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ON- **FARM RESEARCH DIVISION**
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PREFACE

On-Farm Research Division (OFRD) of Bangladesh Agricultural Research Institute (BARI) is going to publish the Annual Research Report of the experiments conducted during 2004-05 and rabi season 2005-06 at different Farming System Research and Development (FSRD) and Multilocation Testing (MLT) sites all over the country. The mandate of OFRD is to conduct research for the improvement of existing farming system and testing and validation of on-station technologies under a wide range of agro-climatic situation for the fine tuning of the technologies. 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 which to be addressed comprehensively for sustainable crop production. Priority was given on cropping pattern based balanced fertilization for major AEZs. Emphasis was given on IPNS approach and location specific soil test based fertilizer recommendation to maintain and improve soil fertility through SFFP. Research report on socio-economic studies, integrated farming system and on-farm verification of advanced lines and technologies were also included in this report.

Similarly, on-farm trial of maize, tuber crops and Horticultural crops has done at different MLT and FSRD sites across the country through collaboration with CIMMYT and SAIP. Results of these activities also incorporated in this report. Different training activities for farmers, DAE personal, SSA/SA as well as for the scientists of OFRD has organized during 2005-06 through SFFP, CIMMYT and ATT project funded by BARC.

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

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

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Contents

SUBPROJECT: CROPPING PATTERN BASED FERTILIZER MANAGEMENT

Development of Fertilizer Recommendation for Different Cropping Patterns and Environments

Abstract

The experiment was initiated in 1999-2000 and continued to 2004-05 at different locations through out the country to develop cropping pattern based fertilizer recommendation with the emphasis on IPNS. A total of 11 (eleven) dominant cropping patterns were tested at 17 different locations. Three nutrient management approaches- soil test based nutrient management (STB), IPNS and verification of FRG'97 was studied along with existing farmers' practice and no fertilizer (control). In STB the fertilizer dose for MYG and HYG was also included. Results revealed that in general, higher yield was recorded from STB for HYG and IPNS based fertilizer recommendation. Higher gross return as well as gross margin was also obtained with the same treatments. But due to higher fertilization cost in IPNS the MBCR was slightly lower than other nutrient management packages. Apparent nutrient balance showed that the balance was negative for N and K in all cases. Usually, farmers' apply a higher dose of P fertilizer and a considerable amount of P is accumulated in the soil. In FRG'97, nutrient mining was higher due to less fertilization. The IPNS practice was found favourable in respect of nutrient balance compared with other nutrient management approaches.

Introduction

Soil fertility is a dynamic property which varies with crops, cropping intensity and input use. More than 50% of our cultivated soil contains organic matter below the critical level (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. To maintain and improve soil fertility and organic matter content of the soil it felt necessary to use organic manures along with inorganic fertilizers as an integrated approach. Nutrients present in soil, added as inorganic and organic sources and the nutrient harvested by crops should be considered to develop a cropping pattern based fertilizer recommendation. BARC developed a national fertilizer recommendation guide '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 considering the above mentioned issues.

Objectives

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

Materials and Methods

The experiment was conducted at different locations under different AEZs on different cropping patterns to find out a cropping pattern based fertilizer recommendation for dominant cropping patterns and to determine the economic use of fertilizer in promising pattern. It was initiated in 1999-2000 and continued to 2004-05. During 2004-05 a total of eleven (11) dominant cropping patterns were tested at 17 different locations covering 9 major AEZs through out the country. The experiment was laid out in RCB design with six dispersed replications. The following six fertilizer management packages were verified-

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	Nandigram, Phulpur, Netrokona
2.	Wheat-Jute-T.Aman	Ishan Gopalpur, Lalmonirhat, Palima
3.	Wheat-Mungbean-T.Aman	Jhenaidah, Natore
4.	Potato-Jute-T.Aman	Melandah
5.	Wheat-T.Aman	Boda
6.	Potato-Boro-T.Aman	Syedpur, Sherpur
7.	Potato-T.Aus-T.Aman	Kishoreganj, Katiadi
8.	Boro-T.Aus-T.Aman	Chandina
9.	Chilli-T.Aman	Hathazari
10.	Mustard-Boro	Manikganj, Mymensingh
11.	Maize-T.Aman	Pabna

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

Site: Nandigram, Bogra

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

Site: 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	100-20-60-0-0-0	30-5-30-0	60-12-30-0
T_6	0-0-0-0-0-0	0-0-0-0	0-0-0-0

Site: 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

Site: Manikganj

Treatment	Mustard (N-P-K-S-CD)	Boro (N-P-K-S-CD)
T_1	60-18-10-10	100-15-35-6-1
T_2	80-20-15-15	135-20-48-8-1.5
T_3	65-18-0-15	135-20-48-8-1.5
T_4	60-15-10-10	100-15-35-6-1
T_5	105-24-45-5	104-27-28-15-1.5
T_6	0-0-0-0	0-0-0-0

Site: Melandah, Jamalpur

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

Site: Sherpur, Jamalpur

Treatment	Potato (N-P-K-S-Zn-B-MOC)	Boro (N-P-K-S-Zn-MOC)	T.Aman (N-P-K-S-MOC)
T_1	104-22-84-12-3	104-11-42-8	72-8-32-5
T_2	147-32-120-19-4	147-15-59-12	98-10-41-6
T_3	132-27-105-19-4+ 5 t/ha	147-15-59-12	98-10-41-6
T_4	90-15-50-10-1	100-12-40-7	60-8-30-4
T_5	120-20-80-0	112-25-45-18	60-10-0
T_6	0-0-0-0-0-0-0	0-0-0-0-0-0	0-0-0-0-0

Site: Phulpur, Mymensingh

Treatment	Mustard (N-P-K-S CD t/ha)	Boro rice (N-P-K-S)	T.Aman rice (N-P-K-S)
T_1	84-25-39-26-0.5	90-15-68-17	66-11-48-11
T_2	118-31-56-32-1	126-22-95-24	84-13-61-14
T_3	88-21-26-32-1.5 + CD 5t/ha	126-22-95-24	84-13-61-14
T_4	70-15-25-15-0	100-12-40-7	60-8-30-4
T_5	55-20-20-0	113-18-31-0	82-0-0
T_6	0-0-0-0	0-0-0-0	0-0-0-0

Site: Netrakona, Mymensingh

Treatment	Mustard (N-P-K-S CD t/ha)	Boro rice	T.Aman rice
T_1	68-24-38-26-0.5	98-23-67-17	68-17-49-10
T_2	95-31-55-32-1	168-33-94-23	92-21-62-13
T_3	65-21-25-32-1+ CD 5t/ha	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
T_6	0-0-0-0-0-0-0	0-0-0-0	0-0-0-0

Site: Boda, Dinajpur

Treatments	Wheat (N-P-K-S-Zn-B + CD t/ha)	T.Aman (N-P-K-S-Zn)
T_1	84-14-53-20-1-0.6	67-4-37-8-1-0
T_2	120-20-75-30-1.5-1	90-5-47-10-1.5
T_3	105-05-60-30-1.5-1+ CD 5t/ha	90-5-47-10-1.5
T_4	90-20-45-15-1.5-0.5	75-10-35-4-0
T_5	86-24-40-13-0	75-15-22-6-3
T_6	0-0-0-0-0	0-0-0-0-0

Site: Ishan Gopalpur, Faridpur

Treatment	Wheat (N-P-K-S-Zn-B + CD t/ha)	Jute (N-P-K-S)	T. Aman (N-P-K-S)
T_1	73-25-35-7-2	65-9-35-3	57-8-25-1.5
T_2	100-35-50-10-2	85-12-50-5	78-10-33-2
T_3	70-25-20-10-2+ CD 10 t/ha	85-12-50-5	78-10-33-2
T_4	75-20-25-10-2	65-7-20-3	60-6-16-4
T_5	105-21-26-14	31-11-44-0	90-20-25-15
T_6	0-0-0-0-0-0	0-0-0-0	0-0-0-0

Site: Lalmonirhat, Rangpur

Treatment	Wheat (N-P-K-S-Mg-Zn-B + CD t/ha)	Jute (N-P-K-S)	T. Aman (N-P-K-S)
T_1	90-14-58-20-10-3-0	80-7-43-8	70-3-30-5
T_2	130-20-80-30-15-4-0	112-9-60-12	100-4-38-7
T_3	108-13-58-30-15-4+ CD 10 t/ha	112-9-60-12	100-4-38-7
T_4	85-20-30-12-0-1.5-1	70-7-20-5	65-7-20-3
T_5	70-23-32-12-0-0+ CD 7 t/ha	48-0-0	78-19-28-11
T_6	0-0-0-0-0-0	0-0-0-0	0-0-0-0

Site: Palima, Tangail

Treatments	Wheat (N-P-K-S-Zn-B + CD t/ha)	Jute (N-P-K-S)	T.Aman (N-P-K-S)
T_1	91-30-53-18-0.5	81-10-42-8	71-19-27-9
T_2	131-41-75-27-1.0	113-13-60-11	97-12-50-6
T_3	115-36-60-27-1+ CD 5 t/ha	113-13-60-11	97-12-50-6
T_4	60-15-25-8-1	55-7-25-5	40-6-15-2
T_5	55-12-15-0	58-21-31	58-3-31
T_6	0-0-0-0	0-0-0-0	0-0-0-0

Site: Katiadi, Kishoreganj

Treatment	Potato (N-P-K-S-Zn-B-CD t/ha)	T.Aus (N-P-K-S-)	T.Aman (N-P-K-S-)
T_1	96-23-66-12-0	66-8-21-5	66-8-21-5
T_2	135-32-107-17-0	90-6-29-6	90-6-29-6
T_3	120-27-92-17+ CD 5 t/ha	90-6-29-6	90-6-29-6
T_4	90-15-50-10-0	60-8-30-4	60-8-30-4
T_5	124-51-150-0+ CD 10 t/ha	50-10-17-0	52-14-25-2
T_6	0-0-0-0-0-0	0-0-0-0-0-0	0-0-0-0-0

Site: Kishoreganj sadar

Treatment	Potato (N-P-K-S-Zn-B-CD t/ha)	T.Aus (N-P-K-S-)	T.Aman (N-P-K-S-)
T_1	90-20-69-11-0	61-7-24-5	61-7-24-5
T_2	120-29-98-16-0	84-8-31-6	84-8-31-6
T_3	105-24-83-16+ CD 5 t/ha	84-8-31-6	84-8-31-6
T_4	90-15-50-10-0	60-8-30-4	60-8-30-4
T_5	152-45-75-0+ CD 10 t/ha	50-0-0-0	96-16-24-0
T_6	0-0-0-0-0-0	0-0-0-0-0-0	0-0-0-0-0

Site: Hathazari, Chittagong

Treatments	Chilli (N-P-K-S-Zn-B + PM t/ha)	T.Aman (N-P-K-S-Zn)
T_1	106-17-106-18	71-5-32-5
T_2	138-22-138-23	97-5-41-6
T_3	108-3-117-23+ PM 3 t/ha	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	0-0-0-0

Site: Chandina, Comilla

Treatment	Boro (N-P-K-S-Zn-B-CD t/ha)	T.Aus (N-P-K-S)	T.Aman (N-P-K-S-)
T_1	83-14-48-12	57-5-33-4	57-5-33-4
T_2	117-18-67-16	78-6-43-5	78-6-43-5
T_3	102-14-52-16+ CD 5 t/ha	78-6-43-5	78-6-43-5
T_4	95-20-40-10	65-7-25-4	65-7-25-4
T_5	120-61-100-0	110-25-44-0	110-25-44-0
T_6	0-0-0-0-0-0	0-0-0-0-0-0	0-0-0-0-0

Site: Jhenaidah, Jessore

Treatments	Wheat (N-P-K-S-Zn-B + CD t/ha)	Mungbean (N-P-K-S)	T.Aman (N-P-K-S)
T_1	77-25-38-3-2	16-6-8-1	60-7-18-2
T_2	110-34-54-5-3	22-9-11-2	82-9-23-2
T_3	95-29-39-5-3+ CD 5 t/ha	22-9-11-2	82-9-23-2
T_4	90-20-35-10-2	20-10-10-6	70-6-20-4
T_5	74-21-26-19-2	20-5-8-0	87-21-26-14-4
T_6	0-0-0-0	0-0-0-0	0-0-0-0

Site: Natore

Treatments	Wheat (N-P-K-S-Zn-B + CD t/ha)	Mungbean (N-P-K-S)	T.Aman (N-P-K-S)
T_1	87-25-42-8-0.5-0.5	17-12-9-0*	64-13-19-3
T_2	124-32-60-10-1-1	17-12-9-0*	87-16-24-4
T_3	109-27-45-10-1-1+ CD 5 t/ha	17-12-9-0*	87-16-24-4
T_4	90-20-35-10-2-0.5	20-10-10-6	70-6-20-4
T_5	95-21-30-14-0-0	20-10-10-0	98-21-24-10
T_6	0-0-0-0	0-0-0-0	0-0-0-0

*For average yield goal

Results and Discussion

CP : Mustard-Boro-T.Aman
Location : Phulpur, Mymensingh (AEZ 9)
Year : 2002-03 to 2004-05

Average of two years data showed that seed yield of Mustard did not differ appreciably among the different fertilizer packages except with T_4, T_5 (FP) and no fertilizer (T_6). However the higher yield was recorded from T_3 and T_2 where IPNS based fertilizer and inorganic fertilizer for HYG was applied. During 2002-03 the crop was damaged due to shower. Results over the year showed that significantly higher seed yield of Mustard was recorded from T_2 and T_3 during 2003-04 however; the yield was drastically reduced due to late sowing. But in 2004-05, the yield was quite satisfactory and the highest yield was obtained with T_3 followed by T_2. In Boro rice, higher grain yield was recorded from T_2 and T_3. Almost similar yield was recorded from T_1, T_4 and T_5 (FP). However, the trend was slightly varied over the years. The highest yield was obtained from T_2 but it was identical to T_3 during 2002-03. In 2003-04, significantly higher yield was obtained with T_2 but in 2004-05 grain yield did not vary significantly among the nutrient management packages except with no fertilizer treatment (T_6). Similarly in T.Aman rice, higher yield was obtained from T_2 and T_3. However, the yield did not differ appreciably due to different fertilizer packages. During 2002-03, identical yield was recorded from different treatments and varied only with FP and no fertilizer treatment. Grain yield of T.Aman rice was very low during 2003-04 and 2004-05 but the trend was more or less same with 2002-03. Regarding stover/straw yield almost similar trend was found. Initial nutrient status of the soil showed that the soil of the experimental plot was deficit in NPK but the response of crops to higher doses of nutrients was not apparent. The status of micronutrients like Zn and B was not known and not applied in the soil at all. That might be one of the reasons for low response of nutrients towards yield.

On an average, cost and return analysis showed that the highest gross margin was obtained from T_2 followed by T_3 (IPNS). But fertilization cost was higher in T_2 and T_3 and therefore, the marginal benefit cost ratio was less. Similarly, MBCR was found higher in T_4 and T_5 due to less fertilization cost.

Total NPK uptake in different treatments varied from 194-223, 33-38 and 215-248 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was higher in T_2 and IPNS treatment (T_3). The partial net balance of N and K was negative in all cases and ranged from -102 to -119 and -29 to -164 kg/ha, respectively. Potassium balance was found more negative in FP and FRG' 97 due to less application of K in the soil. However, P balance was positive in all the cases. Even a large amount of P was accumulated in the soil in T_2 and T_3 treatment. Regarding N and K mining IPNS was found favourable in this regard.

Considering the agro-economic performance STB fertilizer dose for HYG was found better and application of organic manure (3-5 t/ha) once in a year could be suggested for sustaining soil fertility.

Table 1. Yield of Mustard, Boro and T.Aman as affected by fertilizer levels in the cropping pattern Mustard-Boro-T.Aman at Phulpur, Mymensingh during 2002-03 to 2004-05

Treat	Seed/grain yield (t/ha)			Seed/grain yield (t/ha)			Seed/grain yield (t/ha)		
	2002-03			2003-2004			2004-05		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
T_1	Damaged	4.76 cd	4.43 a	558 b	5.25 c	2.60c	1250ab	5.84 a	2.73ab
T_2		5.43 a	4.55a	692 a	5.99 a	2.73a	1380 a	6.16 a	2.88a
T_3		5.12 ab	4.41a	675 a	5.74 b	2.68ab	1350 ab	6.15 a	2.90a
T_4		4.40 d	4.17ab	550 b	5.28 c	2.60c	1140 bc	5.87 a	2.75ab
T_5		4.96 bc	3.90b	550 b	5.13 c	2.60c	1060 c	5.71 a	2.66b
T_6		3.49 e	3.42c	258 c	3.63 d	2.23d	570 d	3.39 b	2.31c

Table 1. Contd.

Treat	Stover/ Straw yield (t/ha)			Stover/ Straw yield (t/ha)			Stover/ Straw yield (t/ha)		
	2002-03			2003-2004			2004-05		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
T_1		4.76 cd	4.43 a	1300 b	5.25 c	2.60c	1080 a	5.84 a	2.73ab
T_2		5.43 a	4.55a	1433 a	5.99 a	2.73a	1240 a	6.16 a	2.88a
T_3		5.12 ab	4.41a	1458 a	5.74 b	2.68ab	1240 a	6.15 a	2.90a
T_4		4.40 d	4.17ab	1275 b	5.28 c	2.60c	1000 a	5.87 a	2.75ab
T_5		4.96 bc	3.90b	1308 b	5.13 c	2.60c	1100 a	5.71 a	2.66b
T_6		3.49 e	3.42c	658 c	3.63 d	2.23d	500 b	3.39 b	2.31c

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

Table 2. Yield, cost and return analysis of Mustard -Boro-T.Aman cropping pattern as affected by fertilizer levels at Phulpur, Mymensingh during 2002-03 to 2004-05 (Avg.of 3 years)

Treat	Grain yield (t/ha)			Stover/straw yield (t/ha)			GR	VC	GM	MBCR
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman				
T_1	904	5.28	3.25	1190	5.85	5.02	86796	10374	76422	2.58
T_2	1036	5.86	3.39	1337	6.33	5.53	94792	13840	80952	2.51
T_3	1013	5.67	3.33	1349	6.19	5.51	92477	14000	78477	2.32
T_4	845	5.18	3.17	1138	5.82	5.12	84727	6975	77752	3.54
T_5	805	5.27	3.05	1204	6.07	5.02	83881	7414	76467	3.22
T_6	414	3.50	2.65	579	4.66	4.14	60021	0	60021	-

Output: Mustard Tk. 15.00, T.Aman rice = Tk. 7.00, Boro =Tk. 7.00, Mustard straw = Tk. 0.50, Rice straw = Tk. 0.50
Inputs: Urea = Tk. 6.00, TSP = Tk. 14.00, MP =Tk. 10.00, Gypsum =Tk. 4.00, Cowdung =Tk. 0.50

Table 3. Effect of different fertilizer management packages on the soil nutrient balance in Mustard-Boro-T.Aman rice cropping pattern at Phulpur, Mymensingh during 2002-03 to 2004-05 (Avg.of 3 years)

Treatment	Nutrient uptake (kg/ha)			Nutrient added (Inorg.+Org.) (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	203	35	225	240	51	155	-119	16	-70
T_2	223	38	248	328	66	212	-108	28	-36
T_3	217	37	241	328	66	212	-102	29	-29
T_4	196	33	218	230	35	95	-115	2	-123
T_5	194	33	215	250	38	51	-106	18	-164

CP : Mustard-Boro-T.Aman
Location : Netrakona, Mymensingh (AEZ 9)
Year : 2002-03 to 2004-05

Average of two years data showed that seed yield of Mustard did not differ appreciably among the different fertilizer packages except with T_5 (FP) and no fertilizer (T_6). However the higher yield was recorded from T_3 and T_2 where IPNS based fertilizer and inorganic fertilizer for HYG was applied. During 2002-03 the yield was drastically reduced due to late sowing and identical yield was recorded from different treatments except with FP (T_5) and no fertilizer (T_6). But in 2003-04, the yield was quite satisfactory and significantly higher yield was obtained with T_2 and T_3. The crop was damaged due to heavy rain in 2004-05. In Boro rice, higher grain yield was recorded from T_2 and T_3. Almost similar yield was recorded from T_1, T_4 and T_5 (FP). However, the trend was slightly varied over the years. The highest yield was obtained from T_3 followed by T_2 and T_1 during 2002-03. More or less similar trend was observed over the years. Similarly in T.Aman rice, higher yield was obtained from T2 and T_3. However, the yield did not differ appreciably due to different fertilizer packages. During 2002-03, the highest yield was recorded from T_2 followed by T_3. Satisfactory yield was found in FP along with T_1 and T_4. Higher and identical yield was obtained with T_2 and T_3 during 2003-04 and 2004-05. Regarding stover/straw yield almost similar trend was found. Initial nutrient status of the soil showed that the soil of the experimental plot was deficit in NPK and a considerable response of crops to higher doses of nutrients was observed to some extent.

Cost and return analysis (average of 3 years) showed that the highest gross margin was obtained from T_3 closely followed by T_2 and T_4. But fertilization cost was higher in T_2 and T_3 and therefore, the marginal benefit cost ratio was less. Similarly, MBCR was found higher in T_4 and T_5 due to less fertilization cost.

Total NPK uptake in different treatments varied from 186-238, 31-41 and 207-265 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was higher in T_2 and IPNS treatment (T_3). The partial net balance of N and K was negative in all cases and ranged from --93 to -125 and -46 to -179 kg/ha, respectively. Potassium balance was found more negative in FP and FRG' 97 due to less application of K in the soil. However, P balance was found positive in all the cases except in FP where it was negative (-6 kg/ha). A quite higher amount of P was accumulated in the soil in T_2 and T_3 and T_1 treatment. Farmers usually apply a very lower amount of P and K that resulted more nutrient mining in the soil.

Considering the agro-economic performance the present fertilizer recommendation from FRG'97 (T_4) was found better and application of organic manure (3-5 t/ha) once in a year could be suggested for sustaining soil fertility.

Table 4. Yield of Mustard, Boro and T.Aman as affected by fertilizer levels in the cropping pattern Mustard-Boro-T.Aman at Netrakona, Mymensingh during 2002-03 to 2004-05

Treat	Seed/grain yield (t/ha)			Seed/grain yield (t/ha)			Seed/grain yield (t/ha)		
	2002-03			2003-2004			2004-05		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
T_1	630a	5.52c	3.58c	1025b	4.71bc	3.48b		6.20bc	3.51ab
T_2	720a	6.26ab	4.08a	1158a	4.99ab	3.72a	Damaged	6.63ab	4.39a
T_3	800a	6.38a	3.96ab	1167a	5.32a	3.69a		6.93a	4.50a
T_4	650a	5.98ab	3.73bc	992bc	4.58c	3.54ab		6.40b	3.59ab
T_5	280b	5.87bc	3.21c	908c	4.44c	3.23c		5.90c	2.95bc
T_6	58c	3.33d	2.75d	250d	2.49d	2.73d		2.98d	2.29c

Table 4. Contd.

Treat	Stover/ Straw yield (t/ha) 2002-03			Stover/ Straw yield (t/ha) 2003-2004			Stover/ Straw yield (t/ha) 2004-05		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
T_1	1382bc	6.38b	5.04ac	2067ab	5.55c	4.59cd		6.83bc	4.55c
T_2	1760ab	6.96a	5.64a	1992ab	6.08b	5.02a		7.31ab	5.73ab
T_3	2010a	7.03a	5.56ab	2133a	7.39a	4.88ab	Damaged	7.58a	5.90a
T_4	1820ab	6.75ab	5.06bc	2042ab	5.58c	4.70bc		7.03b	4.60bc
T_5	990c	6.68ab	4.63c	1817b	5.04d	4.35d		6.45c	3.67c
T_6	353d	3.53c	3.29d	467c	2.96e	3.68e		3.51d	3.05d

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

Table 5. Yield, cost and return analysis of Mustard -Boro-T.Aman cropping pattern as affected by fertilizer levels at Netrokona, Mymensingh during 2002-03 to 2004-05 (Avg.of 3 years)

Treat	Grain yield (t/ha)			Stover/straw yield (t/ha)			GR	VC	GM	MBCR
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman				
T_1	828	5.48	3.52	1725	6.25	4.73	90107	11455	78652	3.47
T_2	939	5.96	4.06	1876	6.78	5.46	100830	15773	85057	3.20
T_3	984	6.21	4.05	2072	7.33	5.45	103682	16404	87278	3.25
T_4	821	5.65	3.62	1931	6.45	4.79	92375	8315	84060	5.05
T_5	594	5.40	3.13	1404	6.06	4.22	82410	5985	76425	5.35
T_6	154	2.93	2.59	410	3.33	3.34	50397	0	50397	-

Output: Mustard Tk. 15.00, T.Aman rice = Tk. 7.00, Boro =Tk. 7.00, Mustard straw = Tk. 0.50, Rice straw = Tk. 0.50
Inputs: Urea = Tk. 6.00, TSP = Tk. 14.00, MP =Tk. 10.00, Gypsum =Tk. 4.00, Cowdung =Tk. 0.50

Table 6. Effect of different fertilizer management packages on the soil nutrient balance in Mustard-Boro-T.Aman rice cropping pattern at Netrokona, Mymensingh during 2002-03 to 2004-05 (Avg.of 3 years)

Treatment	Nutrient uptake (kg/ha)			Nutrient added (Inorg.+Org.) (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
ED_1	207	35	230	234	64	154	-125	29	-76
ED_2	232	39	257	355	85	211	-108	46	-46
IPNS	238	41	265	355	85	211	-114	44	-54
FRG’97	212	36	235	250	41	75	-124	5	-160
FP	186	31	207	266	25	28	-93	-6	-179

CP : Mustard-Boro-T.Aman
Location : Nandigram (AEZ 25)
Year : 2003-04 & 2004-05

Average of two years data showed that the highest seed yield of Mustard was obtained with STB for HYG (T_2) closely followed by IPNS (T_3). The next higher yield was found in FRG’97. Almost similar yield was recorded from STB for MYG (T_1) and FP (T_5). IPNS practice failed to show yield advantage over inorganic fertilizers of same level. The trend over the year is more or less same but yield was drastically reduced in 2003-04 due to late sowing of Mustard. In Boro rice, grain yield did not vary appreciably, however higher yield was recorded from T_2 and T_3. Almost similar yield was obtained with T_1 and T_4 which was slightly higher than T_5. Almost similar trend was observed in both the years. Significantly higher yield was found in T_2 followed by T_3. Similarly in T.Aman rice, higher yield was obtained from T_2 and T_3. More or less similar yield was recorded from T_1, T_4 and T_5. Over the years data showed that significantly higher yield was obtained from T_2 and T_3. Regarding stover/straw yield almost similar trend was found. Initial nutrient status of the soil showed that the soil of the experimental plot was deficit in NPK and a considerable response of crops to higher doses of nutrients was observed to some extent.

Cost and return analysis (average of 2 years) showed that the highest gross return as well as gross margin was obtained from T_2 closely followed by T_2. But fertilization cost was higher in T_2 and T_3 and therefore, the marginal benefit cost ratio was less in compared to T4. MBCR was found higher in T_4 due to less fertilization cost.

Total uptake of NPK in different treatments varied from 200-253, 34-43 and 222-281 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was higher in T_2 and IPNS treatment (T_3). The partial net balance of N and K was negative in all cases and ranged from -126 to -152 and -23 to -110 kg/ha, respectively. Potassium balance was found more negative in FP and FRG' 97 due to less application of K in the soil. However, P balance was found positive in all the cases and ranged from 10 to 24 kg/ha. A quite higher amount of P was accumulated in the soil in T_2 and T_3 and T_1 treatment.

Considering the agro-economic performance STB fertilizer dose for HYG was found better and application of organic manure (3-5 t/ha) once in a year could be suggested for sustaining soil fertility.

Table 7. Yield of crops as influenced by fertilizer levels in the cropping pattern Mustard-Boro-T.Aman at Nandigram, Bogra during 2003-04 to 2004-05

Treat	Seed/grain yield (t/ha) 2003-04			Seed/grain yield (t/ha) 2004-2005			Seed/grain yield (t/ha) Mean		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
T_1	0.57b	5.07b	4.02b	1.15b	5.17b	3.78ab	0.86	5.12	3.90
T_2	0.78a	5.79a	4.68a	1.76a	5.59 a	4.38a	1.27	5.69	4.53
T_3	0.71a	5.30ab	4.57a	1.71a	5.55a	4.21a	1.21	5.42	4.39
T_4	0.59b	5.27ab	3.95b	1.45ab	5.09bc	3.65b	1.02	5.18	3.80
T_5	0.51b	4.77b	4.12b	1.11b	4.74c	3.64b	0.81	4.75	3.88
T_6	0.29c	2.19c	2.16c	0.25c	2.86d	2.25c	0.27	2.52	2.20

Table 7. Contd.

Treat	Stover/ Straw yield (t/ha) 2003-04			Stover/ Straw yield (t/ha) 2004-2005			Stover/ Straw yield (t/ha) Mean		
	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman	Mustard	Boro	T.Aman
T_1	2.76b	5.52ab	4.34ab	2.83b	5.30b	4.64a	2.80	5.41	4.49
T_2	3.02a	5.85a	4.88a	3.37a	5.85a	5.40a	3.20	5.85	5.14
T_3	3.20a	5.52ab	4.72a	3.15a	5.75a	4.88a	3.18	5.63	4.80
T_4	2.70b	5.54ab	4.12b	3.36a	5.12bc	5.00a	3.03	5.33	4.56
T_5	2.59b	4.75b	4.45ab	3.31a	4.87c	4.50a	2.95	4.81	4.48
T_6	1.52c	2.88c	2.51c	1.16c	2.90d	2.50b	1.34	2.89	2.50

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

Table 8. Cost and return analysis of Mustard -Boro-T.Aman cropping pattern as influenced by fertilizer levels at Nandigram, Bogra during 2003-04 to 2004-05 (Avg.of 2years)

Treat	GR	VC	GM	MBCR
	107200	11534	95666	4.98
T_2	120470	16068	104402	4.41
T_3	115555	16116	99439	4.09
T_4	103710	10732	92978	5.03
T_5	96745	10669	86076	4.41
T_6	49665	0	49665	-

Output: Mustard Tk. 20.00, T.Aman rice = Tk. 10.00, Boro =Tk. 7.50, Mustard straw = Tk. 0.50, Rice straw = Tk. 0.50
Inputs: Urea = Tk. 6.00, TSP = Tk. 14.00, MP =Tk. 10.00, Gypsum =Tk. 4.00, Cowdung =Tk. 0.50

Table 9. Effect of different fertilizer management packages on the soil nutrient balance in Mustard-Boro-T.Aman rice cropping pattern at Nandigram, Bogra during 2003-04 to 2004-05 (Avg.of 2 years)

Treatment	Nutrient uptake (kg/ha)			Nutrient (Inorg.+Org.) added (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
ED_1	209	36	233	207	48	179	-136	12	-54
ED_2	253	43	281	288	65	247	-152	22	-34
IPNS	243	41	270	288	65	247	-142	24	-23
FRG'97	217	37	241	245	47	135	-131	10	-82
FP	200	34	222	210	55	112	-126	21	-110

Location : Mymensingh (AEZ 9)
CP : Mustard-Boro
Year : 2002-03 to 2004-05

Average of three years data revealed that seed yield of Mustard increased substantially with IPNS based fertilizer application. On an average about 90 kg/ha of yield increased with IPNS (T_3) over STB inorganic fertilizer (T_2). The 2nd highest yield was obtained with T_2 followed by FRG'97 (T_4) and Farmers' practice (T_5). Almost similar trend was observed over the years. However, higher and identical yield was recorded from T_2 and T_3 during 2002-03 and 2004-05 but in 2003-04 significantly the highest yield was obtained with T_3. Similarly, in Boro rice higher grain yield was found in T_3 followed by T_2. More or less similar yield was obtained with FRG'97 and Farmers' practice. Regarding stover and straw yield of crops, similar trend was found as observed in grain yield. A considerable response of crops to organic manure was observed in Mustard-Boro rice cropping pattern.

Cost and return analysis showed that the highest gross return as well as gross margin was obtained from IPNS based fertilizer dose (T_3) followed by STB inorganic fertilize (T_2). Fertilizer dose from FRG'97 (T_4) also gave satisfactory economic return. Marginal benefit cost ratio is the highest in FRG'97 (T_4). In spite of highest fertilization cost IPNS (T_3) also gave 2nd highest value which was similar to farmers' practice (T_5).

Total uptake of NPK in different fertilizer packages varied from 125-160, 21-27 and 139-177 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Therefore, nutrient uptake is higher in IPNS as the yield was comparatively higher. The apparent nutrient balance of N and K was negative in all the nutrient management packages and ranged from -53 to -72 and -60 to -125. The farmers usually apply less amount of K and therefore, the K balance was the lowest in farmers' practice followed by FRG'97. But P balance was found positive in all the fertilizer packages. P balance was the lowest (3 kg/ha) in ED1 because of comparatively lower dose of P was added. But the farmers' apply a much higher dose of P in Mustard and therefore, a large amount of P (44 kg/ha) accumulated in the soil every year.

Based on three years of experimentation the IPNS based fertilizer dose for HYG (T_3) was found superior in respect of yield and profit and it could be recommended for sustainable productivity as well as soil fertility concern.

Table 10. Yield of crops as influenced by different fertilizer packages in Mustard-Boro rice cropping pattern at Mymensingh during 2002-03 to 2004-05

Treat	Seed (kg/ha) and grain yield (t/ha)*							
	2002-03		2003-04		2004-05		Mean	
	Mustard	Boro*	Mustard	Boro*	Mustard	Boro*	Mustard	Boro*
T_1	725b	4.75c	842c	4.47c	580c	5.13d	715	4.78
T_2	813a	5.83a	1008b	5.50ab	840ab	5.89ab	887	5.74
T_3	838a	5.93a	1163a	5.86a	930a	5.92a	977	5.90
T_4	713bc	5.30b	1006b	4.84c	770b	5.63c	829	5.26
T_5	663c	4.51d	1043b	5.27b	810b	5.77bc	838	5.18
T_6	425d	3.05e	408d	4.06d	450d	3.94e	427	3.68

Table 10. Contd.

Treat	Stover (kg/ha) and Straw yield (t/ha)							
	2002-03		2003-04		2004-05		Mean	
	Mustard	Boro	Mustard	Boro	Mustard	Boro	Mustard	Boro
T_1	1600b	5.98ab	2122c	4.47c	1450c	6.72d	1724	5.72
T_2	1900a	4.10c	2534b	5.92a	1900ab	8.40a	2111	6.14
T_3	2050a	7.39a	2905a	5.94a	2020a	8.60a	2325	7.31
T_4	1500b	4.83b	2545b	5.64b	1670bc	7.28c	1905	5.92
T_5	1463b	5.63ab	2600b	5.80a	1820ab	7.76b	1961	6.40
T_6	775c	4.20c	962d	4.38d	1000d	5.80e	912	4.79

Table 11. Cost and return of Mustard -Boro rice cropping pattern as influenced by different fertilizer packages at Mymensingh during 2002-03 to 2004-05 (Average)

Treatment	GR	VC	GM	MBCR
T_1	54862	8012	46850	1.95
T_2	66124	11185	54939	2.40
T_3	69392	11795	57597	2.55
T_4	60437	6468	53969	3.27
T_5	59206	7818	51388	2.55
T_6	39228	0	39228	-

Table 12. Effect of different fertilizer management packages on the apparent soil nutrient balance in Mustard-Boro rice cropping pattern at Mymensingh (avg. of 2002-03 to 2004-05)

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	125	21	139	179	39	77	-53	18	-62
T_2	152	26	169	250	53	109	-52	27	-60
T_3	160	27	177	250	53	109	-60	26	-68
T_4	140	24	155	170	27	75	-72	3	-80
T_5	139	24	154	169	68	29	-71	44	-125

CP : Mustard-Boro
Location : Manikganj (AEZ 9)
Year : 2001-02 to 2004-05

The experiment was initiated in 2001-02 but due to heavy rain and flood the crop (mustard) was damaged in 2003-04. Results of 2001-02, 2002-03 and 2004-05 are presented in Table 11. Average of three years data revealed that seed yield of Mustard increased substantially with IPNS based fertilizer application. On an average about 110 kg/ha of yield increased with IPNS (T_3) over STB inorganic fertilizer (T_2). The 2nd highest yield was obtained with T_2 followed by FRG'97 (T_4) and Farmers' practice (T_5). Almost similar trend was observed over the years. Significantly higher yield was recorded from T_3 during all the years. Almost similar yield was recorded with STB fertilizer dose for MYG (T_1) and FRG'97 (T_4) along with farmers' practice (T_5) during 2001-02 and 2004-05. However, in 2002-03 yield was significantly higher with T_4 and T_5. Similarly, in Boro rice the highest grain yield was found in T_3 and the 2nd highest yield was obtained with T_2. However, nutrient dose was same in T_2 and T_3 but yield was significantly higher in T_3 probably due to residual effect of cowdung applied in T_3 in Mustard. More or less similar yield was obtained with FRG'97 (T_4), Farmers' practice (T_5) and STB for MYG (T_1). Regarding stover and straw yield of crops almost similar trend was found as observed in grain yield. A considerable response of crops to organic manure was observed in Mustard-Boro rice cropping pattern.

Cost and return analysis showed that the highest gross return as well as gross margin was obtained from IPNS based fertilizer dose (T_3). Fertilizer dose from FRG'97 (T_4) and STB inorganic fertilize for HYG (T_2) also gave satisfactory economic return. Marginal benefit cost ratio is the highest in FRG'97 (T_4) due to lowest fertilization cost. In spite of highest fertilization cost IPNS (T_3) also gave next higher value with T_1.

Total uptake of NPK in different fertilizer packages varied from 127-159, 22-27 and 141-177 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Therefore, nutrient uptake is higher in IPNS as the yield was comparatively higher. The apparent nutrient balance of N and K was negative in all the nutrient management packages and ranged from -50 to -71 and -760 to -105. But P balance was found positive in all the fertilizer packages. P balance was the lowest (7 kg/ha) in FRG'97 because of comparatively lower dose of P was added.

Based on three years of experimentation the IPNS based fertilizer dose for HYG (T_3) was found superior in respect of yield and profit and it could be recommended for sustainable productivity as well as soil fertility concern.

Table 13. Yield of crops as influenced by different fertilizer packages in Mustard-Boro rice cropping pattern at Manikganj during 2001-02 to 2004-05

Treat	Seed (kg/ha) and grain yield (t/ha)*							
	2001-02		2002-03		2004-05		Mean	
	Mustard	Boro*	Mustard	Boro*	Mustard	Boro*	Mustard	Boro*
T_1	609c	4.74c	718c	4.49b	670bc	5.88c	670	5.04
T_2	729b	5.40ab	885ab	5.14a	710b	6.73b	775	5.76
T_3	844a	5.72a	950a	5.31a	860a	7.43a	885	6.15
T_4	649c	5.15b	817ab	5.04a	640c	5.85c	702	5.38
T_5	679c	5.10bc	757bc	4.21b	690bc	6.59b	709	5.30
T_6	295d	2.56d	325d	3.13c	210d	2.94d	280	2.88

Table 13. Contd.

Treat	Stover (kg/ha) and Straw yield (t/ha)*							
	2001-02		2002-03		2004-05		Mean	
	Mustard	Boro*	Mustard	Boro*	Mustard	Boro*	Mustard	Boro*
T_1	1192c	6.0c	1930b	5.72b	1430a	6.10b	1520	5.94
T_2	1451b	6.69ab	2130ab	6.15ab	1450a	7.25ab	1677	6.70
T_3	1720a	7.07a	2450a	6.49a	1660a	8.31a	1945	7.29
T_4	1337b	6.77ab	2010a	5.80b	1440a	6.50b	1596	6.36
T_5	1190c	6.20bc	1980b	5.96b	1460a	7.98a	1543	6.71
T_6	565d	3.92d	990c	3.91c	540b	4.50c	700	4.11

Table 14. Cost and return of Mustard -Boro rice cropping pattern as influenced by different fertilizer packages at Manikganj during 2001-02 to 2004-05 (Average)

Treat	GR	VC	GM	MBCR
T_1	64700	7264	57436	4.31
T_2	69175	10075	59100	3.55
T_3	79140	11122	68018	4.11
T_4	65540	5679	59861	5.66
T_5	65124	8685	56439	3.65
T_6	33375	0	33375	-

Table 15. Effect of different fertilizer management packages on the apparent soil nutrient balance in Mustard-Boro rice cropping pattern at Manikganj (avg. of 2002-03 to 2004-05)

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	127	22	141	162	40	51	-62	18	-90
T_2	146	25	162	228	53	72	-55	28	-90
T_3	159	27	177	228	53	72	-68	26	-105
T_4	135	23	150	160	30	45	-71	7	-105
T_5	134	23	149	209	51	73	-50	28	-76

CP : Wheat-Jute-T.Aman
Location : Ishan Gopalpur, Faridpur (AEZ 12)
Year : 2003-04 to 2004-05

Average of 2 years data showed that the highest grain yield of wheat was recorded from STB fertilizer dose for HYG (T_2) followed by IPNS (T_3). IPNS failed to show higher yield advantage over inorganic fertilizer. Almost similar yield was recorded from STB for MYG (T_1) and FRG'97 (T_4) along with Farmers' practice (T_5). Significantly higher yield was obtained with T_2 and T_3 during 2003-04. But in 2004-05 yield of wheat was very low due to high temperature during grain filling stage. Grain yield did not vary significantly among the different nutrient management packages except with no fertilizer. In Jute the highest fibre yield was obtained from T_2 followed by T_3. Fiber yield of Jute did not vary appreciably with T_1, T_4 and T_5. During 2003-04 yield was significantly higher with T2 but in 2004-05 identical yield was obtained with different fertilizer packages. In T.Aman rice the trend was similar to wheat and Jute. Higher yield was recorded from T_2 and T_3. Similar yield was also found in T_1, T_4 and T_5. However, the trend was little differed over the years. In 2003-04, significantly higher yield was found in T_2 followed by T_3 but in 2004-05 higher and identical yield was recorded from T_2 and T_3. Regarding straw and stick yield more or less similar trend was observed in Wheat, T.Aman rice and Jute. Initial soil nutrient status showed that the soil was deficit in N and P but response to higher level of nutrient was very distinct at all.

The cost and return analysis of crops grown in Wheat-Jute-T.Aman cropping pattern showed that the highest gross return and gross margin was obtained from treatment T_2 followed by T_3 and T_1. The highest MBCR (4.61) was obtained from the same treatment T_2. Higher MBCR was also found in T_1 and T_4 due to less fertilization cost. Additional cost for organic manure in T_3 reduces the MBCR.

Total NPK uptake in different treatments varied from 168-202, 31-38 and 238-288 kg/ha, respectively. Nutrient uptake by crop is related to biomass production. Yield and nutrient uptake was highest in STB for HYG (T_2) followed by IPNS treatment (T_3). The partial net balance of N and K was found negative in all cases and ranged from -94 to -110 and -133 to -177 kg/ha, respectively. However, P balance was positive in all cases and varied from 2 to 22 kg/ha. The balance was more positive in STB fertilizer dose for HYG (T_2) and IPNS (T_3) as well as in FP due to higher addition. Initially the soil was rich in K and less amount of K was applied. The K balance was more negative in present fertilizer recommendation (FRG'97) as the lowest amount of K (61 kg/ha/year) was applied.

After two years of experimentation, considering yield profit as well as long term soil fertility, STB fertilizer dose for HYG could be suggested for recommendation for the cropping pattern in grater Faridpur.

Table 16. Yield of crops influenced by different fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at Ishan Gopalpur, Faridpur during 2003-04 to 2004-05

Treat	Grain/fibre yield (t/ha)			Grain/fibre yield (t/ha)			Grain/fibre yield (t/ha)		
	2003-04			2004-05			Mean		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
T_1	2.56b	2.36b	2.99ab	1.00a	2.28a	2.37b	1.78	2.32	2.68
T_2	2.97a	2.80a	3.30a	1.06a	2.52a	2.91a	2.01	2.66	3.10
T_3	2.53a	2.28bc	2.84b	1.16a	2.62a	2.98a	1.84	2.45	2.91
T_4	2.44b	2.04c	2.67b	0.99a	2.28a	2.53ab	1.71	2.16	2.60
T_5	2.51b	2.18bc	2.89b	1.05a	2.38a	2.30b	1.78	2.28	2.59
T_6	1.58c	1.58d	1.67c	0.74b	1.67b	1.40c	1.16	1.62	1.53

Table 16. Contd.

Treat	Straw/Stick yield (Tk/ha)								
	2003-04			2004-05			Mean		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
T_1	4.69b	3.98b	4.09ab	2.74	4.85	3.55	3.71	4.41	3.82
T_2	5.37a	4.62a	4.05ab	2.85	5.68	4.05	4.11	5.15	4.05
T_3	4.62b	3.81b	3.68b	2.97	5.88	4.06	3.79	4.84	3.87
T_4	4.29b	3.82b	4.31ab	2.55	4.67	3.65	3.42	4.24	3.98
T_5	4.44b	3.70b	4.53a	2.50	4.69	3.84	3.47	4.19	4.18
T_6	2.82c	2.72c	2.23c	1.68	2.86	1.97	2.25	2.79	2.10

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

Table 17. Cost and return analysis of Wheat-Jute-T.Aman cropping pattern as influenced by different fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at Ishan Gopalpur, Faridpur during 2003-04 to 2004-05 (Avg. of 2 years)

Treat.	GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
T_1	99797	8007	91790	4.42
T_2	114342	10838	103504	4.61
T_3	106002	13155	92847	3.16
T_4	95015	6925	88090	4.42
T_5	97857	9162	88695	3.65
T_6	64412	0	64412	-

Table 18. Effect of different fertilizer management packages on the soil nutrient balance in Wheat-Jute-T.Aman rice cropping pattern at Ishan Gopalpur, Faridpur during 2003-04 to 2004-05 (Avg. of 2 years)

Treatment	Nutrient uptake (kg/ha)			Nutrient added (Inorg.+Org.) (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	176	33	252	195	42	95	-108	9	-157
T_2	202	38	288	263	57	133	-110	19	-155
T_3	186	35	266	263	57	133	-94	22	-133
T_4	168	31	238	200	33	61	-98	2	-177
T_5	173	32	247	226	52	95	-94	20	-152

CP : Wheat-Jute-T.Aman
Location : Lalmonirhat (AEZ 3)
Year : 2002-03 to 2004-05

Average of 3 years data showed that the highest grain yield of wheat was recorded from IPNS (T_3) followed by STB fertilizer dose for HYG (T_2). STB for MYG (T_1) gave higher yield than FRG'97 (T_4). Farmers' practice gave slightly lower yield than FRG'97. Yield over the years showed that significantly higher yield was obtained with IPNS followed by STB for HYG and similar trend was found in the three years. Yield advantage was found in IPNS over only inorganic fertilizer. Identical yield was recorded from T_1, T_4 and T_5 during 2002-03 but in 2003-04 and 2004-05 yield was higher in T_1. Similarly, in Jute the highest fibre yield was obtained from T_3 followed by T_2. More or less similar yield was found with T_1 and T_4 which was higher than FP (T_5). Almost similar trend was observed over the years and significantly higher yield was obtained with IPNS, however, the nutrient level was same. Identical yield was also found in T_1 and T_4. In T.Aman rice almost similar yield was obtained with T_3 and T_4. Similar yield was also found in T_1 and T_4 along with FP. The trend was more or less same in different years. Initial soil nutrient status showed that the nutrient status of the soil was low and a positive response of crops to higher level of nutrients was evident.

The cost and return analysis of crops grown in Wheat-Jute-T.Aman cropping pattern showed that the highest gross return and gross margin was obtained from treatment T_3 (IPNS) followed by T_2. Fertilization cost was also higher in the same treatments which reduced the MBCR. The highest MBCR (4.21) was obtained from treatment T_4 (FRG '97) due to use of less amount of fertilizers.

Total NPKS uptake in different treatments varied from 190-263, 35-49 and 242-343 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was highest in IPNS treatment (T_3) followed by STB fertilizer dose for HYG (T_2). The partial net balance of N and K were negative in all cases and ranged from -121 to -143 and -142 to -193 kg/ha, respectively. Similarly, P balance was found negative in all the treatments except in FP. Initially the P status of the soil was medium and therefore, comparatively less amount of P was added in STB fertilizer doses. The P balance was found more negative in those treatments. Regarding K less amount of K was added in FRG'97 and in FP. Therefore, the balance was found more negative.

After three years of experimentation, considering yield profit as well as long term soil fertility, IPNS based fertilizer dose for HYG could be suggested for recommendation for the cropping pattern.

Table 19. Yield of crops as influenced by different fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at Lalmonirhat during 2002-03 to 2004-05

Treat	Grain/fibre yield (t/ha)			Grain/fibre yield (t/ha)			Grain/fibre yield (t/ha)		
	2002-03			2003-2004			2004-05		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
T_1	2.97c	1.95c	3.75c	3.01bc	2.08c	2.94b	3.07bc	2.06c	2.91c
T_2	3.40ab	2.30b	4.11ab	3.27ab	2.40b	3.41a	3.35ab	2.38b	3.46ab
T_3	3.78a	2.57a	4.31a	3.58a	2.72a	3.48a	3.62a	2.70a	3.52a
T_4	2.88c	1.92c	3.79bc	2.75cd	1.96cd	3.07b	2.74cd	1.90cd	3.11b
T_5	2.71c	1.69d	3.64c	2.59d	1.78d	2.89b	2.63d	1.72d	2.82b
T_6	1.30d	1.22e	1.57d	1.26e	1.28e	1.39c	1.30e	1.20e	1.41e

Table 19. Contd.

Treat	Straw/Stick yield (Tk/ha)								
	2001-02			2000-2001			1999-2000		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
T_1	3.71c	3.89b	4.59b	3.76b	4.01b	4.51b	3.86b	3.94b	4.60b
T_2	4.38ab	4.61a	5.14a	4.50a	4.74a	5.08a	4.53a	4.59a	5.20a
T_3	4.79a	4.84a	5.31a	4.63a	4.91a	5.48a	4.65a	4.76a	5.32a
T_4	3.66c	3.70bc	4.92ab	3.81b	3.79bc	4.71ab	3.85b	3.72bc	4.94ab
T_5	3.37c	3.54c	4.51b	3.55b	3.59c	4.50b	3.61c	3.56c	4.53b
T_6	1.60d	2.57d	3.23c	1.58c	2.60d	3.06c	1.64c	2.59d	3.25c

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

Table 20. Yield, cost and return analysis of Wheat-Jute-T.Aman cropping pattern as affected by fertilizer levels at Lalmonirhat during 2002-03 to 2004-05 (Avg. of 3 years)

Treat.	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman				
T_1	3.01	2.03	3.32	3.78	3.95	4.57	83853	12589	71264	3.35
T_2	3.34	2.47	3.67	4.47	4.65	5.14	95342	17075	78267	3.14
T_3	3.66	2.67	3.77	4.69	4.84	5.27	102440	17077	85363	3.56
T_4	2.79	1.93	3.32	3.77	3.74	4.86	81450	9437	72013	4.21
T_5	2.64	1.73	3.12	3.51	3.56	4.51	76032	10623	65405	3.23
T_6	1.29	1.23	1.46	1.61	2.59	3.18	41720	0	41720	-

Table 21. Effect of different fertilizer management packages on the soil nutrient balance in Wheat-Jute-T.Aman rice cropping pattern at Lalmonirhat during 2002-03 to 2004-05

Treatment	Nutrient uptake (kg/ha)			Nutrient (Inorg.+Org.) added (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	215	40	275	240	24	131	-131	-16	-144
T_2	245	46	320	342	33	178	-125	-13	-142
T_3	263	49	343	342	33	178	-143	-16	-165
T_4	205	38	263	220	34	70	-128	-4	-193
T_5	190	35	242	196	42	60	-121	7	-182

CP : Wheat-Jute-T.Aman
Location : Palima, Tangail (AEZ 8)
Year : 2002-03 to 2004-05

Average of 3 years data showed that the highest grain yield of wheat was recorded from IPNS (T_3) followed by STB fertilizer dose for HYG (T_2). FRG'97 (T_4) and STB for MYG (T_1) gave almost similar yield. Yield over the years showed that significantly higher yield was obtained with IPNS and STB for HYG in 2002-03 and 2004-05 but in 2003-04 it was significantly higher with IPNS. An appreciable yield increase was observed in IPNS treatment against only inorganic fertilizer for HYG. Similarly, in Jute the highest fibre yield was obtained from T_3 followed by T_2. More or less similar yield was found with T_1 and T_4 which was higher than FP (T_5). Fiber yield was significantly higher with T_3 during 2002-03 and 2004-05 but there was no significant difference was found among the different nutrient management packages in 2003-04. In T.Aman rice More or less similar yield was obtained with T_3 and T_2 which was slightly higher than T_1. Almost similar yield was also found in T4 and FP. The trend was almost same over the years. Initial soil nutrient status showed that the nutrient status of the soil was low and a positive response of crops to higher level of nutrients was evident.

The cost and return analysis of crops grown in Wheat-Jute-T.Aman cropping pattern showed that the highest gross return and gross margin was obtained from treatment T_3 (IPNS) followed by T_2. Fertilization cost was also higher in the same treatments which reduced the MBCR. The highest MBCR (6.44) was obtained from treatment T_4 (FRG '97) due less fertilization cost.

Total NPK uptake in different treatments varied from 197-288, 37-54 and 282-403 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was highest in IPNS treatment (T_3) followed by STB fertilizer dose for HYG (T_2). The partial net balance of N and K were negative in all cases and ranged from -137 to -186 and -178 to -265 kg/ha, respectively. The N and K balance was more negative in FRG'97 (T4) due to less addition of nutrients in the soil. Phosphorus balance was found positive in all the treatments except in FRG'97 and FP. The balance was more negative in FRG'97.

After three years of experimentation, considering yield profit as well as long term soil fertility, IPNS based fertilizer dose for HYG could be suggested for recommendation for the cropping pattern.

Table 22. Yield of crops as influenced by different fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at Palima, Tangail during 2002-03 to 2004-05

Treat	Grain/fibre yield (t/ha) 2002-03			Grain/fibre yield (t/ha) 2003-2004			Grain/fibre yield (t/ha) 2004-05		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
T_1	2.89ab	2.58c	3.51b	1.67c	2.37a	4.64ab	2.71c	3.42b	3.92b
T_2	3.05a	2.89b	3.64b	2.34b	2.60a	4.81ab	3.10b	3.53b	4.08ab
T_3	3.30a	3.19a	4.12a	2.62a	2.90a	4.92a	3.43a	4.17a	4.25a
T_4	2.83b	2.39d	3.55b	1.40b	2.80a	4.17c	3.32a	3.06c	3.67bc
T_5	2.29c	2.25e	3.27c	1.11e	2.68a	4.47bc	1.60d	2.62d	3.38c
T_6	1.31d	1.06f	1.62d	0.63f	1.23b	2.70d	0.77e	1.92e	2.53d

Table 22. Contd.

Treat	Straw/Stick yield (Tk/ha) 2001-02			2000-2001			1999-2000		
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman
T_1	3.77ab	5.45ab	4.01a	3.32c	3.50c	4.83ab	4.15a	5.40c	5.45b
T_2	3.91a	5.59ab	3.91a	4.11b	3.63b	5.13ab	4.98a	5.72b	5.65a
T_3	4.01a	5.91a	3.77ab	4.36a	4.62a	5.67a	5.22a	6.15a	5.82a
T_4	2.91c	5.20b	3.12bc	2.71d	4.46a	4.38b	4.13a	5.12d	5.30bc
T_5	3.12bc	4.65c	2.91c	2.22e	3.95b	4.83ab	2.68b	4.67e	5.13cd
T_6	2.64c	2.67d	2.64c	1.11f	2.03d	3.27c	1.62c	2.78f	4.00d

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

Table 23. Yield, cost and return analysis of Wheat-Jute-T.Aman cropping pattern as affected by fertilizer levels at Palima, Tangail during 2002-03 to 2004-05 (Avg. of 3 years)

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Wheat	Jute	T.Aman	Wheat	Jute	T.Aman				
T_1	2.50	2.95	4.00	3.85	4.94	4.94	81848	11680	70168	3.84
T_2	2.90	3.14	4.15	4.50	5.17	5.09	87861	15660	72201	3.22
T_3	3.20	3.61	4.24	4.70	5.71	5.27	95690	15988	79702	3.65
T_4	2.72	2.83	3.77	3.75	4.98	4.53	78908	6452	72456	6.44
T_5	1.65	2.54	3.63	2.68	4.49	4.50	71160	7001	64159	4.82
T_6	0.87	1.53	2.35	1.75	2.57	3.48	37384	0	37384	-

Table 24. Effect of different fertilizer management packages on the soil nutrient balance in Wheat-Jute-T.Aman rice cropping pattern at Palima, Tangail during 2002-03 to 2004-05

Treatment	Nutrient uptake (kg/ha)			Nutrient added (Inorg.+Org.) (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	242	45	338	243	49	122	-160	4	-216
T_2	262	49	363	340	66	185	-143	17	-178
T_3	288	54	403	340	66	185	-169	12	-218
T_4	240	45	330	155	28	65	-186	-17	-265
T_5	197	37	282	171	36	77	-137	-1	-205

CP : Wheat-T.Aman
Location : Boda, Dinajpur (AEZ 1)
Year : 2002-03 to 2004-05

The average of three years result revealed that the higher grain yield of wheat was recorded from IPNS (T_3) and STB for HYG (T_2). Grain yield did not influenced appreciably due to IPNS over inorganic fertilizer. Almost similar yield was obtained with STB for MYG (T_1) and FRG'97 (T_4) along with Farmers' practice (T_5). T_1, T_4 and STB fertilizer dose for MYG. In T.Aman rice grain yield did not vary markedly among the different fertilizer management packages. However, higher yield was recorded from T_3 and T_2 and similar yield was found in T_1, T_2 and T_5 (FP). Farmers' dose of nitrogen was very close to recommended N for MYG but it was higher for P and lower for K. More or less similar trend was observed in straw yield of wheat and T.Aman rice.

Cost and return analysis results showed that the highest gross return and gross margin was recorded from T_3 followed by T_2. Other fertilizer management packages gave almost similar return. Fertilization cost was higher in T_3 and T_2. Marginal benefit cost ratio (MBCR), however, did not vary appreciably with different packages over control. MBCR was higher in T_1 due to less fertilization cost followed by T_3.

The partial net balance of N was negative in all the cases and ranged from -79 to -93 kg ha^{-1}. The lowest negative balance was obtained in IPNS practice. Similarly, K balance was negative in all treatments and it was ranged from -27 to -71 kg ha^{-1}.The balance was more negative in Farmers' practice due to less application (62 kg/ha) of K. On the other hand, P balance was also found negative in T_1, T_2 and T_3 because of less requirement of P was found based on soil analysis. But the balance was positive in FRG'97 and in FP due to higher application of P.

After three years of experimentation it was evident that integrated nutrient management package is suitable for Wheat-T.Aman cropping pattern considering yield, economics and long term soil fertility management.

Table 25. Effect of different nutrient management packages on the yield and mean yield of crops in Wheat-T.aman cropping pattern at Boda, Dinajpur during 2002-03 to 2004-05

Treatment	2002-03		2003-04		2004-05	
	Wheat	T.Aman	Wheat	T.Aman	Wheat	T.Aman
			Grain yield (t ha^{-1})			
T_1	2.93ab	3.33ab	2.58b	3.22b	2.78b	3.33b
T_2	3.19a	3.47a	2.93ab	3.79a	3.00ab	3.93a
T_3	3.29a	3.39a	3.37a	3.83a	3.33a	4.20a
T_4	2.78b	3.29ab	2.44b	3.19b	2.84b	3.19b
T_5	2.89b	2.99b	2.81b	3.33b	2.64b	3.39b
T_6	1.46c	2.12c	1.39c	2.11c	1.59c	1.59c
			Straw yield (t ha^{-1})			
T_1	3.79ab	4.81b	3.81b	5.19b	3.75b	4.59b
T_2	3.90a	5.25a	4.39a	5.83a	4.33a	5.70a
T_3	4.04a	5.31a	4.69a	6.22a	4.22a	5.77a
T_4	3.88a	4.72b	3.56b	5.44ab	3.83b	4.68b
T_5	3.67b	4.47b	4.19ab	5.55ab	4.00ab	4.72b
T_6	2.28c	3.54c	2.39c	3.62c	2.33c	3.63c

Table 26. Yield and economics of Boro -T.Aman rice cropping pattern as affected by fertilizer levels at Boda, Dinajpur during 2002-03 to 2004-05

Treatment	Grain yield (t/ha)		Straw yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)	MBCR (over control)
	Wheat	T.Aman	Wheat	T.Aman				
T_1	2.76	3.29	3.78	4.86	52720	6067	46653	3.69
T_2	3.04	3.73	4.21	5.59	59060	8411	50649	3.42
T_3	3.33	3.81	4.32	5.77	62165	9071	53094	3.51
T_4	2.69	3.22	4.04	4.95	51775	6667	45108	3.22
T_5	2.78	3.24	3.95	4.91	52590	6996	45594	3.18
T_6	1.48	1.94	2.33	3.59	30320	0	30320	-

* Variable Cost = Fertilizer Cost only

Table 27. Effect of different fertilizer management packages on the soil nutrient balance in Wheat-T.Aman cropping pattern at Boda, Dinajpur during 2002-03 to 2004-05

Treatment	Nutrient uptake (kg/ha)			Nutrient added (inorg. + org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	141	25	134	151	18	90	-88	-7	-44
T_2	157	28	149	210	25	122	-83	-3	-27
T_3	167	30	158	210	25	122	-93	-5	-36
T_4	137	25	130	165	30	90	-79	5	-40
T_5	140	25	133	161	39	62	-84	14	-71

35% of applied fertilizer/manure N was considered effective

CP : Wheat-Mungbean-T.Aman
Location : Jhenaidah (AEZ 11)
Year : 2003-04 to 2004-05

Average of 2 years data showed that grain yield of wheat did not influenced appreciably due to different fertilizer management practices. Higher yield was obtained with T_2 and T_3 which was closely followed by T_1. Effect of higher level of fertilizers on the yield of wheat was not evident. More or less similar yield was recorded from T_1 and T_4 along with farmers' practice. During 2003-04 significantly higher yield was found in T_1, T_2 and T_3 but in 2004-05 no significant yield difference was observed among the different fertilizer packages except with control. In mungbean the highest yield was obtained with T_2 and more or less similar yield was found in T_1, T_3 and T_4. Over the years results showed that significantly higher yield was obtained with T_2. Similarly, In T.Aman rice the highest grain yield was recorded from T_2 followed by FP (T_5). Similar yield was also found in T_1, T_3 and T_4. The yield was significantly higher in T_2 during both the years.

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

Total uptake of NPK in different treatments varied from 294-348, 55-66 and 226-261 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Yield and nutrient uptake was highest in STB for HYG treatment (T_2) followed by IPNS (T_3). The partial net balance of N, P and K were negative in all cases and ranged from -231 to -273, -8 to -23 and -157 to -174 kg/ha, respectively. Initially the P status of the soil medium and less amount of P was added in STB fertilizer doses. But P uptake of Mungbean is much higher, therefore P balance was found negative.

After two years of experimentation, considering yield profit as well as long term soil fertility, STB fertilizer dose for HYG could be suggested for recommendation for the cropping pattern. Crop residues of mungbean could be incorporated in the soil for sustaining soil fertility.

Table 28. Yield of crops as influenced by different fertilizer levels in the cropping pattern Wheat-Mungbean-T.Aman at Jhenaidah during 2003-04 to 2004-05

Treat	Grain/fibre yield (t/ha)			Grain/fibre yield (t/ha)			Grain/fibre yield (t/ha)		
	2003-2004			2004-05			Mean		
	Wheat	M.bean	T.Aman	Wheat	M.bean	T.Aman	Wheat	M.bean	T.Aman
T_1	2.85a	1558b	4.11c	3.03a	1.47c	3.33bc	2.94	1.52	3.72
T_2	2.96a	1705a	4.73a	3.27a	1.69a	3.68a	3.12	1.70	4.21
T_3	3.07a	1582b	4.09c	3.14a	1.57b	3.39b	3.11	1.58	3.74
T_4	2.55b	1555b	4.10c	3.09a	1.53bc	3.19c	2.82	1.55	3.65
T_5	2.52b	1511b	4.47b	2.96a	1.54bc	3.56a	2.74	1.33	4.02
T_6	1.22c	965c	2.33d	1.47b	0.95d	2.67d	1.35	0.96	2.50

Table 28. Contd.

Treat	Straw/Stover yield (t/ha)								
	2003-2004			2004-05			Mean		
	Wheat	M.bean	T.Aman	Wheat	M.bean	T.Aman	Wheat	M.bean	T.Aman
T_1	5.94a	309	5.97abc	5.39a	305	2.75c	5.67	307.0	4.86
T_2	6.08a	321	6.45a	5.64a	315	3.50a	5.86	318.0	5.48
T_3	6.13a	322	5.59c	5.38a	317	3.26ab	5.76	319.5	4.93
T_4	5.36ab	284	5.87bc	5.37a	295	2.98bc	5.37	289.5	4.93
T_5	5.27ab	323	6.17ab	5.22a	310	3.43a	5.25	316.5	5.30
T_6	2.51c	268	4.61d	2.10b	270	2.06d	2.31	269.0	3.84

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

Table 29. Yield, cost and return analysis of Wheat-Mungbean-T.Aman rice cropping pattern at Jhenaidah during 2003-04 to 2004-05 (Avg. of 2 years)

Treat.	GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
T_1	113556	6725	106831	6.76
T_2	125637	9328	116309	6.17
T_3	117058	10902	106156	4.50
T_4	112119	7191	104928	6.13
T_5	115102	8740	106362	5.38
T_6	68065	0	68065	-

Table 30. Effect of different fertilizer management packages on the soil nutrient balance in Wheat-Mungbean-T.Aman rice cropping pattern at Jhenaidah during 2003-04 to 2004-05 (Avg. of 2 years)

Treatment	Nutrient uptake (kg/ha)			Nutrient (Inorg.+Org.) added (kg/ha)			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	315	60	236	153	38	64	-261	-22	-174
T_2	348	66	261	214	52	88	-273	-14	-173
T_3	327	62	245	214	52	88	-252	-10	-157
T_4	313	59	234	180	36	65	-250	-23	-169
T_5	294	55	226	181	47	60	-231	-8	-166

CP : Potato-Jute-T.Aman
Location : Melandah, Jamalpur (AEZ 9)
Year : 2002-03 to 2004-05

Average of three years data revealed that higher grain yield of Potato was obtained from IPNS (T_3) followed by STB fertilizer dose for HYG (T_2). FRG'97 (T_4) gave significantly higher yield over STB fertilizer dose for MYG (T_1). Farmers' practice (T_5) produced lower yield than other fertilizer packages except no fertilizer. Results over the years showed that significantly higher tuber yield was obtained with IPNS treatment. Tuber yield did not vary significantly with T2, T4 and T1. Farmers yield was lower than other fertilizer packages but fertilizer dose was close to the recommended dose. The trend was almost very same over the year. In Jute, the higher yield was recorded from T_2 and T_3. The yield was higher in T4 than T1. Almost similar yield was found in T_1 and T5 (FP). In T.Aman rice the higher yield was obtained with T_2 and T_3. Yield did not vary appreciably among the treatments T1, T4 and T5. More or less similar result was found in all the years. Almost similar trend was observed in straw and stick yield of crops. Mustard oil cake @ 500 kg/ha was applied in Potato in IPNS treatment and a considerable response was found in the yield of Potato.

Cost and return analysis showed that the higher gross return as well as gross margin was obtained from IPNS (T_3) and STB fertilizer dose for HYG (T_2) treatment. Marginal benefit cost ratio was higher with FRG'97 (T_4) due to lower fertilization cost. Gross margin, gross return and MBCR was less in Farmers' practice than other nutrient management packages. Fertilization cost was higher in IPNS due to cost of MOC.

Total uptake of NPK in different fertilizer packages varied from 237-335, 44-62 and 341-490 kg/ha, respectively. Nutrient uptake by crop is associated with biomass production. Therefore, nutrient uptake is higher in ED_2 and IPNS due to higher yield. The apparent nutrient balance of N and K was negative in all the nutrient management packages and ranged from -160 to -226 kg/ha and -162 to -305 kg/ha. The balance was more negative in FRG'97 and FP as the addition of nutrients was comparatively lower. Phosphorus balance was also found negative in all the fertilizer packages except Farmers' practice (T5). The farmers usually apply a higher dose of P particularly in Potato, therefore, the balance was found positive in FP. But P balance was the lowest (-14 kg/ha) in FRG'97 because of comparatively lower dose of P was added. It is also noticed that due to lower dose of fertilizer in FRG'97 the balance was more negative and it will be a great concern in future.

Based on three years of experimentation the STB fertilizer dose for HYG (T_2) as well as IPNS was found superior in respect of yield. Application of organic manure @ 2-5 t/ha as IPNS once in a year could be recommended for sustainable productivity and soil fertility concern.

