea-TSP-MP-Gypsum- Zinc oxide -Borax ha^{-1}) than that of recommendation (180-140-40-110-9.6-7.5 kg/ha Urea-TSP-MP-Gypsum-Zinc oxide-Borax) (BARC, 1997). This wide gap in fertilizer use might be the cause of such yield gap. It was observed that any of the farmers group do not use recommended dose of fertilizer but better practiced farmers were closer to the recommended dose of fertilizer.

Cost of cultivation

In case of BPFP and APFP the average total cost was found Tk 13428 and Tk 9654, respectively. The higher cost incurred in Wheat cultivation under better practiced plots compared to average farmers' practices was mainly due to higher use of material inputs and improved management practices (Table-2). The better-practiced farmers' plots obtained higher gross margin (Tk 9801) than average practiced farmers' plots (Tk. 7313). It noticed that 28% gap in total cost caused 27% gap in grain yield and 25% gap in gross margin. It indicates that the cost incurred at average practiced farmers' plot was not rational and provides less return to the farmers.

Contribution of key factors to the yield gap of Wheat

The Cobb-Douglas production function estimated the relative contribution of key factors in yield gap, which is presented in Table 3. The relative contribution of specified factors influencing yield gap can be explained from the estimates of regression equation.

The coefficient of gap in use of Urea was found 0.328 implying that one percent increase in urea by APFP, keeping other factors constant, would decrease the yield gap by 0.328 percent. Similarly the coefficient of gap in use of TSP, MP and borax were found 0.17, 0.39 and 0.38 respectively, implying that one percent increase in use of TSP by APFP, keeping other factors constant, would decrease the yield gap by 0.17 percent, one percent increase in MP by APFP, keeping other factors constant, would decrease the yield gap by 0.39 percent and one percent increase in borax by APFP, keeping other factors constant, would decrease the yield gap by 0.38 percent (Table 3).

The co-efficient of multiple determinations R^2 was found 0.73 implying that the explanatory variables included in the model explained 73% of the variation in the yield gap of Wheat. The summation of all production co-efficient (**Σ** bi) was found 0.89, means that the production function exhibits decreasing returns to scale. It means if all the inputs specified in the function are increased by 1 percent, yield would have increased 0.89 percent. F value was found 2.58 indicated that all the included explanatory variables are important for explaining the gap in yield of Wheat production (Table 3).

The above-mentioned results and discussions reveal that the production of Wheat can be increased by following recommended practices and yield gap can also be minimized. It was found that TSP, gypsum and borax played significant role in yield gap of Wheat production. As a result the yield level of APFP can be increased by increasing the use of TSP and borax and decrease the use of gypsum. The yield of average practiced farmers' plots can be increased by increasing use of the recommended dose of inputs.

Table 1. Level of technology employed and yield obtained in Wheat cultivation under different management practices at Polashbari MLT site, Rangpur, 2004

Sl. no	Management factor	Situations	
		Better practiced farmers' plots	Average practiced farmers' plots
01	Variety	Kanchan	Kanchan
02	Human labour (man-days)	92	61
03	Plough with mechanical power (No.)	2-3	1-2
04	Seed rate (kg ha^{-1})	150	140
05	Sowing period	29 Nov.-10 Dec.	2-12 Dec.
06	Fertilizer used (kg ha^{-1}):		
	Total (Urea-TSP-MP-Gyp-ZnO-Borax)	199-118-68-74-5-4	167-96-62-64-0-0
07	Irrigation (times)	1-2	1
08	Harvesting time	27 March-6 April	2-6 April
09	Yield (kg ha^{-1}):		
	Grain	2564	1876
	Straw	2870	2042
Gap in grain yield (kg)		688 (27 %)	

Table 2. Difference in average level of variable costs per hectare between BPFP and APFP of Wheat cultivation at Polashbari MLT site, Rangpur, 2004

Items	BPFP	APFP	Difference BPFP-APFP
Mechanical power	375	318	57
Human labour	6440	427	2170
Seed	2100	1964	136
Fertilizer:			
Urea	1195	1002	193
TSP	1537	1251	286
MP	681	624	57
Gypsum	259	225	34
ZnO	198	-	198
Borax	643	-	643
Total cost	13428	9654	3774 (28%)
Main product	21794	15946	5848
By- product	1435	1021	414
Gross return	23229	16967	6262 (27%)
Gross margin	9801	7313	2488 (25%)

BPFP = Better practiced farmers plot, APFP = Average practiced farmers plot

Table 3. Cobb-Douglas production function model estimate of determinants of yield gap in Wheat cultivation at Polashbari MLT site, Rangpur, 2004

Variable	Co-efficient of determination	
Intercept	4.47	(1.76)
X_1 Human labour (Man-days)	0.04	(0.03)
X_2 = Urea (kg/ha)	0.328	(0.17)
X_3 = TSP (kg/ha)	0.174**	(0.12)
X_4 = MP (kg/ha)	0.39	(0.37)
X_5 = Gypsum (kg/ha)	- 0.59*	(0.40)
X_6 = Zinc oxide (kg/ha)	0.174	(0.26)
X_7 = Borax (kg/ha)	0.38**	(0.23)
R^2	0.73	
F-statistics	2.58	
Return to scale ($\sum$ bi)	0.89	
No. of observation	20	

Figures in the parenthesis indicate standard error of mean

** Significant at 1% level, * Significant at 5% level.

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YIELD GAP ANALYSIS OF CHICKPEA UNDER DIFFERENT MANAGEMENT SITUATION AT NACHOLE AREA, CHAPAI NAWABGANJ

Abstract

The study was conducted at MLT site, Nachole, Chapai Nawabganj under OFRD, Rajshahi during April-May 2004 to find out the yield and benefit gap under different management practices of Chickpea (Var. BARI Chola-5) cultivation. A total of 40 plots of 40 farmers were selected randomly to collect primary data, of them 20 farmers were under Better Practiced Farmers plots (BPFP) and the rest were Average Practiced Farmers Plots(APFP). Yield gap between BPFP and APFP was found 324 kg (31%) per hectare as well as gross margin gap was Tk. 3839 per hectare. It was estimated that the key factors behind yield gap were Mp gypsum and borax which significantly influenced in yield gap of Chickpea. The research suggests this apparent yield and economic gap can be minimized at farm level to follow recommended package of technologies.

Introduction

Chickpea is grown in a vast area in Barind area as well as Nachole under Chapai Nawabganj district. It is cultivated in Chickpea-green manure- T.Aman cropping pattern. It is a micro climate sensitive crop. So, it is not possible to grow Chickpea over the year. About 85 percent of total production of Chickpea is produced from the five greater districts as Rajshahi, Pabna, Kushtia, Jessore and Faridpur districts. It is observed that the yield of Chickpea in farmers field differ from that obtained in research station or demonstration plot. This might be due to some variations in cultural practices. Most of the farmers cultivate local varieties of Chickpea with traditional practices caused lower yield. On-Farm Research Division, Rajshahi trying to extend the area of Chickpea with BARI Chola-5 in this area. The farmers do not follow the recommended practices. But there are some farmers whose management is better compared to the average farmers and thus they obtain better yield. In order to increase the production of Chickpea to its maximum possible extent at farm level, it is necessary to identify the factors behind this yield gaps. So, the study has been undertaken to identify the factors that behind the yield gap. The objectives of the study were to estimate the yield and benefit gap of Chickpea between Better Practiced Farmers plots (BPFP) and Average Practiced Farmers Plots (APFP) and to identify the factors that are responsible for yield gap of Chickpea.

Methodology

The study was conducted at MLT site, Nachole in Chapai Nawabganj under OFRD, Rajshahi to estimate the yield and benefit gap under different management practices of Chickpea (Var. BARI Chola-5) cultivation during April-May 2004. The farmers' management practices were classified into two groups. The first group consists of better-practiced 50 percent farmers (better practiced farmers' plot-BPFP) who got comparatively higher yield and the rest 50 percent were the average practiced farmers' plots (APFP). A total of 40 plots of 40 farmers were selected randomly to collect primary data, of them 20 farmers were under Better Practiced Farmers plots (BPFP) and the rest were Average Practiced Farmers Plots(APFP). Data were collected through survey method by using a pre-tested schedule. The collected data were edited, summarized, analyzed statistically and presented in a tabular form in order to achieve the objectives of the study.

Cobb-Douglas production function was selected to quantify the relative contribution of different production factors to the yield gap between farmers' practices and demonstration plot. For being easy on logarithmic transformation, the function becomes a simple linear one and the co-efficient of the production factors is the elasticity of production.

The Cobb-Douglas functional form of the multiple regressions is as follows:

$$Y= a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7}$$

The function can be linearised by transforming it into the logarithmic form

$$\text{Log } Y = \text{Log } a + b_1 \text{Log} X_1 + \ldots\ldots\ldots\ldots\ldots\ldots + b_7 \text{Log} X_7$$

Where,

Y= Yield gap between Better Practiced Farmers plots (BPFP) and Average Practiced Farmers Plots (APFP)

X_1= Difference in Animal power input (Tk/ha)

X_2= Difference in Human labour input (TK/ha)

X_3= Difference in Urea (kg/ha)

X_4= Difference in TSP (kg/ha)

X_5= Difference in MP (kg/ha)

X_6= Difference in Gypsum (kg/ha)

X_7= Difference in Borax (kg/ha)

b_1…….b_7= Co-efficient of the respective variables.

Results and Discussion

It was observed that there were differences in agronomic practices as well as input use levels between BPFP and APFP. Better practiced plots received more amount of chemical fertilizer 45-83-35-31-7 kg Urea-TSP-MP-Gypsum- Borax ha^{-1} respectively than that of average practiced plots 0-38-15-0-0 kg Urea-TSP-MP-Gypsum- Borax ha^{-1} respectively. It was found that the farmers did not use urea, gypsum and borax in AFPP due to their traditional practice (Table 1).

It was observed that higher yield was found from BPFP (1049 kg/ha) while APFP gave less yield (723.7 kg/ha). The gross margin was obtained Tk.16231 per hectare in BPFP while it was Tk. 12392 from APFP. It was observed that 43% gap in total cost caused 31% gap in yield and 31% gap in gross margin(table2).Farmer did not use fertilizer rationally and it might be due to lack of proper knowledge and cash. BPFP were to use more amount of fertilizer than APFP caused higher yield.

Regression analysis

It was found that the coefficient of multiple determinations, R^2 is 0.69 which means that the explanatory variables included in the model explained 69% of the variation in the yield gap. The relative contribution of specified factors influencing yield gap can be seen from the estimates of regression equation. The elasticity of coefficient ($\sum$bi) was found 0.81 means that the production function exhibits decreasing returns to scale, it means if all the inputs specified in the functions are increased by 1 percent, yield would have increased by 0.81 percent (Table 3).

It is suggested that in order to enhance yield, the farmers should increase the use of urea, MP, gypsum and borax. The co-efficient of gap in use of , MP, gypsum and borax were found 0.12, 0.25, 0.14 and 0.21 respectively implies that one present increase in the use of MP, gypsum and borax in the farmers practices, keeping other factors constant, would decrease the yield gap by 0.12, 0.25, 0.14 and 0.21 percent, respectively. It was observed that MP, gypsum and borax showed significant contribution to the yield gap of Chickpea. As a result the yield level of farmers practice can be increased by increase use of MP, gypsum and borax.

It was observed in the study area that pod borer was attack continuously in both plots of Chickpea. In case of APFP, farmers did not use any insecticides due to higher cost and lack of knowledge in that case.

Table 1. Level of technology employed and input used in Better Practiced Farmers plots (BPFP) and average Practiced Farmers Plots (APFP) in Chickpea cultivation at Nachole, Chapai Nawabganj

Input/technology used	BPFP	APFP
Variety	BARI Chola-5	BARI Chola-5
Seed rate (kg/ha)	45	50
Plough with mechanical power (No.)	2	1-2
Human labour (Man-days)	59.2	33.4
Date of sowing (ranges)	20-27 Nov	1-8 Dec.
Fertilizer used (kg/ha):		
Urea	45	-
TSP	83	38
MP	35	15
Gypsum	31	-
Borax	7	-
Insecticides	Ripcord, Symbose	Symbose
Time of harvesting	24-30 March	27 March- 2 April
Grain yield (kg/ha)	1047.8	723.7
Gap in grain yield	324(31%)	

Table 2. Cost and return of Chickpea production at MLT site, Nachole, Chapai Nawabganj

Variable cost item (Tk./ha)	BPFP	APFP	Difference BPFP-APFP
Mechanical power cost	1015	875	140
Human labour cost	4130	2312	1818
Seed cost	1125	1250	-125
Fertilizer cost:			
Urea	240	-	240
TSP	1040	494	546
MP	315	150	165
Gypsum	93	-	93
Borax	980	-	980
Insecticides	1027	602	425
Total variable cost	9965	5683	4282 (41%)
Gross return	26196	18075	8121 (31%)
Gross margin	16231	12392	3839 (23%)

Table 3. Cobb-Douglas production model estimate of determinants of yield gap in Chickpea production

Explanatory variables and output	Coefficient of determination
Intercept	2.29 (1.19)
X_1 = Human labour (man-day)	0.03 (0.02)
X_2 = Mechanical power (Tk/ha)	0.01 (0.005)
X_3= Urea (kg/ha)	0.12 (0.05)
X_4= TSP (kg/ha)	0.05 (0.04)
X_5= MP (kg/ha)	0.25* (0.09)
X_6 = Gypsum (kg/ha)	0.14** (0.056)
X_7 = Borax (kg/ha)	0.21* (0.08)
R^2	0.69
F- Statistics	5.35
Returns to scale (Ebi)	0.81
No. of observation	20

* denoted 1% level of significance ** refers to 5% level of significance
Figures in the parenthesis indicate standard error of mean

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FERTILIZER MANAGEMENT PRACTICES OF EXISTING MULTIPLE CROPPING SYSTEM AT FARMERS LEVEL IN TANGAIL AND PABNA

Abstract

The study was conducted at MLT site, Modhupur, Tangail and FSRD site, Goyeshpur, under OFRD, BARI, Pabna during February-April, 2004 to identify the existing fertilizer management practices of multiple cropping at farmers levels. A total of 50 farmers who practiced in multiple cropping were selected randomly from each location with the help of pre-designed interview schedule. The study revealed from Modhupur that about 50 percent farmers practiced pineapple + zinger intercropping followed by pineapple + panchmukhi intercropping of 35%. Highest equivalent yield (21.80 t/ha) was recorded from pineapple + zinger and lowest from pineapple + cassava. The same combination also showed highest gross return as well as gross margin and BCR (2.87), which was closely followed by pineapple + panchamukhi (BCR 2.85). Farmers opined that intercultural operation is difficult followed by lack of knowledge about production technology. At Goyespur, Pabna, 45% farmers practiced turmeric mixed with brinjal followed by sesame. But highest equivalent yield was obtained from turmeric/brinjal/chilli-followed turmeric/brinjal-sesame. The former treatment also showed highest gross return, gross margin but higher BCR was recorded from khesari + mustard due to less variable cost. The main problems was attacked by insects and disease followed by intercultural operation. In both the sites fertilizer were used mainly in main crop. No fertilizers were used in kherari + mustard intercropping system. Steps should be taken to meet up the existing problems of multiple cropping by increasing the extension and training program about modern method of cultivation & ensure quality of seeds.

Introduction

The system, which various crops are grown together or one after another on a piece of land, is multiple cropping. Growing two or more crops simultaneously on the same land that may or may not be sown or harvested at the same time is called intercropping. The main object of this cropping is to utilize the wide space left between two subsequent rows of slow growing main crops during early growth period. System of raising two or more crops together on a piece of land during a specific period of time by using the mixed seeds of various crops is mixed cropping. The main object is to get at least one crop, especially during hazards e.g. flood, drought or in any other situations.

Multiple cropping as mixed, inter and relay cropping is widely practiced in some part of country especially in greater Pabna, Tangail, Jessore, Rangpur and Faridpur districts of Bangladesh. There are many scope to cultivate more crops in same land around the year in respect of soil and climatic condition in our country. At present, the cropping intensity of Bangladesh is 174 percent. This cropping intensity may be increased up to 300 to 400 percent through mixed and intercropping system. Farmers of Tangail and Pabna area practice multiple cropping of Pineapple with zinger and turmeric with brinjal respectively that higher return than their sole crop. Multiple cropping that practiced by the farmers need to be documented to know which practice is more profitable to them. Farmers are getting higher benefit than sole crop but due to lack of proper planting geometry and fertilizer management, yield is not quite satisfactory. Therefore, the study has been undertaken to identify the existing multiple cropping pattern, fertilizer management practice and its constraints for documentation.

Methodology

The study was conducted at MLT site Modhupur, Tangail and FSRD site, Goyeshpur, Pabna of OFRD, BARI during February-April, 2004 with a view to identify the existing fertilizer management practices of multiple cropping at farmers level. In this report, inter and mixed cropping are denoted by the sign of (+) and (/) respectively. A total of 50 farmers who practiced in multiple cropping were selected randomly from each location. The required data were collected with the help of pre-designed and pre-tested interview schedule. Collected data were summarized, analyzed and presented in a tabular form.

Land Equivalent Ratio (LER)

The land equivalent ratio is the total land required by the sole crop to produce as much yield as can be obtained from an intercropping system.

The land equivalent ratio (LER) and equivalent yield (EY) of the multiple cropping were also calculated according to Willey, (1979).

$$LER = \frac{\text{Intercrop yield of crop A}}{\text{Sole crop yield of crop A}} + \frac{\text{Intercrop yield of crop B}}{\text{Sole crop yield of crop B}}$$

$$EY = \text{Yield of main crop} + \frac{\text{Yield of intercrop x Price (Tk/kg)}}{\text{Price of main crop (Kg/ha)}}$$

Limitation

Survey work was not possible to conduct in the districts of Jessore, Rangpur and Faridpur in this season due to time and resource constraints and it will be done in next year.

Results and Discussion

Existing multiple cropping pattern

Four dominant intercropping were identified at Modhupur, Tangail as pineapple+zinger, pineapple+panchamukhi, pineapple+turmeric and pineapple+casava. According to the respondent, about 50 percent farmers practiced pineapple+zinger intercropping while 35 percent involved with pineapple+panchamukhi intercropping practices (Table 1).

Seven major cropping patterns with four mixed crops were identified at Goyshepur in Pabna district. The mixed crops were as turmeric/brinjal, turmeric/brinjal/chilli, lentil/mustard and khesari/ mustard. It was observed that 45 percent farmers followed turmeric/brinjal- sesame cropping pattern and 15 percent farmers practiced turmeric/brinjal/chilli-sesame cropping pattern. About three and two percent farmers involved in lentil/mustard-sesame-T.aman and khesari/mustard-sesame-T.aman cropping pattern, respectively.

Intercropping practice at Modhupur, Tangail

Pineapple + Zinger: Most of the Farmers were practiced pineapple + zinger as intercropping in the study area. They planted pineapple during October-November and zinger in March. The farmers used Honey Queen and Giant que extensively as a variety of pineapple in the study area. They used 25000-27000 suckers per hectare for pineapple and 500-650 kg/ha seed for zinger. Farmers mainly used fertilizer in their main crops (pineapple). Average 371 kg, 543 kg, 271 kg and 198 kg cowdung, Urea, TSP and MP per hectare fertilizer were used in pineapple. It was observed that a small amount of fertilizer was applied in zinger. Urea was only applied as top dress by the farmers. Average dose of fertilizer was found 181 kg, 90 kg and 40kg/ha urea, TSP and MP, respectively in zinger. The average yield of pineapple and zinger was 11296 kg and 2995 kg/ha, respectively while the sole crop yield was 14861 kg for pineapple and 4610 for zinger. The land equivalent ratio (LER) was found 1.43 in pineapple+zinger cropping pattern. It indicates that by intercropping pineapple with zinger farmers could produce 11296 kg/ha pineapple and 2995 kg/ha zinger from one hectare of land instead of growing them separately in 1.43 hectare of land to obtain the same yield (Table 2).

The equivalent yield of zinger, gross return, total variable cost, and gross margin of this intercropping were 21805 kg, Tk. 124287, Tk 43357 and Tk 80930 per hectare, respectively. Benefit cost ratio (BCR) was found highest (2.87) from pineapple+zinger combination (Table 4).

Pineapple + Panchamukhi: Panchamukhi is a delicious vegetable. It was grown in between two rows of pineapple in the study area. Farmers planted panchamukhi in March with 1100-1300 kg/ha cormels as seed rate. They used honey queen and local as a variety of pineapple and panchamukhi, respectively. They applied average 806 kg, 554 kg and 403 kg/ha urea, TSP and MP in pineapple respectively while 469 kg, 41 kg, 25 kg and 30 kg/ha urea, TSP, MP and gypsum were used in panchamukhi respectively. Average yield of pineapple and panchamukhi was obtained 13284 kg and 8268 kg/ha, respectively. The sole crop yield of pineapple and panchamukhi was found 14861 kg and 9824 kg/ha, respectively. LER was estimated 1.74 (Table 2).

The equivalent yield of panchamukhi was 20537 kg/ha. Gross return, total variable cost and gross margin was found Tk. 117059, Tk 41061 and Tk 75998 per hectare respectively in pineapple + panchamukhi inter cropping. Benefit cost ratio (BCR) was found 2.85 (Table 4)

Pineapple + Turmeric: Intercropping of turmeric with pineapple was practiced about 10 percent farmers in the study area. They sowed turmeric in between two rows of pineapple. Turmeric was sown during March-April with local variety and 600-650 kg/ha rhizome as seed rate. It was observed that farmers applied 378 kg/ha urea as top dress in turmeric. No other fertilizers were fund to apply in turmeric in the study area. Average yield of turmeric and pineapple was 2973 kg and 13095 kg/ha, respectively while sole crop yield was found 3408 kg/ha in turmeric. LER was estimated 1.75 (Table 2).

The equivalent yield of turmeric was found 16224 kg/ha. Gross return and TVC was Tk. 92479 and Tk. 37248/ha respectively caused a gross margin of Tk 55231/ha. Benefit cost ratio (BCR) was found 2.48 (Table 4).

Pineapple + Cassava: A few percent of farmers were practiced cassava with pineapple as intercropping. This crop mainly used as industrial raw materials for producing sucrose. Farmers were sown cassava in the month of April with 1200-1500 stem/ha. Farmers did not use any fertilizer in cassava. They applied fertilizer only in pineapple with the dose of 732kg, 547kg and 424kg Urea, TSP and MP per hectare, respectively. Average yield of pineapple and cassava was found 13429 kg and 4574 kg/ha, respectively. LER was estimated 1.84 (Table 2).

Equivalent yield of cassava was 15836 kg/ha. Gross return and TVC was estimated Tk. 90267 and Tk. 3517 per hectare resulting a gross margin of Tk 55097 per hectare. Benefit cost ratio (BCR) was found 2.57 (Table 4).