Table 31. Yield of crops as influenced by different fertilizer packages in Potato-Jute-T.Aman rice cropping pattern at Melandah during 2002-03 to 2004-05

Treat	Tuber /grain/fiber yield (t/ha)								
	2002-03			2003-04			2004-05		
	Potato	Jute	T. Aman	Potato	Jute	T. Aman	Potato	Jute	T.Aman
T_1	30.03	2.45	4.71	30.63	2.83	4.03	30.82	2.43	4.01
T_2	35.59	2.99	5.17	34.95	3.75	5.08	33.89	3.86	5.75
T_3	37.68	2.62	4.85	36.96	3.43	4.73	38.05	3.73	5.29
T_4	34.76	2.88	4.43	33.87	2.72	4.34	32.27	2.92	4.97
T_5	27.63	2.04	4.19	25.36	2.65	4.87	28.69	2.15	3.66
T_6	6.18	1.21	1.13	5.98	1.23	1.01	7.01	1.29	1.32

Table 32. Mean yield, cost and return analysis of Potato-Jute-T.Aman rice cropping pattern as influenced by different fertilizer packages at Melandah during 2002-03 to 2004-05

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR	VC	GM	MBCR
	Potato	Jute	T.Aman	Potato	Jute	T.Aman				
T_1	30.49	2.57	4.25	-	4.42	5.54	225000	11104	213896	14.9
T_2	34.81	3.53	5.33	-	6.21	6.76	269640	13615	256025	15.4
T_3	37.53	3.26	4.96	-	5.61	6.36	276230	16113	260117	13.4
T_4	33.63	2.84	4.58	-	5.19	5.78	247390	11253	236137	16.7
T_5	27.22	2.28	4.24	-	3.99	5.21	204220	12485	191735	11.6
T_6	6.39	1.24	1.15	-	2.50	1.66	59750	0	59750	-

Table 33. Effect of different fertilizer management packages on the apparent soil nutrient balance in Potato-Jute-T.Aman rice cropping pattern at Melandah (avg. of 2002-03 to 2004-05)

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	268	49	386	225	36	140	-189	-13	-246
T_2	335	62	490	320	50	185	-223	-12	-305
T_3	328	61	477	320	50	185	-216	-11	-292
T_4	293	54	424	190	30	100	-226	-24	-193
T_5	237	44	341	220	49	75	-160	5	-162

CP : Potato-Boro-T.Aman
Location : Sherpur, Jamalpur (AEZ 9)
Year : 2004-05

Tuber yield of Potato influenced significantly due to different fertilizer packages. Significantly the highest yield was obtained with IPNS (T_3) based fertilizer dose. Effect of cowdung applied in T_3 was observed on the yield of Potato. The 2nd highest yield was recorded from STB fertilizer dose for HYG (T_2) which was identical with FRG'97 (T_4) and STB fertilizer dose for MYG (T_1). Tuber yield was significantly lower in FP compared with other nutrient management packages. However, the nutrient dose was very close to recommended practices. In Boro rice higher and identical grain yield was recorded from T_2 and T_3. Similar yield was also found in T_1 and T_4 which was significantly higher than FP (T5). Straw yield did not vary significantly among the fertilizer packages except with FP (T5) and no fertilizer (T6) treatment. In T.Aman rice significantly higher grain yield were recorded from STB fertilizer dose for HYG (T_2) and IPNS (T3). Similar yield was obtained with T_1 and T_4 which was significantly higher than Farmers' practice (T_5). Almost similar trend was found in straw yield.

From the cost and return analysis it was found that the highest gross return and gross margin was obtained from T_3 followed by T_2 treatment. Treatment FRG'97 (T_4) also gave satisfactory gross margin. Marginal benefit cost ratio (MBCR) over control was higher in T_4 due to lower fertilization cost. The 2nd highest value was found in STB fertilizer dose for MYG (T1). In spite of additional cost of cowdung applied in IPNS treatment the MBCR was almost same with T2 and FP. Considering yield, economic return as well as soil fertility concern IPNS based fertilizer dose for HYG (T_3) was found superior over other fertilizer packages.

Table 34. Yield, cost and return analysis of Potato-Boro-T.Aman cropping pattern as influenced by different fertilizer packages at Sherpur, Jamalpur during 2004-05

Treat.	Tuber/ /grain yield (t/ha)			Straw yield (t/ha)		GR (Tk/ha)	VC (Tk/ha)	GM (Tk/ha)	MBCR
	Potato	Boro	T.Aman	Boro	T.Aman				
T_1	25.27b	5.39b	4.08b	5.98a	5.19b	207695	13351	194344	10.99
T_2	28.98ab	6.50a	5.54a	6.91a	6.61a	247980	18660	229320	10.02
T_3	32.31a	6.01a	5.32a	6.57a	6.24a	258595	20262	238333	9.75
T_4	26.72b	5.68b	4.25b	6.41a	5.69ab	219090	11777	207313	13.4
T_5	17.92c	4.95c	3.16c	5..30b	3.68c	158970	12068	146902	8.12
T_6	8.17d	1.21d	1.09d	2.05c	1.43d	60990	0	60990	-

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

CP : Potato-T.Aus-T.Aman
Location : Katiadi, Kishoreganj (AEZ 9)
Year : 2002-03 to 2004-05

Tuber yield of potato influenced significantly by different nutrient management packages. Higher and identical tuber yield was recorded from IPNS (T_3) and Farmers' practice (T_5). Generally, farmers' apply higher amount of P and K along with cowdung @ 10 t/ha in potato. A positive effect of organic manure on the yield of potato was observed. However, same amount of nutrients were applied in IPNS and ED_2 but IPNS treatment produced statistically higher tuber yield as compared to soil test based fertilizer dose for high yield goal (ED_2). Higher tuber yield obtained in IPNS might be due to the effect of cowdung. However, the trend was slightly varied over the years. During 2002-03 tuber yield was comparatively lower. In 2003-04 identical yield was found with T_2 and T_3 along with FP (T_5). Average of three years results showed that the highest tuber yield of potato was obtained with FP followed by IPNS (T3). IPNS gave about 24% higher yield over only inorganic fertilizer for HYG but it was about 7% lower than FP. Higher yield obtained in FP due to application of higher dose of fertilizers along with cowdung @ 10 t/ha. Fertilizer dose for MYG both STB and FRG'97 (T_1 and T_4) also produced similar yield. In T.Aus rice the highest grain yield was obtained with T3 followed by T_2. But the trend was varied narrowly over the years. The yield was identical with T_2 in 2002-03 and with FP during 2004-05. Mean yield was almost same in T_1 and T_4 which was slightly lower than FP. In T.Aman rice higher yield was obtained with T_2 and T_3. The trend was more or less same over the years. Similar yield was also found in T_1 and T_4 along with FP. Regarding straw yield more or less similar trend was observed in T.Aus and T.Aman rice.

Average cost and return analysis showed that the higher gross return as well as gross margin was obtained from IPNS (T_3) followed by FP. The next higher return comes from STB for HYG (T2). Fertilization cost was higher in IPNS and FP due to additional cost of cowdung. Marginal benefit cost ratio (MBCR) was also found higher in the same treatments. MBCR was comparatively higher in FRG'97 due to less fertilization cost.

The amount of nutrients uptake by the crops varied widely with the treatments. Nutrient uptake by crop was mainly influenced by biomass production. Nitrogen replenishment through chemical fertilizer and cowdung addition either singly or in combination was not enough to balance N removal by crops since much of the applied N was lost from the soil. The N balance thus, negatively appeared to have been removed in excess of the amounts added in soil. The P balances was found positive in all the cases. A huge amount of P (52 kg/ha/year) was accumulated in the soil in FP due to excess application of P fertilizer in potato. But in case of K, it was evident that this element was removed in large excess of the amount added as fertilizer. This may lead to K depletion in the long run. The K balance was found positive in FP as the farmers apply a higher dose of K fertilizer in Potato.

Based on three years of experimentation and considering overall yield, economic performance as well as soil fertility concern the IPNS practice could be recommended for Potato-T.Aus-T.Aman cropping pattern at Kishoreganj.

Table 35. Yield of crops as influenced by different fertilizer packages in Potato-T.Aus-T.Aman rice cropping pattern at Katiadi during 2002-03 to 2004-05

Treat	Tuber /grain yield (t/ha)								
	2002-03			2003-04			2004-05		
	Potato	T.Aus	T. Aman	Potato	T.Aus	T. Aman	Potato	T.Aus	T.Aman
T_1	9.37c	2.70b	3.18ab	15.51b	2.97c	3.41bc	14.97c	2.34b	3.49a
T_2	11.96b	2.98ab	3.50ab	22.13a	3.19b	3.66a	18.36b	2.50b	4.03a
T_3	16.96a	3.13a	3.66a	25.42a	3.49a	3.73a	22.86a	3.13a	4.27a
T_4	11.78b	2.63b	2.92c	15.90b	2.79c	3.29c	13.14c	2.50b	3.44b
T_5	20.13a	2.60b	2.96c	26.20a	2.82c	3.26c	23.48a	2.88a	3.37b
T_6	3.80d	1.57c	1.47d	6.41c	1.82d	1.75d	4.85d	1.59c	1.91c

Table 36. Mean yield, cost and return analysis of Potato-T.Aus-T.Aman rice cropping pattern as influenced by different fertilizer packages at Katiadi during 2002-03 to 2004-05

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR	VC	GM	MBCR
	Potato	T.Aus	T.Aman	Potato	T.Aus	T.Aman				
T_1	13.28	2.67	3.36	-	3.98	4.30	135080	9259	125821	7.86
T_2	17.48	2.89	3.73	-	4.13	4.50	163315	12559	150755	8.04
T_3	21.75	3.25	3.89	-	4.51	4.69	192770	14122	178648	9.24
T_4	13.61	2.64	3.22	-	3.97	4.20	134660	8786	125874	8.23
T_5	23.27	2.77	3.20	-	3.98	4.12	187654	14916	172738	8.40
T_6	5.02	1.66	1.71	-	2.56	2.76	62320	0	62320	-

Table 37. Effect of different fertilizer management packages on the apparent soil nutrient balance in Potato-T.Aus-T.Aman rice cropping pattern at Katiadi (avg. of 2002-03 to 2004-05)

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	155	27	178	228	39	108	-75	12	-70
T_2	181	31	207	315	50	165	-71	19	-42
T_3	205	36	236	315	50	165	-95	14	-71
T_4	154	27	176	210	31	110	-81	04	-66
T_5	190	33	219	256	85	222	-100	52	03

CP : Potato-T.Aus-T.Aman
Location : Kishoreganj Sadar (AEZ 9)
Year : 2002-03 to 2004-05

Almost similar trend of results was found at Kishoreganj sadar like Katiadi. Higher yield of potato was obtained with IPNS (T_3) and FP (T_5) followed by STB for HYG (T_2). Fertilizer dose from FRG'97 (T_4) and STB for MYG (T_1) gave similar yield. The highest yield of T.Aus and T.Aman rice was recorded from (T_3) closely followed by T_2. However, statistically similar yield of rice was obtained with T_3 and T_2 over the years.

Cost and return analysis was also similar with Katiadi. Higher gross margin and MBCR was obtained from T_3 followed by FP (T_5). The trend of apparent nutrient balance was also similar to Katiadi. Farmers of Kishoreganj sadar apply higher dose of N and lower dose of P and K than Katiadi.

The IPNS practice could be recommended for Potato-T.Aus-T.Aman cropping pattern at Kishoreganj considering yield, economic performance and long term soil fertility management.

Table 38. Yield of crops as influenced by different fertilizer packages in Potato-T.Aus-T.Aman rice cropping pattern at Kishoreganj sadar during 2002-03 to 2004-05

Treat	Tuber /grain yield (t/ha)								
	2002-03			2003-04			2004-05		
	Potato	T.Aus	T. Aman	Potato	T.Aus	T. Aman	Potato	T.Aus	T.Aman
T_1	9.61c	2.63ab	3.15ab	15.79b	2.86c	3.93b	13.56c	2.41b	3.23b
T_2	12.05b	2.86ab	3.55a	21.59a	3.25b	4.08ab	17.33b	2.76a	4.37a
T_3	18.54a	2.92a	3.59a	22.54a	3.54a	4.24a	21.97a	3.21a	4.62a
T_4	11.16b	2.51ab	2.99b	14.11b	2.66c	3.54c	13.14c	2.33b	3.13b
T_5	18.76a	2.46b	2.28c	25.14a	2.26d	3.60c	21.39a	2.44b	3.08b
T_6	4.59d	1.51c	1.49d	5.59c	1.35e	1.62d	5.60d	1.86c	2.09c

Table 39. Mean yield, cost and return analysis of Potato-T.Aus-T.Aman rice cropping pattern as influenced by different fertilizer packages at Kishoreganj sadar during 2002-03 to 2004-05

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR	VC	GM	MBCR
	Potato	T.Aus	T.Aman	Potato	T.Aus	T.Aman				
T_1	12.99	2.63	3.44	-	3.16	3.98	128018	9138	118880	7.38
T_2	16.99	3.02	4.00	-	3.25	4.35	156848	12376	144472	7.78
T_3	21.02	3.22	4.15	-	3.73	4.43	182887	13968	168919	8.76
T_4	12.80	2.50	3.22	-	2.75	3.63	121925	8413	113512	7.29
T_5	21.76	2.39	2.99	-	2.68	3.71	173102	14113	158989	7.97
T_6	5.26	1.57	1.73	-	2.33	2.71	60588	0	60588	-

Table 40. Effect of different fertilizer management packages on the apparent soil nutrient balance in Potato-T.Aus-T.Aman rice cropping pattern at Kishoreganj sadar (avg. of 2002-03 to 2004-05)

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	155	27	177	212	34	117	-81	07	-60
T_2	186	32	213	288	45	160	-85	13	-53
T_3	207	36	238	288	45	160	-106	09	-78
T_4	148	26	169	210	31	110	-75	05	-59
T_5	174	30	201	331	72	132	-58	42	-69

CP : Boro-T.Aus-T.Aman
Location : Chandina, Comilla (AEZ 1 9)
Year : 2002-03 to 2004-05

Grain yield of Boro rice did not influenced appreciably by different nutrient management packages. However, higher yield was obtained with IPNS (T3) but it was very close to other nutrient management packages. The trend of yield over the years varied slightly. During 2004-05 significantly higher yield was recorded from T3 but in 2002-03 and 2003-04 yield was almost similar with other treatments except with control treatment. In T.Aus and T.Aman rice more or less similar trend was observed. Grain yield was higher in T3 but close to other fertilizer packages. Over the years results showed that in T.Aus rice significantly higher yield was obtained with T3 during 2002-03 and 2004-05 but it was identical to T2 and FP in 2003-04. In T.Aman rice no significant difference was observed among the treatments except with control in 2002-03 and 2004-05. However, the crop was damaged due to flood in 2003-04. Usually, farmers' apply higher amount of fertilizers compared with STB recommended dose. Particularly the dose of P was much higher. In spite of higher dose of fertilizers the yield was lower than IPNS (T3) and STB for HYG (T2) .Farmers did not use any S fertilizer in any rice crop and it might be responsible for lower yield.

Average of cost and return analysis showed that the higher gross return as well as gross margin was obtained from IPNS (T_3) followed by STB for HYG (T2). Fertilization cost was higher in FP and IPNS. Marginal benefit cost ratio (MBCR) was found higher in T1 and T4 due to less fertilization cost. The MBCR was also found satisfactory in IPNS practice.

The amount of nutrients uptake by the crops varied with the treatments. Nutrient uptake by crop was mainly influenced by biomass production. Highest Nutrient uptake was found in IPNS practice as the total yield was highest in this treatment. Uptake of NPK varied from 226-252, 37-42 and 247-281 kg/ha, respectively. The partial net balance of N and K were negative in all cases and ranged from -107 to -156 and 63 to -162 kg/ha, respectively. Phosphorus balance was also found negative in all the cases except in FP. Initially the status of P was medium and comparatively less amount of P was added in STB fertilizer doses. But in farmers' practice a very high dose of P was applied and a huge amount of P (72 kg/ha/year) was accumulated in the soil.

Based on three years of experimentation and considering overall yield, economic performance as well as soil fertility concern the IPNS practice could be recommended for Boro-T.Aus-T.Aman cropping pattern at Comilla.

Table 41. Yield of crops as influenced by different fertilizer packages in Boro-T.Aus-T.Aman rice cropping pattern at Chandina, Comilla during 2002-03 to 2004-05

Treat	Grain yield (t/ha)								
	2002-03			2003-04			2004-05		
	Boro	T.Aus	T. Aman	Boro	T.Aus	T. Aman	Boro	T.Aus	T.Aman
T_1	5.96ab	3.02c	3.55a	5.66a	2.97b	Damaged due to flood	6.05c	2.97c	3.38a
T_2	6.35ab	3.49b	3.85a	5.7a	3.42a		6.56b	3.10bc	3.28a
T_3	6.38a	3.88a	3.68a	6.14a	3.63a		7.46a	3.81a	3.52a
T_4	5.89b	3.52b	3.25a	6.0a	3.08b		6.5b	3.17bc	3.14a
T_5	5.92ab	3.69b	3.18a	6.0a	3.24a		6.09c	3.33b	3.26a
T_6	3.08c	1.77d	1.52b	2.78b	1.94c		2.14d	2.00d	1.88b

Table 42. Mean yield, cost and return analysis of Boro-T.Aus-T.Aman rice cropping pattern as influenced by different fertilizer packages at Chandina, Comilla during 2002-03 to 2004-05

Treat	Grain yield (t/ha)			Stover/ straw yield (t/ha)			GR	VC	GM	MBCR
	Boro	T.Aus	T.Aman	Boro	T.Aus	T.Aman				
T_1	5.89	2.98	3.46	6.40	4.47	4.54	106345	7050	99647	7.30
T_2	6.20	3.34	3.56	6.82	5.01	5.48	113455	9476	104456	6.19
T_3	6.66	3.77	3.60	7.66	5.28	5.94	121680	10256	111895	6.52
T_4	6.13	3.26	3.19	6.70	4.30	5.16	108720	7553	101352	7.14
T_5	5.90	3.42	3.22	6.36	4.50	5.38	108440	15825	92806	3.39
T_6	2.67	1.90	1.70	4.05	2.77	2.50	54820	0	54820	-

Table 43. Effect of different fertilizer management packages on the apparent soil nutrient balance in Boro-T.Aus-T.Aman rice cropping pattern at Chandina, Comilla (avg. of 2002-03 to 2004-05)

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	222	37	247	197	23	114	-153	-14	-133
T_2	236	39	262	273	30	153	-140	-9	-109
T_3	252	42	281	273	30	153	-156	-12	-128
T_4	226	38	252	225	34	90	-147	-4	-162
T_5	226	38	251	340	110	188	-107	72	-63

CP : Maize-T.Aman
Location : Goyeshpur, Pabna (AEZ 11)
Year : 2002-03 to 2004-05

Average of three years data revealed that grain yield of Maize influenced substantially with different fertilizer packages. The highest yield was obtained with RF (T_4) where the nutrient dose was higher than other packages. The 2nd highest yield was found in STB for HYG (T_2) followed by IPNS (T_3). Farmers' practice also gave similar yield with T_2. IPNS practice failed to show yield advantage over inorganic fertilizers. The nutrient level was higher in RF than STB for HYG. Higher yield obtained with RF probably due to higher dose of fertilizers. Yield over the years showed that significantly higher yield was recorded from T_4 followed by T_2 during 2003-04 and 2004-05 but in 2002-03 identical yield was found with T_2 and T_4. Maize is an exhaustive crop and responded positively to higher doses of fertilizers. In T.Aman rice the highest grain yield was recorded from T_3 followed by T_2. More or less similar yield was obtained with T_1 and T_4 along with FP (T_5). Grain yield was found higher with IPNS may be due to residual effect of poultry manure applied in Maize. However, yield did not vary significantly among the different nutrient management packages during 2002-03 but in

2003-04 and 2004-05 significantly higher yield was found in T_3 followed by T_2. More or less similar trend was observed in case of stover and straw yield of Maize and T.Aman rice, respectively.

Cost and return analysis showed that the highest gross return as well as gross margin was obtained from T_4 closely followed by T_2 and T_3. Fertilization cost was higher in T_2, T_3 and T_4 due to higher dose of fertilizers. Marginal benefit cost ratio did not vary markedly in different packages. However, the highest value (3.39) was found in T_2 due to less fertilization cost in compared with T_3 and T_4.

Total uptake of NPK in different fertilizer packages varied from 201-233, 36-41 and 187-214 kg/ha, respectively. The apparent nutrient balance of N and K was found negative in all the nutrient management packages and ranged from -120 to -134 kg/ha and -80 to -109, respectively. But P balance was found positive in all the fertilizer packages and ranged from 15 to 33 kg/ha.

Based on two years of experimentation recommended fertilizer dose (BARI) for Maize and STB fertilizer dose for HYG for T.Aman rice was found superior in respect of yield and profit. Application of poultry manure @ 3 t/ha once in a year could be recommended for sustainable productivity as well as soil fertility concern.

Table 44. Yield of crops as influenced by different fertilizer packages in Maize-T.Aman rice cropping pattern at Goyeshpur, Pabna during 2002-03 to 2004-05

Treat	Grain yield (t/ha)							
	2002-03		2003-04		2004-05		Mean	
	Maize	T.Aman	Maize	T.Aman	Maize	T.Aman	Maize	T.Aman
T_1	6.91ab	3.09a	6.67c	4.02b	6.54c	4.11ab	6.71	3.74
T_2	7.82a	3.30a	7.55ab	5.22ab	7.30b	4.15ab	7.56	4.22
T_3	7.08ab	3.74a	7.73ab	5.63a	6.82bc	4.53a	7.21	4.63
T_4	8.59a	3.14a	7.82a	5.11ab	7.97a	3.49ab	8.13	3.91
T_5	7.72a	3.64a	7.50b	4.87b	6.94bc	3.46ab	7.39	3.99
T_6	4.54b	2.40b	3.67d	2.50c	3.32d	2.40b	3.84	2.43

Table 44. Contd.

Treat	Straw yield (t/ha)							
	2002-03		2003-04		2004-05		Mean	
	Maize	T.Aman	Maize	T.Aman	Maize	T.Aman	Maize	T.Aman
T_1	7.24ab	4.00a	7.16d	5.35b	6.07d	5.86a	6.82	5.07
T_2	8.00ab	4.10a	8.13b	5.56b	8.29b	6.03a	8.14	5.23
T_3	7.58ab	4.39a	8.80a	6.64a	8.63b	6.08a	8.34	5.70
T_4	8.63a	4.18a	9.05a	5.53b	9.26a	6.16a	8.98	5.29
T_5	7.17ab	4.28a	7.73c	5.40b	7.50c	6.22a	7.47	5.30
T_6	4.86b	3.15b	4.62e	3.22c	4.75e	3.83b	4.87	3.40

Table 45. Cost and return of Maize-T.Aman rice cropping pattern influenced by different nutrient management packages at Goyeshpur, Pabna during 2002-03 to 2004-05

Treat	GR	VC	GM	MBCR
T_1	94778	9814	84964	3.32
T_2	104973	12615	92358	3.39
T_3	104892	13766	91126	3.10
T_4	106522	13513	93009	3.28
T_5	99127	11260	87867	3.28
T_6	62157	0	62157	-

* 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.

Table 46. Effect of different fertilizer management packages on the apparent soil nutrient balance in Maize-T.Aman rice cropping pattern at Goyeshpur, Pabna during 2002-03 to 2004-05

Treat.	Nutrient uptake (kg/ha)			Nutrient added (inorg.+ org.) kg/ha			Apparent nutrient balance (kg/ha)		
	N	P	K	N	P	K	N	P	K
T_1	201	36	187	200	57	78	-131	21	-109
T_2	227	40	210	265	73	101	-134	33	-109
T_3	227	40	210	265	73	101	-134	33	-109
T_4	233	41	214	323	58	134	-120	17	-80
T_5	220	39	203	248	54	123	-133	15	-80

CP : Chilli-T.Aman
Location : Hathazari, Chittagong (AEZ 23)
Year : 2002-03 & 2004-05

Average of three years result revealed that fruit yield of chilli influenced appreciably among the treatments. Higher yield of chilli was recorded from IPNS (T_3) and STB for HYG (T_2). Farmers' practice (T_5) also gave higher yield over STB for MYG (T_1) and FRG'97 (T_4). Similar yield was obtained with (T_1) and (T_4). More or less similar trend was found over the years. Significantly higher and identical yield was obtained with T_2 and T_3 in three years. Similarly, in T.Aman rice higher yield was recorded from the same treatments T_2 and T_3. The trend was same over the years. Almost similar yield was found in T_1 and T_4 which was slightly higher than farmers' practice (T_5). No appreciable yield advantage was found in IPNS over inorganic fertilizers (T_2).

Cost and return analysis results showed that the highest gross return and gross margin was recorded from T_2 and T_3. Fertilization cost was higher in T_2, T_3 and in FP (T_5). Farmers' usually apply a very higher dose of P along with cowdung (6.5 t/ha), therefore the cost of fertilization was higher. Marginal benefit cost ratio (MBCR) was also higher in T_2 and T_3.

After the years of experimentation it was evident that STB fertilizer dose for HYG or IPNS could be recommended for Chilli-T.Aman rice cropping pattern at Chittagong region for higher yield, economic return as well as soil fertility concern.

Table 47. Effect of different nutrient management packages on the yield and mean yield of crops in Chilli-T.aman rice cropping pattern at Hathazari, Chittagong during 2002-03 to 2004-05

Treatment	2002-03		2003-04		2004-05	
	Chilli	T.Aman	Chilli	T.Aman	Chilli	T.Aman
	Grain yield (t ha^{-1}) & Fruit yield (kg/ha)					
T_1	880b	4.39bc	981bc	4.03b	1000b	4.91b
T_2	1176a	5.13a	1360a	4.68a	1335a	5.15ab
T_3	1055a	5.05ab	1308a	4.86a	1427a	5.31a
T_4	788b	4.14c	866c	3.97b	1173ab	5.09ab
T_5	895b	3.89c	1055b	3.72b	1304ab	5.05b
T_6	455c	2.81d	529d	2.71c	690c	3.30c

Table 48. Cost and return analysis of Chilli -T.aman rice cropping pattern as influenced by different fertilizer doses at Hathazari, Chittagong during 2002-03 to 2004-05

Treatment	Average yield		Gross return	Variable	Gross margin	MBCR
	Chilli (kg/ha)	T.Aman (t/ha)	(Tk/ha)	cost (Tk/ha)	(Tk/ha)	(over control)
T_1	954	4.44	130887	13733	117154	3.04
T_2	1290	4.99	168927	15994	152933	5.12
T_3	1263	5.07	166920	15955	150965	4.97
T_4	942	4.40	129433	7975	121458	4.64
T_5	1084	4.22	142227	15607	126620	3.22
T_6	558	2.94	79320	0	79320	-

* Variable Cost = Fertilizer Cost only

CP : Wheat-Mungbean-T.Aman
Location : Natore (AEZ 11)
Year : 2004-05

Grain yield of wheat, mungbean and T.aman were influenced significantly due to different fertilizer packages. The highest grain yield of wheat was obtained with STB for HYG (T_2) which was statistically identical to that record in IPNS (T_3). The yield improvement of wheat with estimated mineral fertilizer dose and integrated nutrient management for high yield goal were 18 and 14% compared to farmers' practice (T_5), respectively. Treatment FRG'97 (T_4) produced moderately higher grain yield of wheat which was identical with STB for MYG (T_1) and farmers' practice (T_5). Highest straw yield was recorded in ED_2 (T_2) which is closely followed by T_1, T_3, T_4 and T_5. Grain yield of mungbean also showed significant variations across the nutrient management packages. The highest grain yield of mungbean was obtained from STB for HYG (T_2) which was significantly different from those of all other treatments. Plants grown without fertilizer had the lowest grain yield of mungbean (T_6) and it was statically identical with farmers' practice (T_5). The highest grain yield of T.aman was recorded with IPNS (T_3) which was statistically identical to that recoded in $T_{2,}$ T_3 and $T_{5.}$ Higher straw yield was also obtained from IPNS.

Cost and return analysis results showed that the higher gross return, gross margin and fertilizer cost were recorded from T_2 and T_3. Among the treatments, higher MBCR was recorded from FRG'97 (T_4) and farmers' practice (T_5) due to lower fertilizer cost.

Table 35. Yield, cost and return analysis of Wheat-Mungbean-T.Aman cropping pattern as influenced by different fertilizer packages at Natore during 2004-05

Treat.	Grain yield (t/ha)			Straw yield (t/ha)		GR	VC	GM	MBCR
	Wheat	Mungbean	T.Aman	Wheat	T.Aman	(Tk/ha)	(Tk/ha)	(Tk/ha)	
T_1	3.17b	0.70b	3.66b	3.85a	4.82d	91565	7754	83811	5.31
T_2	3.69a	0.89a	4.46a	4.39a	5.92ab	110325	10060	100265	5.96
T_3	3.58ab	0.68b	4.50ab	4.08a	6.49a	104490	9645	94845	5.61
T_4	3.23b	0.73b	4.05ab	3.84a	5.64bc	96970	7222	89748	6.45
T_5	3.14b	0.59bc	4.38a	3.97a	5.21cd	94665	7224	87441	6.13
T_6	1.43c	0.54c	1.92c	2.04b	3.37e	50410	-	50410	

Output (Tk/kg): Wheat grain= 12.00, wheat straw = 0.50, Mungbean=25.00, T.Aman rice = 8.00, Rice straw = 1.00,
Inputs (Tk/kg):Urea= 6, TSP= 13, MP= 13, Gypsum= 4, Cowdung (Tk/ha)= 100

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			
Phulpur (9)	MHL	I	5.22	1.17	0.08 (VL)	0.15 (M)	15.3 (M)	11.6 (L)	1.30 (M)	0.20 (L)
Netrokona (9)	MHL	I	5.08	1.38	0.09 (L)	0.15 (M)	4.68 (VL)	14.1 (L)	1.08 (M)	0.31 (M)
Hathazari (23)	MHL	I	5.23	1.90	0.11	0.29	9.83	6.67	-	0.09
Narikeli (9)	MHL	I	5.6	2.0	0.12 (L)	0.12 (M)	10.0 (L)	10.0 (L)	0.6 (M)	0.20 (L)
Melandah (9)	MHL	I	5.0	2.0	0.12 (L)	0.12 (M)	10.0 (L)	10.0 (L)	0.6 (M)	0.20 (L)
Sherpur (9)	MHL	I	5.6	1.40	0.07 (VL)	0.09 (VL)	5.96 (VL)	6.64 (L)	0.39 (VL)	0.20 (VH)
Palima (9)	MHL	I	5.3	2.08	0.10 (L)	0.12 (L)	5.0 (VL)	51.0 (H)	2.42(H)	-
Kishoreganj	MHL	I	-	-	0.09 (L)	0.31 (M)	4.11 (VL)	21.9 (M)	1.27 (M)	-
Katiadi (9)	MHL	I	6.8	1.41	0.09 (L)	0.15 (L)	6.23 (VL)	8.85 (L)	-	-
Syedpur (3)	MHL	I	5.4	2.41	0.14 (L)	0.17 (M)	9.1 (L)	33.9 (Opt)	1.3 (Opt)	0.24 (L)
Lakmonirhat (3)	MHL	I	5.4	-	0.07 (VL)	0.09 (VL)	16.6 (M)	5.32 (VL)	0.39 (VL)	0.37 (M)
Jhenaidah (11)	MHL	I	-	-	0.11 (L)	0.18 (L)	7.04 (VL)	26.1 (O)	0.69 (L)	-
Goyeshpur (11)	MHL	I	7.7	2.06	0.12 (L)	0.23 (M)	6.5 (VL)	5.36 (M)	0.45 (M)	0.33 (O)
Ishan Gopalpur (12)	MHL	I	7.5	-	0.18 (M)	0.42 (VH)	9.03 (L)	18.0 (M)	-	-
Chandina (19)	MHL	I	5.6	-	0.13 (L)	0.15 (L)	13.0 (M)	12.4 (L)	1.7 (O)	-
Natore	MHL	I	8.26		0.10 (L)	0.20 (M)	8.43 (L)	26.71 (O)	0.61 (L)	-

Appendix Table 2. Crop management practices

Site	Cropping pattern	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Phulpur	Mustard	BARI Sharisa 9	10	3^{rd} week of Nov	1^{st} week of Feb
	Boro	BRRI dhan 28	40	2^{nd} week of Feb	4^{th} week of May
	T.Aman	BRRI dhan 32	40	Last week of July	2^{nd} week of Nov
Netrokona	Mustard	BARI Sharisa 9	10	3^{rd} week of Nov	1^{st} week of Feb
	Boro	BRRI dhan 29	40	2^{nd} week of Feb	4^{th} week of May
	T.Aman	BRRI dhan 32	40	1^{st} week of Aug	2^{nd} week of Nov
Palima	Wheat	Kanchan	120	1^{st} week of Dec.	3^{rd} week of March
	Jute	O-9897	08	2^{nd} week of April	3^{rd} week of July
	T.Aman	BR 25	50	2^{nd} week of Aug	3^{rd} week of Nov
Ishan Gopalpur	Wheat	Protiva	120	1^{st} week of Dec.	1^{st} week of April
	Jute	O-9897	08	3^{rd} week of April	Last week of July
	T.Aman	BRRI dhan 32	50	2^{nd} week of Aug	Last week of Nov
Lalmonirhat	Wheat	Protiva	120	1^{st} week of Dec.	Last week of Mar.
	Jute	O-9897	08	2^{nd} week of April	3^{rd} week of July
	T.Aman	BR 11	50	Last week of July	3^{rd} week of Nov
Jhenaidah	Wheat	Shatabdi	120	Last week of Nov	3^{rd} week of March
	Mungbean	BARI Mung 5	40	1^{st} week of April	3^{rd} week of June
	T.Aman	BRRI dhan 39	50	Last week of July	Last week of Oct.
Katiadi	Potato	Diamont	1500	4^{th} week of Nov.	1^{st} week of March
	Aus	BR 26	40	2^{nd} week of May	1^{st} week of Aug.
	T.Aman	BRRI dhan 32	40	2^{nd} week of Aug.	3^{rd} week of Nov.
Kishoreganj	Potato	Diamont	1500	4^{th} week of Nov.	1^{st} week of March
	Aus	BR 26	40	2^{nd} week of May	1^{st} week of Aug.
	T.Aman	BRRI dhan 32	40	2^{nd} week of Aug.	3^{rd} week of Nov.
Sherpur	Potato	Diamont	1500	1^{st} week of Dec.	2^{nd} week of Feb.
	Boro	BRRI dhan 28	40	3^{rd} week of Feb.	2^{nd} week of May
	T.Aman	BRRI dhan 33	40	3^{rd} week of July	3^{rd} week of Nov.
Melandah	Potato	Cardinal	1500	Last week of Nov.	Last week of Feb.
	Jute	O-9897	08	4^{th} week of March	3^{rd} week of July
	T.Aman	BRRI dhan 33	40	Last week of July	Last week of Oct.
Chandina	Boro	BRRI dhan 29	40	3rd week of Jan.	1^{st} week of May
	T.Aus	BR 20	40	3^{rd} week of May	3^{rd} week of Aug.
	T.Aman	BR 11	40	4^{th} week of Aug.	4^{th} week of Nov.
Manikganj	Mustard	Tori-7	8	3^{rd} week of Nov	Last week of Jan.
	Boro	BRRI dhan 29	40	2^{nd} week of Feb.	Last week of May
Boda	Wheat	Shatabdi	120	1^{st} week of Dec	Last week of Mar.
	T.Aman	BR 11	40	Mid. July	2^{nd} week of Nov.
Hathazari	Chilli	Hathazari Local	600g	1^{st} week of Dec	Last week of Mar.
	T.Aman	BRRI dhan 30	40	Mid. July	2^{nd} week of Nov.
Natore	Wheat	Shatabdi	120	Last week of Nov	3^{rd} week of March
	Mungbean	BARI Mung 5	40	1^{st} week of April	3^{rd} week of June
	T.Aman	BR 11	50	Last week of July	Last week of Oct.

Recommendation

Based on 2-3 years study and considering yield, economic benefit as well as soil fertility concern the following fertilizer doses could be recommended for different cropping patterns at different locations for sustainable productivity.

Location	AEZ	Nutrient dose for the cropping pattern (N-P-K-S-Zn-B kg/ha)		
		Crop		
		Mustard	**Boro**	**T.Aman**
Phulpur	9	100-25-50-20-0-1	125-20-60-15-2-0	85-12-50-10-1-0
Netrokona	9	80-25-40-25-0-1 + OM @ 3-5 t/ha	140-25-60-15-2-0	90-15-50-10-1-0
Nandigram	25	85-25-55-20-0-1	120-20-80-10-1-0	80-15-60-5-1-0
		Wheat	**Jute**	**T.Aman**
Ishan Gopalpur	12	100-30-40-5-0-1	85-12-40-0-0-0	80-10-30-10-2-0
Lalmonirhat	3	105-15-50-10-0-1 + CD 3-5 t/ha	100-9-50-5-0-0	100-8-30-10-2-0
Palima	8	105-20-50-10-0-1 + CD 3-5 t/ha	100-12-50-5-0-0	95-12-40-15-2-0
		Potato	**Jute**	**T.Aman**
Melandah, Jamalpur	9	120-25-90-10-0-0 + OM 3-5 t/ha	90-10-50-5-0-0	90-10-35-10-2-0
		Potato	**T.Aus**	**T.Aman**
Kishoreganj	9	115-25-85-10-0-0 + OM 3-5 t/ha	85-8-30-10-0-0	85-8-30-10-0-0
Katiadi	9	120-30-90-10-0-0 + OM 3-5 t/ha	90-9-30-10-2-0	90-9-30-10-2-0
		Potato	**Boro**	**T.Aman**
Rangpur	3	120-30-120-10-0-0	130-10-70-10-2-0	90-8-40-10-1-0
Sherpur	9	130-30-105-10-0-0	130-15-55-10-2-0	90-10-40-10-1-0
		Wheat	**Mungbean**	**T.Aman**
Jhenaidah	11	110-30-50-5-0-0	25-10-20-0-0	85-9-25-10-2-0 + CR 2-3 t/ha
		Boro	**T.Aus**	**T.Aman**
Chandina, Comilla	19	105-15-55-10-2-0 + OM 3-5 t/ha	80-8-40-10-1-0	80-8-40-10-1-0
		Wheat	**T.Aman**	
Boda, Panchagar	1	105-15-60-10-0-1 + CD 3-5 t/ha	90-8-40-20-2-0	
		Mustard	**Boro**	
Manikganj	8	85-25-20-30-0-1 + CD 3-5 t/ha	130-20-40-10-2-0	
Mymensingh	9	100-25-40-30-0-1 + CD 3-5 t/ha	130-20-40-10-2-0	
		Chilli	**T.Aman**	
Chittagong	23	130-20-130-10-0-0	95-8-40-15-2-0	

OM = Organic manure, CD = Cowdung, RS= Rice straw

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

Abstract

The experiment was conducted at Modhupur, expanded area of Goyeshpur FSRD site and Dashuria MLT site, Pabna during 2003-04 to determine a suitable ratio of inorganic and organic fertilizer for improvement of soil fertility and productivity. The cropping pattern Maize-Mungbean-T.Aman and Cauliflower-Stem amaranth-Jute were tested at Modhupur are Dashuria, Pabna, respectively. Four different ratios of organic and inorganic fertilizers were verified along with full dose of inorganic fertilizers (T_1) and no fertilizer (T_6) in the study. Different combinations were 75% inorganic + 25% PM (T_2), 50% inorganic + 50% PM (T_3), 25% inorganic+ 75% PM (T_4) and 100% PM (T_5). From the first year result, it was found that higher grain yield of maize was obtained from 75% inorganic fertilizer with 25% PM (T_2) which was identical to 50% inorganic fertilizer with 50% PM (T_3) and 100% inorganic fertilizer (T_1). But in T.Aman rice yield did not vary significantly among the treatments except with control. Similarly, in Cauliflower higher yield was obtained with T_2 and T_3 but it also similar with other treatments except control. The highest yield in stem amaranth was found with T_3 but it was also identical to T_2 and T_4. In Jute, higher and identical yield was obtained with T_3 and T_5. Regarding cost and return, higher gross margin was calculated from T_1 and T_2 in Maize-T.Aman cropping pattern. But the highest gross margin was found with T_3 in Cauliflower-Stem amaranth-Jute cropping pattern. However, MBCR was higher in only inorganic fertilizers due to less fertilization cost involvement.

Introduction

The farmers at FSRD site, Goyeshpur and in the Pabna district as a whole are recently producing more high value crops including vegetables, papaya, banana and hybrid maize. Among those, hybrid maize and cauliflower are introduced to large areas by FSRD team and Maize-Mungbean-T.Aman and Cauliflower-Stem amaranth-Jute cropping patterns are widely practiced by the farmers. Nutrient demand of hybrid maize and cauliflower is very high. The farmers' are using a very high dose of inorganic fertilizers to meet the demand. Continuous use of inorganic fertilizers at a high rate makes sense of a threat on soil complexities where no or very little amount of organic recycling is under practice. On the other hand, the FSRD team introduced small scale poultry litter in the district where a huge amount of droppings are being produced, which have seldom use in crop fields. At ARS Pabna, poultry based compost used at active stage of composting produced better/equal rice and stem amaranths yield against 100% inorganic fertilizer. Further more, poultry droppings has become an environment polluting agent in spite its high value as organic material. Therefore, there has developed a concern on using PM for sustaining soil fertility and crop productivity. Keeping this view in mind the experiment was designed to find out the best combination of organic and inorganic fertilizers through integrated nutrient management for the high value crop based cropping pattern for improving soil fertility and productivity.

Objective: To find out suitable ratio of inorganic and organic fertilizer for long-term use as cropping pattern basis

Materials and Methods

The experiment was conducted at Madhupur, expanded area of Goyeshpur FSRD site and Dashuria MLT site, Pabna during 2003-04 in Gopalpur soil series under High Ganges River Flood Plain Soil (AEZ-11). Before starting the experiment soil samples were collected from farmers' field and analyzed in the laboratory. The soil analytical results indicated that soil was slightly alkaline, percent of organic matter and total N which calculated from organic carbon were very low. Status of P was very low, S was medium, K & Zn were low (Appendix-1). The experiment was laid out in randomized complete block (RCB) design with six replications (dispersed) and unit plot size was 6m

× 5m. Five different organic and inorganic fertilizer doses were tested against Maize-Mungbean-T.Aman and Cauliflower-Stem amaranth-Jute cropping patterns. The treatments were; T_1= 100% inorganic fertilizer, T_2=75% inorganic + 25% PM, T_3= 50% inorganic + 50% PM, T_4= 25% inorganic+ 75% PM, T_5= 100% PM & T_6= Control. Nutrient rate fot the two cropping patterns are shown below-

CP: Maize (hybrid)-Mungbean-T.Aman

Treatment	NUTRIENT RATE (kg/ha)													
	Rabi (Hybrid Maize)							Kharif (T.Aman)						
	N	P	K	S	Zn	B	PM	N	P	K	S	Z	B	PM
T_1	200	66	88	21	3	0.74	-	92	15	30	5	-	-	-
T_2	150	50	66	16	2.25	0.56	3750	69	12	22	4	-	-	1750
T_3	100	33	44	11	1.5	0.37	7500	46	8	15	3	-	-	3500
T_4	50	17	22	5	0.75	0.19	11250	23	4	8	2	-	-	5250
T_5	-	-	-	-	-	-	15000	-	-	-	-	-	-	7000
T_6	-	-	-	-	-	-	-	-	-	-	-	-	-	-

CP: Cauliflower-Stem amaranth-Jute

Treatment	NUTRIENT RATE (kg/ha)																				
	Rabi (Cauliflower)							Kharif (Stem amaranth)							Kharif-11(Jute)						
	N	P	K	S	Zn	B	PM	N	P	K	S	Zn	B	PM	N	P	K	S	Z	B	PM
T_1	173	30	42	30	3	1	-	156	15	53	3	-	-	-	124	6	14	11	-	-	-
T_2	130	23	32	22	2.25	.75	3.25	117	12	40	2.25			3	93	5	10	8			2.25
T_3	87	15	21	15	1.25	.50	6.5	78	8	27	1.5			6	62	3	7	5			4.5
T_4	44	8	11	8	.75	.25	9.75	39	4	13	.75			9	31	2	4	3			6.75
T_5	-	-	-	-	-	-	13	-	-	-	-			12	-	-	-	-			9
T_6	0	0	0	0	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0			0

PM (Poultry manure) in t/ha

Poultry manure (Active compost) was the organic source which was made by fresh poultry dropping 50%, chopped crop residues 50%, with Urea 1%, TSP 0.5%, Gypsum 1% of total organic manure and effective microorganism (EM) solution as needed. Poultry manure (PM) contains 1.32% N (Appendix-2) which was the base for calculation of required PM for different treatments. Here, N percent of PM was considered only because N has no residual effect and other nutrient is present in sufficient amount in the PM. Fertilizer application and crop management practices are given in appendix table 4 & 5. Different intercultural operations such as weeding, irrigation and plant protection measures were taken as and when required. Due to delaying in maize harvest, mungbean could not grow. At maturity different data were collected accordingly and subjected to statistical analysis.

Results and Discussion

CP: Maize-Mungbean-T.Aman

2003-04

Maize: Yield and yield contributing characters of maize were affected significantly due to different treatments (Table 1) higher grain yield was obtained from T_2 treatment and it might be due to the cumulative effect of higher 100 grain weight and second highest no. of grains cob^{-1} and it also statistically similar with T_1 and T_3 treatments. Higher stover yield also obtained from T_2 treatment which was statistically identical with T_3 and T_4 treatments. Significantly lowest yield and yield attributes were obtained from control (T_6) treatment. During the grain filling season there was a scarcity of irrigation and rain water and it might be the main cause of lower yield of maize in 100% PM (T_5) treatment.

T.Aman: Yield and yield contributing characters of T.Aman differed significantly among the treatments (Table 2). Higher plant height was obtained from T_4 treatment, which was statistically identical with T_2, T_3 and T_5 treatment. Higher grain and straw yield was obtained from T_3 treatment and it is the cumulative effect of higher value of other yield attributes. Grain yield of T_3 treatment is also statistically at par with other treatments except control. Yield and yield attributes were lowest in control treatment.

2004-05

Maize: Yield and yield contributing characters of maize were affected significantly due to different treatments (Table 1). The highest grain yield was obtained from T_2 treatment might be the resultant effect of maximum grains per cob and 100 grain weight. The second highest grain yield was recorded in T_1 which was statistically identical to T_3 and T_4 treatment. The similar response was observed in the case of stover yield. The lowest yield and yield attributes were obtained from control (T_6) treatment.

T.aman: Yield and yield contributing characters of T.aman differed significantly due to different treatments (Table-2). The highest grain yield was obtained from 50% chemical + 50% PM statistically followed by 100% chemical. The maximum weight of 1000-grain and other yield contributing characters might be contributed to higher grain yield. The residual effect of PM might have positive effect on the balanced uptake of nutrients in T.aman rice which ultimately resulted higher yield. Similar response was found in straw yield. The lowest performance in yield and yield attributes were observed in control treatment.

Mean yield of two years data showed that the highest grain yield of maize was obtained with 75% inorganic fertilizer with 25% PM (T_2) followed by 100% inorganic fertilizer (T_1). Comparable yield also obtained from 50% inorganic with 50% PM (T_3). But in T.Aman rice the highest yield was recorded from T_3 closely followed by T_1. However, yield of crops did not vary appreciably due to different nutrient management packages.

Cost and return analysis: Mean of two years **c**ost and returns analysis showed that the highest gross return as well as gross margin was obtained with T_2 where 75% inorganic fertilizer was applied along with 25% PM. Fertilization cost was increased with the increase of PM ratio. The highest cost was found with 100% PM applied treatment. And the lowest was obtained with 100% inorganic fertilizer treatment. Marginal benefit cost ratio (MBCR) over control was calculated from T1 due to less fertilization cost. Treatment T_2 also gave satisfactory MBCR.

Recommendation

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

Crop	Nutrient dose (kg/ha)						PM
	N	P	K	S	Zn	B	(t/ha)
Maize (Hybrid)	150	50	66	16	2.25	0.56	3.75
T.Aman	70	12	22	4	-	-	1.75

CP: Cauliflower-Stem amaranth-Jute

2003-04

Cauliflower: Yield and yield attributes of cauliflower were insignificant among the treatments except control (Table 4). However, higher curd yield, and other yield attributes was found in 50% ch.+ 50% PM treatment which was also statistically identical with other treatments except control. Yield and other attributes were found lowest in control treatment. Here, all treatments except control gave very close results and it might be due to almost same nutrient (mainly N) treatment. But little higher yield was obtained from 50% ch. + 50% PM treatment and it might be due to slow and long time releasing of nutrient from PM and early stage of crop can get required nutrient from chemical source easily.

Stem amaranth: Yield and yield attributes of stem amaranth were affected significantly among the treatments (Table 5). Higher yield was obtained from 50% ch.+50% PM treatment and it might be the cumulative effect of highest number. of plant population, longest plant height and succeeding effect of pervious PM. Base circle was highest in 100% chemical treatment. Yield and yield contributing characters were found lowest in control treatment.

Jute: Yield and yield parameters were significantly differ among the treatments (Table 6). Higher Fiber yield was obtained from 50% chemical + 50% PM treatment which is the cumulative effect of higher plant population, longer size of plant and might be succeeding effect of previous used PM increased the soil health and JO condition. On the other hand, jute seed size is small which can germinate easily on that soil and it tends to higher plant population. All parameters were found lowest in control treatment.

2004-05

Cauliflower: Yield and yield contributing characters as affected by different treatments were statistically identical except control (Table-1). However, numerically slightly higher curd yield was attained in 50% Ch.+ 50% PM which was statistically identical with other treatments except control. The cumulative positive effect of yield attributes might be resulted in increased curd yield of cauliflower. The lowest performance of yield and yield attributes was observed in control. It revealed that all treatments except control exerted very close results in view of yield and yield attributes and it might be due to retain almost same nutrient level (mainly N) in each treatment. But little higher yield was obtained from 50% ch. + 50% PM combination might be due to slow and long term releasing of nutrient from PM and early stage of crop can get required nutrient from chemical source easily i.e. balanced uptake of nutrients from both the sources.

Stem amaranth: The result showed significant variation among yield and yield attributes of stem amaranth due to different treatments (Table 2). The highest yield was obtained from 50% Ch. + 50% PM which was statistically similar to other treatments except control. The cumulative effect of highest number of plant population, longest plant height and maximum base circle might be resulted the highest yield. The balanced uptake of nutrients from 50% Ch. + 50% PM accelerated optimum plant growth which ultimately produced increased yield. The lowest performance of yield and yield contributing characters were found in control.

Jute: Different treatments exerted significant variation among yield and yield attributes of jute (Table 3). The highest fiber and stalk yield was recorded in 50% Ch. + 50% PM which was followed by other treatments except control. The cumulative effect of higher plant population and longer size of plant might be contributed to higher yield in jute. The lowest fiber and stalk yield was observed in control. The succeeding effect of previous used PM increased the soil health and water holding capacity (maintain zoe condition). On the other hand, jute seed size is small which can germinate easily on that soil and it tends to higher plant population which showed positive effect on yield. The lowest yield and inferior performance of yield attributes were achieved in control treatment.

Mean yield of two years data showed that the curd yield of cauliflower did not vary markedly among the treatments except with control treatment. However, the highest yield was found with T_3 closely followed by T_2. Application of 25% and 50% PM along with inorganic fertilizer produce higher yield in compared to only inorganic fertilizers. Similarly, higher yield of stem amaranth and jute was also obtained with the same treatments. Effect of poultry manure on the yield of crops was evident.

Cost and return analysis: Mean of two years **c**ost and return analysis showed that the highest gross return as well as gross margin was obtained with T_3 where 50% inorganic fertilizer was applied along with 50% PM. The 2^{nd} highest value was obtained from T_2 (75% inorganic fertilizer + 25% PM) Fertilization cost was increased with the increase of PM ratio. The highest cost was found with 100% PM applied treatment. And the lowest was obtained with 100% inorganic fertilizer treatment. The highest marginal benefit cost ratio (MBCR) over control was calculated from T_1 due to less fertilization cost. Treatment T_2 also gave satisfactory MBCR.

Recommendation

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

Crop	Nutrient dose (kg/ha)						PM (t/ha)
	N	P	K	S	Zn	B	
Cauliflower	130	23	32	22	2.25	0.75	3.25
Stem amaranth	117	12	40	-	-	-	3.0
Jute	93	5	10	8	-	-	2.25

Cost and return analysis: From cost and return analysis (Table 7), it was found that highest MBCR was obtained from 100% ch. treatment and lowest from 100% PM treatment and it is mainly due to higher amount and value of PM of 100% PM treatment. But the highest gross return and gross margin was obtained from 50% chemical. + 50% PM treatment.

Farmer's reaction:

Farmer's of that location opined that both organic and inorganic fertilizer application is very good for their crop and soil but they need to have proper and available source of PM and water.

Conclusion

From the average of two years result it was found that higher maize yield was obtained from 75% inorganic fertilizer with 25% PM (T_2) which was followed by 100% inorganic fertilizer (T_1). But in T.Aman rice the highest yield was obtained with 50% PM + 50% inorganic fertilizers (T_3) followed by 100% inorganic fertilizer (T_1). Similarly, in Cauliflower higher yield was obtained with T_2 and T_3 but it also similar with other treatments except control. The highest yield in stem amaranth was found with T_3 closely followed by T_2. In Jute, higher yield was obtained with T_3. However yield did not vary markedly among the nutrient management packages. Regarding cost and return, higher gross return as well as gross margin was calculated from T_2 in Maize-T.Aman cropping pattern. But the highest gross return and gross margin was found with T_3 in Cauliflower-Stem amaranth-Jute cropping pattern. The cost of fertilization increased with the increase of PM ratio and it is higher than the cost of only inorganic fertilizers. Therefore, MBCR was higher in 100% inorganic fertilizers followed by 75% inorganic + 25% PM (T_2). From the study, a good response to organic manure was noticed in all the crops tested.

Table 1. Yield and yield contributing characters of Maize under Maize-Mungbean-T.Aman cropping pattern as affected by different treatments at expanded Modhupur during 2003-04

Treatment	Days to maturity	Plant height (cm)	Ear height (cm)	Grains cob^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{1})	Stover yield (t ha^{-1}))
T_1	151a	187.08b	95.67a	379.03a	296.00a	7.10a	7.27b
T_2	149b	193.07ab	100.08a	376.27ab	299.17a	7.31a	9.02a
T_3	149b	195.45a	99.90a	348.77ab	295.50a	7.14a	8.23ab
T_4	149b	191.33ab	99.95a	321.43ab	289.00b	6.64b	7.71ab
T_5	149b	179.30c	85.43b	309.83b	259.33c	5.99c	6.89b
T_6	147c	142.77d	59.10c	228.43c	257.50d	3.76d	3.89c
CV (%)	0.14	3.53	4.15	15.91	1.77	4.41	17.80
LSD (0.05)	0.25	7.62	4.44	61.93	5.99	0.34	1.55

Table 2. Yield and yield contributing characters of T.Aman under Maize-Mungbean- T.Aman cropping pattern as affected by different treatments at Modhupur during 2003-04

Treatment	Days to maturity	Plant pop. m^{-2} (no.)	Plant height (cm)	Panicle hill^{-1} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	1000-Grain wt.(g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1	105.67a	27.99a	97.42b	8.63ab	23.33ab	129.50a	25.67a	5.44a	6.44c
T_2	106.00a	32.11a	99.47ab	8.65ab	22.87ab	123.50a	25.42a	5.49a	6.11d
T_3	105.67a	30.22a	98.95ab	8.87a	23.58a	137.50a	25.75a	5.68a	7.17a
T_4	105.17a	30.83a	100.15a	8.27ab	22.57b	122.17a	25.42a	5.66a	6.79b
T_5	105.67a	28.83a	98.02ab	9.03a	22.77ab	132.33a	25.00ab	5.46a	6.61bc
T_6	102.50b	29.17a	87.57c	7.17b	21.12c	100.17b	24.08b	2.94b	2.22e
CV (%)	0.61	12.59	1.84	14.58	3.11	9.68	3.46	4.00	3.25
LSD (0.05)	0.77	NS	2.12	1.46	0.84	14.30	1.04	0.25	0.24

Table 3. Yield and yield contributing characters of Maize under Maize-Mungbean-T.aman cropping pattern as affected by different treatments at expanded FSRD site, Madhupur during 2004-05

Treatment	Plant height (cm)	No. of cobs/m^2	Grains/cob (no.)	100-grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1= 100% ch.	161.9ab	5.48ab	441.5ab	30.77ab	7.53b	8.76b
T_2 = 75%ch.+25%PM	164.9a	5.52a	478.0a	33.23a	8.35a	9.92a
T_3=50%ch.+50% PM	155.2b	5.57a	445.7ab	31.50ab	7.21b	8.61b
T_4=25%ch.+75%PM	161.7ab	5.40bc	421.2bc	30.80ab	7.07b	8.61b
T_5= 100% PM	145.1c	5.38c	400.3c	30.17bc	6.13c	8.15b
T_6= Control	131.7d	5.38c	264.2d	27.77c	4.28d	5.53c
CV (%)	4.49	1.40	7.95	7.03	8.35	9.57
LSD (0.05)	8.193	0.092	57.64	2.567	0.671	0.940

Table 4. Yield and yield contributing characters of T.aman under Maize-Mungbean-T.aman cropping pattern as affected by different treatments at expanded FSRD site, Madhupur during 2004-05

Treatment	Plant height (cm)	No. of tiller/hill	No. of unfilled grains/panicle	No. of filled grains/panicle	1000-grain wt.(g)	Grain yield (t/ha)	Straw yield (t/ha)
T_1= 100% ch.	97.65ab	8.20a	28.82ab	92.47ab	25.25ab	4.64ab	6.01ab
T_2 = 75%ch.+25%PM	99.08a	8.13a	26.47b	99.62a	25.45ab	4.21bc	5.43bc
T_3=50%ch,+50% PM	95.63b	8.02a	28.52ab	95.40a	25.66a	4.78a	6.45a
T_4=25%ch.+75%PM	96.07ab	7.90a	29.95a	96.38a	24.85bc	4.14c	4.91c
T_5= 100% PM	95.30b	7.82a	28.17ab	81.85bc	25.55a	4.22bc	5.28c
T_6= Control	89.98c	6.87b	28.40ab	79.10c	24.27c	3.19d	4.00d
CV(%)	2.77	10.04	8.34	11.07	2.11	8.39	9.90
LSD	3.155	0.934	2.816	11.95	0.633	0.418	0.629

Table 5. Mean yield and cost and return analysis of Maize- T.Aman cropping pattern as influenced by different treatments at Madhupur during 2003-04 to 2004-05

Treatments	Mean yield (t/ha)		Gross return (Tk ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	MBCR (over control)
	Maize	T.Aman				
T_1	7.31	5.04	114265	14336	99929	4.28
T_2	7.83	4.85	116932	16740	100192	3.81
T_3	7.17	5.23	115530	19574	95956	3.15
T_4	6.85	4.90	114185	22466	91719	2.44
T_5	6.06	4.84	102115	25300	76815	1.87
T_6	4.02	3.06	52550	-	52550	-

Input price (Tk./kg): Urea = 6.25, TSP = 14, MP = 14, Gypsum= 3, ZnO = 40, Borax= 40 & Cowdung = 1
Output price (Tk./kg: Maize = 7.5, T.Aman rice = 10 & Stover/Straw = 0.50

Table 6. Effect of different doses of organic and inorganic fertilizers on yield and yield contributing characters of Cauliflower under Cauliflower-Stem Amaranth- Jute cropping pattern during 2003-04

Treatments	50% curd initiation (days)	Days to harvest (days)	Plant height (cm)	Whole plant wt. (kg)	Marketable weight (kg)	Curd length (cm)	Curd breath (cm)	Curd yield (t ha^{-1})
T_1	50	72.67	76.77a	2.57a	1.53a	11.71a	19.32a	47.25a
T_2	51.83	73	75.15a	2.39abc	1.50a	11.56a	19.36a	49.53a
T_3	50.17	73.67	76.57a	2.50ab	1.89a	11.77a	19.42a	49.64a
T_4	52.17	72.66	74.03a	2.32bc	1.44a	11.74a	19.24a	47.38a
T_5	52.83	73	73.23a	2.26c	1.41a	11.61a	18.62a	46.90a
T_6	54.17	73	53.01b	2.17d	0.83b	8.31b	13.35b	27.46b
CV (%)	-	-	4.3	8.1	9.3	5.1	5.0	11.5
LSD (0.05)	-	-	-	-	-	-	-	6.09

Table 7. Effect of different doses of organic and inorganic fertilizers on yield and yield contributing characters of Stem amaranth under Cauliflower-Stem Amaranth-Jute cropping pattern during 2003-04

Treatment	Days to harvest	No. of plant pop. ($5m^{-2}$)	Plant height (cm)	Base Circle (cm)	Wt. of 10 plants (kg)	Yield (t ha^{-1})
T_1	45	137.50c	79.60ab	6.85a	1.5b	27.96b
T_2	45	129.50d	79.75ab	6.40a	1.61ab	30.25ab
T_3	45	166.00a	83.45a	6.47a	1.73a	31.41a
T_4	45	138.50c	79.55ab	6.23a	1.53b	28.71ab
T_5	45	158.00b	75.85b	6.29a	1.42b	27.36b
T_6	45	159.00b	52.35c	4.70b	0.79c	14.64c
CV (%)	-	1.4	3.3	10.1	6.9	5.6
LSD (0.05)	-	3.80	4.52	1.15	0.18	2.74

Table 8. Effect of different doses of organic and inorganic fertilizers on yield and yield contributing characters of Jute under Cauliflower-Stem amaranth-Jute cropping pattern during 2003-04

Treatment	Plant population (no.$5m^{-2}$)	Plant height (cm)	Fibre yield (t ha^{-1})	Stalk yield (t ha^{-1})
T_1	34.33d	2.40a	2.45ab	4.00c
T_2	40.67bc	2.50a	2.58ab	4.67b
T_3	48.78a	2.60a	2.90a	5.50ab
T_4	42.00bc	2.47a	2.48ab	4.79abc
T_5	45.00ab	2.32a	2.85a	5.80a
T_6	38.89cd	2.01b	2.35b	3.00d
CV (%)	6.8	6.0	9.0	11.7
LSD (0.05)	5.14	0.26	0.43	0.99

Table 9. Effect of different doses of organic and inorganic fertilizers on yield and yield contributing characters of Cauliflower under Cauliflower-Stem Amaranth- Jute cropping pattern during 2004-05

Treatments	Plant height (cm)	Leaf/plant (no.)	Whole plant wt. (kg)	Marketable weight (kg)	Curd length (cm)	Curd breath (cm)	Curd yield (t ha^{-1})
T_1 = 100% Ch	61.00a	21.3ab	1.80a	1.20a	10.60a	15.70a	50.81a
T_2 = 75%ch.+25%PM	62.10a	22.1a	1.70a	1.20a	10.80a	15.50a	52.30a
T_3 =50%ch,+50% PM	61.60a	22.5a	1.90a	1.22a	11.50a	16.60a	52.99a
T_4 =25%ch.+75%PM	58.20a	21.8a	1.80a	1.21a	10.90a	15.80a	51.41a
T_5 = 100% PM	58.40a	21.9a	1.90a	1.20a	11.10a	16.50a	52.36a
T_6 = Control	45.40b	19.9b	1.30b	0.80b	8.90b	13.20b	29.39b
CV (%)	5.25	4.9	14	9.99	5.9	6.19	11.04
LSD (0.05)	4.575	1.594	0.363	0.172	0.946	1.45	8.080

Table 10. Effect of different doses of organic and inorganic fertilizers on yield and yield contributing characters of Stem amaranth under Cauliflower-Stem Amaranth-Jute cropping pattern during 2004-05

Treatment	Days to harvest	Plants/5m^2	Plant height (cm)	Base circle (cm)	Wt. of 10 plants (kg)	Yield (t ha^{-1})
T_1 = 100% Ch	45	55ab	74.00a	6.40a	1.55b	49.00a
T_2 = 75% Ch.+ 25%PM	45	53ab	74.00a	6.60a	1.64ab	49.00a
T_3 = 50% Ch.+ 50% PM	45	67ab	76.00a	7.00a	1.75a	50.00a
T_4 = 25% Ch.+ 75%PM	45	57ab	74.00a	6.60a	1.50b	47.00a
T_5 = 100% PM	45	68a	73.00a	6.50a	1.44b	47.00a
T_6 = Control	45	52b	49.00b	4.60b	0.83c	22.00b
CV (%)	-	15.93	9.63	12.98	5.95	15.70
LSD	-	14.02	10.14	1.227	0.191	10.40

Table 11. Effect of different doses of organic and inorganic fertilizers on yield and yield contributing characters of Jute under Cauliflower-Stem Amaranth-Jute cropping pattern during 2004-05

Treatment	Plant population (no.5m^{-2})	Plant height (cm)	Fiber yield (t ha^{-1})	Stalk yield (t ha^{-1})
T_1 = 100% Ch	43.25ab	3.67ab	3.98b	7.45b
T_2 = 75% Ch.+ 25%PM	43.17ab	3.50ab	4.13ab	8.30ab
T_3 = 50% Ch.+ 50% PM	43.33ab	3.62ab	4.68a	9.15a
T_4 = 25% Ch.+ 75%PM	42.50ab	3.57ab	4.18ab	8.30ab
T_5 = 100% PM	46.67a	3.70a	4.28ab	9.05a
T_6 = Control	38.58b	3.41b	2.92c	6.04c
CV (%)	9.78	5.34	9.82	10.06
LSD (0.05)	5.14	0.26	0.43	0.99

Table 12. Mean yield and cost and return analysis of Cauliflower-Stem amaranth-Jute cropping pattern influenced by different treatment at Dashuria, Pabna during 2003-04 to 2004-05

Treatments	Mean yield (t/ha)			Gross return (Tk ha^{-1})	Variable cost (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	MBCR (over control)
	Cauliflower	Stem amaranth	Jute				
T_1	49.0	38.5	3.21	431410	15476	414933	11.90
T_2	50.9	39.6	3.35	447083	22051	425032	9.05
T_3	51.3	40.7	3.79	459492	29984	429505	6.97
T_4	49.4	37.8	3.33	433774	37946	395828	4.79
T_5	49.6	37.2	3.56	437865	45900	391965	4.04
T_6	28.4	18.3	2.63	250961	-	250961	-

Input price (Tk./kg): Urea = 6.25, TSP = 14, MP = 14, Gypsum= 3, ZnO = 40, Borax= 40 & Cowdung = 1
Output price (Tk./kg): Cauliflower = 5, Stem amaranth = 2.5, Fibre = 15 & Stick = 0.60

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

Name of farmer	pH	OC (%)	Total N (%)	Available (PPM)				K(me/100g soil)
				P	S	Zn	B	
Md. Abdul Wahab	7.5	0.60	0.0864	2.63	14.53	1.00	-	0.12
Md. Amzad Hossain	7.5	0.56	0.081	2.75	18.25	0.64	-	0.13
Md. Mostafa Kamal	7.3	0.60	0.0864	2.63	17.91	0.90	-	0.16
Mean of Nutrient status	7.43	0.59	0.085	2.67	16.90	0.85	-	0.14
Interpretation		Slightly alkaline	VL	VL	M	L		L

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

Replication	pH	OM (%)	Total N (%)	Available (PPM)			K (meq/100g soil)
				P	S	Zn	
R-I	7.4	0.92	0.051	26.73	3.63	0.55	0.48
R-II	7.6	0.99	0.048	24.57	5.45	0.26	0.28
R-III	7.6	0.71	0.046	9.99	3.63	0.35	0.34
R-IV	7.7	0.64	0.032	9.72	7.27	0.31	0.51
R-V	7.7	0.64	0.032	9.72	11.82	0.67	0.31
R-VI	7.7	0.42	0.030	20.52	12.27	0.60	0.30
Mean of Nutrient status	7.6	0.72	0.042	16.88	7.35	0.46	0.37
Interpretation	slight alkaline		VL	M	VL	L	H

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

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

Appendix 4. Crop management practices

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

Appendix 5**.** Fertilization method

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

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

Abstract

The experiment was conducted at Multilocation Testing (MLT) site, Sujanagar, Pabna during 2004-05 to determine the productivity and profitability of the newly proposed fertilizer recommendation for wider adaptation and to create awareness among the farmers and extension personnel about the new technology. Six different nutrient packages were employed for the study. From the first year result, it was revealed that the highest grain yield of wheat and T. aman were obtained from IPNS based fertilizer along with brown manuring treatment (T_4). Cost and return analysis of different nutrient management packages over whole cropping pattern showed that the highest benefit cost (BCR) was obtained from high yield goal fertilizer with brown manuring (T_2) treatment.

Introduction

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

Objectives:

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

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

Materials and Methods

The experiment was conducted at MLT site, Sujanagar, Pabna during the year 2004-05 under High Ganges River Flood plain Soil (AEZ 11). After selection of the cooperator farmers a composite soil sample was collected and analysed. The experiment was laid out in randomized complete block (RCB) design with six replications and unit plot size was 8m × 5m. Fertilizer doses were calculated for wheat and T. aman using soil test value on the basis of high yield goal (HYG). Fertilizer doses for farmers practice was formulated by interviewing 20 different farmers of the site area. Wheat seed was sown on December 12, 2004. Weedicide was applied 24 days after sowing for controlling weeds. Single irrigation was provided at crown root initiation stage. The crop was harvested on March 24, 2005. After harvesting of wheat mungbean seed (BARI Mung-5) was sown on March 27, 2005 without any fertilizer as per specification of the treatment. Mungbean was harvested on May 25-30, 2005. At the beginning of the experiment each plot of the treatment was divided into two subplots. But in wheat and mungbean the two subplots were imposed with same treatment. Before transplanting of T.aman one subplot was incorporated with mungbean biomass after harvest of grain other one subplot was not incorporated with mungbean of each main plot. For IPNS treatment 5 ton cowdung ha^{-1} was applied and it was rationalized with chemical fertilizer. The seedling of T.aman was transplanted on 1st week of August, 2005. Fertilizer application and other intercultural operation were done as and when required. The crop was harvested on November 10, 2005. Data on different parameters were collected and analysed statistically.

Results and Discussion

Wheat: Yield and yield contributing characters of wheat were influenced significantly due to different treatments (Table 1). The highest grain yield was obtained from IPNS coupled with mungbean stover incorporation (T_4 treatment) which was statistically identical with all other treatments except farmers practice. The lowest grain yield was attained in farmers fertilizer package without mungbean inclusion (T_5) which was identical to same fertilizer package with mungbean incorporation. The cumulative effect of grains spike^{-1} and 1000 grain weight might have significant contribution to increased yield in T_4 treatment. Imbalanced fertilizer and improper management might be resulted in lower yield in farmer's fertilizer package.

Table 1. Yield and yield contributing characters of wheat affected by different nutrient packages under Wheat- Mungbean-T.aman cropping pattern at MLT site Sujanagar, Pabna during 2004-05

Treatment	Plant height (cm)	Tiller hill^{-1} (no.)	Length of spike (cm)	Grains spike^{-1} (no.)	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1 (HYG)	90.55a	3.30ab	9.64a	40.37a	39.17a	3.40a	3.62a
T_2 (HYG+BM)	90.15a	3.43a	9.36a	38.5a	37.83a	3.33a	3.50ab
T_3 (IPNS)	89.22a	3.28ab	9.71a	37.88a	38.50a	3.15a	3.35ab
T_4 (IPNS+BM)	89.43a	3.27abc	9.63a	38.47a	37.92a	3.45a	3.60a
T_5 (FP)	86.50b	3.13bc	9.48a	37.93a	37.67a	2.03b	3.47ab
T_6 (FP+BM)	85.78b	3.05c	9.43a	37.15a	37.75a	2.20b	3.23b
LSD (0.05)	2.703	0.2127	0.707	4.116	1.494	0.3871	0.2961
CV (%)	2.57	5.51	5.85	9.02	3.29	9.97	7.18

Mungbean: Yield and yield contributing characters of mungbean were effected significantly due to different treatments (Table 2). The highest grain yield was obtained from T_2 treatment which was statistically similar with the same fertilizer package (T_1). The lowest grain yield was observed in T_5 treatment which was identical to T_3, T_4 and T_6 treatment. The residual effect of high yield goal fertilizer and brown manuring applied for the preceding crop might be attributed to higher grain yield in T_2 treatment. The imbalance fertilization in the preceding wheat crop under farmer's fertilizer package and no addition of brown manuring might causes lower grain yield of mungbean. The highest mungbean biomass was attained in T_4 which was similar with T_1 and T_2 treatment.

Table 2. Yield and yield contributing characters of mungbean affected by different nutrient packages under Wheat-Mungbean-T.aman cropping pattern at MLT site Sujanagar, Pabna during the year 2004-05

Treatments	Plant /m^2 (no.)	Plant height (cm)	Pods/plant (no.)	Seed pod^{-1} (no.)	Grain yield (kg ha^{-1})	Straw yield (t ha^{-1})
T_1 HYG	25.4ab	58.5a	17.6a	9.5a	904a	8.0ab
T_2 HYG	26.0a	58.7a	17.5a	9.9a	920a	8.0ab
T_3 IPNS	25.2ab	61.4a	14.9b	8.8b	874b	7.9b
T_4 IPNS	25.6ab	61.6a	15.6b	8.8b	874b	8.6ab
T_5 FP	24.9b	60.7a	15.0b	8.5b	848c	8.3
T_6 FP	24.8b	60.6	14.8b	8.6b	856bc	7.8b
LSD (0.05)	3.23	4.46	8.74	4.40	2.11	3.14
CV (%)	0.975	3.20	1.65	0.47	22.06	0.300

T.Aman: Significant variation was observed among the treatments (Table 3). The highest grain yield was obtained from IPNS based fertilizer along with the residual effect of brown manuring. Integrated nutrient management from both organic and inorganic sources along with residual effect of brown manuring may lead to proper growth of rice plant and succeeding effect on yield. The cumulative effect of tiller hill^{-1}, grains panicle^{-1} and 1000 grain yield might be contributed to increased grain yield of T.aman crop. The lowest grain yield was recorded in farmer's fertilizer package.

Table 3. Yield and yield contributing characters of T.aman affected by different nutrient packages under Wheat-Mungbean-T.aman cropping pattern at MLT site, Sujanagar, Pabna during the year 2004-05

Treatment	Plant height (cm)	Tiller hill^{-1} (no.)	Plants m^{-2} (no.)	Panicle length (cm)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
T_1 HYG	96.8b	11.1bc	272.8a	20.2b	117.8a	23.57b	4.10c	7.6c
T_2 HYG+BM	95.5bc	10.9c	256.1b	19.5c	105.9b	23.13b	3.90d	7.1d
T_3 IPNS	100.a	12.0ab	278.3a	21.4a	123.2a	25.18a	4.35b	8.2b
T_4 IPNS+BM	99.7a	12.2a	274.2a	21.8a	122.4a	24.70a	4.60a	8.6a
T_5 FP	94.2cd	9.5d	259.5b	19.2c	104.3b	23.18b	3.88d	7.1d
T_6 FP+BM	93.4d	9.3d	274.0b	19.1c	101.5b	22.90b	3.77d	7.0d
LSD (0.05)	1.85	7.19	4.19	2.18	4.01	3.91	3.65	4.37
CV (%)	2.127	0.9355	13.17	0.5251	5.357	1.10	0.1768	0.3962

Cost and return analysis: Cost and return analysis of different nutrient management packages over whole cropping pattern showed that the highest benefit ratio (BCR) was obtained from high yield goal fertilizer with brown manuring (T_2) treatment and the second highest BCR was attained in IPNS based fertilizer with brown manuring (T_4) treatment (Table 4). The lowest BCR was recorded in farmer fertilizer package (T_5) treatment.

Table 4. Cost and return of Wheat-Mungbean-T.aman cropping pattern as affected by different nutrient packages at MLT site, Sujanagar, Pabna during the year 2004-05

Treatment	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1 HYG+N	114585	50689	63896	2.26
T_2 HYG+Y	121285	49789	71496	2.44
T_3 IPNS+N	121640	54606	67034	2.23
T_4 IPNS+Y	128195	53706	74489	2.39
T_5 FP-N	102701	48322	54379	2.13
T_6 FP+Y	103630	47422	56208	2.19

Farmer's reaction

Farmer's of that location opined that different nutrient management packages are very good for their crop and soil fertility. Growing of mungbean is benefited them through cash income and soil improvement for increased crop production.

Conclusion

From the first year experiment it was revealed that the highest grain yield of wheat and T.aman were obtained from IPNS based fertilizer along with brown manuring treatment (T_4) and it is mainly due to available source of nutrient. If water source could be available during the whole cropping season then higher ratio of nutrient would be available due to rapid decomposition of incorporated mungbean plant and more yields will be obtained. Incorporated mungbean plants have considerable positive residual effect on soil. So, if we are continued mungbean cultivation year after year, soil would be healthier and that will lead to more yield. This is first year's result, so it should be continued further for a concrete decision.

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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 different locations with dominant cropping patterns during 1999-2000 to 2004-05 to find out an optimum fertilizer dose for the crops grown in different cropping pattern. Different crops grown in 12 cropping patterns at 18 locations were tested during 2004-05. 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 added nitrogen was evident irrespective of locations and crops. Even in some locations the response was linear. A considerable response to phosphorus was also observed particularly in rabi crops at most of the locations where phosphorus deficiency was found. But response to potassium and sulphur was not clear in some of the locations. From the mean yield data a response curve was drawn and the relationship was quadratic in nature. From the response curve the fertilizer dose for different crops grown in different cropping patterns at different locations that maximized yield and profit 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 was conducted during 1999-2000 to 2004-05 at different locations through out the country to determine optimum and economic dose of fertilizer nutrients for major crops grown in different cropping patterns. A total of 12 dominant cropping patterns were tested at 18 locations during 2004-05. 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

Cropping pattern	Locations
Mustard - Boro - T.Aman	Narikeli, Gabtali
Wheat-Jute-T.Aman	Lalmonirhat
Potato-Jute-T.Aman	Melandah, Paba
Potato-T.Aus-T.Aman	Kishoreganj
Potato-Boro-T.Aman	Syedpur, Joypurhat
Potato-Mungbean-T.Aman	Bagherpara
Lentil-Jute-T.Aman	Maghura, Keshobpur, Rajbari
Wheat-Jute-Mungbean	Gangni
Boro-T.Aus-T.Aman	Chandina
Mustard-Boro	Manikganj
Chilli-T.Aman	Hathazari
Chickpea-T.Aman	Chabbishnagar, Nachole

Intercultural operations such as irrigation, weeding and pest control were done properly. From the yield data a response curve was drawn and the relation ship was quadratic in nature in most cases. From the response curve fertilizer dose that maximized yield and profit were find out. Optimum rate for maximum yield was determined from the regression equation of yield by using the following formula:

Rate opt. = - b/2c,

where, b and c= regression coefficients

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

Rate Eco. = ½c (Pf ÷Py – b)

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

Results and Discussion

Cropping pattern : Mustard -Boro - T.Aman
Location : Gabtali, Bogra (AEZ 4)
Year : 2003-04 to 2004-05

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

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

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

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

Crop	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Mustard	98	25	60	-	90	20	55	-
Boro	140	22	60	-	130	15	50	-
T.Aman	86	20	50	-	80	12	40	-

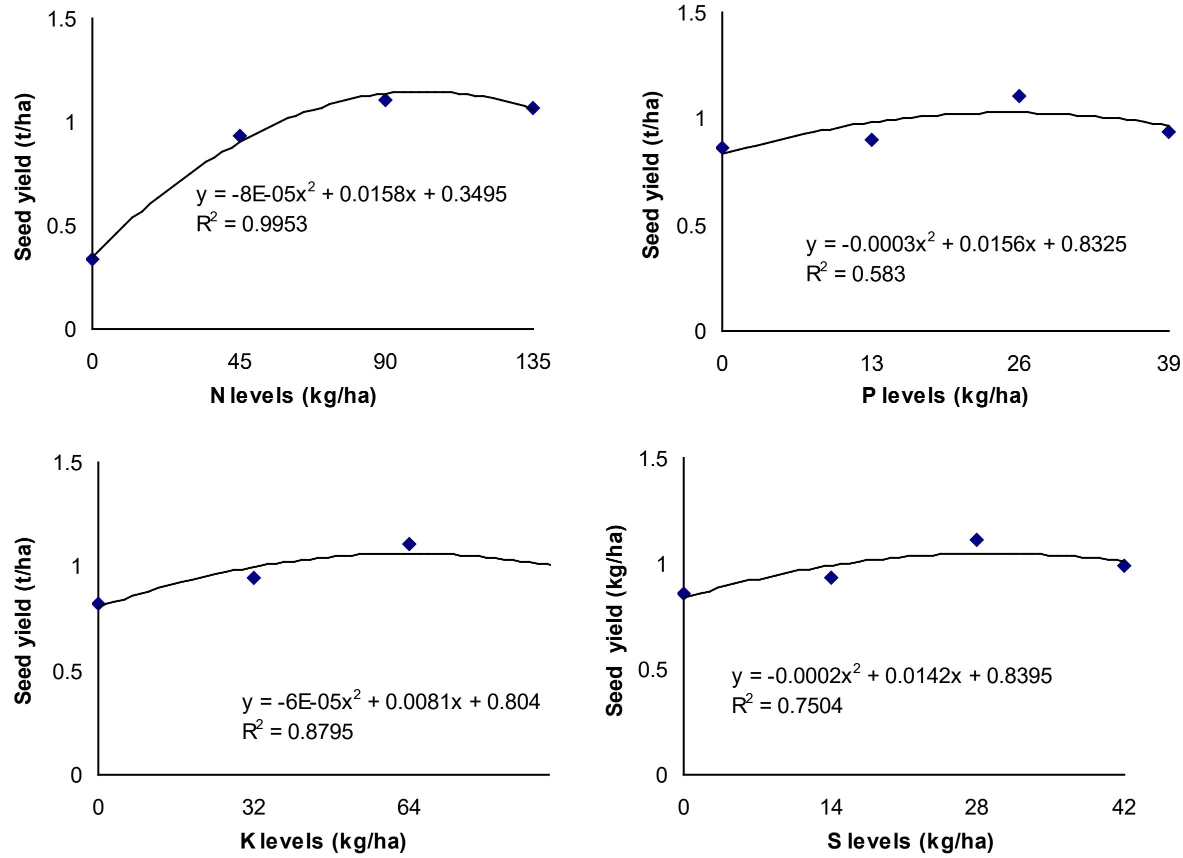


Figure 1. Response of Mustard to added N, P, K & S in Mustard-Boro-T.Aman cropping pattern at Gabtali, Bogra during 2002-03 to 2003-04.

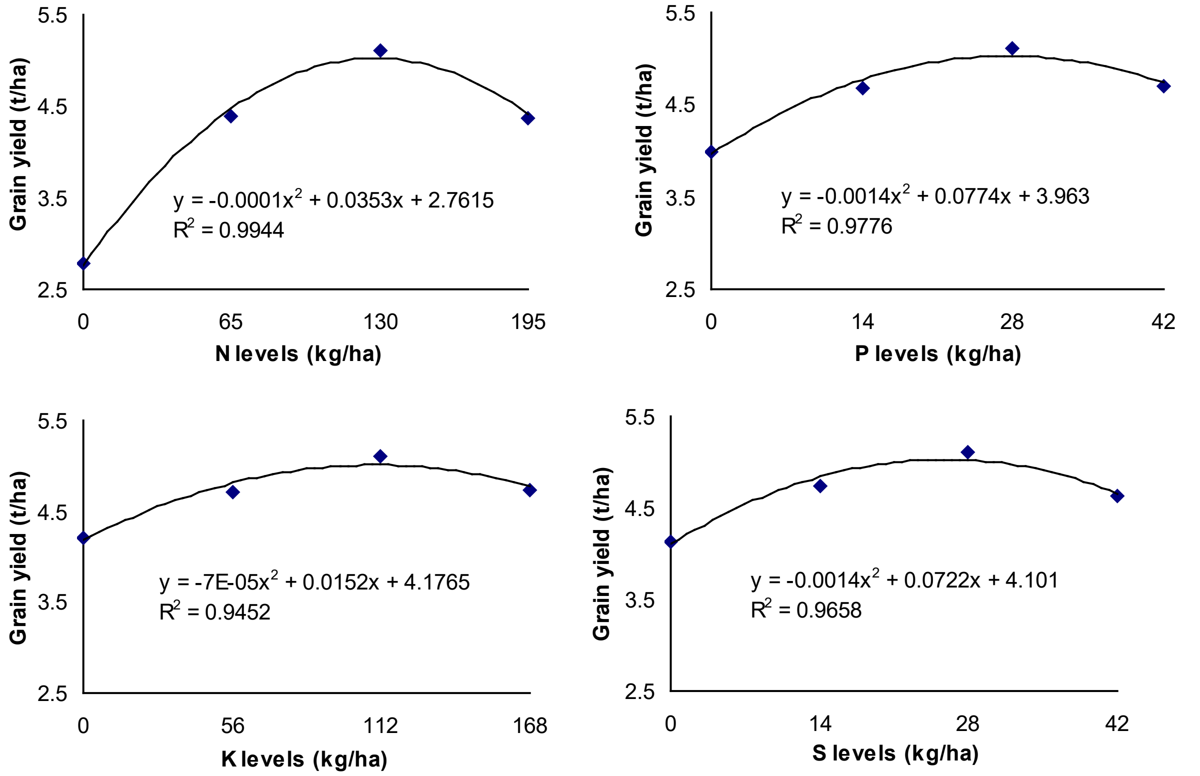


Figure 2. Response of Boro to added N, P, K & S in Mustard-Boro-T.Aman cropping pattern at Gabtali, Bogra during 2002-03 to 2003-04.

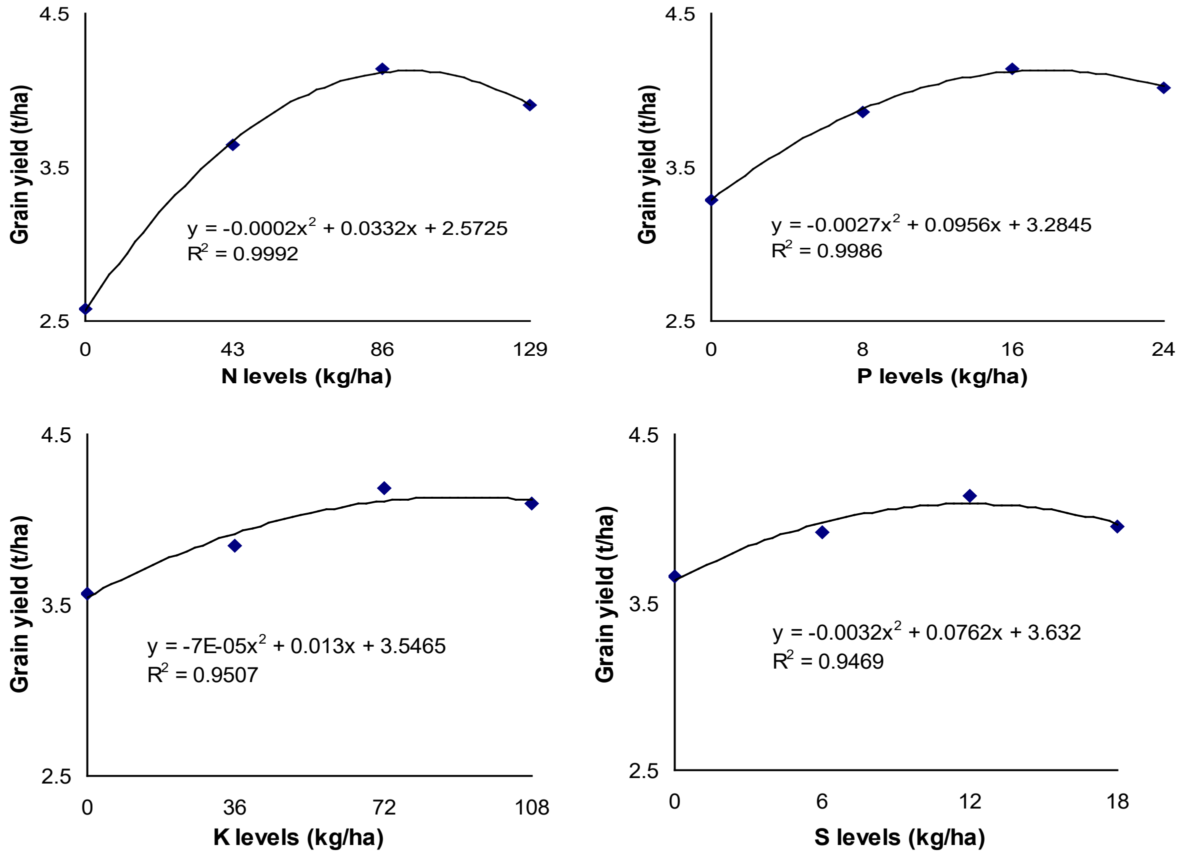


Figure 3. Response of T.Aman to added N, P, K & S in Mustard-Boro-T.Aman cropping pattern at Gabtali, Bogra during 2002-03 to 2003-04.

Table 1. Effect of different levels of fertilizer nutrients on the yield of Mustard in Mustard-Boro T.Aman rice cropping pattern at Gabtali, Bogra during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2004-05	Mean
N	0	0.39	0.30	0.34
	45	0.98	0.88	0.93
	90	1.10	1.13	1.11
	135	1.06	1.08	1.07
P	0	0.83	0.90	0.86
	13	0.85	0.95	0.90
	26	1.10	1.13	1.11
	39	0.91	0.97	0.94
K	0	0.85	0.80	0.82
	32	0.97	0.93	0.95
	64	1.10	1.13	1.11
	96	0.97	0.10	0.98
S	0	0.93	0.80	0.86
	14	0.99	0.87	0.93
	28	1.10	1.13	1.11
	42	1.03	0.96	0.99

Table 2. Effect of different levels of fertilizer nutrients on the yield of Boro in Mustard-Boro T.Aman rice cropping pattern at Gabtali, Bogra during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.97	2.61	2.79
	65	4.43	4.36	4.39
	130	4.94	5.29	5.11
	195	3.95	4.82	4.38
P	0	3.64	4.34	3.99
	14	4.35	5.03	4.69
	28	4.94	5.29	5.11
	42	4.25	5.17	4.71
K	0	4.15	4.27	4.21
	56	4.35	5.08	4.71
	112	4.94	5.29	5.11
	168	4.35	5.13	4.74
S	0	3.94	4.32	4.13
	14	4.42	5.09	4.75
	28	4.94	5.29	5.11
	42	4.08	5.18	4.63

Table 3. Effect of different levels of fertilizer nutrients on the yield of T.Aman in Mustard-Boro T.Aman rice cropping pattern at Gabtali, Bogra during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.40	2.76	2.58
	43	3.57	3.74	3.65
	86	4.02	4.26	4.14
	129	3.87	3.94	3.90
P	0	3.17	3.41	3.29
	8	3.59	4.14	3.86
	16	4.02	4.26	4.14
	24	4.00	4.05	4.02
K	0	3.37	3.77	3.57
	36	3.61	4.10	3.85
	72	4.02	4.35	4.18
	108	3.95	4.23	4.09
S	0	3.48	3.82	3.65
	6	3.75	4.10	3.92
	12	4.02	4.26	4.14
	18	3.85	4.06	3.95

Cropping pattern : Mustard -Boro - T.Aman
Location : Melandah (AEZ 9)
Year : 2003-04 to 2004-05

Mustard: A considerable response of mustard to nitrogen was observed. Seed yield of mustard increased markedly with the increase of nitrogen up to 100 kg/ha of N. After that level yield was tended to decline. But the rate of increase was comparatively higher up to 70 kg/ha of nitrogen. Similarly, response of mustard to added P, K and S was observed to some extent. Seed yield increased gradually up to 24, 26 and 30 kg/ha of P, K and S, respectively. More or less similar trend was found during both the years.

Boro: Grain yield of Boro rice increased sharply with the increase of N up to 100 kg/ha of nitrogen. Yield also showed increasing but comparatively at slower rate up to 130 kg/ha and then tended to decrease. Response of crop to P, K and S was also found to some extent. Yield increased appreciably up to 18, 321 and 16 kg/ha of P, K and S, respectively. After that level no significant yield increase was noticed.

T.Aman: Grain yield of T.Aman rice increased markedly with the increase of N levels up to 70 kg/ha of N and then yield also increased but a slower rate up to 100 kg/ha of added nitrogen. Some response to added phosphorus was also found and grain yield increased gradually up to 16 kg/ha of P. But in case of K and S no significant yield increased was observed. However, yield increased up to application of 23 and 9 kg/ha of K and S, respectively. Initially the soil status of NPKS was low, low, medium and low, respectively.

From the average of two years data response curve was drawn and a quadratic relationship was found. The nutrient dose that maximizes yield and profit was found out.

Crop	Agronomically optimum dose (kg/ha)				Economically optimum dose (kg/ha)			
	N	P	K	S	N	P	K	S
Mustard	100	24	25	30	90	20	20	25
Boro	135	24	40	20	130	20	30	15
T.Aman	100	16	30	12	90	12	20	10

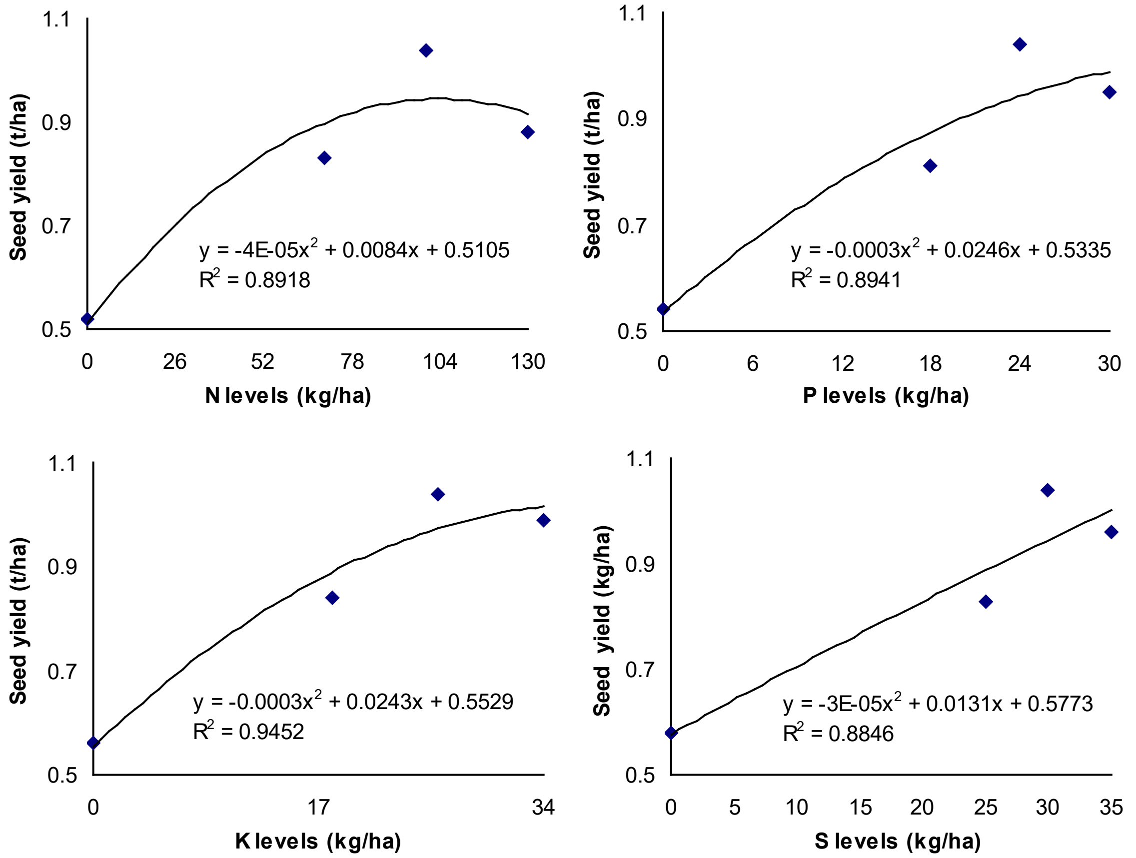


Table 4. Response of Mustard to added N, P, K & S in Mustard-Boro T.Aman rice cropping pattern at Melandah, Jamalpur during 2000-01 & 2001-02

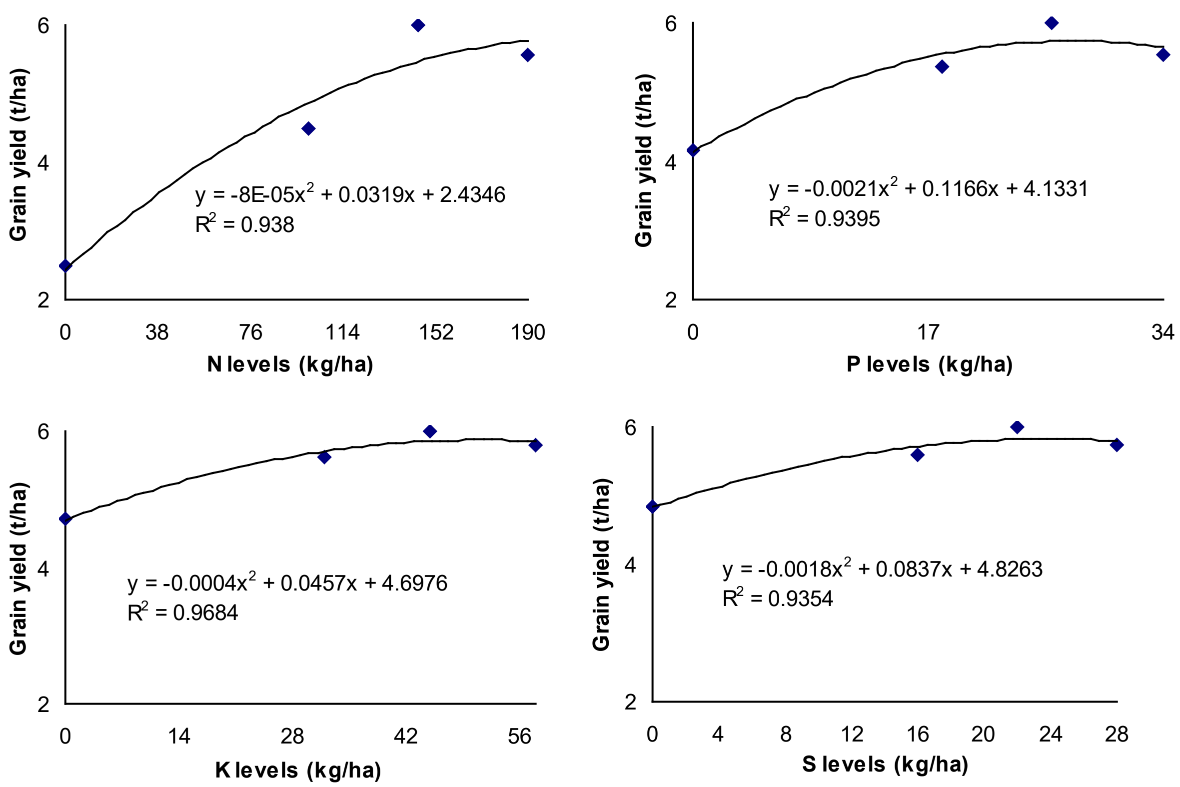


Table 5. Response of Boro to added N, P, K & S in Mustard-Boro T.Aman rice cropping pattern at Melandah, Jamalpur during 2000-01 & 2001-02

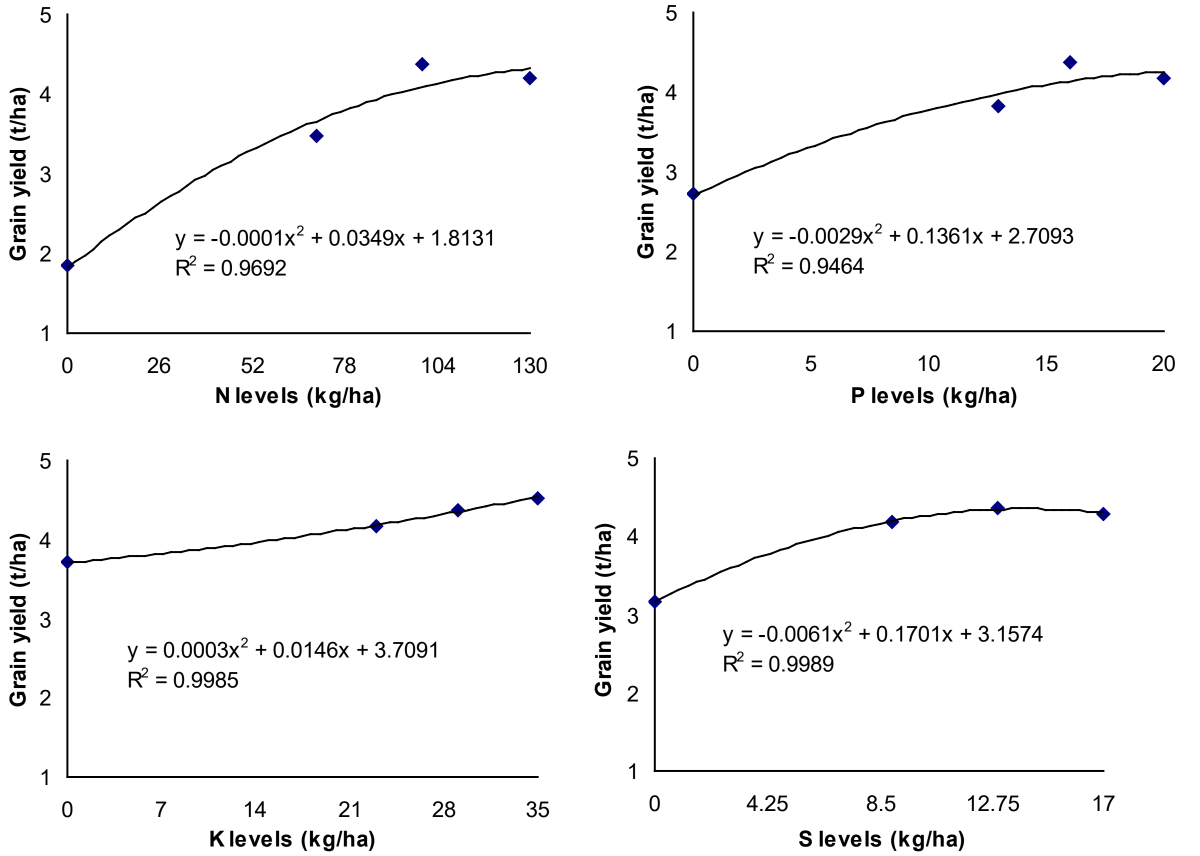


Table 6. Response of T.Aman to added N, P, K & S in Mustard-Boro T.Aman rice cropping pattern at Melandah, Jamalpur during 2000-01 & 2001-02

Table 4. Effect of different levels of fertilizer nutrients on the yield of Mustard in Mustard-Boro T.Aman rice cropping pattern at Melandah, Jamalpur during 2000-01 & 2001-02

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2000-01	2001-02	Mean
N	0	0.51	0.53	0.52
	70	0.80	0.86	0.83
	100	1.03	1.05	1.04
	130	0.85	0.91	0.88
P	0	0.52	0.56	0.54
	18	0.78	0.85	0.81
	24	1.03	1.05	1.04
	30	0.98	0.92	0.95
K	0	0.53	0.60	0.56
	18	0.79	0.89	0.84
	26	1.03	1.05	1.04
	34	1.00	0.98	0.99
S	0	0.54	0.63	0.58
	25	0.83	0.84	0.83
	30	1.03	1.05	1.04
	35	0.97	0.95	0.96

Table 5. Effect of different levels of fertilizer nutrients on the yield of Boro in Mustard-Boro T.Aman rice cropping pattern at Melandah, Jamalpur during 2000-01 & 2001-02

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2000-01	2001-02	Mean
N	0	2.55	2.43	2.49
	100	4.00	4.98	4.49
	145	5.78	6.21	5.99
	190	5.20	5.94	5.57
P	0	4.30	4.01	4.16
	18	5.30	5.43	5.36
	26	5.78	6.21	5.99
	34	5.50	5.60	5.55
K	0	4.78	4.65	4.71
	32	5.38	5.84	5.61
	45	5.78	6.21	5.99
	58	5.61	6.00	5.80
S	0	4.82	4.86	4.84
	16	5.43	5.78	5.60
	22	5.78	6.21	5.99
	28	5.54	5.93	5.73

Table 6. Effect of different levels of fertilizer nutrients on the yield of T.Aman in Mustard-Boro T.Aman rice cropping pattern at Melandah, Jamalpur during 2000-01 & 2001-02

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2000-01	2001-02	Mean
N	0	2.18	1.50	1.84
	70	3.90	3.04	3.47
	100	4.50	4.25	4.37
	130	4.26	4.17	4.21
P	0	3.26	2.19	2.72
	13	4.00	3.64	3.82
	16	4.50	4.25	4.37
	20	4.16	4.20	4.18
K	0	4.01	3.41	3.71
	23	4.65	3.69	4.17
	29	4.50	4.25	4.37
	35	4.80	4.27	4.53
S	0	3.82	2.50	3.16
	9	4.43	3.93	4.18
	13	4.50	4.25	4.37
	17	4.54	4.05	4.29

Cropping pattern : Boro-T.Aus- T.Aman
Location : Chandina, Comilla (AEZ 19)
Year of establishment : 2002-03 to 2004-05

Boro: A considerable response of Boro rice to added nitrogen was found. Grain yield of Boro rice increased appreciably with the increase of N levels and the highest yield was obtained with 120 kg/ha of N. More or less similar trend was found over the years, however, yield was comparatively lower during 2003-04. Similarly, response of Boro rice to added P was evident to some extent. Grain yield increased appreciably up to 23 kg/ha of phosphorus. But response to added K and S was not found at all.

T.Aus: A considerable response of T.Aus rice to nitrogen was found. Grain yield increased appreciably 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: Response of T.Aman rice to nitrogen was found. Grain yield increased considerably with the increase of nitrogen up to 60 kg/ha and after that level no appreciable yield increase was found. The crop was damaged due to flood in 2003-04 and the yield was comparatively lower in 2004-05.

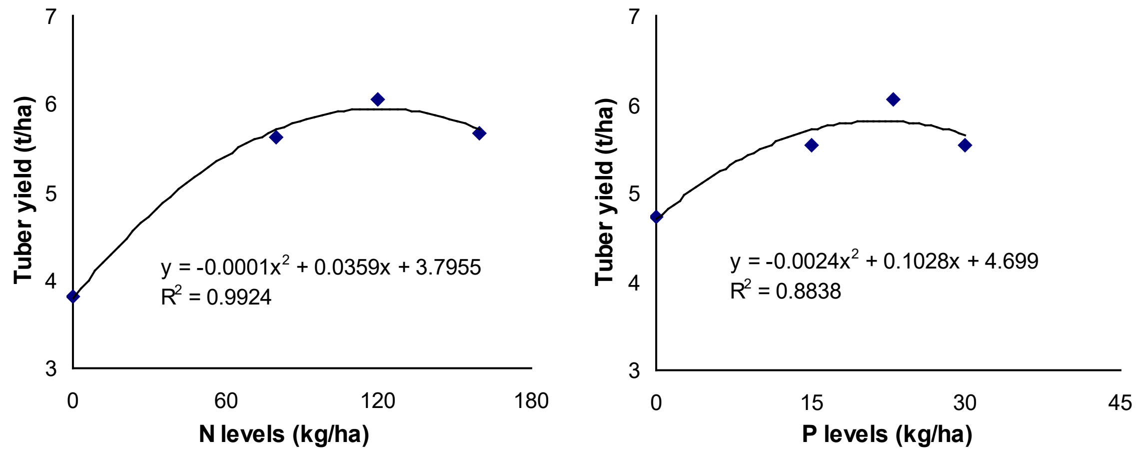


Figure 7. Response of Boro to added N & P in Boro-T.Aus-T.Aman cropping pattern at Chandina, Comilla during 2002-03 to 2004-05

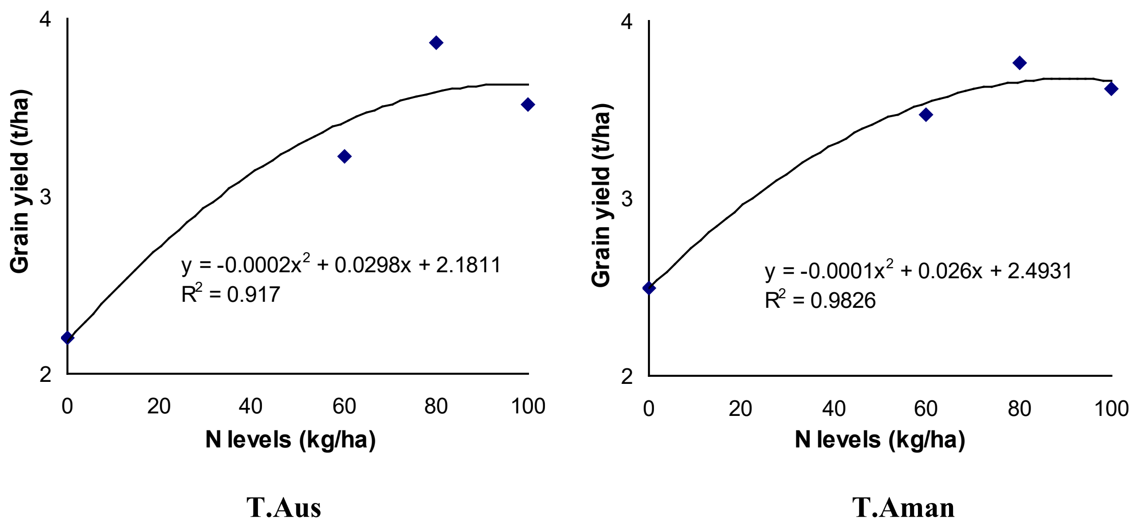


Figure 8. Response of T.Aus and T.Aman to added N in Boro-T.Aus-T.Aman cropping pattern at Chandina, Comilla during 2002-03 to 2004-05.

Table 7. Effect of different levels of fertilizer nutrients on the yield of Boro in Boro-T.Aus-T.Aman rice cropping pattern at Chandina, Comilla during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	3.53	3.81	4.10	3.81
	80	6.44	4.86	5.56	5.62
	120	6.60	5.10	6.49	6.06
	160	6.42	5.02	5.54	5.66
P	0	5.02	4.00	5.19	4.73
	15	6.04	4.56	5.99	5.53
	23	6.60	5.10	6.49	6.06
	30	5.94	4.96	5.76	5.55
K	0	5.98	4.46	5.43	5.29
	60	6.11	4.80	5.60	5.50
	80	6.60	5.10	6.49	6.06
	100	6.12	5.05	5.55	5.57
S	0	5.98	4.84	5.58	5.47
	15	6.20	4.98	5.52	5.57
	20	6.60	5.10	6.49	6.06
	25	6.24	4.96	5.63	5.61

Table 8. Effect of different levels of fertilizer nutrients on the yield of T.Aus in Boro-T.Aus-T.Aman rice cropping pattern at Chandina, Comilla during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	2.28	2.12	2.22	2.20
	60	3.87	3.02	2.79	3.23
	80	4.52	3.60	3.49	3.87
	100	4.21	3.14	3.20	3.52
P	0	4.13	2.96	3.16	3.42
	9	4.38	3.18	3.20	3.59
	12	4.52	3.60	3.49	3.87
	15	4.01	3.16	2.87	3.35
K	0	4.34	2.64	3.14	3.37
	36	4.49	2.86	3.23	3.53
	48	4.52	3.60	3.49	3.87
	60	4.30	3.18	3.96	3.81
S	0	3.92	2.86	2.93	3.24
	8	4.64	3.12	3.06	3.61
	12	4.52	3.60	3.49	3.87
	16	4.04	3.16	3.16	3.45

Table 9. Effect of different levels of fertilizer nutrients on the yield of T.Aman in Boro-T.Aus-T.Aman rice cropping pattern at Chandina, Comilla during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	2.73	Damaged	2.28	2.50
	60	3.99		2.96	3.47
	80	4.38		3.14	3.76
	100	4.26		2.98	3.62
P	0	3.92		2.55	3.23
	9	4.23		2.91	3.57
	12	4.38		3.14	3.76
	15	4.31		3.00	3.65
K	0	4.04		2.46	3.25
	36	4.14		2.51	3.32
	48	4.38		3.14	3.76
	60	4.32		2.95	3.63
S	0	4.08		2.86	3.47
	8	4.41		2.90	3.65
	12	4.38		3.14	3.76
	16	4.28		2.89	3.58

Cropping pattern : Wheat-Jute- T.Aman
Location : Lalmonirhat MLT site, Rangpur (AEZ 3)
Year : 2002-03 to 2004-05

Wheat: Average of three years data showed that grain yield of wheat increased sharply with the increase of N levels and the highest yield was obtained from 110 kg/ha of N and then tended to decline. However, the rate of increase was higher up to 55 kg/ha of nitrogen. In case of K and S comparatively slow but positive response was found and yield increased up to 60 and 30 kg/ha of K and S, respectively. However, yield increased sharply up to the application of 30 and 15 kg/ha of K and S, respectively.

Jute: Fibre yield of Jute increased appreciably with the increase of N. Yield increased considerably up to 50 kg/ha and after that level the rate of increment was slow. However, yield increased up to 100 kg N/ha. Almost similar trend was found in case of K and S. Fibre yield increased appreciably up to 30 and 10 kg/ha of K and S, respectively. But yield increased slowly up to 60 and 20 kg/ha of K and S, respectively.

T.Aman: A considerable response of T.Aman rice to added nutrients was also observed. Grain yield increased with the increase of N levels up to 90 kg/ha of N and then tended to decrease. Similarly, K and S also showed a positive response towards the yield of T.Aman rice. Grain yield increased up to 40 and 12 kg/ha of K and S, respectively.

Initially the soil was deficient in N, K and S but status of P was optimum. That's why a positive response of crops to added N, K and S was evident. 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	K	S	N	K	S
Wheat	120	62	34	110	50	28
Jute	100	61	25	90	55	15
T.Aman	94	46	14	90	35	10

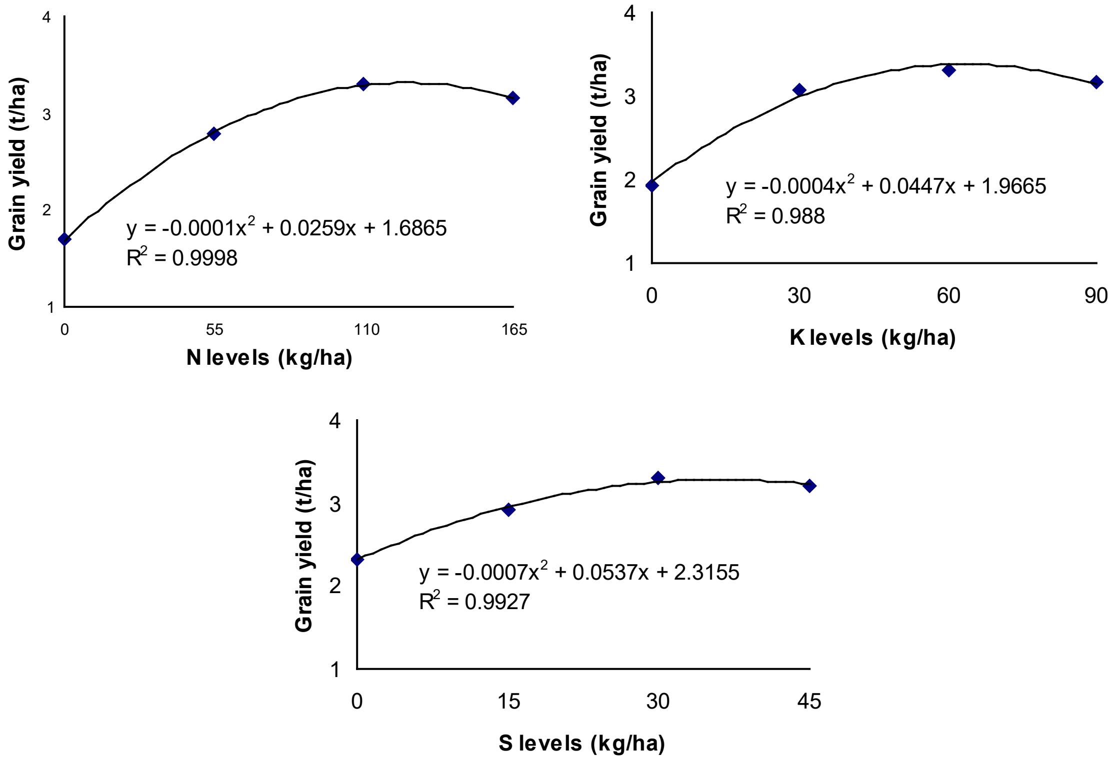


Figure 9. Response of Wheat to added N, K & S in Wheat-Jute-T.Aman cropping pattern at Lalmonirhat during 2002-03 to 2004-05

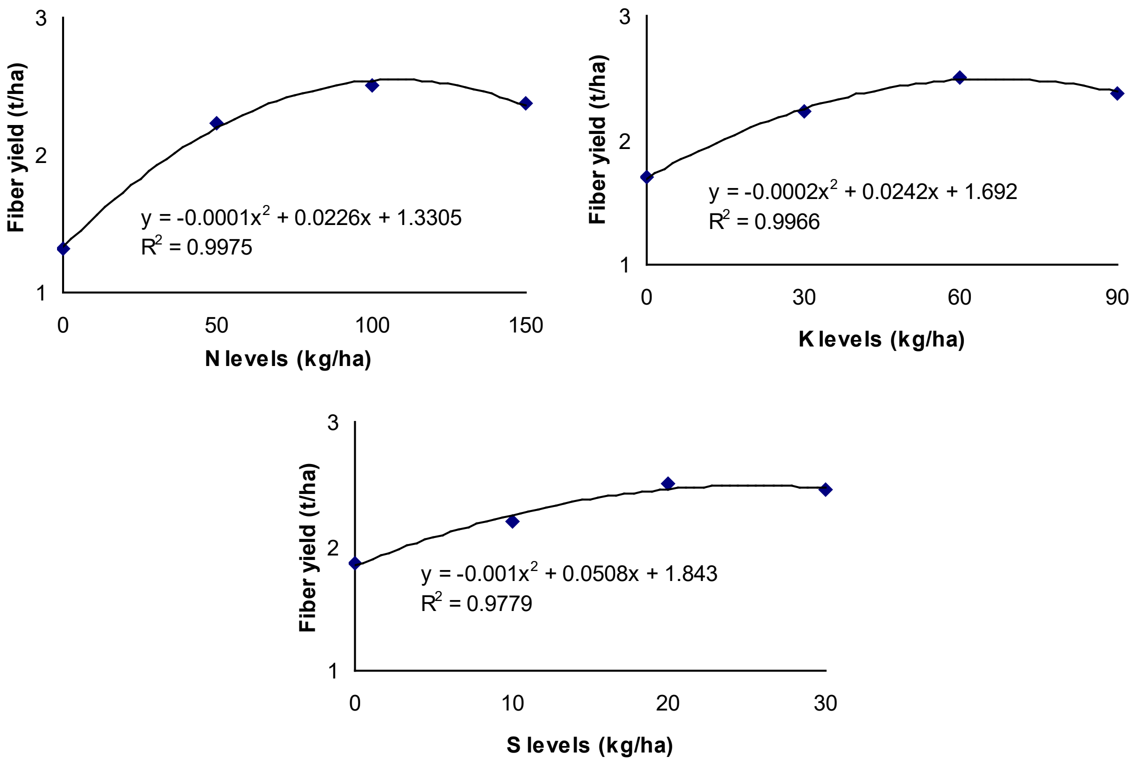


Figure 10. Response of Jute to added N, K & S in Wheat-Jute-T.Aman cropping pattern at Lalmonirhat during 2002-03 to 2004-05

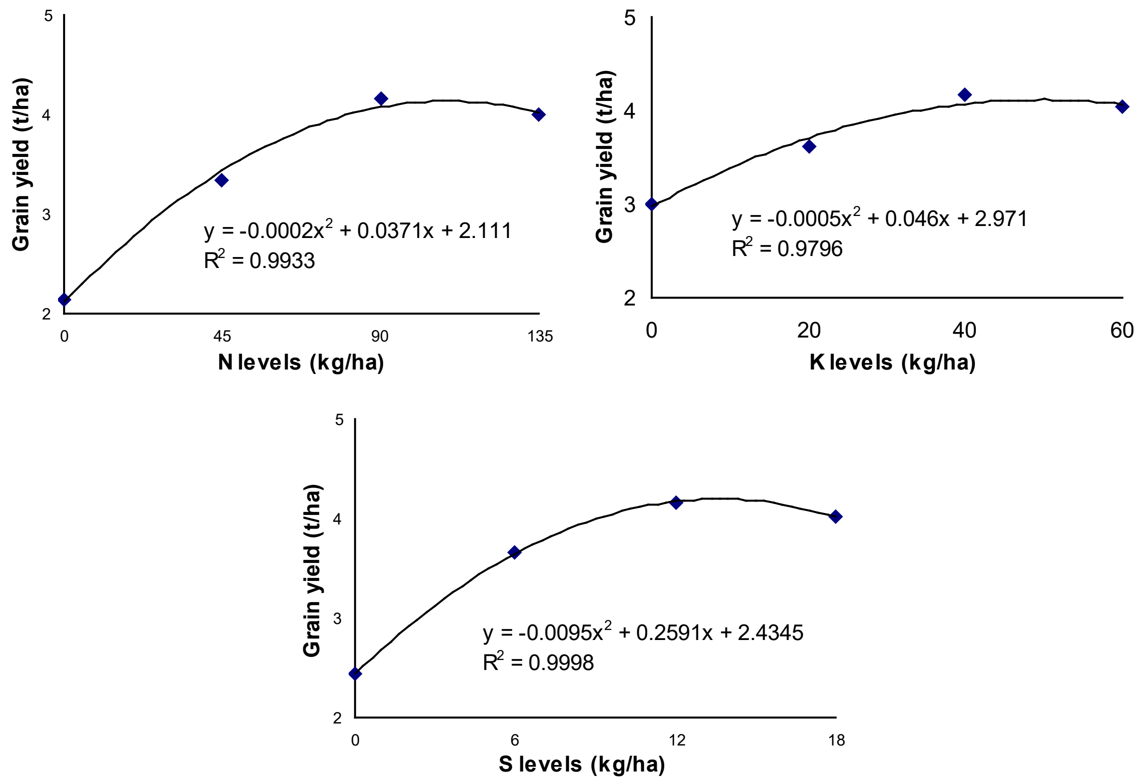


Figure 11. Response of T.Aman rice to added N, K & S in Wheat-Jute-T.Aman cropping pattern at Lalmonirhat during 2002-03 to 2004-05

Table 10. Effect of different levels of fertilizer nutrients on the yield of Wheat in Wheat-Jute T.Aman rice cropping pattern at Lalmonirhat MLT site during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	1.76	1.64	1.68	1.69
	55	2.90	2.70	2.79	2.79
	110	3.40	3.22	3.28	3.30
	165	3.25	3.09	3.12	3.15
K	0	2.11	1.97	1.92	1.94
	30	3.04	2.88	3.10	3.07
	60	3.40	3.22	3.28	3.30
	90	3.36	3.19	3.16	3.16
S	0	2.39	2.27	2.32	2.33
	15	3.02	2.81	2.90	2.91
	30	3.40	3.22	3.28	3.30
	45	3.29	3.14	3.20	3.21

Table 11. Effect of different levels of fertilizer nutrients on the yield of Jute in Wheat-Jute T.Aman rice cropping pattern at Lalmonirhat MLT site during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Fibre yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	1.28	1.38	1.31	1.32
	50	2.23	2.25	2.22	2.23
	100	2.46	2.58	2.50	2.51
	150	2.30	2.46	2.36	2.37
K	0	1.63	1.78	1.69	1.70
	30	2.15	2.32	2.22	2.23
	60	2.46	2.58	2.50	2.51
	90	2.35	2.42	2.36	2.38
S	0	1.85	1.89	1.85	1.86
	10	2.20	2.22	2.19	2.20
	20	2.46	2.58	2.50	2.51
	30	2.41	2.50	2.44	2.45

Table 12. Effect of different levels of fertilizer nutrients on the yield of T.Aman in Wheat-Jute T.Aman rice cropping pattern at Lalmonirhat MLT site during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	2.35	1.95	2.11	2.14
	45	3.66	3.05	3.34	3.35
	90	4.46	3.87	4.15	4.16
	135	4.29	3.70	3.98	3.99
K	0	3.23	2.79	2.98	3.00
	20	3.93	3.32	3.61	3.62
	40	4.46	3.87	4.15	4.16
	60	4.41	3.68	4.03	4.04
S	0	2.69	2.19	2.42	2.43
	6	4.01	3.32	3.65	3.66
	12	4.46	3.87	4.15	4.16
	18	4.38	3.68	4.01	4.02

Cropping pattern : Wheat- Jute-Mungbean
Location : Gangni, Kushtia (AEZ 11)
Year : 2003-04to 2004-05

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

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

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

Initially the soil status of K and S was satisfactory. Therefore, those nutrients are not included in the study. But the soil was deficient with N and P and a considerable response of crops to added nutrients was observed.

Table 13. Effects of different levels of fertilizer nutrients on the yield of Wheat in Wheat-Jute-Mungbean cropping pattern at Gangni, Kushtia during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2004-05	Mean
N	0	1.93	1.96	1.94
	50	3.07	3.15	3.61
	100	3.90	4.35	4.12
	150	3.75	3.91	3.83
P	0	2.39	2.45	2.42
	15	3.55	3.60	3.57
	30	3.90	4.35	4.12
	45	3.84	4.00	3.92

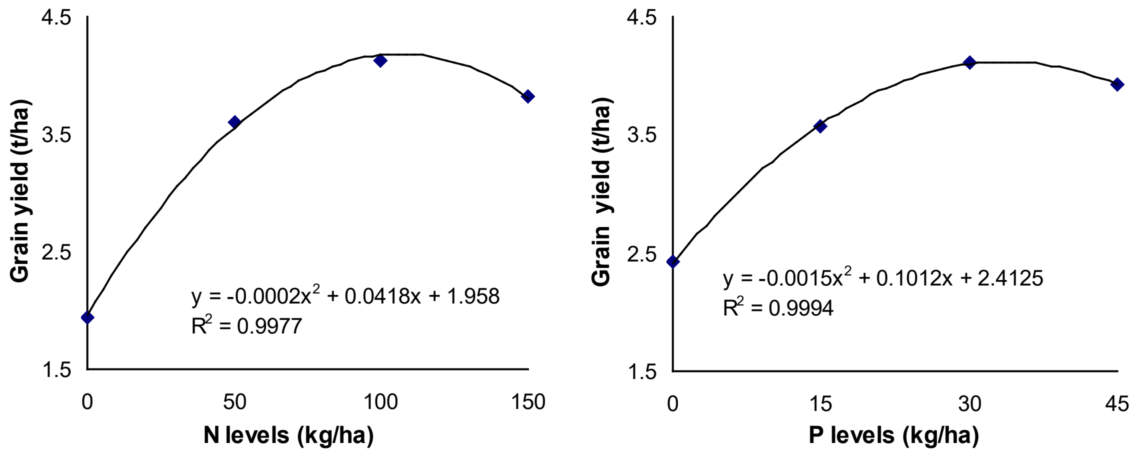


Figure 12. Response of Wheat to added N & P in Wheat-Jute-Mungbean cropping pattern at Gangni, Kushtia, during 2003-04 to 2004-05

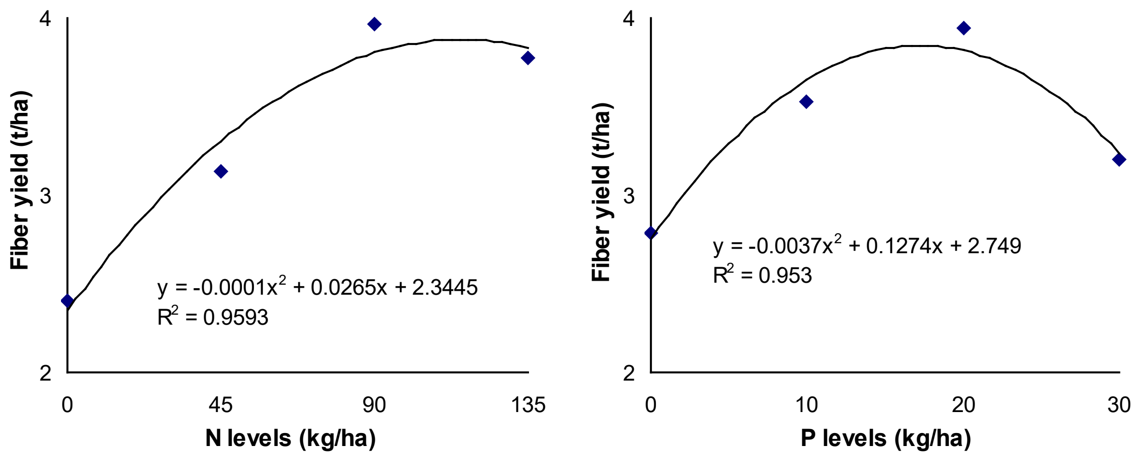


Figure 13. Response of Jute to added N & P in Wheat-Jute-Mungbean cropping pattern at Gangni, Kushtia, during 2003-04 to 2004-05

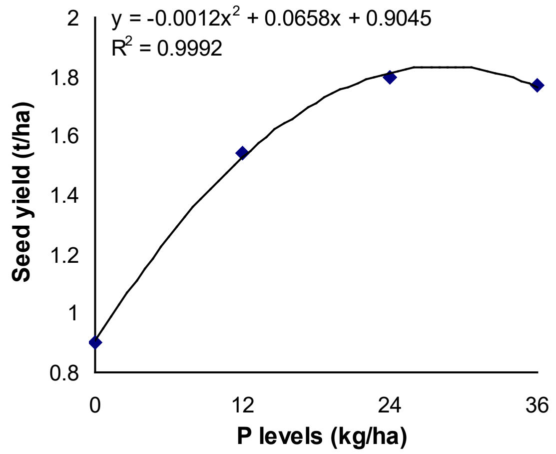


Figure 14. Response of Mungbean to added P in Wheat-Jute-Mungbean cropping pattern at Gangni, Kushtia, during 2003-04 to 2004-05.

Table 14. Effects of different levels of fertilizer nutrients on the yield of Jute in Wheat-Jute-Mungbean cropping pattern at Gangni, Kushtia during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Fiber yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.08	2.01	2.40
	45	3.09	3.19	3.14
	90	3.90	3.94	3.97
	135	3.35	3.30	3.94
P	0	2.82	2.77	2.79
	10	3.57	3.50	3.53
	20	3.90	3.94	3.94
	30	3.15	3.25	3.20

Table 15. Effects of different levels of fertilizer nutrients on the yield of Mungbean in Wheat-Jute-Mungbean cropping pattern at Gangni, Kushtia during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
P	0	0.91	0.89	0.9
	12	1.48	1.61	1.54
	24	1.82	1.78	1.80
	36	1.76	1.78	1.77

Cropping pattern : Chilli-T.Aman rice
Location : Hathazari, Chittagong
Year of establishment : 2002-03 to 2004-05

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 gradually up to 110 and 20 kg/ha of K and S, respectively. However, the rate of increment was higher at 55 and 10 kg/ha of K and S. Almost similar trend was found over the years.

T.Aman: A considerable response of T.Aman rice to added nitrogen was evident. Grain yield increased sharply up to 40 kg/ha of N and after that level yield also increased slowly up to 80 kg/ha. Response to K and was also observed to some extent. Grain yield increased appreciably up to 20 and 5 kg/ha of K and S, respectively. But yield increased at a slower rate up to 40 and 10 kg/ha of added potassium and sulphur.

A response curve was drawn from the average 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	K	S	N	K	S
Chilli	120	110	20	115	100	15
T.Aman	80	40	10	75	35	10

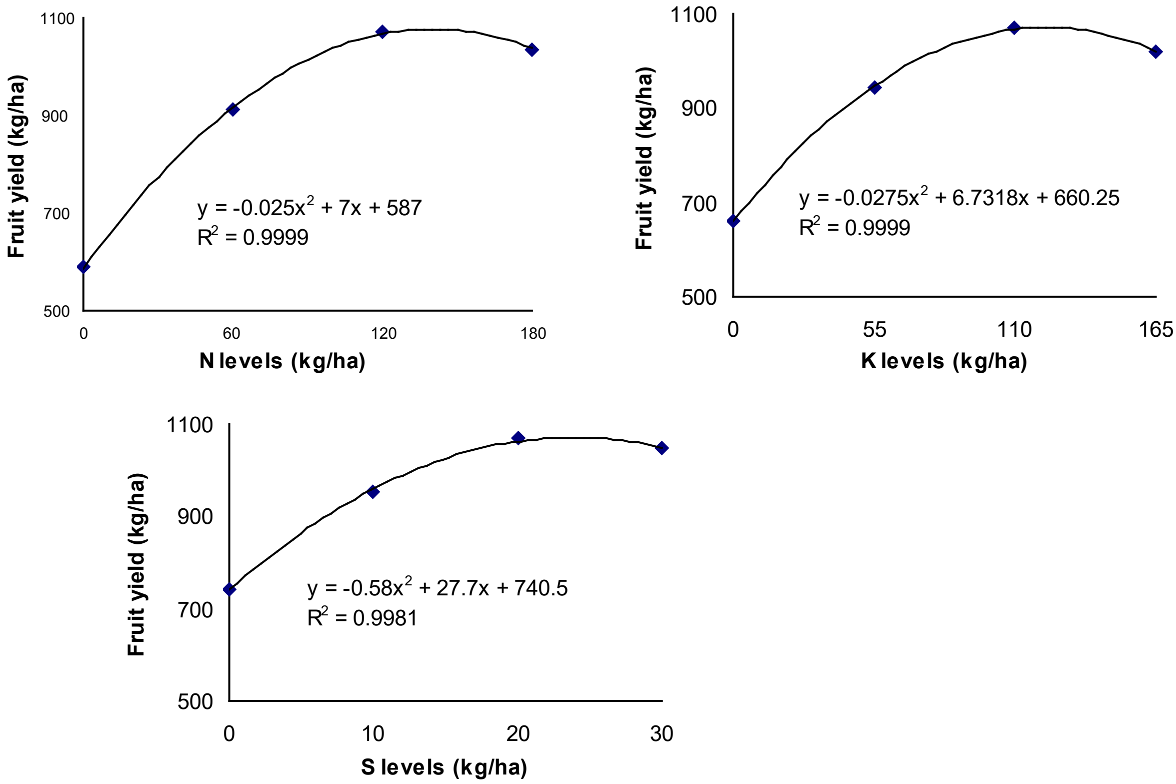


Figure 15. Response of Chilli to added N, K & S in Chilli-T.Aman Cropping pattern at Hathazari, Chittagong during 2002-03 to 2004-05.

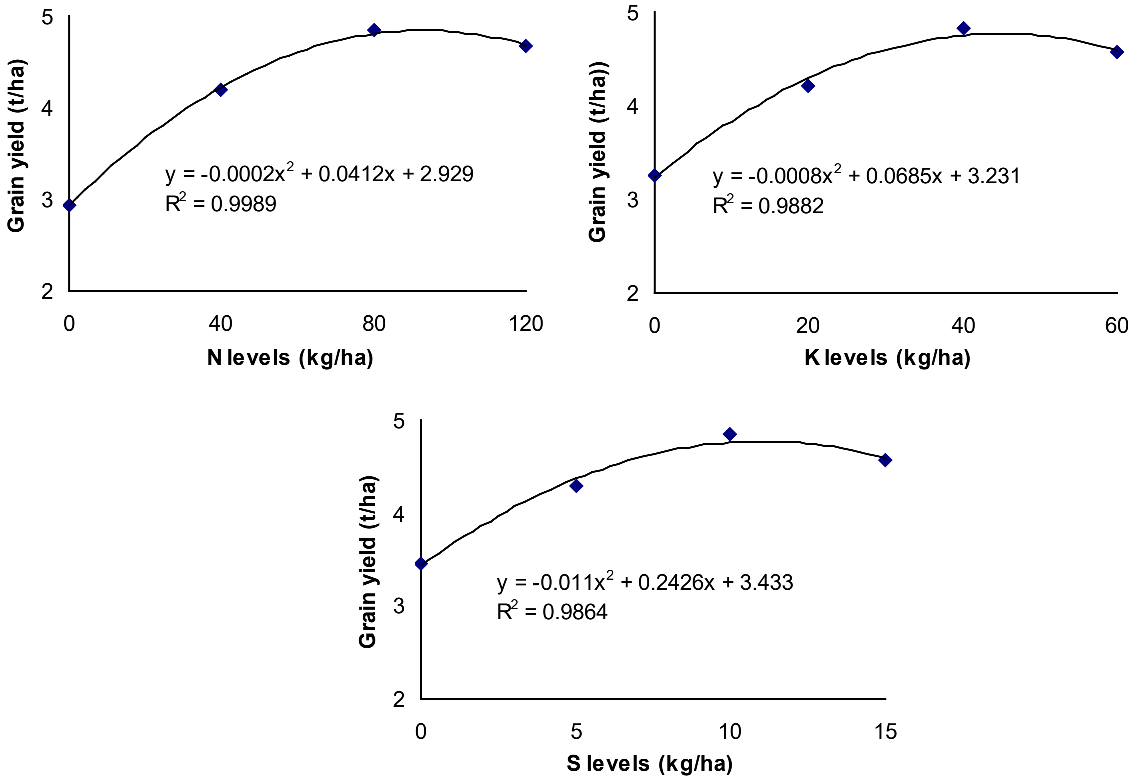


Figure 16. Response of T.Aman to added N, K & S in Chilli-T.Aman Cropping pattern at Hathazari, Chittagong during 2002-03 to 2004-05.

Table 15. Effect of different levels of fertilizer nutrients on the yield of Chilli in Chilli-T.Aman rice cropping pattern at Hathazari during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	548	596	621	588
	60	885	941	915	914
	120	1090	1107	1014	1070
	180	1043	1074	992	1036
K	0	684	662	638	661
	55	965	990	879	945
	110	1090	1107	1014	1070
	165	1070	1076	917	1021
S	0	703	703	823	743
	10	962	973	922	952
	20	1090	1107	1014	1070
	30	1065	1081	995	1047

Table 17. Effect of different levels of fertilizer nutrients on the yield of T.Aman rice in Chilli-T.Aman rice cropping pattern at Hathazari during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2002-03	20034-04	Mean
N	0	2.91	2.97	2.94
	40	4.10	4.29	4.19
	80	4.76	4.93	4.84
	120	4.58	4.77	4.67
K	0	3.28	3.35	3.26
	20	4.05	4.38	4.21
	40	4.76	4.93	4.84
	60	4.48	4.67	4.57
S	0	3.42	3.50	3.46
	5	4.16	4.42	4.29
	10	4.76	4.93	4.84
	15	4.52	4.62	4.57

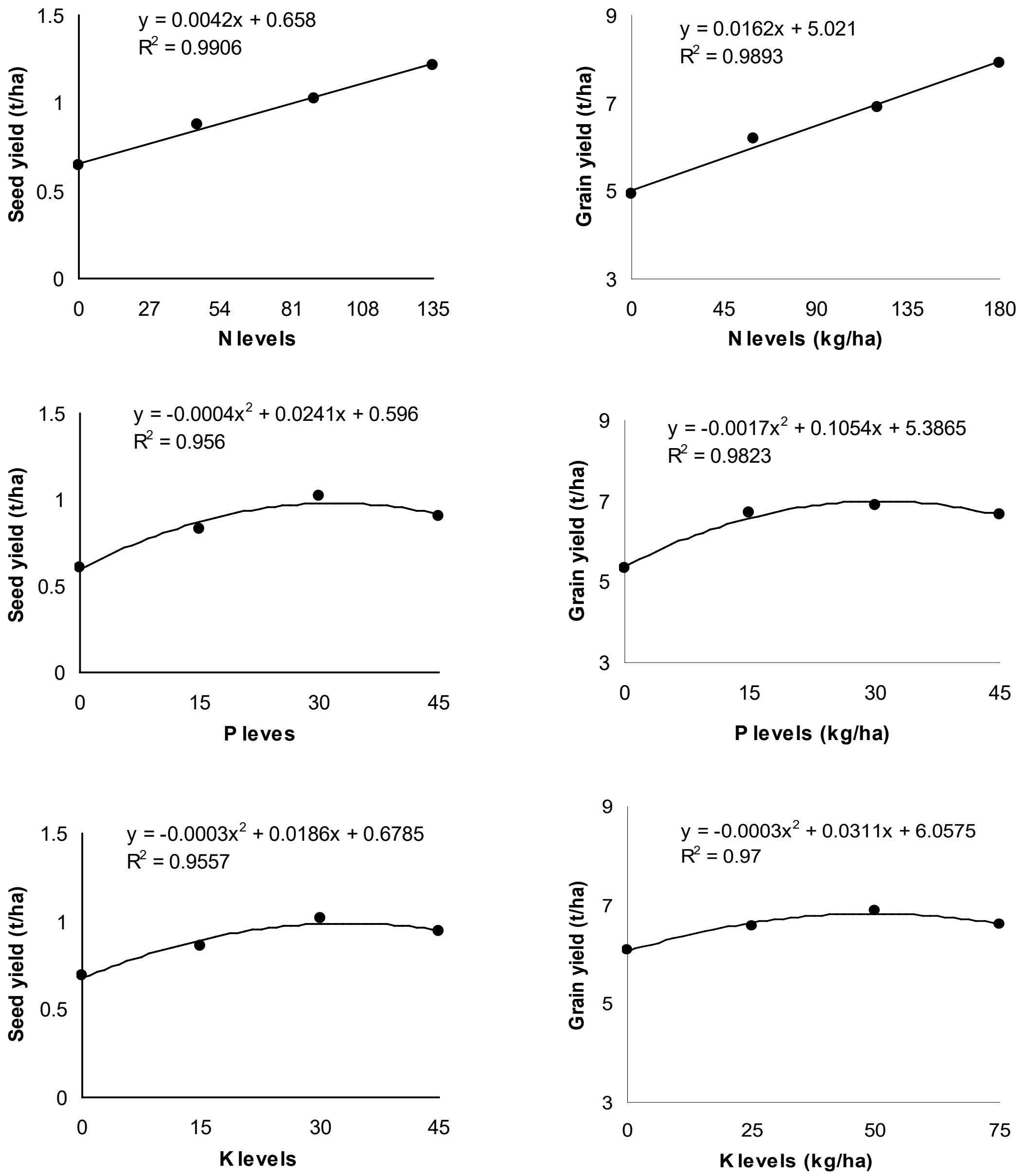
Cropping pattern : Mustard-Boro
Location : Kaliakoir, Gazipur
Year : 2003-04 to 2004-05

Mustard: Mean of two years data showed that response of Mustard to nitrogen was observed. 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, to find out the optimum dose of nitrogen for mustard another higher level of N should be included in next year. 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 and after that level tended to decrease.