Mixed cropping practice at Goyeshpur, Pabna

Turmeric/Brinjal: This practice used by the farmers in the high land of study area in mixed combination. Mixed cropping of brinjal with turmeric is mainly practiced under turmeric/brinjal-sesame and turmeric/brinjal-fallow cropping pattern. Turmeric and brinjal was sown by 25 May to 15 June with 1200-1500 kg rhizome per hectare. About 1500-1700 seedlings/ha were used as seed rate. They used `Arani' for turmeric and `Shoyla' for brinjal as a local variety. Farmers applied average 4332 kg, 96 kg, 129 kg, 86 kg and 47 kg cowdung, Urea, TSP, MP and Gypsum per hectare, respectively in turmeric. On the other hand, 1796 kg, 104 kg, 145 kg, 65 kg and 40 kg cowdung, Urea, TSP, MP and Gypsum per hectare were found to apply in brinjal, respectively. They used urea as top dress in brinjal. Farmers, used more insecticides i.e. 2-3 times per week in the study area. They harvested brinjal every week during harvesting time.

Average yield of turmeric and brinjal was found 8302 kg and 10725 kg/ha, respectively. Sole crop yield of turmeric and brinjal was 11731 kg and 16834 kg/ha. The land equivalent ratio was 1.34 (Table 3).

Equivalent yield of turmeric/brinjal mixed cropping was recorded 17836 kg/ha. Gross return and total variable cost was Tk. 160527 and Tk. 49137/ha, respectively resulting a gross margin of Tk. 111390/ha. Benefit cost ratio (BCR) was found 3.27 (Table 4).

Turmeric/Brinjal/Chilli: Mixed cropping of brinjal and chilli with turmeric is mainly practiced under turmeric/brinjal/chilli-sesame cropping pattern in highland of study area. They used `dhany' as a local variety of chilli with 1200-1400 seedlings/ha as seed rate. Crops were sown during 25 May to 20 June. It was observed that farmers applied only urea as top dress in chilli at the rate of 48 kg/ha. Incase of brinjal, they applied 49 kg, 34 kg, 13 kg/ha Urea, TSP and MP, respectively. About 2138kg, 82kg, 56kg and 37 kg/ha cowdung, Urea, TSP and MP were respectively used by the farmers in turmeric of turmeric/brinjal/chilli mixed cropping. Average yield of turmeric, brinjal and chilli was estimated 8217 kg, 8833kg and 999 kg/ha respectively. Sole yield of chilli was found 1349 kg/ha. The land equivalent ratio was estimated 2.08 (Table 3).

Equivalent yield of turmeric in turmeric/brinjal/chilli was found 18306 kg/ha. Gross return, total variable cost and gross margin was estimated Tk.164757, Tk.41517 and Tk.123240/ha respectively. Benefit cost ratio (BCR) was found 3.97 (Table 4).

Lentil/Mustard: Lentil and mustard mixed cropping is practiced mainly under lentil/mustard-sesame-T.Aman cropping pattern in medium high land. Farmers sown lentil and mustard during 20 October to 25 November with 20 kg and 2 kg seed rate respectively. They used local variety of lentil and tori-7 for mustard. It was noticed that farmers did not apply any fertilizer in mustard but less amount of fertilizer in lentil at the rate of 65 kg, 43 kg and 22 kg urea, TSP, and MP respectively. Average 520 kg and 217 kg per hectare yield were obtained from lentil and mustard respectively. Sole crop yield of lentil and mustard was found 814 kg and 637 kg/ha respectively. Land equivalent ratio was 0.98 indicating not profitable in mixed cropping (Table 3).

Equivalent yield of mustard was estimated 697 kg/ha. Gross return was obtained Tk 19182/ha and total variable cost was Tk 5811/ha caused in a gross margin of Tk. 13371/ha. Benefit cost ratio (BCR) was found 3.30 (Table 4).

Khesari/Mustard: Mustard with khesari is mainly practiced under khesari/mustard-seasem-T.aman cropping pattern in medium high land. Farmers used local variety in both crops. They used 50 to 60 kg seed per hectare for khesari and 5 kg/ha for mustard. Khesari was main crop while mustard was a chance crop to them. Sowing date of khesari and mustard was 25 October to 20 November. Farmers did not use any fertilizer in both crops. Average yield of khesari and mustard was found 807 kg and 206 kg/ha respectively. Sole crop yield was 911 kg and 637 kg/ha respectively. Land equivalent ratio was 1.21 (Table 3).

Gross return and total variable cost was estimated Tk. 15933 and Tk. 3139/ha, respectively for this cropping pattern. Gross margin was found Tk. 12794 per hectare. Benefit cost ratio (BCR) was found 5.07 (Table 4).

Constraints to multiple cropping

Farmers were asked to identify some major problems related to the production of multiple cropping in both locations. They opined that it is difficult to perform intercultural operation in multiple cropping to 90 percent farmers and second most problem was lack of knowledge on modern production technology to 85 percent farmers in Modhupur, Tangail. Attack of insects and disease was the main problem to 95 percent farmers and difficult to operate intercultural activities was the second highest problem in mixed cropping at Goyeshpur, Pabna (Table 5).

According to the respondent farmers the following steps can be taken to meet up the existing problems in both locations, as extension service should be strengthened, arrange training for modern production technology and awareness of pest, insect and diseases and ensuring good quality of seeds for production of multiple cropping.

Table 1. Existing multiple cropping and cropping pattern at Modhupur, Tangail and Goyeshpur, Pabna

Location	Cropping pattern	% Farmers practiced
Tangail (Modhupur)	Pineapple/zinger	50
	Pineapple/Panchamukhi	35
	Pineapple/turmeric	10
	Pineapple/Cassava	5
Pabna (Goyeshpur)	Turmeric/Brinjal-Sesame	45
	Turmeric/Brinjal-Fallow	15
	Turmeric/Brinjal-Vegetable	10
	Turmeric/Brinjal/Chilli-Sesame	15
	Turmeric/Brinjal/Chilli-Fallow	10
	Lentil/Mustard-Sesame-T.aman	3
	Khesari/Mustard-Sesame-T.aman	2

Table 2. Agronomic performance of multiple cropping practices at Modhupur, Tangail

Item	Pineapple +	Zinger	Pineapple +	Panchamukhi	Pineapple +	Turmeric	Pineapple +	Cassava
Variety	Honey queen/ Giant que.	Local	Honey queen	Local	Giant que.	Local	Honey queen	Local
Seed rate	25000-2700 (Sucker)	500-650	25000-27000	600-650 (cormel)	25000-27000	600-650 (rhizome)	25000-27000	1200-1500 (stem)
Sowing time	Oct-Nov.	March	Oct.-Nov.	March	Oct.-Nov.	March-April	Oct.-Nov.	April
Fertilizer (kg/ha)								
Cowdung	371	-	-	-	-	-	-	-
Urea	543	181	806	469	808	378	732	-
TSP	271	90	554	41	724	-	547	-
MP	198	40	403	25	461	-	424	-
Gypsum	-	-	-	30	-	-	-	-
Zinc	-	-	-	-	-	-	-	-
Borax	-	-	-	-	-	-	-	-
Yield crop (kg/hg)	11296	2995	13284	8268	13095	2973	13429	4574
Sole crop yield (kg/ha)	14861	4610	14861	9824	14861	3408	14861	4910
LER	1.43		1.74		1.75		1.84	

Table 3. Agronomic performance of multiple cropping practices at Goyeshpur, Pabna, 2004.

Item	Turmeric /	Brinjal	Turmeric /	Brinjal /	Chilli	Lentil /	Mustard	Khesri /	Mustard
Variety	Arani	Soyla	Arani	Soyla	Local	Local	Tori-7	Local	Tori-7
Seed rate	1200-1500 kg	1500-1700 no.	1200-1500 kg (rhizome)	1500-1700#	1200-1500 #	20kg	2 kg	50-60kg	5 kg
Sowing time	25 May -	15June	25 May	20 June		20 Oct.	15 Nov.	25 Oct.	20 Nov.
Fertilizer (kg/ha)									
Cowdung	4332	1796	2138	-	-	-	-	-	-
Urea	96	104	82	49	48	65	-	-	-
TSP	129	145	56	34	-	43	-	-	-
MP	86	65	37	13	-	22	-	-	-
Gypsum	47	40	-	-	-	-	-	-	-
Zinc	-	-	-	-	-	-	-	-	-
Borax	-	-	-	-	-	-	-	-	-
Crop yield (kg/ha)	8303	10725	8217	8853	999	520	217	807	206
Sole crop yield (kg/ha)	1731	16834	11731	16834	1349	814	637	911	637
LER	1.34		2.08			0.98		1.21	

Table 4. Equivalent yield and economic performance of Multiple cropping at Modhupur, Tangail and Goyeshpur, Pabna

Location	Multiple cropping	Equivalent yield (kg/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Tangail (Modhupur)	Pineapple+zinger	21805	134287	43357	80930	2.87
	Pineapple+panchamukhi	20537	117059	41061	75995	2.85
	Pineapple+turmeric	16224	92479	37248	55231	2.48
	Pineapple+cassava	15836	90267	35170	55077	2.57
Pabna (Goyeshpur)	Turmeric/brinjal	17836	160527	49137	111390	3.27
	Turmeric/brinjal/chilli	18306	164757	41517	123240	3.97
	Lentil/mustard	697	19182	5811	1337	3.30
	Khesari/mustard	1138	15933	3139	12794	5.07

Price (Tk/kg): Pineapple = 5.70, Zinger= 20.00, Chilli= 20.00, Khesari = 14.00, Turmeric(Pabna)= 9.00 , Panchamukhi = 5.00, Cassava= 3.00, Brinjal= 8.00, Turmeric(Tangail) = 6.00, Lentil= 27.50 & Mustard= 22.50

Table 5. Problems faced by the farmers in multiple cropping at Modhupur, Tangail and Goyeshpur, Pabna

Sl. no.	Problems	% Farmers responded		All
		Tangail	Pabna	
1.	Difficult to do intercultural operation	96	86	91
2.	Lack of knowledge on production technology	85	67	76
3.	Difficult to use of fertilizer and insecticides	52	74	63
4.	Attack of insects and diseases	83	95	89
5.	Lack of quality seeds	55	61	58

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INTEGRATED APPROACH TO FARMING SYSTEMS RESEARCH AND DEVELOPMENT, NARIKELI, JAMALPUR

Abstract

The study was conducted in 2003-04 with four farmers at Farming Systems Research and Development Site, Narikeli, Jamalpur with an aim to develop a sustainable integrated farming module. Appropriate sets of technologies were intervened replacing the existing one in major sectors of farming like crop, fisheries and homestead production system. The issue of sustainability of the systems was analysed in the context of cash income, nutrition, employment, resource use pattern, technical know how, micro environment, adoption of innovation and social status etc.

Introduction

The subsistence farms of Bangladesh are highly diversified with complex relationships between the various components of enterprises. While there is different components i.e., production alternatives, farmers have a limited set of resources. These resources should be utilized in such a manner that maximizes farmer's benefit in an environmentally sound and sustainable way. Technology generation and packaging should be done to achieve this end. A holistic look into farming systems, the interactions between different components and that between the production systems and the environment (biophysical and socio-economic) are very much essential. Traditional commodity oriented agricultural research dose not necessarily consider these realities. As a result, the farmers have not adopted many of the technologies developed by different research institute or else. They have not been successful in promoting equitable socio-economic development. The main objective of farming systems research and development is to improve the existing farming systems through the development and transfer of integrated whole farm production module for stratified clientele groups. It is expected that if the technologies suitable for the resource base of a farmer is identified and intervene that will, perhaps, give a positive impact on the farm economy. Such a methodology is scantly in Bangladesh. So, an integrated intervention for improving existing farming should be made with the broad objectives of the study was:

i) to determine the effect of integrated farming
ii) to utilize available farm resources in a better way.
iii) Interventions on overall development of a farm family.

Methodology

The study was carried out at the FSRD site, Narikeli, Jamalpur during the season 1999-2001 with 10 (ten) farmers belonging to landless, marginal, small and medium farm category. But due to scarcity of fund, four farmers of landless and marginal were taken under study during 2003-04.

As the effort of packaging and testing technologies for developing integrated farming practices for highly complex and subsistence livelihood system in whole farm perspective is new, there is no recommended methodology for such studies. Accordingly, a 5-step new methodology being developed through an evolutionary process of trial and error using the experiences of FSRD practitioners of OFRD, BARI was adopted.

Step 1. Identification of proven/recommended technologies: A comprehensive list of all packages of recommended technologies of crops, livestock, fisheries and other components of the farming system for specific location/environment was prepared to help selection of appropriate technologies for intervention.

Step 2. Selection of farmer Cooperator: The cooperator farmers representing small and marginal farmers with farming as major profession, having major components of farming and sizable homestead under single ownership were selected at each site. The number of farmers selected at different sites ranged from two to more than 10.

Step 3. Accounting of pre-intervention status: The pre-intervention status of the selected farms was evaluated through case studies/surveys. In the process, the existing farm resources, assets, liabilities, present use of resources, existing farming practices and technologies used, level of input use and outputs obtained, performances of different enterprises, farm income and expenditure status, etc. was assessed for each farm.

Step 4. Analysis of existing system and selection of technologies for intervention: Based on the pre-intervention status, the system performance was analyzed in the context of existing biophysical and socio-economic environment of the farm and constraints and potentials were identified. To ensure maximum utilization of existing farm resources, alternate/new packages of technologies for different enterprises of all components of the farm were identified and finally selected on the basis of farmers' option. The number of new technologies/practices taken for intervention for different sub-systems varied from farm to farm depending on farmers' option and perceived potentials of the technologies. It may be mentioned that in the intervention plan, some of the farmer's earlier adopted practices were retained while some new practices replaced the traditional practices. To use the unexploited resources/ opportunities, a large number of new practices were also included.

Step 5. Implementation of intervention and performance evaluation: After finalizing the proposed interventions, the farmers were motivated through all possible ways to utilize their own resources to adopt the interventions. However, in implementing some new technologies, a few critical inputs were provided free of cost and/or on credit. Throughout the entire period of implementation, regular technical support was provided on as and when necessary basis and the performance of different interventions were monitored regularly and necessary data were collected directly using standard methods.

Results and Discussion

The results are presented below:

Resource mobilisation

The study revealed that an individual farm consist several resources like homestead, crop livestock, poultry, fisheries etc. which were not utilised properly for production purpose. It was evident that after motivation of the farmers and introduction of several alternatives for each production unit the farmers adopted several new technologies according to his goal, preference and availability of resources. The productivity of the existing farming was improved due to integration of technologies through holistic approach. The findings of the study depicted that integrated farming had more enterprises and mobilised use of resources for cash income, nutrition, employment etc.

Identification of farmers with their family structure, assets, liabilities and livelihood before intervention

Farmer	1	2	3	4
Name	Md. Abdul Khaleque	Md. Ranju Fakir	Shamsul Haque Akanda	Abu Taleb
Village	Nishindi	Nishindi	Goherpara	Kumarpara
PS and Dist	Jamalpur	Jamalpur	Jamalpur	Jamalpur
Farm category	Marginal	Landless	Small	Landless
Education	Class- V	Class-V	Class-V	Class-V
Age	56	36	56	31
Occupation	Agriculture	Agriculture	Agriculture	Agriculture
Family Member	7 (M-3, F-4)	3 (M-2, F-1)	5 (M-2, F-3)	4 (M-2, F-2)
Component	HS, C, LS, AF	HS, C, LS, AF	HS, C, LS, AF, F	HS, C, LS, AF, F
Land				
Homestead	0.26	0.20	0.52	0.13
Own cultivated	0.52	-	2.64	0.18
Rented in	-	-	-	-
Mortgaged in	-	-	-	-
Total Land	0.78	0.20	3.16	0.31
Livestock				
Milch cow	-	-	-	1
Ox	-	1	2	1
Calf	1	-	-	1
Chicken	-	-	10	6
Hen	6	-	5	2
Duck	-	-	2	-
Goat	-	-	-	-
Tress				
Mango	5	4	2	3
Jack fruit	2	1	5	3
Guava	2	3	3	6
Jujube	2	1	-	1
Betel nut	10	7	26	12
Other timber	28	15	46	21
Species	-	-	1	-
Residential				
Residence	2	1	2	1
Cooking shade	1	1	1	1
Cow shade	1	1	1	1
Chicken house	-	-	-	-

Ag-Agriculture; C- Crop; AF-Homestead tress; B-Business; Hs- Homestead; LS- Livestock; F-Fisheries; OFF-Off-Farm

Economic impacts of intervention by comparing pre and post intervention periods of on farm resource use efficiency (land use, crop, homestead and off-farm)

Farmer 1: Md. Abdul Khaleque

A. Crop

Resource	Area	Before intervention					After intervention					
		Pattern	Yield (kg)	GR	TVC	GM	Pattern used	Yield (kg)	GR	TVC	GM	Increase net return
MHL-1	26 d	Aman (Pajam) Boro (BR 14)	200 360	1636 1734	800 1150	836 584	Aman (BR 32) Boro (BR 28)	330 400	2286 3175	1300 2000	986 1175	
Sub-Total				3360	1950	1420			5461	3300	2161	741
LL	26 d	Boro (local)	150	900	450	450	Boro (BR 29)	350	1925	850	1075	625

B. Homestead

Resource	Area	Before intervention					After intervention					
		Practice used	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Practice used	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
Roof	2 d	White gourd	25 N	150	60	90	Sweet gourd	25 N	250	75	175	
Open field	4 d	Not cultivation	-	-	-	-	Homestead model	90	605	195	410	
Partial shade area	2 d	Not cultivation	-	-	-	-	Turmeric Ginger	26 3	405	135	270	
Waste land	2 d	Not cultivation	-	-	-	-	Kachu (Latijaj)	52	525	175	350	
On support	1 d	Not used	-	-	-	-	Potato yam BARI shim	35 29	575	175	400	
Sub. Total	12 d	-	-	150	60	90			2360	755	1605	1515

C. Livestock

Resource	No	Before intervention					Resource	No	After intervention					
		Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)			Practiced	Yield (kg/No)	GR (Tk)	TVC (Tk)	GM (Tk)	Increase GM
Hen (L) Hen (Improve)	-	-	-	-	-	-	Hen (L) Hen Improve	- 6 N	- Vaccination and feeding	- 1500	- 4450	- 2100	- 2350	
Sub-Total				-	-	-					4450	2100	2350	2350

Farmer 2: Ranju Fakir

A. Crop: Not available

B. Homestead

Resource	Area	Before intervention					After intervention					
		Practice used	Yield (kg)	TR (Tk)	TVC (Tk)	GM (Tk)	Practice used	Yield (kg)	TR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
Roof	2 d	White gourd	20N	160	45	115	Sweet gourd	23 N	230	60	170	
Trail	1 d	Bottle gourd	8 N	65	30	35	Sweet gourd Pointed gourd Cucumber	13 17 18	620	185	435	
Open field	5 d	Not cultivation	-	-	-	-	Homestead model	95	760	290	470	
Partial shade area	1 d	Not cultivation	-	-	-	-	Turmeric Ginger Elephant taro	12 3 25	705	270	435	
On support	2 d	Not used	-	-	-	-	Potato yam BARI shim	90 60	1350	195	1155	
Sub. Total	11 d	-	-	225	75	150			3665	1000	2665	2515

C. Livestock

Resource	No	Before intervention					Resource	No	After intervention					
		Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)			Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
Ox	-	-	-	-	-	-	Ox	1 N	Dewarming UMS diet	Meat 82 kg	8000	5340	2660	
Sub-Total	-	-	-	-	-	-					8000	5340	2660	2660
Off-Farm activities		-	-	-	-	-	Off-Farm activities		-	-	1600	500	1100	1100
Total														3760

Farmer 3: Md. Shamsul Haque Akanda

A. Crop

Resource	Area	Before intervention					After intervention					
		Pattern used	Yield (kg)	GR	TVC	GM	Pattern used	Yield (kg)	GR	TVC	GM	Increase GM
MHL-1	36 d	Aman (Pajam) Boro (BR 14)	350 400	2800 2800	1200 1550	1600 1250	Aman (BR 32) Boro (BR 28)	480 500	3360 3500	1450 1580	1910 1920	
MHL-2	26 d	Aman (BR 11) Boro (BR 14)	350 390	2450 2750	1250 1150	1200 1600	Aman (BR 32) Boro (BR 29)	360 450	2520 2700	1225 1450	1295 1250	
MLL	100 d	Boro (BR 14)	3500	21000	13050	7950	Mustard (Tori 7) Boro (BR 28)	950 3400	16150 23800	8000 15000	8150 8800	
LL	85 d	Boro (Local)	2000	14000	6000	8000	Boro (BR 29)	4000	24000	15500	8500	
Pond	17 d	Exotic culture	100	5000	2000	3000	Improve technique	250	12500	5000	7500	
Total				50800	26200	24600			88530	33705	39325	14725

B. Homestead

Resource	Area	Before intervention					After intervention					
		Practice used	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Practice used	Yield (kg)	TR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
Roof	4 d	White gourd	42	252	90	162	Sweet gourd	45	450	150	300	
Trail	2 d	Bottle gourd	30	210	80	130	Sweet gourd Pointed gourd	32 29	460	160	200	
Open field	6 d	Not cultivation	-	-	-	-	Homestead model	200	1600	450	1150	
Partial shade area	4 d	Not cultivation	-	-	-	-	Turmeric Ginger Elephant taro	35 4 30	845	340	505	
Waste land	4d	Not cultivation	-	-	-	-	Kachu (latiraj)	115	675	180	495	
Ponds surroundings	2 d	Not used	-	-	-	-	White gourd Bottle gourd BARI Shim-1	32 38 20	745	600	145	
On support	4 d	Not used	-	-	-	-	Potato yam BARI Shim-1	35 35	670	520	150	
Sub. Total	44 d	-	-	462	170	292			5445	2400	3045	2753

C. Livestock

Resource	No	Before intervention					Resource	No	After intervention					
		Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)			Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
Hen (L)	5	No Vaccination	Egg 200	580	250	330	Hen (L)					-	-	
Hen (Improve)	-	-	-	-	-	-	Hen (Improve)	5	Vaccination and feeding	Egg 600	1740	450	1290	
Duck (L)	2	No vaccination	Egg 120	350	250	100	Duck (L)	2 N	Vaccination and feeding	Egg 225	662	370	292	
Ox	2	Use for draft power						2 N	Use for draft power					
Sub-Total				930	500	430					2402	820	1582	1152
Pond	6 d	Traditional	35 kg	1750	850	900	Pond	6 d	Mixed culture	75 kg	3750	1550	2200	1300

Farmer 4. Md. Abu Taleb

A. Crop

Resource	Area	Before intervention					After intervention					
		Pattern used	Yield (kg/plot)	GR	TVC	GM	Pattern used	Yield (kg)	GR	TVC	GM	Increase net return
MHL-1	18 d	Aman (Pajam) Jute (local)	310 175	2480 1400	1050 1250	1430 1515	Aman (BR 32) Boro (BR 28)	326 345	2280 2415	960 1110	1320 1305	
Sub- Total				3880	2302	1578			4695	2070	2625	1047

B Homestead

Resource	Area	Before intervention					After intervention					
		Practice used	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Practice used	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
Roof	2 d	White gourd	16	100	32	68	Sweet gourd White gourd	22 N 40 N	696	165	531	
Trail	1 d	Bottle gourd	26	165	90	75	Snake gourd Sweet gourd	26 15	1300 150	860 60	440 90	
Open field	2 d	Not cultivated	-	-	-	-	Homestead model	70	660	180	480	
Partial shade area	1 d	Not cultivated	-	-	-	-	Turmeric Ginger Mukhi khakhu Elephant font	20 4 21 30	780	360	420	
Ponds surroundings	1 d	Not used	-	-	-	-	White gourd Bottle gourd	25 40 N	550	320	230	
On support	1 d	Not used	-	-	-	-	Potato yam BARI shim	45 35	1234	345	889	
Sub. Total	8 d	-	-	265	122	143			5370	2290	308 0	2937

C. Livestock

Resource	No	Before intervention					Resource	No	After intervention					
		Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)			Practiced	Yield (kg)	GR (Tk)	TVC (Tk)	GM (Tk)	Increase net return
-	-	-	-	-	-	-	Hen (Improve)	2	Vaccination and feeding	Egg 1200	3480	500	2980	
Ox	-	-	-	-	-	-	Ox	1	Dewarming UMS diet	meat 85 kg	5344	2430	2914	
Milch cow	-	-	-	-	-	-	-	1	Dewarming UMS diet	900 kg milk	9000	3000	6000	
Sub-total											17824	5930	11894	11894
Pond	3 d	Traditional practice	50	2500	610	1890	Pond	3 d	Mixed culture	80	4000	1150	2850	960
Off-farm activities	1 N	-	-	2000	500	1500	Off-Farm activities	1N	-	-	3000	1000	2000	500
Total				4500	1110	3390					24824	8080	16744	13354

Impact on employment generation and women labour utilization

Use of under utilized family labour (viz. women 75% children 10%) and male labour (15%) was increased due to huge intervention of technologies in integrated farming. The higher participation of women in agricultural activities, made positive impact on equity issue within the family and the community as a whole.