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 and the highest yield was found in the highest level of nitrogen. Response to P was also observed to some extent. Yield increased appreciably up to 15 kg/ha and after that level rate of increment was slow. However, yield increased up to 30 kg/ha of P. Response of Boro rice to added K was not very clear. But yield increased very slowly up to 50 kg/ha of K. Almost similar trend was observed over the years.

Table 18. Effect of different levels of fertilizer nutrients on the yield of mustard in Mustard-Boro rice cropping pattern at Kaliakoir MLT site during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2043-05	Mean
N	0	0.672	0.60	0.64
	45	0.912	0.85	0.88
	90	0.960	1.07	1.02
	135	1.158	1.29	1.22
P	0	0.595	0.62	0.61
	15	0.816	0.85	0.83
	30	0.960	1.07	1.02
	45	0.859	0.95	0.90
K	0	0.682	0.69	0.69
	15	0.872	0.84	0.86
	30	0.960	1.07	1.02
	45	0.890	0.99	0.94



Mustard **Boro**

Figure 17. Response of Crops to added NPK in Mustard-Boro cropping pattern at Kaliakoir, Gazipur during 2003-04 & 2004-05

Table 19. Effect of different levels of fertilizer nutrients on the yield of Boro rice in Mustard-Boro rice cropping pattern at Kaliakoir MLT site during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2002-03	2003-04	Mean
N	0	5.41	4.42	4.92
	60	6.62	5.73	6.18
	120	7.47	6.31	6.89
	180	8.23	7.60	7.92
P	0	5.81	4.89	5.35
	15	6.95	6.43	6.69
	30	7.47	6.31	6.89
	45	7.39	5.96	6.68
K	0	6.38	5.77	6.08
	25	6.85	6.28	6.57
	50	7.47	6.31	6.89
	75	7.37	5.81	6.59

Cropping pattern : Potato-T.Aus- T.Aman
Location : Kishoreganj sadar (AEZ 9)
Year : 2002-03 to 2004-05

Potato: Response of potato to added nutrients was observed. Tuber yield of potato increased markedly with the increase of nitrogen up to 120 $kgha^{-1}$ of N and after that level yield tended to decrease (Fig1). But the response was very sharp up to 60 kg/ha of nitrogen. As the soil was deficit in N and therefore response to added nitrogen was evident in the tuber yield of potato. Similarly, in case of P, K and S a positive response was also found towards the yield. Tuber yield increased up to the application of 30, 90 and 20 $kgha^{-1}$ of P, K and S, respectively.

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

T.Aman: In T.Aman rice, almost similar trend like T.Aus rice was found. Grain yield increased up to 90, 18, 45 and 14 $kgha^{-1}$ of N, P, K and S respectively (Fig 3). After that level rate of increment was slow.

From the average data a response curve was drawn and a quadratic relationship was found. From the response curve the agronomically and economically optimum dose that gave maximum yield and profit for potato, T.Aus and T.Aman was find out.

Crop	Agronomically optimum dose (kg/ha)				Economically optimum dose (kg/ha)			
	N	P	K	S	N	P	K	S
Potato	122	35	121	19	107	32	86	18
T.Aus	82	18	33	12	77	17	30	11
T.Aman	83	17	40	12	78	16	32	11

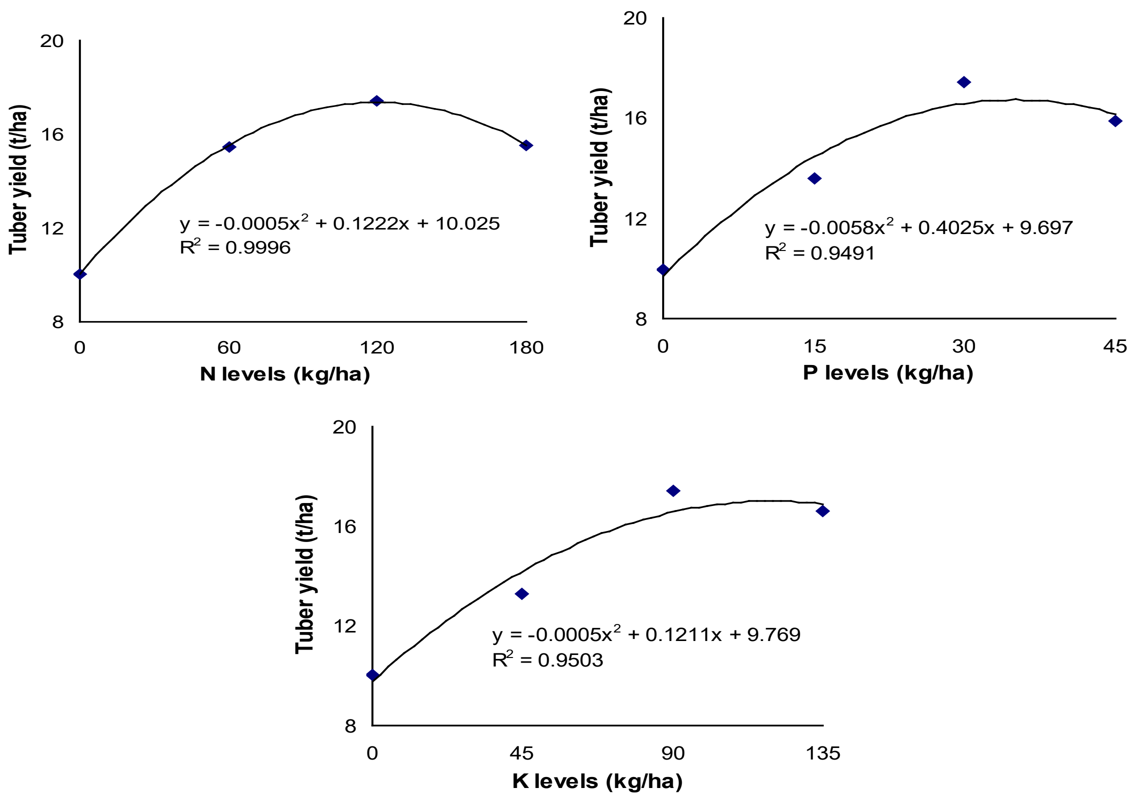


Figure 18. Response of Potato to added N, P &K in Potato-T.Aus-T.Aman cropping pattern at Kishoreganj Sadar during 2003-04 & 2004-05.

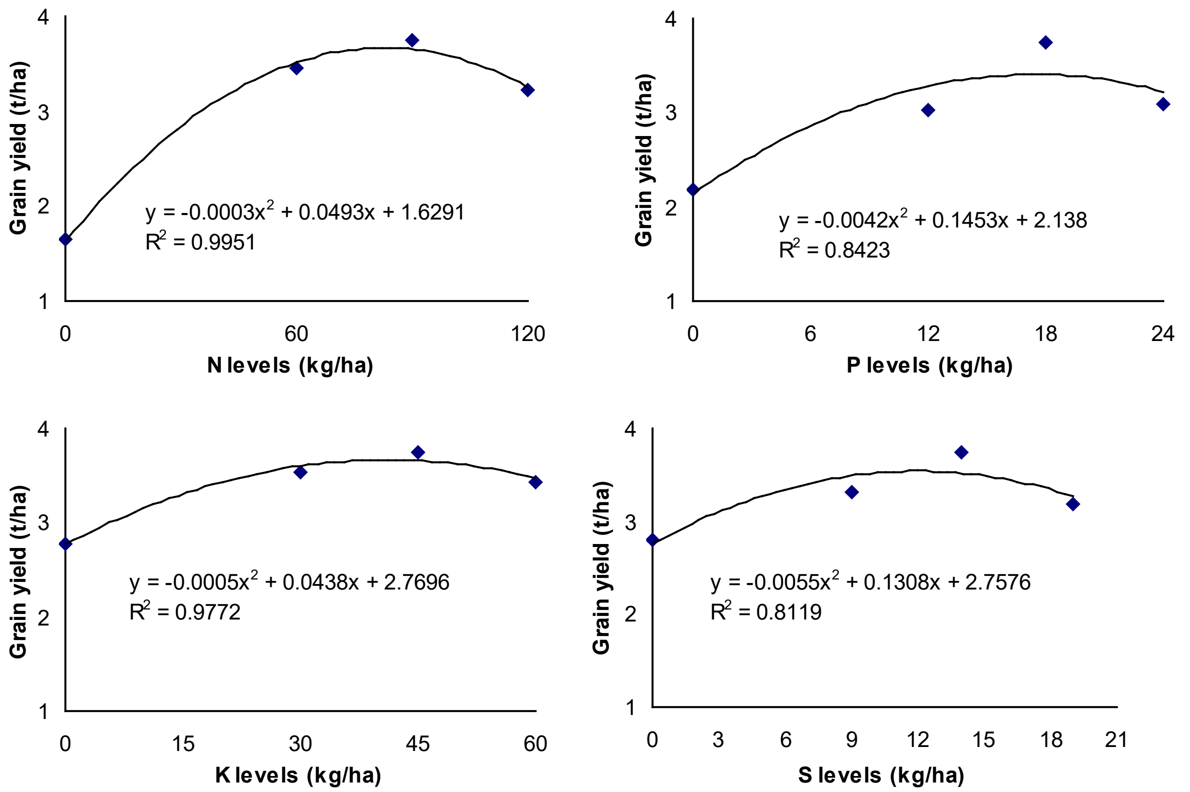


Figure 19. Response of T.Aus to added N, P, K & S in Potato-T.Aus-T.Aman cropping pattern at Kishoreganj Sadar during 2003-04 & 2004-05.

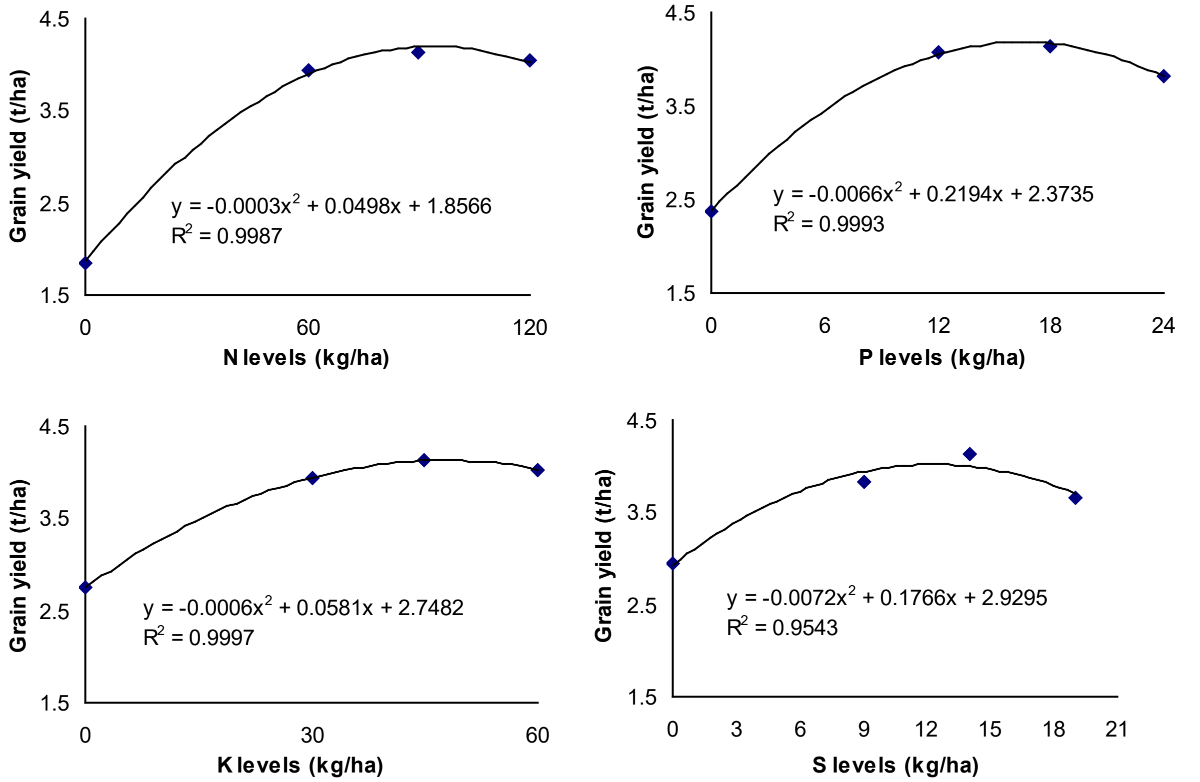


Figure 20. Response of T.Aman to added N, P, K & S in Potato-T.Aus-T.Aman cropping pattern at Kishoreganj Sadar during 2003-04 & 2004-05.

Table 20. Effect of different levels of nutrients on the yield of Potato crop grown in Potato–T.Aus–T.Aman rice cropping pattern at Kishoregonj sadar MLT site, 2003-2004 ton 2004-05

Nutrient levels (kgha^{-1})				Tuber/Grain yield (t ha^{-1})						Mean of 2 years		
				2003-04			2004-05					
Levels	Potato	T.Aus	T.Aman	Potato	T.Aus	T.Aman	Potato	T.Aus	T.Aman	Potato	T.Aus	T.Aman
N	0	0	0	10.43	1.58	1.84	11.66	1.70	1.86	10.05	1.64	1.85
	60	60	60	13.40	3.39	3.97	17.53	3.51	3.89	15.45	3.45	3.93
	120	90	90	16.21	3.68	4.18	18.66	3.80	4.09	17.44	3.74	4.14
	180	120	120	13.54	3.17	4.05	17.50	3.27	4.03	15.52	3.22	4.04
P	0	0	0	8.28	2.49	2.41	11.68	2.36	2.33	9.98	2.18	2.37
	15	12	12	10.54	3.20	3.87	16.63	2.75	4.26	13.59	3.03	4.07
	30	18	18	16.21	3.68	4.18	18.66	3.80	4.09	17.44	3.74	4.14
	45	24	24	14.61	3.25	3.67	17.13	2.95	3.96	15.87	3.10	3.82
K	0	0	0	9.23	2.87	2.80	10.88	2.68	2.69	10.06	2.78	2.75
	45	30	30	13.67	3.39	4.06	16.96	3.68	3.79	13.32	3.54	3.93
	90	45	45	16.21	3.68	4.18	18.66	3.80	4.09	17.44	3.74	4.14
	135	60	60	15.50	3.14	4.00	17.70	3.14	4.06	16.60	3.44	4.03
	0	0	0	14.26	2.76	2.97	15.86	2.81	2.93	15.06	2.79	2.95
S	10	9	9	15.21	3.33	3.81	16.66	3.31	3.84	15.94	3.32	3.83
	20	14	14	16.21	3.68	4.18	18.66	3.80	4.09	17.44	3.74	4.14
	30	19	19	15.96	3.16	3.70	16.16	3.21	3.59	16.06	3.19	3.65

Cropping pattern : Potato-Boro - T.Aman
Location : Syedpur FSRD site, Rangpur (AEZ 3)
Year : 2002-03 to 2004-05

Potato: A considerable response of potato to added nitrogen was evident. Average of three years data showed that tuber yield of potato increased sharply with the increase of N levels up to 55 kg/ha and there after the rate of increment was comparatively slower. But yield increased up to 110 kg N/ha and then tended to decline. Response of potato to P, K and S was also observed. Yield increased appreciably up to 15, 35 and 10 kg/ha of P, K and S, respectively and after that level the rate of increment was slow. But yield increased up to 30, 70 and 20 kg/ha of P, K and S, respectively ant there after gradually decrease.

Boro: Response of boro rice to added N and P was also evident. Fiber yield increased appreciably with the increase of nutrient level. Yield increased sharply up to 55 and 15 kg/ha of N and P and after that level the rate of increment was slow. However, yield increased up to 110 and 30 kg/ha of N and P, respectively. But response to K and S was not very distinct but yield increased up to, 60 and 20 kg/ha of K and S, respectively.

T.Aman: Grain yield of T.Aman rice increased with the increase of N levels up to 70 kg/ha of N and then tended to decrease. Similarly, phosphorus also showed a positive response towards the yield of T.Aman rice. Grain yield increased up to 20 kg/ha of phosphorus. Response to K and S was also observed to some extent and grain yield increased appreciably up to 40 and 10 kg/ha of K and S, respectively.

Initial nutrient status of the soil showed that the soil was deficient in nutrients and therefore, the crops responded positively to added nutrients. 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	118	36	78	23	115	30	70	20
Boro	102	33	60	23	98	25	55	20
T.Aman	73	23	43	12	70	18	35	10

Table 21. Effect of different levels of fertilizer nutrients on the yield of Potato in Potato-Boro-T.Aman rice cropping pattern at Syedpur, Rangpur during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Tuber yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	15.9	14.3	15.1	15.1
	55	20.1	21.1	25.1	22.1
	110	29.9	28.0	29.0	29.0
	165	29.4	27.0	28.4	28.0
P	0	18.4	16.8	17.6	17.6
	15	25.5	23.8	25.6	24.6
	30	29.9	28.0	29.0	29.0
	45	29.7	27.9	28.8	28.8
K	0	17.8	16.6	17.2	17.2
	35	25.2	24.6	26.4	25.4
	70	29.9	28.0	29.0	29.0
	105	29.2	27.6	28.4	28.4
S	0	21.8	19.8	20.8	20.8
	10	27.3	25.3	26.3	26.3
	20	29.9	28.0	29.0	29.0
	30	29.4	27.4	28.4	28.4

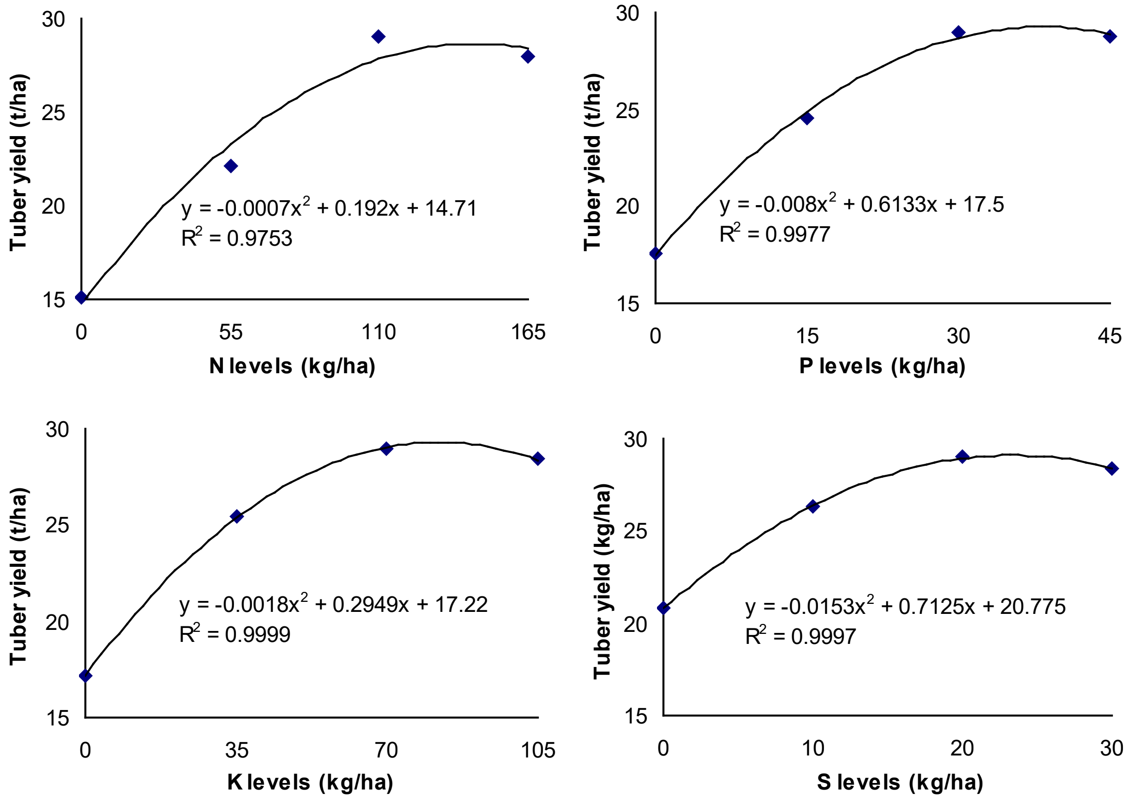


Figure 21. Response of Potato to added N, P, K & S in Potato-Boro-T.Aman rice cropping pattern at Syedpur, Rangpur during 2002-03 to 2004-05

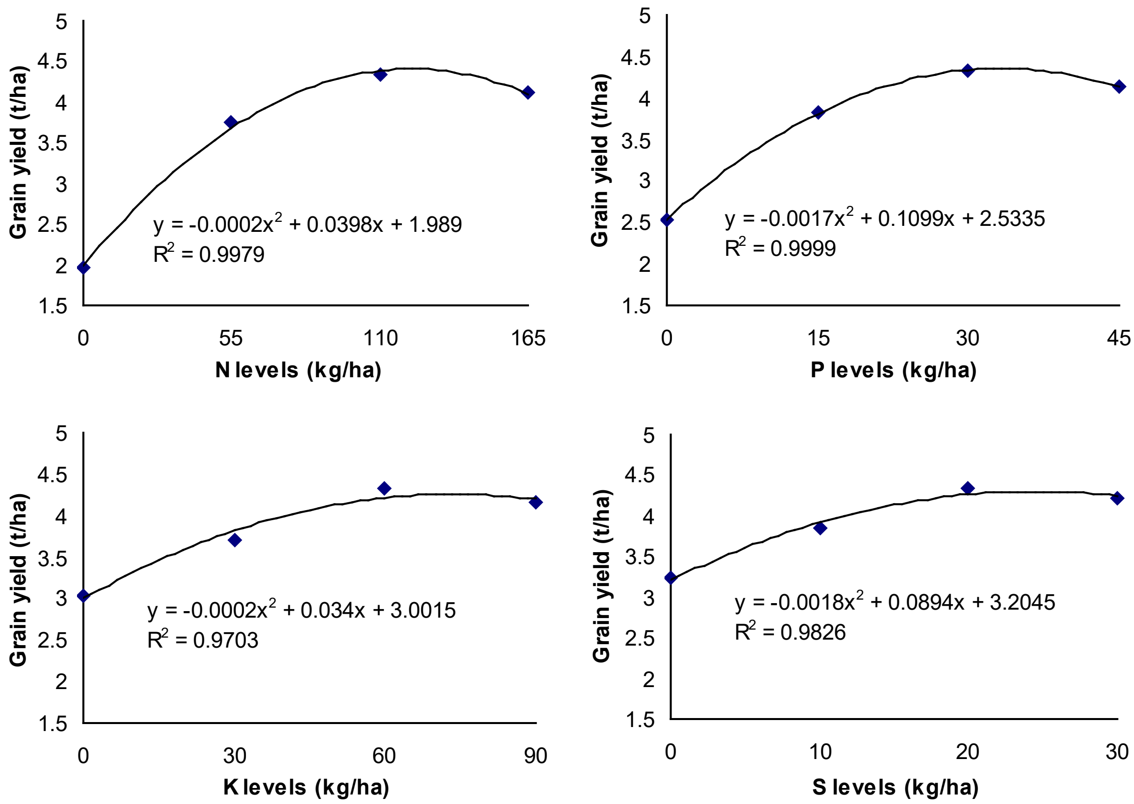


Figure 22. Response of Boro to added N, P, K & S in Potato-Boro-T.Aman rice cropping pattern at Syedpur, Rangpur during 2002-03 to 2004-05

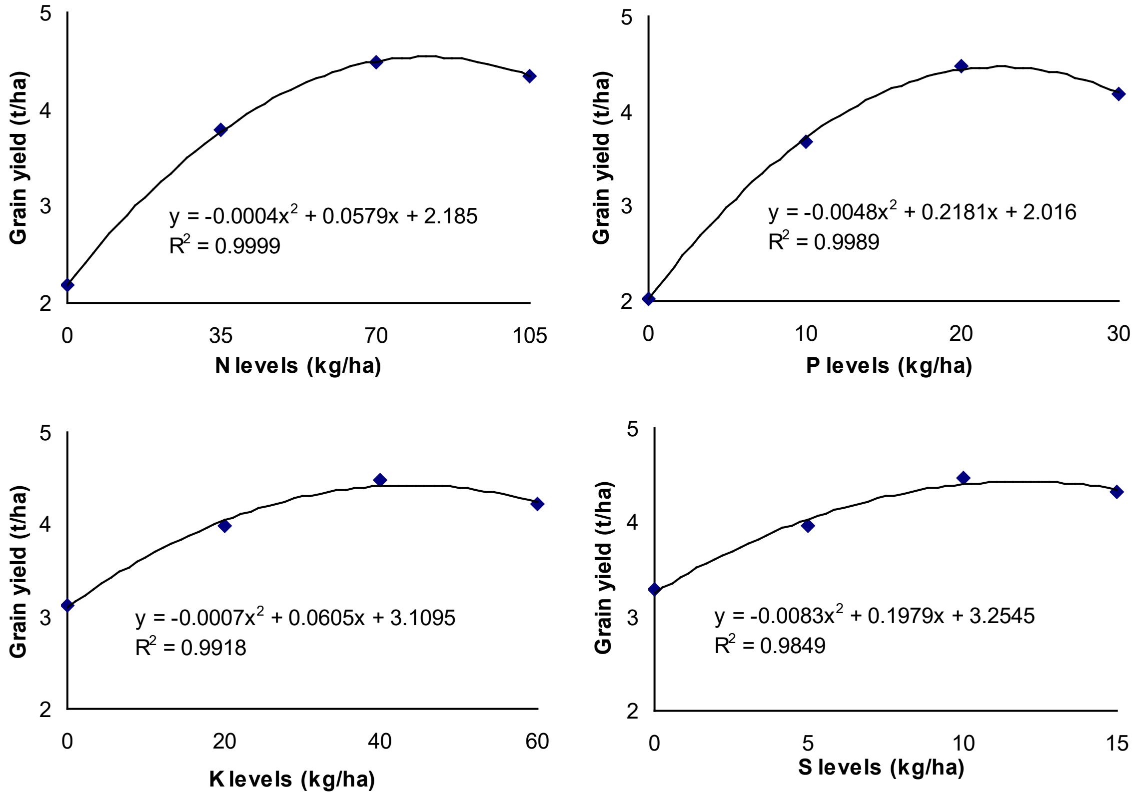


Figure 23. Response of T.Aman to added N, P, K & S in Potato-Boro-T.Aman rice cropping pattern at Syedpur, Rangpur during 2002-03 to 2004-05

Table 22. Effect of different levels of fertilizer nutrients on the yield of Boro rice in Potato-Boro-T.Aman rice cropping pattern at Syedpur, Rangpur during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	2.07	1.89	1.95	1.97
	55	3.93	3.56	3.74	3.74
	110	4.49	4.21	4.30	4.33
	165	4.20	3.90	4.25	4.12
P	0	2.63	2.44	2.54	2.53
	15	3.98	3.65	3.82	3.82
	30	4.49	4.21	4.30	4.33
	45	4.20	3.93	4.27	4.13
K	0	3.15	2.92	3.04	3.04
	30	3.86	3.55	3.70	3.70
	60	4.49	4.21	4.30	4.33
	90	4.24	3.94	4.29	4.16
S	0	3.34	3.11	3.23	3.23
	10	3.99	3.71	3.82	3.84
	20	4.49	4.21	4.33	4.34
	30	4.31	4.07	4.29	4.22

Table 23. Effect of different levels of fertilizer nutrients on the yield of T.Aman rice in Potato-Boro-T.Aman rice cropping pattern at Syedpur, Rangpur during 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	2.42	1.95	2.16	2.18
	35	4.15	3.47	3.79	3.79
	70	4.95	4.03	4.46	4.48
	105	4.71	4.00	4.33	4.35
P	0	2.20	1.93	1.97	2.03
	10	4.02	3.33	3.65	3.67
	20	4.95	4.03	4.46	4.48
	30	4.62	3.80	4.19	4.18
K	0	3.28	3.00	3.11	3.13
	20	4.35	3.62	3.96	3.98
	40	4.95	4.03	4.46	4.48
	60	4.60	3.85	4.20	4.22
S	0	3.54	3.04	3.26	3.28
	5	4.37	3.56	3.94	3.96
	10	4.95	4.03	4.46	4.48
	15	4.73	3.95	4.30	4.33

Cropping pattern : Potato -Boro - T.Aman
Location : Joypurhat, Bogra (AEZ 25)
Year : 2003-04 to 2004-05

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

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

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

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

Crop	Agronomically optimum dose				Economically optimum dose			
	N	P	K	S	N	P	K	S
Potato	130	24	172	21	125	22	150	15
Boro	120	18	80	30	115	15	70	20
T.Aman	90	16	70	20	85	12	60	15

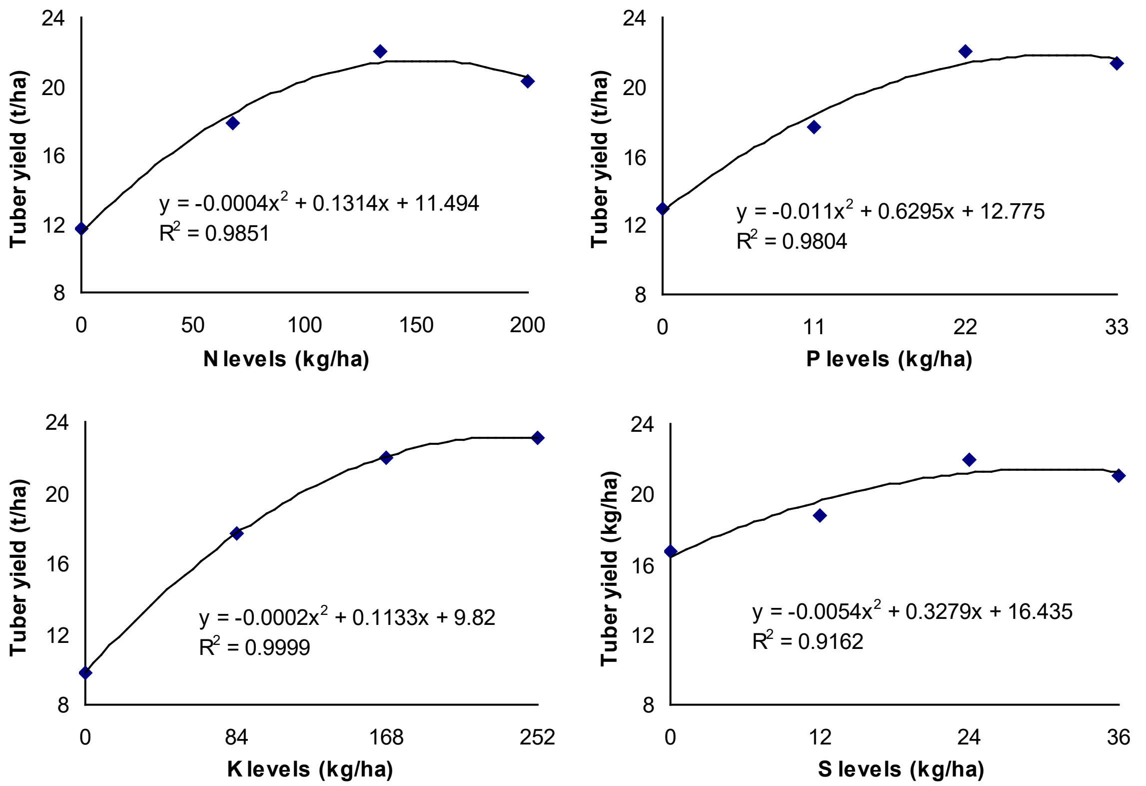


Figure 24. Response of Potato to added N, P, K & S in Potato-Boro-T.Aman rice cropping pattern at Joypurhat during 2003-04 & 2004-05

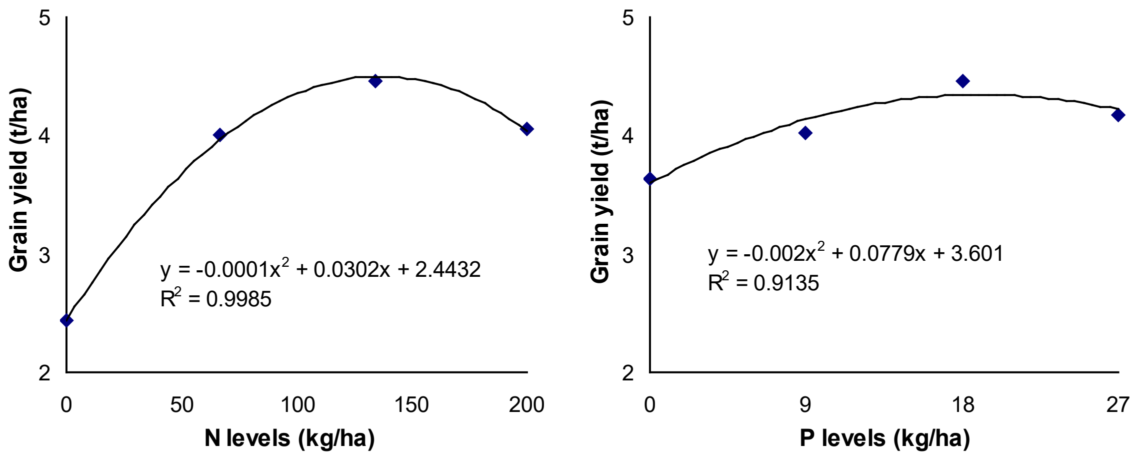


Figure 25. Response of Boro to added N & P in Potato-Boro - T.Aman rice cropping pattern at Joypurhat during 2003-04 & 2004-05

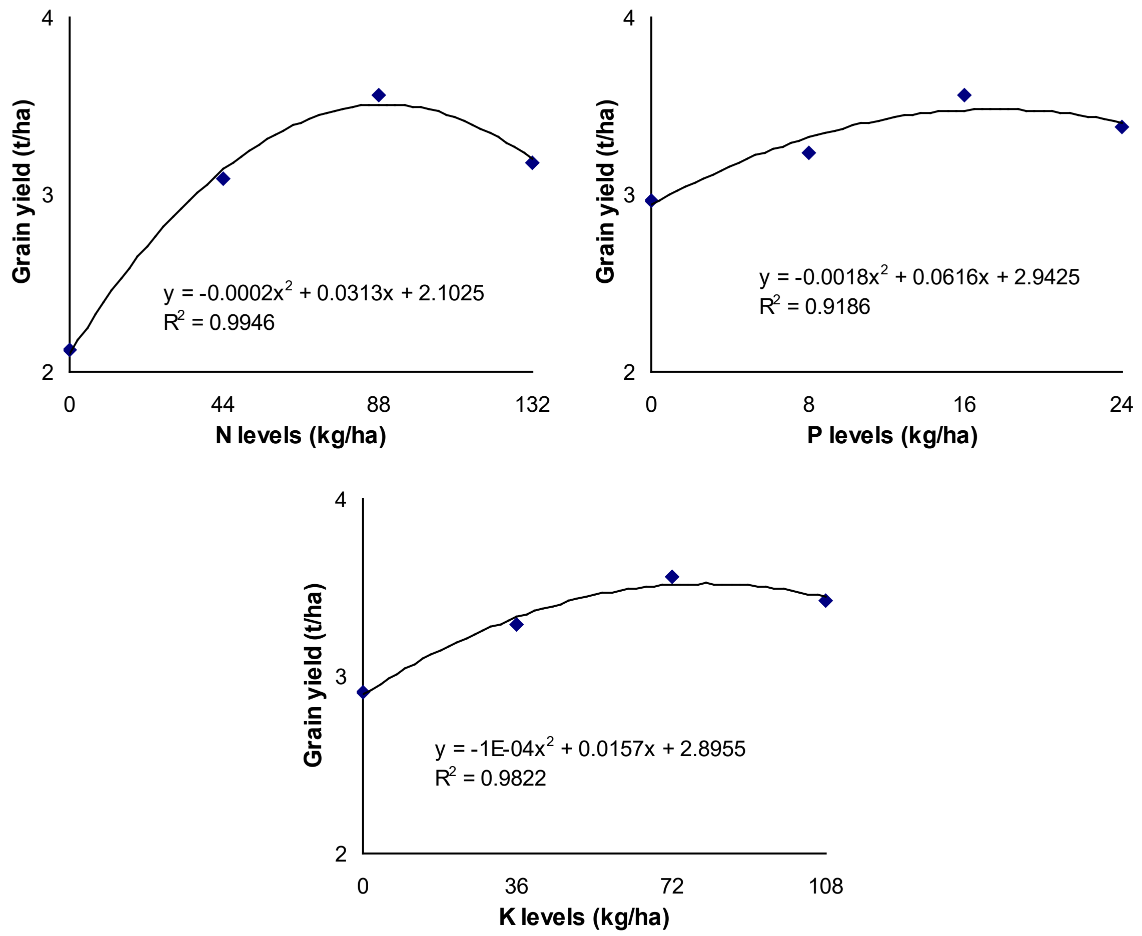


Figure 26. Response of T.Aman to added N, P & K in Potato-Boro-T.Aman rice cropping pattern at Joypurhat during 2003-04 & 2004-05

Table 25. Effect of different levels of fertilizer nutrients on the yield of Potato in Potato-Boro-T.Aman rice cropping pattern at Joypurhat during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Tuber yield (t/ha)		
		2003-04	2004-05	Mean
N	0	12.2	11.2	11.7
	68	18.7	17.0	17.8
	134	23.1	21.0	22.0
	200	21.9	18.7	20.3
P	0	13.8	12.3	13.0
	11	17.5	18.0	17.7
	22	23.1	21.0	22.0
	33	22.9	19.9	21.4
K	0	10.4	9.2	9.8
	84	17.4	18.1	17.7
	168	23.1	21.0	22.0
	252	24.3	22.0	23.1
S	0	17.0	16.4	16.7
	12	18.9	18.7	18.8
	24	23.1	21.0	22.0
	36	21.7	20.4	21.0

Table 26. Effect of different levels of fertilizer nutrients on the yield of Potato in Potato-Boro T.Aman rice cropping pattern at Joypurhat during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.32	2.55	2.43
	67	3.98	4.05	4.01
	134	4.28	4.64	4.46
	200	3.94	4.18	4.06
P	0	3.72	3.56	3.64
	9	4.00	4.04	4.02
	18	4.28	4.64	4.46
	27	4.12	4.24	4.18
K	0	3.91	3.74	3.82
	57	4.18	4.27	4.22
	114	4.28	4.64	4.46
	170	4.22	4.33	4.27
S	0	4.10	4.02	4.06
	15	4.17	4.17	4.17
	30	4.28	4.64	4.46
	45	4.23	4.09	4.16

Table 27. Effect of different levels of fertilizer nutrients on the yield of Potato in Potato-Boro T.Aman rice cropping pattern at Joypurhat during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.09	2.16	2.12
	44	3.05	3.13	3.09
	88	3.57	3.55	3.56
	132	3.29	3.07	3.18
P	0	3.02	2.91	2.97
	8	3.30	3.18	3.24
	16	3.57	3.55	3.56
	24	3.34	3.41	3.38
K	0	2.95	2.87	2.91
	36	3.37	3.21	3.29
	72	3.57	3.55	3.56
	108	3.57	3.29	3.43
S	0	3.26	3.08	3.17
	8	3.33	3.22	3.28
	16	3.57	3.55	3.56
	24	3.42	3.27	3.35

Cropping pattern : Potato-Jute - T.Aman
Location : Melandah, Jamalpur
Year of establishment : 2002-03 to 2004-05

Potato: Average of three years data showed that tuber yield of potato influenced significantly due to different levels of added nitrogen. Tuber yield increased with the increase of nitrogen up to 130 kg/ha of N and after that level tended to decrease. However, the rate of increase was higher up to 90 kg in comparison to 130 kg.

Similarly, a positive response to phosphorus and potassium was also observed on tuber yield of potato. Yield increased markedly up to the application of 30 and 100 kg/ha of P and K, respectively.

Tuber yield did not increase after that level. But the rate of increment was higher up to 20 and 70 kg/ha of P and K.

Jute: Response of jute to added n, P and K was also evident. Fiber yield increased considerably up to the application of N @ 100 kg/ha and thereafter the yield decreased slowly. However, rate of increment was more evident up to 70 kg/ha of nitrogen. Similar trend was observed in case of phosphorus and potassium and the highest yield was recorded from 12 and 55 kg/ha of P and K, respectively. But the rate of increment was higher up to 10 and 40 kg/ha of P and K.

T.Aman rice: Response of nitrogen was found on the yield of T.Aman rice. Grain yield increased markedly with the increase of nitrogen up to 90 kg/ha but the rate of increase was higher up to 60 kg/ha of N.

In case of phosphorus and potassium grain yield increased appreciably up to 8 and 30 kg/ha of P and K and after that level yield also increased slowly up to 10 and 40 kg/ha of P and K.

The soil was initially deficient in NPK and the status was very low to low. That's why a considerable response of crops to added nutrients was observed. From the average data a response curve was drown and the optimum dose of N, P and K was find out.

Crop	Agronomically optimum dose (kg/ha)				Economically optimum dose (kg/ha)			
	N	P	K	S	N	P	K	S
Potato	140	30	105	-	128	27	90	-
Jute	100	13	55	-	90	10	48	-
T.Aman	95	11	40	-	88	8	35	-

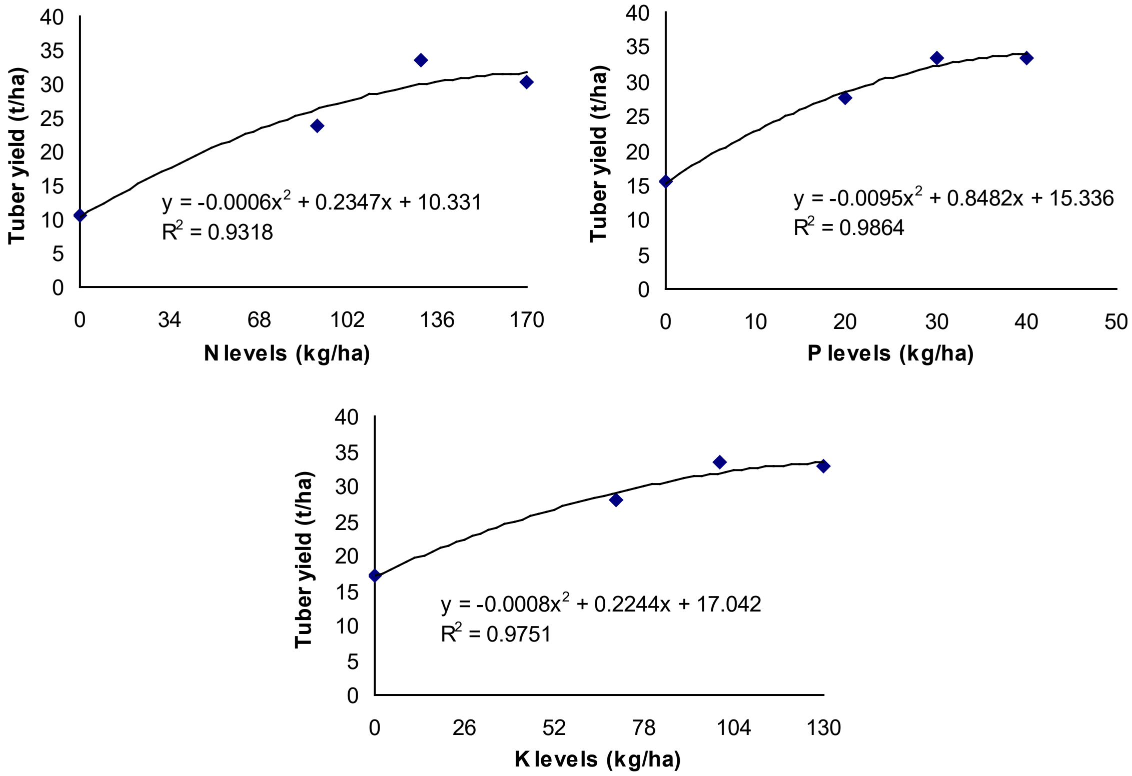


Figure 27. Response of Potato to added N, P & K in Potato-Jute-T.Aman cropping pattern at Melandah, Jamapur during 2002-03 to 2004-05

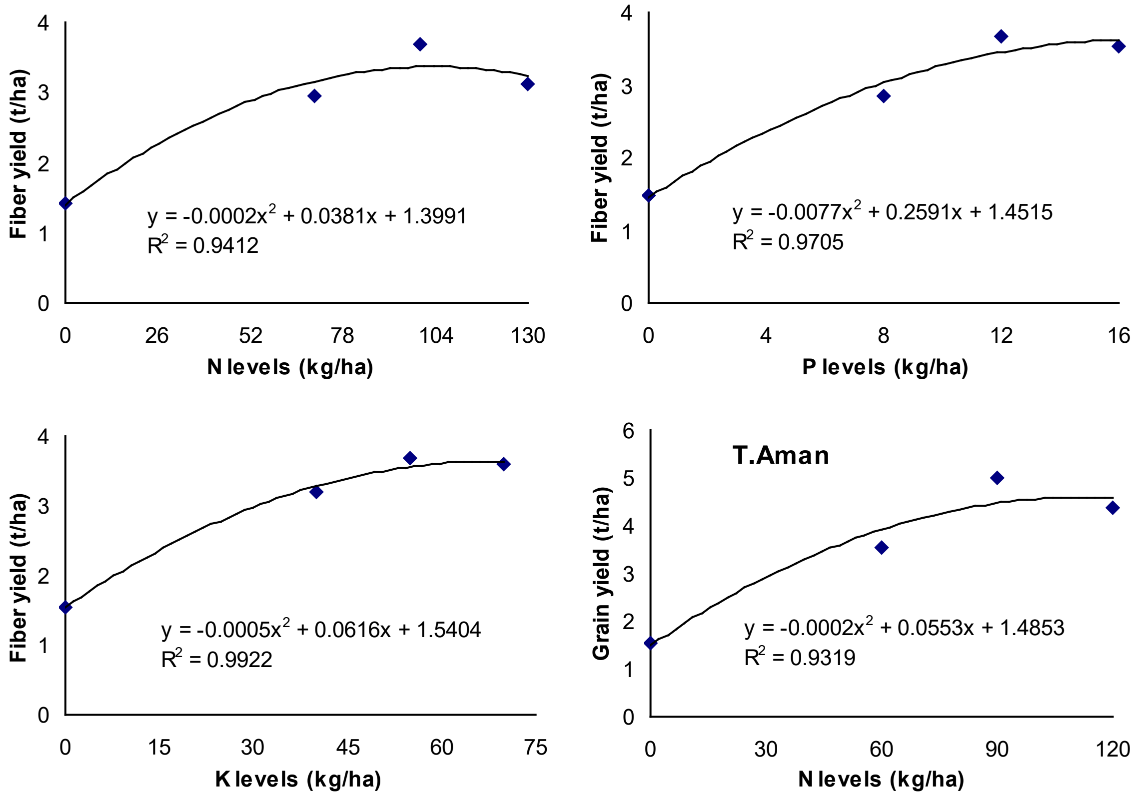


Figure 28. Response of Jute to added N, P & K and T.Aman to added N in Potato-Jute-T.Aman cropping pattern at Melandah, Jamapur during 2002-03 to 2004-05

Table 28. Effect of different level of fertilizer nutrients on the yield of Potato in Potato-Jute-T.Aman cropping pattern at Melandah, Jamalpur during 2002-03 to 2004-05

Fertilizer level	Tuber/Fiber/Grain yield (t/ha)			
	2002-03	2003-04	2004-05	Average
N level (kg/ha)				
0	10.1	11.2	10.8	10.7
90	23.9	25.0	22.1	23.7
130	33.4	34.6	32.5	33.5
170	30.7	31.2	29.0	30.3
P level (kg/ha)				
0	15.0	17.0	14.6	15.5
20	27.9	28.8	25.9	27.5
30	33.4	34.6	32.5	33.5
40	33.0	35.0	32.6	33.5
K level (kg/ha)				
0	16.5	17.0	18.0	17.2
70	28.5	29.1	26.0	27.9
100	33.4	34.6	32.5	33.5
130	33.0	33.6	31.9	32.8

Table 29. Effect of different level of fertilizer nutrients on the yield of Jute in Potato-Jute-T.Aman cropping pattern at Melandah, Jamalpur during 2002-03 to 2004-05

Fertilizer level	Tuber/Fiber/Grain yield (t/ha)			
	2002-03	2003-04	2004-05	Average
N level (kg/ha)				
0	1.35	1.51	1.42	1.43
70	2.84	3.05	2.93	2.94
100	3.25	4.00	3.78	3.68
130	3.04	3.45	2.87	3.12
P level (kg/ha)				
0	1.40	1.57	1.48	1.48
8	2.92	2.82	2.85	2.86
12	3.25	4.00	3.78	3.68
16	3.01	3.89	3.71	3.54
K level (kg/ha)				
0	1.48	1.62	1.56	1.55
40	3.04	3.65	2.91	3.20
55	3.25	4.00	3.78	3.68
70	3.15	3.98	3.65	3.59

Table 30. Effect of different level of fertilizer nutrients on the yield of T.Aman in Potato-Jute-T.Aman cropping pattern at Melandah, Jamalpur during 2002-03 to 2004-05

Fertilizer level	Grain yield (t/ha)			
	2002-03	2003-04	2004-05	Average
N level (kg/ha)				
0	1.65	1.44	1.55	1.55
60	3.72	3.42	3.45	3.53
90	4.97	5.07	4.92	4.99
120	4.67	4.37	4.12	4.39
P level (kg/ha)				
0	2.98	2.83	3.53	3.11
8	4.21	4.02	4.12	4.12
10	4.97	5.07	4.92	4.99
12	4.62	4.45	4.50	4.64
K level (kg/ha)				
0	3.66	3.43	3.56	3.55
30	4.45	4.30	4.38	4.38
40	4.97	5.07	4.92	4.99
50	4.78	4.58	4.68	4.68

Cropping pattern : Potato-Jute-T.Aman rice
Location : Paba, Rajshahi
Year : 2003-04 to 2004-05

Potato: A considerable response of potato to nitrogen was observed. Tuber yield of Potato increased markedly with increase of nitrogen up to 80 kg/ha and after that level yield also found increasing but at a slower rate up to 160 kg/ha. Response of Potato to P and K was also observed to some extent. Yield increased up to 10 and 30 kg/ha of P and K, respectively. But response to S was not found.

Jute: Fibre yield of Jute increase markedly with the increase of N up to 50 kg/ha and after that yield slowly increase up to 100 kg/ha of N. But response of Jute to P, K and S was not evident.

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

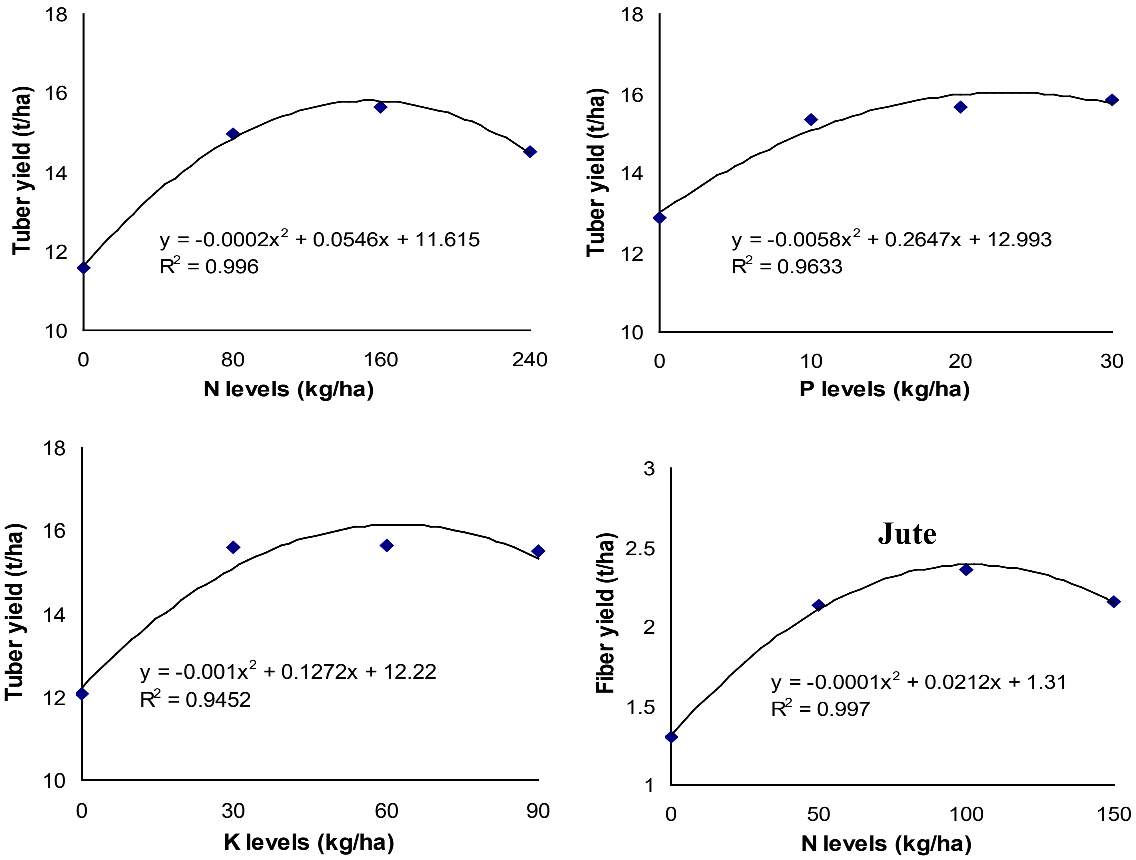


Figure 29. Response of Potato to added N, P & K and Jute to added N in Potato-Jute-T.Aman cropping pattern at Paba, Rajshahi during 2003-04 to 2004-05

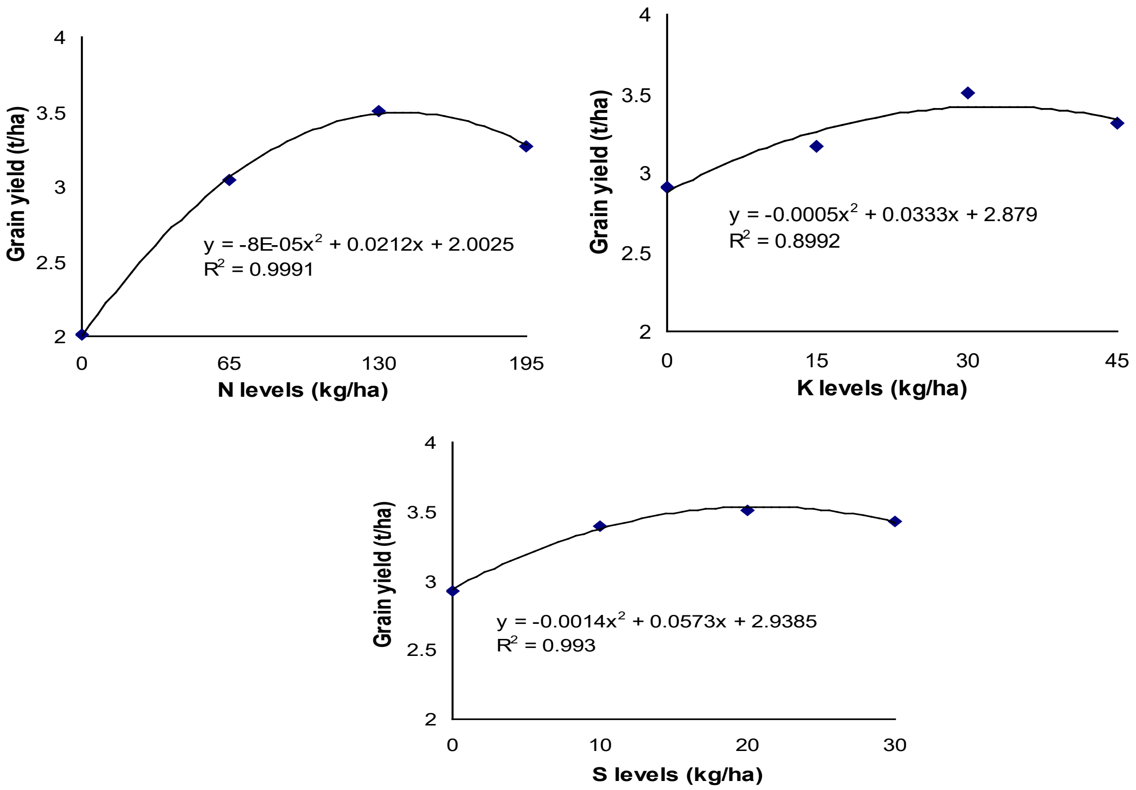


Figure 30. Response of T.Aman to added N, P & K in Potato-Jute-T.Aman cropping pattern at Paba, Rajshahi during 2003-04 to 2004-05

Table 31. Effect of different levels of fertilizer nutrients on the yield of crops in Potato-Jute-T.Aman cropping pattern at Paba, Rajshahi during 2003-04 to 2004-05 (average)

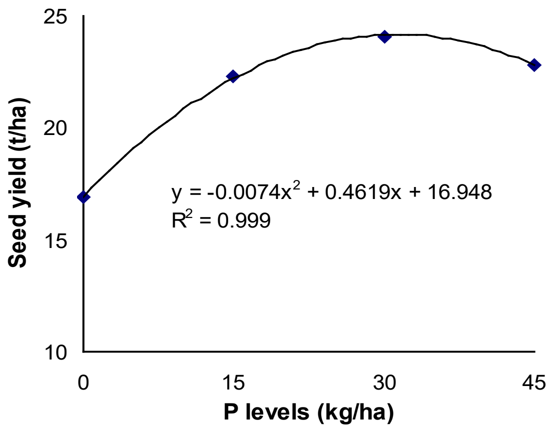
Nutrient	Levels (kg/ha)			Tuber/Fibre/Grain yield (t/ha)		
	Potato	Jute	T.Aman	Potato	Jute	T.Aman
N	0	0	0	11.57	1.30	2.01
	80	50	65	14.98	2.14	3.04
	160	100	130	15.67	2.36	3.51
	240	150	195	14.53	2.16	3.27
P	0	0	0	12.89	2.09	3.15
	10	6	6	15.37	2.30	3.46
	20	12	12	15.67	2.36	3.51
	30	18	18	15.84	2.51	3.47
K	0	0	0	12.06	2.28	2.91
	30	22	15	15.59	2.36	3.17
	60	44	30	15.67	2.36	3.51
	90	66	45	15.50	2.56	3.31
S	0	0	0	14.85	2.16	2.93
	10	10	10	15.28	2.25	3.40
	20	20	20	15.67	2.36	3.51
	30	30	30	15.31	2.30	3.43

Cropping pattern : Potato-Mungbean - T.Aman
Location : Bagherpara, Jessore (AEZ 11)
Year : 2003-04 to 2004-05

Potato: Response of Potato to nitrogen was found. Tuber yield increased appreciably with the increase of nitrogen up to140 kg/ha and then trended to decline. Similarly, response to P was observed to some extent. Tuber yield increased up to 30 kg/ha of P.

Mungbean: No considerable response of Mungbean to added NPK was found. However, seed yield increased slowly up to 28 kg/ha and 16 kg/ha kg/ha of NP, respectively.

T.Aman: Response of T.Aman rice to nitrogen was observed to some extent. Grain yield increased appreciably with the increase of N up to 70 kg/ha of N and after that level yield increased slowly up to 140 kg/ha. But response to added phosphorus was not observed at all.



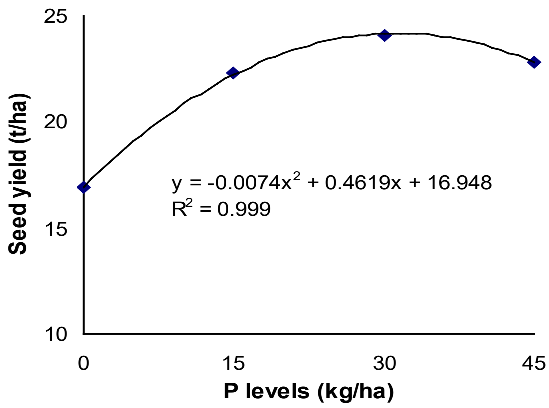
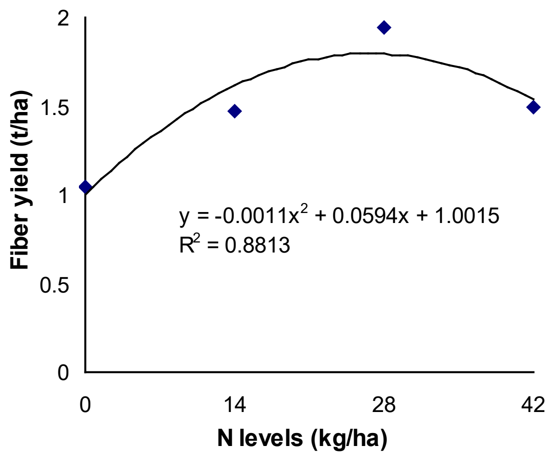


Figure 31. Response of Potato to added N & P in Potato-Mungbean-T.Aman cropping pattern at Bagherpara, Jessore during 2003-04 & 2004-05



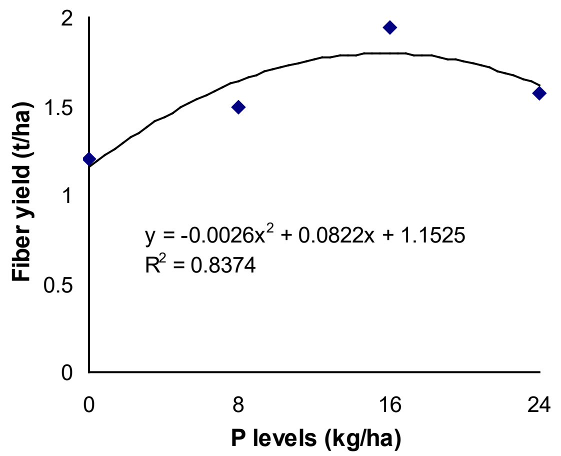


Figure 32. Response of Mungbean to added N & P in Potato-Mungbean-T.Aman cropping pattern at Bagherpara, Jessore during 2003-04 & 2004-05

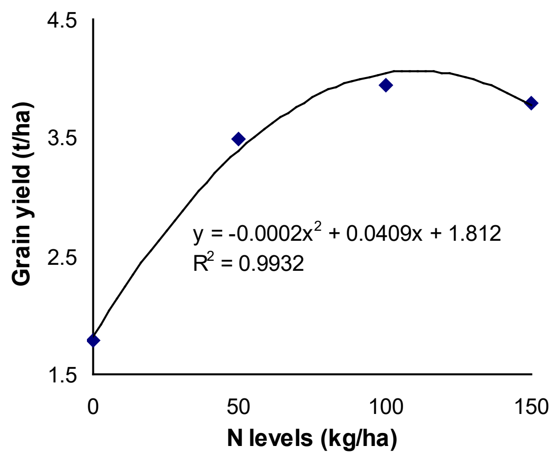


Figure 33. Response of T.Aman to added N & P in Potato-Mungbean-T.Aman cropping pattern at Bagherpara, Jessore during 2003-04 & 2004-05

Table 32. Effects of different levels of fertilizer nutrients on the yield of Potato in Potato-Mungbean-T.Aman cropping pattern at Bagherpara, Jessore during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2004-05	Mean
N	0	12.42	13.92	13.17
	70	22.62	21.80	22.21
	140	24.43	23.67	24.05
	210	22.51	22.84	22.67
P	0	17.60	16.23	16.91
	15	22.19	22.47	22.33
	30	24.43	23.67	24.05
	45	23.03	22.64	22.83

Table 33. Effects of different levels of fertilizer nutrients on the yield of Mungbean in Potato-Mungbean-T.Aman cropping pattern at Bagherpara, Jessore during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	1.03	1.07	1.05
	14	1.40	1.55	1.47
	28	1.82	2.06	1.94
	42	1.20	1.78	1.49
P	0	1.18	1.22	1.20
	8	1.19	1.82	1.50
	16	1.42	2.06	1.94
	24	1.19	1.95	1.57

Table 34. Effects of different levels of fertilizer nutrients on the yield of T.Aman in Potato-Mungbean-T.Aman rice cropping pattern at Bagherpara, Jessore during 2003-04 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.17	1.40	1.78
	50	4.10	2.88	3.49
	100	4.54	3.36	3.95
	150	4.30	3.31	3.80
P	0	3.73	3.17	3.45
	8	4.07	3.21	3.64
	16	4.54	3.36	3.95
	24	4.31	3.11	3.71

Cropping pattern : Lentil-Jute - T.Aman
Location : Magura, Jessore (AEZ 11)
Year : 2003-04 to 2004-05

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

Jute: A considerable response of jute to N and P was found. Fibre yield increased with the increase of nutrients levels. Fiber yield of jute increased sharply up to 45kg/ha of N and there after gradually increase up to 90 kg/ha of nitrogen. Similarly, yield increased appreciably up to 12 kg/ha of P. After that level yield was found increasing but a slower rate up to 24 kg/ha of phosphorus.

T.Aman: Response of T.Aman rice to nitrogen and phosphorus was also observed to some extent. Grain yield increased with the increase of N and P level up to 80 and 20 kg/ha of N and P. Initially the soil was deficit in nitrogen and phosphorus and a considerable response was found towards the yield. But status of K and S was quite satisfactory and therefore, K and S was not included in the study.

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 (kg/ha)		Economically optimum dose (kg/ha)	
	N	P	N	P
Lentil	20	28	16	25
Jute	90	26	84	20
T.Aman	85	22	80	15

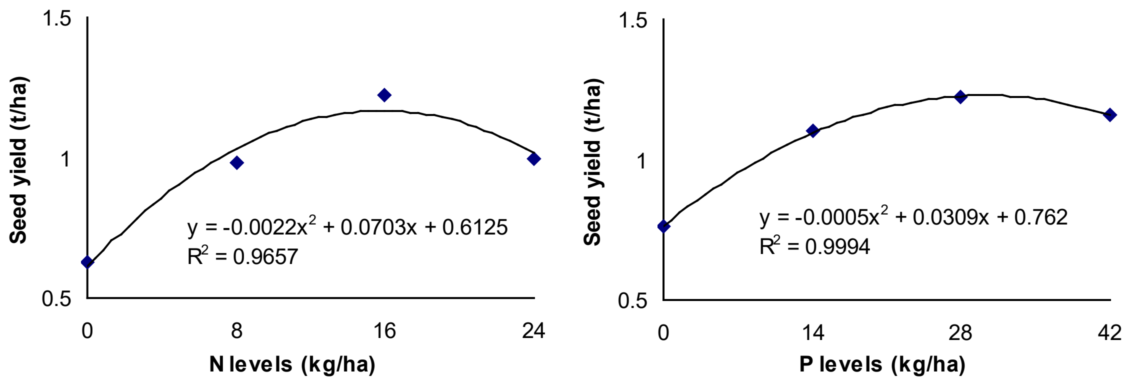


Figure 34. Response of Lentil to added N & P in Lentil-Jute-T.Aman cropping pattern at Magura, Jessore during 2003-04 & 2004-05

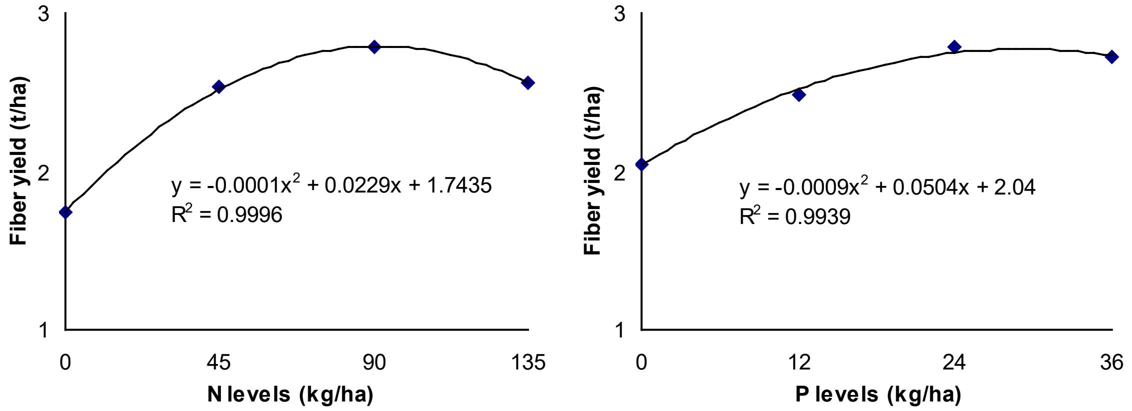


Figure 35. Response of Jute to added N & P in Lentil-Jute-T.Aman cropping pattern at Magura, Jessore during 2003-04 & 2004-05

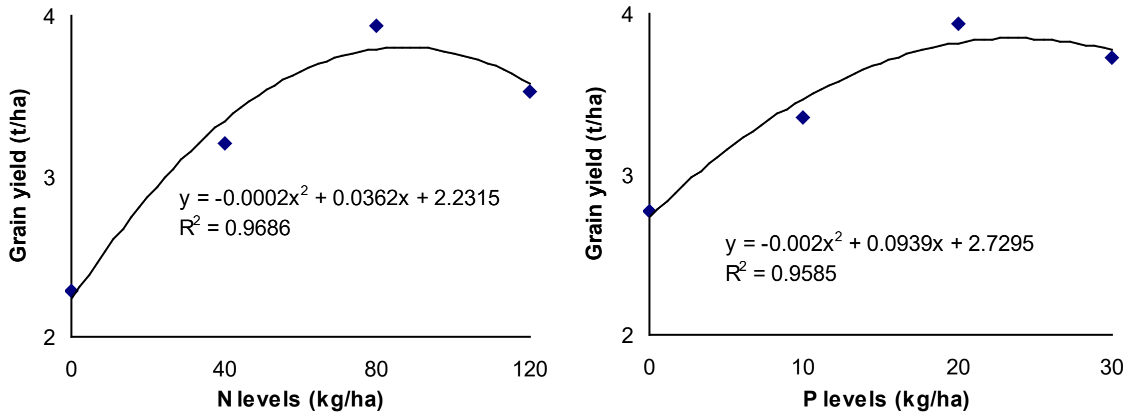


Figure 36. Response of T.Aman to added N & P in Lentil-Jute-T.Aman cropping pattern at Magura, Jessore during 2003-04 & 2004-05

Table 35. Effects of different levels of fertilizer nutrients on the yield of Lentil in Lentil-Jute-T.Aman cropping pattern at Magura, Jessore during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2004-05	Mean
N	0	0.64	0.62	0.63
	8	1.01	0.96	0.98
	16	1.24	1.20	1.22
	24	1.03	0.98	1.00
P	0	0.75	0.69	0.70
	14	1.14	1.06	1.10
	28	1.24	1.20	1.22
	42	1.20	1.12	1.16

Table 36. Effects of different levels of fertilizer nutrients on the yield of Jute in Lentil-Jute-T.Aman cropping pattern at Magura, Jessore, during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	1.98	1.50	1.74
	45	2.34	2.73	2.53
	90	2.48	3.08	2.78
	135	2.24	2.89	2.56
P	0	1.97	2.13	2.05
	12	2.43	2.55	2.49
	24	2.48	3.08	2.78
	36	2.47	2.98	2.72

Table 37. Effects of different levels of fertilizer nutrients on the yield of T.Aman rice in Lentil-Jute-T.Aman cropping pattern at Magura, Jessore, 2003-04 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.26	2.31	2.28
	40	3.23	3.18	3.20
	80	3.68	4.20	3.94
	120	3.12	3.34	3.23
P	0	2.87	2.67	2.77
	10	2.93	3.18	3.05
	20	3.68	4.20	3.94
	30	3.42	4.05	3.73

Cropping pattern : Lentil-Jute-T.Aman
Location : Keshobpur, Jessore (AEZ 11)
Year : 2003-04 to 2004-05

Lentil: Response of Lentil to nitrogen was not found. Seed yield did not increase appreciably with the increase of nitrogen. Similarly response to P and K was also not observed at all. During 2003-04 response to added nutrient was found to some extent but in 2004-05 no response was observed at all.

Jute: A considerable response of Jute to nitrogen was found. Fibre yield of Jute increased with the increase of nitrogen levels. The highest yield was found with 80 kg/ha of N. But response to P and K was not evident.

T.Aman: Response of T.Aman rice to nitrogen was observed to some extent. Grain yield increased appreciably with the increase of N level up to 70 kg/ha. But response to P and K was not evident.

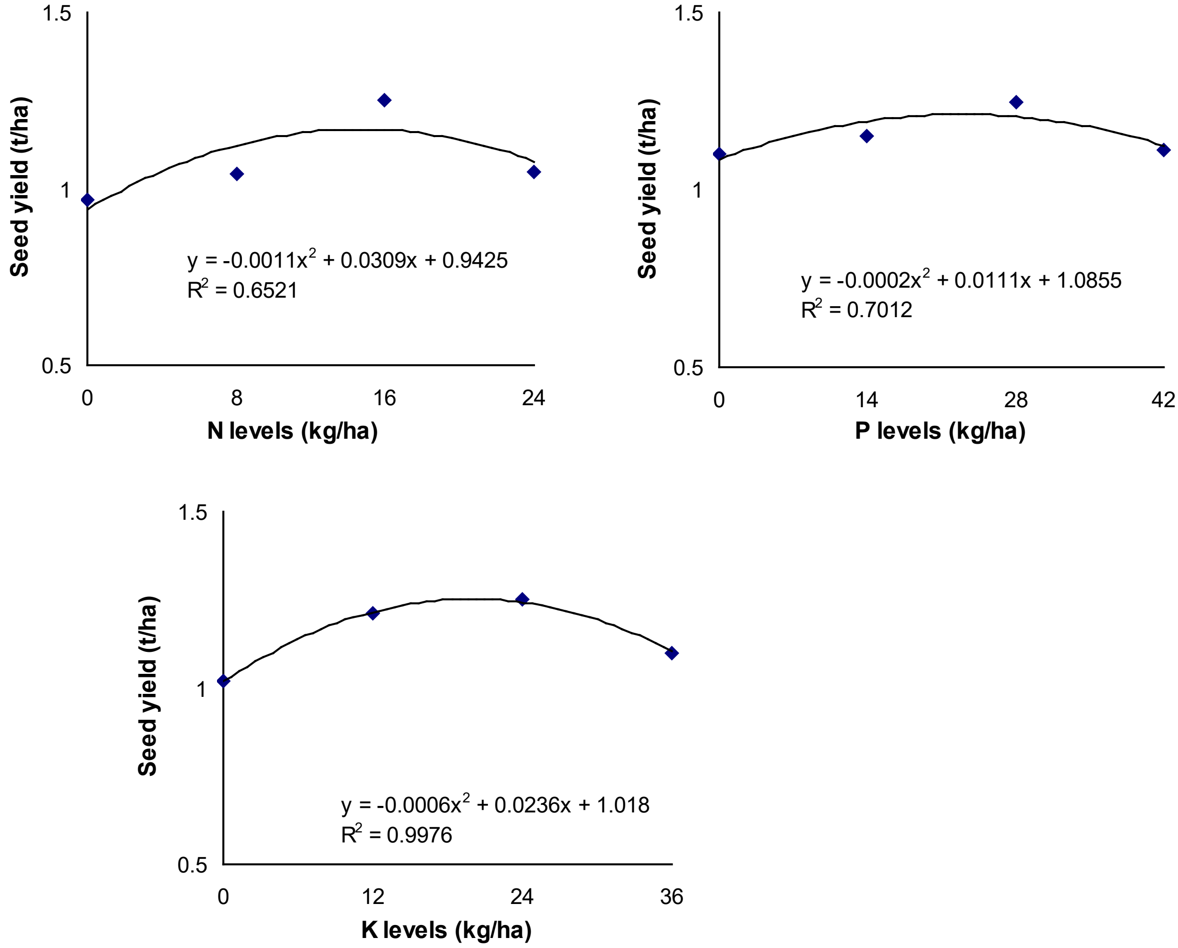
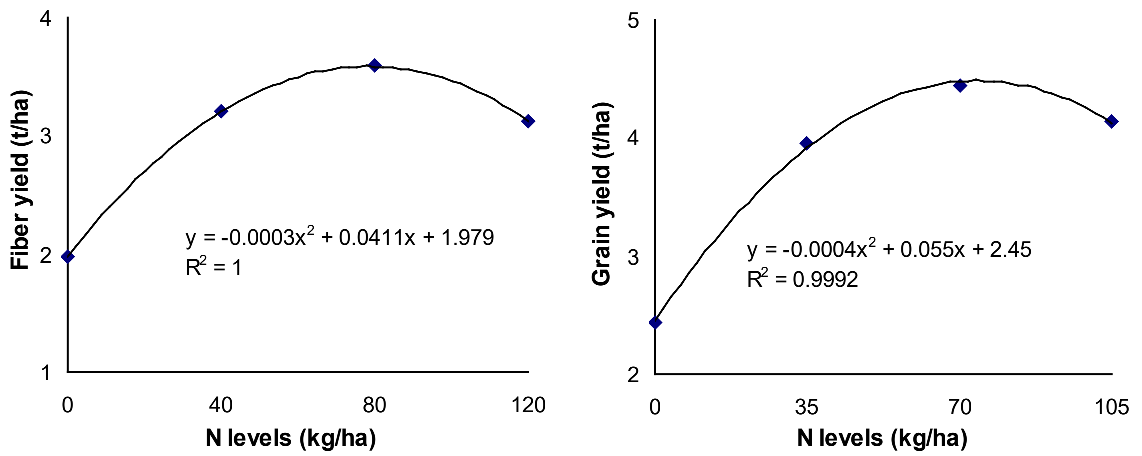


Figure 37. Response of Lentil to added N, P & K in Lentil-Jute-T.Aman cropping pattern at Keshobpur, Jessore during 2003-04 & 2004-05



Jute **T.Aman**

Figure 38. Response of Jute and T.Aman to added N in Lentil-Jute-T.Aman cropping pattern at Keshobpur, Jessore during 2003-04 & 2004-05

Table 38. Effects of different levels of fertilizer nutrients on the yield of Lentil in Lentil-Jute-T.Aman cropping pattern at Keshobpur, Jessore during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2004-05	Mean
N	0	0.95	0.99	0.97
	8	1.08	1.01	1.04
	16	1.38	1.12	1.25
	24	1.12	0.99	1.05
P	0	1.22	0.99	1.10
	14	1.23	1.08	1.15
	28	1.38	1.12	1.25
	42	1.25	0.97	1.11
K	0	1.08	0.97	1.02
	12	1.37	1.05	1.21
	24	1.38	1.12	1.25
	36	1.21	0.99	1.10

Table 39. Effects of different levels of fertilizer nutrients on the yield of Jute in Lentil-Jute-T.Aman cropping pattern at Keshobpur, Jessore, during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	1.95	2.01	1.98
	40	3.10	3.30	3.20
	80	3.42	3.76	3.59
	120	3.22	3.05	3.13
P	0	3.02	3.25	3.03
	10	3.38	3.44	3.41
	20	3.42	3.76	3.59
	30	3.18	3.45	3.31
K	0	3.15	3.26	3.20
	30	3.18	3.36	3.22
	60	3.42	3.76	3.59
	90	3.18	3.50	3.34

Table 40. Effects of different levels of fertilizer nutrients on the yield of T.Aman rice in Lentil-Jute-T.Aman cropping pattern at Keshobpur, Jessore, 2003-04 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.20	2.68	2.44
	35	3.90	4.00	3.95
	70	4.56	4.35	4.45
	105	4.30	3.98	4.14
P	0	3.93	4.00	3.96
	7	4.20	4.17	4.18
	14	4.56	4.35	4.45
	21	4.10	4.05	4.70
K	0	4.00	3.92	3.96
	16	4.20	4.17	4.18
	32	4.56	4.35	4.45
	48	4.30	4.15	4.22

Cropping pattern : Lentil-Jute - T.Aman
Location : Rajbari, Faridpur (AEZ 12)
Year : 2003-04 to 2004-05

Lentil: Grain yield of lentil did not increase appreciably with the increase of N levels. Lentil is a legume crop and therefore, response to nitrogen was not evident. However, seed yield increased slowly up to16 kg/ha of N and then trended to decline. Similarly, response to P and K was not observed at all. However, grain yield increased slowly up to 24 and 20 kg/ha of P and K, respectively.

Jute: Response of jute to added nitrogen was found to some extent. Fiber yield increased appreciably up to 60 kg/ha of N but after that level yield also found increasing very slowly up to 90 kg/ha of N. But no considerable response of jute to P and K was found.

T.Aman: Response of T.Aman rice to nitrogen was observed to some extent. Grain yield increased with the increase of N level up to 75 kg/ha of N and then trended to decrease. But response to P, K and S was not evident. However, grain yield increased slowly up to 22, 35 and 6 kg/ha of P, K and S, respectively. From the response curve the optimum dose of nutrients were found out.

Crop	Agronomically optimum dose (kg/ha)				Economically optimum dose (kg/ha)			
	N	P	K	S	N	P	K	S
Lentil	20	23	9	21	18	20	8	18
Jute	92	20	45	10	85	20	40	5
T.Aman	66	18	31	6	62	15	27	5

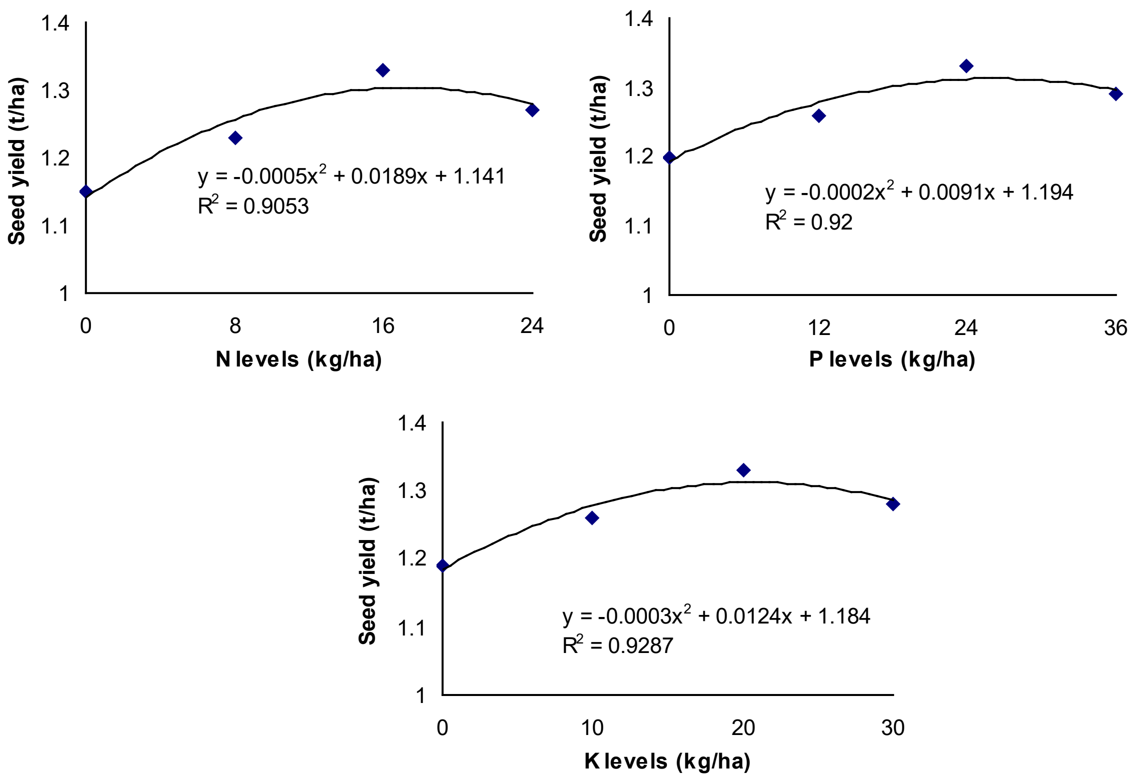


Figure 39. Response of Lentil to added N, P and K in Lentil-Jute-T.Aman cropping pattern at Rajbari during 2003-04 & 2004-05

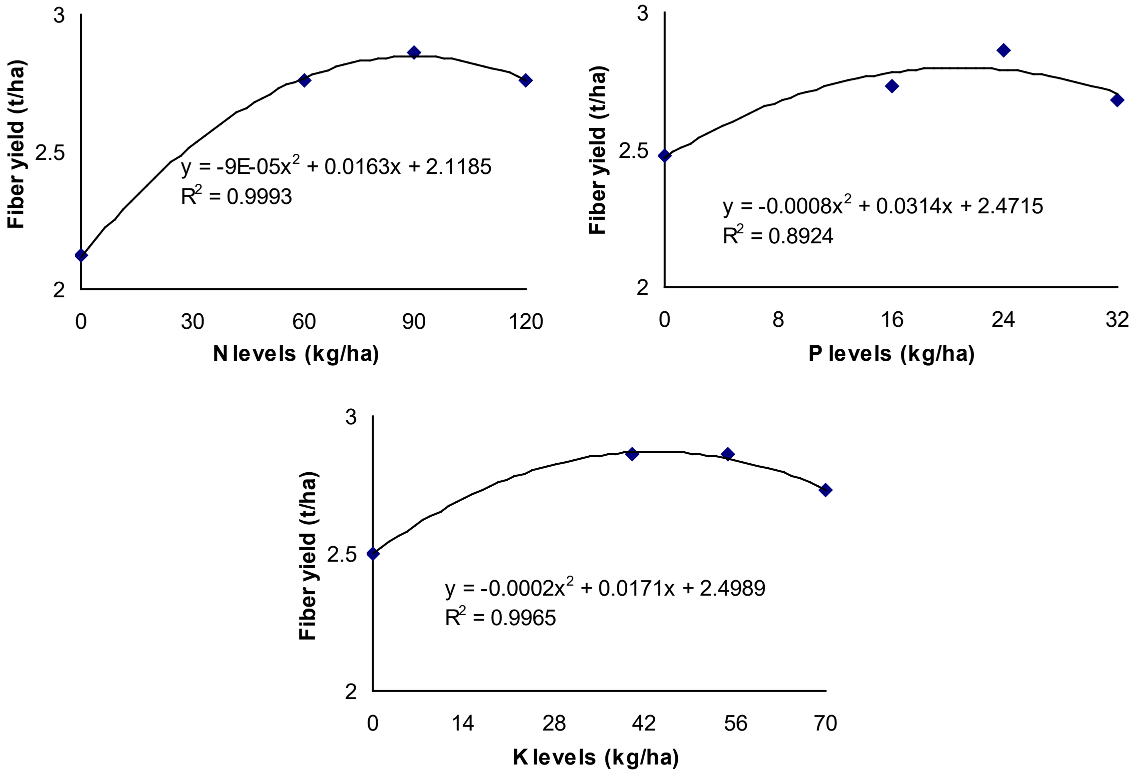


Figure 40. Response of Jute to added N, P and K in Lentil-Jute-T.Aman cropping pattern at Rajbari during 2003-04 & 2004-05

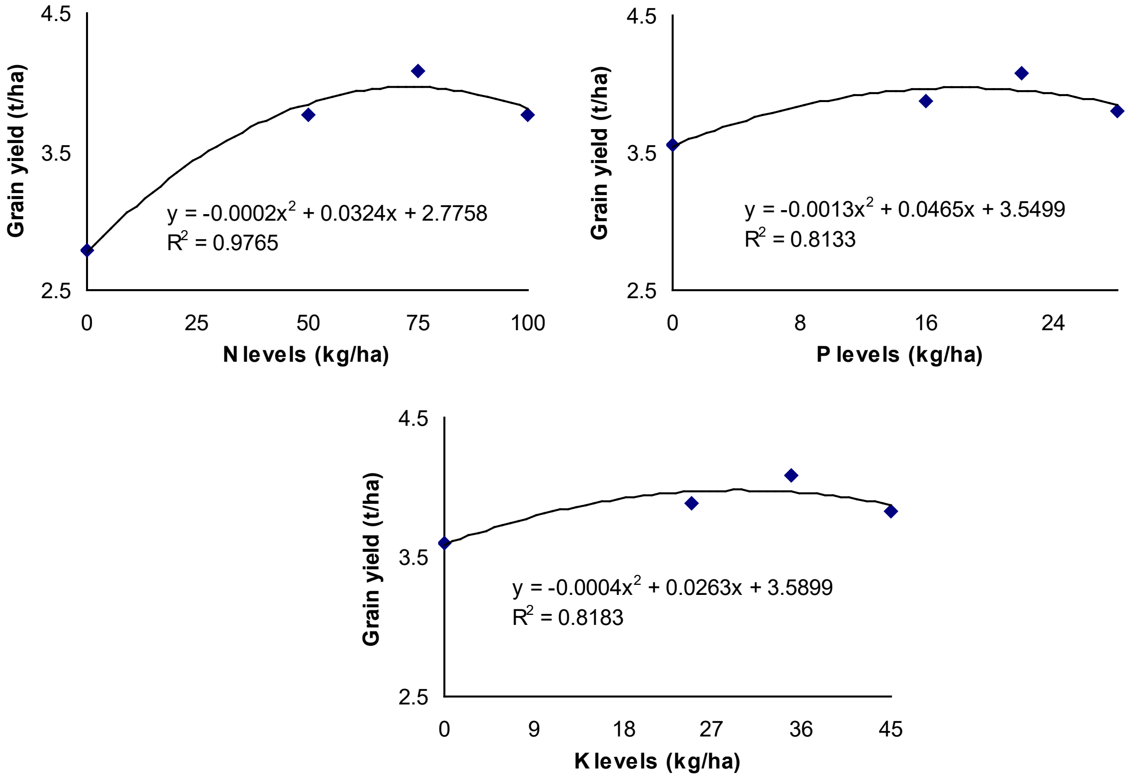


Figure 41. Response of T.Aman to added N, P and K in Lentil-Jute-T.Aman cropping pattern at Rajbari during 2003-04 & 2004-05

Table 41. Effects of different levels of fertilizer nutrients on the yield of Lentil in Lentil-Jute-T.Aman cropping pattern at Rajbari, Faridpur during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Seed yield (t/ha)		
		2003-04	2004-05	Mean
N	0	1.18	1.13	1.15
	8	1.24	1.23	1.23
	16	1.36	1.31	1.33
	24	1.33	1.21	1.27
P	0	1.22	1.19	1.20
	12	1.29	1.23	1.26
	24	1.36	1.31	1.33
	36	1.34	1.24	1.29
K	0	1.25	1.14	1.19
	10	1.30	1.22	1.26
	20	1.36	1.31	1.33
	30	1.34	1.23	1.28

Table 42. Effects of different levels of fertilizer nutrients on the yield of Jute in Lentil-Jute-T.Aman cropping pattern at Rajbari, Faridpur during 2003-04 & 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	2.05	2.19	2.12
	60	2.81	2.71	2.76
	90	2.88	2.84	2.86
	120	2.82	2.71	2.76
P	0	2.38	2.59	2.48
	16	2.78	2.69	2.73
	24	2.88	2.84	2.86
	32	2.70	2.66	2.68
K	0	2.46	2.55	2.50
	40	2.88	2.71	2.86
	55	2.88	2.84	2.86
	70	2.80	2.66	2.73

Table 43. Effects of different levels of fertilizer nutrients on the yield of T.Aman rice in Lentil-Jute-T.Aman cropping pattern at Rajbari, Faridpur during 2003-04 to 2004-05

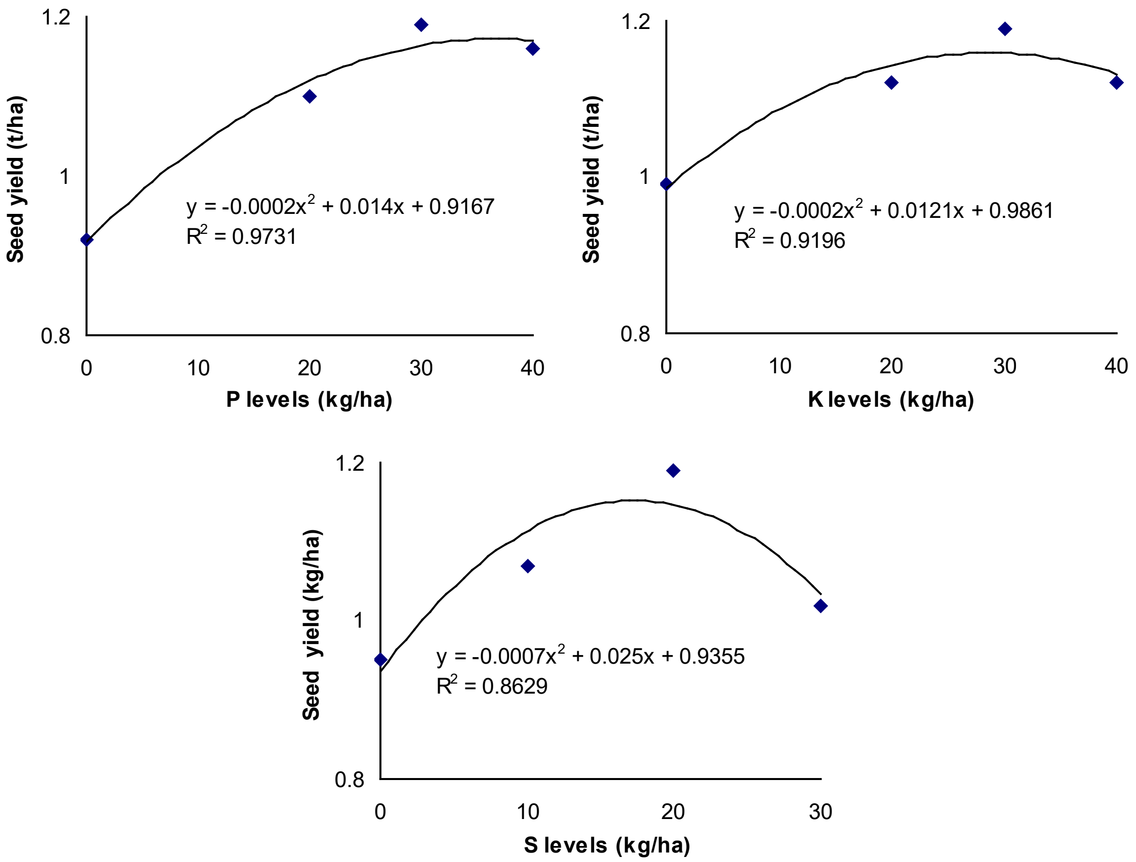
Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
N	0	3.13	2.45	2.79
	50	3.81	3.71	3.76
	75	4.25	3.92	4.08
	100	3.81	3.74	3.77
P	0	3.46	3.67	3.56
	16	3.94	3.83	3.88
	22	4.24	3.92	4.08
	28	3.80	3.81	3.80
K	0	3.56	3.65	3.60
	25	3.96	3.82	3.89
	35	4.24	3.92	4.08
	45	3.87	3.79	3.83

Cropping pattern : Chickpea -T.Aman rice
Location : Barind, Rajshahi
Year : 2002-03 to 2004-05

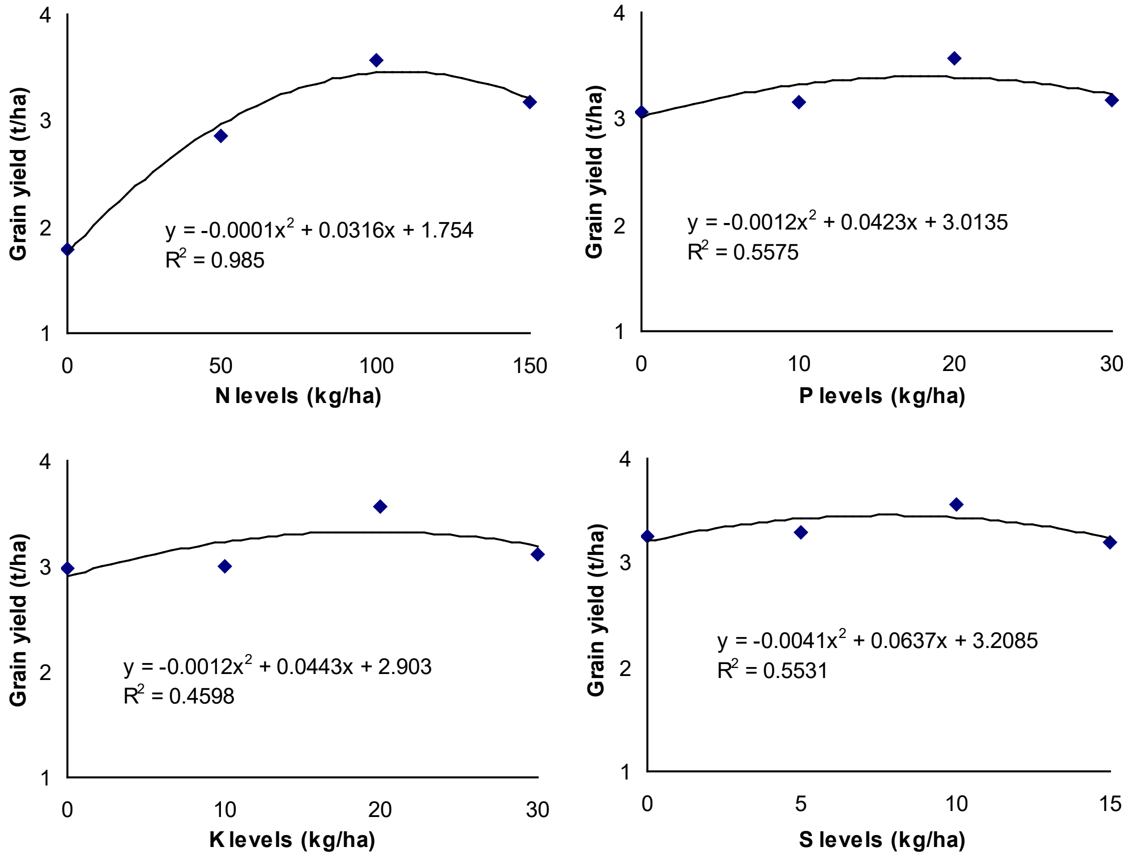
Chickpea: Nitrogen was not included in Chickpea for response study. But response of Chickpea to P, K and S was not very distinct. However, seed yield increased up to 30, 30 and 20 kg/ha of P, K and S, respectively. But the rate of increment was higher up to 15, 20 and 10 kg/ha of P, K and S. More or less similar trend was found over the years.

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. Initial soil status showed that the status of NPK and S was very low, very low, medium and low, respectively. But except nitrogen no considerable response was observed at all.

Crop	Agronomically optimum dose (kg/ha)				Economically optimum dose (kg/ha)			
	N	P	K	S	N	P	K	S
Potato	140	30	105	-	128	27	90	-
Jute	100	13	55	-	90	10	48	-
T.Aman	95	11	40	-	88	8	35	-



Fibure 42. Response of Chickpea to added P, K & S in Chickpea-T.Aman cropping pattern at Chabbishnagar, 2002-03 to 2004-05



Fibure 43. Response of T.Aman to added N, P, K & S in Chickpea-T.Aman cropping pattern at Chabbishnagar, 2002-03 to 2004-05

Table 44. Effect of different level of fertilizer nutrients on the yield of Chickpea in Chickpea-T.Aman cropping pattern at Chabbishnagar, 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
P	0	1.09	0.74	0.93	0.92
	15	1.17	1.07	1.07	1.10
	30	1.30	1.11	1.15	1.19
	45	1.32	1.09	1.07	1.16
K	0	1.31	0.80	0.85	0.99
	20	1.36	1.05	0.95	1.12
	30	1.30	1.11	1.15	1.19
	40	1.24	1.09	1.02	1.12
S	0	1.15	0.76	0.93	0.95
	10	1.15	1.01	1.04	1.07
	20	1.30	1.11	1.15	1.19
	30	1.15	1.01	0.91	1.02

Table 45. Effect of different level of fertilizer nutrients on the yield of T.Aman in Chickpea-T.Aman cropping pattern at Chabbishnagar, 2002-03 to 2004-05

Fertilizer levels (kg/ha)		Grain yield (t/ha)			
		2002-03	2003-04	2004-05	Mean
N	0	1.62	2.05	1.71	1.79
	50	2.98	2.80	2.80	2.86
	100	4.40	3.30	2.98	3.56
	150	3.75	2.94	2.81	3.17
P	0	3.23	3.15	2.83	3.07
	10	3.29	3.25	2.90	3.15
	20	4.40	3.30	2.91	3.56
	30	3.31	3.27	2.94	3.17
K	0	3.27	2.82	2.85	2.98
	10	3.47	2.72	2.80	3.00
	20	4.40	3.30	2.90	3.56
	30	3.59	2.86	2.92	3.12
S	0	3.80	3.09	2.87	3.25
	5	3.78	3.26	2.87	3.30
	10	4.04	3.30	2.90	3.56
	15	3.82	2.98	2.80	3.20

Cropping pattern : Chickpea -T.Aman rice
Location : Nachole, Barind, Rajshahi
Year : 2002-03 to 2004-05

Chickpea: Nitrogen was not included in Chickpea for response study. Average of two years data revealed that response of chickpea to added P, K and S was observed to some extent. Grain yield increased gradually up to 30 kg/ha of P, K and S. Almost similar trend was found in both the years.

T.Aman: Response of T.Aman to nitrogen was observed. Grain yield increased markedly with the increase of N level up to 80 kg/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 soil was deficient in N and S but response was found only with nitrogen.

Table 46. Effect of different level of fertilizer nutrients on the yield of Chickpea in Chickpea-T.Aman cropping pattern at Nachole, Rajshahi during 2002-03 to 2004-05.

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2003-04	2004-05	Mean
P	0	0.89	0.77	0.83
	15	0.98	0.91	0.94
	30	1.13	0.99	1.06
	45	1.07	0.89	0.98
K	0	0.98	0.82	0.90
	20	1.10	0.96	1.03
	30	1.13	0.99	1.06
	40	1.08	0.97	1.02
S	0	0.85	0.75	0.80
	15	1.02	0.95	0.98
	30	1.13	0.99	1.06
	45	1.14	0.97	1.05

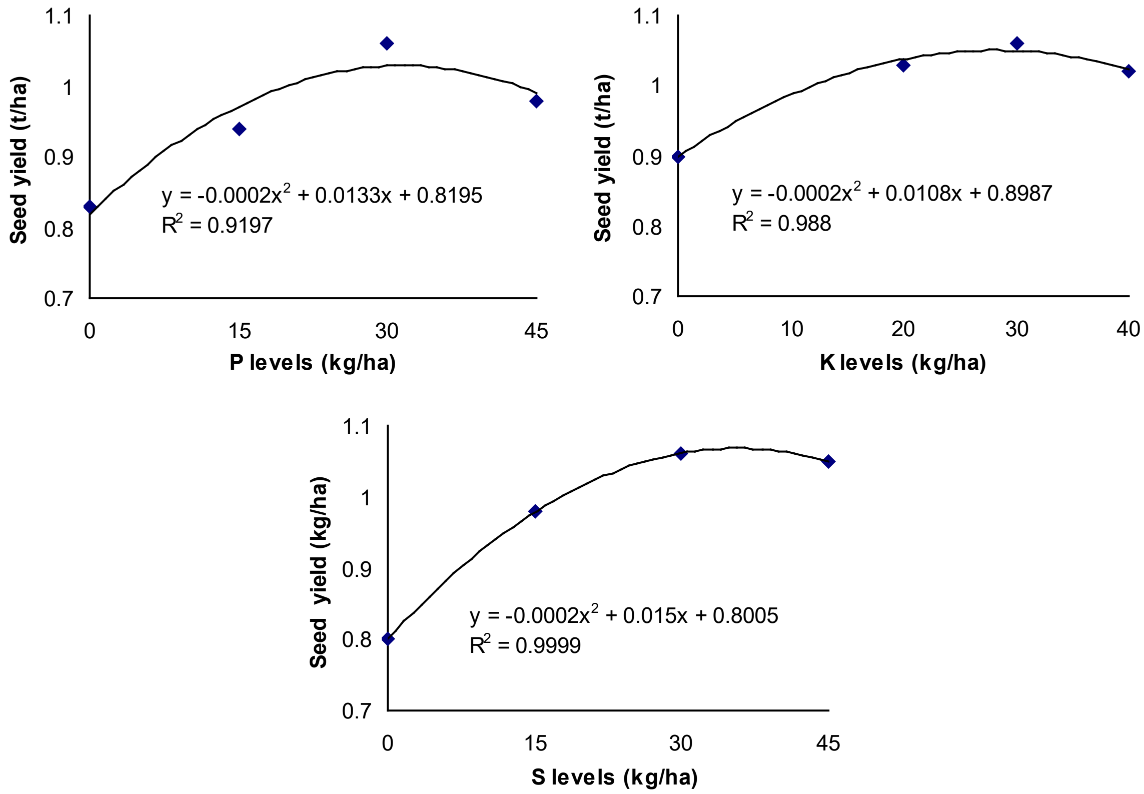


Figure 44. Response of Chickpea to added P, K & S in Chickpea-T.Aman cropping pattern at Nachole, Rajshahi during 2002-03 to 2004-05.

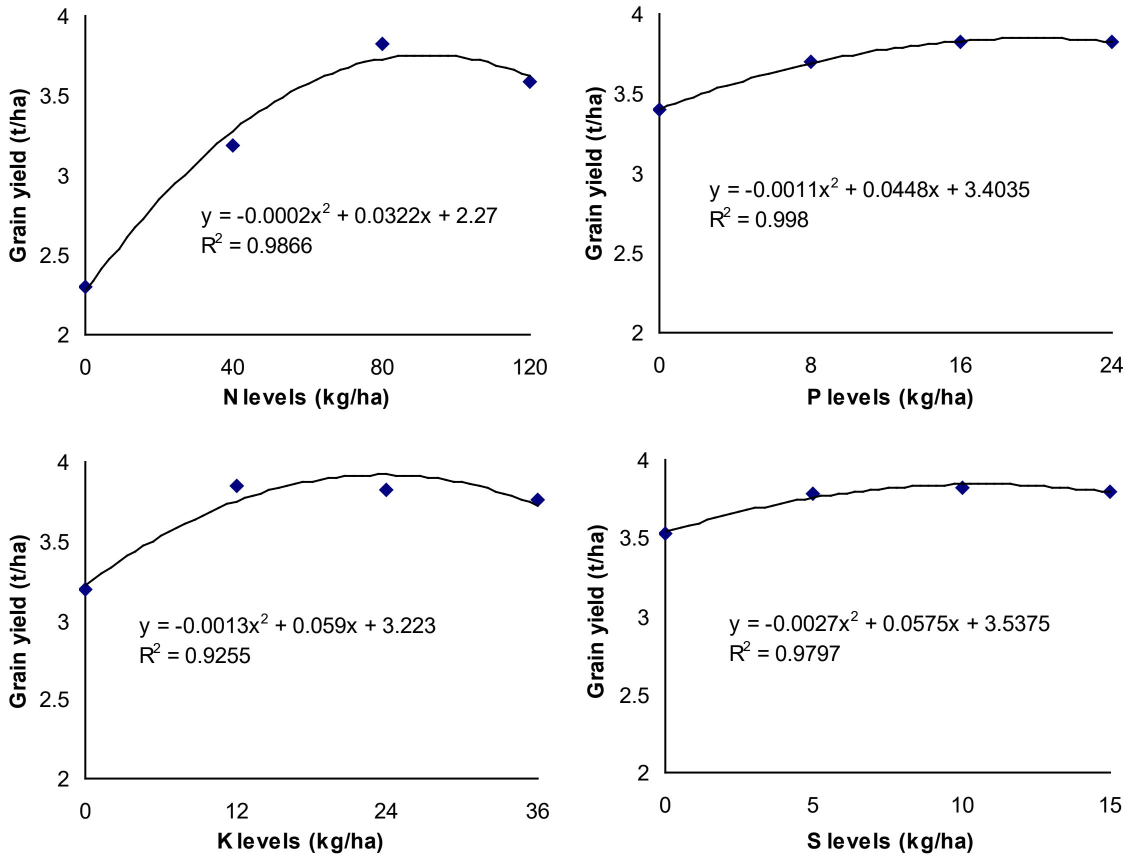


Figure 45. Response of T.Aman to added P, K & S in Chickpea-T.Aman cropping pattern at Nachole, Rajshahi during 2002-03 to 2004-05.

Table 47. Effect of different level of fertilizer nutrients on the yield of T.Aman in Chickpea-T.Aman cropping pattern at Nachole, Rajshahi during 2002-03 to 2004-05.

Fertilizer levels (kg/ha)		Grain yield (t/ha)		
		2004	2005	Mean
N	0	2.55	2.06	2.30
	40	3.37	3.02	3.19
	80	4.01	3.63	3.82
	120	3.61	3.58	3.59
P	0	3.68	3.12	3.40
	8	3.85	3.55	3.70
	16	4.01	3.63	3.82
	24	4.00	3.67	3.83
K	0	3.35	3.03	3.19
	12	4.20	3.50	3.85
	24	4.01	3.63	3.82
	36	3.81	3.72	3.76
S	0	3.75	3.31	3.53
	5	3.91	3.65	3.78
	10	4.01	3.63	3.82
	15	3.85	3.76	3.80

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			
Kishoreganj	MHL	I		0.99	0.11 (L)	0.14 (L)	8.52 (L)	9.56 (L)	-	-
Hathazari (23)	MHL	I	5.23	1.90	0.11 (L)	0.29 (M)	9.83 (L)	6.67 (VL)	-	-
Melandah	MHL	I	5.8	1.55	0.07 (VL)	0.12 (L)	8.9 (L)	14.0 (L)	1.65 (M)	
Palima (9)	MHL	I	5.3	2.08	0.10 (L)	0.12 (L)	5.0 (VL)	51.0 (H)	2.42(H)	-
Narikeli	MHL	I	5.6	1.20	0.07 (VL)	0.62 (O)	8.0 (L)	7.8 (L)	4.0 (M)	0.17 (L)
Paba	MHL	I	8.4	3.83	0.09 (VL)	0.21 (M)	16.0 (M)	6.63 (VL)	2.29 (O)	0.46 (O)
Chabbishnagar	MHL	I	5.7	1.12	0.07 (VL)	0.26 (M)	6.17 (VL)	15.0 (L)	1.22 (M)	0.18 (L)
Nachole	MHL	I	5.8	-	0.07 (VL)	0.20 (M)	16.0 (M)	6.62 (VL)	2.24 (H)	0.46 (O)
Lalmonorhat	MHL	I	5.4	-	0.07 (VL)	0.13 (L)	21.6 (M)	7.35 (VL)	0.31 (VL)	0.44 (M)
Syedpur	MHL	I	6.0	-	0.12 (L)	0.12 (L)	6.33 (VL)	12.8 (L)	0.55 (L)	0.40 (M)
Kushtia	MHL	I	8.1	2.54	0.15 (L)	0.69 (VH)	3.98 (VL)	30.0 (O)	0.82 (L)	0.36 (M)
Magura	MHL	R	-	-	0.12 (L)	0.26 (M)	5.79 (VL)	24.0 (O)	0.48 (L)	-
Keshobpur	MHL	R	-	-	0.14 (L)	0.15 (L)	7.64 (L)	31.1 (O)	0.81 (M)	-
Bagherpara	MHL	I	-	-	0.06 (VL)	0.20 (M)	6.96 (VL)	19.3 (M)	0.95 (M)	-
Chandina	MHL	I	5.8	-	0.12 (L)	0.11 (L)	13.4 (L)	8.4 (L)	1.08 (O)	-
Joypurhat	MHL	I	4.9	-	0.06 (VL)	0.07 (VL)	13.4 (L)	7.15 (VL)	1.66 (O)	-
Gabtali	MHL	I	5.9	-	0.10 (L)	0.07 (VL)	8.49 (L)	8.93 (L)	-	-
Rajbari	MHL	R	7.4	2.85	0.14 (L)	0.19 (M)	6.09 (VL)	19.2 (M)	-	-

Appendix table 2. Crop management practices

Site	Cropping pattern	Variety	Seed rate (kg/ha)	Planting time	Harvesting time
Bagherpara	Potato	Heera	1500	Last week of Nov	2nd week of Feb
	Mungbean	BARI Mung 5	40	3rd week of March	1st week of June
	T.Aman	BRRI dhan 32	40	3rd week of July	4th week of Nov
Keshobpur	Lentil	Local	30	3rd week of Nov	1st week of March
	Jute	O-9897	10	2nd week of April	3rd week of July
	T.Aman	BRRI dhan 32	50	1st week of Aug	2nd week of Nov
Magura	Lentil	Local	30	3rd week of Nov	1st week of March
	Jute	O-9897	10	2nd week of April	3rd week of July
	T.Aman	BRRI dhan 32	50	1st week of Aug	2nd week of Nov
Narikeli	Mustard	Tori-7	08	3rd week of Nov	Last week of Jan
	Boro	BRRI dhan 29	50	1st week of Feb	Last week of May
	T.Aman	BRRI dhan 32	50	3rd week of July	1st week of Nov
Gangni	Wheat	Protiva	100	1st week of Dec.	3rd week of March
	Jute	O-9897	10	1st week of April	2nd week of Aug
	Mungbean	BARI Mung-5	40	Last week of Aug	3rd week of Nov
Melandah	Potato	Cardinal	1800	3rd week of Nov	3rd week of Feb
	Jute	O-9897	08	Last week of Mar.	3rd week of July
	T.Aman	BRRI dhan 33	50	Last week of July	Last week of Oct.
Melandah	Mustard	Tori-7	07	4th week of Nov	Last week of Jan.
	Boro	BRRI dhan 28	50	1st week of Feb	Last week of May
	T.Aman	BRRI dhan 33	50	Last week of July	2nd week of Nov.
Lalmonirhat	Wheat	Protiva	120	1st week of Dec.	3rd week of March
	Jute	O-9897	08	2nd week of April	1st week of Aug
	T.Aman	BR 11	50	Last week of July	4th week of Nov
Kishoregonj	Potato	Diamont	1500	1st week of Dec.	2nd week of March
	T.Aus	BR 26	40	2nd week of May	1st week of Aug
	T.Aman	BRRI dhan 32	50	2nd week of Aug	4th week of Nov
Syedpur	Potato	Cardinal	1800	1st week of Dec.	Last week of Feb
	Boro	BRRI dhan 28	50	2nd week of March	3rd week of July
	T.Aman	BR 11	50	Last week of July	Last week of Oct.
Chandina	Boro	BRRI dhan 29	40	3rd t week of Jan.	1st week of May
	T.Aus	BR 26	40	2nd week of May	3rd week of Aug.
	T.Aman	BRRI dhan 32	40	Last week of Aug.	1st week of Dec.
Hathazari	Chilli	Hathazari local	600 g	Last week of Nov	Feb-March
	T.Aman	BRRI dhan 30	40	Last week of July	2nd week of Nov.
Paba	Potato	Cardinal	1800	1st week of Dec	2nd week of Feb
	Jute	Falgunitosha	08	2nd week of April	Last week of July
	T.Aman	BRRI dhan 39	50	1st week of Aug	Last week of Nov.
Chabbishnagar	Chickpea	BARI Chola-5	40	3rd week of Nov	4th week of March
	T.Aman	BRRI dhan 39	40	3rd week of July	Last week of Oct.
Nachole	Chickpea	BARI Chola-5	40	2nd week of Nov	3rd week of March
	T.Aman	BRRI dhan 39	40	3rd week of July	Last week of Oct.
Rajbari	Lentil	BARI Mashur-4	30	3rd week of Nov	1st week of March
	Jute	O-9897	10	Last week of Mar.	3rd week of July
	T.Aman	BRRI dhan 32	50	1st week of Aug	2nd week of Nov

Response of Vegetable Crops to Added Fertilizer Nutrients

Abstract

The experiment was conducted at Shibpur, Rangpur, Tangail and Sylhet during the rabi season of 2004-05 and 2005-06 to find out an optimum fertilizer dose for the hybrid variety of Cabbage, Cauliflower and Tomato. Five different levels of NPK were tested at farmers' field. A considerable response on the yield of crops to added fertilizer nutrients was observed. Yield increased with the increase of nutrients levels up to certain level and then tended to decline. Regression analysis was done with the yield data and the relationship was found quadratic in nature in most cases. Fertilizer doses of Cabbage, Cauliflower and Tomato that maximized yield as well as profit were found out from the response curve.

Introduction

Cabbage, Cauliflower and Tomato are very popular winter vegetable crops in Bangladesh. Farmers' grow the vegetables all over the country. Recently, hybrid varieties of the vegetable crops are become available in the market and farmers' grow the hybrid varieties. Due to higher yield hybrids become very popular to the farmers and area is increasing day by day. But fertilizer recommendations for hybrid varieties of vegetables are not available in Bangladesh and the research work has so far been done in this regard are very scanty. Therefore, it is very important to develop a national fertilizer recommendation for different hybrid varieties of vegetables for the country. In this context the experiment was carried out to find out optimum fertilizer dose for hybrid varieties of Cabbage, Cauliflower and Tomato at different locations.

Materials and Methods

The experiment was initiated in 2004-05 and continued to 2005-06 at Shibpur, Rangpur, Tangail and Sylhet to determine optimum and economic dose of fertilizer nutrients for hybrid variety of Cabbage, Cauliflower and Tomato. 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 dispersed replications across the field. Five different levels of NPK for different crops were verified. The treatment concept was as follows-

Crop	Levels	N	P	K
Cabbage	0	0	0	0
	1	60	20	40
	2	120	40	80
	3	180	60	120
	4	240	80	160
Cauliflower	0	0	0	0
	1	50	25	40
	2	100	50	80
	3	150	75	120
	4	200	100	160
Tomato	0	0	0	0
	1	80	30	50
	2	160	60	100
	3	240	90	150
	4	320	120	200

Crop management practices followed at different locations are given in appendix table. Intercultural operations such as irrigation, weeding and pest control were done properly. From the yield data a response curve was drawn and the nutrient dose that maximized yield as well as profit was found out by using formula.

Results and Discussion

Location : Shibpur, Narsingdi
Crop : Cabbage

Response of Cabbage to added nutrients was found. Head yield increased appreciably with the increase of nitrogen levels up to 180 kg/ha of added nitrogen. However, the rate of increment was comparatively higher up to the application of 60 kg/ha of nitrogen. More or less similar trend was found in case of phosphorus and potassium. Yield increased considerably with the increase of P and K up to 40 and 120 kg/ha, respectively. Yield did not increase markedly beyond 40 kg/ha of added P but yield was slowly increased up to 60 kg/ha of added P. But in case of K yield increase more or less steadily up to 120 kg/ha and after that tended to decline. From the yield data a response curve was drawn and the relationship was quadratic in nature. Fertilizer dose that maximized yield as well as profit was found out from the equation.

Table 1. Effects of different levels of fertilizer nutrients on the yield of Cabbage at Shibpur, Norshingdi during 2005-06

Nutrient: N		Nutrient: P		Nutrient: K	
Fertilizer (kg/ha)	Head yield (t/ha)	Fertilizer (kg/ha)	Head yield (t/ha)	Fertilizer (kg/ha)	Head yield (t/ha)
0	43.7	0	58.0	0	60.5
60	62.7	20	65.3	40	66.0
120	68.5	40	72.5	80	68.5
180	73.3	60	73.3	120	73.3
240	70.7	80	72.0	160	72.5

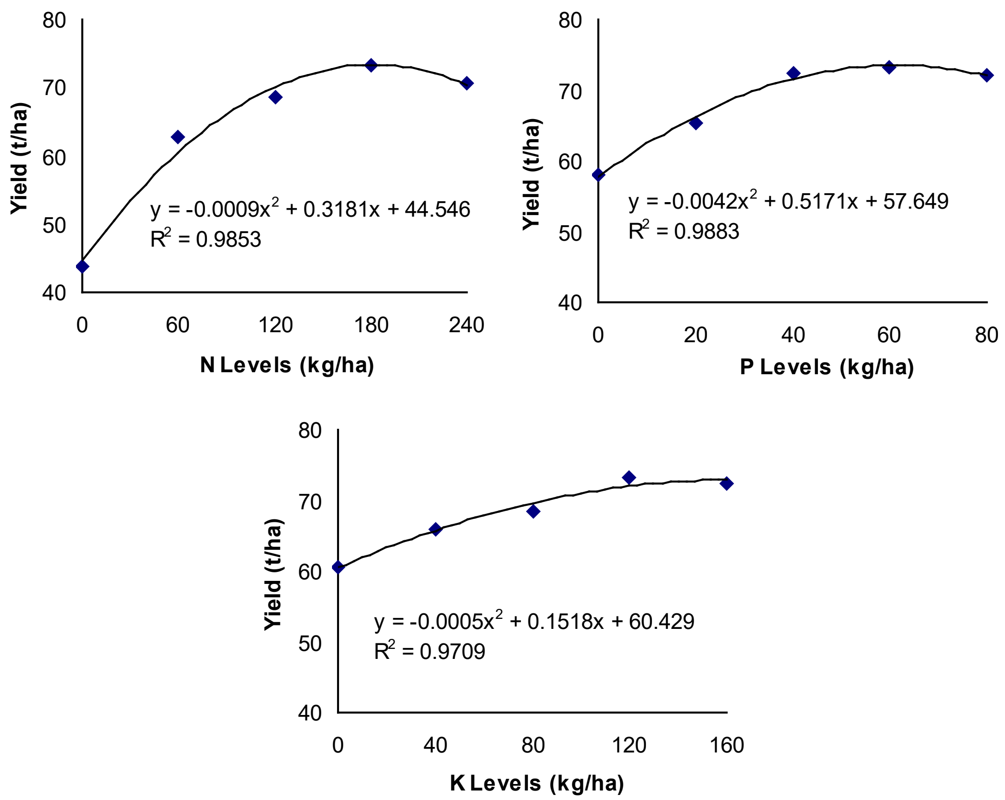


Figure 1. Response of Cabbage to N, P and K at Shibpur, Narsingdi

Location : Shibpur, Narsingdi
Crop : Cauliflower

A considerable response of Cauliflower to added nutrients was found. Average of two years data showed that curd yield of Cauliflower increased appreciably with the increase of nitrogen levels up to150 kg/ha of nitrogen. But the rate of increment was much higher up to 50 kg/ha. Yield increase gradually up to 150 kg/ha and after that started to decrease. Regarding P and K a considerable response was also found. Yield increased appreciably up to the application of 50 and 80 kg/ha of P and K, respectively. Curd yield started to decline after that level. From the yield data a response curve was drawn and the relationship was quadratic in nature. Fertilizer dose that maximized yield as well as profit was found out from the equation.

Table 2. Effects of different levels of fertilizer nutrients on the yield of Cauliflower at Shibpur, Narsingdi during 2004-05 to 2005-06

Level	Fertilizer (kg/ha)	Marketable curd yield (t/ha)		
		2004-05	2005-06	Mean
N	0	25.5	22.2	23.8
	50	35.2	33.9	34.5
	100	37.6	39.3	38.4
	150	40.5	41.1	40.8
	200	40.2	39.9	40.0
P	0	34.1	32.4	33.2
	25	36.8	36.2	36.5
	50	41.8	40.8	41.3
	75	40.5	41.1	40.8
	100	39.7	40.0	39.8
K	0	34.3	33.2	33.7
	40	37.9	36.5	37.2
	80	42.3	40.4	41.3
	120	40.5	41.1	40.8
	160	42.1	39.2	40.6

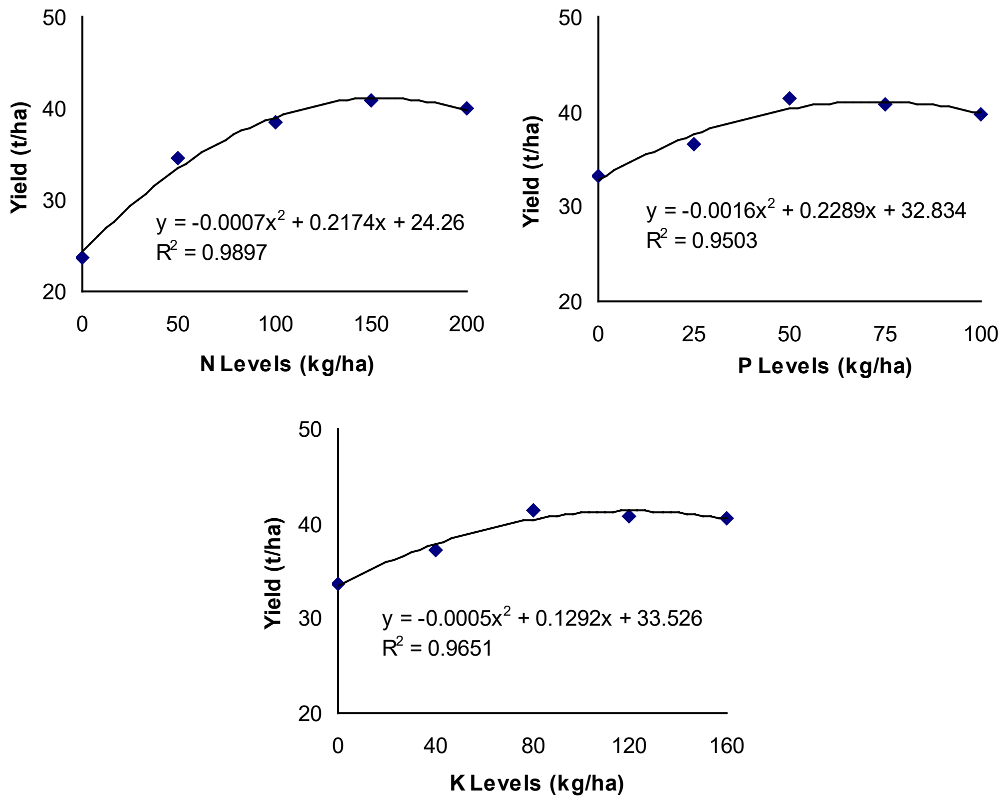


Figure 2. Response of Cauliflower to N, P and K at Shibpur, Narsingdi

Fertilizer dose for Cabbage and Cauliflower that maximized yield and profit at Shibpur, Narshingdi are given below-

Crop	Fertilizer dose maximized yield (kg/ha)			Fertilizer dose maximized profit (kg/ha)		
	N	P	K	N	P	K
Cabbage	200	60	150	180	50	130
Cauliflower	170	60	120	150	50	100

Location : Rangpur
Crop : Cauliflower

Response of Cauliflower to added nutrients was found. Average of two years data showed that curd yield of Cauliflower increased appreciably with the increase of nitrogen levels up to150 kg/ha of nitrogen. But the rate of increment was higher up to 100 kg/ha of added nitrogen. Yield of cauliflower showed to decrease beyond the application of 150 kg/ha of nitrogen. Almost similar trend was observed with P and K. A considerable yield increase was noticed up to 75 and 120 kg/ha of added phosphorus and potassium, respectively. Curd yield tended to decline after that level. More or less similar results were obtained in both the year. A response curve was drawn from the average data and the relationship was found quadratic in nature. From the response curve the nutrient dose that maximized yield as well as profit was found out.

Crop	Fertilizer dose maximized yield (kg/ha)			Fertilizer dose maximized profit (kg/ha)		
	N	P	K	N	P	K
Cauliflower	163	82	132	157	76	122

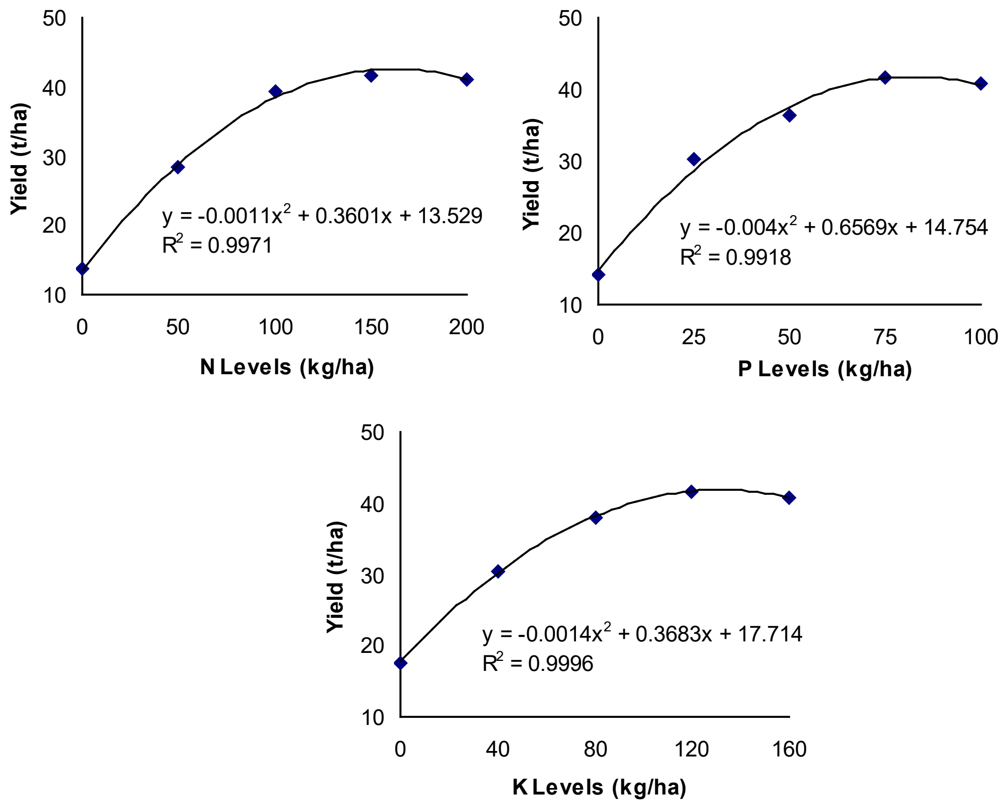


Figure 3. Response of Cauliflower to N, P and K at Rangpur

Table 3. Effects of different levels of fertilizer nutrients on the yield of Cauliflower at Rangpur during 2004-05 to 2005-06

Level	Nutrient (kg/ha)	Marketable curd yield (t/ha)		
		2004-05	2005-06	Mean
N	0	13.6	13.5	13.6
	50	28.9	27.8	28.3
	100	38.6	39.9	39.3
	150	42.2	41.1	41.7
	200	41.8	40.6	41.2
P	0	14.2	14.2	14.2
	25	30.1	30.2	30.2
	50	36.4	36.5	36.4
	75	42.2	41.1	41.7
	100	40.6	40.7	40.7
K	0	18.0	17.0	17.6
	40	31.0	30.0	30.5
	80	37.5	38.4	38.0
	120	42.2	41.1	41.7
	160	40.8	40.8	40.8

Location : Rangpur
Crop : Tomato

Response of Tomato to added N, P and K was found to some extent. Fruit yield of Tomato increased considerably with the increase of nitrogen levels up to 240 kg/ha of nitrogen. Yield increased sharply up to 80 kg/ha of nitrogen and after that level yield was also increased gradually up to 240 kg/ha. Yield tended to decline after that level. Almost similar trend was observed with P and K. A considerable yield increase was found up to 90 and 150 kg/ha of added phosphorus and potassium, respectively. Fruit yield tended to decline after that level. A response curve was drawn from the average data and the relationship was found almost quadratic in nature. From the response curve the nutrient dose that maximized yield as well as profit was found out.

Crop	Fertilizer dose maximized yield (kg/ha)			Fertilizer dose maximized profit (kg/ha)		
	N	P	K	N	P	K
Tomato	219	122	132	211	120	115

Table 4. Effects of different levels of fertilizer nutrients on the yield of Tomato at Rangpur, 2005-06

Level	Nutrient (kg/ha)	Yield (t/ha)
N	0	69.7
	80	85.8
	160	88.7
	240	93.3
	320	84.4
P	0	80.8
	30	84.5
	60	87.9
	90	93.3
	120	90.7
K	0	84.4
	50	85.1
	100	88.9
	150	93.4
	200	86.7

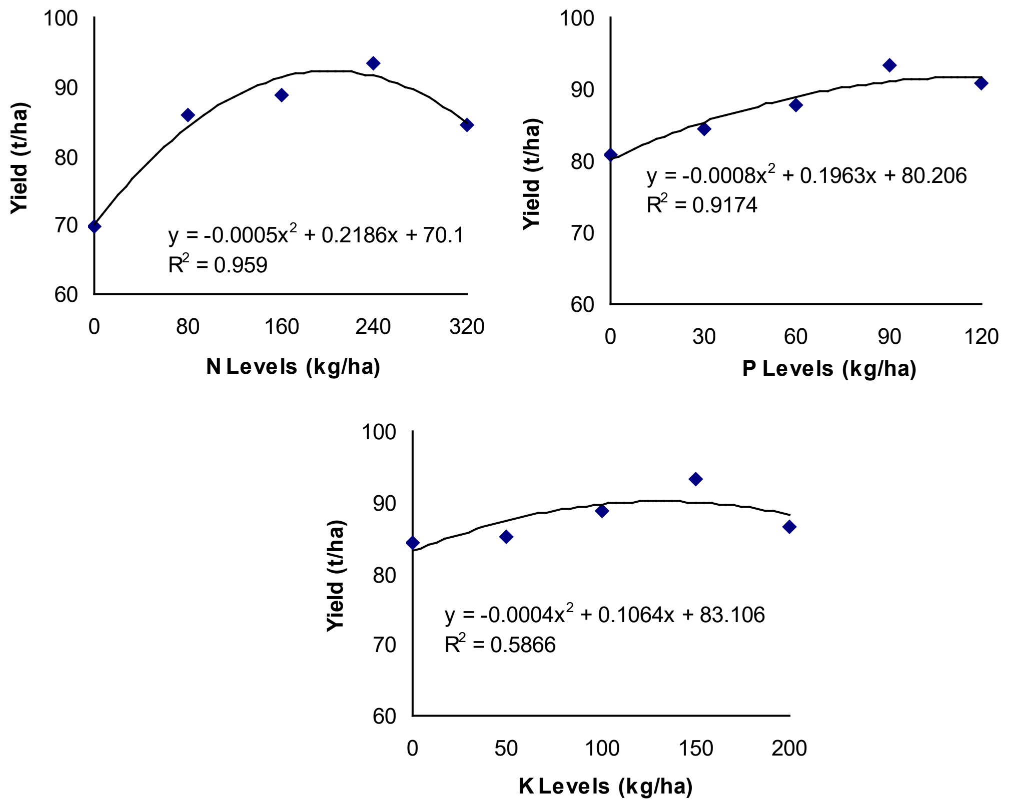


Figure 4. Response of Tomato to N, P and K at Rangpur

Location : Tangail
Crop : Cabbage

Response of Cabbage to added nutrients was found to some extent. Head yield of Cabbage increased with the increase of nitrogen and the highest yield was recorded with the highest level of nitrogen. Some response was also found in case of phosphorus. Yield increased considerably up to the application of 20 kg/ha of added phosphorus. Regarding potassium no response was observed at all. Response of nitrogen was linear and therefore, it was not possible to find out the optimum dose of N for cabbage.

Table 5. Effects of different levels of fertilizer nutrients on the yield of Cabbage at Tangail, 2005-06

Level	Nutrient (kg/ha)	Head yield (t/ha)
N	0	84.8
	60	93.9
	120	96.7
	180	97.2
	240	107.8
P	0	95.1
	20	101.8
	40	99.8
	60	97.2
	80	100.9
K	0	94.2
	40	94.7
	80	94.8
	120	97.2
	160	93.0

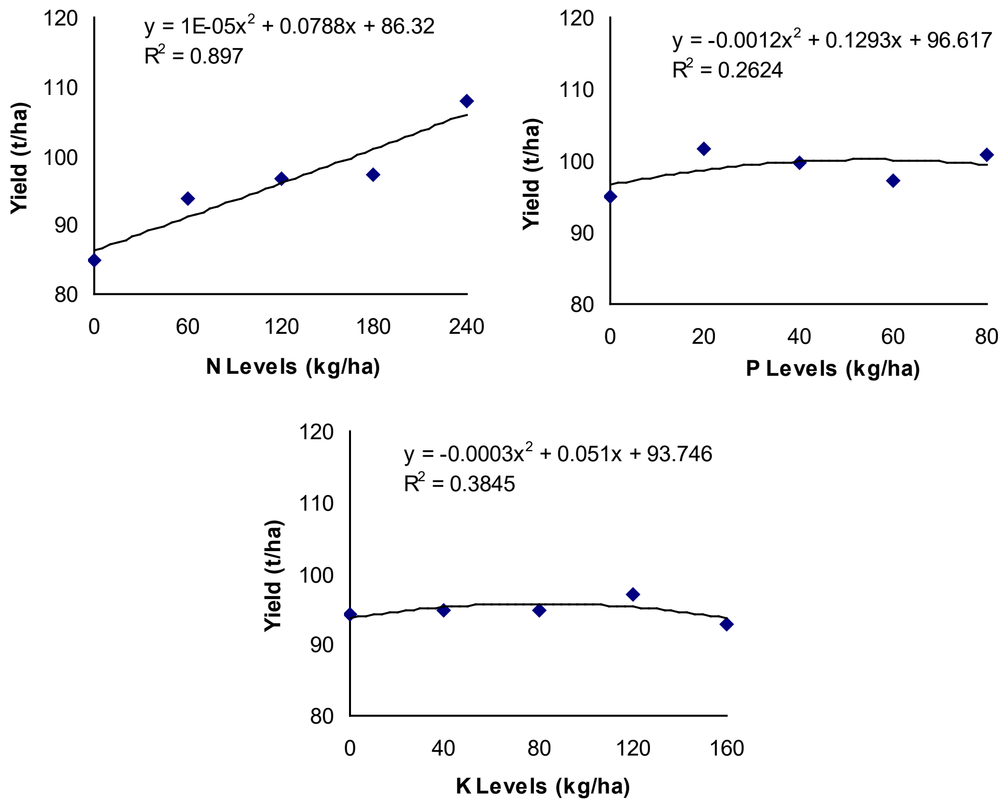


Figure 5. Response of Cabbage to N, P and K at Tangail

Location : Sylhet
Crop : Tomato

Response of Tomato to added nutrients was found. Fruit yield of Tomato increased considerably with the increase of nitrogen up to 240 kg/ha of nitrogen and after that level tended to decline. Similarly, a considerable yield increase was noticed up to 60 and 100 kg/ha of added P and K, respectively. From the yield data a response curve was drawn and the relationship was quadratic in nature. Fertilizer dose that maximized yield and profit was found out.