Identification of the impacts of interventions

Name	Assets developed	Living standard				Children education	Savings
		Food	Living condition	Sanitation	Medicine		
1. Md. Shamsul Haque	Made of another residence for his son by tin, made of furniture	Increase intake of vegetable, meat and fish	Increase of social acceptability	Use of sanitary latrine	Take better health care	One of his girl read in School	around 8,000/- per year
2.Md. Abdul Khaleque	Improvement of residence	Increase intake of vegetable	Increase of social acceptability	Use of sanitary latrine	Take better health care	One of his girl read in School	around 5,000/- per year
3 Md. Ranju Fakir	Improvement of residence, made a khat by wood	Increase intake of vegetable	Increase of social acceptability	Use of sanitary latrine	Take better health care	One of his son read in School	around 5,000/- per year
4 Abu Taleb	Improvement of residence by tin	Increase intake of vegetable and fish	Increase of social acceptability	Use of sanitary latrine	Take better health care	One of his girl read in School	around 2500/- per year

Adoption of technology after intervention

Resource	Production before intervention	Production after intervention
Homestead Open land	Lau, Shim (Local)	BARI Shim, Sweet gourd, Potato yam
Roofs	Not used	Potato Yam, BARI Shim,
Trellis	Lou, Shim (local)	Potato Yam, BARI Shim
Creeper vegetables	Not cultivate	Potato yam, Betel vine
Partially shady area	Not used	Ginger and turmeric
Marshy land	Not used	Bitter gourd, Potato Yam, Cucumber
Fence	Not used	Seedless lemon, BARI Guava, Coconut & betel nut
House boundary	Betel nut, Coconut, banana, drumstick	Mango (Amrapali, Khirshapati, Gopal bogh, Langra, Fazli, BARI mango-3, BARI mango-4), Litchi (China-3), Guava (BARI Guava-1 and 2)
Trees management	None	Fertilization of Coconut & betel nut, Jujube budding
Backyard pond	Not used	Seasonal fish culture
Other development activities in the homestead	Not used	Drumstick pruning, Coconut & Betel nut management
Grafting	Not practiced	Jujube budding
Sanitation and health	Traditional latrine	Sanitary latrine, cleaning the homestead area
Cooking	Traditional Chula	BARI Chula
Pond culture	Local fish	Grass carp, Sharpunti, Silver carpl
Livestock	Cow (Local), Poultry (Local)	Ox and cow Poultry (Foumi, Sonali)

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HOMESTEAD AGRICULTURAL PRODUCTION POSSIBILITY UNDER GOYESHPUR MODEL

Abstract

A study was undertaken at FSRD site, Goyeshpur for testing possibility of growing homestead crop production under Pabna-Goyeshpur Model. The average productions per day of each of marginal, small and medium farm categories were 2.46, 259 and 1.45 kg. Cash income and return in Taka were highest with small farm category (Tk.2296 and 4985 year^{-1}). Out of the produce, 58% was consumed by medium farms, 34% by small and 30% by marginal group.

Introduction

Bangladesh is one of the poorest developing countries with highest population density, of which 50 per cent under poverty level, 70 percent under nourished and a vast population unemployed. Even more than 30,000 people get blind at childhood every year due to deficiency in vitamin A (BARC, 1990). An earlier survey indicated that 93 percent family in Bangladesh suffering from vitamin C deficiency, 85 percent in riboflavin, 81 percent in vitamin A and calcium, 60 percent in protein and 59 percent in calorie requirement (Mahmud, 1985). Unemployment triggered lawlessness and social security and shattered national growth and development. Creating new job and employing people is a recommended solution for the prevailing problem in the country. As the country is agro-based and people are acquainted with some sorts of agribusiness any such programme on agriculture do have much better acceptance here. There are about 18-20 million families in Bangladesh most of them live in rural areas having a homestead for each. These homesteads are the most effective and common production units for supplying food, fuel, timber and other family needs and employing family labours. When produced in homesteads, the consumption rate is naturally increased and more family nutrition is obtained through supply of fresh fruits and vegetables round the year. The income is evenly distributed round the year and women and men are most likely to prefer such a work having aesthetic, economic, sanitation and nutritional values.Like many other Asian countries the homesteads are either under utilized or over crowded (Momin, *et al.*, 1990) with unplanned or unproductive vegetation in Bangladesh. As reported by Hussain *et al*. (1988) only 13 percent homestead area was under vegetable cultivation. The on-farm research division (OFRD) of BARI considering this context designed a model of home gardening (well known as *Kalikapur model*) in mid 80's with 14 different vegetables under five cropping patterns in a fixed 6m×6m open sunny land. The model, in spite of initial success, showed some limitations including non-inclusion of some other important production niches and resources, non-regarding environmental issues and insufficient production to meet up family needs. Thus, there was a demanding need for a comprehensive model for achieving the objectives to-

i) Develop a complete model of homestead gardening which maximizes production utilizing all available resources.
ii) Ensure food security round the year from homestead and improve family nutrition
iii) Create employment for family members including women in an environment friendly, productive activity for gender equity

Materials and Methods

The Pabna-Goyeshpur Model of homestead utilization system was used. It included nine production units under following patterns:

Sl #	Spaces		Cropping patterns
1.	Open land	a.	Radish - Stem Amaranth - Indian spinach
		b.	Cabbage - Brinjal - Red amaranth
		c.	Tomato + Spinach - Okra
2.	Roof	a.	Bottle gourd - Wax gourd
3.	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 recommended production practices with conventional fertilization but biological pest control were followed for each crop. The cost of all the operations and inputs except seeds and seedlings was borne by farmers. Weekly monitoring was done and FSRD team members guided all operations.

Results and Discussion

Crop yield

The output of the model harvested during the period May'03 to April' 04 has been presented (Table 1). The amount harvested from open sunny land, creeper vegetables, shady and marshy area and fruit trees were 200, 99, 33 and 566 kg respectively per marginal family during 2003-2004. It was 155, 198, 60 and 532 kg in small and 164, 166, 52 and 138 kg in medium farm catigory.

The average per day production per family was 2.46, 2.59 and 1.45 kg respectively in marginal, medium farm categories. The lower yield in medium farms was due to less production from trees because of more use of homesteads for post harvest operation of field crops.

Return in Taka

The return of the produce of the model in taka was the highest in small farm group where bottle gourd and papaya were the vital contributing crops (Table 1a, b, c) Medium group farmers had the lowest return owing to less output from trees of the model and creepers.

Consumption by family members

Highest consumption percent (58%) of 520 kilogram total produce (300 kg year^{-1}) was in medium land category. lowest percent was in marginal group (30%) with 271 kg per year. With the consumption rate of 34 percent the small category farmers consumed more with 324 kg fruits and vegetable averaged at 889 gram a day (Table 3). The average production per day over the farmers group was 2.15 kg surpassing the need for 1.2-1.5 kg a day for a 6-7-member family.

Cash income

Above the nutritional contribution the growers earned a cash money of Taka 1448 per family which as a liquied cash in hand over the year had a good contribution towards mitigation of day to day family needs.

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 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.

Problems encountered

1. Lack of fund forced growing crops under conventional system
2. 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.
3. Women farmers were not ready to cooperate spontaneously with the male scientific assistants in the implementation process.
4. Creeper crop got less emphasizes with lack in adequate amount of organic matter, size of pit, fertilization and other cares.
5. Consumption rate was poor 38.5% of the produce due to lack in awareness on health care.
6. Long drought and water scarcity drastically reduced production of many crops like brinjal, okra, bitter gourd etc.
7. Lack in easy analytical tool to interpret data comfortably (Needs a computer programming on analysis of results

Conclusion

Due to total lack of fund allocation for the trial it could not be conducted with organic inputs. But the crops are now being grown with organic inputs from farmers own source. Provided the fund is available the program will be continued in wider scale to achieve its targeted objectives.

Recommendation

- The program is to be continued and expanded with adequate fund allotment, intensive cooperation, monitoring and awareness raising programs on consumption practices.
- Emphasize should be on optimizing production from each crop and highest possible consumption by family members retaining food value for the edible parts.
- More participation by women members is to be ensured.

Table 1a. Performance of vegetable crops of marginal farm group under new homestead production model at FSRD site, Goyeshpur during 2003-2004 (May 2003 to April 2004)

Crops	Performance						
	Harvest period	#/ amount harvested (kg)	Return in Tk.	Consumption/ day/person (g)	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)
A. Field crops							
Radish	38	25	92	71	0	12	37
Stem amaranth	21	28	133	55	4	17	73
Indian Spinach	38	37	93	71	7	15	37
Cabbage	27	47	142	120	9	19	70
Red amaranth	15	9	74	67	3	-	-
Spinach	10	9	41	77	1	3	5
Tomato	30	7	33	33	1	-	-
Okra	61	38	194	63	3	12	77
Total	240	200	802	557	28	78	299
Average	30	25	100.25	69.63	3.5	13.5	49.83
B. Creeper vegetable crop							
Country bean	64	32	194	31	8	13	52
Bottle gourd #	22	36	240	39	-	-	-
Ash gourd #	162	34	158	33	3	-	-
Sponge gourd	137	27	219	26	2	4	32
Total	385	99	811	129	13	17	84
Average	96.25	24.75	202.75	32.25	4.33	8.5	42
C. Shady area crops							
Leaf aroid	66	14	28	29	1	8	16
Elephant foot yam	48	19	127	31	2	8	48
Total	114	33	155	60	3	16	64
Average	57	16.5	77.5	30	1.5	8	32
D. Fruit tree							
Papaya	127	184	607	64	10	149	480
Plantain Banana#	25	261	244	88	8	241	200
Guava	50	120	600	200	6	55	275
Lemon	30	1	25	-	-	-	-
Total	232	566	1476	352	24	445	955
Average	58	141.5	369	117.33	8	148.33	318
Grand Total	971	898	3244	1098	68	556	1402
Average	54	50	180	61	4	31	78

Table 1b. Performance of vegetable crops of small farm group under new homestead production model at FSRD site, Goyeshpur during 2003-2004 (May 2003 to April 2004)

Crops	Performance						
	Harvest period	#/ amount harvested (kg)	Return in Tk.	Consumption/ day/person (g)	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)
A. Field crops							
Red amaranth	26	11	85	34	3	-	-
Radish	37	13	57	65	3	-	-
Stem amaranth	21	18	63	88	3	10	30
Indian Spinach	71	20	72	72	4	-	-
Cabbage	29	34	97	91	6	22	44
Brinjal	76	5	49	14	0.5	-	-
Spinach	26	9	39	50	2	2	6
Tomato	37	19	121	58	4	5	-
Okra	102	26	126	28	7	-	-
Total	425	155	709	500	32.5	39	80
Average	47.22	17.22	78.78	55.56	3.61	9.75	26.67
B. Creeper vegetable							
Country bean	68	42	402	45	4	10	62
Sweet gourd	42	26	123	155	-	-	-
Bitter gourd	139	12	100	13	4	-	-
Potato yam	26	8	83	19	-	6	60
Sponge gourd	99	27	191	43	5	6	40
Bottle gourd	117	83	886	49	2	58	622
Total	491	198	1785	324	15	80	784
Average	81.83	33	297.5	54	3.75	20	196
C. Shady area crops							
Leaf aroid	59	9	18	23	4	-	-
Elephant foot yam	36	13	81	28	2	7	42
Water Taro	139	38	169	49	11	-	-
Total	234	60	268	100	17	7	42
Average	78	20	89.33	33.33	5.67	7	42
D. Fruit tree							
Papaya	140	287	1238	63	14	216	955
Guava	52	50	400	192	10	-	-
Banana	83	125	375	60	5	100	300
Plantain Banana	24	70	210	156	10	45	135
Total	299	532	2223	471	39	361	1390
Average	74.75	133	555.75	117.75	9.75	120.33	463.35
Grand Total	1449	945	4985	1395	104	487	2296
Average	66	43	227	63	5	22	104

Table 1c. Performance of vegetable crops of medium farm group under new homestead production model at FSRD site, Goyeshpur during 2002-2003 (May 2002 to April 2003)

Crops	Performance						
	Harvest period	#/ amount harvested (kg)	Return in Tk.	Consumption/ day/person (g)	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)
A. Field crops							
Radish	50	32	125	59	7	8	32
Stem amaranth	24	11	49	60	4	-	-
Indian Spinach	75	20	49	32	5	-	-
Cabbage	37	38	117	66	12	21	65
Brinjal	59	20	240	48	4	1	12
Spinach	30	6	60	33	1	-	-
Tomato	36	15	60	26	-	8	32
Okra	79	22	120	118	1	-	-
Total	390	164	820	442	34	38	141
Average	48.75	20.5	102.5	55.25	4.86	9.5	35
B. Creeper vegetable/crop							
Bottle gourd #	108	65	523	46	7	40	320
Ash gourd #	49	55	165	138	10	15	45
Country bean	102	33	264	26	12	-	-
Yard long bean	53	8	105	17	2	-	-
Spong gourd	66	5	44	8	1	-	-
Total	378	166	1101	235	32	55	365
Average	75.6	33.2	220.2	47	6.4	27.5	182.5
C. Shady area crops							
Leaf aroid	119	19	34	20	2	-	-
Water Taro	210	53	250	37	8	-	-
Total	329	52	284	57	10	-	-
Average	164.5	26	142	28.5	5	-	-
D. Fruit tree							
Papaya	192	66	286	29	19	15	72
Guava	41	23	150	32	3	11	68
Lemon	42	3	26	9	1	-	-
Jujubee	27	6	40	31	-	-	-
Plantain Banana	13	40	240	384	2	-	-
Total	315	138	742	485	25	26	140
Average	63	27.6	148.4	97	6.25	13	70
Grand Total	1412	520	2947	1219	101	119	646
Average	71	26	147	61	5	6	32.3

Table 2a. Average performance of vegetable crops of farmers group -marginal under new homestead production model at FSRD site, Goyeshpur during 2002-2003 (May '2002 to April '2003)

Crops	Performance					
	Harvest period	#/amount harvested (kg)	Return in Tk.	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)
A. Field crops						
Total		200	802	28	781	299
Average	30			3.5	13.0	49.83
B. Creeper vegetable						
Total		99	811	13	17	84
Average	96.25			4.33	8.5	42
C. Shady area crops						
Total		33	155	3	16	64
Average	57			1.5	8	32
D. Fruit tree						
Total		566	1476	24	445	955
Average	58			8	148.33	318
Grand total		898	3244	68	556	1402
Grand average	54			4	31	78

Table 2b. Average performance of vegetable crops of farmers group small under new homestead production model at FSRD site, Goyeshpur during 2002-2003 (May '2002 to April '2003)

Crops	Performance					
	Harvest period	#/amount harvested (kg)	Return in Tk.	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)
A. Field crops						
Total		155	709	32.5	39	80
Average	47.22			3.61	9.75	26.67
B. Creeper vegetable						
Total		198	1785	15	110	784
Average	81.83			3.75	27.5	196
C. Shady area crops						
Total		60	268	17	7	42
Average	78			5.67	7	42
D. Fruit tree						
Total		532	2223	39	361	1390
Average	74.75			9.75	120.33	463.35
Grand total		945	4985	104	517	2296
Grand Ave.	66			5	24	104

Table 2c. Average performance of vegetable crops of farmers group medium under new homestead production model at FSRD site, Goyeshpur during 2002-2003 (May '2002 to April '2003)

Crops	Performance					
	Harvest period	#/amount harvested (kg)	Return in Tk.	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)
A. Field crops						
Total		164	820	34	38	141
Average	48.75			4.86	9.5	35
B. Creeper vegetable						
Total		166	1101		55	365
Average	75.6			6.4	27.5	182.5
C. Shady area crops						
Total		52	284	10	-	-
Average	164.5			5	-	-
D. Fruit tree						
Total		138	742	25	26	140
Average	63			6.25	13	70
Grand Total		520	2947	101	119	646
Average	71			5	6	32.3

Table 3. Average harvest and consumption rates of vegetables by different farm categories under new homestead production model at FSRD site, Goyeshpur, Pabna during 2002-03 (May 2002 to April 2003)

Farm category		Performance						
		Harvest period/ crop	#/amount harvested (kg)	Return in Tk.	Amount/# distributed (kg)	Amount sold (kg)	Cash income (Tk./F)	Cash income (Tk./F)
Marginal	Total		898	3244	30%	68 (8%)	559 (62%)	1402
	Ave.*	54				4	31	78
Small	Total		945	4985	34%	104 (11%)	517(55%)	2296
	Ave.	66				5	24	104
Medium	Total		520	2947	58%	101(19%	119(23%)	646
	Ave.	71				5	6	32.3
Grand Total			2363	11176		273	1192	4344
Grand Mean**		64	787 2.15 kg/day /family	3725	38.5%	91 (11.5%)	397(50%)	1448

* Per crop ** Av. of 3 groups

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STUDY ON THE FEASIBILITY OF GROWING VEGETABLES IN HOME GARDEN ROUND THE YEAR

Abstract

An experiment was conducted on growing vegetables round the year in homestead of Farming Systems Research and Development Site, Narikeli, Jamalpur during the period from Kharif 2002 to Rabi 2003 with a view to find out a profitable sequence of vegetables pattern and to utilize the unused under utilized places of homestead. Five vegetable patterns were tested in this context. Indian spinach-Tomato gave the highest net return followed by Kangkong- Lalshak + Cabbage pattern. The lowest net return and benefit cost ratio was obtained from Latiraj kachu-carrot-Bitter gourd. Individually, tomato gave the highest net return and benefit cost ratio.

Introduction

Vegetables are the major dietary nutritional source for the mass people in Bangladesh (Huq and Rahman, 1994). Per day per head consumption of vegetables in Bangladesh is very low (about 30 g/ day/person) compared to that of the neighboring countries like Nepal (42 g), Pakistan (91 g), India (135 g) and Sri Lanka (120 g) (Rampal and Gill, 1990). Intensive vegetable production could provide not only nutritional security but also be useful for employment generation, higher farm income, better export potential and lower dependency on cereal consumption. Farmers in rural Bangladesh especially low-income groups are seriously suffering from malnutrition. Scarcity of vegetables leads to problems of malnutrition such as iron deficiency, anemia and exophthalmia etc. Nutrition problem can be reduced by regularly eating green and yellow leafy vegetables (Javier, 1992). It is a great opportunity to make effort of female labour in the homestead vegetable production because in Bangladesh, female labours are not interested to work with male in the cropland. With the ever-increasing problems of malnutrition and not much land devoted to vegetable production, the only feasible option particularly for the small holder is to grow vegetables intensively in homestead. Hence, an experiment was conducted to find out the profitable vegetable production sequence in the homestead.

Materials and Methods

Trials on different vegetables growing patterns at homestead round the year started at Farming Systems Research and Development (FSRD) Site, Narikeli, Jamalpur, from Kharif 2002 to rabi 2003 with a view to find out a profitable sequence of vegetable patterns and to utilize the unused under utilized places of homestead. Five patterns included 17 different kinds of vegetables were cultivated in three different seasons of the year.

The patterns were as follows:

Plot number	**Kharif-I**	**Kharif-II**	**Rabi**
Plot 1	Indian spinach	Data	Tomato
Plot 2	Brinjal	Kangkong	Lalshak + Cabbage
Plot 3	Okra	Broad leaf coriander	Coriander + Onion
Plot 4	Chilli		Spinach+ Garlic
Plot 5	Latiraj kachu		Carrot+ Bitter gourd

$^{+}$Intercropping

A total sample of ten farmers was selected through proportionate stratified sampling basis from landless (0-0.2 ha) and small (0.51-1.0 ha) farm family. In Kharif-I, different vegetables were Indian spinach, Brinjal, Okra, Kharif-II were Data, Kangkong and Broad leaf coriander and in Rabi, different vegetables were Tomato, Lalsak, Cabbage, Coriander, Onion, Spinach, Garlic, Carrot and Bitter gourd while Chilli and Latiraj Kachu were both in Kharif-I and Kharif-II. 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 for each crop.

Results and Discussion

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): Out of two Kharif–I vegetable, okra took maximum field duration 46 days (sowing to 1st harvest) and Indian spinach took minimum days (Table 1).

Yield (t/ha): The highest yield was obtained from Indian Spinach (20.6 t/ha) while the lowest from Okra (9.0 t/ha). The highest net return was recorded from Okra (Tk. 25000/ha) and the lowest from Indian spinach (Tk.19900/ha). The highest benefit cost ratio was found in Okra (2.25) and lowest 1.32 from Indian spinach. The causes behind the highest BCR from Okra was due to its lower variable cost (Table 1).

Kharif-II

Field duration (days): Out of three Kharif– II vegetables, maximum field duration was taken by Latiraj Kachu 160 days and the minimum was 44 days by Kangkong (Table 2).

Yield (t/ha): The highest yield was recorded from kangkong (27.5 t/ha) while the lowest from chilli in dry weight (2.2 t/ha). Data and Broad leaf coriander were damaged. The highest gross benefit was obtained from Kangkong (Tk.110000/ha) which followed by Lotiraj kachu (Tk. 97,000/ha). The lowest gross benefit was obtained from chilli (Tk. 77,000/ha). The maximum benefit cost ratio was recorded from Chilli (2.57) and lowest (1.6) was from Lotiraj kachu (Table 2).

Rabi

Field duration (days): Out of nine rabi vegetable, maximum field duration required for Bitter gourd (158 days) followed by Garlic (137) and the lowest for Lalsak (26) (Table 3).