Crop	Fertilizer dose maximized yield (kg/ha)			Fertilizer dose maximized profit (kg/ha)		
	N	P	K	N	P	K
Tomato	310	74	139	242	61	100

Table 6. Effects of different levels of fertilizer nutrients on the yield of Tomato at Sylhet, 2005-06

Level	Nutrient (kg/ha)	Yield (t/ha)
N	0	72.9
	80	79.7
	160	88.5
	240	91.4
	320	91.0
P	0	67.7
	30	85.5
	60	88.3
	90	86.4
	120	83.4
K	0	67.2
	50	73.0
	100	87.3
	150	83.1
	200	80.7

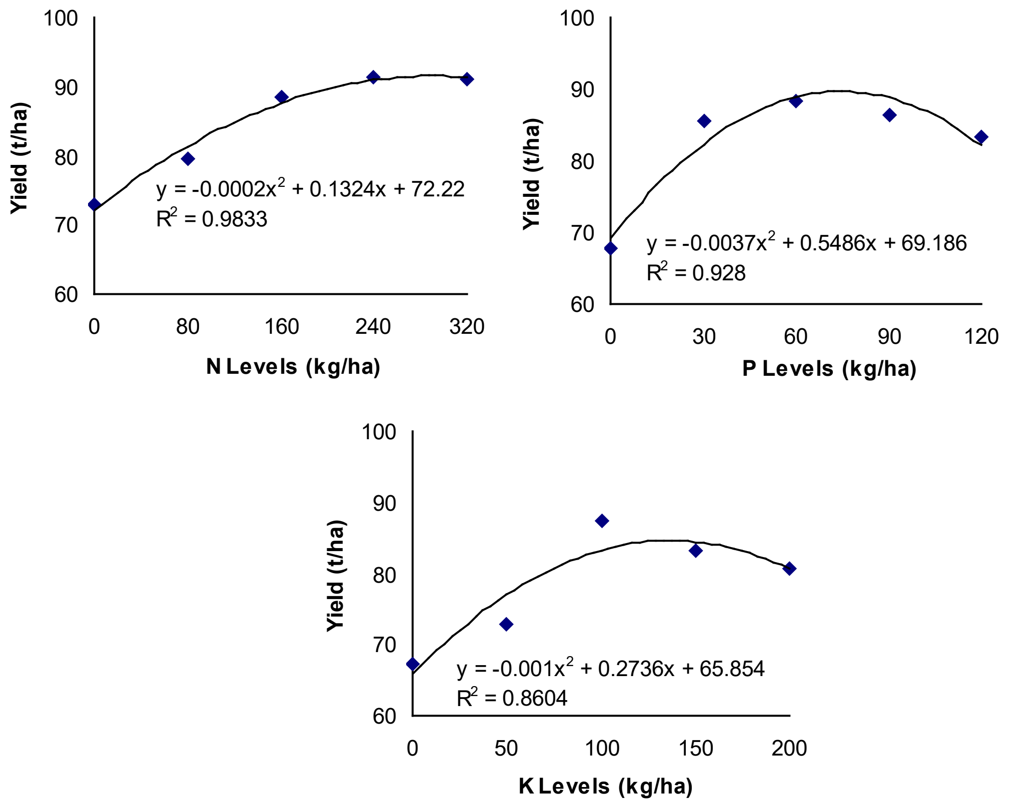


Figure 6. Response of Tomato to N, P and K at Sylhet

Appendix table: Crop management practices

Location	Crop	Variety	Date of transplanting	Seedling age	Spacing (cm)	Date of harvest
Shibpur	Cabbage Cauliflower	Autumn Queen Shiragiku F	Last week of October	25-30	80 x 60	January
Rangpur	Cauliflower Tomato	Snow crown Surakkha	1st week of Dec.	25-30	60 x 60	February
Tangail	Cabbage	Autmn Queen	1st week of Nov.	25-30	60 x 60	January
Sylhet	Tomato	Epock	Mid Dec.	30	60 x 60	March

❈ ❈ ❈

SUBPROJECT: VERIFICATION OF FERTILIZER MANAGEMENT PRACTICES

Effect of Plant Spacing and Fertilizer on the Yield of Potato at Munshiganj

Abstract

The experiment was conducted at Munshiganj MLT site during the Rabi season of 2004-05 and 2005-06 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. Soil test based (STB) fertilizer dose for HYG and two IPNS treatment with poultry manure and cowdung along with farmers' practice and no fertilizer treatment were tested against two recommended practices and farmers' spacing (30 x 15 cm). Recommended practices were i) whole tuber with 60 x 20 and cut tuber (15-20 g) with 45 x 15 cm. Results revealed that tuber yield of potato influenced significantly due to plant spacing. The highest yield was recorded from farmers' spacing followed by recommended practice with cut tuber. Recommended practice with whole tuber gave the lowest yield due to less plant population. But weight of tuber/plant was significantly higher in recommended spacing with whole tuber. Effect of different fertilizer packages on the yield of potato was observed. The highest yield was obtained from farmers' dose which was identical with STB fertilizer dose and IPNS with PM. Interaction effect of spacing and fertilizer dose was found significant. The highest tuber yield was recorded from farmers' fertilizer dose with farmers' spacing which is statistically similar with farmers' dose with recommended spacing ii. Cost and return analysis showed that higher economic return was obtained from IPNS with PM and STB fertilizer dose with recommended spacing ii. Due to higher seed and fertilizer cost gross margin and BCR was less in farmers' practice in spite of higher yield.

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 of Potato for Munshiganj

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 2004-05 and 2005-06. The land type was medium low land and the soil texture of the experimental plot was silty clay which belongs to Old Meghna Estuarine Floodplain soil (AEZ 19d). Before conduction of the experiment the initial soil samples were collected and analyzed at BINA laboratory, Mymensingh. The P^H of the soil was slightly acidic and except nitrogen all other nutrient elements were optimum to high in the soil (Appendix 1).The experiment was laid out in split-plot design with six dispersed replication. Two recommended plant spacing and farmers' spacing (30cm x 15cm) was given in the main plot. Two recommended plant spacing were i) whole tuber with 60 x 20 and cut tuber (15-20 g) with 45 x 15 cm. Five different fertilizer packages- IPNS with poultry manure (T_1) and cowdung (T_2), Soil test based fertilizer (STB) dose for HYG (T_3), Farmers' dose (T_4) and no fertilizer (T_5) was given in the sub-plot. Fertilizers were applied as per treatment. Well decomposed poultry manure and cowdung was applied one week before planting. Potato, variety `Diamont' was planted during the last week of November as per treatment. Seed rate was 2.0, 2.2 and 2.7 t/ha, for recommended practices and farmers' practice, respectively. Ridomil gold was sprayed 3 times to control late blight disease. Crop was irrigated twice and mulched with water hyacinth. At maturity the crop was harvested on last week of February. Necessary data were collected and analyzed statistically.

Treatment (Fertilizer dose (kg/ha) for Potato)

Treatment	N	P	K	
T_1 = IPNS with PM for HYG	115	5	45	2.5 t/ha PM
T_2= IPNS with CD for HYG	125	15	45	5 t/ha CD
T_3= Soil test based fertilizer dose for HYG	140	20	60	-
T_4= Farmers' dose	368	150	350	-
T_5= No fertilizer	0	0	0	-

Results and discussion

Effect of plant spacing: Effect of plant spacing on the yield of potato is given in Table 1. Tuber yield of potato influenced significantly due to plant spacing. The highest yield was recorded from farmers' spacing (30 x 15 cm) but it was statistically similar with recommended practice with cut tuber planted in 45 x 15 cm spacing. Significantly lower yield was obtained from recommended practice with whole tuber grown in 60 x 20 cm spacing. Farmers' practice gave about 6 and 2 t/ha higher yield over recommended practice i and ii, respectively. Higher yield obtained in farmers' spacing is due to higher plant population. Plant population varied with plant spacing and it was 83300, 148149 and 222200/ha in recommended practice i, recommended practice ii and farmers' practice, respectively. 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. Almost similar trend was found in both the years. Closer spacing required higher seed rate and therefore, seed rate was highest in farmers' spacing. Seed rate was 2700 kg/ha in farmers' spacing where as it was 2000 kg and 2200 kg/ha in recommended practice i and ii, respectively. Average of two years results showed that Farmers spacing produced about 23% and 7% higher yield over recommended practice i and ii, respectively. Again recommended practice ii (cut tuber with closer spacing) gave 16% higher yield against recommended practice i (whole tuber with wider spacing). Higher yield obtained in closer spacing is due to higher plant population. But tuber weight/plant was about 70% and 22% higher with rec. spacing i over farmers' spacing and rec. spacing ii.

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. The highest tuber yield of potato was obtained from farmers' practice but it was identical with IPNS with PM (T_1) and STB for HYG (T_3) treatment in 2004-05. But in 2005-06 higher and identical yield was obtained from T_1, T_2 and T_4. Effect of organic manure applied in IPNS was not very evident. However, effect of poultry manure on the yield of potato was observed to some extent. Soils of Munshiganj remain submerge at least for 3-4 months and a considerable amount of siltation take place. Residues of water hyacinth and jute leaves accumulated in the soil. Therefore, response of organic manure may not be observed. Farmers' of Munshiganj traditionally apply a very high dose of inorganic fertilizers in potato which was much higher than recommended dose. But the yield was not much higher in comparison to recommended dose. From the soil test data it was found that except nitrogen the status of other nutrient elements are satisfactory. Therefore, yield did not increase significantly in farmers' practice. On an average about 1 and 2.5 t/ha yield increased in farmers' practice over T_1 (IPNS with PM) and T_3 (STB fertilizer dose for HYG). But the cost of fertilizer is much higher in farmers' practice. The cost of fertilizer is about Tk. 21000/ha in farmers' practice against about 5000 Tk./ha over recommended practice.

Interaction between Spacing and fertilizer: Effect of spacing x fertilizer interaction on the tuber yield of Potato is given in Table 3. The interaction was found significant. The highest tuber yield was recorded from T_4S_3 which was followed by T_4S_2 and T_3S_3. Generally, all the fertilizer packages produced higher yield at farmers' spacing over recommended spacing mainly due to population effect. Recommended spacing ii with cut tuber gave almost similar yield with farmers' spacing irrespective of fertilizer dose. However, from the interaction table it was evident that higher plant population responded positively to higher nutrient level. The lowest yield was obtained from no fertilizer treatment with recommended spacing i. More or less similar trend was found in both the years. From the average data it was found that the highest yield (36.8 t/ha) was obtained from farmers' spacing with farmers' fertilizer dose followed by recommended spacing ii with farmers' fertilizer dose.

Cost and return analysis: Cost and return analysis was done for plant spacing, fertilizer dose and spacing x fertilizer interaction independently. Higher seed cost is related with seed rate and obviously the highest cost was involved in farmers' spacing (Table 4). Farmers' seed rate was 500 and 700 kg/ha higher than recommended practice ii and i, respectively that resulted 9000 and 12600 Tk/ha extra seed cost. Gross return was higher in farmers' practice due to higher yield. But gross margin and BCR was higher in recommended practice with cut tuber due to comparatively less seed cost. Similarly, fertilization cost was much higher in farmers' practice (Table 5) as the farmers apply a very high dose of fertilizers in potato. It was about 15000 Tk/ha higher than recommended doses. In spite of higher yield and gross return MBCR was the lowest in farmers' practice due to higher fertilization cost. IPNS with PM (T_1) gave the highest gross margin and MBCR over control. Cost and return of spacing x fertilizer interaction (Table 6) showed that the highest gross return was obtained from farmers' fertilizer dose with farmers' spacing due to higher yield. Variable cost (seed and fertilizer) was also the highest in the same treatment. Farmers usually apply a very high dose of inorganic fertilizer in potato with a very close spacing that increased the variable cost. Higher gross margin was found in IPNS with PM and STB with recommended spacing ii (cut tuber with closer spacing). Benefit cost ratio (BCR) was also higher with the same interaction treatments. The lowest BCR was obtained with farmers spacing x farmers' fertilizer dose due to higher variable cost.

Conclusion

From the two years experimentation it was found that the highest yield of potato was obtained with farmers' spacing which was also identical with recommended spacing ii. Similarly the highest yield was recorded from farmers' fertilizer dose but it was closely followed by IPNS with PM treatment. Interaction showed that higher yield was obtained from farmers' spacing with farmers' fertilizer dose. But the higher economic return was obtained from IPNS with PM and STB recommended fertilizer dose with recommended spacing ii (cut tuber with 45 x 15 cm).

Table 1. Effect of plant spacing on the yield of Potato at Munshiganj during 2004-05 to 2005-06

Spacing (cm)	Wt. of tuber /plant (g)			Tuber yield (t/ha)		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean
S_1= Recom. i (whole tuber with 60 x 20)	487a	405a	446	30.2b	27.1b	28.6
S_2 = Recom. ii (cut tuber with 45 x 15)	383b	350b	366	33.9ab	32.4ab	33.1
S_3= Farmers (30 x 15)	285c	240c	262	36.2a	34.5a	35.3

Table 2. Effect of different fertilizer doses on the yield of Potato at Munshiganj during 2004-05 to 2005-06

Treatment	Tuber yield (t/ha)		
	2004-05	2005-06	Mean
T_1 = IPNS with PM for HYG	34.7ab	32.4a	33.5
T_2= IPNS with CD for HYG	32.8b	30.1ab	31.4
T_3= Soil test based fertilizer dose for HYG	34.7ab	29.5b	32.1
T_4= Farmers' dose	35.8a	33.2a	34.5
T_5= No fertilizer	17.8c	16.8c	17.3

Table 3. Interaction effect of spacing and fertilizer on the yield of potato at Munshiganj during 2004-05 to 2005-06

Treatment	Tuber yield (t/ha)		
	2004-05	2005-06	Mean
T_1S_1	30.6c	28.3c	29.4
T_1S_2	32.4bc	31.9ab	32.1
T_1S_3	34.9b	33.1a	34.0
T_2S_1	28.5c	26.5cd	27.5
T_2S_2	32.8bc	30.4b	31.6
T_2S_3	34.0b	32.3ab	33.1
T_3S_1	30.9c	25.7d	28.3
T_3S_2	34.5bc	30.1bc	32.3
T_3S_3	35.8ab	32.4ab	34.1
T_4S_1	30.5c	28.7c	29.6
T_4S_2	36.9ab	32.8ab	34.8
T_4S_3	39.0a	34.7a	36.8
T_5S_1	16.3e	15.7f	16.0
T_5S_2	17.8de	17.5e	17.6
T_5S_3	18.6d	17.9e	18.2

Table 4. Plant population, seed rate, seed size and seed cost of potato influenced by different plant spacing at Munshiganj during 2004-05 to 2005-06

Spacing (cm)	Tuber yield (t/ha)	Seed size (g)	Seed rate (t/ha)	Seed cost (Tk./ha)	Gross return (Tk/ha)	Gross margin (Tk/ha)	BCR
S_1= Recom. i (whole tuber with 60 x 20)	28.6	25-30	2.0	36000	114400	78400	3.18
S_2 = Recom. ii (cut tuber with 45 x 15)	33.1	15-20	2.2	39600	132400	92800	3.34
S_3= Farmers (30 x 15)	35.3	12-15	2.7	48600	141200	92600	2.90

Table 5. Effect of different fertilizer doses on the yield of Potato at Munshiganj during 2004-05

Treatment	Tuber yield (t/ha)	Fertilizer cost (Tk./ha)	Gross return (Tk/ha)	Gross margin (Tk/ha)	MBCR
T_1 = IPNS with PM for HYG	33.5	5287	134000	128713	12.2
T_2= IPNS with CD for HYG	31.4	6060	125600	119540	9.30
T_3= Soil test based fertilizer dose for HYG	32.1	5400	128400	123000	10.9
T_4= Farmers' dose	34.5	21284	138000	116716	3.23
T_5= No fertilizer	17.3	0	69200	69200	-

Table 6. Cost & return analysis of Potato affected by spacing and fertilizer doses at Munshiganj during 2004-05 to 2005-06

Treatment	Tuber yield (t/ha)	Variable cost (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1S_1	29.4	38287	117600	79313	3.07
T_1S_2	32.1	41687	128400	86713	**3.09**
T_1S_3	34.0	51887	136000	84113	2.62
T_2S_1	27.5	40060	110000	69940	2.74
T_2S_2	31.6	43460	126400	82940	**2.90**
T_2S_3	33.1	53660	132400	78740	2.47
T_3S_1	28.3	39400	113200	73800	2.87
T_3S_2	32.3	42800	129200	86400	**3.01**
T_3S_3	34.1	53000	136400	83400	2.57
T_4S_1	29.6	56284	118400	62132	2.10
T_4S_2	34.8	59684	139200	79516	**2.33**
T_4S_3	36.8	69884	147200	77316	2.10
T_5S_1	16.0	34800	64000	29200	1.83
T_5S_2	17.6	38200	70400	32200	**1.84**
T_5S_3	18.2	48600	72800	24200	1.49

Variable cost = Seed cost + fertilizer cost.

Appendix 1. Initial soil status of the experimental plots of Potato at Munshiganj

SL.	Soil Characteristic	Status	SL.	Soil Characteristic	Status
1.	pH	6.3	7.	P (Micro gram g^{-1} soil)	16.3 (M)
2.	OC (%)	1.59	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)	0.19 (M)			
5.	Ex. Ca (m eq/100g soil)	4.73 (Opt.)			
6.	Total N (%)	0.11 (L)			

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 season of 2003-04, 2004-05 and 2005-06 to evaluate the proper nutrient management packages and to determine the economic dose of fertilizer for Cabbage and Tomato under irrigated condition. The cabbage variety Atlas-70 and Tomato variety BARI tomato-8 was tested against six fertilizer management packages (soil test based fertilizer dose for MYG & HYG, IPNS for HYG, BARI Rec. dose Crop removal and farmers' practice). Average of three years data showed that the highest head yield of Cabbage (90.44 tha^{-1}) was obtained with IPNS based fertilizer dose (T_3) followed by BARI recommended dose (T_4). Similarly, in Tomato higher fruit yield was obtained with the same treatment. Regarding cost and return, higher gross margin and BCR was calculated from T_3.

Introduction

The importance of cabbage (*Brassica oleracea* var. capitata Lin) tomato (*Lycopersicon esculentum* Mill.) as vegetables due to supply of adequate vitamins, carbohydrates and minerals is well known. These are the most important winter vegetables and are grown throughout Bangladesh. But there has been a gradual declining or stagnation trend in the yield almost all over Bangladesh. Cabbage and Tomato are intensively grown under irrigated Medium High Land of Kendua MLT site, Natrokuna. But a recent field survey and soil test data reveals that yield of cabbage and tomato are 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 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, Netrokona under AEZ-9.

Materials and Methods

The experiment was conducted under irrigated condition during the period from November 2003 to March 2004, November 2004 to March 2005 and November 2006 to March 2006 at Kendua MLT site, Netrakuna. 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. In both the years average maximum ambient temperature were 24.68^{0}C and 25.28^{0}C and minimum 20.25^{0}C and 19.07^{0}C respectively, and rainfall were 30 and 55 mm during the period of study. 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 and T_6 = Farmer's practice (FP).

Nutrient rate kg/ha

Treatment	Cabbage					Tomato				
	CD	N	P	K	S	CD	N	P	K	S
T_1	-	131	26	102	25	-	119	27	114	20
T_2	-	191	36	145	36	-	170	38	157	29
T_3	8000	167	28	121	36	6000	152	32	139	29
T_4	8000	150	44	138	0	10000	254	88	125	0
T_5	-	414	28	466	89	-	126	18	183	17
T_6	8000	99	39	80	11	6000	90	35	69	16

In the crop N, P, K and S were applied through urea, triple super phosphate, muriate of potash and gypsum, respectively. The entire amount of cowdung P, S and one half of K were applied during final land preparation according to the described treatments. 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 at 21 and 35 days after transplanting of tomato seedlings as ring method. The cabbage variety Atlas-70 and tomato variety BARI tomato-8 were tested against six different fertilizer management packages. The thirty days old seedling of cabbage were transplanted on 6-11, November and harvested 1-12 February respectively where as tomato seedling transplanted on 06-11, November, and harvested 23 January to 14 February, respectively. One seedling was transplanted at a spacing 60×45 cm for both the crops. Irrigation was given six times and one irrigation required time 30 minutes, which supplied 4.8 cm available water in 6 decimal, plot. The total requirement of water in tomato is 30 cm during crop season (Sixth Annual Report, Agricultural Engineering Division, BARC, 1985-86). Intercultural operations such as weeding, pruning, and staking to the plant and pest control were done as and when needed to maintain the normal crop growth. Data on yield and yield attributes along with other parameters were collected properly and subjected to statistical analysis. Statistical analysis and means were compared by DMRT and economic analysis was done for gross return and marginal benefit cost ratio for different fertilizer treatments.

Result and Discussion

Cabbage

The effect of different nutrient management packages on the yield of cabbage is presented in Table 1. Average of three years data showed that the highest marketable head yield was obtained with T_3 where IPNS based fertilizer dose was applied. The yield was higher than only inorganic fertilizer for HYG (T_2). Yield was significantly higher in T_3 during 2004-2005 and 2005-06. But in 2003-2004 it was identical with other fertilizer packages except with T_1 where STB fertilizer dose for MYG was applied (Appendix1). Fertilizer dose based on BARI recommendation gave higher yield over STB fertilizer dose for HYG and MYG (T_1 and T_2). The lowest yield found with STB fertilizer dose for MYG (T_1), which was also lower than Farmers' practice (T_6). Fertilizer dose based on crop removal for HYG (T_5) also gave satisfactory yield and it was similar to STB fertilizer dose for HYG (T_2). Similar trend was followed in case of head yield with outer leaves. The highest yield was obtained with T_3, which was closely followed, by T_4 and T_5.

Cost and return analysis: The cost and return analysis of cabbage has been presented in Table 3. The highest gross return as well as gross margin was calculated from T_3 followed by T_4. Total cost was the highest in T_5 due to crop removal basis fertilizer dose was very high in cabbage. The second highest figure was found in T_4 followed by T_3 due to the cost of cowdung involved in these treatments. Benefit cost ratio (BCR) was the highest in T_3 due to higher gross return and lower fertilization cost.

Tomato

The effect of different nutrient management packages on the yield of tomato is presented in Table 2. Fruit yield of tomato was influenced by different fertilizer treatment. Average of three years data showed that higher yield was obtained from T_3 and T_4. Significantly higher yield was obtained with IPNS (T_3) and BARI recommended dose (T_4) during 2003-04, 2004-05 and 2005-06. Similarly, STB fertilizer dose for HYG (T_2) and fertilizer dose based on crop removal (T_5) gave identical yield. The lowest yield was found in farmers' practice (T_6).

Cost and return analysis: The cost and return analysis of tomato has been presented in Table 4. The highest gross margin was calculated from T_3, which was closely followed by T_4. Total cost of cultivation was the highest in T_4 followed by T_3 due to higher fertilizer dose and cost of cowdung involved in these treatments. However, the gross return and BCR were higher in T_3 followed by T_4

Conclusion and Recommendation

From three years study, it revealed that IPNS based fertilizer dose was found superior to other treatments in respect of yield and economic benefits for cabbage and tomato at Kendua. The highest yielded treatment T_3 gave higher BCR than other treatment. Considering the yield and economic benefit IPNS based fertilizer dose could be recommended for cabbage and tomato cultivation.

Table 1. Effect of different nutrient management packages on the yield of cabbage at MLT site Kendua during 2003-04 to 2005-06 (average of 3 years)

Treatment	Marketable head weight (kg)	Head yield with outer leaf (t ha^{-1})	Marketable head yield (t ha^{-1})
T_1	2.16b	70.33c	61.63d
T_2	2.77a	91.88ab	82.66b
T_3	2.89a	99.95a	90.44a
T_4	2.79a	96.66a	86.21b
T_5	2.52b	95.05a	82.44b
T_6	2.27b	86.81b	73.40c
CV (%)	11.28	8.57	11.61

Figures in a column means followed by same letter(s) are not different significantly at 5% level by DMRT.

Table 2. Effect of different nutrient management packages on the yield of tomato at MLT site Kendua during 2003-04 to 2005-06

Treatment	Fruit yield (tha^{-1})			Mean
	2003-04	2004-05	2005-06	
T_1	60.50b	59.00b	56.64b	58.71
T_2	61.95b	62.98b	61.29b	62.07
T_3	71.38a	72.53a	74.73a	72.88
T_4	74.38a	72.55a	71.06a	72.66
T_5	62.08b	60.71b	59.70b	60.83
T_6	55.10c	54.14c	55.41c	54.98
CV (%)	5.55	5.28	6.77	5.87

Figures in a column means followed by same letter(s) are not different significantly at 5% level by DMRT

Table 3. Cost and return analysis of different nutrients management packages in cabbage at MLT site Kendua during 2003-04 to 2005-06

Treatment	Gross return (Tk ha^{-1})	Total cost of cultivation (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
2003-2004				
T_1	88088	28070	60018	3.14
T_2	120190	30617	89544	3.93
T_3	129010	33285	95725	3.88
T_4	133196	33578	99618	3.97
T_5	124894	40580	84314	3.08
T_6	118300	31694	86606	3.73
2004-2005				
T_1	93248	29345	63906	3.18
T_2	129088	33722	96766	3.83
T_3	144592	34737	109855	4.16
T_4	131792	35400	96392	3.72
T_5	127456	44779	82677	2.85
T_6	106768	32979	73789	3.24
2005-2006				
T_1	101251	32490	68761	3.12
T_2	129490	36867	92623	3.51
T_3	141192	37882	103310	3.73
T_4	128981	38545	90436	3.35
T_5	124736	47924	76812	2.60
T_6	109678	35124	74554	3.12

Table 3. Contd.

Treatment	Gross return (Tk ha^{-1})	Total cost of cultivation (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
		Mean		
T_1	94196	29969	64227	3.14
T_2	126256	33745	92511	3.74
T_3	138265	35301	102964	3.92
T_4	131324	35841	95483	3.66
T_5	125695	44428	81267	2.83
T_6	111582	33266	78316	3.35

Table 4. Cost and return analysis of different nutrients management packages of tomato at MLT site Kendua, Netrakuna during 2003-2004 to 2005-06

Treatment	Gross return (Tkha^{-1})	Total cost of cultivation (Tkha^{-1})	Gross margin (Tkha^{-1})	BCR
		2003-2004		
T_1	121000	42376	78624	2.86
T_2	123900	45371	78529	2.73
T_3	142760	46811	95949	3.05
T_4	148760	52628	96123	2.83
T_5	124160	43232	80928	2.87
T_6	110200	43778	66422	2.52
		2004-2005		
T_1	177000	43762	133238	4.04
T_2	188940	47653	135287	3.96
T_3	217590	48465	167125	4.49
T_4	216450	54963	161487	3.94
T_5	182130	45045	137085	4.04
T_6	162420	45637	116783	3.56
		2005-06		
T_1	169920	49400	120520	3.44
T_2	183870	52300	131570	3.52
T_3	224190	54150	170040	4.14
T_4	213180	55450	157730	3.84
T_5	179100	50150	128950	3.57
T_6	166230	51550	114680	3.22
		Mean		
T_1	155973	45179	110794	3.45
T_2	165570	48441	117129	3.42
T_3	194847	49809	145038	3.91
T_4	192797	54347	138450	3.55
T_5	161797	46143	115654	3.51
T_6	146283	46829	99454	3.12

Note: Price of inputs and outputs of cabbage and tomato:

Input	Price (Tk.kg^{-1})			Output	Price (Tk.kg^{-1})		
	2003-04	2004-05	2005-06		2003-04	2004-05	2005-06
Urea	6.00	6.00	6.00				
TSP	12.00	15.00	18.00				
MP	10.00	14.00	16.00	Cabbage	1.40	1.60	1.59
Gypsum	4.00	4.00	4.00	Tomato	2.00	3.00	3.00
Cowdung	0.50	0.50	0.50				

Appendix 1. Effect of different nutrient management packages on the yield of cabbage at MLT site Kendua during 2003-04 to 2005-06

Treatment	Head yield with outer leaf (tha^{-1})			Marketable head yield (tha^{-1})		
	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
T_1	71.10b	67.43c	72.45c	62.92b	58.28d	63.68d
T_2	93.67a	92.48ab	89.49ab	85.85a	80.68b	81.44b
T_3	99.89a	100.35a	99.61a	92.15a	90.37a	88.80a
T_4	102.99a	93.11ab	93.87ab	95.14a	82.37b	81.12b
T_5	107.88a	89.74b	87.57b	89.21a	79.66b	78.45b
T_6	92.52a	83.47b	84.44b	84.50a	66.73c	68.98c
CV (%)	8.10	8.25	9.41	16.92	7.85	10.05

Appendix 2. Effect of different nutrient management packages on yield parameters of cabbage at MLT site Kendua, Netrakona during Rabi, 2003-04 to 2005-06

Treatment	Plant height (cm)			Head pericycle (cm)		
	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
T_1	20.60	18.16	17.79	66.18ab	64.08b	63.80b
T_2	21.08	17.88	18.17	69.37a	70.46a	70.14a
T_3	20.88	17.97	19.14	67.82ab	69.52a	68.25a
T_4	20.50	17.96	18.43	66.83ab	70.20a	71.09a
T_5	20.75	18.58	17.23	67.26ab	68.74a	67.59a
T_6	20.80	17.22	18.00	62.95b	65.84b	66.01b
CV (%)	2.81	5.99	7.89	5.82	3.16	6.15

Figures in a column means followed by same letter(s) are not different significantly at 5% level by DMRT.

Appendix 2 (Contd.)

Treatment	Whole plant wt. (kg)			Marketable head weight (kg)		
	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
T_1	2.27b	2.85b	2.76b	1.98b	2.30b	2.20b
T_2	2.82b	3.58a	3.47a	2.57a	2.81a	2.92a
T_3	3.13a	3.64a	3.46a	2.74a	2.96a	2.96a
T_4	3.22a	3.45a	3.46a	2.85a	2.78a	2.74a
T_5	3.32a	3.27ab	3.19ab	2.72a	2.37b	2.48b
T_6	2.77b	2.81b	2.93b	2.55a	2.12b	2.14b
CV (%)	9.29	10.61	13.04	13.92	8.60	11.33

Appendix 3. Effect of different nutrient management packages on yield parameters of tomato at MLT site Kendua during 2003-04 and 2005-06

Treatment	Plant height (cm)			Fruits/plant (no.)			Yield/plant (kg)		
	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06	2003-04	2004-05	2005-06
T_1	75.58	75.48	74.30	22	15	14	1.67c	1.67c	1.56c
T_2	78.18	75.62	74.10	23	16	16	1.83b	1.80bc	1.76bc
T_3	81.30	74.96	75.68	24	16	17	1.91ab	1.94ab	1.99a
T_4	81.98	73.66	78.45	24	17	15	2.02a	1.99a	1.88ab
T_5	85.23	74.6	74.35	24	15	15	1.96ab	1.79bc	1.75bc
T_6	82.18	75.52	75.95	19	13	13	1.65c	1.48d	1.57c
CV (%)	4.59	2.07	3.24	6.33	12.34	6.25	6.13	6.55	8.34

Figures in a column means followed by same letter(s) are not different significantly at 5% level by DMRT.

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

Abstract

An experiment on the effect of inorganic and organic fertilizer of summer onion was conducted at MLT site, Moulvibazar, Syhet, Faridpur sadar and FSRD site, Razakhali, Patuakhali during Kharif-1, 2006. Four different combinations of inorganic and organic fertilizer packages along with no fertilizer treatments were employed for the experiments. Result revealed that the highest bulb yield was obtained from T_3 (90-55-75-20 kg N-P-K-S/ha + 3 t/ha PM) at Moulvibazar. Statistically yield variation was not found from the different fertilizer packages, however higher yield was obtained from T_1 (120-45-85-40 kg NPKS/ha +5 t/ha CD) at Faridpur Sadar but at Patuakhali significantly higher yield was obtained from T_1 and T_3 treatments. Considerable yield variation was observed among the locations.

Introduction

Summer onion is a newly introduced spices crop in our country. Bangladesh face a great crises of onion during the off period of onion and a large amount of money was lost to import onion from neighbouring country to meet up the demand of our country people. To meet up this demand onion production should must be increased and to develop new variety of this crop. BARI has already developed two varieties of summer onion and some improved and promising lines of summer onion but under trial. Sylhet region is the most rainfall area of the country and the fertilizer management of this area is also very important. For this reason, a trial was undertaken to test the adaptability and the effect of different fertilizer level on the performance of summer onion (Var. OF-5) in Sylhet region.

Materials and methods

An experiment on the effect of inorganic and organic fertilizer of summer onion was conducted at Moulvibazar MLT site during Kharif-1, 2006. The experiment was designed RCB with 6 dispersed replication with advance line OF-5. The treatments were T_1 (Recommended from Ph.D. work)= 120-45-85-40 kg/ha N,P,K,S + 5 t/ha CD, T_2(Recommended from Sp. Res. Centre) = 90-55-75-20 kg/ha N, P, K, S + 5 t/ha CD, T_3 (IPNS)= 3 t/ha poultry manure + remaining amount from inorganic fertilizer for T_2, T_4 (IPNS)= 5 t/ha poultry manure + remaining amount from inorganic fertilizer for T_2 and T_5= Control. The unit plot size was 2m x 2m. The crop was transplanted on 2 March at Moulvibazar, 10 April at Faridpur and 2 February at Patuakhali, 2006. The crop was weeded 3-4 times with spraying Rovral and Redimil gloc @ 2 g/litre water at every 10 days interval to control purple blotch. The crop was harvested on 5 June at Moulvibazar, 18 June at Faridpur and May at Patuakhali, 2006.

Result and Discussions

Moulvibazar: Plants/m^2 was same in all the treatments. The highest no. of onion/kg was obtained from T5 and the lowest from T_3. The highest bulb yield was recorded from inorganic fertilizer with poultry manure. All the treatments showed reasonable good yield as summer onion but cowdung with inorganic fertilizer failed to showed higher yield than poultry manure with inorganic fertilizer. So, poultry manure could be used as a source of organic manure with recommended fertilizer from SRC.

Faridpur: Plant height, bulb length, bulb diameter, single bulb weight and yields were significantly affected by fertilizer treatments. In plant height, bulb length and bulb yield no significant difference was found among the fertilized plots but it was significantly higher than control treatment. The higher bulb diameter was obtained from T1 which was identical to other fertilized plots but T_3, T_4 and control plots are identical. Similar trend of results was also observed in case of single bulb weight. The maximum individual bulb weight (22.2 g) was recorded in T1 which was statistically identical with T_2, T_3 and T_4. The highest bulb yield (13.8 t/ha) was recorded in T_1 but statistically identical to T_2, T_3 and T_4. The lowest bulb yield (7.52 t/ha) was recorded from unfertilized control plot. Regarding cost and return analysis the highest gross margin (Tk. 154176/ha) was calculated from T_1 (120-45-85-40 kg N-P-K-S/ha along with 5 t/ha cowdung) followed by T_2 (90-55-75-20+5 t CD) (Tk. 138340/ha) and highest MBCR (6.92) from T_3 (60-35-55-20 kg N-P-K-S/ha + 3 t/ha poultry manure) followed by T_1 (6.60).

Patuakhali: There was no significant variation in plant population and plant height due to different fertilizer packages. Significantly the highest individual bulb weight was obtained from T_1 followed by T_3. Higher and identical bulb yield was obtained from T_1 and T_3. Among the treatments, IPNS with poultry manure (3 t/ha) produced significantly higher yield over IPNS with cowdung (5 t/ha).

Farmers' reaction

Moulvibazar: Farmers are very much interested to cultivate this crop. They need seed and seedling in proper time. Extension personnel need to motivate with training for the production technology of summer onion. Purple blotch is a problem for this crop.

Patuakhali: Farmers are satisfied to summer onion performance. They are interested to cultivate summer onion. Seed is not available. Seedling raising and seedling establishment is critical.

Conclusion

The yield performance of summer onion is found promising in this area with poultry manure and balanced fertilization for the better performance onion production. The trial should be conducted another year for confirmation.

Table 1. Yield performance of summer onion affected by different fertilizer level at Moulvibazar

Treatment	Plants/m^2	Number of bulb/kg	Bulb yield (kg/plot)	Bulb yield (t/ha)
T_1	51	25 c	8.13 c	20.33 c
T_2	51	26 b	7.77 d	19.44 d
T_3	51	21 e	9.53 a	23.82 a
T_4	51	23 d	8.69 b	21.73 b
T_5	51	29 a	6.89 e	17.22 e
LSD (0.05)	NS	0.15	0.26	0.68
CV (%)		1.47	2.65	2.72

Table 2. Yield and yield contributing characters of summer onion as affected by inorganic and organic fertilizers at Faridpur in 2006

Treatment	No. of plants/m^2	Plant height (cm)	Bulb length (cm)	Bulb diameter (cm)	Single bulb wt. (g)	Bulb yield (t/ha)
T_1	62	46.4	4.52	3.87	22.2	13.8
T_2	61	44.3	4.31	3.61	18.5	12.4
T_3	60	41.6	4.25	3.44	17.8	11.6
T_4	60	42.8	4.48	3.54	17.9	11.8
T_5	58	36.4	3.26	2.86	14.5	7.52
LSD (0.05)	-	4.63	0.66	0.70	4.50	3.45
CV (%)	6.22	5.80	5.82	10.70	13.10	10.80

Table 3. Cost and return analysis of summer onion during Kharif I, 2006 at Faridpur

Treatment N-P-K-S kg/ha	Gross return (Tk./ha)	Variable cost (Tk./ha)	Gross margin (Tk./ha)	MBCR
T_1	165000	11424	154176	6.60
T_2	148800	10460	138340	5.60
T_3	139200	7070	132130	6.92
T_4	141600	9370	132230	5.48
T_5	90240	-	90240	-

Price (Tk./kg): Onion=10, Urea=6, TSP=16, MP=14, Gypsum=6, Cowdung=0.50 and Poultry manure=0.50

Table 4. Yield and yield contributing characters of BARI onion-2 at Razakhali, Patuakhali in 2005-06

Treatment	PP/m^2	Plant height (cm)	Individual bulb wt. (g)	Bulb yield/m^2 (g)	Bulb yield (t/ha)
T_1	45 a	33 a	19.5 a	876 a	8.76 a
T_2	47 a	36 a	16.3 c	768 bc	7.68 bc
T_3	46 a	33 a	17.7 b	814 a	8.14 a
T_4	46 a	34 a	15.7 c	722 c	7.22 c
T_5	28 b	25 b	9.5 d	266 d	2.66 d
CV (%)	5.6	8.3	10.2	8.7	11.5

The values with same letter(s) within the column do not differ significantly by DMRT

Effect of Urea Super Granule and Prilled Urea on the Performance of Maize

Abstract

The experiment was conducted at FSRD site, Ellenga, Tangail for the year of 2005-06 in medium high land under AEZ-8 to observe the efficiency of USG application on Maize production in comparisons to application of prilled urea. There were six treatments viz. T_1- prilled urea (rec. and one application), T_2- prilled urea (rec. and two application), T_3- USG (one application), T_4-USG (two applications), and T_5- 10% less USG (one application) and T_6- farmers practice. Effect of urea super granule on different parameters was found significant. The result revealed that the highest grain yield (10.31t/ha) was obtained from T_4 (i.e. rec. USG two applications). Maximum benefit cost ratio (2.64) was obtained from the treatment T_4.

Introduction

In our country different types of fertilizer materials are becoming available in the market. Urea Super Granule (USG) is one of the most popular nitrogenous fertilizers which is now available in the market and the farmers are already using it in boro rice and also using it in different upland vegetables and fruit crops such as brinjal, cabbage, cauliflower, banana etc. Maize is one of the profitable field crops at Tangail. The cultivation area of this crop is increasing day by day. But the efficiency of USG to this crop is yet to be established, however few farmers already using it in their crop. Therefore it is very important to evaluate the efficiency of USG on Maize. Hence the experiment was undertaken to find out the optimum and economic dose of USG for Maize.

Materials and Methods

The experiment was carried out at FSRD site, Ellenga, Tangail for the year of 2005-06 in the medium highland under AEZ-8. The study was laid out having RCB design with four dispersed replications. The unit plot size was 5 m × 4 m, with spacing 75 cm × 25 cm. The variety BHM-03 was used in this experiment. The six treatments were considered as T_1- prilled urea (rec. and one application), T_2- prilled urea (rec. and two applications), T_3- USG (one application), T_4- USG (two applications), and T_5- 10% less USG (one application) and T_6 - farmers practice. Fertilizer doses for each treatment were calculated on the basis of Krishi Projkuti Hand Book. They are as follows-

Treatments	Nutrient dose (kg/ha)					
	Urea	TSP	MP	Gypsum	Zinc	Boron
T_1	545	250	200	250	10	6
T_2	545	250	200	250	10	6
T_3	545	250	200	250	10	6
T_4	545	250	200	250	10	6
T_5	490	250	200	250	10	6
T_6	500	100	150	-	-	6

Above all other fertilizers except urea were applied as basal but USG was applied as ring method 10-15 cm from plant stalk, and 7.5-10 cm depth in soil. Twice weeding and irrigations were done in a cropping season before fertilization of soil. The data on different plant characters and yield components were collected from 10 plants selected at random in each 7.5 m^2 area of each replication and yield was calculated per 7.5 m^2 area. Data were analyzed and compiled.

Methods of fertilizer application

Treatments	Frequency of applications	Forms of Urea	Time of application (DAS)		
			1^{st}	2^{nd}	3rd
T_1	One	Prilled	15-20	-	-
T_2	Two	Prilled	15-20	45-50	-
T_3	One	USG	15-20	-	-
T_4	Two	USG	15-20	45-50	
T_5	One	10% less USG	15-20	-	-
T_6	Three	Prilled	15	30	50

DAS (days after sowing)

Result and Discussions

The plant characteristics and yield and other attributes were varied among the treatments. The yield and yield contributing characters were presented in Table 1. Ear height of plant was not significant but higher ear height was observed in T_2, followed by T_1. Significant variation was observed among the treatments in the case of cob length. The treatment T_4 showed higher cob length but at par to treatments T_3 whereas farmer's practices produced the lowest length of cob. Maximum number of grains/cob was produced by the treatment T_4, which was statistically difference from others and lowest number of grains/cob was observed in farmers' practices. Significantly higher 1000 grain weight was produced by the treatment T_3, followed by T_5. Statistically significant variation was found in the grain yield of maize. The treatment T_4 produced maximum grain yield followed T_3 and T_2. The lowest grain yield was produced by the farmers' practices. It is noticed that USG showed higher yield than prilled urea except T_5 where 10% less USG was used. Two times USG application is found better than one time application of USG.

Cost and return analysis

The highest gross return was obtained from T_4 which was followed by T_3. Treatment T_5 (where 10% less USG was applied) showed higher gross return than T_1 where prilled urea used. Gross margin was also higher from T_4 though higher cost was involved than prilled urea. But the highest BCR was recorded from USG with 2 time applications and other treatments failed to show higher benefit than prilled urea.

Farmers' reaction: Farmers are interested to use USG in Maize cultivation

Conclusion

Based on one-year results it could be concluded that urea super granule (USG) is better for Maize cultivation and two times application of USG may be profitable for the farmers. It needs to another year trial for confirmation.

Table 1. Yield and yield contributing characters of hybrid maize (Ellenga, Tangail, 2005-06)

Treatments	Ear height (cm)	Cob length (cm)	Grains/ cob	1000-grain wt. (g)	Grain yield (t/ha)
T_1	109.4	17.68	499	391	8.46
T_2	109.5	18.11	522	390	9.21
T_3	99.20	18.68	504	409	9.54
T_4	107.3	19.47	546	392	10.31
T_5	105.9	18.20	500	400	8.89
T_6	102.3	17.20	481	380	8.15
LSD (0.05)	NS	1.83	55.07	27.90	1.34
CV(%)	7.81	5.52	5.95	4.17	8.03

Table 2. Cost and return analysis of hybrid maize

Treatments	Gross return (Tk./ha)	Variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	96082	37937	58145	2.53
T_2	99372	38937	60435	2.55
T_3	101683	38937	62746	2.61
T_4	109772	40937	68835	**2.64**
T_5	97968	38607	59361	2.53
T_6	86483	35076	51407	2.46

Price of inputs (Tk./kg): Urea–6.00, TSP-14.00, MP-12.00, Gypsum-5.00, Zinc-30.00 and Boron-60.00
Price of outputs (Tk./kg): Grain–10.00 and Byproduct-0.50

Appendix- A: Monthly average weather data of experimental site, Tangail

Months	Rainfall (mm)	Temperature (0^C)	
		Maximum	Minimum
November, 05	11.10	27.80	18.10
December, 05	5.00	27.00	13.20
January, 06	2.30	24.50	11.50
February, 06	13.00	31.20	17.60
March, 06	5.00	32.00	18.90
April, 06	36.30	33.30	22.40
May, 06	74.00	33.40	24.00

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

Abstract

The experiment was conducted at Sylhet during 2005-06 to find out effect of Urea Super Granule (USG) on Tomato USG 10% and 20% less of recommended USG were tested along with recommended dose of prilled urea, USG and farmers practice. Results revealed that yield of crops increased due to application of USG over prilled urea. The highest yield was obtained from the USG (Rec. dose). Regarding cost and return higher gross return and margin as well as BCR (5.17 were obtained from USG treatments. Even 10% less USG showed similar BCR as 100% prilled urea.

Introduction

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

Materials and Methods

The experiment was conducted at Anantapur, Sylhet of AEZ-20 during rabi 2005-06. The land type is medium highland with pH 5.05. Organic matter is low (1.94%), P low (7.68), K (0.15 k mg/100g) low, S (25.27 ug/S of soil) optimum and B (0.053 ug/g soil) optimum, respectively. The variety was Epock. Tomato was transplanted from 18 December 2005 to 6 January 2006 with 30 days old seedlings. Spacing was 80cm x 60cm. There were five treatment i.e. prilled urea, USG (Rec.), USG (100 < Rec.), USG (20% < Rec.) and farmers practice. The crops were harvested from 24 March to 17 April 2006.

Results and Discussion

From Table 1, it was revealed that yield of Tomato increased due to application of USG over prilled urea. The highest yield was obtained from the USG (Rec.dose) followed by USG (10% <Rec. dose). In most cases 10-20% nitrogenous fertilizer could be save by using USG instead of traditional prilled urea. Regarding cost and return analysis, higher gross return was obtained from USG treatments with gross margin. The highest BCR (5.17) was obtained from the USG (Rec. dose). Even 10% less recommended dose of USG showed similar BCR as 100% prilled urea.

So, from one year result showed that USG could be used instead of prilled urea for higher benefit.

Table. 1**.** Effect of USG on yield and economics of Tomato (Anantapur, Sylhet during 05-06)

Treatment	Yield (t/ha)	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Prilled urea (Rec)	85.39	42695	93708	333242	4.55
USG (Rec)	101.36	506800	97920	408880	5.17
USG(10%<Rec)	88.12	440600	96696	343904	4.55
USG(20%<Rec)	75.14	375700	96472	279228	3.89
Farmers practice	47.14	235700	91329	144391	2.58

Market price (Tk./kg): Tomato=5/-, Urea=5/70, USG=6/-, TSP=12/-, MP=9/-, Gypsum=4/-, $ZnSO_4$=35/-

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Evaluation of Different Packages of Fertilizer on the Yield of Sweet Potato Varieties

Abstract

An experiment was conducted at Laxmigonj village of Netrokona Sadar MLT site during rabi 2005-06 to evaluate the performance of newly developed BARI sweet potato varieties (BARI SP-4,5,6 and 7) with a local under low different fertilizer levels (HYG & MYG). The effect of fertilizer was not significant. But the effect of variety and interaction was significant. Out of the tested varieties, all the BARI developed varieties gave higher yield than the local. The highest (29.82 t/ha) yield was recorded from the variety BARI SP-7 under high yield goal fertilizer level. The medium yield goal fertilizer level gave lower yield in all the varieties. The highest gross return (Tk. 119280/ha) and gross margin (Tk. 108244/ha) were recorded from the variety BARI SP-7 under HYG fertilizer level but highest benefit cost ratio(13.51) was obtained from the same variety under MYG fertilizer level. The local variety gave the lower benefit cost ratio (6.57 in HYG and 8.07 in MYG).

Introduction

Sweet potato is an important root crop in Bangladesh. The poor people take it as staple food in many areas of Bangladesh. Its cultivation in wide spread in the char areas. In Netrakona district char lands of Laxmiganj is a suitable land for sweet potato cultivation. But the farmers are applying unbalanced fertilizers for their sweet potato crop. Tuber Crop Research Centre of Bangladesh Agricultural Research Institute has already developed some improved varieties of sweet potato which needs to be verified at farmers' field as compared to local variety. On the other hand a complete package of fertilizer to be evaluated for better economic yield. So, the experiment was designed to compare the BARI developed improved varieties of sweet potato with the farmers variety under variable fertilizer packages.

Materials and Methods

The experiment was conducted at Laxmiganj village of Netrakona Sadar MLT site during rabi 2005-06. The design of the experiment was randomized complete block with four replications. The unit plot size was 4m X 5m. Vine cutting of size about 30 cm was planted at spacing 50cm X 30cm on 28 November 2005. The treatments of the experiment were five sweet potato varieties viz., BARI SP-4, BARI SP-5, BARI SP-6, BARI SP-7 and local and two fertilizer doses viz., High yield goal (HYG) i.e., 68-66-162-23 kg/ha of NPKS and medium yield goal (MYG) i.e., 55-50-123-18 kg /ha of NPKS, respectively. Except urea all other fertilizers were applied as basal during final land preparation. Urea was applied as top dresses in two equal splits during 20 DAP and 50 DAP. One weeding was done on 35 days after planting. No irrigation was given but one light rainfall was occurred on 65 days after planting. The crop was harvested on 4th April, 2006. Data on yield contributing characters, yield and economics were recorded and analyzed statistically where necessary. Economic analysis was done on the basis of prevailing market prices of input and output.

Results and discussion

Effect of variety: The BARI developed sweet potato varieties gave better performance for both yield and yield contributing characters compared to local variety. Table 1 shows the yield and yield contributing characters of sweet potato varieties. All the yield contributing characters and yields were statistically significant except number of tubers / plant. Out of the five tested varieties BARI SP-7 gave the highest tuber yield (29.16 t/ha). The local variety gave the lowest yield of 17.56 t/ha. Although, all the BARI developed varieties were high yielder yet the local variety was more preferred by the farmers due to its more sweetness than the improved varieties. However, the BARI developed varieties were also preferred by the farmers for their high yield.

Effect of fertilizer: The effects of fertilizer on sweet potato varieties were not statistically significant. However, better performance was given by the HYG fertilizer levels. In HYG the tuber yield was 25.11 t/ha whereas in MYG the tuber yield was 23.37 t/ha.

Interaction between variety and fertilizer: From table 1 it is evident that the interaction effect of variety and fertilizer was significant at 5% level. Vine length was highest (275 cm) in BARI SP-7 with HYG followed by BARI SP-4. The local variety was short plant statured (84 cm in HYG and 82 cm in MYG). Number of branches / plant was higher (10.0-11.3) in BARI SP-6 in both the fertilizer levels. Other plant characters and yield was higher in the BARI developed varieties compared to local in both fertilizer levels. Better yield attributes of the BARI developed varieties contributed to their higher tuber yields. The local variety was low yielder but it was sweeter than the BARI varieties. However, the farmers liked the BARI varieties for their higher yields. The highest tuber yield of 29.82 t/ha in HYG and 28.46 t/ha in MYG were obtained from BARI SP-7. These varieties were suitable for processed foods in the factories. So, these varieties may be recommended for both local consumption as well as for industrial use.

Cost and return analysis: Higher gross return and gross margin were obtained from the HYG fertilizer level (Table 2). In case of MYG, the variable cost was lower which resulted higher benefit cost ratio through the gross return or gross margin were lower in MYG. Out of the five tested varieties BARI SP-7 gave the highest gross return (Tk.119280/ha), gross margin (Tk.108244/ha) in HYG and highest benefit cost ratio (13.51) in MYG. Other BARI SP varieties also gave better benefit cost ratio of 8.81-9.91 in HYG and 10.42-12.18 in MYG. The local variety gave the lowest benefit cost ratio of 6.57 in HYG and 8.07 in MYG.

F armers' reaction

Farmers liked the BARI developed varieties for their higher yield but they commented that the taste specially sweetness of local variety is more than the BARI varieties. However, the farmers are willing to cultivate the BARI SP-7 for its whitish skin colour, good yield and taste.

Table 1. Yield and yield contributing characters of sweet potato varieties under two different fertilizer levels at Netrakona during 2005-06

Treatments	Length of vine (cm)	Branches/ plant	Leaves/ plant	Tubers / plant	Wt. of tubers /plant (kg)	Tuber yield (t/ha)
Effect of variety						
BARI SP-4	259 ab	7.75 b	190 a	4.0	1.44 a	23.14 d
BARI SP-5	236 b	6.75 b	200 a	3.5	1.24 bc	24.81 c
BARI SP-6	239 b	10.63 a	199 a	3.5	1.29 bc	26.51 b
BARI SP-7	275 a	6.63 b	190 a	4.0	1.37 ab	29.16 a
Local	83 c	4.25 c	118 b	3.9	1.22 c	17.56 e
LSD (0.05)	23.06	1.62	21.77	NS	.014	1.28
Effect of fertilizer						
HYG	219	7.55	181	3.80	1.35	25.11
MYG	218	6.85	178	3.75	1.27	23.37
LSD (0.05)	NS	NS	NS	NS	NS	NS
Variety X Fertilizer						
F_1 X V_1	260 ab	8.0 bc	191 a	4.0	1.46 a	24.32 de
F_1 X V_2	238 b	7.0 c	201 a	3.5	1.26 bc	25.87 cd
F_1 X V_3	236 b	11.3 a	200 a	3.8	1.29ab	27.35 bc
F_1 X V_4	275 a	7.0 c	190 a	4.0	1.41 ab	29.82 a
F_1 X V_5	84 c	4.5 de	123 b	3.8	1.33 ab	18.12 g
F_2 X V_1	258 ab	7.5 c	189 a	4.0	1.41 ab	21.95 f
F_2 X V_2	235 b	6.5 cd	199 a	3.5	1.22 bc	23.75 ef
F_2 X V_3	241 b	10.0 ab	198 a	3.3	1.27 abc	25.67 cd
F_2 X V_4	274 a	6.3 cde	189 a	4.0	1.32 ab	28.46 ab
F_2 X V_5	82 c	4.0 e	112 b	4.0	1.10 c	17.00 g
LSD (0.05)	32.62	2.29	30.79	NS	0.19	1.81
CV (%)	10.30	15.90	11.83	15.75	10.21	5.14

Table 2. Economic analysis of sweet potato varieties under two different levels at Netrakona during 2005-06

Treatment	Gross return (Tk /ha)	*TVC (Tk /ha)	Gross margin (Tk/ha)	BCR
F_1 X V_1	97280	11036	86244	8.81
F_1 X V_2	103480	11036	92444	9.38
F_1 X V_3	109400	11036	98364	9.91
F_1 X V_4	119280	11036	108244	10.81
F_1 X V_5	72480	11036	61444	6.57
F_2 X V_1	87800	8428	79372	10.42
F_2 X V_2	95000	8428	86572	11.27
F_2 X V_3	102680	8428	94252	12.18
F_2 X V_4	113840	8428	105412	13.51
F_2 X V_5	68000	8428	59572	8.07

*TVC includes cost of fertilizer only.

Price: Sweet potato- Tk. 4.00/kg, N-Tk. 13.32/kg, P- Tk. 75.00/kg, K - Tk. 28.00/kg, S -Tk. 27.50 /kg

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Effect of Different Fertilizer Management Packages on Chilli

Abstract

The study was conducted at FSRD site Hazirhat, Noakhali and MLT site, Laxmipur during Rabi season of 2005-06. Chilli was evaluated with five different management practices. Among the five treatments the highest yield (1.31 t/ha) and (1.53 t/ha) was observed with the treatment T_1 (150% Recommended fertilizer dose) which was almost similar with T_2 (100% Recommended fertilizer dose) and the lowest yield (0.60 t/ha) and (0.65 t/ha) was recorded with the treatment T_5 in both the locations.

Introduction

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

Materials and Methods

The study was conducted at FSRD site Hazirhat, Noakhali and MLT site Laxmipur during Rabi season of 2005-06. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain (AEZ 18f) and Meghna Estuarine Floodplain (AEZ 18) respectively. The experiment was laid out in RCB design with four replications. Unit plot size was 3 m X 2 m. Seedlings were planted in lines maintaining 40 cm X 30 cm spacing. There were five treatments as follows: T_1 = 150% RD, T_2 = 100% RD i.e. 50, 32 and 50 kg/ha N, P and K respectively (FRG'97), T_3 = 50% RD, T_4 = Farmers practice (29 and 13 kg/ha N and P respectively) and T_5 = control. The whole amount of P, K and 1/3 of N were applied at the time of final land preparation and remaining N was applied in two installments at 25 and 50 DAT. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 3.67 to 11.31 ds/m.

Results and Discussion

Different fertilizer management packages showed a significant influence on different yield and yield contributing characters of chilli in both the locations (Table 1 and 2). Plant height, branch /plant, length of fruit, breadth of fruit no. of fruit /plant, weight of fruit/plant and yield increased with the increasing fertilizer dose.

FSRD site Hazirhat

Treatment T_1 gave the highest number of fruit/plant (38.86) and the lowest was found from T_5 (25.44). The highest weight of fruit /plant was obtained from treatment T_1 (25.45 g) that was almost double of T_5. As the highest number and weight of fruit /plant were found from the treatment T_1 and the highest yield (1.31 t/ha) was also found from the treatment T_1. Control plots gave the lowest yield (0.60 t/ha).

From the economic point of view, the highest gross return (65500 Tk.) was observed in T_1 treatment where 1.5 times fertilizers were used of recommended dose (RD) and the lowest gross return (30000 Tk.) was found in T_5, i.e. control plots. The highest Benefit Cost Ratio (2.04) was obtained in T_2, i.e. RD of FRG'97 and the lowest BCR (1.15) was found in control plots.

MLT site, Laxmipur

Treatment T_1 gave the highest number of fruit/plant (51.45) and the lowest was found from T_5 (30.05). The highest weight of fruit /plant was obtained from treatment T_1 (29.82 g) that was more than double of T_5. As the highest number and weight of fruit /plant were found from the treatment T_1, the highest yield (1.53 t/ha) was also found from the treatment T_1. Control plots (T_5) gave the lowest yield (0.65 t/ha).

From the economic point of view, the highest gross return (75500 Tk.) was observed in T_1 treatment where 1.5 times fertilizers were used of recommended dose (RD) and the lowest gross return (32500 Tk.) was found in T_5, i.e. control plots. The highest Benefit Cost Ratio (2.22) was obtained in T_2, i.e. RD of FRG'97 and the lowest BCR (1.15) was found in control plots.

Farmers' Reaction

Yield of chilli was highest in 150% of recommended fertilizer dose but it needed more capital to use to get highest economic benefit over the 100% recommended rate of fertilizer. So the farmers opined that existing recommended dose is best for them.

Conclusion

From the results of the present study, it may be concluded that though the yield and yield contributing characters are found to be best in T_1 but the treatment T_2 is the best in case of yield and economic benefit with using optimum fertilizer in these areas.

Table 1. Yield, yield contributing characters and economic analysis of chilli at FSRD site, Hazirhat (2005-06)

Treatment	Fruits/ plant	Wt. of fruits / plant (g)	Fruit yield (t/ha)	Gross return (Tk./ha)	Total Cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	38.86 a	25.45 a	1.31 a	65500	34000	31500	1.92
T_2	35.50 b	23.78 b	1.28 ab	64000	31300	32700	2.04
T_3	32.69 c	20.01 c	1.12 bc	56000	28600	27400	1.95
T_4	29.88 d	14.63 d	0.87 c	43500	28200	15300	1.54
T_5	25.44 e	13.84 d	0.60 d	30300	25900	4100	1.15
CV (%)	3.01	2.33	8.53	-	-	-	-
$LSD_{0.05}$	1.832	0.858	0.253	-	-	-	-

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

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

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

Abstract

The experiment was conducted in farmers field at FSRD site, Hazirhat, Noakhali and at MLT site, Laxmipur and Feni, on-farm research Division, Bangladesh Agricultural Research Institute, Noakhali during the Rabi season of 2005-06 to study the effect of spacing and nitrogen (N) application on the yield of Batishak (Brassica chinensis). Three spacings (40 × 15, 40 × 25 and 40 × 35 cm) and four levels of N (O, 40, 80 and 120 kg/ha) were used in the study. The results showed that the closest spacing (40 × 15 cm) coupled with 120 kg N/ha gave the highest yield (27.1, 33.8 and 31.8 t/ha).

Introduction

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

Materials and Method

The experiments were conducted at farmer's field of FSRD site, Hazirhat, Noakhali, MLT sites of Laxmipur and Feni in the growing season of 2005-06. The soils of the experimental plot were sandy loam in texture. The treatments consisted of 3 levels of plant spacing (40 cm x 15cm, 40 cm x 25 cm and 40 cm x 35 cm) and 4 levels of N-doses (0, 40, 80 and120 kg/ha). The experiments were set in randomized complete block design with three replications. The seeds were sown on the third week of December 2005. The unit plot size was 4 m x 3m. Twenty days old healthy seedlings were transplanted in the main field. Phosphorus and potassium were applied as basal during final land preparation at the rate of 30 kg P and 65 kg K per hectare in the form of triple super phosphate and muriate of potash. As a source of nitrogen urea was applied in two equal splits at 10 days interval after planting. All other intercultural operations were done when and as necessary. There were no pest infestations in the treatment plots. Data on yield and yield contributing characters were recorded and analyzed by computer programme MSTAT-C and means were separated with Duncan's Multiple Range Test (DMRT). During the experiment period the salinity range was 2.44 to 8.30 ds/m.

Results and Discussion

Effect of plant spacing: Effect of different plant spacing on various aspects of morphological, yield contributing characters and yield of batishak are shown in table 1, 4 and 7. Plant spacing had no significant effect on plant height and number of leaves per plant in all the locations. Higher spread of plant was found in the broader spacing i.e. 40 cm x 35 cm. Fresh yield / plant was also higher in the broader spacing at all the locations. But incase of fresh green yield higher yield was obtained from the closer spacing i. e. 40 cm x 15 cm because of the higher number of plant per unit area.

Effect of N-doses: Effect of different N- doses on various aspects of morphological, yield contributing characters and yield of batishak are shown in table 2, 5 and 8. The level of nitrogen applications had a marked influence on different yield components and yield of Batishak. For all the characters, the better results were obtained with the application of highest level of nitrogen at all the locations.

Combined effect: The plant spacing and the level of nitrogen application had a marked influence on different yield components and yield of Batishak at all the experimental sites (Table 1, 2 and 3). For all the characters, the better results were obtained with the application of highest level of plant spacing and nitrogen level except yield (t/ha). The plant height was found to be increased significantly with the increase in the level of nitrogen and plant spacing and the tallest plants (30.6 cm, 26.6 cm and 32.7 cm) were obtained from the highest dose (120 kg / ha) with the spacing 40 x 35 cm respectively. The shortest plants (23.0 cm, 22.0 cm and 17.3 cm) were found in control plots with 40 x 15 cm. The number of leaves produced per plant showed the same pattern of response as of plant height to nitrogen application. The highest number of leaves per plant (19.13, 19.60 and 23.20) was obtained when 120 kg N/ha with spacing 40 x 35 cm was applied. The plants in control plots gave the lowest number of leaves. The level of nitrogen influenced significantly on the length of leaf produced. A marked increase was found in maximum length of leaf by application of 120 kg /ha. However, application of nitrogen at the highest level (120 kg/ha) gave the maximum length of leaf, similarly, the maximum plant spread (31.7, 31.6 and 39.2 cm) were obtained from application of 120 kg N/ha along with 40 x 35 cm plant spacing. The highest fresh weight of plant (298, 336 and 303 g) were produced from 120 kg N / ha with 40 x 35 spacing, however, the lowest fresh yield/plant (135, 122 and 114 g) were obtained from the control plots with 40 x15 cm. Yields, in fresh weight were increased significantly with an increase in the level of nitrogen and spacing also. Application of nitrogen at 120 kg/ha with the spacing 40 x 15 cm produced the highest fresh yields (27.1, 33.8 and 31.8 t/ha). Previous reports of a number of workers supports the present findings either partially or fully (Miah, 1987; kraxner *et al.*, 1988; Ahmad, and Shahjahan, 1991 and Sarder, 1992). The combined effect of spacing and nitrogen application was found to be significant for all the characters studied in this experiment (Table 1, 2 and 3). The fresh yield was found to be increased with the increasing level of N irrespective of spacing. The closest spacing (40 x 15 cm) accompanied with maximum dose of N (120 kg/ha) gave the highest yield of Batishak.

Farmers Reaction

Batishak is a newly introduced crop in this area. Farmers were much interested about this crop because of its higher yield and better taste over other leafy vegetables in the market. Some farmers also stored the seeds for future use.

Conclusion

The yield was increased with highest fertilizer application, not with the plant spacing only because of its dense population with the narrow spacing. The highest yield was found in the plant spacing 40 x 15 cm with 120 kg N/ha. So the results of the present experiment suggest that Batishak can be grown at a plant spacing 40 x 15 cm with 120 kg N/ha for the highest yield. The experiment was conducted only one year so another year trial is needed for confirmation.

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

Spacing (cm)	Plant height (cm)	No. Of leaves/ Plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
40 × 15	28.2	15.1	28.5	28.5	127	21.2
40 × 25	28.7	16.3	29.5	28.2	173	17.4
40 × 35	29.5	16.4	30.4	28.1	227	16.2
LSD $_{0.05}$	NS	NS	NS	NS	40.34	3.21

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

N-doses (kg/ha)	Plant height (cm)	No. of leaves/ Plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
0	25.1	13.3	25.5	24.6	123	12.9
40	28.7	15.4	29.4	28.5	154	16.3
80	30.6	16.3	30.8	29.7	193	19.9
120	30.7	18.6	31.8	30.3	233	24.0
LSD $_{0.05}$	1.23	1.87	1.62	2.13	27.4	3.17

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

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

Table 4. Effect of spacing on the yield and yield Contributing characters of Batishak at MLT site, Laxmipur

Spacing (cm)	Plant height (cm)	No. of leaves/ plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
40 × 15	23.8	16.6	13.7	20.7	159	26.4
40 × 25	24.4	17.4	18.5	21.4	197	19.7
40 x 35	24.7	17.5	28.5	22.1	249	17.7
LSD $_{0.05}$	NS	NS	2.14	NS	33.97	4.04

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

N-doses (kg/ha)	Plant height (cm)	No. of leaves/ Plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
0	22.3	15.3	17.5	19.1	143	15.5
40	23.5	16.2	19.7	21.2	177	18.1
80	25.2	18.0	21.0	21.9	220	23.2
120	26.2	19.2	22.7	23.3	264	27.7
LSD $_{0.05}$	0.15	1.51	1.17	1.13	25.65	3.65

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

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

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

Spacing (cm)	Plant height (cm)	No. Of leaves/ Plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
40 × 15	23.9	17.5	27.1	20.6	150	25.0
40 × 25	27.4	21.0	27.7	21.1	185	18.5
40 × 35	25.5	18.9	30.4	21.1	232	16.5
$LSD_{0.05}$	NS	2.17	2.55	NS	31.29	3.77

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

N-doses (kg/ha)	Plant height (cm)	No. Of leaves/ Plant	Spread of plant (cm)	Length of leaves (cm)	Fresh wt./ plant (g)	Green biomass (t/ha)
0	18.6	12.1	20.1	19.9	133	14.3
40	24.1	19.1	24.7	22.9	171	18.1
80	27.6	22.3	31.6	25.7	207	21.8
120	32.1	23.5	37.1	33.3	245	25.8
$LSD_{0.05}$	3.51	2.67	3.42	2.15	30.57	3.71

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

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

On-Farm Verification on Sulphur Fertilization of Onion Production

Abstract

Experiment with three rates of sulphur (0, 30 and 60 kg/ha) with a blanket dose of $N_{120}P_{40}K_{75}Zn_5$ kg/ha + 5t CD/ha including farmers' practice ($N_{115}P_{30}K_{60}$ kg/ha+5 t CD/ha) were conducted at farmers' field of Manikganj and Pabna to verify the effect of different rates of sulphur on the productivity of onion. Yield attributes and yield of onion varied significantly due to sulphur fertilization at Manikganj. The highest bulb yield (7.66 t/ha), the maximum gross margin (Tk.71366) and the MBCR (5.93) were recorded when the plots received 60 kg S/ha along with $N_{120}P_{40}K_{75}Zn_5$ kg/ha+5 t CD/ha. The lowest bulb yield (5.33 t/ha) and gross margin (Tk.50061) were obtained from the farmer's practices or without added sulphur fertilizer. At Pabna area, the highest yield (8.28 t/ha), gross margin and BCR (2.15) was recorded from 60 kg S/ha. There is trend to increase yield with the increase of dose of fertilizer but 60 kg S/ha is essential for optimum bulb production in Manikganj and Pabna area.

Introduction

Onion (*Allium upa* L.) is an important spice crop grown all over Bangladesh during the winter season. It is used in almost all food preparation and is an integral part of Bangaldesh diet (Hossain and Islam, 1994). However, the average yield of onion is 4.17 t/ha, which is very low as compared to other onion productions countries of the world. Application of imbalanced fertilizer and use of local varieties are some of the important reasons for this low yield. Onion yield can be increased by the application of sulphur fertilizer in association with major nutrients, high yielding varieties and appropriate management practices.

Sulphur has recently been raised as the fourth major nutrient after N, P and K. Onion crop has high sulphur requirement for its proper growth and yield (Ajoy and Singh, 1994; Singh et al, 1996). Sulphur has been found not only to increase the bulb yield but also to improve its quality, particularly pungency and flavors (Jagoo and Dixit, 199). Sulphur containing secondary compounds is not only important for nutritive value or flavors but also for resistance against pests and diseases (Bell, 1981. Lack of its optimum supply in different plant parts may limit the crop growth at any stage resulting in yield reduction. The present study was therefore, undertaken at farmer's field to verify the effect of different rates of sulphur fertilization on the yield of onion and farmer's response to new technology.

Materials and Methods

The experiment was conducted at farmer's field of MLT site, Manikganj and Sujanagar, Pabna during rabi season of 2005-2006. The soil of the experimental field was sandy loam. The soil was slightly acidic (pH 6.4), low in fertility status having organic matter 1.02%, total nitrogen (0.045%), available phosphorus (7.02 ppm), shulphur (10 ppm), potatssium (125 ppm) and zinc 1.0 ug/mg) at Manikganj. The treatment consisted of four combinations viz. $T_1 = N_{120}\ P_{40}\ K_{75}\ S_0\ Zn_5$ kg/ha + 5 t/ha CD/ha, $T_2 = N_{120}\ P_{40}\ K_{75}\ S_{30}\ Zn_5$ kg/ha + 5 t/ha CD/ha, $T_3= N_{120}\ P_{40}\ K_{75}\ S_{60}\ Zn_5$ kg/ha + 5 t/ha CD/ha and $T_4= N_{115}\ P_{30}\ K_{62}\ S_0\ Zn_0$ kg/ha + 5 t/ha CD/ha (FP). The experiment was conducted in a randomized complete block design with five dispersed replications. The unit plot size was 4mx 5m. Fertilizer was applied in the form of urea, triple superphosphate, muriate of potash, gypsum and zinc oxide, respectively. Cowdung was applied before final land preparation. The whole amount of triple superphosphate, muriate of potash, gypsum, zinc oxide and half of the urea were applied at the time of final land preparation. The remaining urea was applied in two equal installments in the 3rd and 6th weeks after transplanting followed by light irrigation. The test variety was Taherpuri. The seedlings of 45 days old were planted at 10cm spacing in rows 20cm apart on 2 January, 2006. The crop was harvested on 23 March, 2006 at Manikganj and 7 January at Pabna when the tops turned into yellowish. Data thus collected were subjected to analysis of variance LSD test was used for mean separation.

Results and Discussion

Manikganj: Sulphur fertilizer had significant influence on the plant height, number of leaves/plants, individual bulb weight, bulb diameter and bulb yield. Number of bulb at harvest did not vary due to variation of treatments. In general, plants grown with farmer's practice were found to be significantly shorter and gave lower number of leaves/plant than the plants grown with adequate amount of fertilizers. The maximum plant height was recorded for plants treated with 60 kg S/ha, which however, differed significantly from those of other treatments. Addition of 60 kg S/ha also produced the higher leaves/plant which was closely followed by 30 kg S/ha. Plants grown without added sulphur and farmer's practice produced the least number of leaves. The weight of individual bulb ranged between 12.5 to 18.2 g across the treatments. Weight of individual bulb was maximum in plant treated with 60 kg S/ha and it was significantly different from other treatments. No sulphur application as well as farmers practice produced statistically identical bulb weight. Bulb diameter varied significantly due to sulphur fertilization. It was highest for the plants grown with 60 kg S/ha and the lowest for those with 0 kg s/ha and also farmer's practice. The bulb yield of onion also varied significantly due to sulphur fertilization (Table-1). Bulb yield ranged between 5.33 to 7.66 t/ha across the treatments. But highest yield was obtained with 60 kg S/ha. Nasreen and Huq (2002) also reported that application of 45-60 kg s/ha resulted higher bulb yield of onion. The yield advantage of sulhpur fertilization at 60 kg S/ha was 11, 32 and 44% higher over 30 kg S/ha (T_2), without added sulphur (T_1) and farmer's practice (T_4), respectively There was trend to increase bulb yield with the increase of S dose. On an average farmers are used lower dose NPK and without S and Zn. This resulted lower yield in farmers practice. Beside all the nutrients were used in treatment T_1. The soil test value showed that experimental field was highly deficient in sulphur and also NPKZn. Application of sulphur along with other essential nutrients helped maintain soil fertility and responded favorably which resulted in a big yield difference. Moreover, increase in the yield of bulbs at 60 kg S/ha might be due to production of higher bulb size and weight. Plants grown without sulphur (T_1) as well as farmers practice (T_4) had the lowest bulb yield of onion. However, the result of the on-station was in agreement or similar with that of farmer's field.

Economic evaluation: The cost and return analysis was done over farmer's practice which showed that the highest gross return was found from T_3 followed by T_2 (Table 2). Gross margin was also found highest from the same treatment. The highest MBCR (593) was also observed in T_3 due to its higher yield as well as gross return. Though lower cost of fertilizer was involved in treatment T_1 but addition only Tk. 2000/ha for sulphur in treatment T_3 which earned more than Tk.18956/ ha where only 60 kg S/ha was used. But due to omission of sulphur, the yield was not increased substantially. So, it proves that sulphur is essential element for onion cultivation.

Sujanagar, Pabna: The highest bulb yield was obtained from recommended S_{60} fertilizer (T_3).The cumulative effect of maximum diameter and weight per bulb might have significant contribution to increased bulb yield in S_{60} fertilizer (T_3) treatment. The lowest bulb yield was recorded in farmers practice (T_4) (without S) treatment might be due to no addition of sulphur fertilizer and imbalanced nutrient management. From the cost and return analyses, the highest gross margin and benefit cost ratio (BCR) was obtained from recommended sulphur fertilizer (S_{60}). The lowest BCR was recorded in farmers practice (no S fertilizer).

Farmers reaction

Manikganj : The variety is acceptable for good in production. It has a market demand. It should be planted in early. Color is attractive. Positive effect of sulphur for higher yield to farmers

Pabna : Farmers of that location are highly pleased to observe the positive effect of S on onion production. They opined that in future they will use S fertilizer for onion production.

Conclusion

From one year result showed that 60 kg S/ha is required for optimum bulb production for onion in Manikganj and Pabna area.

Table 1. Yield and yield attributes of onion as influenced by sulphur fertilization at MLT site, Manikganj

Fertilizer level N-P-K-S-Zn -CD (kg/ha)	Bulbs/ m^2 (no.)	Plant height (cm)	Leaves/ plant (no.)	Single bulb wt. (g)	Bulb diameter (cm)	Bulb yield (t/ha)
T_1= 120-40-75-0-5-5000	46	26.7	7	13.5	2.7	5.80
T_2= 120-40-75-30-5-5000	47	27.9	9	16.0	2.9	6.90
T_3= 120-40-75-60-5-5000	47	30.1	10	18.2	3.2	7.66
T_4= 115-30-62-0-0 -5000	46	24.7	6	12.5	2.5	5.33
LSD (0.05)	NS	1.8	2	1.9	0.2	0.46

NS= Not significant, CD= Cowdung

Table 2. Cost and return analysis of onion as influenced by different fertilizer packages at MLT site, Manikganj 2005-06

Treatments	Gross return (Tk/ha)	Variable cost* (Tk/ha)	Gross margin (Tk/ha)	MBCR (over farmers practice)
T_1	63800	10890	52910	2.22
T_2	75900	11892	64008	5.20
T_3	84260	12894	71366	5.93
T_4	58630	8569	50061	-

* Variable cost = Fertilizer cost only
Price (Tk/Kg) : Urea = 6, TSP= 18, MP=15, Gypsum=6, Zinc=70 and Cowdung=0.50

Table 3. Yield and yield attributes of Onion as affected by different treatments at MLT site, Sujanagar, Pabna, during 2005-06

Treatment	Plant height (cm)	Leaves/Plant (no.)	Diameter/ bulb (cm)	Weight/bulb (g)	Bulb yield (t/ha)
T_1 = No S	33.75 ab	3.95 b	3.18c	12.68c	7.13 c
T_2 = with S_{30}	34.85 a	4.55 a	3.45b	13.86b	7.34b
T_3 = with S_{60}	35.88 a	4.55 a	3.65a	15.91a	8.28a
T_4 = FP	32.15 b	4.05 ab	2.79d	10.85d	6.96d
CV%	3.98	7.27	2.89	4.79	0.76
LSD	2.173	0.498	0.152	0.351	0.087

Table 4. Cost and return analysis of different treatments of Sulphur fertilization for Onion production at MLT site Sujanagar, Pabna during 2005-06

Treatment	Total variable cost (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk/ha)	Benefit cost ratio
T_1	45525	89099	43574	1.96
T_2	46521	91753	45232	1.97
T_3	47517	103421	55904	2.18
T_4	43550	87028	43478	1.99

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Response of Mungbean to Boron and Molybdenum Fertilization

Abstract

The experiment was carried out at Farming Systems Research and Development (FSRD) site, Pushpapara, Pabna and Faridpur during the kharif-1 season, 2006 to find out the response of mungbean to boron (B) and molybdenum (Mo) fertilization for sustainable yield of mungbean. The highest seed yield was obtained from 2 kg B along with blanket dose of all other fertilizer (NPKSZN) including cowdung (5 t/ha). Molybdenum did not show any positive response in mungbean at Pabna whereas 2 kg B and 1 Kg Mo gave higher benefit at Faridpur.

Introduction

Mungbean (*Vigna mungo* L. Wilczek), is the second most popular pulse crop in Bangladesh. With the introduction of newly released photo period insensitive short duration variety like BARI Mung-5, the farmers are getting more interest in mungbean cultivation. However, deficiency of micronutrients is reported to be very pronounced in different parts of the country, which caused lower yield of crops. Both boron and molybdenum play important roles in increaseing yield of legumes like pulse crop. Boron is essentially required for pod and seed formation. Molybdenum is responsible for the formation of the nitrate reductase enzyme and in the legume it plays an additional role in symbiotic nitrogen fixation. Effects of molybdenum and boron on different legumes have been reported by many scientists (Bhuiyan *et al*. 199, Miah *et. al*. 1992 and Tiwar *et al.* 1989). Therefore, application of boron and molybdenum in addition to essential major elements along with a maintenance dose of cowdung has gaining practical significance. In this context, a two years study conducted by Soil Science Division, BARI showed that application of boron and molybdenum @ 2 kg and 1 kg ha^{-1} respectively increased the yield (1.29 t ha^{-1}) of mungbean (cv. BARI Mung-5) significantly, which was almost 51 % higher over control (Bo Mo). However, on farm verification of the said findings are needed to be tested at different mungbean area of Bangladesh.

Materials and Methods

The experiment was carried out at Farming Systems Research and Development (FSRD) site, Pushpapara, Pabna and Faridpur during the kharif-1 season, 2006. The experiment consisted of five treatments viz. T_1= N_{40} P_{25} K_{35} S_{20} Zn_2 B_2 Mo_0 kg/ha + cowdung 5 t/ha, T_2= N_{40} P_{25} K_{35} S_{20} Zn_2 B_0 Mo_1 kg/ha + cowdung 5 t/ha, T_3= N_{40} P_{25} K_{35} S_{20} Zn_2 B_2 Mo_1 kg/ha + cowdung 5 t/ha, T_4= Farmer's practice and T_5= Control. The experiment was laid out in randomized complete block design with four replications. The unit plot size was 4 m x 4 m. Fertilizers were applied as per treatment specification during the final land preparation. Mungbean seeds were sown on March 15 at Pabna and 5 April Faridpur, 2006. Single light irrigation was provided at 13 days after sowing of seed to ensure proper germination. One weeding was done at 42 days after sowing. Plant protection measure was taken when necessary. The crop was harvested 66 DAS at Faridpur. Data on yield and yield contributing characters were collected and analyzed statistically.

Results and Discussion

Pabna: Plant height obtained from different treatments was statistically identical except control. Number of pods/ plant was at par with slightly higher in T_1 treatment. Identical response was also observed in case of pod length and seeds/pod. Numerically little higher seeds/pod was observed in T_1 treatment. Maximum weight of 1000 seed was recorded in T_3 treatment which was followed by T_1 and T_4 treatment. The application of B in T_1 treatment might enhance the balance uptake of nutrients by the plants which resulted higher seed yield. The highest seed yield was obtained from T_1 treatment. The cumulative effect of pods/plant, seeds pod^{-1} and other identical yield attributes might have attributed to increased yield in T_1 treatment. The lowest performance of yield and yield attributes was observed in control.

Faridpur: Yield and yield attributes viz, plant height, pods/plant, 1000- seeds weight and yield significantly responded to different treatments except plant population and seeds/pod. When B and Mo applied in addition to blanket dose (Bd) early flowering have got larger period for pod formation leading to increase yield. The combined application of 2 kg B/ha with 1kg Mo/ha has given the highest number of pods/plant (25) and 1000-seed weight (38g). However, amongst the treatments, application of Mo @ 1kg/ha as a single with Bd and B @ 2 kg/ha was more effective for increasing seed yield. However, result showed that the combined treatments were better for increasing yields in mungbean and application of 2 kg B/ha with 1 kg Mo/ha obtained the highest yield (1337 kg/ha). The lowest yield (1025 kg /ha) was obtained from T_5 treatment. The treatment of 2 kg B/ha in combination with 1 kg Mo/ha increased yield of 21% over blanket dose (Bd).

Cost and return analysis

The economics of different treatments on yield /ha showed that maximum gross margin of Tk. 51132/- was obtained from the treatments T_3 followed by the treatment T_1 (Tk. 50582/-). But the micronutrient treatment, 1 kg Mo/ha when applied as single gave the lowest gross margin (Tk. 44512/-).

Conclusion

Treatment T_1 was found promising for increasing yield of mungbean. The application of B (2 kg/ha) along with other recommended fertilizers (N_{40} P_{25} K_{35} S_{20} Zn_2 B_2 kg/ha) might have positive effect for higher yield of mungbean especially in boron deficient soil.

Recommendation

This was first year experimentation. So the experiment should be conducted in the next year to draw conclusion.

Table 1. Performance of mungbean to boron and molybdenum fertilization at FSRD site, Pushpapara during the Kharif season 2005-06

Treatment	Plants/ m^{-2}	Plant height (cm)	No. of pods/plant	Pod length	Seeds/pod (no.)	1000-seed wt. (g)	Seed yield (t/ha)
T_1	32.76	43.10a	16.05	9.23	10.15	42.18ab	1.35a
T_2	32.42	44.80a	15.78	8.80	9.55	41.78b	1.22c
T_3	34.09	43.00a	15.10	9.30	9.43	42.33a	1.29b
T_4	32.67	42.63a	14.65	9.25	9.45	42.00ab	1.17d
T_5	31.92	38.45b	14.73	9.33	9.30	41.80b	1.04e
CV%	7.81	9.66	6.43	3.93	6.10	2.69	3.00
LSD	NS	6.31	NS	NS	NS	0.45	0.05

Table 2. Effect of B and Mo yield and yield components in mungbean at Faridpur during 2006

Treatment	Plant pop/m^2	Plant height (cm)	Pods/pl (no)	Seed/pod (no)	1000-seed wt (g)	Seed yield (kg/ha)
T_1	30	70.13	24	13	34.50	1227
T_2	34	68.23	22	12	33.10	1137
T_3	37	83.40	**25**	13	**37.90**	**1337**
T_4	33	62.60	22	13	32.60	1105
T_5	30	48.80	23	12	32.23	1025
LSD (0.05)	ns	6.36	3.70	ns	4.30	70.0
CV (%)	17.70	5.10	8.50	4.20	2.73	3.20

(Bd-Blanket dose, FP- Farmers practice)

Table 2. Cost and return analysis of different treatments in mungbean at Faridpur during 2006

Treatments	Gross return (Tk/ha)	Variable cost (Tk/ha)	Gross margin (Tk/ha)
T_1 = Bd+2 kg B/ha	55215	4633	50582
T_2 = Bd+ 1 kg Mo/ha	51165	6653	44512
T_3 = Bd+2 kg B/ha +1 kg Mo/ha	60165	9033	**51132**
T_4= Bd	49725	4453	45272
T_5 = FP	46125	2381	43744

Variable cost = Fertilizer cost only

Crops and input price (Tk/kg)

Mungbean	:	45.00
Urea	:	6.50
TSP	:	16.00
MP	:	14.00
Gypsum	:	5.00
ZnSO4	:	65.00
Boric acid	:	90.00
Sodium molybdate	:	2200.00

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

Abstract

The experiment was conducted at Jessore, Faridpur and Kushtia during 2005-06.The experiment was laid out in RCBD with six replications. Unit plot size was 4m x 5m. Four fertilizer treatment viz. T_1 = 50-22-42-20 kg NPKS/ha, T_2 = 0-22-42-20 kg NPKS/ha + inoculum, T_3 = 0-0-0-0 kg PKS/ha + inoculum and T_4 = 20-15-18-8 kg NPKS/ha were studied. Significantly higher yield was obtained in T_1 and T_2 at Jessore. Similar trend was also observed at Faridpur and Kushtia. But the yield was comparatively low at Faridpur due to environmental condition.

Introduction

New Rhizobium bio-fertilizer has been developed for lentil. The strain was found better performance in the research stations. Findings from different station showed that seed yield of lentil increased by 10-20% over control with the use of the bio-fertilizer. So, performance of the biofertilizer needs to be verified in the farmers' field. The present investigation was undertaken.

Objectives

i) To observe the response of lentil to newly developed bio-fertilizer under farmers' field condition.

ii) To reduce the use of N-fertilizer in lentil cultivation.

Materials and Methods

The experiment was conducted at Jessore, Faridpur and Kushtia during 2005-06. The experiment was laid out in RCBD with six replications. Unit plot size was 4m x 5m. Four fertilizer treatment viz.T_1=50-22-42-20 kg NPKS/ha, T_2 = 0-22-42-20 kg NPKS/ha + Inoculum, T_3= 0-0-0-0 kg NPKS/ha + Inoculum and T_4= 20-15-18-8 kg NPKS/ha were studied. Seeds of BARI musur-4 were sown 16 November at Jessore, 22 November at Faridpur and 7 November at Kushtia, 2005 in 30cm wide solid rows. All fertilizer was used as basal during final land preparation. Other intercultural operations were done as and when necessary. The crops were harvested during 2-6 March at Jessore, 6 March at Faridpur and 28 February at Kushtia, 2006. Data on yield and yield attributes were recorded and analyzed statistically.

Results and Discussion

Bagherpara, Jessore: Performance of biofertilizer with chemical fertilizer is presented in the Table 1. Treatment T_1 showed higher yield (1.18 t/ha), which was statistically identical with T_2. Treatment T_3 & T_4 produced lower yield (1.03 t/ha) comparing with other treatments. It is evident from the table that when only inoculum is used for lentil production then its yield slightly decreases but when inoculum used with chemical fertilizer (except N) then seed yield is at par to only chemical fertilizer.

Ishan Gopalpur, Faridpur: The yield and yield contributing characters were significantly influenced the treatment. Only seeds/pod was non-significant. The treatment T_2 showed higher yield (596 kg/ha) due to higher all contributing character. The lowest yield was obtained from farmers practice (375 kg/ha). Inoculums with inorganic fertilizer (T_2) showed the better performance than only inorganic fertilizer (T_1). The yield was 66 kg higher than T_1 (530 kg) due to use of inoculum. The yield of lentil was less due to delay sowing and high temperature during the growing period.

Bheramara, Kushtia: Plants population /m^2, plant height (cm), pods/plant and 1000-seeds wt. (g) were not significantly affected by different fertilizer treatments. Only seed yield was significantly affected from treatment. Seed weight showed higher in treatments T_1 that was closely followed by treatments T_2. Higher grain yield (1.56 t/ha) was obtained from PKS + Bio-fertilizer (T_2) and it was identical to treatment T_1 (1.53 t/ha). But the BCR was highest in treatment T_3 (Inoculum).

Farmers reaction

At Kushtia farmers are satisfied with the use of inoculum in lentil.

Conclusion

Biofertilizer did not show better performance over chemical fertilizer at Jessore. But at Kushtia only inoculum showed higher benefit and at Faridpur overall yield is low in all the treatments. So, the experiment needs another year trial for confirmation.

Table 1. Yield and yield attributes of lentil at FSR site, Bagherpara, Jessore during rabi 2005-06

Treatment	Plant Pop./m^2	Plant height (cm)	Pods/ plant (no)	Seeds/ pod (no)	1000- gr. wt. (g)	Seed yield (t/ha)	Straw yield (t/ha)
T_1	170	28.20	40.38a	1.82	18.58a	1.18a	1.35a
T_2	168	27.83	33.08bc	1.82	18.27b	1.16a	1.39a
T_3	158	28.35	28.45c	1.77	18.22b	1.03b	1.15b
T_4	168	27.47	34.87b	1.73	18.23b	1.08b	1.33a
CV (%)	11.66	6.84	11.55	5.55	5.45	6.59	5.18
F-test	NS	NS	**	NS	*	**	**

Table 2. Yield and yield attributes of lentil as affected by inoculum and fertilizer (Ishan Gopalpur, Faridpur, 2005-06)

Treatment	Pl.pop/ m^2	Pl. height (cm)	Branches/pl (No)	Pods/pt (No)	Seed /pod (No)	TSW (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	227	23.90	2.15	13	1.65	18.05	530	265
T_2	219	23.02	2.40	15	1.70	18.65	596	280
T_3	216	24.60	2.15	10	1.72	17.80	328	258
$T_{4\,(FP)}$	197	24.50	1.95	11	1.72	17.50	375	263
LSD	4.33	0.67	0.35	1.37	ns	1.85	3.29	0.57
CV (%)	12.50	3.92	6.57	4.20	3.63	4.90	11.27	11.10

Table 3. Yield and yield components of lentil as affected by bio-fertilizer at Bharamara and Gangni MLT site, Kushtia during 2005-06

Verity	Plant population/ (m^2)	plant height(cm)	Pods / plant	Seeds / pod (No.)	1000 seeds wt. (g)	Grain yield. (t/ha)	Straw yield (t/ha)	BCR
T_1	146.80	34.54	28.18	1.68	18.15	1.53	2.05	4.72
T_2	149.08	36.14	34.30	1.76	17.97	1.56	2.25	5.01
T_3	146.75	34.50	25.57	1.74	16.53	1.40	1.90	6.73
T_4	146.55	35.25	28.44	1.69	17.26	1.25	1.85	4.76
LSD	NS	NS	NS	NS	NS	0.10	NS	

Price: 32 Taka per kg

Response of Gardenpea to Developed Bio-Fertilizer in the Farmers Field

Abstract

The experiment was conducted at farmers field of Ishan Gopalpur-Faridpur, Babuganj-Barisal and Melandah-Jamalpur during rabi 2005-06 to observe the response of garden pea to newly developed bio-fertilizer. The variety BARI Motorshuti-2 was tested with new developed strain. Significantly the highest yield was recorded from inoculum + PKSZn treatment at Faridpur and Jamalpur. But at Barisal similar pod yield was obtained with only chemical fertilizer and inoculum + PKSZn treatment.

Introduction

Gardenpea (*Pisum sativum* L.) is a protein rich vegetable grown in Bangladesh. It belongs to the farmily Fabaceae and is capable of using atmospheric nitrogen. However, per hectare yield of gardenpea in Bangladesh is very low. This can be done by many ways of which the most important are the introduction of high yielding varieties and judicious application of fertilizer along with bio-fertilizer. Though the cultivated area is small but it has a wide scope for cultivation in Bangaldesh (BBS, 2004). At present, vegetable section of BARI released two varieties of gardenpea. It is cultivated during rabi season in Bangladesh. There is a great possibility to increase its production by exploiting better colonization of their root and rhizosphere through rhizobial inoculation which can fix atmospheric nitrogen. The experiment evidences showed that Pk was very much beneticial for boosting up production of pea (Pershak and Tishehenko, 1987 and Singh *et al*., 1992). The present study was undertaken to observe the response of garden pea to newly developed bio-fertilizer under farmer's condition and to reduce the use of N-fertilizer in garden pea cultivation.

Materials and Methods

The experiment was conducted at farmers field at Ishan Gopalpur, Faridpur and Babuganj, Barisal during rabi 2005-06. It was desigined RCB with 4 replications. The unit plot size was 3m x 4m with a row to row distance of 30 cm and plant to plant spacing of 10 cm. The treatments were; T_1= 50-22-42-20-5 kg N-P-K-S-Zn/ha, T_2= 0-22-42-20-5 kg N-P-K-S-Zn/ha + inoculum, T_3= Inoculum and T_4= Control. The variety BARI Motorshuti-2 was sown on 11 November at Barisal, 24 November at Faridpur and 25 November at Jamalpur, 2005. All the fertilizers were applied at the time of final land preparation. Other cultural management like, irrigation, weeding, mulching and crop protection measures were done. The plants were harvested at 26 February at Barisal, 6 March at Faridpur and 10 March at Jamalpur, 2006. Data on different parameters were recorded from each plot and statistical analysis was done.

Results and Discussion

Ishan Gopalpur, Faridpur: The yield and yield contributing characters were significantly influenced by rhizobium. Seeds/pod was showed non significant. The treatment T_2 showed higher yield (1414 kg/ha) due to higher all contributing character. The lowest yield was obtained from absolute control (805 kg/ha). Inoculums with inorganic fertilizer showed the better performance against only inorganic fertilizer. Yield was 250 kg more than without inoculums**.**

Chandpasa, Babuganj, Barisal: The results showed that plants receiving newly isolated rhizobium strain with recommended doses of PKS gave significantly higher nodule number (51.38/plant), nodule weight (42.75 mg/plant), root weight (0.22 g/plant) and shoot weight (1.89 g/plant). But stover yield (13.40 t/ha) and pod yield (7.73 t/ha) was the highest in the treatment where N was applied in chemical form (T1). Use of inoculum along with PKS also gave the similar stover and pod yield. The pod yield increase higher (28%) when N was supplied as urea whereas use of inoclum with PKS increases 23%. The results are in agreements with the results of Eusul Zai e*t al*. (1999). Das *e. al* (1997, 1999), Bhuiyan *et al*. (2001), Khanam *et al*. (1999), Ardeshna (1993). Singh *et al*. (1992a, 1992b) and Deka and Kakati (1993) who worked on lentil, mungbean and gardenpea.

Melandah, Jamalpur: The highest number of nodule/plant (127.25) was recorded from chemical fertilizer with inoculum treatment but it was statistically similar to inoculum treatment. The lowest nodule/plant (66.53) was achieved from control treatment. The highest nodule wt./plant (247.50 g) was recorded from chemical fertilizer with inoculum treatment but it is statistically significant from other treatment. The lowest nodule wt./plant (62.18 g) was found from control treatment. Root wt. (g/plant) and shoot weight (g./plant) was found statistically insignificant. The longest plant was observed from chemical fertilizer+inoculum treatment but it is statistically different from other treatments. The shortest plant (52.55 cm) was recorded from control treatment. Similar trend was observed from branches/plant, pods/plant and seeds/pod. 100 seed wt. was found statistically insignificant among the treatment variation. However, the highest seed yield (1.95 t/ha) was found from chemical fertilizer+ inoculum treatment. This might be the causes of higher number of nodule/plant which influenced higher number of branches/plant, higher number of pods/plant and higher number of seeds/pod. It was statistically significant from other treatment. The lowest seed yield (0.88 t/ha) was achieved from control treatment.

Farmers' reaction

Faridpur: Farmers were very much encouraged to observe the performance of BARI Motorshuti-2 with inoculums.

This is 1ns year experiment. It needs to verify another year.

Table 1. Yield and yield attributes of BARI Motorshuti-2 as affected by rizhobium (Ishan Gopalpur, Faridpur, 2005-06

Treatment (N-P-K-S-Zn kg/ha)	Plants/ m^2	Plant height (cm)	Pods/ plant	Seeds/ pod	1000-seed wt. (g)	Seed yield (kg/ha)
T_1= 50-22-42-20-5	19	55.10	4.2	4.9	199.0	1163
T_2= 0-22-42-20-5 + inoculum	20	61.70	4.6	4.6	210.0	1414
T_3= Inoculum	17	57.30	3.8	4.8	201.3	944
T_4= Control	14	53.25	4.4	4.6	179.3	805
LSD (0.05)	4.05	3.85	0.35	ns	11.58	17.66
CV (%)	8.7	9.5	3.2	2.1	13.8	12.4

Table 2. Effect of rhizobium strains on nodulation, dry matter and yield of BARI Motorshuti-2 (Chandpasa, Babuganj, Barisal, 2005-06)

Treatment (N-P-K-S-Zn kg/ha)	Nodules/ plant	Nodule weight (mg/plant)	Root wt. (g/plant)	Shoot weight (g/plant)	Plant height (cm)	Pod yield (t/ha)	Stover yield (t/ha)	Yield increase over control (%)
T_1= 50-22-42-20	30.50b	22.50b	0.21a	1.87a	91.23	7.73	13.40a	28.83
T_2= 0-22-42-20 + inoculum	51.33a	42.75a	0.22a	1.89a	88.13	7.38	13.23a	23.00
T_3= Inoculum	44.63a	31.50b	0.18ab	1.77b	99.78	6.66	10.39b	11.00
T_4= Control	23.75b	21.50c	0.15b	1.57b	82.75	6.00	9.72b	-
CV (%)	21.6	15.2	17.9	8.8	13.3	17.6	13.1	-

Table 3. Effect of *Rhizobium* inoculum and chemical fertilizers on nodulation, dry matter production and yield of garden pea at farmer's field of Jamalpur during 2005-06

Treatment	Nodule/plant (No.)	Nodule weight (mg/plant)	Root weight (g/plant)	Shoot weight (g/plant)
NPKSZn	82.75 b	136.25 c	0.42	6.29
PKSZn+Inoculam	127.25 a	247.50 a	0.48	6.35
Inoculum	119.15 a	188.35 b	0.41	5.60
Control	66.53 b	62.18 d	0.41	5.13
F	**	**	NS	NS
CV (%)	19.0	16.5	20.5	17.2

Table 4. Yield and yield contributing characters of garden pea at MLT Site, Melandah during 2005-06

Treatment	Plant ht. (cm)	Branches/ plant (no.)	Pods/plant (no.)	Seeds/ pod (no.)	100 seed wt (g) at dry	Seed yield (t/ha)	% increase over control
NPKSZn	76.20 b	4.33 b	14.10 b	7.40 b	18.25	1.73 b	97
PKSZn+Inoculam	81.80 a	5.35 a	16.50 a	8.30 a	18.50	1.95 a	122
Inoculum	71.50 b	3.40 c	11.08 c	5.25 c	18.00	1.43 c	63
Control	52.55 c	2.63 d	7.49 d	4.05 d	17.25	0.88 d	-
F	*	**	**	**	NS	**	
CV (%)	5.96	5.12	8.94	7.85	6.35	8.48	

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

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

Abstract

A field experiment was conducted at FSRD site Razakhali, Patuakhali during rabi 2005-06 to find out the response of newly developed Rhizobium strain on Mungbean. Newly isolated strain BARI RVr-404 was tested with BARI Mung-5. Inoculum with other fertilizers produced highest yield (1517 kg/ha) but it was identical with only inorganic fertilizer treatment.

Introduction

Mungbean (*Vigna radiata*) occupies the major portion of rabi crops growing area of the southern region of Bangladesh. In this area it is cultivated in late rabi season under rainfed condition. The yield of mungbean is very poor. There is a great possibility to increase its yield by exploiting better colonization of their root and rhizosphere through Rhizobium bacteria, which can minimize nitrogenous fertilizer use, protect environment. But there is still lacking of sufficient, efficient and resistant Rhizobium strain can solve this problem. When used Rhizobium strain, there is no need to apply nitrogen at all. Therefore, the present study was undertaken to find out the response of mungbean to Rhizobium strain BARI RVr-404.

Materials and Methods

The experiment was laid out in RCB design having five replications with four treatments. Unit plot size was 4 x 5m. Seeds were sown in a continuous row keeping line to line 30 cm apart. Mungbean variety BARI mung-5 and Rhizobium strain BARI RVr-404 were used. Four treatments were T_1: 50-22-42-20-5 kg/ha NPKSZn, T_2: 0-22-42—20-5 kg/ha NPKSZn + Inoculum, T_3:0-0-0-0 kg/ha NPKSZn + Inoculum and T_4: Control (Uninoculated and unfertilizer). All fertilizers were applied as basal dose. During the course of experiment growth and development of plants in the field were carefully observed. Data on plant height, pods/plant, seeds/pod, 1000-seed weight and seed yield were recorded. Pods were harvested on May 13, 2006.

Results and Discussion

Higher pods/plant was obtained from treatment T_2 but seed/pod and seed weight did not influenced by the treatment. Highest seed yield was recorded from inoculum with PKSZn fertilizer but only inoculum showed lower yield than recommended fertilizer. From one year result showed that inoculum with PKSZn could be used for higher seed yield of mungbean.

Farmers' reaction

1. Inoculum is not available in the local market
2. Use of inoculum is critical

Table 1. Yield and yield contribution characters of BARI mung-5 as affected by rhizobium strain

Treatment	Plant/m^2	Plant height (cm)	Pods/plant	Seeds/pod	1000-grain wt. (g)	Seed yield (kg/ha)
T_1	33	40.6	15	9	32	1425a
T_2	31	42.8	17	9	32	1517a
T_3	32	41.6	13	8	32	1064b
T_4	33	36.5	12	7	31	859d

Letter within a column do not differed significantly at 5% level of significance as per DMRT

Effect of Fertilizer on the Yield of Banana Varieties

Abstract

The experiment was conducted during the Kharif I season of 2005 in the farmers' field of SAIP area to evaluate the performance of different banana varieties as well as to determine the optimum dose of fertilizer of banana at Nakla, Sherpur and Melandah, Jamalpur. Three varieties of banana viz. i) BARI banana 1, ii) Amrith sagar (local) , iii) Sabri (local) and three fertilizer doses viz. i) Farmers' practice, ii) Soil test based dose, iii) FRG/97 were tested. At Nakla, Sherpur, the highest banana yield was obtained by BARI Banana-1 with FRG/97 doses (35.95 t/ha) followed by same variety with farmers practice (34.50 t/ha). The lowest banana yield was obtained from Sabri with soil test based doses (23.12 t/ha). The highest gross return (561719 Tk/ha) and gross margin (427281 Tk/ha) was recorded from BARI Banana 1 by FRG/97 doses. The lowest gross return (283147 Tk/ha) was recorded from Amrith sagor by soil test based value and gross margin (216555 Tk/ha) was recorded from Sabri by farmers practice. At Melandah, the highest banana yield was obtained by BARI Banana-1 with FRG/97 doses (34.10 t/ha) followed by same variety of soil test based value (33.10 t/ha). The highest gross return (602487 Tk/ha) and gross margin (468029 Tk/ha) was recorded from Sabri by FRG/97 doses. The lowest gross return (308383 Tk/ha) and gross margin (250352 Tk/ha) was recorded from Amrithsagor by soil test based value.

Introduction

Banana is an important fruit in Bangladesh. Farmers' in SAIP districts are growing banana for long time but using mostly the local varieties with inherently low yielding ability and susceptible to diseases. Bangladesh Agricultural Research Institute (BARI) has developed an improved variety through tissue culture, BARI banana-1, which is dwarf type, early maturing, high yielder and disease resistance. Besides, farmers are not using fertilizer in proper dose which causes deformation of fruits and forced maturity. For high yield of good quality banana and at the same time to maintain soil fertility there is a need to identify and recommend suitable variety and appropriate fertilizer management practices for the area to maximize farmers' benefit. Keeping the views in mind the experiment was undertaken during the Kharif I season of 2005 in the farmers' field of SAIP area to evaluate the performance of different banana varieties as well as to determine the optimum dose of fertilizer of banana at two locations viz. Nakla, Sherpur and Melandah, Jamalpur.

Materials and Methods

The experiment was conducted during the Kharif I season of 2005 in the farmers' field of SAIP area to evaluate the performance of different banana varieties as well as to determine the optimum dose of fertilizer of banana at Nakla, Sherpur and Melandah, Jamalpur. Three varieties of banana viz. i) BARI banana 1, ii) Amrith sagar (local) , iii) Sabri (local) and three fertilizer doses viz. i) Farmers' practice, ii) Soil test based dose, iii) FRG/97 were tested. The unit plot size was 8m x 6m. The sucker was planted at the spacing 2m x 2m from March 21 to April 5, 2005 across the location. Fertilizer doses of different location was shown in Appendix 1, soil and land characteristics were shown in Appwndix 2a and 2 b. Half of cow dung was applied at the time of final land preparation, 50% of TSP and the rest half of cow dung was applied in the pit before planting. The amount of 25% urea, 50% MP and the rest 50% TSP were broadcasted in the field and mixed properly with the soil after two months of planting. After three months, the rest 50% MP and 50% urea was applied in the pit. Again, the 25% urea were applied in the field at the time of flowering. One weeding was done during the period of 45 day after planting. The crop was attacked by the disease Tikka and Panama wilt. To control the disease Tilt @ 1g/litre of water with Bavistin @ 1 g/litre of water were sprayed for three times at 15 days interval. The crop was harvested from 26.02.05 to 20.03.06. The data were taken as per schedule and analysed statistically and means were separated as per DMRT.

Fertilizer doses at different location

Fertilizer dose	Melandah (N-P-K-S-Zn-MOC-CD kg/ha)	Nakla (N-P-K-S-Zn-MOC-CD kg/ha)
F_1=Farmers' practice	352-172-250-0-0-50	395-114-300-25000
F_2=Soil test based dose	152-26-60-50-1.11	147-27-129-50-1.4
F_3= FRG/97.	690-170-375	690-170-375

Results and Discussion

Nakla, Sherpur

Effect of variety: The results obtained from the study indicated that all most all the yield and yield contributing characters of banana as affected by variety were significant (Table 1). It was observed that the longest plant height was recorded from Sabri and it was statistically different form other two varieties. The highest bunch weight was found in BARI Banana-1 which the lowest bunch weight from Sabri. The identical bunch length was noted from BARI Banana-1 and Sabri while Amrith sagor produced the lowest bunch length. The highest number of hands/bunch was recorded from BARI Banana-1 and it was identical to Amrith sagor. The variety Sabri produced the lowest number of hands/bunch. The highest number of finger/hand was found in BARI Banana-1. The longest finger length was recorded from BARI Banana-1 and it was identical to Amrith Sagor. The shortest finger length was recorded Sabri. But finger diameter was found highest in Sabri. The highest finger weight was found in BARI Banana-1 and was statistically different from other variety. But the skin weight was found highest in Amrith Sagor. But the edible portion was found highest in BARI Banana-1 while the lowest was from Sabri. However, the highest banana yield was recorded from BARI Banana-1 (34.05 t/ha). This might be the cumulative effect of higher bunch weight, higher bunch length, higher number of finger/hand, higher finger length, individual higher finger weight and higher edible portion which influenced highest yield.

Effect of fertilizer: The result showed that the different levels of fertilizer had significant effect on plant hieght (Table 1). The longest plant was recorded from FRG/97 which was statistically identical to soil test based dose. The shortest plant was recorded from farmers' dose. Higher bunch weight was recorded from FRG/97 dose which was similar to farmer's dose. The soil test value dose produced the lowest bunch weight. The longest bunch was found from farmer's dose followed by FRG/97 dose. The shortest bunch length was recorded from the soil test based value. The number of hands/bunch was found insignificant due to variation in fertilizer levels. But the fingers/hand was recorded higher from FRG/97 doses and it was identical to farmers' practice. The finger diameter was found highest in farmers' practice which was statistically identical to FRG/97. Again, the skin weight was found highest in farmers' practice which was statistically different from other two doses. These two doses produced identically significant lowest skin weight. Edible portion was similar to FRG/97 and farmers' dose. The lowest edible portion was found from soil test based doses. However, higher yield was recorded from FRG/97 (29.75 t/ha) and farmer's dose (29.40 t/ha). There was might be the effect of higher number of fingers/hand, higher finger diameter and higher amount of edible portion. The lowest banana yield was recorded from soil test based value (27.70 t/ha) due to low yield attributes.

Interaction effect: From the interaction between banana varieties and fertilizer levels it was observed that all most all the yield contributing characters were statistically significant (Table 2). However, the highest banana yield was obtained by BARI Banana-1 with FRG/97 doses (35.95 t/ha). It was might be effect higher bunch weight, higher bunch length, higher number of hands/bunch, higher number of fingers/hands, higher finger weight, higher amount of edible portion. The second highest banana yield was recorded from BARI Banana-1 by the farmers practice (34.50 t/ha). The lowest banana yield was obtained from Sabri with soil test based doses (23.12 t/ha).

Cost and return analysis: The highest gross return (Tk. 561719/ha) and gross margin (Tk. 427281 /ha) was recorded from BARI Banana 1 by FRG/97 doses (Table 3). The lowest gross return (Tk. 283147/ha) was recorded from Amrithsagor by soil test based value and gross margin (Tk. 216555/ha) was recorded from Sabri by farmers practice.

Melandah, Jamalpur

Effect of variety: The results obtained from the study indicated that all most all the yield and yield contributing characters of banana as affected by fertilizer were significant (Table 4). It was observed that the longest plant was recorded from Sabri and it was statistically different form other two varieties. The highest bunch weight was found in BARI Banana-1 while the second highest weight was found in Amrith sagor. The highest bunch length was noted from BARI Banana-1. The similar trend was also observed in case of number of hands/bunch. The highest number of fingers/hand was found in BARI Banana-1 and it was statistically different from Amrith Sagor and Sabri. But these two varieties produced identical number of fingers/hand among which Sabri produced the lowest number. The longest finger length was recorded from BARI Banana-1 and it was identical to Amrith Sagor. The shortest finger length was recorded Sabri. But finger diameter was found insignificant among the varieties. The highest finger weight was found in Amrith sagor and was statistically identical to BARI Banana-1 but different from Sabir. Sabri produced significantly lowest finger weight. The skin weight was found highest in BARI Banana-1 and it was statistically different from Amrith sagor and Sabri. Amrith sagor produced the second highest skin weight and while Sabri produced the lowest skin weight. But the edible portion was found highest in BARI Banana-1 and it was statistically identical to Amrith sagor. The lowest edible portion was recorded from Sabri. However, the highest banana yield was recorded from BARI Banana-1 (33.20 t/ha). This might be the cumulative effect of higher bunch weight, higher bunch length, higher number of hands/bunch, higher number of fingers/hand, higher finger length, individual higher finger weight and higher edible portion which influenced highest yield. The second highest yield was obtained from Amrith sagor (27.75 t/ha). The lowest banana yield was recorded from Sabri (25.05 t/ha). This might be the causes of lower number of yield contributing characters.

Effect of fertilizer: The result showed that the different levels of fertilizer had significant effect on plant hieght (Table 4). The longest plant was recorded from FRG/97 which was statistically significant to soil test based dose. The shortest plant was recorded from dose of farmers' practice. The highest bunch weight was recorded from the dose applied of FRG/97 which was different from other two treatments. The soil test value dose produced the lowest bunch weight. The similar pattern of behaviour was also observed in case of bunch length. The number of hands/bunch was found insignificant due to variation in fertilizer levels. But the fingers/hand was recorded highest from soil test value and was statistically identical to FRG/97 doses. The farmers dose produced the lowest number of fingers/hand. The finger length, finger diameter, finger weight, skin weight was found insignificant due to different levels of fertilizer variation. The highest edible portion was recorded from farmers practice and was identical to soil test value. The FRG/97 gave the lowest edible portion. However, the highest yield was recorded from FRG/97 (30.70 t/ha) which was statistically different from other two treatments. There was might be the effect of higher bunch weight, higher bunch length, higher number of fingers/hand. The lowest banana yield was recorded from farmers practice and soil test based value (28.40 t/ha).

Interaction effect: From the interaction between banana varieties and fertilizer levels it was observed that all most all the yield contributing characters were statistically significant (Table 5). However, the highest banana yield was obtained by BARI Banana-1 with FRG/97 doses (34.10 t/ha). It was might be effect higher bunch weight, higher bunch length, higher finger length, higher finger weight. The second highest banana yield was recorded from BARI Banana-1 by the soil test based value (33.10 t/ha). Significantly the lowest banana yield was obtained from Amrithsagor with soil test based doses (25.75 t/ha).

Cost and return analysis: The highest gross return (Tk. 602487/ha) and gross margin (Tk. 468029/ha) was recorded from Sabri by FRG/97 doses (Table 6). The lowest gross return (Tk. 308383/ha) and gross margin (Tk. 250352/ha) was recorded from Amrithsagor by soil test based value.

Farmers' reaction

BARI Banana 1 was lucrative than Amirithsagor and Sabri and ripe early. The height is short. So there is less chance to damage by storm. Sabri has the higher price than these varieties and has the chance to damage by storm. Banana cultivation is more profitable than the cereal crops.

Table 1. Yield and yield contributing characters of banana varieties as affected by fertilizer at Nakla, Sherpur

Treatment	Plant ht (cm)	Bunch wt. (kg)	Bunch leng. (cm)	Handa/ bunch (no.)	Finger /hand (no.)	Finger leng. (cm)	Finger dia (cm)	Finger wt. (g)	Skin wt. (g)	Edible portion (g)	Yield (t/ha)
Variety											
V_1	210.8b	13.62a	90.7a	7.41a	14.9a	17.68a	1.81b	95.1a	33.3b	61.8a	34.05a
V_2	238.4b	11.53b	73.2b	7.03ab	14.0b	17.55a	1.66c	87.4b	39.1a	48.7b	28.82b
V_3	302.9a	9.59c	85.8a	6.89b	13.6b	14.48b	2.32a	70.1c	27.4c	41.9c	23.97c
Fertilizer											
F_1	251.0a	11.76a	85.6a	7.08	14.5a	16.52	1.98a	85.6	32.9b	51.0ab	29.40a
F_2	239.2b	11.08b	79.3b	7.20	13.4b	16.58	1.85b	82.2	33.1b	49.6b	27.70b
F_3	251.8a	11.90a	84.9a	7.06	14.6a	16.62	1.97a	84.8	33.7a	51.8a	29.75a
F	**	*	*	*	*	*	**	*	*	*	**
CV(%)	4.98	8.07	6.43	6.41	4.78	6.67	3.16	4.50	4.06	4.67	9.02

The figure in the column having similar letter(s) do not differ significantly
V_1=BARI banana 1, V_2= Amrith sagar (local), V_3= Sabri (local), F_1=Farmers' practice, F_2= Soil test based dose, F_3= FRG/97.

Table 2. Interaction between banana varieties and fertilizer at Nakla, Sherpur

Interaction (Variety x fertilizer)		Plant ht (cm)	Bunch wt. (kg)	Bunch leng. (cm)	Hands/ bunch (no.)	Finger/ hand (no.)	Finger leng. (cm)	Finger dia (cm)	Finger wt. (g)	Skin wt. (g)	Edible portion (g)	Yield (t/ha)
	F_1	212.4	13.80b	95.2a	7.41a	15.7a	17.85	1.88c	96.6a	33.1bc	63.7a	34.50b
V1	F_2	212.3	12.67c	81.8bc	7.50a	12.9b	17.55	1.72d	92.7ab	32.8c	59.0b	31.67c
	F_3	207.7	14.38a	95.1a	7.33ab	15.9a	17.65	1.82c	96.0a	34.1b	62.7a	35.95a
	F_1	234.4	11.72d	74.2cd	7.08ab	13.9b	17.35	1.66de	85.8c	39.0a	46.6c	29.30d
V2	F_2	237.1	11.30d	73.2d	7.08ab	14.1b	17.50	1.60e	87.3bc	39.1a	50.1c	28.25d
	F_3	243.6	11.57d	72.0d	6.92ab	14.2b	17.80	1.72d	89.0bc	39.3a	49.6c	28.92d
	F_1	308.6	9.76e	87.2ab	6.75b	13.9b	14.35	2.38a	74.1d	26.8d	42.7d	24.40e
V3	F_2	298.3	9.25f	82.6ab	7.00ab	13.3b	14.70	2.21b	66.5e	27.5d	39.8d	23.12f
	F_3	301.7	9.74e	87.6ab	6.92ab	13.6b	14.00	2.35a	69.5de	27.8d	43.1d	24.35e
F		**	*	*	*	*	*	**	*	*	*	*
CV(%)		4.98	8.07	6.43	6.41	4.78	6.67	3.16	4.50	4.06	4.67	9.02

The figure in the column having similar letter(s) do not differ significantly
V_1=BARI banana 1, V_2= Amrith sagar (local), V_3= Sabri (local), F_1=Farmers' practice, F_2= Soil test based dose, F_3= FRG/97.

Table 3. Investment due to fertilizer and return per hectare as influenced by variety and fertilizer dose in banana at Nakla, Sherpur during 2005-06

Variety	Fertilizer dose		
	F1(FP)	F2 (STV)	F3(FRG'97)
Cost for fertilizer (Tkha-[1])			
BARI banana 1	35730	10026	59438
Amritsagar	35730	10026	59438
Sabri	35730	10026	59438
Cost of sucker (Tkha-1)			
BARI banana 1	75,000	75,000	75,000
Amritsagar	50,000	50,000	50,000
Sabri	75,000	75,000	75,000
Gross return from harvested Banana (Tkha-[1])			
BARI banana 1	357143	298935	561719
Amritsagar	341492	283147	487416
Sabri	329285	304217	525540
Gross margin (Tkha-[1])			
BARI banana 1	244413	213909	427281
Amritsagar	255757	223121	109438
Sabri	216555	219191	391102

Product (banana) was considered to calculate gross return and cost of sucker and fertilizer and additional cost were considered to calculate variable cost.
Product: (Tk/kg): BARI Banana 1=4.00, Amritsagar=3.50 and Sabri=6.00
Inputs : Sucker- BARI Banana 1=3 Tk/sucker, Amritsagar=-2Tk/sucker and Sabri=3Tk/sucker
Urea=6.00 Tk/kg, TSP=15.00 Tk/kg, MP=14.00 Tk/kg, Gypsum= 7.00 Tk/ka, Zinc sulphate= 65.00 Tk/kg and cowdung=0.50 Tk/kg.

Table 4. Yield and yield contributing characters of banana varieties as affected by fertilizer at Melandah, Jamalpur

Treatment	Plant ht (cm)	Bunch wt. (kg)	Bunch leng. (cm)	Hands/ bunch (no.)	Finger/ hand (no.)	Finger leng. (cm)	Finger dia (cm)	Finger wt. (g)	Skin wt. (g)	Edible portion (g)	Yield (t/ha)
Variety											
V_1	148.9c	13.28a	69.3 a	7.22 a	13.5a	14.52a	2.99	74.2 a	35.08 a	59.46a	33.20a
V_2	165.8b	11.10b	48.2 c	5.22 c	11.4b	14.12a	2.94	82.8 a	29.81 b	56.31a	27.75b
V_3	216.7a	10.02c	59.5 b	6.24 b	12.6ab	10.79b	3.13	60.9 b	23.25 c	38.15b	25.05a
Fertilizer											
F_1	168.3b	11.48b	54.6 b	6.14	11.5 b	13.15	3.04	74.1	30.06	55.80a	28.70b
F_2	179.2ab	11.36b	55.9 b	6.35	13.2 a	12.92	3.05	71.6	28.88	50.70ab	28.40b
F_3	183.6a	12.28a	66.5 a	6.22	12.8ab	13.36	2.97	72.3	29.21	47.43b	30.70a
F	**	**	*	**	*	**	NS	**	*	*	**
CV(%)	7.18	10.27	10.42	7.33	14.11	5.51	7.64	13.83	6.16	9.32	10.07

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

V_1=BARI banana 1, V_2= Amrith sagar (local), V_3= Sabri (local)
F_1=Farmers' practice, F_2= Soil test based dose, F_3= FRG/97.

Table 5. Interaction between banana varieties and fertilizer at Melandah, Jamalpur

Interaction (Variety x fertilizer)		Plant ht (cm)	Bunch wt. (kg)	Bunch leng. (cm)	Hands/ bunch (no.)	Finger/ hand (no.)	Finger leng. (cm)	Finger dia (cm)	Finger wt. (g)	Skin wt. (g)	Edible portion (g)	Yield (t/ha)
	F_1	140.6e	12.94 ab	66.0b	7.24ab	12.4 b	14.3ab	2.90	70.2ab	38.4a	62.6	32.35ab
V_1	F_2	150.9de	13.24 a	65.1b	7.57a	16.2 a	13.7b	3.05	75.4a	33.8b	60.7	33.10a
	F_3	155.3de	13.64 a	76.9a	6.83bc	11.9 b	15.5a	3.02	77.1a	33.0bc	55.1	34.10a
	F_1	168.4d	11.14 bc	47.4c	5.24ef	11.1 b	14.6ab	3.15	83.5a	29.3c	59.7	27.85bc
V_2	F_2	173.4cd	10.30 c	46.8c	5.33ef	10.9 b	13.7b	2.95	83.5a	29.9c	55.4	25.75c
	F_3	155.7de	11.94abc	50.3c	5.08f	12.2 b	14.1ab	2.72	81.7a	30.2bc	53.7	29.85abc
	F_1	195.9bc	10.34 c	50.2c	5.91de	11.1 b	10.6c	3.07	68.5ab	22.5d	45.1	25.85c
V_3	F_2	213.2b	10.60 c	55.8c	6.16cd	12.5 b	11.3c	3.15	56.1b	22.8d	35.9	26.50c
	F_3	240.0a	11.24 bc	72.0ab	6.74bc	14.3 ab	10.5c	3.17	58.3b	24.4d	33.5	28.10bc
F		**	*	*	**	*	**	NS	**	*	*	*
CV(%)		7.18	10.27	10.42	7.33	14.11	5.51	7.64	13.83	6.16	9.32	10.07

The figure in the column having similar letter(s) do not differ significantly
V_1=BARI banana 1, V_2= Amrith sagar (local), V_3= Sabri (local)
F_1=Farmers' practice, F_2= Soil test based dose, F_3= FRG/97

Table 6. Investment due to fertilizer and return per hectare as influenced by variety and fertilizer dose in banana at Melandah during 2005-06

Variety	Fertilizer dose		
	F1(FP)	F2 (STV)	F3(FRG'97)
Cost for fertilizer (Tk ha-^{1})			
BARI banana 1	38189	8031	59438
Amritsagar	38189	8031	59438
Sabri	38189	8031	59438
Cost of sucker (Tk ha-1)			
BARI banana 1	75,000	75,000	75,000
Amritsagar	50,000	50,000	50,000
Sabri	75,000	75,000	75,000
Gross return from harvested Banana (Tkha-^{1})			
BARI banana 1	576033	438992	552853
Amritsagar	416917	308383	456701
Sabri	471715	472371	602487
Gross margin (Tk ha-^{1})			
BARI banana 1	462844	355961	418415
Amritsagar	328728	250352	347263
Sabri	358526	389340	468029

Product (banana) was considered to calculate gross return and cost of sucker and fertilizer and additional cost were considered to calculate variable cost.
Product (Tk/kg): BARI Banana 1=5.00, Amritsagar=4.00 and Sabri=5.00
Inputs : Sucker- BARI Banana 1=3 Tk/sucker, Amritsagar=-2Tk/sucker and Sabri=3Tk/sucker
Urea=6.00 Tk/kg, TSP=15.00 Tk/kg, MP=14.00 Tk/kg, Gypsum= 7.00 Tk/ka, Zinc sulphate= 65.00 Tk/kg and cowdung=0.50 Tk/kg.

Appendix 1. Land and soil characteristics of the experimental plots at Nakla, Sherpur

Soil association	Land type	Irrigated	Soil texture	PH	OM (%)	Total N (%)	Available nutrients (ppm)			Exchangeble cation meq (%)
							P	S	Zn	K
Nakla	Medium highland	Irrigated	Loamy to clay loam	5.6	0.75	0.0665	5.936	6.643	0.339	0.09
Critical level				7.00	2.0	0.12	10.00	10.00	0.6	0.12
Interpretation					L	VL	VL	VL	VL	VL

L= Low, M= Medium, VL= Very Low, VH= Very High

Appendix 2. Land and soil characteristics of the experimental plots at Melandah, Jamalpur

Soil association	Land type	Irrigated	Soil texture	PH	OM (%)	Total N (%)	Available nutrients (ppm)			Exchangeble cation meq (%)
							P	S	Zn	K
Silmondi	Medium highland	Irrigated	Loamy to clay loam	5.05	0.66	0.056	10.18	6.42	0.52	0.236
Critical level				7.00	2.0	0.12	10.00	10.00	0.6	0.12
Interpretation					L	VL	L	VL	VL	M

L= Low, M= Medium, VL= Very Low, VH= Very High

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

Introduction

Cabbage and cauliflower are the most important and popular winter vegetable crops in Dhirashram at Gazipur Sadar under AEZ 28. Farmers recently grow the hybrid varieties due to available seed in the market and higher yield. Hybrids become very popular to the farmers and the area for vegetable cultivation is increasing day by day. But fertilizer recommendation for hybrid varieties of vegetable is not available in Bangladesh. In Gazipur sadar, the farmers applied high dose of chemical fertilizers and a recent field survey and soil test data reveals that the yield of cabbage and cauliflower is lower than expected yield which might be due to imbalance use of inorganic fertilizer and less use of organic manure. An integrated use of inorganic and organic fertilizer are may help to improve soil fertility and also increase crop productivity. Therefore, keeping all these views the present study was taken to find out the proper nutrient management packages for cabbage and cauliflower in medium highland soil at Gazipur Sadar under AEZ 28.

Materials and Methods

The experiment was conducted under irrigation condition during the rabi season of 2005-06, at MLT site Dhirashram, Gazipur under AEZ 28 (Madhupur Tract). The design of the experiment was RCBD with five dispersed replications. It was 1st year experiment. The plot size was 4m x 5m (20 m^2). The crop varieties Autumn Queen (cabbage) and Shiragiku F_2 (cauliflower) were transplanting during 31st October to 2nd November, 2005. Fertilizers were applied as per treatment based on soil analysis and BARC fertilizer recommendation guide 1997. Five different fertilizer packages were tested and the treatments are T_1= IPNS basis fertilizer management for high yield goal (HYG) with PM, T_2= IPNS with CD for HYG, T_3= Soil Test basis for HYG, T_4= Farmers' dose and T_5= Control.

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

The entire amount of CD, PM, P, S, B and one half of K were applied during final land preparation. Total amount of urea and remaining one half of K were applied as top dress in three equal splits at 7-10, 25-30 and heading and curd formation stage for cabbage and cauliflower, respectively. Thirty five days old seedlings of cabbage and cauliflower were transplanted at a spacing of 60cm x 60cm. Intercultural operations such as weeding, irrigation and pest control measures were done in order to maintain the normal crop growth. Irrigation was given six times. The crops were harvested on 18 January to 5 February, 2006. Data on yield and yield attributes along with other parameters were collected properly and subjected to statistical analysis.

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

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

Results and Discussion

Yield: Effect of different nutrient management packages on the yield of cabbage and cauliflower are presented in table 1 and 3. Different fertilizer treatments significantly influenced the head and curd yield of cabbage and cauliflower. Yield of crops with different fertilizers dose were identically superior to that over control. The initial soil status of experimental site showed that except phosphorous and zinc (very high) all other nutrients are at low to very low level. Therefore, nutrients were applied as per treatment. The significantly highest head and curd yield were recorded from integrated nutrient management treatment (IPNS) and estimated dose of inorganic fertilizer for high yield goal. A positive response of poultry manure and decomposed cowdung on the yield of cabbage and cauliflower were observed. Farmers practice gave superior yield due to use of high level of fertilizers. Head yield of cabbage was significantly lower due to less use of N and K compared with recommended dose. However, N and P requirement of cabbage was quite high. But high and identical yield of cauliflower was obtained with FP. Farmer's usually apply a higher dose of P along with CD @ 8 t/ha.

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

Conclusion

Based on one year study, IPNS (T_1 and T_2) and STB inorganic fertilizer dose (T_3) was superior for cabbage and cauliflower. The experiment needs to be repeated another years for final recommendation.

Table 1. Effect of different nutrient management packages on yield and yield attributes of cabbage at MLT site Dhirashram, during 2005-06

Treatments	Plant height (cm)	Whole plant wt. (kg)	Marketable head wt. (kg)	Marketable head yield (t/ha)
T_1	37.9a	3.90a	3.47a	104.1a
T_2	33.2b	3.84a	2.35ab	101.3a
T_3	33.1b	3.88a	3.46a	104.5a
T_4	34.2b	3.01b	2.73b	89.7b
T_5	28.4c	1.37c	0.98c	31.3b
CV (%)	5.51	12.21	12.68	11.10

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

Treatments	Gross return (Tk./ha)	Variable cost* (Tk./ha)	Gross margin (Tk./ha)	MBCR (over control T_5)
T_1	312330	23016	289314	12.0
T_2	304020	29400	274620	8.5
T_3	313590	14102	299488	23.6
T_4	269310	37364	231946	5.4
T_5	94110	4800	89310	-

*Seed and fertilizer cost only

Table 3. Effect of different nutrient management packages on yield of cauliflower at MLT site Dhirashram, during 2005-06

Treatments	Plant height (cm)	Whole plant wt. (kg)	Marketable head wt. (kg)	Marketable head yield (t/ha)
T_1	24.9ab	2.24ab	1.87a	56.9a
T_2	24.9ab	2.35ab	1.87a	55.6a
T_3	25.4a	2.42a	1.96a	57.6a
T_4	23.6b	2.04b	1.69a	50.0a
T_5	19.7c	1.07c	0.65b	19.3b
CV (%)	4.39	12.08	12.68	11.10

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

Treatments	Gross return (Tk./ha)	Variable cost* (Tk./ha)	Gross margin (Tk./ha)	MBCR (over control T_5)
T_1	398580	28133	370447	16.3
T_2	389410	34517	354893	11.3
T_3	403410	20195	383215	32.8
T_4	350000	32564	317436	10.5
T_5	134820	12000	122820	-

*Seed and fertilizer cost only

A. Plain land Area's Crops

Intercropping of Groundnut with Different Short Duration Vegetable Crops

Abstract

The experiment was conducted at MLT site Katiadi, Kishoregonj during rabi season of 2004-05 and 2005-06. There were five treatments viz. T_1= Monoculture groundnut T_2=Two rows of lalshak in between two 40 cm apart rows of groundnut T_3= Two rows of spinach in between two 40 cm apart rows of groundnut, T_4= Two rows of amaranth in between two 40cm apart rows of groundnut and T_5= Two rows of bushbean in between two 40 cm apart rows of groundnut. Average higher groundnut equivalent yield was obtained from the treatment groundnut + spinach (3.47 t/ha) followed by groundnut + Lalshak (2.98 t/ha) which were 41 and 21% higher than sole groundnut. The combination of groundnut+spinach intercropping system showed higher gross return, gross margin & BCR (2.15).

Introduction

Intercropping is a very common practice throughout the country. It is the practice of growing two or more crops simultaneously in the same land area. It paves the way for increasing crop production per unit land area. This has been reported from many countries viz. Bangladesh, India, China, Sri Lanka, Taiwan. In Bangladesh continued population expansion has been facing. The farm household to utilize the available crop land more intensively to produce more food. Groundnut (*Arachis hypogaea*) is an oilseed crop having high energy index. On the other hand, leguminous crops are highly nutritious and improve soil fertility by fixing atmospheric nitrogen. Vegetable like Lalshak, Spinach, Data, Bushbean are grown in the marginal lands and the yield of these crops is low. In Kishoregonj district, groundnut is a major oilseed crop generally grown as sole crop. Now a days groundnut is grown sporadic and in some pocket areas due to expansion of Boro rice cultivation. So, to increase the production of vegetable, intercropping with groundnut may be good practice. Therefore, the experiment was designed to study the feasibility growing different rabi vegetables with groundnut with the following objectives:

1. To find out the agro economic performance of inter cropping vegetable with groundnut
2. To increase vegetable production of the locality.

Materials and Methods

The experiment was conducted at MLT site Katiadi, Kishoregonj during rabi season of 2004-05 and 2005-06. The experiment was laid out in RCB design with four replications. The unit plot size was 5m x 4 m. There was five treatments viz. T_1= Monoculture groundnut, T_2=Two rows of lalshak in between two 40cm apart rows of groundnut, T_3= Two rows of spinach in between two 40cm apart rows of groundnut, T_4=Two rows of amaranth in between two 40cm apart rows of groundnut and T_5= Two rows of bushbean in between two 40cm apart rows of groundnut. Spacing of groundnut was maintained at 40cm x 10cm. The plot was fertilized with 30-44-83-30-4-1 kg of NPKSZnB/ha. Additional 60kg N/ha was applied in intercropping plots as top dressing in 20 and 35 days after emergence (DAE) of groundnut. The variety of groundnut was Dhaka-1. Seeds of groundnut and vegetable were sown on 9 December, 2004 and 7 December, 2005 and harvested on 30 April 2005 and 28 April, 2006, respectively. Groundnut plant characters were recorded and analyzed statistically.

Result and Discussion

The highest groundnut yield was obtained from sole groundnut in both the years. More groundnut yield was depressed in amaranth and bushbean as intercrop but reasonable yield was recorded from lalshak and spinach. Average higher groundnut equivalent yield was obtained from the treatment groundnut + spinach (3.47 t/ha) followed by groudnut + lalshak (2.98 t/ha). The lowest groundnut equivalent yield (2.10 t/ha) was obtained from the combination of groundnut + bushbean. Groundnut +spinach and groundnut + lalshak equivalent yields were 47% and 28% higher than sole groundnut. Gross return varied from Tk. 42,090.00 to Tk. 70,840.00/ha. The highest gross return was obtained from groundnut + spinach intercropping system which was 41% higher than sole groundnut. The benefit cost ratio in the intercrop varied from 1.29 to 2.15. The average highest benefit cost ratio was in groundnut + spinach followed by lalshak + groundnut. Other two combinations failed to show higher BCR than sole groundnut.

Farmers reaction

Farmers opined that spinach and lalshak in between two rows of groundnut was more suitable combination due to moderate yield of groundnut with additional higher yield of spinach and lalshak. They also opined that if they can grow vegetable in early then it could be more profitable.

Table 1. Yield of groundnut and intercrop in different combination (MLT site, Katiadi, 2004-06)

Treatment	Pod yield (t/ha)			Intercrop yield (t/ha)			Groundnut equivalent yield (t/ha)		
	2004-05	2005-06	Mean	2004-05	2005-06	Mean	2004-05	2005-06	Mean
T_1	2.41a	2.52a	2.47	-	-	-	2.41	2.52	2.42
T_2	1.78b	1.69b	1.74	6.50	5.96	6.23	3.08	2.88	2.98
T_3	1.87b	1.79b	1.83	8.36	7.98	8.17	3.59	3.39	3.47
T_4	1.40c	1.32c	1.36	7.43	7.14	7.29	2.51	2.39	2.45
T_5	1.20c	1.22c	2.21	6.03	5.05	5.92	2.10	2.09	2.10

Table 2. Cost and return analysis of groundnut intercropping with vegetable at MLT site Katiadi during rabi, 2004-05 and 2005-06

Treatment	Gross return (Tk/ha)		Cost of cultivation (Tk/ha)		Gross margin (Tk/ha)		BCR	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
T_1	48200	50400	29525	29964	18675	20436	1.63	1.68
T_2	61600	57640	31235	33487	30365	23973	1.97	1.72
T_3	70840	6772	31405	33313	39435	34407	2.26	2.03
T_4	56290	47820	31825	33138	24465	14682	1.77	1.44
T_5	42090	41830	31995	33313	10095	8517	1.32	1.26

Price (Tk/kg): Groundnut= 20/-, Spinach and lalshak= 4/-, Amaranth and bushbean = 3/-

Performance of Intercropping Banana with Vegetables and Spices

Abstract

The experiment was conducted at MLT site, Modhupur, Tangail for the year 2003-2005 in medium high land under AEZ-28 to find out the suitable as well as profitable crops for banana intercropping. There were four treatment combinations viz. T_1 = Banana (Sole), T_2 = Banana + Okra, T_3 = Banana + Sweet gourd and T_4 = Banana + Bitter gourd. The result showed that highest banana equivalent yield (94.03 t/ha) was recorded from the treatment combination Banana + Sweet gourd. The same treatment also showed the highest BCR (2.41), which indicated that intercropping banana with sweet gourd is profitable than sole banana.

Introduction

Cropping intensity as well as crop production can be increased by multiple cropping practices. Intercropping is one of the way of multiple cropping has long been recognized as a very common practice. It is suggested that intercropping can provide substantial yield advantages compared to sole crop (Singh *et al.*, 1992). Banana (*Musa sapientum*) is nutritional fruit in Bangladesh. In Bangladesh, Banana occupies a total of 97465 acres of land producing 561770 metric ton (BBS, 1999). Banana is largely grown in Modhupur,Tangail which occupies 3440 acres of land producing19960 metric tons (BBS,1999). Banana is largely grown in well drained high land, which is also suitable for growing other cash crops. In the early growing period of Banana, the inter row spaces remains under utilized. During this period short duration crops may be grown as intercrop in banana. Most of the farmers of Madhupur, Tangail, grow garlic, onion and coriander and short growing vegetables as intercrop in Banana with inadequate knowledge of agronomic practices as well as benefit of the crop. Intercrop should be selected such a way so, that there is no or little adverse affect on the main crop. The proper crop combinations of existing practices have not been standardized. Hence, it is necessary to find out the potential of intercropping in Banana with vegetables to increase production as well as profitability to the farmers

Materials and Methods

The experiment was carried out at MLT site, Madhupur, Tangail for the year of 2003-2005 in the medium highland under AEZ-28. The experiment was laid out having RCB design with four replications. The unit plot size was 6 m × 6 m, with spacing 2 m × 2 m. The variety Amrit Sagar was used in this experiment. The suckers were planted in 60 cm x 60 cm x 60 cm size of pit. The four treatments were considered as T_1=Banana (sole), T_2= Banana + Okra, T_3=Banana + Sweet gourd and T_4 = Banana + Bitter gourd. Soil samples were collected and its chemical analysis was done, before setting of the experiments. The soil values based on chemical analysis were pH (5.01), OM (1.55 %), N (0.10 %), P (21.94 µg), K (0.05 meq/100g soil), S (4.12µg/g), B (0.08µg/g) and Zn (1.00µg/g). The values showed that NKS and B very low, P optimum, Zn medium respectively.

Fertilizer dose were calculated on the basis of soil test values followed by FRG, BARC, 1997. Urea, TSP, MP, Gypsump, Zinc sulphate and Boric acid were applied at the rate of 0.650-0.400-0.300-0.127-0.0036-0.00056 kg/plant (STB). Fifty percent TSP and one half of potassium, sulphur and zinc were applied in the pit during pit preparation .Remaining urea, TSP and MP was applied as ring method 30 cm, 60 cm and 90 cm from plant stalk for 1, 2 and 3 top dress of fertilizer respectively and 7.5-10 cm depth in soil. No additional fertilizer was applied for intercrops but plant protection measured and intercultural operations have been taken. Straw mulch was used incase of Bitter gourd and sweet gourd intercropping plot. Three irrigations were applied after three times top dressed of fertilizer. Thrice weeding and earthing up were done at 60, 135 days after planting (DAP) and before flowering. Fyfanon (0.2%) were sprayed four times for controlling sigatoga and furadan 5G was used for control banana beetle respectively, in cropping season. Collected data were analyzed statistically using computer package MSTATC.

Results and Discussion

Banana with vegetables intercropping

Results revealed that maximum number of leaves per plant and finger/bunch was counted in T_4 treatment, which was statistically different from other treatments. The higher weight of finger was produced by the treatment T_3 but statistically at per to other treatments. Higher weight of bunch (24.66 kg) was obtained in Banana + sweet gourd intercropping, which was statistically identical to T_4 (Banana + bitter gourd) treatment. The yield was not significantly influenced but higher yield (61.69 t/ha) was obtained from T_3 followed by T_4. Higher yield might be due to add of mulch and higher crop residues in soil which increased the soil moisture, and keeps the soil temperature cool and enhance the normal growth. All the intercropping systems showed higher equivalent yield than sole crop but the highest banana equivalent yields (94.03 t/ha) was obtained from banana with sweet gourd intercropping. The lowest banana equivalent yield (51.13 t/ha) was obtained from banana sole.