Yield (t/ha): The highest yield was obtained from Cabbage (45 t/ha) while the lowest yield was obtained from Garlic (3.85 t/ha). The highest net return (Tk. 200000/ha) and benefit cost ratio (2.67) were obtained from Tomato. Ahmed (1995) reported that Tomato + Batisak gave the highest net return and BCR. The lowest yield was obtained from all the vegetable sequence due to unfavorable climatic condition. The lowest net return (Tk.27000/ha) was obtained from the plot Carrot + Bitter gourd. The lowest benefit cost ratio (1.36) was also obtained from Carrot + Bitter gourd (Table 3)

Performance of the vegetables patterns

Performance of vegetable patterns was shown in Table 4. From the Table, it was revealed that the cropping pattern Indian spinach - Tomato performed better than the other patterns. This pattern gave the highest gross and net return (Tk 402400 /ha) and (Tk.219900/ha), respectively. BCR (2.28) was the highest for the pattern Kangkong-Lalshak+Cabbage. The lowest gross return, Net return and BCR (Tk.199680/ha, Tk 64680/ha and 1.48, respectively) was given by Lotiraj kachu-Carrot+Bitter gourd vegetable sequence due to lower yield of this pattern.

Conclusion

Among the five vegetable patterns, Indian spinach-Data - Tomato gave the highest net return (Tk. 635500/ ha). However, all of the patterns might be beneficial for the farmer both in nutritional and economic point of view. The experiment will be continued for the next year.

Table 1. Yield, cost and return analysis of different vegetables of Kharif-I at FSRD site, Narikeli, Jamalpur 2002

Crop	Field duration (Sowing to Ist harvest days)	Yield (t/ha)	Total return (Tk/ha)	Total variable cost (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio
Indian Spinach	38	20.6	82400	62500	19900	1.32
Brinjal	-	-	-	-	-	-
Okra	46	9.0	45000	20000	25000	2.25
Chilli	-	-	-	-	-	-
Latiraj kachu	-	-	-	-	-	-

Price: Indian Spinach - Tk.4.00/kg, Brinjal - Tk.4.00/kg, Okra - Tk.5.00/kg

Table 2. Yield, cost and return analysis of different vegetables of Kharif-II at FSRD site, Narikeli, Jamalpur 2002

Crop	Field duration (days)	Yield (t/ha)	Total return (Tk/ha)	Total variable cost (Tk/ha)	Net return (Tk/ha)	BCR
Data	-	-	-	-	-	-
Kangkong	44	27.5	110000	46000	64000	
Broad leaf coriander	-	-	-	-	-	-
Chili	85	2.2	77000	30000	47000	2.57
Latiraj kachu	160	16.28	97680	60000	37680	1.6

Price (Tk./kg): Data -2.00, Kangkong - 4.00, Broad leaf coriander -.25.00, Chili- 35.00, Latiraj kachu- 6.00

Table 3. Yield, cost and return analysis of different vegetables of Rabi at FSRD site, Narikeli, Jamalpur 2002-03

Crop	Field duration (days)	Yield (t/ha)	Total return (Tk/ha)	Total Variable Cost (Tk/ha)	Net return (Tk/ha)	BCR
Tomato	88	40	320000	120000	200000	2.67
Lalshak +Cabbage	26	8	32000	115000	142000	2.23
	78	45	225000			
Coriander +Onion	30	5	100000	80000	76000	1.95
	48	7.0	56000			
Spinach + Garlic	29	14.0	56000	90000	62250	1.70
	137	3.85	96250			
Carrot + Bitter gourd	72	12.0	72000	75000	27000	1.36
	158	5.0	30000			

Price (Tk./kg): Tomato - 8.00, Coriander - 20.00, Lalshak - 4.00, Onion - 8.00, Cabbage- 5.00, Spinach- 4.00, Garlic- 25.00, Carrot - 6.00, Bitter gourd - 6.00

Table 4. Cost and return analysis of different vegetables pattern round the year at FSRD site, Narikeli, Jamalpur 2002-03

Patterns	Total return (Tk/ha.)	TVC (Tk/ha)	Net return (Tk/ha)	BCR
Indian spinach –Tomato	402400	182500	219900	2.20
Kangkong- Lalsak + Cabbage	367000	161000	206000	2.28
Okra-Coriander + Onion	201000	100000	101000	2.01
Chilli - Spinach+ Garlic	229250	120000	109250	1.91
Latiraj kachu - Carrot+ Bitter gourd	199680	135000	64680	1.48

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CROP-FISH-LIVESTOCK INTEGRATED FARMING IN CROP FIELD OF GANGES TIDAL FLOODPLAIN (AEZ-13)

Abstract

One alternate modules of Crop-Fish-Livestock integrated farming was designed to test against farmers existing cropping pattern Mungbean-T.Aus- T.Aman in the crop field of Tidal Ganges Floodplain (AEZ-13) at FSRD site, Lebukhali, Patuakhali, from March, 2002. The Gher module was tested for two years. Total production, gross return and gross margin were markedly higher in Gher module than that of farmers' practice. Though the operational cost was higher in gher module, it gave a MBCR of 5.5 over farmers' practice. Crop diversification especially vegetables and fish production was an important benefit from gher module.

Introduction

Farming of tidally flooded non-saline region of Patuakhali (AEZ-13) is mainly rice based. Transplant aus in Kharif-1 and transplant aman in Kharif-2 season are grown and yield level is potentially high for both local and modern varieties. Crop diversification in rabi season is less. Mungbean, Khesari, Cowpea, Chilli and Sweet potato are main rabi crops but area coverage is less than 25% of cultivable land. Improvement of existing cropping system is constrained by some of its special features such as: (i) inundation of crop field (up to 3 feet) twice daily by tidal water in monsoon season. (ii) late harvest of T.Aman rice delayed rabi crops. (iii) rainfall and tidal inundation of crop field in late November delayed '300' condition of soil which in turns limits rabi cultivation only for some selected crops like Mungbean, Khesari, Cowpea, Chilli etc. (iv) short winter.

Improvement of cropping system in the existing context requires mainly control of entrance of tidal water into the field and diversification of crop production integrated with fishery and livestock production system. Rice-fish culture is being practiced by some farmers sporadically in the area. The present study is designed to integrate field and horticulture crops, fishery and livestock components to develop a module for maximum utilization of resources with high economic return.

Objectives:

a) Maximum utilization of available resources
b) Higher economic return
c) Diversification of production system with sustainability
d) Supply of balanced nutrition to farm family members round the year.

Materials and Methods

It was designed to test two alternative modules of integrated farming along with the existing Mungbean- T.Aus-T.Aman cropping pattern. Due to shortage of fund allocation, only one alternate module was tested with existing cropping pattern from March 2002. The alternative module was named as Gher module to grow crop, fish and livestock in same piece of land.

Description of Gher: An embankment surrounding the crop field was made digging a canal inside the embankment. In the middle, the crop field was kept as it was. Area distribution in the Gher was:

Embankment:	25%	i.e. 12.5 decimal
Bauckchar:	5%	i.e. 2.5 ”
Canal:	25%	i.e. 12.5 ”
Crop field:	45%	i.e. 22.5 ”
Total:	100%	i.e. 50.0 ”

The gher was completed within March 2002 with a cost of Tk 12,000/=

Integration of components in the module:

a) Crop field: Mungbean -T.Aus (MV)-T.Aman (MV) cropping pattern in15 decimal.
Zero tillage potato -T.Aus (MV)-T.Aman (MV) cropping pattern in 5 decimal.

b) Canal: Stocking / rearing of fish.

Ruhit	150 No.	13.5.02
Katla	150 ”	”
Silver carp	150 ”	”
Mrigel	150 ”	”
Raj puti	100 ”	”

c) Embankment top: Banana plantation (80 no.) + Radish (4 decimal) and Red amaranth(4 decimal)

d) Embankment slope: Creeper vegetables. (80 m long)

Pattern 1	Crops	Bitter gourd	-	Bottle gourd
	Planting date	25-30 March		1-7 September
Pattern 2	Crops	Bitter gourd		Country bean
	Planting date	25-30 March		20-25 August
Pattern 3	Crops	Ribbed gourd		Bitter gourd
	Planting date	1-5 April		10-15 September
Pattern 4				
	Crops	Snake gourd		Bitter gourd
	Planting date	1-5 April		10-15 September

Farmers’ existing practice: Mungbean – T.Aus (local) – T.Aman cropping pattern (50dec.)

Result and Discussion

Total production was increased tremendously in alternate module in comparison to farmers’ existing practice. Total variable cost was also higher in alternate module but gross margin was higher enough to produce an MBCR 5.50 over farmers’ practice. Though the initial cost is high, it could be recovered with in the first year. Gross margin and BCR were also higher in the “Gher” module.

Benefits derived from Gher module were:

- More production.
- Diversified production especially fruits, vegetables and fish.
- Higher economic return.
- Income generation round the year.
- More employment.
- Maximum utilization of the resources.
- Better irrigation management.

Limitation

- More labour requirement
- Intensive care, management and planning
- Requires high initial cost
- Requires higher operational cost
- Water management was difficult for field crops.

Conclusion

The trial was carried out for two years only. It was expected that the alternate module could be an excellent technology to increase production and income of the farmers of the region. But it needs further details study for long term.

Table 1. Production of different components in alternative modules and farmers' practices (Average of 2 years)

Practices	Total area/No.	Production (kg/no.)	Price (Tk)
	Alternate modules		
Fruits & vegetables			
Banana	80 nos.	1300	10400
Country bean	20 pits	180	1440
Snake gourd	20 pits	180	1080
Bottle gourd	20 pits	80 No.x3kg	800
Ribbed gourd	20 pits	150	1200
Bitter gourd	80 pits	410	3280
Red amaranth	4 decimal	485	1940
Radish	4 decimal	650	2600
Total		3110	22740
Crops			
T.Aus	20 decimal	350	2275
T.Aman	20 decimal	420	2730
Potato	5 decimal	500	2500
Mungbean	15 decimal	50	1400
Total		1320	8905
Fish			
Ruhit	150 no.	30	900
Katla	150 no.	35	1050
Silver carp	150 no.	40	1200
Mrigel	150 no.	15	450
Raj puti	100 no.	20	600
Total		140	4200
	Farmers' practice		
Mungbean	50 decimal	125	3500
T.Aus	50 decimal	400	2600
T.Aman	50 decimal	500	3260
Total		1025	9360

Table 2. Cost and return of alternative module and farmers' practice

Practices	Gross return (Tk)	TVC (Tk)	Gross margin (Tk)	BCR	MBCR over FP
			Alternate module		
Fruit (Banana)	10400/=	1480/=	8920/=	7.03	
Vegetables	12340/=	3625/=	8715/=	3.40	5.5
Fish	4200/=	1660/=	2540/=	2.53	
Crops	9360/=	3594/=	5766/=	2.60	
Sub total	36300/=	10359/=	25941/=	3.50	
			Farmers practice		
Crops	9360/=	5483/=	3877/=	1.71	-

Input price: Fish finger ling: Tk 1/piece, Banana sucker: Tk 3/piece, Mungbean seed: Tk 40/kg, T.Aus/T.Aman seed: 15.00/kg, Potato seed: Tk 14/kg, Urea : Tk 6/kg, TSP: Tk 15/kg,MP: Tk 10//kg.

Input price (Tk./kg): Country bean: 8.00, Ribbed gourd: 8.00, Bottle gourd: 10.00/ piece, Bitter gourd: 8.00, Snake gourd: 6.00, Red amaranth: 4.00, Radish: 4.00, Banana: 8.00(approx.), Fish: 30.00, Potato: 5.00, Mungbean: 28.00, Rice: 6.50.

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FARMERS PARTICIPATORY RESEARCH ON INTEGRATED RICE-BASED FARMING FOR IMPROVED LIVELIHOOD FOR RESOURCE POOR FARM HOUSEHOLDS- Compile report of 4 sites (PETRRA, SUB-PROJECT)

SUMMARY

Noakhali: The following development activities were conducted at the FSRD site, Atkapalia, Noakhali to increase the production, income, employment opportunity, nutrition etc. and ultimately enhance livelihood status of the target resource poor farmers (RPF`s) towards poverty alleviation. This study looked at the improvement of technologies from livelihood perspective, verification of results in collaboration with farmers, government and non-government organizations with special emphasis on nutrition and gender sensitivity. Different interventions like field crop, homestead, poultry, livestock, fisheries, fruit trees management and off-farm activities introduced among fifty RPF`s farming families. More detailed recording is being carried out with nine households (4 landless, 3 marginal and 2 small). Fallow-T.Aman-Fallow is the major cropping pattern of this locality. After introduction of the project, potato, soybean, mungbean, groundnut etc. were cultivated in the fallow period due to which cropping intensity as well as net income of the farmer increased in substantial amount. In homestead, roof top, open sunny place, partially shady place, compost area, boundary, ails and trellis were utilized in a manner so that productivity of vegetables both in number, yield and nutritive value increased after the intervention. In the homestead area modern high yielding varieties of radish, lalshak, tomato, danta, cabbage, cauliflower, kangkong, puishak, ladies finger, brinjal, batishak and many other vegetables were introduced in 'Kalikapur modified model' of year round vegetable production by preparing beds in the homestead area. Social status of the participating resource poor farmers have increased due to intervention. Neighbors and relatives from far off places came to them to know about the new technologies and voluntarily took seeds of new crops and vegetables. Due to increased production of crops and vegetables food security of the participating RPFs has increased and health condition improved.

Introducing of beef fattening and layering with Fyomi was demonstrated at the site area. By rearing Fyomi on an average Tk. 2565 obtained within a period of 7 months. A net income of Tk. 3875 per household was earned by beef fattening of a single heifer. Fish rearing is a profitable business to earn more money in the seasonal ponds. Gift telapia and sharputi were intervened among the twenty five households. Average fish production was 12kg /decimal. The highest net return Tk. 6861/pond was found in small farm household. The larger was the pond size higher was the more profit. Off-farm activities mainly introduced with mora and pati making

All the stake holders involved in On-Farm and Off-Farm activities increased their income and the highest net return was Tk. 34952 was recorded among marginal farmers and the lowest Tk. 14531 in the landless farm category. Different technologies offered among the 50 RPFs included potato cultivation with mulch, soybean cultivation with inoculum, Fyomi rearing for egg production and year round vegetables programs were found to be more successful intervention for rapid progress in poverty alleviation. It was found that women are mainly involved in Fyomi rearing and homestead gardening throughout the year. After intervention of technologies the farmers' net benefit from crop, homestead, livestock, fisheries and off-farm increased by Tk. 12191, 1962, 4136, 5484 and 3450 respectively than that of pre project status irrespective of the farm household sizes. Increased income was found to be utilized in the formation of assets like, improvement in the housing facilities, purchase of furniture, improved sanitation and drinking water, children's education and changing life style. The greatest achievement at the output level was in the active participation of women RPFs, particularly in validation and adoption of year round vegetable production in the homestead area, rearing of improved poultry breed, beef fattening and seed preservation. Inclusion of woman farmers in the sub project activities was found to create synergetic effect on the output.

Rangpur: The PETTRA sub-project activity was initiated since 01 September 2002 and it would be continued till 30 June 2004. According to the aim of the project only landless, marginal and small households of five villages (Syedpur, Birahim, Monurchara, Chandipur and Chalunia) of Pirgacha Upazila at PETRRA site, Rangpur were targeted as resource poor. Among the total farm households of three categories only 50 farm households were selected of which 20, 20 and 10 from landless (0-50 decimal land holdings), marginal (51-125 decimal land holdings) and small (126-250 decimal land holdings) were selected respectively through purposive random sampling technique. Before implementing the project activities a household survey was carried out and detail information in respect of livelihoods maintained by the selected households was documented. 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 participatory farmers (both the male and female) of each farm group were given orientation separately on the program activities prior to implementation. The programs were taken for best utilization of unutilized or under-utilized homestead area for year round vegetable production following improved cropping patterns with modern varieties and proper management, year-round roof-top utilization with creeping vegetables, fruits tree management, utilization of shady places and boundary ails, use of modern packages in crop field, goat and broiler rearing for meat production, cattle beef fattening, pigeon rearing, vaccination of local poultry birds, utilization of pond with modern fish culture, deworming of cattle and off-farm & non-farm activities for higher income and employment of target farm families. As a result the net return from different sectors as well as net income of participatory farm families has increased significantly compare to previous years. After intervention mental strength of participatory farm families has improved because, they believe that after receiving need based training their knowledge about agricultural activities, own resource use, primary health care and sanitation, group formation & management and off-farm & non-farm activities has increased. Now the participatory farm families are well aware about their children education. Due to intervention availability of nutritious foods from different sectors of farm households have increased which leads them better nutrition and good health. Social status of participatory farm families has increased. Neighbors and relatives from far off places come to them to know about the new technologies and the way of their holistic development. After intervention family labours of participatory farm families are maximum utilized. Women members of target farm families do most of the work for homestead vegetable production and livestock rearing. The women members are directly selling their products especially for homestead and taking decision for future planning with her husband. After intervention microclimate of project area has improved due to increasing cropping intensity, which is maintaining carbon-di-oxide balance and deposition of household waste for composting. Now, the participatory farm families are producing seeds and preserving for next year use. Net working committee of PETRRA site has developed linkages with the farmers so that farmers know from where to get the services for different activities. Formations of farmer's co-operative society are helping the members to take loan for purchasing productive enterprises and avoiding the lengthy process for taking loan from bank.

Barind: Due to intervention, productivity of rice in all farm households increased. Modem high yielding varieties replaced the local and old varieties thus increasing the yield and production of rice. Number and quality of vegetables increased. In the homestead area of participating farmers, roof top, open sunny space, partially shady place, boundary walls, trellis were optimally utilized thus increasing year round production of vegetables. Intervention in replacement of local low yielding poor quality vegetables by improved high yielding vegetables rich in protein and vitamins has increased income and nutrition level of the farm household members including children. It also helped to reduce rice consumption. Intervention has increased rice-provisioning ability of the resource poor farmers, both by increasing rice production and reducing rice consumption through increased vegetable intake, which was *more* pronounced among landless and marginal farmers. Social status of the participating resource poor farmers has increased due to intervention. Neighbors and relatives from far off places came to them to know about the new technologies and voluntarily took seeds of new crops and vegetables. Due to increase production of crops and vegetables, food security of the participating RPFs has increased and health condition improved. Increased income was found to be utilized in the formation of assets like, improvement in the housing facilities, purchase of rickshaw Venn, improved sanitation and drinking water, children's education and changing life style.

'Barind model' of year round vegetable production by preparing beds in the homestead area was followed in almost all households. In all households, modern high yielding varieties of BARI seem, carrot, tomato, batishak, bush bean, gimakolmi and many other vegetables were in the RPFs' homestead area. Local varieties of rice in T.Aman season were replaced by short duration modern varieties like, BRRI dhan 28, 32, 39 etc. instead of local variety "Shoma". Modern varieties of rice helped to increase cropping intensity and rice production as well as rice provisioning ability of resource poor farmers. In Rabi season, some rainfed and partially irrigated HY crop varieties like-chickpea, wheat, mustard etc were introduced in the crop fields. In irrigated land, mungbean and sesame were intervened after harvesting of Rabi crops during Kharif season at high Barind area. In the livestock sub-system, Vaccination, Deworming, improved feed supplies etc. were adopted and on the other hand, monoculture and poly culture of carp fish were cultured in seasonal and perennial ponds respectively. Finally, some economically profitable off-farm activities like muri frying, katha sewing, tailoring etc. were practiced to increase the cash income. Considering farmer's choice and existing resources, an appropriate set of' proven technologies was introduced replacing the inferior ones in all sectors of farming like crop, livestock, fisheries and homestead production system as well as off- farm activities.

OFRD, Barind Station with the assistance of other scientists from local level - research partner and service providers of the locality, organized intensive training for the participating male and female farmers. These training included the improved technologies on homestead vegetables, better management practices of crop production, seed preservation, fish culture, livestock and poultry rearing, IPM, vaccination to poultry and cattle, off farm activities like 'katha' sewing, tailoring etc. After receiving training farmers developed confidence to perform the job skillfully; Women farmers were found more receptive to the training. It was found that instead of giving training to the male members only, if training could be provided to both m ale and female members of the households, it creates synergetic effect.

The activities of the sub project has created new employment opportunities for the women farmers, Their workload has increased in the production of homestead vegetables, rearing poultry, goat, pigeon, livestock and in off farm activities. The productivity of the existing farming was improved due to integration of technologies through holistic approach.

Faridpur: The PETRRA subproject was implemented in PETRRA working site, Ishan Gopalpur, Faridpur by BARI. Finally forty-one resource poor farmers were selected on the basis of their own land in two villages of the study area. Out of which 14 were landless, 14 marginal and 13 small households. Interventions were made in homestead area, cropland, poultry, livestock, fisheries, fruit trees management and in off-farm activities replaced by high yielding varieties and different technologies. The gross margin increased in landless, marginal and small farm house hold was 170, 155 and 122 percent respectively. The vegetable consumption increased from 105, 143 and 126 g/day/person to 187, 230 and 212 g/day/person in landless, marginal and small farm households respectively. Intervention has increased rice-provisioning ability of the resource poor farmers by 2 to 4 months. The expenditure pattern of the farmers has also changed and expending more money for education, cloths and recreation purpose. Social status of the participating resource poor farmers has increased due to intervention. Neighbors and relatives from far off places came to them to know about the new technologies and voluntarily took seeds of new crops and vegetables.

The activities of the subproject have created new work opportunities for the women farmers by 1 to 2 hrs daily. A female association was formed in this site. The association will be helpful to sustain the income generation activities after the termination of the project.

This site has developed different communication materials, these included brochures, reports, training manuals and videos. Also some success stories have been published in the daily national newspapers.

BACKGROUND OF THE PROJECT

Rice is the most important crop of Bangladesh in relation to food, economy and rural culture. Poverty elimination is the new challenge for all researchers, extensionists and farmers. In this venture Bangladesh Agricultural Research Council (BARC) initiated systems research on rice-based cropping systems during 70s. Later it was turned into Farming Systems Research (FSR) to address all subsystems giving holistic boons on rural farms. BARC coordinated FSR activities of Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Livestock Research Institute (BLRI), Bangladesh Fisheries Research Institute (BFRI), Bangladesh Jute Research Institute (BJRI) and Bangladesh Agricultural University (BAU) during 80s and 90s and contributed significant contribution to poverty elimination efforts through developing, refining and packaging hundreds of technologies related to all subsystems of agriculture. But less emphasis was given to off-farm and non-farm opportunities of resource poor small farmers of their livelihood systems. Thus, livelihood systems approach considers all kinds of living and earning opportunities of resource poor farming households of rural areas. Such action research would help them to enhance production and income in maintaining better living. To alleviate productivity and income, PETRRA (Poverty Elimination Through Rice Research Assistance) was approached to assist in the endeavour, which they agreed. This resulted in the initiation of this subproject. The objectives to be attained through integration of all potential components of rice based farming systems. It would employ participatory systems approach for research and development under livelihood perspectives. The project is aimed to increase the production, income, employment opportunity, nutrition etc. and ultimately enhance livelihood status of the target farms towards poverty alleviation.

Objectives

- Improvement of technologies from livelihood perspective appropriate to resource poor farmers.
- Identify and verify the results in collaboration with farmers, extension agents and policy markers.

METHODOLOGY

Areas of Research

- Focus on livelihood- The technologies will be developed with the livelihood strategies
- Gender sensitivity- Given women equal weights in setting research priorities, in participating technology development & evaluating their impact on crop production and income.
- Participatory and demand led - research

Duration: Twenty-two months. September 2002-June 2004

Locations

1. Syedpur - Rangpur (BARI)
2. Chabbishnagar - Rajshahi (BARI)
3. Ishan Gopalpur - Faridpur (BARI)
4. Atkapalia - Noakhali (BARI)

Target Group

Three categories of farmer are involved: They are:

a) Landless (0-0.02 ha)
b) Marginal (0.02-0.05 ha)
c) Small (0.05-1.0 ha)

There are 50 households of which 100 farmers (50 male, 50 female) are involved.

Selection of net working members

The main researcher of this sub-project is On-Farm Research Division (OFRD), BARI, Rangpur, Barind, Faridpur, Noakhali and for integration of farming components many others stakeholders as net working members at local level like DAE, DLS, DOF, BRR!, BJRI, SRDI and NGOs. 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 but only the collected data from 4 landless, 3 marginal and 3 small households up to 31 May 2004 were analyzed using simple statistical tools and their results have incorporated in this report.

Noakhali:

Site description: The project was initiated on 1st September 2002. The project area is FSRD site, Atkapalia, Noakhali which comprises two villages- Char Jubilee and Char Jabber. The site area is located about 25 km southern side of Maijdee court, Noakhali at 22°429′ N latitude and 91°94′ E longitude. The site represents of the vast saline area of AEZ-18f (Young Meghna Estuarine Floodplain). The extrapolation area includes a large part (88%) of greater Noakhali district and part of Bhola, Chittagong and Patuakhali district. The major land types of the extrapolation area (AEZ-18) represent medium highland (79%) and medium lowland (10%). Rest of the area (11%) is covered by homesteads and water bodies excluding rivers. Soils are silty clay, low in organic matter content and have little structural stability making them poorly suited for crops due to poor aeration, less available water and surface water logging after heavy rainfall and salinity in January to April.

Climatically the site represents a very wet region with annual rainfall ranging from 2500-3000 mm with relatively earlier on-set. The area experiences a short duration of cool winter period but lack extremely high summer temperature due to proximity to Bay of Bengal. The ecological hazards hitting the area are frequent cyclones and storm surges of various intensities and exceptionally high tides resulting in salt water flooding of agricultural lands intensification of ground water salinizations. The water is almost level with very low ridges and broad depression having few or no cricks excepts on the tidal flood margins. Shifting channels erodes land and deposit new char formations constantly. Bank erosion silting of channels and new char formations hamper soil stabilization process and degrade soil productively. The agricultural lands being dominated by MHL is shallowly flooded by rainwater and local run-off in depressions, where accumulation of water often too deep for growing T.Aman rice Kharif I crops planted in pocket areas often suffers from surface crusting during pre-early monsoon periods. Dry season crop production is affected by salinity resulting from capillary rise from slightly to strongly saline ground water at 2-4 m. Te whole extrapolation area lack fresh surface or ground water for irritation, as such the entire area remains unutilized during the dry season making the area chronically deficient in pulses oilseeds and winter vegetables.

The homesteads are often on raised land and small. The potential of home gardening is limited to some extent due to salinity. However, relatively older homestead have moderate to good potential for developing improved homestead agro-forestry practices as well as improving family nutrition through home gardening. Local bread of cattle, buffaloes and poultries area commonly reared. Acute fodder shortage is a characteristic feature of the area, particularly in the dry season with consequent low cattle head density, health problems and poor productivity.

Table 1. Available Technology for intervention at Atkapalia, Noakhali

Resources	Name of the technology for information
Crops and cropping pattern	1. Production program of Groundnut-T.Aman 2. Production program of BARI Tomato-2, 7, 8 and 9 3. Production program of BARI Mula 1, 2 and others 4. Production program of BARI Seem 1 5. Production program of BARI Lau 1 6. Production program of Dherosh 1 7. Production program of T.Aman rice (BRRI dhan 30, 31, 32, 40 and 41) 8. Cultivation of mustard under minimum tillage 9. Cultivation of wheat under minimum tillage 10. Cultivation of potato using mulch 11. Cultivation of tomato using mulch 12. Production program of summer tomato 13. Production program of BARI Mung 3, 4 & 5 with inoculum 14. Production program of BARI Khesari 1 & 2 15. Production program of Ground
Homestead utilization and family nutrition	1. Production program of creeper vegetables and cucurbits 2. Homestead vegetables production round the year practicing Kalikapur model 3. Mango hopper control program 4. Improving production of tree/fruit tree through recommended management practices
Gender issue	Improvement storing of cereals, pulses, vegetables and oilseeds using BARI developed technologies involving farm women
Livestock system	1. Chick (layer) rearing in semi-scavenging condition (Mini units of 25 layers) 2. Deworming and vaccination to cattle and poultry 3. Beef fattening with UMS diets
Fishery system	Polyculture in seasonal ponds

Rangpur

Existing Syedpur FSRD site is about 15 km away from ARS, BARI, Rangpur on Rangpur- Pirgacha Upazila metalled road. It spreads over five villages namely Syedpur, Birahim, Jagatpur, Kisamatkala and Monurchara villages of Pirgacha Upazila under the district of Rangpur. But to implement the present project activities two new villages viz. Chalunia and Patchim Chandipur were selected including the previous three villages namely Syedpur, Birahim, and Monurchara. The project site is located at 25°25 N' latitude and 89°25 E' longitude. The site area is 3 1.3m above from sea 1evel. It represents mostly highland and medium highland areas of the Tista meander Floodplain (AEZ# 3). The extrapolation area of the site under AEZ# 3 is about 946800 ha. 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.

Most of the extrapolation area have b road floodplain ridges and almost level basins. The higher part of the ridges stands above normal flooded level while the lower part of the ridges and basins are mainly shallowly flooded by rainwater. Moderately deep flooding occurs in basin centers. Hence, most of the area is suitable for year round crop production with adequate irrigation facilities. The soils are generally loamy, rapidly permeable in the upper part of the ridges and slowly permeable silt loams in the lower part of the ridges and basins. The organic matter content in the upper ridges is generally below 1.0% but gradually increases to about 2.0% in lower ridges and basins.

Table 2. Available technologies for intervention of tested integrated farming systems of Rangpur site are as follows;

Resources	Technologies for intervention
A: Homestead	
1. Roof top (2 Nos.)	• Bottle gourd (L)- Ash gourd (L) • BARI Seem 1 – Sweet gourd (L)
2. Open place (2-5 dec.)	• Radish (Tasakisan)-Lalshak (BARI Lalsak-1-Kangkong (BARI Gimakalmi-1) • Brinjal (Khatkhotia)-Spinach (L)-Indian spinach (BARI puisak-1) • Garlic – Okra (BARI Dherosh-1) • Coriander - Chili (L) + Lalshak (BARI lalshak-1)-Okra (BARI Dherosh-1) • Carrot-Indian Spinach • Bitter gourd and ribbed gourd on fence
3. Boundary / Ail: Fallow	Papaya plants (Shahi) and Napashak
4. Partially shady place	Zinger (L) and Turmeric (Dimla).
5. Plantation crops	• Proper fertilization, irrigation, insect & disease management and pruning on Mango, Jackfruit and Coconut trees. • Proper fertilization and irrigation management on Betel nut and Guava tress. • Proper pruning of other trees
6. Compost/Farm yard manure heap	Farm yard manure heap and post heap in two chambered
B: Field crop (Land 125-192 dec.)	1. Potato (Cardinal) - Jute (0-9897)-T.Aman (BR11) in highland 2. Papaya (Shahi) garden with recommended management 3. Potato (Cardinal) – Ash gourd (L) in highland 4. Potato (Cardinal)-Boro (BRRI dhan-28)-T.Aman (BRRI dhan 33) in highland 5. Cauliflower (Rupa) – Okra (BARI Dherosh-1) 6. Tomato (Ratan)–T.Aman seed bed (BR11)–Cabbage (Atlas-70) 7. Potato (Cardinal)-T.Aman seedbed - Cabbage (Atlas-70) 8. Potato (Cardinal) – Summer vegetables 9. Boro(BRRIdhan28)-Fallow-T.Aman(BR11) in medium highland
C: Livestock	Recommended management a) Vaccination to poultry bird b) Deworming of cow c) Goat rearing under improve feeding d) Cattle beef fattening of Ox e) Broiler rearing f) Pigeon rearing in household situation
D: Fisheries: 7-16 dec.	Pisciculture with recommended management
E: Off-farm	
Shallow tube well and Business	Shallow tube well, Embroidery, Batik, Butik, Blocking and Tailoring and Business

Barind, Rajshahi

Site description: Existing FSRD site is located at Rishikul Union under Godagari Thana, about 16 km west to Rajshahi city. It comprises of 7 villages namely Chabbishnagar, Sholapara, Hazipara, Baipur, Kalidashpur and Tilahari under Godagari Upazila of Rajshahi district. It is situated at 24° 23' north latitude and 88°20' east longitude belonging to High Barind Tract (AEZ 26) with uneven land topography of which 70% rainfed highland, 20% rainfed medium highland and 10% partially irrigated highland. The physical extrapolation area of the site is about 1600 sq. km (UNDP/FAO, 1988), which covers the districts of Rajshahi, Nawabganj and Naogaon. The soils are generally silty loam to silty clay loam with grey terrace. The organic matter content of the soils generally 0.6-0.8% with pH: 5.0-6.0. Due to short monsoon and poor water holding capacity, soil water depletion starts from late October and no available soil moisture exist by the end of December (Idris and Haque, 1987). The mean annual rainfall is about 1200 ± 300 mm. The mean monthly maximum temperature of the area is 34° C in May, June and September and the minimum 11° C in January. The winter in this region ranges from 100-125 days in a year with minimum temperature below 15° C. For 5-15 days, more than 40° C temperatures prevails generally in May. The drought is a main climatic hazard in the area.

The cropping intensity of this area is 143 percent. Crop production depends mostly on the amount and distribution of rainfall. The area is predominantly used by rain fed T.Aman rice, which covers more than 95% of the available land. The cultivars used mainly local with 10-15 percent modern varieties. Single rain fed local T.Aman rice was the predominant crop of this area. The important dry land Rabi crops in this area is Chickpea, Linseed, Wheat, Mustard, Barley and Coriander. Other crops are broadcast Aus rice and a number of vegetables in the homestead area, producing only a fraction of the requirements.

Table 3. Available technologies for intervention of the tested integrated farming systems, Rajshahi site are as follows;

Resources	Technologies for interventions
A. Homestead	
1. Open land: year round vegetables production	
Bed-1	Okra – Amaranth - Tomato
Bed-2	Indian spinach - lalshak+Brinjal
Bed-3	Kangkong - lalshak + Brinjal
Bed-4	Lalshak + Okra – Indian spinach
2. Roofs	Country bean
3. Trellis	Bottle gourd – White gourd
4. Tree support	Potato yam
5. Partially shady area	Oal
6. Fence	Yard long bean/ Bitter gourd/ Country bean
7. Muddy wall	Country bean – Sponge gourd
8. Back yard	Lazina, Plantain banana
9. Composed shade	White gourd
B. Pond bank	Country bean, Gaj karolla, Tomato, papaya, lalshak, stem amaranth etc.
C. Ponds (Fisheries)	
Seasonal pond	Mono culture of carps
Perennial pond	Poly culture of carps
D. Livestock	
i. Chicken Layering	Vaccination and improved feeding
ii. Goose rearing	Vaccination and improved feeding
iii. Duck rearing	Vaccination and improved feeding
Iv. Pigeon rearing	Grain mixture and proper management
v. Goat rearing	Deworming, Vaccination and UMS diet
vi. Cattle rearing	Deworming, Vaccination and UMS diet
vii. Beef fattening	Deworming, Vaccination and UMS diet

Resources	Technologies for interventions
E. Cropland (crops & cropping)	
i. Rain fed condition	Chickpea-T.Aman, Chickpea-GM- T.Aman,
ii. Irrigated condition	Chickpea-T.Aman (BRRI dhan 39), Mustard (BARI Sarisha 9) -Boro (BRRI dhan 28)-T.Aman (BRRI dhan 39), Linseed-GM-T.Aman (BRRI dhan 39), Chickpea-Mungbean-T.Aman (BRRI dhan 39), Wheat (Shatabdi)-Mungbean (BARI Mung 5-T.Aman (BRRI dhan 39), Potato (Cardinal)- Mungbean-T.Aman (BRRI dhan 39), Potato (Cardinal)-T.Aman (BRRI dhan 39)
F. Other development activities of the homestead	
Existing trees	Modern management practices like manuring, fertilization, irrigation & drainage, pest management, training and pruning etc.
New plantation of HY varieties	Mango, Litchi and Guava
Grafting nursery for HYV fruit and cash income	Grafting of Mango, Litchi and Jujube seedling
Use of organic wastes as organic manure	Composting with house waste, poultry liter and cattle liter
Seed preservation	Using scientific method like seed preservation with neem cake or neem leaves
G. Off-Farm activities	Muri fraying, Tailoring, Katha sewing, Basket making etc

Faridpur

Site description: The PETRRA sub-project activity was conducted PETRRA working site Ishan Gopalpur, Sadar Upazila, Faridpur situated at 23°29" and 23°44" north latitude and 89°34" and 89°56" cast longitude. The area is under Low Ganges River Floodplain (AEZ-12). In the study area the farmers' category was 47% landless, 24% marginal, l6% small, 7% medium and 6% large. Major cropping pattern is Wheat-Jute-T.Aman, Pulse-Jute-T.Aman and Boro-T.Aman. Before going to implement the project activities a household survey (Benchmark survey) was carried out and detail information in respect of livelihoods maintained by the selected households were documented in October 2002. 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 (hath the male and female) and members of local not working group. According to the aim of the project only landless, marginal and small fanners of two villages (Ishan Gopalpur and Bishnupur) of the PETRRA site were targeted as resource poor. Forty-one household were selected out of which 14 from landless, 14 marginal and 13 small households. 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 fanners (both the male and female) and field staffs were organized.

The main researcher of this sup-project is On-Farm Research Division (OFRD), BARI, Faridpur and for integration of farming components many others stakeholders were selected as net working members at local level like BRRI, BADC, BJRI, DAE, DOF, DLS, NGOs e.g. ITDG and World vision. The main objective of collaboration of these stakeholders is to introduce them with farmers of this subproject and finally farmers can utilize their technologies after termination of the project.

Fifty farm households of landless, marginal and small farm categories were selected for this project as per project proposal, but intensive data collection was done from nine farmers of which 3 farm households from landless category, 3 from marginal and 3 from small category farm households. The data were analysis using simple statistical tools considering i) cost and benefits, ii) financial balances,

iii) yield of crops and other enterprises, iv) livelihood analysis, v) women employment and vi) net worth of the farmer from all components compared with previous performance.

Table 4. Available technologies for intervention of the tested integrated farming systems of Faridpur are as follows

Resources	Technologies for interventions
A. Homestead: Year round vegetables production	
1. Open land:	
Bed-1	Cabbage-Lalshak-Gimakalmi
Bed-2	Brinjal-Okra-Okra
Bed-3	Cauliflower-Amaranth-Indian spinach
Bed-4	Potato-Okra-Okra
Bed-5	Bushbean-Lalshak-Indian spinach
Bed-6	Tomato-Okra-Okra
Bed-7	Radish-Lalshak-Amaranth
2. Roofs	- BARI Seem 1-Sponge gourd - BARI Seem 1- Ash gourd
3. Trellis	- BARI Seem 1-Sponge gourd - BARI Seem 1- Cucumber - Bottle gourd-Cucumber - Bottle gourd-Snake gourd
4. On support	Potato yam/country bean
5. Partially shady area	Turmeric/Elephant foot
6. Marshy land	Taro (Latiraj)
B. Field crops (chickpea, wheat, T.Aman etc.)	High yielding variety and fertilizer management
C. Trees	- Mango hopper control - Irrigation - Fertilization
D. Pond	Pond management for fish culture and vegetable productions
E. Livestock	- Cattle fattening - Deworming of cattle - Vitamin feeding of cattle - Vaccination of poultry - Vaccination of duck - Poultry rearing for egg production - Improve breed of duck rearing - Pigeon rearing
F. Off-Farm activities	Ice-cream making, Jhuri vaja, Embroidery (katha sewing), cooperative
G. Others	- Compost shed preparation - Seed preservation technique - Plantain plantation in homestead

RESEARCH FINDINGS

Noakhali:

Change of cropping pattern: Fallow-T.Aman-Fallow is the major cropping pattern in the FSR site Atkapalia, Noakhali. Success of growing crops in the coastal area Noakhali which usually remains fallow during rabi season could be brought under profitable cultivation. Use of improved varieties, better quality seeds, use of mulch on potato and application of recommended production practice increased the cropping intensity and simultaneously yield of different field crops of potato, rice, wheat, soybean, groundnut, mungbean in these areas.

Field crops: The major interventions were in field crops like potato, wheat, soybean, groundnut, mungbean, T.Aman rice etc. where high net returns were obtained from field crops. The total net return in the field crops increased Tk. 12191 than the previous level. Among the different crops potato with mulch gave the highest net return Tk. 68000/ha. This technology was economically viable, biologically feasible and socially acceptable. Other technologies like wheat cultivation with minimum tillage, soybean, groundnut and mungbean cultivation with inoculum, local T.Aman variety replaced by BRRI dhan 32 were accepted by the farmers. Now the PETRRA beneficiaries know that where quality seeds are available and how the seeds should be preserved. Due to use of their own seed like soybean, wheat, mungbean, groundnut etc. the total crop area and net income also increased in Rabi 2003-2004 than the previous year.

Homestead gardening: Homestead gardening was introduced among the thirty RPF`s. Due to different agro-ecological situation modified Kalikapur model was followed here within 35 sq m. homestead area for round year vegetable production. In the homestead eleven number of vegetables were (lalshak, radish, tomato, danta, cabbage, cauliflower, kangkong, puishak, lady's finger, brinjal, batishak) introduced for cultivation. The average vegetable production in every homestead during previous seventeen months was 20 kg/month. It created a very positive impact on family members, neighbors and visitors due to good performance and yield which helped in family nutrition and proper utilization of homestead areas.

Livestock: Introducing of beef fattening, layering with Fyomi, deworming of cattle and improved management increased the meat and egg production. 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. UMS program*:** This program was conducted among the 11 households. Due to better management e.g. deworming and use of feed concentrates, feed intake has increased. The results revealed that the UMS diets gave higher body weight gain in comparison to farmers traditional feeding and management practices. The individual body weight increased 380, 410, 375 gm/day in landless, marginal and small category farmer.

***B. Poultry*:** Among the different income generating activities layering with Fyomi was more profitable within a short time. Twenty-seven households were supplied each 10 Fyomi birds aged 60 days. Fyomi birds started on lying at 23rd week and the maximum egg production attained on the 32nd week. The average egg production for 10 birds per family was 44 in each week.

More egg laying and daily cash income specially created interest among the women. Now the majority of the family showed their interest on buying more Fyomi bird.

Beef fattening and layer production programs have created impacts in the locality. These have contributed to the employment and income generation of the farm family.

Fisheries: Gift telapia and sharpunti were supplied to twenty five households. Before intervention these homestead ditches and derelict ponds were cultivated with local fish like taki, puti, kai etc. The supplied fingerlings were harvested after five months. Average fish production was 12 kg/decimal. The success of this production is due to a higher body weight gain of telapia in a short duration.

Off-farm activities: Off-farm activities have been initiated involving women members of the household. After intervention two women were trained about small cottage industry for making mora and paty. Another woman is trained for vaccination in the site area. In the short period their success was very hopeful. Mrs. Bibi Rahima landless farmer earned 300/- by selling ten moras at every month. Similarly Aseya Begum marginal farmer sold four paties at every month and earned 500/-. Nur Banu marginal farmer earned 200/- per month by vaccinating poultry in his local area.

Resource mobilization

The study revealed that after intervention of different sub systems like crops, livestock, fishery, homestead and off-farm activities the resources available to the farmers were utilized properly for production purposes. It was evident that after motivation of the farmers and introduction of several alternatives for each production unit the farmer adopted several new technologies according his goal, preference and availability of resources. The productivity of the existing farming was improved due to integration of technologies through a holistic approach. The findings of the study showed that due to the utilization of all available resources and more enterprises, the RPF earned cash income in regular manner which helped him make capital investments in different subsystems for optimum production.

Income enhancement and livelihood development

Due to technical assistance, farmers participation, proper resource mobilization in different IGA (income generating activity) every sub systems income was increased remarkably. The net benefit increased from crop sector, homestead, livestock, fisheries and off-farm activities were Tk. 12191, 1962, 4136, 5484 and 3450, respectively. The average net income increased Tk 18724 in the project period than the previous status irrespective of the farm household size. Previously the majority of the farmers consumed the small amount of vegetable, fruits and animal protein. After intervention of year round homestead model, egg layering, polyculture of fish etc., the nutritional intake and consumption habits of the family members of the households were increased. Before intervention of different IGA`s the income of the resource poor farmer were very limited. Also their nutrient uptake and livelihood status was very poor. Intervention of different sub-systems technologies like homestead gardening, egg layering, fish culture, increased field crops, fruit production like banana, mango etc. influencing income as well as family nutrition. On an average, family consumption and income increased substantially. Due to intervention of different sub systems total income increased in landless Tk. 15240, marginal Tk. 29051 and small Tk.22903 during the project period (Table 5, 6 & 7). They used this additional amount of money in food, clothes, medicine, oil, other family material, educational costs, house repairing and land purchase etc. Due to more income and production changed their food habit, improved physical appearance of family members. Change of cropping pattern increased the cropping intensity as well as organic matter of the soil due to cultivation of soybean & pulse crops. Also, in project period increased their social status due to more solvency and access to different officials and other people.

Farmers training

The training included the improved technologies on homestead vegetable, seedbed preparation and seedling production, better management practices of crop production, seed preservation, fish culture, livestock and poultry rearing, IPM, vaccination to poultry and cattle, off-farm activities like 'mora' or "pati' making etc. Women farmers were found more receptive to the training. It was found that instead of giving training to the male members only, if training could be provided to both male and female members of the households, it creates synergetic effect.

Table 5. Cost and return from different sub system (Landless*)

	Before intervention				After intervention			
Source	GR(Tk)	TVC(Tk)	GM(Tk)	BCR	GR(Tk)	TVC(Tk)	GM(Tk)	BCR
1. Crops								
Rice	10045	7917	2128	1.27	10706	8158	2548	1.31
Soybean	1350	1190	160	1.34	2548	1548	1000	1.64
Mungbean	1050	435	615	2.41	1245	489	755	2.55
Groundnut	1762	1080	682	1.63	1682	1087	595	1.55
Wheat	-	-			1060	676	384	1.57
Potato	-	-			1842	1111	731	1.66
Tomato	-	-			375	450	225	7.50
Okra	-	-			348	39	309	8.92
2. Homestead	-	-			2201	214	1887	10.28
3. i) livestock	-	-			5700	1950	3750	2.92
ii) poultry	-	-			2660	1970	690	1.35
4. Fishery	690	250	440	2.76	4659	967	3691	2.36
5. Off-farm	-	-			4950	1250	2700	3.96
Total			4025				19265	

* Average of 20 farm households.

Table 6. Cost and return from different sub system (Marginal*)

	Before intervention				After intervention.			
Source	GR(Tk)	TVC(Tk)	GM (Tk)	BCR	GR (Tk)	TVC(Tk)	GM(Tk)	BCR
1. Crops								
Rice	18121	15532	2589	1.16	18776	15707	3069	1.19
Wheat	1280	670	610	1.91	1578	1108	470	1.42
Potato	2500	1122	2378	2.23	6108	2725	3383	2.24
Tomato	-	-			1710	550	1160	3.10
Okra	-	-			2250	280	1970	8.03
Soybean	2550	2037	513	1.25	10320	4879	5441	2.11
Mungbean	1600	1165	435	1.37	3837	1134	2703	3.38
G. Nut	1960	1264	696	1.55	4260	2557	1703	1.50
2. Homestead	-	-			2499	439	2059	5.70
3. i) livestock	-	-			6150	1950	4200	3.15
ii) poultry	-	-			2634	1970	664	1.34
4. Fishery	1040	389	651	2.67	7396	1494	5901	4.95
5. Off-farm	-	-			12500	8300	4200	1.51
Total			7872				36923	

* Average of 18 farm households.

Table 7. Cost and return from different sub system (Small*)

	Before intervention				After intervention.			
Source	GR(Tk)	TVC(Tk)	GM(Tk)	BCR	GR(Tk)	TVC(Tk)	GM(Tk)	BCR
1. Crops								
Rice	23270	18301	4969	1.27	24811	18603	6208	1.33
Wheat	-	-			1328	886	442	1.50
Potato	-	-			5082	2702	2380	1.88
Tomato	990	800	190	1.24	3300	1350	1950	2.44
Okra	-	-			660	180	480	3.67
Soybean	750	205	545	3.66	7995	3564	4431	2.24
Mungbean	1650	309	1341	5.34	1865	347	1518	5.37
G. Nut	1305	766	539	1.70	2835	2001	834	1.42
2. Homestead	-	-			2380	439	1940	5.42
3. i) livestock	-	-			5625	1950	3675	2.88
ii) poultry	-	-			2400	1970	430	1.84
4. Fishery	1150	487	662	2.36	8352	1490	6861	5.60
5. Off-farm	-							
Total			8246				31149	

* Average of 11 farm households.

Rangpur:

a. 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 the PETTRA Sub- project, target farm families are growing 17-20 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, onion, garlic, spinach, napashak, 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 zinger and turmeric (var. Dimla) 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. PETTRA beneficiaries are producing 450-550 Kg different vegetables from 2-3 decimal of homestead area per year of which consume 50-55%, distribute to relatives and others 3-5% and sale 42-45%. They produce 70-100 kg zinger and turmeric from shady place of 1-2 decimal per year. They profit Tk. 4600-5000/- per year where production cost is Tk. 1500-2000/-. 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 influenced to grow more vegetables at their homestead area with modern varieties and proper management.

Roof top: Year round creeper vegetable production on rooftop is one of the most profitable technology for landless, Marginal and small farm at the site. Before PETRRA program the rooftop of farm families were not utilized properly. But after the project initiation, 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 Seem 1 - Sweet gourd but who have two roof top can grow both in profitable way.

Seed production and preservation: After receiving training from the project the target farm families are producing seeds of different vegetables easily. Female members of the family do most of the activities like seed collection, cleaning, drying and preservation. Now the farm families are exchanging their seeds to each other and sometimes selling seeds also.

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 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-Jute-T.Aman and Potato-vegetable-T.Aman of the project site, Rangpur. About 80% farmers of this site are following Potato-Boro rice-T.Aman rice cropping pattern. 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. 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. As a result production cost of those crops becomes lower but the yield of said crops 15-20% higher. At present, average return from Potato-Boro-T.Aman rice Tk.75,000/- per acre per year where production cost is Tk.30,000/-. After intervention the income increases 20-25% more from this cropping pattern with the using of quality seed and proper management. They are using O–9897 variety for jute and improved high yielding varieties for vegetable production.

b. Livestock sector

Introducing of beef fattening, goat rearing, broiler rearing, pigeon rearing, vaccination of local poultry bird, deworming of cattle and improved management increased the meat, milk and egg production. 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.

Broiler rearing: Broiler rearing is a profitable business to earn more money with in short time. But it is observed that this technology is feasible for small farm family. Initially five beneficiaries of PETRRA sub- project have started this program with the supply of feed and medicine (vaccine). At present it has created positive impact among the farm families at the site. Production cost for 100 birds Tk.7600-8000/- (broiler cost Tk.1800/- and feed & other costs Tk.5800-6200/- per 100 birds) and return in Tk.10500-11000/- from 42 days.

Cattle fattening: After intervention PETRRA beneficiaries can easily practice this technology in profitable way. Ten beneficiaries of PETRRA Sub- project at Rangpur site are involved in this program. From this sub-project supplied feed and medicine (for deworming). It was observed that each beneficiary could profit easily Tk. 2500-3000/- from one bull-calf within four months where investment was Tk. 5600-6200/-(initial cost of 2 years aged bull-calf Tk. 2800-3200/- whereas feed & other costs Tk. 2700-3000/-).

c. Fisheries sector

Fish production of PETRRA beneficiaries is also increased due to adopt modern methods of pisciculture.

d. Off-farm and non-farm sector

After intervention the income from labour sell for landless and marginal has decreased because their workload has increased in the production activities in their own field. But they are earning more from "Barga land" by the adoption of modern technology of agriculture. After receiving proper training the women members of some farm families are spending their rest time for batique-boutique, blocking, stitching and tailoring activities. They are now saving money in some extent by the making their own cloths and earning something by selling their materials. It has created a positive impact to the neighboring farm families.

Formation of RPF's Society

After intervention the target farm families of PETRRA sub project, Rangpur has formed their own formal society separately like landless farmers' society, marginal farmers' society and small farmers' society. They think that the resources, choice and ability are different from each group to another group. In most of the cases female members are holding the executive post of the society. They have deposited money from their savings in Grameen Bank. The members of the society are taking loan for goat rearing, potato cultivation or any production enterprises.

Other aspects of intervention

The nutrition, resource use, knowledge and skill of the members, social acceptance and the microenvironment of the families were improved a lot by this time following the intervention. Active participation of women RPF's has increased particularly in validation and adopt in on year-round vegetable production in the homestead area, broiler rearing, vaccination of local poultry bird, goat rearing, beef fattening and preservation of seed. Number of quality vegetables increased in the homestead area of participating farmers, rooftop, open space, partially shady place, boundary ail, trellis are optimally utilized thus increasing year-round vegetables and spices. It has increased income and nutrition level of the farm household members including children. Net working committee of PETRRA site, Rangpur included members from different research Institute, DAE, DLS, DOF, related

NGOs and others. The committee has supervised the sub project activities at farmers' level. This committee has developed linkages with the farmers so that farmers know where to get the services for different activities. Due to sub-project activities, social and natural environment of the locality have improved.

Economics

The gross margin increased substantially in all the sectors of the cooperators under study. It is found that net income of landless, marginal and small households has increased by 46-192 %, 51-155 % and 86-174 %, respectively, compare with previous years (Table 8, 9 & 10). It is mentioned that subsidies from PETRRA sub-project have considered in costing.

Table 8.. Cost and return from different sub-system (Landless)

Resource	Before intervention (2001-02)			After intervention (Sept.2002- Mar.04)			
	GR (TK.)	TVC (TK.)	GM (TK.)	GR (TK.)	TVC (TK.)	GM (TK.)	MBCR
Homestead	540	80	460	7508 4741*	1211 765*	6397 3976*	6.13*
Crop	12385	5450	6395	32898 20777*	12930 8166*	19968 12611*	3.09*
Livestock	990	320	670	19685 12432*	10453 6602*	9232 5830*	1.82*
Fishery	-	-	-	-	-	-	-
Off farm & non-farm	20500	1800	18700	30010a	2015a	27995a	-

TVC: Total variable cost, GM: Gross margin, MBCR: Marginal benefit cost ratio. * = Considering one year

Table 9. Cost and return from different sub-system (Marginal)

Resource	Before intervention (2001-02)			After intervention (Sept.2002- Mar.04)			
	GR (TK.)	TVC(TK.)	GM (TK.)	GR (TK.)	TVC(TK.)	GM (TK.)	MBCR
Homestead	3980	1025	2955	16238 10255*	3520 2223*	12718 8032*	5.23*
Crop	17570	7632	9938	54988 34729*	18857 11909*	36131 22820*	4.01*
Livestock	4140	1846	2294	23349 14747*	12232 7726*	11117 7021*	1.80*
Fishery	1525	751	774	4490 2835*	1629 1029*	2861 1806*	4.71*
Off farm & Non-farm	23545	5551	17994	32250a	6350a	25900a	-

TVC: Total variable cost, GM: Gross margin, MBCR: Marginal benefit cost ratio. * = Considering one year

Table 10. Cost and return from different sub-system (Small)

Resource	Before intervention (2001-02)			After intervention (Sept.2002- Mar.04)			
	GR (TK.)	TVC (TK.)	GM (TK.)	GR (TK.)	TVC (TK.)	GM (TK.)	MBCR
Homestead	4638	978	3660	17220 10875*	3820 2412*	13400 8463*	4.34*
Crop	59842	24385	35457	150926 95321*	50223 31720*	100703 63601*	4.83*
Livestock	1496	560	936	56660 35785*	37800 23873*	18860 11912*	1.47*
Fishery	1810	885	925	4890 3088*	1785 1127*	3105 1961*	5.28*
Off-farm & Non-farm	7333	3666	3667	11670a	5885a	5785a	-

* = Considering one year

Observation on livelihood change

Due to intervention the livelihood of resource poor farm families has changed positively. The changes are mentioned bellow.

a. Changes in social status

Due to participation in the subproject activities, the income of RPFs increased and hence their social status increased. Before intervention, they were not cared by the village leaders and elites. Their neighbors and relatives also seldom came to them. But now, all of them look at different angle. Many neighbors and relatives came to them to see their crops and homestead gardens and took seeds of vegetables and new technology. It was found that more than five neighbors or relatives who took improved seeds and new knowledge from them.

b. Changes in food security

Particularly marginal and landless farmers had increased their food security. Previously, they had to spend many days without any food. They had limited food which they had to purchase from the market. But now with the increase in homestead production of vegetables and rice, they don't have to go to market for purchase of vegetables. Moreover, they can take home produced eggs. The day to day agony of participated farm families regarding next day's food has been removed. Now, they did not have to think much about food.

c. Changes in dietary

Among the participated resource poor farmers, it was observed that dietary habit has been changed, which was found more pronounced among landless and marginal farmers. Due to year round production of vegetables and increased production of eggs, they have developed tendency to take more of nutritious vegetables and eggs. While previously they used to take rice with green chilli or chilli paste or with onion only, now they developed the habit of taking enough vegetables in every meal. This has reduced their rice consumption as well (Table 11).

Table 11. Comparative assessment of food source of different categories

Farmer	Cereals (%)		Vegetable (%)		Fruits (%)		Fisheries (%)		Poultry and livestock (%)		Bazar (%)	
	B	A	B	A	B	A	B	A	B	A	B	A
Landless	80	70	13.5	22.00	0.50	1.00	1.50	2.0	2.5	2.5	3.00	2.50
Marginal	75	67	17.5	24.10	0.65	1.10	1.75	2.2	2.9	2.9	3.40	2.70
Small	73	65	18.7	24.65	0.85	1.35	1.90	2.4	1.95	3.6	3.60	3.00

*B = Before, A = After -

d. Changes in income and expenditure pattern

It is found that the income of participatory farm families has increased. They can now take better food, better housing and many landless and marginal farmers were found to deposit money in the bank. They said that due to intervention, their overall expenditure increased, but simultaneously income and labor employment also increased.

e. Utilization pattern of income

Increased income of the participated RPFs was found to utilize in purchasing necessary articles for improvement of their livelihood. For many poor farmers, number of rooms has increased, thatched roof has been replaced by tin roof, new furniture like chair, table, cot and almirah have been added. Many farmers have changed their katha toilet into sanitary latrine. For drinking water, many farmers could purchase hand tube wells. In four sites participating ~ male and female farmers formed groups and started weekly savings of their own. They could take loan from this saving money to purchase cattle for beef fattening or purchase goat J rearing or purchase inputs for off farm enterprises.

Table 12. Comparative performance of expenditure pattern of different categories

Farmers group	Food (%)		Cloth (%)		Housing (%)		Education (%)		Medicare (%)		Others (%)		Group (%)	
	B	A	B	A	B	A	B	A	B	A	B	A	B	A
Landless	65	30	6	9	3	10	5	12	9	4	1	4	11	31
Marginal	53	26	8	12	5	12	6	12	8	4	2	4	18	30
Small	40	22	9	12	8	14	8	15	6	4	4	5	25	28

B = Before, A = After

f. Changes in children education

Few landless and marginal farmers, who earlier were found difficult to continue their children education, told that now they can afford to send their children to school.

g. Changes in life style

Now participating farm families can take meals three times a day but before intervention they every often could take one time in a day. However, their anxiety and agony reduced considerably and now whenever necessary, they could take homegrown vegetables and chicken eggs. Apart from food intake, it was observed that the family members of the participating RPFs could purchase sarees, shirts and children garments to wear etc.

Barind:

Increase resource mobilization

The study revealed that after motivation of the farmers and introduction of several alternatives for each production unit the farmer adopted several new technologies according to his goal, preference and availability of resources. An individual homestead of a farm household consists of sunny space, roof, trellis, tree support, shade area, fence of the homestead area, muddy wall of the households, back yard etc. and provided several proven technologies in order to effectively use of such resources. Barind model vegetables production in homestead area was introduce in open sunny space. Different type of creeper vegetables were grown in roof, trellis, tree support, fence, muddy wall, and compost shade. According to their availability of resources several technologies like Vaccination, Deworming, improved feed etc. were provided in livestock sub-system. In cropland, on the other hand, some improved varieties were introduced.

The productivity of the existing farming was improved due to integration of technologies through holistic approach. The findings of the study depicted that integrated farming had more enterprises and mobilized use of resources for cash income, nutrition, employment etc. which ultimately contributed to the improvement of the livelihood of the farm households and managing risk and uncertainty due to rapid change in biophysical and socio-economic environment.

Income enhancement

Every subsystems income was increased remarkably which was differed with different farm categories. In landless farm category the net benefit obtained from crop, homestead, livestock, fisheries and off-farm subsystems were 38.72%, 306.45% 336.42%, 40.46% and 44.22% respectively. Regarding whole farm resources the net income was increased 67.70% over pre-project status. In case of marginal farm category the net benefit obtained from the respective subsystem were 32.11%, 143.65%, 67.70%, 29.49% and 14.19%. The net income was increased 42.25% over pre project status considering whole farm resources (Table-3). It was found that the net benefit were recorded 24.00%, 73.59%, 93.33%, and 65.56% from crop, homestead, livestock, and off-farm same sub systems and net income was increased 41.18% in small farm category (Table-4). Among three categories of farmers highest average net income (67.70%) was recorded in case of landless farm category probably due to cumulative income increased from crop, homestead, fisheries and especially from livestock subsystems. It was also revealed that the lowest average net income was recorded in small farm category might be due to less interest in homestead and livestock sub sector compared to landless and marginal farm category and no profit was obtained although income was increased markedly from other subsystems. The MBCR was found 1.35, 1.48 and 1.06 in landless, marginal and small farm category respectively considering all farm resources (Table 13, 14 & 15).

Table 13. Cost and return from different sub-system of integrated farming of Landless farm category (average of 4 farmers) at PETRRA site, Chabbishnagar, Rajshahi

Resources	Pre-project Status (Tk.)		Post-project Status (Tk.)						MBCR
			2002-2003		2003-2004		Mean		
	TVC	GM	TVC	GM	TVC	GM	TVC	GM	
Crop land (38.72%)	1138	2603	1730	3445	1765	3776	1748	3611	1.65
Homestead (306.45%)	201	774	1112	2672	1289	3619	1201	3146	2.37
Livestock (336.42%)	119	519	798	1733	950	2796	874	2265	2.31
Fisheries (40.46%)	1220	1755	1925	2980	757	1950	1341	2465	5.87
Off-farm (44.22%)	4150	8550	8718	11408	8809	13254	8764	12331	0.82
Total*	6828	14202	14283	22238	13570	25395	13927	23817	1.35

*Average net income increased 67.70% over whole resources

Table 14. Cost and return from different sub-system of integrated farming of marginal farm category (average of 3 farmers) at PETRRA site, Chabbishnagar, Rajshahi

Resources	Pre-project Status (Tk.)		Post-project Status (Tk.)						MBCR
			2002-2003		2003-2004		Mean		
	TVC	GM	TVC	GM	TVC	GM	TVC	GM	
Crop land (32.11%)	3350	6146	5250	8277	5293	7963	5272	8120	1.03
Homestead (143.65%)	367	1803	1753	4418	1498	4367	1626	4393	1.98
Livestock (67.70%)	1020	2093	3047	4847	730	2173	1889	3510	1.63
Fisheries (29.49%)	860	2340	1490	3310	1250	2750	1370	3030	1.35
Off-farm (14.19%)	1270	4970	1450	5110	1200	6240	1325	5675	12.81
Total	6500	17352	12990	25962	9971	23493	11481	24728	1.48

* Average net income increased 42.25% over whole resources

Table 15. Cost and return from different sub-system of integrated farming of small farm category (average of 3 farmers) at PETRRA site, Chabbishnagar, Rajshahi.

Resources	Pre-project Status (Tk.)		Post-project Status (Tk.)						MBCR
			2002-2003		2003-2004		Mean		
	TVC	GM	TVC	GM	TVC	GM	TVC	GM	
Crop land (24.00%)	10037	13880	15167	17292	15250	17131	15209	17212	0.64
Homestead (73.59%)	450	2757	2255	4823	1655	4748	1955	4786	1.35
Livestock (93.33%)	707	1683	1983	3263	1375	3245	1679	3254	1.62
Fisheries	-	-	-	-	425	675	425	675	-
Off-farm (65.56%)	960	1600	1300	1900	600	3400	950	2650	-105.0
Total	12154	19920	20705	27278	19305	29199	20005	28239	1.06

* Average net income increased 41.18% over whole resources

Food habit improve

Previously the farmers consumed little amount of vegetable, fruits and animal protein. After intervention of year round new vegetable model, layer rearing, goose rearing, pigeon rearing, poly and mono culture of carp fish etc. technologies, the nutritional intake and consumption habits of the members of the households were increased by about 100%. The per day vegetables production was average 1.86 kg which can fulfill the requirement of five members farm family (Table 16).

Table 16. Vegetables production (Kg) at different farm level at PETRRA site, Rajshahi

Farmer's Category	Vegetables Production (Kg)			
	Pre-Project Status		Post-Project Status	
	Production (Kg/ Year)	Production (Kg/ Day)	Production (Kg/ Year)	Production (Kg/ Day)
Landless	173	0.47	771	2.11
Marginal	323	0.89	597	1.64
Small	330	090	665	1.82
Average				1.86

Increase gender utilization

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. Therefore, use of unutilized family labor (viz. women, children and hired labor) was increased due to huge intervention of technologies in integrated farming. After intervention of different technologies as per resources of an individual farm households, women and children participation were increased specially in homestead gardening and different off-farm activities like Muri fraying, Khatha sewing, Tailoring etc.

Increase Social Acceptance

People in the rural society were highly attracted by the program and it added to the aesthetic standard of the family and thus to the society and microenvironment. Due to production hike and distribution to neighbors and relatives the consumption rate increased remarkably adding to the nutritional uptake by family members and others in the surrounding area.

Development Sustainability

The sustainability issue in development of the livelihood for resource-poor farm households through the integrated farming model is discussed here in context of family income, nutrition, resource use, knowledge and skill, adoption of innovation, soil health, employment, microenvironment, social status and marketing channel with specific indicators.

Faridpur:

A. Income enhancement

It was observed that the gross return and gross margin has increased considerably after the intervention of proven technologies to all farm categories. It was observed that the gross margin increased by 142, 57 and 107 percent in crop sector on landless, marginal and small household respectively. Gross margin increased in the homestead production was 140,293 and 120 percent on landless, marginal and small household respectively. Similarly, livestock sector gave 273, 280 and 178 percent increased gross margin. Similarly fisheries sector gave 90, 481 and 69 percent increased gross margin. The highest gross margin increased in landless farm group was 273 percent from livestock sector followed by crop sector (142%) (Table 1). In marginal group of farmers the highest gross margin increased was 481 percent from fishery followed by homestead (293 %) (Table 2). In small group it was 178 percent from livestock followed by homestead (120 %) (Table 3). Over all farm categories gross margin increased by 170, 155 and 122 percent in land less, marginal and small group of farmers not considering the off farm activities (Table 17, 18 & 19).

Table 17. Comparative performance of cost and return of different subsystems of landless farmers group during the period of June 2003 to May 2004

Resource	Before intervention (Tk.)			After intervention (Tk.)			GM increased (%)
	GR	TVC	GM	GR	TVC	GM	
Crop	7440	2436	4998	18696	6597	12100	142
Homestead	1768	208	1560	4496	753	3743	140
Livestock	3205	460	2745	23258	13015	10243	273
Fishery	1807	572	1234	3150	808	2342	90
Off-farm	27433	-	27433	26950	-	26950	-
Total	41653	3677	37970	76550	21173	55378	170

Table 18. Comparative performance of cost and return of different subsystems of marginal farmers group during the period of June 2003 to May 2004

Resource	Before intervention (Tk.)			After intervention (Tk.)			GM increased (%)
	GR	TVC	GM	GR	TVC	GM	
Crop	15370	8281	7089	22268	11137	11128	57
Homestead	1705	325	1379	6729	1300	5429	293
Livestock	4582	1387	3195	25954	13827	12127	280
Fishery	500	180	320	3470	1597	1860	481
Off-farm	7200	-	7200	8040	-	8040	-
Total	29357	10173	19183	66461	27861	38584	155

Table 19. Comparative performance of cost and return of different subsystems of small farmers group during the period of June 2003 to May 2004

Resource	Before intervention (Tk.)			After intervention (Tk.)			GM increased (%)
	GR	TVC	GM	GR	TVC	GM	
Crop	24615	10422	14193	48836	19470	29366	107
Homestead	2760	382	2347	7603	1450	5154	120
Livestock	5590	775	4815	24073	10660	13413	178
Fishery	1200	200	1000	2133	460	1674	69
Off-farm	2240	-	2240	1750	-	1750	-
Total	36405	11779	24626	84395	32040	51357	122

B. Homestead vegetable production and nutrition

After intervention of proven technologies the homestead vegetable production has increased significantly. It was observed that before intervention the yearly vegetable production in landless, marginal and small farm group was 383, 468 and 644 kg/household. This has increased to 731, 1825 and 1259 kg/household respectively. Similarly the vegetable consumption has also increased. Before intervention the average vegetable consumption rate was 105, 143 and 126 g/day/person in landless, marginal and small group farmers, respectively. The consumption increased to 187, 230 and 212 g/day/person, respectively (Table 20). The increased rate of vegetable consumption was 69 percent.

Table 20. Average vegetable production and consumption by different farmers group

Farmers group	Before intervention			After intervention		
	Total consumption (kg)	Total consumption (kg)	Consumption (g/day/person)	Total production (kg)	Total consumption (kg)	Consumption (g/day/person)
Landless	383	168	105	731	286	187
Marginal	468	230	143	1825	367	230
Small	644	272	126	1259	392	212

C. Women participation

The overall women participation has increased in all sectors after the intervention of proven technologies. The woman of all categories, participation has increased more in homestead and livestock. It was observed that before intervention the women participation in agriculture was 9.6 hrs/day, which increased 11.6 hrs/day (Table 21).

Table 21. Comparative performance of women participation (hrs/day) in agricultural production during June 2003 to May 2004

Farmers category	Homestead		Field crops		Livestock		Total	
	Before	After	Before	After	Before	After	Before	After
Landless	5	7	2	1	1	2	8	10
Marginal	6	8	2	2	2	2	10	12
Small	7	9	2	1	2	3	11	13

D. Livelihood system linkage in the household

According to action plan, sector wise proven technologies were intervened in farmers homestead, field crop, livestock, fisheries and others. In earlier most of the farmers use inferior quality seed, local b reed and traditional practice as a result income was not raised in remarkable level and livelihood status level was stagnant within same circle. Implementation of different activities the RPFs have come out from the vicious circle. Now their income generation activities, food consumption, recreation and others have improved then before. Female members' activities have also increased and side by side they raised as a earning member and their comments are evaluating with honor by male farmers.

D.1. Changes in income and expenditure pattern

The total farm income increased due to intervention of proven technologies, Earlier the expenditure in food and medicare in landless farm group was 59% and 4%, which has come into 31% and 2%, respectively due to more production of vegetable and others and increased consumption. Similar trend was observed in marginal and small farmers. It was 61% and 27 % in food and 4 and 6 % in medicare, which has changed to 47% and 18% for food and 2% and 4% o~, for medicare.

D.2. Changes in dietary habits

The dietary habit has been changed specially in vegetable consumption among the resource poor farmers. In every day, they are laking 80 g/person more vegetable then before. It has been possible due to year round vegetable production in homestead garden.

D.3. Assessment of food source

The food source diversification has increased among all categories of farmers due to intervention of modern technologies replacing the traditional practices. In the beginning the food supply from homestead was 4, 4 and 7 % in landless, marginal and small farm household, which has increased to 8, 9 and 12 % respectively (Table 22).

The food source from field crop has increased by 14%, 10% and 5% in landless, marginal and small farm group respectively. As a result purchasing of different foods from bazaar has remarkable decreased. The rate of decrease of purchasing food from bazaar was 15, 20 and 14% in landless, marginal and small farm group respectively.

Table 22. Comparative assessment of food source of different farm categories during June/03 to May/O4

Farmers group	Homestead (%)		Livestock (%)		Fisheries (%)		Field crop (%)		Bazar (%)	
	Before	After	Before	After	Before	After	Before	After	Before	After
Landless	4	8	3	6	3	6	12	26	78	54
Marginal	4	9	3	7	3	4	32	42	58	38
Small	7	12	5	8	5	7	45	50	38	23

D.4. Changes in social status

All farmers responded that due to participation in the sub project activities their income increased and hence their social status increased. All RPFs told that before intervention the village leaders and elites did not care them. Their neighbors and relatives also seldom came to them. But now, all of them look at different angle. Many neighbors and relatives came to them to see their crops and homestead gardens and took seeds of vegetables and new technology; each intervened farmer could give names of more than five neighbors or relatives who took improved seeds and new knowledge from them.

D.5. Reduce vulnerability

The livelihood systems of all category farmers of the study area sometimes became very vulnerable due to drought, sudden unexpected rainfall, high fluctuation or market price of crops during the harvesting (pick) period, diseases of livestock, quality seed in sowing time etc. Some techniques were intervened to mitigate those problems such as introduction of short duration rice varieties, change of sowing time of crops, preventive measure of livestock diseases etc. The quality seed preservation practice developed among the farmers due to training program. Consequently most of the farmers were benefited and overcame that problem.

D.6. Transforming structures and process

The relationship among the GOs like DAE, UP, DOF, DOL, Bank etc and NGOs has developed strongly than before due to more communication, cross visit and discussion with each other. One-way decision of landlord, local leader became threats in earlier to the targeted fanner, which has unseen due to increased income, awareness of farmers, come to close with high officials etc.

Conclusion and Recommendation

Noakhali:

Conclusion and recommendation:

- Increase supply of quality seeds of all crops to the farmers.
- Among the different sub-systems the net benefit obtained from crop, homestead, livestock, fisheries and off-farm activities were Tk. 121191, 1962, 4136, 5484 and 3450, respectively irrespective of the households.
- Year round vegetable production and Fyomi rearing were found to be the most promising intervention in relation to fulfilling the daily needs of family nutrition and income.
- To increase the income level of RPF`s all the programs should provided technologies as well as credit from different agencies.
- To enhance any IGA the linkage should be strengthened among farmer, GO and NGO`s.
- To encourage both On-farm and Off-farm activities training should be provided and a marketing facility should be established.
- Women direct participation in both On-Farm and Off-Farm activities has brought about a management process which has contributed to the country's economic development.
- Women participation in subproject activities was found to create synergetic effect on the output
- Critical inputs should be provided to carry on the next activities.
- A local network committee should be continued for technical assistance and technology extension.

Rangpur:

Conclusion: From the above discussion it was clear that due to intervention with s elected appropriate technologies in the farms of ten cooperator farmers both the productivity and income increased. The resource base of the farmer could be exploited to a desired level. Family - labors were fully utilized. Increased farm production especially vegetable helped for better nutrition of the family during the intervention. Intervention has increased rice provisioning ability of the resource poor farm families, both by increasing rice production and reducing rice consumption through increased vegetables intake.

Recommendations

- An action plan for livelihood development should be prepared on the basis of available resources, needs and choice with the active participation of family members (both male and female).
- Needs based intensive training to both male and female members of the farm family should be ensured for the holistic livelihood development of Resource-poor Farm Families.
- The formation of a farmers' society is a good sign for the development of a cooperative attitude among farmers. It should be continued and replicated in the other parts of Bangladesh.
- Net working committee activities should be continued and replicated in local and national level.
- Homestead gardening and field crop production is feasible for the all Resource-poor Farm Families group.

- All Resource-poor Farm Families groups can easily continue the goat rearing and beef fattening activities in profitable way. But mostly broiler rearing is feasible for small farm family because initial investment and risk is higher in comparison with others.
- Number of efficient women vaccinators should be increased through proper training to check the mortality of local poultry bird.
- Agricultural inputs should available in local markets in low cost.
- The livelihood approach to form system development needs to be understood by all researchers and others working with resource-poor farmers.

Barind:

Conclusion

- In crop sub sector, the net benefit obtained 38.72%, 32.11% and 24.00% from landless, marginal and small category of farm households, which increased food security as well as farmers' cash income.
- The net benefit 306.45%, 143.65% and 73.59% were observed from landless, marginal and small category of farm households, which increased food security as well as farmers' cash income, increased women employment opportunity, improved caloric intake etc in homestead gardening.
- In livestock sub system, the net benefit obtained 336.42%, 67.70% and 93.33% from landless, marginal and small category of farm households, which increased farmers' cash income as well as ensure protein supply.
- It was found that the net benefit was recorded 40.46% and 29.49% from landless and marginal category of farmers in fisheries sub system which increased farmer's income as well as ensure protein supply.
- The net benefit 44.22%, 14.19% and 65.56% were observed from landless, marginal and small category of farm households, which increased cash income, increased women employment opportunity from off-farm activity.

Department of agricultural Extension (DAE) has field staff at the grass root level. So, in conclusion it may mention that DAE should take up this integrated model of 'whole farm - whole family' approach for the improvement of livelihood of the resource-poor farmers.

Recommendation

- More training is needed for Scientist/ Scientific Assistant/ networking members/farmers
- Quality seed production and distribution system should be ensured
- Vaccination should be supplied to livestock/ poultry by Department of Livestock
- Off-farm activity should be given more priority for women employment opportunity
- BARC should be given fund to respective FSRD site of BARI to continue this project
- Site net working members (DAE, Livestock, Fisheries, BADC, BMDA, NGOs) activity should be continued.

Faridpur:

Conclusion

- Due to intervention with selected appropriate technologies in the farm household the resource base of the farmers was exploited to a desired level and both the productivity of homestead and crop fields has increased.
- Family labours were fully utilized.
- Increased farm production especially vegetable helped for better nutrition of the family during intervention.
- A good impact has created among the farmers to impose the modern technologies in different sub-sectors of agriculture.
- The unutilized and underutilized homestead areas were brought under intensive production.
- The vegetable consumption increased in all the households.
- The net return from crop, livestock, fishery and homestead sector were higher than previous years. The net income increased in the study period.
- The women's participation, empowerment and decision making capacity has increased after impose of the project activity.
- The family nutrition, resource use, knowledge, social status and micro-environment were improved considerable due to intervention of technology.

Recommendation

i. Quality seed production, preservation and exchange system should be ensured.
ii. Chicken, vaccination should be supplied in proper time by department of livestock.
iii. Fingerlings and post management of fish should be ensured by department of fisheries.
iv. More training is needed for Farmers/Scientists/Scientific Assistants/Networking members. Off-farm activities given more priority for women employment.
v. BARC should be given fund respective PETRRA working site of BARI to continue this project.
vi. Off-farm activity should be given priority for women employment opportunity.
vii. Site networking members (DAE, livestock, fisheries, BADC, NGOs and NARS) activity should be continued.

Appendix table 1. Available technologies for intervention of tested integrated farming (Landless farmers) at FSRD site, Syedpur, Rangpur

Before intervention (2001-02)	After intervention (Sept.2002- Mar.04)
A: Homestead	
1. Roof top (1-2) utilization with farmers management Family has 1 no. Roof top • Bottle gourd (L) Family have 2 nos. roof top • Bottle gourd (L) • Country bean (L)	1. Roof top (1-2) utilization with recommended management • Bottle gourd (L) – Ash gourd (L) • Bottle gourd (L) – Ash gourd (L) • BARI Sim-1 – Sweet gourd (L)
2. Open space (2 – 2.5 dec.) utilization with farmers management • Data • Napashak • Garlic • Fallow	2. Open space (2-2.5 dec.) utilization with recommended management. • Radish (Tasakisan) – Lalshak (BARI Lalshak-1) –Kangkong (BARI Gimakalmi-1) • Brinjal (Khatkhotia)-Spinach (L) –Indian spinach (BARI puishak-1) • Garlic – Patshak – Pepper+Lalshak • Tomato (Ratan)+ Napa shak-Okra (BARI Dherosh-1) – Lalshak • Carrot-Indian Spinach • Bitter gourd and ribbed gourd on fence
3. Boundary / Ail : Fallow	3. Boundary /Ail utilized with 4-10 Papaya plants (Shahi) with recommended management and Napashak
4. Partially shady place : Fallow (0.5-1 dec.)	4. Partially shady place utilize with Zinger (L) and Turmeric (Dimla) cultivation following recommended management.
5. Plantation crops with farmers management • Fruit trees (Mango and Jackfruit) • Other trees (Neem and Suktani)	5. Plantation crops with recommended management • Proper fertilization, irrigation, insect & disease management and pruning on fruit trees • Proper pruning of other trees
6. Farm yard manure heap • One FYM heap under farmers management	6. Farm yard manure heap • One FYM heap under recommended management
B: Field crop	
Land 25-40dec.: Crop production with farmers management using locally available seed 1. Potato (Cardinal)-Jute (L)-Fallow in high land 2. Potato (Cardinal) – Boro (BR-14/BR-28) in medium high land	Land 25-40dec.: Crop production with recommended management using improved or certified seed • In high land Potato (Cardinal) – Summer vegetables Tomato (Ratan) – Summer vegetables • In medium high land Potato (Cardinal)-Boro (BR-28)-T.Aman (BR-33)
C: Livestock	
Farmers management a) Hen, Cock and Chicken b) Goat: 1-3 c) Ox: 1	Recommended management a) Vaccination to poultry bird b) Goat rearing under improve feeding c) Cattle beef fattening of 1 Ox d) Pigeon (4-6 Nos.) rearing in household situation
D: Off-farm	
Labour sell, Shopping and Van-puller	Labour sell, Shopping and Van-puller

Appendix table 2. Available technologies for intervention of tested integrated farming (marginal farm) at FSRD site, Syedpur, Rangpur

Before intervention (2001-02)	After intervention (Sept.2002- Mar.04) with variety and recommended practices
A: Homestead	
1. Roof top (2 Nos.) • Bottle gourd (L) • Country bean (L)	1. Roof top (2 Nos.) • Bottle gourd (L) – Ash gourd (L) • BARI Sim-1 – Sweet gourd (L)
2. Open space (2-6 dec.) • Garlic (L) • Napashak • Sweet potato • Follow	2. Open space (2-6 dec.) • Radish (Tasakisan) – Lalsak (BARI Lalsak-1) –Kangkong (BARI Gimakalmi-1) • Cabbage (Atlas-70) – Data (BARI data-1) – Coriender shak • Brinlal (Khatkhotia) + Lalshak (BARI Lalsak-1) -Spinach (L) – Indian spinach (BARI puisak-1) • Garlic –Patshak – Okra (BARI Dherosh-1) • Carrot-Indian Spinach • Tomato (Ratan)+ Napa shak-Okra (BARI Dherosh-1) - Lalshak) • Bitter gourd and ribbed gourd on fence
3. Boundary/Ail: Fallow	3. Boundary /Ail utilized with 5-15 Papaya plants (var. Shahi)
4. Partially shady place (2-3 dec.) utilize with Zinger (L) cultivation and fallow	4. Partially shady place (2-3 dec.) utilize with Zinger (L) and Turmeric (Dimla) cultivation.
5. Plantation crops • Mango, Betel nut, Guava, Jackfruit and coconut trees • Other trees (Neem, Suktani and Mehogoni)	5. Plantation crops • Proper fertilization, irrigation, insect & disease management and pruning on Mango, Jackfruit and Coconut trees. • Proper fertilization and irrigation management on Betel nut and Guava tress. • Proper pruning of other trees
6. Compost/Farm yard manure heap in one chambered	6. Compost/Farm yard manure heap in two chambered
B: Field crop	
Land 42-67 dec. 1. Potato (Cardinal)-Jute (L) -T.Aman (BR-11) in high land 2. Jute (L) – T.Aman (BR11) - Fallow in highland 3. Boro (BRRI dhan 28) –T.Aman (BR11) in medium highland	Land 42-67 dec. Potato (Cardinal)-Jute (O-9897)-T.Aman (BRRI dhan 33) in highland Tomato (Ratan)–Summer vegetables in highland Cabbage (Green-721) - Snake gourd in highland Cauliflower (Rupa) - Bitter gourd in highland Chili (L)- Palwal (L) in highland Potato (Cardinal) - Boro (BRRI dhan 28) -T.Aman (BRRI dhan 33) In medium high land
C: Livestock	
a) Hen, Cock and Chicken b) Cow and Calf c) Goat (2-3) d) Ox (1)	a) Vaccination to poultry bird b) Deworming of cow c) Goat rearing with improve feeding d) Cattle beef fattening of Ox e) Pigeon rearing in household situation
D: Fisheries	
Pisciculture with farmers management: 5-8 dec.	Pisciculture with recommended management: 5-8 dec.
F: Off-farm	
Labour sell, Shopping, Van-puller and Tailoring	Labour sell, Shopping, Van-puller, Embroidery, Batik, Butik, Blocking and Tailoring

Appendix table 3. Available technologies for intervention of tested integrated farming (small farm) at FSRD site, Syedpur, Rangpur

<table>
<tr><th>Before intervention (2001-02)</th><th>After intervention (Sept.2002- Mar.04)</th></tr>
<tr><td colspan="2">A: Homestead</td></tr>
<tr><td>1. Roof top (2 Nos
• Bottle gourd (L)
• Country bean (L)</td><td>1. Roof top (2 Nos.)
• Bottle gourd (L) – Ash gourd (L)
• BARI Sim-1 – Sweet gourd (L)</td></tr>
<tr><td>2. Open place (2-5 dec.)
• Garlic (L)
• Data (L)
• Brinjal (L)
• Follow</td><td>2. Open place (1-5 dec.)
• Radish (Tasakisan) – Lalshak (BARI Lalsak-1) –Kangkong (BARI Gimakalmi-1)
• Brinjal (Khatkhotia)-Spinach (L) –Indian spinach (BARI puisak-1)
• Garlic – Okra (BARI Dherosh-1)
• Coriander - Chili (L) + Lalshak (BARI lalshak-1)-Okra (BARI Dherosh-1)
• Carrot-Indian Spinach
• Bitter gourd and ribbed gourd on fence</td></tr>
<tr><td>3. Boundary/Ail: Fallow</td><td>3. Boundary/Ail utilized with 5-7 Papaya plants (Shahi) with recommended management and Napashak</td></tr>
<tr><td>4. Partially shady place(1-2 dec.) utilize with Zinger (L) in traditional way and fallow.</td><td>4. Partially shady place (1-2 dec.) utilize with Zinger (L) and Turmeric (Dimla) cultivation following recommended management.</td></tr>
<tr><td>5. Plantation crops with farmers management
• Mango, Betel nut, Guava, Jackfruit and coconut trees
• Other trees (Neem, Suktani and Mehogoni)</td><td>5. Plantation crops with recommended management
• Proper fertilization, irrigation, insect & disease management and pruning on Mango, Jackfruit and Coconut trees.
• Proper fertilization and irrigation management on Betel nut and Guava tress.
• Proper pruning of other trees</td></tr>
<tr><td>6. Compost / Farm yard manure heap
• One FYM heap under farmers management</td><td>6. Farm yard manure heap
• One compost heap under recommended management
• One FYM heap under recommended management</td></tr>
<tr><td colspan="2">B: Field crop</td></tr>
<tr><td>Land 125-192 decc.: Crop production with farmers management

1. Potato (Cardinal) -T.Aus(L) -T.Aman (BR11) in high land
2. Potato (Cardinal) - Fallow- T.Aman (BR-11) in high land
3. Tomato (Ratan) -T.Aman (BR-11) seed bed in high land
4. Potato (Cardinal)-T.Aman seed bed-Cabbage (Atlas-70)
5. Boro (BR-28) – Fallow – T.Aman (BR-11) in medium high land</td><td>Land 125-192 decc.: Crop production with recommended management

1. Potato (Cardinal) - Jute (0-9897)-T.Aman (BR-11) in high land
2. Papaya (Shahi) garden with recommended management
3. Potato (Cardinal) – Ash gourd (L) in high land
4. Potato (Cardinal)-Boro (BRRI dhan-28)-T.Aman (BRRI dhan 33) in high land
5. Cauliflower (Rupa) – Okra (BARI Dherosh-1)
6. Tomato (Ratan)–T.Aman seed bed (BR11)–Cabbage (Atlas-70)
7. Potato (Cardinal)-T.Aman seedbed - Cabbage (Atlas-70)
8. Potato (Cardinal) – Summer vegetables
9. Boro (BRRI Dhan-28)-Fallow-T.Aman (BR11) in medium high land</td></tr>
<tr><td colspan="2">C: Livestock</td></tr>
<tr><td>Farmers management
a) Hen, Cock and Chicken
b) Cow and Calf
c) Ox
d) Goat</td><td>Recommended management
a) Vaccination to poultry bird
b) Deworming of cow
c) Goat rearing under improve feeding
d) Cattle beef fattening of Ox
e) Broiler rearing
f) Pigeon rearing in household situation</td></tr>
<tr><td colspan="2">D: Fisheries</td></tr>
<tr><td>Pisciculture with farmers management: 7-16 dec.</td><td>Pisciculture with recommended management: 7-16 dec.</td></tr>
<tr><td colspan="2">E: Off-farm</td></tr>
<tr><td>Shallow tube well and Business</td><td>Shallow tube well, Embroidery, Batik, Butik, Blocking and Tailoring and Business</td></tr>
</table>

Appendix table 4. Systems sustainability consideration in holistic approach of integrated farming at PETRRA site, Chabbishnagar, Rajshahi

Sl #	Area of consideration	Impacts created	Indicators to asses the sustainability
1	Income	Net income increased by 50.38%	- Used modern varieties - Innovative technologies - Use of more area under cultivation/production - Increased production skill due to training and on the spot demonstration
2	Family nutrition	Improved satisfactorily	- Consumption of vegetable, fruits, egg, meat, milk and fish increased by more than 100% - Changed in consumption habit towards vegetable & fruits - Reduced number of disease and frequency of attack - Good appearance of family members
3	Soil health	Maintained/ increased	- Used leguminous crop in cropping pattern eg. Dhaincha, mungbean, chickpea etc. - Use of organic matter increased due to increased production - Use of chemicals/poison decreased due to use of organic matter and integrated pest management - Use of cropping pattern detrimental to soil health (cereal-cereal) has been reduced.
4	Resource use pattern (left adjustment)	Increased	- Used of homestead by 100% - Intensive cropping with appropriate cropping pattern - Introduction of new production units (Goose rearing , pigeon rearing, Papaya garden, Homestead production model etc.)
5	Technical knowledge	Technical knowledge increased sharply	a) The young boys & girl house nice are engaged for implementation of the new technologies - Cash grow many new crops/items independently. b) Training, field days, exchange of views with different types of people - Wife, son daughter speaks to visitors and farmers - Farmer explains his skills in different forums and gatherings
6	Adoption of innovation	Increased (by 75%)	- New crops, vegetables varieties including hybrids are in use - Use of recommended fertilizer (organic, inorganic) dose - Use of different preventive & curative measurement of crop livestock, poultry and fish species - Use of integrated technologies
7	Employment	Increased	- Use of unutilized family labour e.g. children (10%) - Women participation in agricultural activities (increased 85%) made positive effect on equity within the family and the community - Huge hired labour used to integrated farming intervention and created employment (60%)
8	Micro-environment	Preserved and improved	- Household wastes being used for composting (100%) and their use in cropping - Use of improved oven reduced fuel biomass use - Use of IPM saved environment from pollution - New plantation increased vegetation (by about 60%) contributed to the favorable environment - Irrigation to crops and trees added to positive microenvironment
9	Social status	Improved	- Increased access to people specially of high status in the society - Increased acceptability to people due to interaction with various technical, and economic aspects - Improved mental strength due to higher income, development in skill on technologies and public conduct
10	Market channel	Improved	- Created new market channel due to adoption of different, technologies of vegetables, crops, livestock, poultry and fisheries - Farmers directly sold their farm products to the traders ant the farm gate with reasonable price - Increased access to the town for purchase and selling of farm input and output.

Appendix table 5. A comparative list of livelihood systems linkages before and after intervention of technologies among the farmers at Ishan Gopalpur, Faridpur is given below.

Sector	Sub sector	Before intervention	After intervention
Homestead	Vegetable gardening	Fellow or under utilized	- Vegetable cultivation in bed - Use of BARI varieties - Recommended organic and inorganic fertilizer - Utilization of roof top, shady/marshy/pond band area
	Tree management	Improperly	- Improve management (Fertilizer, irrigation practices and mango hopper control fruit trees
	Mango plant protection	Not used	Mango hopper control
	Compost pit	Not done	Practice of two chambered compost pit
Land crop	Variety	Mostly local	Modern varieties
	Fertilizer management	Imbalanced	Recommended fertilizer with organic
	Intercultural operation	Not done properly	Follow modern post harvest technology of different seed preservation
Fisheries	Fish culture	Traditional practice	Use of monoculture and mixed culture method scientifically
Livestock	Cattle	- No use of deworming - Vitamin feeding - Fattening	- Deworming of cattle against warm - Vitamin feeding for improve health - UMS diet for improve health
	Poultry	- Local breed for egg/ meat production - No Vaccination - Country duck was used	- Replace by improved breed (Sonali, Fayomi) - Vaccination against Ranikhet - Improved breed (Khakicamble) use with supply of balanced food, vaccination, etc.)
	Pigeon rearing	Traditional	Follow the practice (improve food, cleaning house, house making in solitary place for well reproduction etc.)
Off-farm	Day labour	Intensively day labour (landless & marginal)	Day labour in leisure period
	Embroidery	Maximum time use	Doing labour in leisure period
Cooperative	-	No farmer association	Build up a association among the female farmers

Appendix table 5. Impacts of Faridpur sites

Sl #	Area of consideration	Impacts created
1.	Income	- Net income increased considerable - Build up new house - Mortgage in crop land - Use more area for cultivation/ production
2.	Family nutrition	- Consumption of vegetables, fruits and fish increased - Pure drinking water ensured by sinking hand tube-well - Changed consumption habit - Reduced disease infestation - Purchased milch cow for milk
3.	Resource use pattern	- Introduction of new crops - Homestead area utilized properly - Used modern varieties
4.	Education and knowledge	- Increased knowledge of family member - Children's started to going school
5.	Refreshment	- Cost of refreshment increased - Purchased of new cloth increased - Purchase of radio
6.	Social status	- Social status increased - Improved mental strength - Increased acceptability to people
7.	Micro environment	- Household waste used for composting - New plantation improve environment - Irrigation to crop and tress improve environment
8.	Others (Off-farm & cooperative)	- More utilization of family labour - Improve the cattle health - Breakdown of unemployment - Female farmer playing vital role in decision making of the family

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TECHNOLOGY TRANSFER

A. Production program

Title	Location	Area (ha)	Farmers involved (no.)	Yield (t/ha)
Wheat				
Protiva	Faridpur	2.00	8	2.74
	Kushtia	0.80	4	4.39
Kanchan	Barind	5.00	4	2.90
Shatabdi	Barind	4.00	4	3.25
Sourav	Barind	2.00	4	2.87
Hybrid Maize				
Pacific 11	Kushtia	21.50	160	7.500
Mustard				
BARI Sarisha 9	Barind	11.00	8	1.110
BARI Sarisha 11	Kushtia	0.50	3	2.000
	Barind	4.00	4	1.500
Tori-7	Barind	1.00	1	1.0
Lentil				
BARI Mashur 4	Faridpur	0.48	2	1.350
	Kushtia	2.00	10	1.700
Chickpea				
BARI Chola 5	Faridpur	1.50	4	1.125
	Barind	6.00	7	1.150
Annigeri	Barind	6.00	7	1.350
Mungbean				
BARI Mung 5	Kushtia	0.70	2	1.400
	Barind	1.50	1	0.80
Sesame				
BARI Sesame 2 & 3	Barind	1.00	2	0.78
Potato				
Cardinal	Barind	1.50	3	18.33
Multa	Barind	0.50	2	15.00
Okra				
BARI Dherosh 1	Jamalpur	0.20	14	12.23
Panikachu				
Latiraj	Jamalpur	0.075	6	13.85

B. Seed Exchange program, Barind, Rajshahi

Crops	Area (ha)	No. of cooperator	Yield (t/ha)	Supplied seed (kg)	Collected seed (kg)
FSRD site					
Mustard					
BARI Sarisha 9	5	20	1.3	50	50
BARI Sarisha 11	2	10	1.8	35	25
Chickpea	6	70	1.1	300	105
Wheat	2	10	3.0	150	148
Linseed	1.5	5	0.85	12	10
Total	24.5	115			
MLT site					
Mustard	3	15	1.0	30	20
Chickpea	15	160	1.2	750	500

C. BARI Technology village

Barind, Rajshahi

Crops	Varieties/Lines	Area	Yield (t ha^{-1})
Wheat	Sourav	3m x 4m	3.00
	Protiva	"	3.20
	Kanchan	"	3.20
	Gourav	"	3.10
	Shatabdi	"	3.70
Chickpea	BARI chola5	"	1.15
	BARI chola3	"	1.05
	BARI chola4	"	0.85
	BARI chola2	"	0.90
	Nabin	"	0.85
	Deshi chola	"	1.00
	BCX84021	"	1.10
Mustard	SS-75	"	1.60
	TS-72	"	1.40
	BARI sharisa- 11	"	1.80
	BARI sharisa- 9	"	1.45
	BARI sharisa- 6	"	1.60
	BARI sharisa- 10	"	1.80
	BARI sharisa- 4	"	1.65
	Tori-7	"	1.30
	BARI sharisa- 12	"	1.80
	Daulat	"	1.70
	Rai- 5	"	1.60
Cheena	Tushar	"	1.08
Niger	Shova	"	0.73
Safflower		"	1.25
Linseed	Nila	"	0.92
Sunflower	Kironi	3m x 4m	1.03
Barley	BARI Barley- 1	"	0.92
Potato	Cardinal	"	16.00
	Hira	"	11.00
	Multa	"	12.00
Maize	BARI Maize- 7	"	7.00
Lentil		"	1.00
Coriander		"	0.80
Methi		"	0.40
Soybean	G-2	"	1.05
	Ranson	"	0.95
	Shohag	"	1.00
Groundnut	BARI chinabadam-5	"	1.00
	BARI chinabadam-6	"	0.90
	ACC-12	"	0.80
	DG-2	"	0.80
	GM-1	"	0.95
Radish	BARI Mula- 1	"	1.20
	BARI Mula- 2	"	0.80
	BARI Mula- 3	"	1.00
Garden pea	BARI Garden pea-1	"	0.40
	BARI Garden pea-2	"	0.80
	BARI Garden pea-3	"	0.60
Bush bean	BARI Bush bean- 1	"	1.08

Pabna

Crop	Variety	Yield/ha^{-1} (t)
Potato	Multa	28.75
	Cardinal	26.00
	Diamont	33.00
Tomato	Ratan	44.33
	BARI-8	38.67
	BARI Tomato-3	36.67
	BARI Tomato-9	40.00
Cauliflower	BARI Fulcopy-1	40.00
Radish	BARI Mula-1	93.00
	BARI Mula-2	65.00
	BARI Mula-3	51.00
Garden Pea	BARI Motorshuti-1	3.30
	BARI Motorshuti-2	2.67
	BARI Motorshuti-3	4.90
Fenugreek	BARI Methi-1	0.50
Coriander	BARI Dhania-1	0.67
Wheat	Gourab	3.75
	Satabdi	4.17
	Sourav	3.5
	Protiva	4.0
Maize	BARI Maize-2(hybrid)	8.00
Onion	BARI Piaj-1	11.4
Bushbean	BARI bushbean-1	22.67

Faridpur

Name of the crops	Variety	Yield (t/ha)	TVC (Tk.)	Gross margin (Tk.)
Bushbean	BARI Jharseem 1	10.6	15500	39500
	BARI Jharseem 2	8.0	15500	24500
Pea	BARI Motorshuti 1	7.5	11475	33525
	BARI Motorshuti 2	9.6	19475	46125
Potato	Hera	26.9	38425	90280
	Multa	20.9	38425	72376
	Cardinal	25.0	38425	88052
Lentil	BARI Mashur 4	1.47	4160	39760
Linseed	Nila	0.85	7000	10000
Chickpea	BARI Chola 4	1.44	6400	22400
	BARI Chola 5	1.25	6400	18600
Mustard	BARI Sarisha 7	2.25	11580	33420
	BARI Sarisha 8	2.30	11580	34420
Wheat	Sourav	2.79	12875	17815
	Shatabdi	3.99	12875	31015
Sunflower	Kironi	1.30	11580	14420
	Sunwheat 101	1.43	11580	17020
Safflower	BARI Saf 1	0.85	10500	6500
Coriander	BARI Coriander 1	0.86	10500	6700

Noakhali

Name of crop	Variety	Yield (t/ha)	Market price (Tk/kg.)
Radish	BARI Mula 1	30.27	3
	BARI Mula 2	34.27	3
	BARI Mula 3	38.88	2.5
Cauliflower	BARI Fulkopi 1	12.29	8
Bushbean	BARI Jharseem 1	7.7	10
Batishak	BARI- Batishak 1	28.54	6.5
Lalshak	BARI Lalshak 1	6.42	7
Tomato	BARI Tomato 2	57.7	5
	BARI Tomato 6	55.62	4.5
	BARI Tomato 7	59.58	4.5
	BARI Tomato 8	67.37	5
Cabbage	BARI Badhakopi 2	18.54	4.5
Pea	BARI Motorshuti 1	1.29	18
	BARI Motorshuti 2	0.92	18
Bringal	BARI-1 (Uttra)	56.66	3
Soyabean	PB-1	1.87	13
	Bangladesh soyabean-4	2.6	13
	Bangladesh soyabean-5	1.79	13
Mungbean	BARI mung-2	0.96	25
Okra	BARI Dherosh 1	2.29	13.5
Groundnut	Dhaka-1	12.83	6
	BARI Badam 5	2.16	13.5
	BARI Badam 6	1.95	13.5
Danta	BARI Badam 1	35.41	4
Potato	Multa	13.33	7
	Heera	10.83	6
	Cardinal	15	7
Wheat	Satabdi	3.25	12
	Protiva	3.12	12
	Sourav	2.5	12
	Gourav	1.87	12

Sylhet

Crops	Varieties/Lines	Area	Yield (t ha^{-1})
Wheat	Sourav	3m x 4m	1.60
	Protiva	"	1.85
Chickpea	BARI chola 3	"	1.30
	BARI chola 5	"	0.95
Mustard	BARI sharisa- 6	"	1.60
	BARI sharisa- 9	"	1.12
	BARI sharisa- 11	"	1.70
Sunflower	Kironi	"	1.65
Maize	BARI Maize- 6	"	5.40
	BARI Hybrid maize 1	"	7.80
Bush bean	BARI Jharseedm 1	"	23.25
Brinjal	BARI Begun 5	"	35.00
Lalshak	BARI Lalshak 1	"	6.25
Amaranth	BARI Data 1	"	20.00
Indian spinach	BARI Puishak 1	"	22.24
Gimakalmi	BARI Gimakalmi	"	47.00
Orka	BARI Derosh 1	"	11.80

Tangail

Crops	Varieties/Lines	Yield (t ha^{-1})
Radish	BARI Mula 1	81.1
	BARI Mula 2	43.3
	BARI Mula 3	55.6
Tomato	BARI Tomato 2	99.2
	BARI Tomato 3	76.7
	BARI Tomato 8	79.5
	BARI Tomato 9	29.4
Cauliflower	BARI Fulkapi 1	15.9
Bushbean	BARI Jharseem 1	9.6
Brinjal	BARI Begun 1	63.2
Potato	Cardinal	29.25
	Heera	28.75
	Multa	20.83
Sweet potato	BARI SP 4	22.0
	BARI SP 5	20.0
Wheat	Shatabdi	4.5
	Protiva	4.0
	Sourav	3.5
	Gourab	-

Taratpara, Gazipur

Name of crop	Variety	Yield (t/ha)
Potato	Heera	22.60
	Cardinal	19.90
	Mulata	14.75
Mustard	BARI Sarisha 11	1.79
Lential	BARI Moshur 3	0.89
Wheat	Sourav	1.24

Hathazari, Chittagong

Crops	Varieties/Lines	Area (dec.)	Yield (t ha^{-1})
Country	BARI Seem 1	279	14.0
Bottle gourd	BARI Lau 1	8	13.3
Radish	BARI Mula 1	9	50.5
	BARI Mula 2	2	45.7
	BARI Mula 3	60	35.8
Tomato	BARI Tomato 2	15	53.2
	BARI Tomato 8	40	54.8
	BARI Tomato 9	2	51.8
Potato	Caridal	43	18.0
	Heera	18	20.0
	Multa	11	22.0
Cauliflower	BARI Fulkapi 1	5	20.0
Cabbage	BARI Badhakapi 2	4	40.2
Bushbean	BARI Jharseem 1	5	10.0
Batishak	BARI Batishak	9	40.0
Chilli	BARI Chilli 1	5	1.1
Orka	BARI Derosh 1	33	11.3
Gimakalmi	BARI Gimakalmi	13	25.0
Mukhi	Bilashi	33	
Indian spinach	BARI Puishak 1	8	10.0
Stem amaranth	BARI Data 1	12	16.0
Sweet potato	Kamlasundari	6	24.0
	BARI SP 4	8	22.0
	BARI SP 5	8	20.0

D. Training, Workshop and Field days

Project: SFFP

Farmers' Training

Location	Date	No. of farmers
Narsinghdi	05 November 2003	10
Joydebpur	06 November 2003	24
Barind	15 November 2003	18
Mymensingh	20 October 2003	24
Kishoreganj	22 October 2003	24
Patuakhali	19 November 2003	21
Khulna	03 November 2003	18
Faridpur	05 November 2003	15
Rangpur	07 December 2004	24
Tangail	26 October 2003	18
Jamalpur	26 October 2003	24
Pabna	03 November 2003	20
Rajshahi	17 November 2003	18
Comilla	03 November 2003	24
Sylhet	22 October 2003	12
Hathazari	18 November 2003	12
Bogra	30 October 2003	24
Jessore	18 November 2003	24
Kushtia	03 November 2003	10
Dinajpur	08 March 2004	12
Noakhali	11 February 2004	24
Total		**400**

Field Day

Location	Date	No. of Participants				
		Farmer	BARI	DAE	NGO	Total
Pabna	15 April, 2004	30	8	10	2	50
Pabna	28 March, 2004	30	8	10	2	50
Mymensingh	24 January, 2004	30	8	10	2	50
Kishoreganj	8 February, 2004	30	8	10	2	50
Kishoreganj	4 March, 2004	30	8	10	2	50
Jessore	28 February, 2004	28	10	10	2	50
Tangail	15 February, 2004	30	8	10	2	50
Bogra	10 February, 2004	30	8	10	2	50
Bogra	18 February, 2004	30	8	10	2	50
Jamalpur	21 January 2004	32	7	09	2	50
Jamalpur	16 February, 2004	32	7	09	2	50
Kaliakoir	25 January 2004	30	8	10	2	50
Kaliakoir	25 January 2004	30	8	10	2	50
Munshiganj	10 March, 2004	30	8	10	2	50
Hathazari	22 February, 2004	30	8	10	2	50
Barind	26 February, 2004	28	10	10	2	50
Barind	26 February, 2004	28	10	10	2	50
Patuakhali	29 April, 2004	30	8	10	2	50

Subproject: PETRRA

Training, Workshop and Field days at Rangpur

Date	Title of the course	Number of participants by type and sex								Total		Days
		Research		Field Staff		Farmers		Others				
		M	F	M	F	M	F	M	F	M	F	
26.12.02 to 28.12.02	Homestead vegetables production and Rabi crop cultivation (3 training)			06		49	51			55	51	one
27.03.03to 29.03.03	Production Technologies of Kharif crops, Livestock and Fisheries (3 training)			08		49	51			57	51	one
25.03.03	Workshop on Implementation strategy			02		16	18			18	18	one
18.06.03	Summer vegetable, Seed production and Preservation , Harvesting Processing and Marketing of Summer vegetables, Papaya production, Management Practice of Fruit Trees and Rearing of Pigeon					25	25			25	25	one
17.03.03	Review Workshop on On-Going activities,2002-2003	08		06		07	08	08		29	08	one
19.06.03	Vegetable Seed production and Preservation					25	25			25	25	one
20.06.03	Block Printing					00	11			0	11	One
22.06.03	Tai dye					00	11			0	11	One
24.06.03	Batik Printing					00	11			0	11	One
26.06.03	Tailoring & Embroidery					00	11			0	11	One
21.06.03	Training on Vegetable					00	19			0	19	One
20.09.03	Vegetable seed production and Rabi crop cultivation			08		50	50			58	50	One
7.10.02	Orientation Workshop on PETRRA sub project,	19		02		17	17	09		47	17	one
28.12.03	Production Technology of Winter vegetables, Vegetable seed and Field crops, Beef Fattening, Broiler and Goat rearing			07		50	50			57	50	one
31.05.03 & 05.06.03	Field day on-On-Going activities for Improvement of the Livelihood of the Resource poor households (2 Fields days)					208				208		one

Training, Workshop and Field days at Barind, Rajshahi

Date	Title of the course	Number of participants by type and sex								Total		Days
		Research		Field Staff		Farmers		Others				
		M	F	M	F	M	F	M	F	M	F	
20.11.02	Orientation Workshop on Petrra sub-project, BARI, Barind	20				03		12		35	0	one
24.12.03-27.12.03 (2 training)	Homestead vegetable production and Rabi crop cultivation			3		32	35			35	35	one
29.03.03 to 31.03.03	Technology on storing of rabi crop (chickpea, wheat and oil seed), Kharif-1 crop cultivation and Livestock rearing			6		30	68			36	68	one
05.06.03	Field day (on –On-going activities for Improvement of the Livelihood of Resource poor house holds					100				100	0	one
17-20 March 04	Seed production and production technology of different rabi crops					50	50			50	50	One

Training, Workshops and Field days at Faridpur

Date	Title of the course	Number of participants by type and sex								Total		Days
		Research		Field Staff		Farmers		Others				
		M	F	M	F	M	F	M	F	M	F	
July-Sept.'02 & Oct.-Dec.' 02(3 training)	Homestead vegetable production and Rabi crop cultivation					54	52			54	52	one
DO	Orientation Workshop					32	02			32	02	one
Jan-March'03	Poultry and Livestock rearing and fish culture for poverty elimination					29	26			29	26	one
April – June '03	Modern rice, jute and summer vegetable production and seed preservation (2 training)					32	20			32	20	one
DO	Female Farmers' Training on Nutrition of vegetables					00	25			00	25	one
DO	One day Farmers' Training on Management of Soil Fertility (2trainings)					60	00			60	00	one
DO	Progress Review Workshop					11	03			11	03	one
April- June, 03	Mobile Workshop for the net working members on motivation for rearing of layer birds					02	08			02	08	one
April- June, 03	Mobile Workshop for the Press men of Farid pur on the activities					10	0			10	0	
April- June, 03	Field day on Homestead vegetable production					89	11			89	11	one
DO	Field day on Research Programme activities					55	04			55	04	one
July-Sept.,03	Training on Modern Method of Fish production and Disease control of Poultry					30	0			30	0	one
DO	Training on the Technique of Seed and Seedling Production for Round year Homestead vegetable production					03	27			03	27	one
DO	Training on Modern method of Rice cultivation (2trainings)				60	00				60	00	one
DO	Field day				17	00				17	00	one
DO	Field Day on Beef Fattening				95	00				95	00	one
DO	Farmers' meeting with the net working members			20	10					20	10	one
Oct.- Dec' 03	Training on the Technique of Homestead vegetable and Rabi crops production (4 training)				30	90				30	90	
DO	Field day on modern method of Fish cultivation				129	01				129	01	one
DO	Female Farmers' day with the net working members on Winter vegetables production				00	45				00	45	one

Training, Workshop and Field days at Noakhali

Date	Title of the course	Number of participants by type and sex								Total		Days
		Research		Field Staff		Farmers		Others				
		M	F	M	F	M	F	M	F	M	F	
27.11.02	Orientation program					32	2			32	2	one
28.11.03	Livelihood improvement through rice based integrated farming system					67	48			67	48	one
02.03.03	Minimum Tillage Wheat Production (Field day)					47	6			47	6	one
11.03.03	Field day					42	09			42	09	
27.03.03, 29-31.03.03 – 27-30.04.03.	Rabi crop, fish and livestock production Tech (8 training)					101	99			101	99	one
17.11.03 to 20.11.03	Seedbed preparation & Vegetable production(4trainings)					49	49			49	49	one
28.12.03-31.12.03	Rabi crop cultivation (4 training)					50	49			50	49	one

Project: CIMMYT

Farmer's training: Whole family maize production

A total of 1160 farm families (1160 x 4 = 4640 male and female, i.e. 50 % male and 50 % female) were trained on hybrid maize production through live samples, flip-chart and colored CD. Most of the locations (Table 1) were located into the rural areas. For the training, OFRD local scientists assisted by OFRD head quarter scientists. The training was also attended by Dr M Shahidul Islam, Director General, Mr. M A Satter, Director (T & C), and Dr M Matiur Rahman, Director (Res.). The training was conducted during September to October, 2003.

Location	No. of families	Total no. of farmers trained
Patgram (Lalmonirhat)	800	3200
Comilla	200	800
Kushtia	160	640
Total	1160	4640

E. Materials Developed

Under SFFP

1. Bio-fertilizer application in pulses and oilseed crops
2. Boron fertilization in mustard, chickpea and papaya
3. Application of Urea Super Granule (USG) in vegetable crop: a profitable technology
4. Fertilizer management for Mungbean-T.Aus-T.Aman rice cropping pattern in Ganges Tidal Floodplain
5. Integrated nutrient management for Potato-T.Aus-T.Aman cropping system

Under PETRRA

1.	Potato cultivation using mulch	Noakhali
2.	Wheat cultivation under minimum tillage	Noakhali
3.	Urea molasses for beaf fattening	Noakhali
4.	Homestead gardening	Noakkahli
5.	Pond bank (vegetable gardening)	Barind, Rajshahi
6.	Mustard cultivation in Barind	Barind, Rajshahi
7.	Goose rearing	Barind, Rajshahi
8.	Homestead gardening	Rangpur
9.	Beef fattening	Rangpur
10.	Homestead gardening (Asiar Barir Angania)	Faridpur
11.	Poultry rearing (Sucess in Kabir life)	Faridpur
12.	Poultry rearing	Rangpur
13.	Sweet and ash gourd in roof	Rangpur
14.	Beef fattening (Success Sk. Samad life)	Faridpur
15.	Mango hopper control (Success in Razaul life)	Faridpur
16.	Onion cultivation (Success in Sourav life)	Faridpur

PETRRA subproject

Rangpur

1. Annual Report, 2002-03 & Action Plan 2003-04
2. Report on Household survey, Sept.02
3. Training Manual on summer crops, livestock & fisheries production technology
4. Training Manual on Year round homestead vegetable production & rabi crop production technology
5. Training Manual on Summer Vegetables seed production, collection, preservation & processing, Fruit production, Pigeon rearing &n boutique, block & tie dye.
6. Activities of PETRRA sub project
7. Six different leaflets on success story of the sub project (to be published soon).

Rajshahi

1. A report on farmers participatory research on integrated rice based farming for improved livelihood for RPF household (Sept.'02-June'03
2. Activities of PETRRA sub project
3. Five different leaflets on success story of the sub project (to be published soon).

Faridpur

1. Research Program(Sept.02/ June03
2. Annual Progress Report
3. Bench mark survey
4. Popular publication in the daily news paper on success story
5. Activities of PETRRA sub project
6. Five different leaflets on success story of the sub project (to be published soon).

Noakhali

1. Annual Research report
2. Orientation workshop for local livelihood network 2002
3. Activities of PETRRA sub project
4. Six different leaflets on success story of the sub project (to be published soon).

THE END