Cost and return analysis: The highest gross return and gross margin was recorded from T_3 treatment combination, but higher cost was involved in treatment T_4. Sole crop failed to show higher benefit due to lower yield and no additional intercrop yield. Higher BCR was recorded from banana with sweet gourd but other treatments are not found encouraging benefit than sole crop but slightly higher return was obtained from banana + okra & banana + bitter gourd.

Banana with spices intercropping

Results revealed that significant variation was not found in plant height and yield attributes. Significantly highest number of leaves/plant was obtained from T_3. Higher number of banana/bunch was produced by the treatment $T_{3,}$ but significant variation was not found among the treatment combinations. Significant variation was not found in case of individual weight of banana, but higher weight was obtained by treatment $T_{4.}$ The higher weight of bunch (34.67 kg) was calculated in Banana + Ginger but which was statistically at par to other treatments. Fruit yield was increased in Banana Ginger intercropping system which was higher than other combinations. The lowest yield was recorded from the treatment Banana + coriander intercropping system may be due to no crop residues was added. Fruit yield of banana increased 1 to 6% in intercropping system but decrease yield 2% in banana + coriander system. All the intercropping systems showed higher equivalent yield than sole crop. The highest banana equivalent yield (110.05 t/ha) was obtained from banana with Ginger intercropping due to higher yield of banana and intercrop yield. Banana + Ginger intercrop combination gave higher crop index than others, which is due to higher banana yield.

Cost and return analysis: The highest gross return (Tk.423693/ha) and margin (Tk.215026/ha) was recorded from T_4 treatment combination. Though higher gross margin was obtain from treatment T_4, but due to higher cost of cultivation less BCR was recorded. In this context Banana + coriander showed higher BCR than other treatments.

Farmers' reaction

- ☺ Farmers are interested to grow intercrop with Banana cultivation
- ☺ Extra income can be earned
- ☺ Ginger was diseases susceptible and cost of cultivation was high.
- ☺ Organic matter can be add in soil through intercrop residues

Table 1. Yield and yield attributes of Banana at Madhupur, Tangail (pooled data from 2003-04 to 2004-05)

Treatments	Plant height (m)	No. of leaves/ plant	No. of fingers/ bunch	Weight of fingers (g)	Wt. of bunch (kg)	Banana yield (t/ha)
Banana (Sole)	2.14	18.46	117.6	175.40	20.48	51.13
Banana + Okra	2.10	19.17	121.1	189.80	23.65	59.13
Banana + Sweet gourd	2.20	19.42	122.1	200.90	24.66	61.69
Banana + Bitter gourd	2.35	20.86	126.7	190.90	24.06	60.19
LSD (.05)	0.03	0.35	2.25	NS	1.45	9.30

Table 2. Yield of Banana and intercrops, yield equivalent of Banana and crop index at Madhupur, Tangail (2003-05)

Treatments	Banana yield (t/ha)	Crop index (%)	Inter crop yield (t/ha)	Banana equivalent yield (t/ha)
Banana (Sole)	51.13	100	-	51.13
Banana + Okra	59.13	115	2.20	61.98
Banana + Sweet gourd	61.69	120	24.90	94.03
Banana + Bitter gourd	60.19	117	5.57	76.10

Table 3. Cost and return analysis of intercrop with Banana at Madhupur, Tangail (2003-05)

Treatments	Gross return (Tk./ha)	Total cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Banana (Sole)	1,96851	135676	61175	1.45
Banana + Okra	2,38623	139286	99337	1.71
Banana + Sweet gourd	3,62016	150424	211592	2.41
Banana + Bitter gourd	2,92985	156257	136728	1.87

Market prices:

Input cost		Price of output
Urea = Tk 6/kg	Irrigation @ Tk 1.67/m^2	Banana = Tk.3.85/kg
TSP = Tk 14/kg	Insecticides @ Tk 0.70/m^2	Okra = Tk.5/kg
MP = Tk 12/kg	Fungicides @ Tk 1.22/m^2	Sweet gourd =Tk.5/kg
Boric acid Tk 60/kg		Bitter gourd = Tk.11/kg
Gypsum Tk 4/kg		

Table 4. Effect of intercrop on yield and yield contributing characters of Banana in Madhupur, Tangail, and 2003-2005 (Poled of two years)

Treatments	Plant height (cm)	Leaves/ plant	No. of Banana/ Bunch	Weight of Banana (gm)	Weight of Bunch (kg)	Fruit Yield (t/ha)
Banana (Sole)	216.4	15 b	163	199.7	32.67	81.67
Banana + Chilli	215.1	16 b	165	200.0	33.0	80.50
Banana + Coriander	218.4	18 a	168	191.3	32.17	80.42
Banana + Ginger	214.3	15 b	163	213.0	34.67	86.67
LSD (.05)	NS	2.91	NS	NS	NS	NS
CV (%)	2.43	9.28	2.32	5.53	6.36	6.36

Table 5. Yield of Banana, intercrop equivalent yield and Banana equivalent yield at Madhupur, Tangail 2003-2005

Treatments	Fruit yield (t/ha)	Crop index (%)	Inter crop yield (t/ha)	Banana equivalent yield (t/ha)
Banana (Sole)	81.67	100	-	81.67
Banana + Chili	80.50	99	1.32	87.36
Banana + Coriander	80.42	98	0.50	87.42
Banana + Ginger	86.67	106	2.00	110.05

Table 6. Cost and return analysis of intercrop with Banana at Madhupur, Tangail, 2003-2005

Treatments	Gross return (Tk./ha)	Total cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Banana (Sole)	314430	135676	178754	2.32
Banana (Chilli)	336336	146508	189828	2.29
Banana + Corriender	336567	140120	196447	2.40
Banana + Ginger	423693	208667	215026	2.03

Input cost (Tk./Kg) :
Urea = 6.00
TSP = 20.00
MP = 14.00
Gypsum = 4.00
Zinc sulphate = 35.00
Boric acid = 80.00

Chilli= 0.10/seedling
Coriander seed = 60.00
Ginger seed = 60.00

Price of output (Tk./ha):
Banana = 3.85
Chili = 20.00
Coriander = (50.00)
Ginger = 45.00

Appendix Table A. Initial soil test values of the experimental plots.

Parameters	p^H	OM (%)	N (%) Total	P (µg/g)	K (meq/100g)	S (µg/g)	Zn (µg/g)	B (µg/g)
Value	5.01 Sl. acidic	1.55 Medium	0.10 V. low	21.94 optimum	0.05 Very Low	4.12 V. Low	1.00 Medium	0.08 Low

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Performance of Intercropping Groundnut with Garlic and Onion

Abstract

An experiment was conducted at MLT Site, Gabtali, Bogra and Faridpur during Rabi season of 2005-06 to verify the performance of onion and garlic as intercropped with groundnut. Two rows of garlic in between 40 cm apart rows of groundnut produced the higher groundnut equivalent yields (2.79 t/ha) with higher gross margin (Tk. 23938/ha) with higher benefit (2.30). Between the intercrops garlic and onion, cultivation of garlic as intercrop with groundnut more profitable at both the sites.

Introduction

Oilseed Research Centre, BARI has developed two intercropping technologies i.e. groundnut + garlic and groundnut + onion with suitable row arrangement. In on station trials, these two intercropping technologies are found agronomically feasible and economically profitable. So, to test their performance in the farmer's field this verification program is needed to verify the performance of groundnut + garlic and groundnut + onion intercropping in the farmer's field.

Materials and Methods

The experiment was conducted at MLT Site, Gabtali, Bogra and Faridpur during the Rabi season of 2005-06. The experiment was laid out in RCB design with 3 replications. The unit plot size was 3.6m×4.0m. There were 5 treatments viz.

T_1 = Monoculture groundnut (324 plants of groundnut)

T_2 = One row of onion in between 30 cm apart rows of groundnut (324 plants of groundnut +440 plants of onion).

T_3 = Two rows of onion in between 40 cm apart rows of groundnut (360 plants of groundnut + 640 plants of onion).

T_4 = One row of garlic in between 30 cm apart rows of groundnut (324 plants of groundnut + 440 plants of garlic) and

T_5 = Two rows of garlic in between 40 cm apart of groundnut (360 plants of groundnut + 640 plants of garlic). Spacing of groundnut was maintained 30 cm× 15 cm in T_1, T_2 and T_4 where as 40 cm×10 cm in T_3 and T_5.

Onion and garlic spacing was single row in T_2 and T_4. Between two rows of groundnut, two rows of onion and two rows of garlic were planted maintaining 40cm × 10cm spacing in T_3 and T_5, respectively. The plot was fertilized with 30-44-83-30-4-1 kg of N-P-K-S-Zn-B per hectare. Additional 60 kg N/ha was applied in intercropping plots (onion and garlic) as side dressing at 25 and 50 days after emergence of groundnut. The variety of groundnut was BARI Badam-6.

Seeds of groundnut, garlic and seedling of onion were sown/planted on 14 and 17 December at Bogra and 15 December at Faridpur of 2005 respectively and harvested on 10 May and 28 March at Bogra and 31 March and 7 May at Faridpur of 2006. The crop sprayed with Diazinon for caterpillar and Rovral against fungal infection. Yield and yield attributes were recorded and analyzed statistically.

Results and Discussion

Gabtali, Bogra: Plant height, Pod/plant, seed wt./plant and nut yield of groundnut were statistically significant in different treatments (Table 1). Significantly the tallest plant height (41.5 cm), the highest pods/plant (15.7), seed wt./plant (8.02 gm) and nut yield (1.58 t/ha) were recorded from sole groundnut. Due to the introduction of onion and garlic in between groundnut rows, yield of groundnut was decreased. But higher groundnut equivalent yields were recorded from all intercrop treatments as compared to sole crop of groundnut. Highest groundnut equivalent yield (2.79 t/ha) was obtained from T_5 (Table 2). Higher gross margin (Tk. 23938/ha) and highest BCR (2.3) were also recorded from T_5. From cost and return analysis (Table 3) it was found that two rows of onion in between 40cm apart rows of groundnut was better than one row of onion in between 30 cm apart of rows of groundnut. Similarly two row of garlic in between 40 cm apart rows of groundnut was better than one rows of garlic in between 30 cm apart rows of groundnut. Yield of groundnut with one row of onion and garlic was higher than two rows of onion and garlic and this might be due to higher plant population of groundnut (Table 2).

Ishan Gopalpur, Faridpur: Yield and yield attributes were significantly influenced by the treatments. The highest yield was recorded from respective sole crop. Among the intercrops, two rows of onion or garlic showed higher yield than single crop. The highest groundnut equivalent yield was recorded from two rows of LER and BCR. Similar trend was followed in case of two rows of garlic in between two rows of groundnut.

Farmers' reaction

Results of intercropping study are very encouraging. They opined that instead of using seedlings of onion, planting of small size onion bulb may be more profitable due to early harvest and higher market price.

However the experiment needs to be studied further more for confirmation.

Table 1. Yield and yield component of groundnut affected by intercropping with garlic and onion (MLT Site, Gabtali, Bogra, 2005-06)

Treatment	Plant height (cm)	No. of pod/plant	No. of seed per pod	Seed wt. per plant(g)	100 kernel wt.(g)	Nut yield (t/ha)
Sole groundnut	41.50 a	15.70 c	1.9	8.02 a	25.93	1.58 a
Groundnut +onion	39.06 bc	14.70 b	1.8	6.80 b	25.53	0.62 b
Groundnut +onion	40.00 b	15.00 b	1.9	7.31 ab	25.70	0.57 b
Groundnut +garlic	37.9 0 c	14.96 b	1.7	6.97 b	26.16	0.66 b
Groundnut +garlic	39.2 0 bc	14.96 b	1.9	7.29 ab	25.70	0.57 b
LSD	1.24**	0.577*	NS	.796*	NS	0.1733**
CV%	1.14	2.03	3.9	5.82	1.09	7.67

Table 2. Yield of Groundnut, Onion and Garlic equivalent yield of groundnut intercropping (MLT Site, Gabtali, Bogra, 2005-06)

Treatments	Yield of groundnut (t/ha)	Yield of intercrop (t/ha)	Groundnut equivalent yield (t/ha)
Sole groundnut	1.58	-	1.58
groundnut +onion	0.62	2.09	2.01
groundnut +onion	0.57	2.46	2.21
groundnut +garlic	0.66	-	2.54
groundnut +garlic	0.57	-	2.79

Table 3. Cost and return analysis of groundnut intercropping with garlic and onion (MLT Site Gabtali, Bogra, 2005-06)

Treatments	Gross return (Tk./ha)	Total cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Sole groundnut	23700	14762	8938	1.60
groundnut +onion	30200	18325	11875	1.64
groundnut +onion	33150	18669	14481	1.77
groundnut +garlic	38100	16712	21388	2.27
groundnut +garlic	42250	18312	23938	2.30

Market price: Groundnut = @ Tk-15/kg, Onion = @ Tk-10/kg & Garlic = @ Tk.-20/kg

Table 4. Yield and yield attributes of groundnut affected by groundnut and onion (Faridpur, 2005-06)

Treatment	Plant height (cm)	Plant pop/ m^2	Brans /plant (No)	Pods/ plant (No)	Seed /pod (No)	100 Kernel wt (g)	Pod yield (t ha^{-1})
Sole groundnut	41.26	30	7.27	13.73	1.83	56.10	2.37
One row onion in between two rows of groundnut	39.20	22	6.13	12.53	1.76	55.36	1.80
Two rows of onion in between two rows of groundnut	37.70	18	5.57	10.30	1.66	54.08	1.72
LSD (0.05)	Ns	3.27	1.52	0.98	0.27	0.30	0.79
CV (%)	7.17	10.50	9.42	8.10	6.53	7.25	11.53

Table 5. Yield and yield attributes of onion affected by groundnut and onion(Faridpur, 2005-06)

Treatment	Plant height (cm)	Pt pop/ m^2	Leaves /plant	Bulb width (cm)	Single bulb wt (g)	Bulb yield (t ha^{-1})
Sole onion	23.47	46	3.63	2.30	20.53	9.62
One row of onion in between two rows of groundnut	21.67	35	2.47	1.84	17.80	6.10
Two row of onion in between two rows of groundnut	20.47	45	3.54	2.27	17.05	9.20
LSD (0.05)	1.10	9.23	1.12	0.32	0.54	0.39
CV (%)	7.92	11.97	8.54	7.56	3.52	8.72

Table 6. Equivalent yield, LER, Cost and return analysis of groundnut and onion (Faridpur, 2005-06)

Treatments	Groundnut equivalent yield (tha^{-1})	LER	Gross return (Tk ha^{-1})	Cost of cultivation (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
Sole groundnut	2.37	1.00	71100	30310	40790	2.35
Sole onion	3.85	1.00	115500	30510	84990	3.80
One row of onion in between two rows of groundnut	4.50	1.39	135000	33560	101440	4.02
Two row of onion in between two rows of groundnut	5.40	1.68	162000	37850	124150	4.30

Table 7. Yield and yield attributes of groundnut affected by groundnut and garlic (Faridpur, 2005-06)

Treatment	Plant height (cm)	Plant pop / m^2	Brans /pt (No)	Pods/ plant (No)	Seeds /pod (No)	100 Kernel wt (g)	Pod yield (t ha^{-1})
Sole groundnut	41.26	30	7.27	13.73	1.83	56.10	2.37
1 row garlic in between 2 rows of groundnut	39.1	22	6.77	12.33	1.77	55.30	1.95
2 row garlic in between 2 rows of groundnut	37.4	25	7.17	12.78	1.82	55.70	2.05
LSD (0.05)	ns	4.35	ns	0.44	ns	ns	0.28
CV (%)	6.78	9.41	8.21	7.76	2.11	8.46	12.30

Table 8. Yield and yield attributes of garlic affected by groundnut and garlic (Faridpur, 2005-06)

Treatment	Plant height (cm)	Pt pop/ m^2	Leaves /plant	Bulb width (cm)	Single bulb wt (g)	Bulb yield (t ha^{-1})
Sole garlic	30.9	45	4.78	2.52	12.05	2.82
1 row garlic in between 2 rows of groundnut	29.2	32	4.23	2.09	9.35	1.72
2 row garlic in between 2 rows of groundnut	28.27	40	3.97	2.03	10.40	2.08
LSD (0.05)	3.56	4.79	ns	ns	1.89	0.45
CV (%)	6.72	14.30	5.96	3.28	3.88	7.82

Table 9. Equivalent yield, LER, Cost and return analysis of groundnut and garlic (Faridpur, 2005-06)

Treatments	Groundnut equivalent yield (tha^{-1})	LER	Gross return (Tk ha^{-1})	Cost of cultivation (Tk ha^{-1})	Net return (Tk ha^{-1})	BCR
Sole groundnut	2.37	1.00	71100	30310	40790	2.35
Sole garlic	3.76	1.00	112800	36756	76044	3.06
One row of garlic in between two rows of groundnut	4.24	1.43	127200	38483	88717	3.30
Two row of garlic in between two rows of groundnut	4.82	1.60	144600	40950	103650	3.53

Price (Tk./kg): Onion= 12/-, Garlic= 40/- & Groundnut= 30/-

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Intercropping of Groundnut with Onion and Garlic

Abstract

The experiments were conducted at farmer's field of FSRD site, Hazirhat, Noakhali and MLT site of Laxmipur during 2005-06 to verify the performance of onion and garlic as intercrop with groundnut. The onion intercropped with two rows produced higher gross return of TK.111440 with LER of 1.08 at farmer's field of FSRD site, Hazirhat, Noakhali. The garlic intercropped with two rows produced higher gross return of TK.93700 with the LER of 1.18. All the intercropped system earned highest 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 which need much shorter duration for their maturity. The inter row spaces of groundnut could be utilized for growing these crops short duration crops. Oil crop Research center, BARI, has developed two intercropping technologies i.e. groundnut + garlic and groundnut + onion with suitable row arrangement. These two intercropping technologies are found agronomically feasible and economically profitable at the farmer's field.

Materials and Method

The experiments were conducted at farmer's field of FSRD site, Hazirhat, Noakhali and MLT site of Laxmipur in the growing season of 2005-06. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain (AEZ 18f) and Meghna Estuarine Floodplain (AEZ 18) respectively. The soils of the experimental plot were sandy loam in texture. The experiments were set in randomized complete block design with three replications. The experiment consisted of 7 treatments are as follows: T_1 = Sole groundnut, T_2 = Sole onion, T_3 = Sole garlic, T_4 = 1 row onion with 100% groundnut, T_5 = 1 row garlic with 100% groundnut, T_6 = 2 row onion with 100% groundnut and T_7 = 2 row garlic with 100% groundnut. The seeds were sown on the third week of December 2005. The unit plot size was 3.6 m x 4 m. Spacing of groundnut was maintained at 30 cm x 15 cm and 40 cm x 15 cm for sole, one row and two row respectively. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 4.33 to 9.31 ds/m.

Results and Discussion

Different intercropping system showed a significant influence on different yield, yield contributing characters, economic study and LER of groundnut, onion and garlic in both the locations (Table 1, 2, 3 and 4).

FSRD site Hazirhat

Groundnut: The longest plant height (35.37 cm) was found from T_1, which was statistically identical with all other treatments except T_5, which showed shortest plant height. The branch/plant, pods/plant and seeds/pod were not significantly influenced by the treatment. Treatment T_1 gave the higher value of 1000 kernel weight/plant (445 g) and the lowest from T_6 (423 g). Yield was statistically identical to all the treatments except T_7, which showed lower yield.

Intercropped yield: Onion & garlic was grown as intercropped in between groundnut rows. There was significant reduction in onion yield in both intercropped situation but two rows of onion showed more yield than one row. Similar trend was followed in case of garlic.

Groundnut equivalent yield: Higher groundnut equivalent yield (5.57 t/ha) was found in T_6 and T_5 showed the lowest groundnut equivalent yield (4.00 t/ha).

Cost & benefit analysis: The treatment T_6 where two rows onion inter cropped with groundnut showed higher gross return, which was closely followed by treatment T_7. All the intercropping treatments showed higher gross return than sole situation of groundnut, onion & garlic. Similar trend was followed incase of gross margin though higher cost was involved in both the treatment. Land equivalent ratio was higher in treatment T_7.

MLT site, Laxmipur

Groundnut: The longest plant height (36.43 cm) was found from T_1, which had no statistically significant difference from other treatments. The highest number of branches/plant (6.1) was also found from T_1, which was statistically at par to different T_4 and T_7. Number of pod per plant showed significant effect where higher was recorded in treatment T_1. Higher number of seeds/pod (1.9) was found from T_1 which had no statistically significant difference from other treatments. Higher 1000 kernel weight was obtained from treatment T_1 (453 g). Higher yield (3.02 t/ha) was obtained from the treatment T_1.

Intercropped yield: Similar trend was followed in case of onion & garlic yield as in Hazirhat.

Groundnut equivalent yield: Higher groundnut equivalent yield (4.69 t/ha) was found in T_7 and T_6 showed the lowest groundnut equivalent yield (4.03 t/ha).

Cost & benefit analysis: The treatment T_7 where two rows garlic inter cropped with groundnut showed higher gross return, which was closely followed by treatment T_4 and T_6. All the intercropping treatments showed higher gross return than sole situation of groundnut, onion & garlic. Similar trend was followed incase of gross margin though higher cost was involved in both the treatment. Land equivalent ratio was higher in treatment T_6.

Farmer's reaction

Though two rows of onion and two rows of garlic in between 100% groundnut intercropping system is the most beneficial but higher cost was involved. So the farmers of these areas chose one row onion in between two rows of groundnut and one row garlic in between two rows of groundnut intercropping system.

Conclusion

It can be concluded from the result that, two rows of onion and two rows of garlic in between 100% groundnut intercropping system is the most beneficial than the other treatments.

Table 1 Yield and yield components of groundnut in sole and intercropped situation (FSRD site, Hazirhat, Noakhali 2005-06)

Treatment	Plant height (cm)	No. of branch/plant	No. of pod/ plant	No. Of seed/ pod	1000-kernel wt (g)	Nut yield (t/ha)
T_1	35.37 a	5.46	12.1	3.4	445 a	2.69 a
T_4	34.97 ab	5.21	12.0	3.4	440 ab	2.54 ab
T_5	34.40 b	5.23	11.7	3.3	432 ab	2.54 ab
T_6	34.65 ab	5.09	10.9	3.3	423 b	2.50 ab
T_7	34.77 ab	5.08	11.9	3.4	426 b	2.39 b
$LSD_{(0.05)}$	0.82	NS	NS	NS	17.28	0.27
CV (%)	1.25	3.87	8.64	2.16	2.12	5.55

Table 2. Yield of groundnut, onion, garlic with economic study and LER in different intercropping system at FSRD site, Hazirhat, Noakhali during rabi 2005-06

Treatment	Yield (t/ha)			Groundnut equivalent yield	Gross return	Total cost (Tk/ha)	Gross margin (Tk/ha)	BCR	LER
	Groundnut	Onion	Garlic						
T_1	2.69 a	-	-	-	53000	32000	21000	1.66	1.00
T_2	-	6.21 a	-	-	74000	40500	33500	1.82	1.00
T_3	-	-	2.68 a	-	67000	38250	28750	1.75	1.00
T_4	2.54 ab	3.38 c	-	4.57	91360	45200	46160	2.03	1.06
T_5	2.54 ab	-	1.17 c	4.00	80050	42000	38050	1.91	1.06
T_6	2.50 b	5.12 b	-	5.57	111440	50550	60890	2.20	1.08
T_7	2.39 b	-	1.95 b	4.83	95750	49750	46000	1.92	1.12

Table 3. Yield and yield components of groundnut in sole and intercropped situation (MLT site, Laxmipur 2005-06)

Treatment	Plant height (cm)	No. of branch/plant	No. of pod/ plant	No. of seed/ pod	1000-kernel wt. (g)	Nut Yield (t/ha)
T_1	36.4	6.1 a	23.7a	1.9	453 a	3.02 a
T_4	34.0	5.6 ab	21.4 b	1.9	440 b	2.72 a
T_5	35.9	5.4 b	21.9 ab	1.8	435 b	2.55 a
T_6	34.5	5.5 b	18.8 b	1.7	405 c	1.84 b
T_7	34.6	5.6 ab	21.5 b	1.7	425 c	2.56 a
$LSD_{(0.05)}$	NS	0.51	2.09	NS	9.53	0.55
CV (%)	3.90	4.75	3.06	2.56	4.06	7.55

Table 4. Yield of groundnut, onion, garlic with economic study and LER in different intercropping system at MLT site, Laxmipur during rabi 2005-06

Treatment	Yield (t/ha)			Groundnut equivalent yield	Gross return	Total cost (Tk/ha)	Gross margin (Tk/ha)	BCR	LER
	Groundnut	Onion	Garlic						
T_1	3.02 a	-	-	-	60400	34500	25900	1.75	1.00
T_2	-	5.81 a	-	-	69720	39250	30470	1.77	1.00
T_3	-	-	2.44 a	-	61000	35000	26000	1.74	1.00
T_4	2.72 a	2.45 c	-	4.19	83800	41500	42300	2.02	1.11
T_5	2.55 a	-	0.97 c	3.76	75250	43750	31500	1.72	1.18
T_6	1.84 b	3.65 b	-	4.03	80600	45380	35220	1.77	1.64
T_7	2.56a	-	1.70 b	4.69	93700	46900	46800	2.00	1.18

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Performances of Seed Priming on the Yield and Yield Contributing Characters of Lentil

Abstract

An experiment was conducted in farmer's field at Kushtia during rabi season from November 2005 to March 06 to study the effect of seed priming on yield and yield contributing character's of lentil at Kushtia region. Four levels of priming (control, 4,8, and 12 hours) were used. Seed soaking at 4 hours showed significantly higher yield than control (nonpriming) of BARI Mashur-4. Beyond 4 hours soakings lentil seed resulted declined yield. Highest yield (1.36 t/ha) and BCR (2.30) was found in 4 hours soaking.

Introduction

Pulse play a vital role in Bangladesh diets and the present per capital consumption of pulse is about 12g per day and if the rate is to be maintained by the year 2010 then the production has to be increased by 25.37% over the present production. Among the pulse crop, lentil is the most important pulse crop in Bangladesh which ranks second in position. It contains a good amount of palatable proteins (25%). Nearly 211987 hectare of land is under lentil with production 158981 tons. Kushtia is one of the major lentils growing area of Bangladesh with 7090 ha land with an average yield 910 kg/ha. There are many problems to associate lentil cultivation. Soil moisture is one of the important factors for crop germination and plant establishment. After harvesting of Aman crop it is difficult to crop establishment due to less moisture. But there is a positive effect of seed priming on germination and crop establishment of lentil. With the view in mind, an experiment was undertaken to find out the effect of seed priming of lentil for better crop establishment.

Materials and Methods

The experiment was conducted at Kushtia during Rabi season of 2005-06. The experiment was laid out in RCB design with 3 (three) replications. The size of each unit plot was 5 × 4 m^2. Nitrogen, phosphorous and potassium was applied as basal during final land preparation at the rate of 20-40-20 kg/ha. Seeds were sown in broadcast method on, 27th November, 2005, at the rate of 40 kg/ha. The crop was harvested on 2 March 2006. Weeding and plant protection measures were done as and when required. Data were collected on different yield and yield components.

Results and Discussion

Priming techniques had positive response to plants/m^2 where higher plant/m^2 was recorded from treatment T_1. There was trend to decrease plants/m^2 with the increase of soaking time. But plant height was higher in treatment T_4. Pods/plant was higher in T_2 followed by T_1. Weight of seed was not influenced by priming or non-priming but seed yield was higher in 4 hour soaking followed by 8 hrs. There was no difference in 12 hrs and control treatment.

Farmer's reaction

Farmers were satisfied with the higher grain yield is priming seed of 4 hrs. Farmers expressed their satisfaction for higher yield without any cost.

Table 2. Performance of different lentil variety on prime & non- prime system at farmers Field in Kushtia region during rabi-2005-06

Treatment	Plants/m^2	Plant height (cm)	Pod/plant (No.)	1000-seed wt. (gm)	Seed yield (t/ha)	Straw yield (t/ha)	BCR
4 hours soaking	144.0	36.31	76	15.33	1.36	1.88	2.30
8 hours soaking	115.6	39.66	79	15.33	1.28	1.69	2.03
12 hours soaking	111.0	34.66	56	15.33	0.94	1.20	1.59
Control	108.3	42.80	71	15.17	0.99	1.25	1.67

Price (Tk./kg): Seed = 32.00

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Controlling Crown Size of Pineapple Fruits by Pinching

Abstract

The trial was conducted during November 2004 to June 2005 at the farmer's field in Madhupur Tract of Tangail district. The Giant Kew variety of pineapple was included in this experiment. Pinching at five stages of crown development and control constitute six treatments. Pinching was done at 30, 35, 40, 45 and 50 days after emergence of inflorescence. The result showed that the pinching at 35 and 40 days gave higher fruit weight than other treatments. Cost benefit analysis showed that higher benefit cost ratio (3.13: 1.00) was recorded from treatment 40 DAIE due to higher fruit yield as well as gross return & margin.

Introduction

Pineapple (*Ananas comosus* L. Merr.) is one of the major quick growing fruits in Bangladesh. It is a good source of vitamins A, B and C. It also contains calcium, iron and phosphorus (Sen 1990). Pineapple is largely grown in Madhupur, Tangail which coverage's 2518 hectares of land producing 28095 metric tons (BBS 2001). Most of the pineapple fruits produced in the country is consumed locally. However, export of fresh pineapple to temperate countries has started recently (Anon 2001). The variety Giant Kew has great potentiality in this aspect. Assurance of regular supply is an important criterion for export market of any commodity, which is equally effective in pineapple export. It has been solved by round the year production of pineapple through application of ethrel (Uddin *et al*. 1998). Large crown creates problems in handling, packaging and transportation of pineapples to markets especially for export, for which smaller and uniform crowns are preferred for good packaging. It is reported that removal of crown did not affect fruit size of pineapple (Uddin *et al*. 1997). The crowns should not be removed as they protect the fruits from sunburn. However, the size of the crowns may be reduced. Information regarding crown management in Giant Kew is scanty under Bangladesh literature. Therefore, the study was under taken to find out suitable stage of pinching to control crown size of pineapples in order to have smaller & uniform crown to facilitate good packing.

Materials and Methods

The study was done during November 2004 to June 2005 at the farmer's field in Madhupur Tract of Tangail district. The experiment was laid out in randomized complete block (RCB) design with three replications. The Giant Kew variety of pineapple was included in this experiment. Pinching at five stages of crown development and control constitute six treatments. Pinching was done at 30, 35, 40, 45 and 50 days after emergence of inflorescence. Seven hundred and fifty plants of uniform growth were selected just shortly after inflorescence emergence from a large existing plantation. There were 18 unit plots in three replications and 50 plants in each unit plot. The apical meristem of the crown was removed manually with the help of a sharp pointed tip of a sickle. In control plots, crowns were allowed to grow undisturbed. Data on different characters of crown, fruit and yields were recorded from all the plants of each treatment and analyzed statistically following (Gomez and Gomez 1993).

Results and Discussions

Length, diameter, crown weight and number of leaves/crown were significantly influenced by different treatments. Control plot showed significantly highest length of crown but among the treatments lowest crown length was recorded in fruits pinched at 30 DAIE, which was statistically at par to 35 DAIE. There was trend to increase length of crown when the increases of time. Similar trend was followed in case of diameter and weight of crown (Table 1). But number of leaves/crown was significantly highest from control treatment & other treatments were statistically identical. The apical meristem is the growing point of crown, which is needed to be removed. As the central leaves of the crown were pinched, the growth of meristem was stopped and no leaves were further developed.

The data in respect of fruit size, number of eyes per fruit, fruit weight, yield, crop duration, days to maturity and TSS (%) was influenced by crown pinching have been presented in Table 2. All the attributes were significantly influenced by pinching the crown compared to control. The highest length of fruit was recorded in the control and other treatments showed statistically similar. But fruit diameter did not differ significantly among the treatments including the control. Higher number of eyes/fruit of control treatment similar to 40 & 45 DAIE and the lowest number of eyes/fruit were observed in treatment 30 DAIE and followed by 50 DAIE. There was no significant difference in individual fruit weight between treatments 35 & 40 DAIE. This two treatments showed higher fruit weight than other treatments. Rest of the treatments showed similar individual fruit weight but lower than 35 & 40 DAIE treatment. Though fruit size was higher in control treatment but yield was not higher than 35 & 40 DAIE. There was no definite order in case of fruit yield but yield was decreased after 40 DAIE & lowest from control treatment. Mainly individual fruit weight influenced the fruit yield in treatment 35 & 40 DAIE. Though the yield under different treatments showed statistical variation, but this difference was not much pronounced from this practical stand point. Days to maturity differ 6 days in treatments 30 and 50 DAIE, but crop duration was almost same which vary only 2 days in control treatment. The treatments had no remarkable influence on total soluble solid (TSS) of fruits. Nazrul *et al.* (2004) also reported similar trend of findings in variety Honey Queen. The percent of total soluble solid was observed to be almost same in all the treatments, except 50 DAIE, which showed lower TSS (%) than that of other treatments. TSS values of the fruits were obtained through different crown management practices showed similar which might be due to the genetically factors of the variety concerned.

Cost and return analysis

The cost benefit analysis was done to compare the cost involved in pinching of crown in different treatments. The definite trend was observed in cost benefit analysis. The highest gross return was obtained from treatment 40 DAIE followed by 35 DAIE where as control treatment gave the lowest gross return. Similar trend was observed in case of gross margin. The cost of cultivation was differed in different treatments, which are due to differences in required number of laborers for removing growing meristems of crown except control treatment. Cost benefit analysis also showed that higher benefit cost ratio (3.13: 1.00) was recorded from treatment 40 DAIE due to higher fruit yield as well as gross return & margin (Table 3). Results reveled that growing meristem of inflorescence's crown could be pinched at 35-40 days after inflorescence emergence to produce exportable pineapple with attractive crown. However, there is a significant contribution of pinching in the export point of view of pineapple.

Table 1. Crown size of pineapple at harvest in different treatments (Madhupur, Tangail, 2004-2005)

Treatments (DAIE)	Crown size (cm)		Crown wt. (g)	No. of leaves per crown
	Length	Diameter		
30	5.73	2.35	23.57	45
35	6.63	2.91	27.61	53
40	7.77	3.45	39.53	60
45	8.83	3.70	49.85	68
50	10.15	4.21	67.79	76
Control	23.27	9.50	270.00	129
LSD(0.05)	1.42	0.66	30.65	37.06
CV (%)	7.53	8.34	21.13	32.81

DAIE = Days after Inflorescence Emergence.

Table 2. Fruit characters, crop duration and yield of pineapple due to pinching of inflorescence's of crown

Treatments (DAIE)	Fruit size (cm)		Number of eyes/fruit	Weight of fruits (g)	Fruit yield (t/ha)	Crop duration (days)	Days to* maturity	TSS (%)
	Length	Diameter						
30	14.40	10.82	92.08	1090	39.15	480	136	14.15
35	14.70	10.61	94.92	1127	40.23	480	136	14.34
40	15.33	11.25	98.34	1153	41.40	481	138	14.07
45	15.34	11.09	97.65	1091	39.30	481	141	14.05
50	15.28	10.95	92.10	1106	38.83	481	142	13.81
Control	18.00	12.09	99.67	1110	38.19	482	137	14.07
LSD (.05)	2.26	NS	7.42	18.40	2.83	-	-	0.44
CV (%)	8.10	6.73	4.36	2.87	4.90	-	-	1.73

* From inflorescence to harvest.

Table 3. Cost benefit analysis of inflorescence pinching in pineapple

Treatments (DAIE)	Fruit yield (t/ha)	Gross return (Tk./ha)	Total cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
30	39.15	228245	77720	150525	2.93
35	40.23	234541	77370	157171	3.03
40	41.40	241362	76880	164482	3.13
45	39.30	229119	77510	151609	2.95
50	38.83	226379	77860	148519	2.90
Control	38.19	222648	74500	148148	2.98

*Only variable cost for removal of crown meristem was considered, since all other costs were same for all treatments.

1. Price of fruits: Tk. 5.83/kg   2. Labours cost Tk. 70/mandy.

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Effect of Sowing Times on the Incidence of Foot and Root Rot and Yield of Bushbean

Abstract

The experiment was conducted at ARS, Bogra during 2005-06 to find out the effect of sowing times on foot and root rot and yield of Bushbean varieties. The highest foot and root rot (17.28%) was observed in BARI Bushbean 2 and October 30 sowing, and the lowest (8.33%) was in BARI Bushbean 1 and December 10 sowing. The highest yield (17.61 t/ha) was recorded in BARI Bushbean 1 and November 10 sowing followed by BARI Bushbean 1 and November 20 sowing, and the lowest yield (8.53 t/ha) was in BARI Bushbean 2 and December 10 sowing. Though November 10 and 20 sowing showed comparatively higher disease incidence than later sowing, but yield and yield attributes were higher with vigourous growth of plants for the varieties in these periods. So, BARI Bushbean 1 may be cultivated in November 10 to 20 for higher yield.

Introduction

Bushbean is the second largest legume producing vegetable in the world. It is used as tender vegetable, shelled green beans, dry bean and pulses. Now a days, it is considered as one of the most important exporting vegetables of Bangladesh to earn foreign currency. But the average yield of French bean is very low due to various reasons, where diseases are one of the important factors. Among the diseases, foot and root rot caused by *Fusarium* species *and Sclerotium rolfsii* is a serious disease. Avoiding the use of chemicals, if sowing time be used for reducing foot and root rot of Bushbean, this may help saving the foreign currency as well as may reduce the environmental pollution. So, the experiment was undertaken to find out the effect of sowing times on the incidence of foot and root rot and yield of Bushbean varieties.

Materials and Methods

The experiment was conducted at ARS, Bogra during 2005-06. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. Cow dung @ 10 t/ha, Urea @ 50 kg/ha, TSP @ 150 kg/ha, MP @ 150 kg/ha were applied. The experiment was carried out in split plot design with three replications. BARI Bushbean 1 and BARI Bushbean 2 were used in main plot and five sowing dates viz. October 30, November 10, 20, 30 and December 10 were applied in sub plot. Size of the plots was 2.0 m X 1.2 m and plant spacing was 30 cm x 15 cm. Intercultural operations were done as per needed and to maintain the normal hygienic condition of crop in the field. Data were recorded on Germination (%), Germination failure (%), Foot and root rot (%), Plant survival (%), Shoot length (cm) after 30 days of sowing, Root length (cm) after 30 days of sowing, Seedling vigour after 30 days of sowing, Plant height (cm) at maturity, Number of pods/plant, Weight of pods/plant and Pod yield (t/ha). The plots were inspected regularly to take observations on foot and root rot disease from seedling to maturity stage of the crop. For seedling vigour or vigour index, data were recorded after 30 days of sowing for each treatment combination. Vigour index was calculated by the following formula of Baki and Anderson (1973) .

Vigour Index = (Mean shoot length + mean root length) x Germination (%)

The recorded data were analyzed statistically to find out the level of significance and the variation among the respective data was compared following Duncan's New Multiple Range Test (DMRT).

Results and Discussion

Effect of variety: Results of varieties on foot and root rot of Bushbean are presented in Table 1. The highest germination (91.66%) and plant survival (88.27%) were observed in BARI Bushbean-1. The lowest germination (88.48%) and plant survival (86.38%) were observed in BARI Bushbean-2. The maximum germination failure (13.62%) was obtained from BARI Bushbean-2 and the minimum (11.73%) was in BARI Bushbean-1.

Results of varieties on seedling vigour and plant height of Bushbean are presented in Table 2. The highest shoot length (24.86 cm), root length (21.52 cm) and seedling vigour (4262.52) after 30 days of sowing were obtained from BARI Bushbean 1 and the lowest results of these parameters were in BARI Bushbean 2. The highest plant height at maturity (45.78 cm) was observed in BARI Bushbean 1 and the lowest (43.88 cm) was in BARI Bushbean-2. The maximum number of pod per plant (22.69), weight of pod per plant (90.76 g) and yield (14.29 t/ha) during harvest were recorded in BARI Bushbean-1 and the lowest results of these yield parameters were in BARI Bushbean-2.

Effect of sowing date: Germination, germination failure, foot and root rot and plant survival were significantly affected by the sowing times of Bushbean varieties (Table 4). Germination ranged from 86.74 to 93.16%, where higher germination was recorded in November 20 sowing which was statistically similar to November 10 sowing. Other treatments showed identical. The maximum germination failure (13.26%) was recorded in December 10 sowing and minimum (6.93%) in November 10 sowing. The highest foot and root rot (16.52%) was obtained from October 30 sowing. There was trend to decrease with the advancement of time. The maximum plant survival (90.9%) was observed in December 10 sowing which was followed by November 30 sowing.

Shoot length, root length, seedling vigour and plant height at maturity were significantly influenced by the sowing times (Table 5). Higher shoot length was recorded in October 30 sowing followed by November 10 and the lowest from December 10 sowing. Similar trend was obtained from in root length. Higher seedling vigour (4257.85) was obtained from October 30 sowing which was followed by November 10 and November 20 whereas the lowest (2813.95) in December 10 sowing. The maximum plant height (48.57 cm) at maturity was observed in October 30 sowing which was statistically similar to November 10 sowing. There was trend to decrease plant height and other characters with the advancement of sowing time.

Sowing times showed significant effect on number of pod per plant, weight of pod per plant and pod yield of Bushbean. Higher number of pods/ (26.63), weight of pod/plant (106.52 g) were recorded in November 10 sowing and the lowest from December 10 sowing. Higher pod yield (16.52 t/ha) was obtained from November 10 sowing which was statistically similar to November 20 (16.19 t/ha). The lowest yield (9.23 t/ha) was in December 10 sowing.

Interaction between variety and sowing date: Germination, germination failure, foot and root rot and plant survival were significantly affected by the varieties and sowing times of Bushbean. The highest germination (94.67%) was recorded in V_1S_3 which was statistically similar to V_1S_2 and the lowest (85.24%) in V_2S_5. The maximum germination failure (14.76%) was recorded in V_2S_5 and the lowest (5.33%) was recorded in V_1S_3. The highest foot and root rot (17.28%) was obtained from V_2 S_1 and the lowest (9.87%) in V_2S_5. The maximum plant survival (90.13%) was observed in V_2S_5 and the lowest (82.72%) was observed in V_2S_1.

Shoot length, root length, seedling vigour and plant height at maturity were significantly influenced by the varieties and sowing times of Bushbean (Table 8). The highest shoot length (28.50 cm) after 30 days of sowing was recorded in V_1S_1 and the lowest (17.95 cm) was in V_2S_5. The maximum root length (24.33 cm) after 30 days of sowing was recorded in V_1S_1 and the lowest (10.66 cm) in V_2S_5. The highest seedling vigour (4802.71) was obtained from V_1S_1 and the lowest (2438.62) was in V_2S_5. The maximum plant height (50.13 cm) at maturity was observed in V_1S_1 which was statistically identical to V_1S_2 (49.66 cm) and the lowest (38.25 cm) was observed in V_2S_5.

Varieties and sowing times showed significant effect on number of pod per plant, weight of pod per plant and pod yield of Bushbean during harvest (Table 9). The highest number of pod per plant (27.66) was recorded in V_1S_2 which was followed by V_1S_1 and V_1S_3 and the lowest (14.27) in V_2S_5. The maximum weight of pod per plant (110.64 g) was recorded in V_1S_2 and the minimum (57.08 g) in V_2S_5. The highest pod yield (17.61 t/ha) was obtained from V_1S_2 which was statistically similar to V_1S_3 (17.43 t/ha) and the lowest (8.53 t/ha) in V_2S_5.

Conclusion

It may be concluded that later sowing of Bushbean showed less disease incidence but lower yield than earlier sowing. Sowing resulted higher yield due to vigourous growth of survived plants and higher number and weight of pods per plant. So, BARI Bushbean-1 could be grown in November 10 to 20 for higher yield.

Reference

Baki, A.A. and J. D. Anderson. 1973. Vigour determination in soybean by multiple criteria. Crop Sci., 13 : 630-633.

Table 1. Effect of varieties on foot and root rot of Bushbean

Varieties	Germination (%)	Germination failure (%)	Foot and root rot (%)	Plant survival (%)
BARI Bushbean-1	91.66	8.34	11.73	88.27
BARI Bushbean-2	88.48	11.52	13.62	86.38

Table 2. Effect of varieties on seedling vigour and plant height of Bushbean

Varieties	Shoot length (cm)	Root length (cm)	Seedling vigour	Plant height at maturity (cm)
BARI Bushbean-1	24.86	21.52	4262.52	45.78
BARI Bushbean--2	22.22	14.93	3295.05	43.88

Table 3. Effect of varieties on yield and yield attributes of Bushbean (during harvest)

Varieties	No. of pod/plant	Wt. of pod/plant (g)	Pod yield (t/ha)
BARI Bushbean 1	22.69	90.76	14.29
BARI Bushbean 2	20.73	82.9	12.33

Table 4. Effect of sowing times on foot and root rot of Bushbean varieties

Sowing times	Germination (%)	Germination failure (%)	Foot and root rot (%)	Plant survival (%)
Oct. 30	88.71 b	11.29 b	16.52 a	83.48 d
Nov. 10	93.07 a	6.93 c	14.45 b	85.55 c
Nov. 20	93.16 a	6.84 c	12.63 c	87.37 bc
Nov. 30	88.66 b	11.34 b	10.67 d	89.33 ab
Dec. 10	86.74 b	13.26 a	9.10 e	90.90 a

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Table 5. Effect of sowing times on seedling vigour and plant height of Bushbean varieties

Sowing times	Shoot length (cm)	Root length (cm)	Seedling vigour	Plant height at maturity (cm)
Oct. 30	26.75 a	21.11 a	4257.85 a	48.57 a
Nov. 10	25.39 ab	20.08 ab	4239.27 a	48.00 a
Nov. 20	24.91 b	19.50 b	4142.23 a	46.13 b
Nov. 30	22.60 c	16.14 c	3440.62 b	42.32 c
Dec. 10	18.06 d	14.31 d	2813.95 c	39.12 d

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Table 6. Effect of sowing times on yield and yield attributes of Bushbean varieties (during harvest)

Sowing times	No. of pod/plant	Wt. of pod/plant (g)	Pod yield (t/ha)
Oct. 30	23.53 a	94.07 c	13.58 b
Nov. 10	26.63 a	106.52 a	16.52 a
Nov. 20	25.53 a	102.12 b	16.19 a
Nov. 30	17.83 b	71.30 d	11.00 c
Dec. 10	15.03 b	60.14 e	9.23 d

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Table 7. Interaction effect of varieties and sowing times on foot and root rot of Bushbean varieties

Interaction	Germination (%)	Germination failure (%)	Foot and root rot (%)	Plant survival (%)
V_1 x S_1	90.90 b	9.10 d	15.76 a	84.24 de
V_1 x S_2	94.57 a	5.43 e	13.49 cd	86.51 cd
V_1 x S_3	94.67 a	5.33 e	11.49 ef	88.51 bc
V_1 x S_4	89.94 bc	10.06 cd	9.60 g	90.40 ab
V_1 x S_5	88.24 bcd	11.76 bc	8.33 g	91.67 a
V_2 x S_1	86.52 cd	13.48 ab	17.28 a	82.72 e
V_2 x S_2	91.58 ab	8.42 d	15.41 ab	84.59 de
V_2 x S_3	91.66 ab	8.34 d	13.77 bc	86.23 cd
V_2 x S_4	87.38 cd	12.62 b	11.75 de	88.25 bc
V_2 x S_5	85.24 d	14.76 a	9.87 fg	90.13 ab

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

V_1= BARI Bushbean-1, V_2= BARI Bushbean-1; S_1 = Oct. 30, S_2 = Nov. 10, S_3 = Nov. 20, S_4 = Nov. 30 and S_5 = Dec. 10

Table 8. Interaction effect of varieties and sowing times on seedling vigour and plant height of Bushbean varieties

Interaction	Shoot length (cm)	Root length (cm)	Seedling vigour	Plant height at maturity (cm)
V_1 x S_1	28.50 a	24.33 a	4802.71 a	50.13 a
V_1 x S_2	26.83 ab	23.49 a	4761.69 a	49.66 a
V_1 x S_3	26.16 b	23.00 a	4649.72 a	46.26 b
V_1 x S_4	24.66 bc	18.83 b	3909.18 b	42.85 c
V_1 x S_5	18.16 e	17.95 bc	3189.28 c	39.99 de
V_2 x S_1	25.00 bc	17.89 bc	3712.98 b	47.00 b
V_2 x S_2	23.95 c	16.66 bc	3716.84 b	46.33 b
V_2 x S_3	23.66 c	16.00 c	3634.75 b	46.00 b
V_2 x S_4	20.55 d	13.45 d	2972.06 c	41.80 cd
V_2 x S_5	17.95 e	10.66 e	2438.62 d	38.25 e

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

Table 9. Interaction effect of varieties and sowing times on yield and yield attributes of Bushbean varieties (during harvest)

Interaction	No. of pod/plant	Wt. of pod/plant (g)	Pod yield (t/ha)
V_1 x S_1	24.66 ab	98.64 d	14.69 b
V_1 x S_2	27.66 a	110.64 a	17.61 a
V_1 x S_3	26.73 a	106.92 b	17.43 a
V_1 x S_4	18.60 bcd	74.40 f	11.77 c
V_1 x S_5	15.80 d	63.20 h	9.94 d
V_2 x S_1	22.41 abc	89.50 e	12.48 c
V_2 x S_2	25.60 a	102.40 c	15.43 b
V_2 x S_3	24.33 ab	97.32 d	14.96 b
V_2 x S_4	17.05 cd	68.20 g	10.23 d
V_2 x S_5	14.27 d	57.08 i	8.53 e

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance

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Performance of Wheat Varieties Developed by BARI

Abstract

On-farm performance of wheat varieties after T.aman harvest was evaluated at Goyanghat upazilla under Sylhet district during rabi 2005-06 to find out suitable variety(s) of wheat. Five varieties viz. Shatabdi, Protiva, Sourav, Gourab, and Kanchan were evaluated. The variety Shatabdi produced slightly higher yield at all the sites.

Introduction

Wheat is the second cereal crop of Bangladesh. But its yield is lower in our country than that of other wheat growing countries. In Sylhet region, a vast area of land remains fallow after harvesting of T. aman. Limited area in Sylhet region is utilized in wheat cultivation. It is cultivated mainly in rainfed condition. Wheat is cultivated at Goyainghat and Jaintapur upazillas as a single crop. But there may be abundant scope for wheat cultivation after harvest of T.aman rice in the fallow land. The farmers in Sylhet region use the variety Kanchan only. Wheat Research Center of BARI has developed four varieties with considerable advantages over Kanchan. It is, therefore, needed to find out the performance of wheat varieties after T.aman harvest at Sylhet area.

Materials and Methods

The experiment was conducted at Jalalpur FSRD site, Goyainghat Upazilla under Sylhet district and at MLT site Moulvibazar at the farmers field in rabi season of 2005-06. The varieties Shatabdi, Protiva, Gourab, Sourav and Kanchan were used in Jalalpur FSRD site and Goyainghat but in MLT site Moulvibazar only Shatabdi and Kanchan was used. The experiment was carried out followed by RCB design with 3 replication. The seeds were sown through power tiller operated wheat seeder on 25-27 November 2005 in Goyainghat and traditional method was followed in other two sites. The crop was fertilized @ 82-36-20-16 kg N, P, K and S/ha. Single irrigation (not sufficiently) was given at CRI stage. Crop was harvested on 15-21 March 2006.

Results and Discussion

Significant variations in all the characters under studied were found significant except plant height. Days to maturity ranged from 114 DAS to 119 DAS. The earliest variety was Gourab and Sourav, which took only 114 days to maturity. The maximum spikes/m^2 was obtained from Shatabdi, which was statistically at par to Protiva. The variety Sourav produced the lowest (297) spikes/m^2 due to less seed germination. Shatabdi gave higher seed weight followed by Protiva. Higher grain yield was obtained from the variety Shatabdi (3.58 t/ha) followed by Kanchan and Protiva. Almost similar trend was obtained in Jalalpur and Moulvibazar both in yield and yield contributing characters (Table 2 and Table 3). But less grain yield was obtained from Moulvibazar due to lower spikes/m^2.

Table 1. Yield and yield contributing characters of five wheat varieties at Goyainghat upazilla under Sylhet district during rabi 2005-06

Variety	Maturity (Days)	Plant height (cm)	Spikes/m^2	Grains/spike	1000 -grains wt (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Shatabdi	117	103.4	326	31	46.33	3.58	4.96
Protiva	117	102.5	322	30	45.83	3.35	4.59
Gourab	114	101.6	308	30	45.17	3.08	4.41
Sourav	114	101.8	317	29	43.83	3.30	4.17
Kanchan	119	101.9	317	30	44.67	3.37	4.40
$LSD_{0.05}$	NS	1.65	9.90	1.26	0.82	0.12	0.19
CV (%)	2.0	1.34	1.84	3.48	1.52	2.27	2.41

Table 2. Yield and yield contributing characters of five wheat varieties at FSRD site, Jalalpur, under Sylhet district during rabi 2005-06

Variety	Maturity (Days)	Plant height (cm)	Spikes/m^2	Grains/spike	1000 -grains wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Shatabdi	112	98.4	306	30	45.33	3.28	4.56
Protiva	112	97.5	302	28	44.83	3.15	4.19
Gourab	109	96.6	298	28	44.17	3.08	4.11
Sourav	109	96.8	287	27	42.83	3.20	4.17
Kanchan	114	96.9	305	28	43.67	3.27	4.40
$LSD_{0.05}$	NS	1.65	9.90	1.26	0.82	0.12	0.19
CV (%)	2.0	1.34	1.84	3.48	1.52	2.27	2.41

Table 3. Yield and yield contributing characters of five wheat varieties at MLT site, Moulvibazar during rabi 2005-06

Variety	Maturity (Days)	Plant height (cm)	Spikes/m^2	Grains/spike	1000 -grains wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Shatabdi	107	93.4	226	31	46.33	2.58	3.96
Kanchan	109	91.9	207	30	44.67	2.17	3.40
$LSD_{0.05}$	NS	1.65	9.90	1.26	0.82	0.12	0.19
CV (%)	2.0	1.34	1.84	3.48	1.52	2.27	2.41

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Performance of Different Chickpea Varieties in Sylhet Region

Abstract

An experiment was carried out at FSRD site Jalalpur, Sylhet and MLT site Sonamgonj during 2005-06 to find out the yield and suitability of chickpea variety(s) after harvest of T. aman rice in the Sylhet region. Six BARI developed Chickpea varieties (BARI Chola- 2, 3, 4, 5, 6, 7 & 8) were evaluated. The variety BARI Chola-8 gave higher yield (1584 kg/ha) followed by BARI Chola-3 at Jalalpur. Similar trend was followed at Sunamganj.

Introduction

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

Materials and Methods

The experiment was conducted in rainfed condition at the FSRD site Jalalpur, Sylhet and MLT site Sunamganj during rabi 2005-06. Six BARI developed chickpea varieties viz. BARI Chola-2, BARI Chola-3, BARI Chola-4, BARI Chola-5, BARI Chola-6, BARI Chola-7 and BARI Chola-8 were included. The experiment was carried out in RCB design with three replications. The plot size was 4m$\times$3m. The seeds were sown on 25 November at FSRD site and 28 November 2005 at Sunamganj. The spacing was 40cm$\times$10cm. Fertilizers were applied at the rate 20-18-17 kg/ha of N, P and K, respectively. The crop was harvested at maturity from 115-122 days according to variety.

Results and Discussion

FSRD site Jalalpur, Sylhet

Days to maturity ranged from 114 to 124 DAS. The earliest variety BARI Chola-4 and BARI Chola-2. The variety BARI Chola-7 produced higher pods/plant which is closely followed by BARI Chola-2 and 3. The lowest pod/plant was observed from BARI Chola-5. The highest seed weight was recorded from BARI Chola-8. The highest seed yield was obtained from BARI Chola-8 due to bigger seed size which was closely followed by BARI Chola-3.

MLT Site Sunamganj

Maturity days varied from 115-122 days. Plant height was similar among BARI Chola-3 and 8. But higher pods/plant was recorded from BARI Chola-7 followed by BARI Chola-2. BARI Chola-8 showed bigger size seed followed by BARI Chola-3 and this character reflected the seed yield from both the variety.

Conclusion

The variety BARI Chola-8 produced higher seed yield at both the locations due to bigger seed size though 7 days later maturity than BARI Chola-2. BARI Chola-8/BARI Chola-3 could be regarded as suitable chickpea cultivates at fallow land in Sylhet region.

Table 1. Yield and yield contributing characters of chickpea varieties at FSRD site, Jalalpur, Sylhet during Rabi 2005-06.

Variety	Days to maturity	Plant height (cm)	Pods/plant (no.)	100-seed wt. (g)	Seed yield (kg/ha)
BARI Chola-2	114	36.15	36.09	13.17	1115
BARI Chola-3	121	42.90	35.24	18.19	1560
BARI Chola-4	116	32.01	30.36	12.69	995
BARI Chola-5	120	29.32	29.18	12.08	925
BARI Chola-6	114	33.73	34.58	14.49	1105
BARI Chola-7	119	37.75	36.79	12.12	1017
BARI Chola-8	124	43.12	31.95	21.72	1583

Table 2. Yield and yield contributing characters of chickpea varieties at MLT site, Sunamganj during Rabi 2005-06

Variety	Days to maturity	Plant height (cm)	Pods/plant (no.)	100-seed wt. (g)	Seed yield (kg/ha)
BARI Chola-2	115	35.32	35.73	12.63	1054
BARI Chola-3	122	41.75	34.12	18.12	1475
BARI Chola-4	117	34.35	29.38	13.33	938
BARI Chola-5	121	28.85	30.82	11.02	854
BARI Chola-6	116	36.72	34.25	14.28	1045
BARI Chola-7	117	36.85	36.26	12.44	948
BARI Chola-8	122	41.25	33.17	20.93	1490

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Studies on High Density Planting of Banana

Abstract

The experiment was conducted at Utholi, Shibganj, Bogra during October, 2004 to November, 2005 to verify the higher density plantation with the recommended spacing in respect of yield. Two plant spacings were used viz. 1.5m x 1.5m (SP_1) and 2.0 m x 2.0 m (SP_2). The highest number of bunch per hectare was observed in SP_1 and the lowest was observed in SP_2. The treatment SP_1 gave the highest yield due to plant population than SP_2. The highest gross margin (Tk. 254622.00) and BCR (3.95) were observed in SP_1 and the lowest gross margin (Tk. 1,58,099.00) and BCR (3.79) were observed in SP_2. Farmers of Shibganj, are very much interested to cultivate Banana by using spacing 1.5 m x 1.5 m instead of spacing 2.0 m x 2.0 m due to higher yield as well as higher gross.

Introduction

Banana is cultivated more of less in whole areas of Bangladesh. It is a delicious and nutritious fruit. Commercial cultivation of Banana is generally done by using the spacing of 2 m x 2 m. It is wider spacing. But in case of varieties and location, now a days, many growers cultivate Banana using closer spacing. They argue that total yield becomes higher through closer spacing. Banana is botanically taller crop and duration is also longer (10-14 months). Closer spacing may help in preventing natural hazards specially speedy wing and storm. So, the present study was undertaken to verify the higher density plantation (spacing 1.5 m x 1.5 m) with the recommended spacing (2.0 m x 2.0 m) in respect of yield and other parameters.

Materials and Methods

The experiment was conducted at Utholi, Shibganj, Bogra during October, 2004 to November, 2005. Two plant spacings were used viz. 1.5 m x 1.5 m and 2.0 m x 2.0 m. The experiment was carried out following Randomized Complete Block Design with five dispersed replications. Rangin Mehersagor variety was used for the study. The Banana suckers were planted on October, 2004. Fertilizers and manures were applied as per recommendation (Anonymous, 2004). Irrigation and intercultural operations were done as per needed. Tilt 250 EC was sprayed for disease control and Savin 85 SP was sprayed for Banana leaf and fruit beetle. Bananas were harvested on October-November, 2005. Data were recorded on number of green leaves per plant, circumference of basegirth per plant, plant height, length/bunch, weight/bunch with peduncle, weight/peduncle, number of clusters/bunch, weight of clusters/bunch, weight/cluster, number of fingers/bunch, number of fingers/cluster, length/finger, circumference/finger and number of bunch/ha. Economic analysis was also done for the study.

Results and Discussion

Average number of green leaves of Banana was more or less same for the two spacing and 8 MAP (months after planting). Spacings did not show any effect on number of green leaves of Banana. Spacing showed effect on circumference of basegirth (Table 2). Higher circumference of basegirth/plant was recorded in SP_2 as compared to SP_1 at 2, 4, 6 and 8 MAP, respectively. Circumference of basegirth was increased with the increase of time. Spacing showed effect on plant height (Table 3). Higher plant height/plant was recorded in SP_2 as compared to SP_1 at 2, 4, 6 and 8 MAP, respectively. Plant height was increased with the increase of time. Yield and yield contributing characters were affected by the spacing (Table 4). The highest length/bunch, weight/bunch with peduncle, weight/peduncle, wt. of clusters/bunch, weight/cluster, no. of fingers/bunch, no. of fingers/cluster, length/finger and circumference/finger were recorded in SP_2 as compared to SP_1. Higher number of bunch per hectare was observed in SP_1 due to higher number of plant population than SP_2.

Cost and return analysis: The highest gross margin and BCR were observed in SP_1 and the lowest gross margin and BCR (3.79) from SP_2. Though higher cost was involved in close spacing but due to higher bunch/ha gave higher profit.

Farmers reaction: Closer spacing 1.5 m x 1.5 m gave higher total yield and economic profit than spacing 2.0 m x 2.0 m of Banana. So, the farmers of Shibganj, Bogra are very much interested to cultivate Banana by using spacing 1.5 m x 1.5 m instead of spacing 2.0 m x 2.0 m due to higher yield as well as higher gross margin.

Conclusion

From the above study, it may be concluded that spacing 1.5 m x 1.5 m gave higher total yield and economic profit than spacing 2.0 m x 2.0 m of Banana. So, the farmers of Shibganj, Bogra may cultivate Banana by using spacing 1.5 m x 1.5 m instead of spacing 2.0 m x 2.0 m.

Table 1. Effect of spacing on number of green leaves and basegirth/plant of Banana

Treatment (Spacing)	Average number of green leaves/plant				Avg. circumference (cm) of basegirth/plant			
	2 MAP	4 MAP	6 MAP	8 MAP	2 MAP	4 MAP	6 MAP	8 MAP
SP_1	8.04	10.9	12.06	10.62	16.18	23.77	59.68	68.38
SP_2	8.38	9.76	12.44	11.30	16.72	24.44	62.04	71.06

SP_1 = 1.5 m x 1.5 m and SP_2 = 2.0 m x 2.0 m; MAP = Month After Planting

Table 3. Effect of spacing on Plant height of Banana

Treatment (Spacing)	Average plant height (cm) per plant			
	2 MAP	4 MAP	6 MAP	8 MAP
SP_1	88.10	127.54	296.25	304.36
SP_2	88.64	128.02	302.09	365.91

Table 4. Effect of spacing on yield and yield contributing characters of Banana

Treatment (Spacing)	Length/ bunch (cm)	Weight/ bunch with peduncle (kg)	Weight/ peduncle (kg)	No. of clusters/ bunch	Wt. of clusters/ bunch (kg)	Wight/ cluster (kg)
SP_1	76.20	20.49	1.45	9.00	19.04	2.12
SP_2	87.90	25.81	1.83	9.00	23.98	2.67

Table 4. Contd.

No. of fingers/ Bunch	No. of fingers/ Cluster	Length/ Finger (cm)	Circum-ference/ Finger (cm)	No. of Bunch/ha
140.20	15.58	15.77	13.29	3966
158.20	17.58	19.98	15.85	2259

Table 5. Cost and return analysis of Banana by using spacing

Treatment (Spacing)	No. of Bunch/ha	Gross return (Tk. /ha)	Total variable cost (Tk. /ha)	Gross margin (Tk. /ha)	BCR
SP_1	3966	3,41,076.00	86,454.00	2,54,622.00	3.95
SP_2	2259	2,14,605.00	56,506.00	1,58,099.00	3.79

Total cost of input per hectare of SP_1		Total cost of input per hectare of SP_2		Price of Output
Items	Price	Items	Price	
Suckers	Tk. 6000.00	Suckers	Tk. 3750.00	Tk. 86.00/Bunch of SP_1 and Tk. 95.00/Bunch of SP_2
Urea	Tk. 13,681.00	Urea	Tk. 7,906.00	
TSP	Tk. 21,513.00	TSP	Tk. 12,424.00	
MP	Tk. 19,530.00	MP	Tk. 11,295.00	
CD	Tk. 7,170.00	CD	Tk. 5,000.00	
Ploughing	Tk. 3,500.00	Ploughing	Tk. 3,500.00	
Pesticides	Tk. 4,000.00	Pesticides	Tk. 3,041.00	
Labour	Tk. 11,060.00	Labour	Tk. 9,590.00	
Total	Tk. 86,454.00	Total	Tk. 56,506.00	

B. COASTAL AREA'S CROPS

Screening of Suitable Rabi Crops after T.Aman Rice Harvest in Ganges Tidal Floodplain (AEZ 13)

Abstract

An attempt was made to identify profitable crop in the Patuakhali area after T.aman harvest in rabi season of 2005-06 in FSRD site Patuakhali. The experiment was initiated in two phases of Medium high land viz. High (Ridge) phase and Low phase. In lower phase only local varieties of T.aman rice is grown which harvest late usually in last of December to mid January. Rabi crops grown in the lower phase but is was not found more profitable. In the ridge almost all rabi crops of the experiment could be grown successfully and profitably. The experiment was conducted with 7 crops for ridge phase of medium high land where modern and local varieties of rice were harvested within 30 November. Among the crops grown Brinjal, Indian spinach, Bushbean, Lady's finger, Potato, Hybrid Maize and Chilli were found profitable of which Brinjal was the highest BCR (6.39) followed by Indian spinach and bushbean.

Introduction

The entire district of Patuakhali, Barguna and part of Barisal, Jhalkati and Priojpur are within the Ganges Tidal Floodplain (AEZ-13). Most of the land of this zone gets tidally flooded from end of March to end of November and in some fields beyond this limit if the link canals are not closed at the point they joined the rivers. More than 60% of all the cultivable land of this area remains fallow winter. There are a lot of reasons like delayed harvested of T.aman rice late in attaining soil joe condition, etc. for which only a limited number of crops like khesari, Cowpea, Mungbean, Chilli, Sweet Potato, G.nut, etc. are grown in about one third of the crop land. Though major part of the area is of medium high land type there are variations in the flooding depth of the crop land varies from 15 to 80cm. Depending upon flooding depth medium high land are divided into 3 phases namely ridge (6-30cm) medium phase (30-60cm) and lower phase (70cm above).

Objective: To identify crops those could be grown profitability in medium high land both ridge and low phase.

Materials and Methods

The experiment was conducted at Farming Systems Research and Development (FSRD) site Razakhali, Patuakhali during rabi 2005-2006. Some vegetable and cash crops were selected as test crop. They study was made as in RCB design with five replications in medium high land. Each unit plot measured 5 x 4m. T.aman rice was harvested within November 30, 2005. Seven crops viz. Potato, Bushbean, Groundnut, Brinjal, Chilli, Indian spinach, Okra for high phase and two crops viz. Sesame and Mungbean for low phase were grown in each unit plot as treatments. Management practices for selected crops are given in Table 1. Other intercultural operations were done as per recommendation.

Results and Discussion

Ten crops were grown of which brinjal, indian spinach, bushbean and Okra were found reasonable yield in medium high land (high phase). In lower phase of medium high land, hybrid maize and mungbean were also found acceptable. All the crops showed higher gross return but highest gross return was obtained from brinjal followed by indian spinach, bushbean in high phase. Mungbean and maize showed reasonable BCR but sesame is not found profitable.

Table 1. Management practice of different crops grown for the experiment

Crops	Variety	Spacing cm x cm	Fertilizer kg/ha (Urea-TSP-MP)	Sowing time	Harvesting time
Medium High Land (High phase)					
Potato	Diamant	45x15	250-150-250	Dec. 15-20, 05	March 3, 06
Bushbean	BARI 1	30x15	55-150-150	Dec.15-20,05	Feb.2-17,06
G.nut	Dhaka-1	30 x 15	25-160-85	Dec. 15-20, 05	May 15, 06
Brinjal	Kajla	70 x50	375-150-250	Dec.15-20, 05	Mar. 25, May, 15, 06
Chilli	Local	40 x30	180-250-150	Dec.15-20, 05	Ap. 20, May, 15, 06
Indian spinach	-	50 x 40	280-125-125	Dec. 15-20, 05	Mar. 20, May, 15, 06
Okra	BARI-1	50 x 40	150-125-125	Dec. 15-20, 05	Mar. 10, May 15, 06
Medium High Land (Low phase)					
Sesame	T-6	30x 10	75-120-50	Feb.5-10, 06	May 8, 06
Mungbean	BARI-5	30 x 10	50-75-30	Feb. 1-05, 06	May 20, 06
Maize	BGM-3	75 x 25	200-275-250	Jan. 1-05	May 1-10

Table 2. Yield and yield contributing characters of selected crops for high (Ridge) phase and low phase of MHL at Lebukhali during rabi 2004-05

Crops	Plant population/m2	Plant height (cm)	Fruits or Pod or Capsule or Tuber or branch/plant	Yield (t/ha)
Medium High Land (High phase)				
Potato	12.33	-	4.66	21.90
Bushbean	20.66	44	15.00	14.44
Groundnut	18.33	40	16.00	2.09
Brinjal	2.66	115	39.00	45.30
Chilli	7.00	49	48.66	1.23
Indian spinach	4.33	170	15.00	15.18
Okra	4.33	170	15.00	15.18
Medium High Land (High phase)				
Sesame	29.66	76	48.67	1.14
Mungbean	31.00	45.33	9.00	1.20
BHM-3	5	190	1	68.50

Table 3. Cost and return analysis different crops after T.aman harvest in Patuakhali region.

Variety	Yield (kg/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk./ha)	BCR
Medium High Land (High phase)					
Potato	21900	109500	43425	66075	2.52
Bushbean	14440	72200	22182	50018	3.25
G.nut	2090	31350	22077	9273	1.42
Brinjal	45300	226500	35437	191063	6.39
Chilli	980	29400	12250	17050	2.40
Indian spinach	35866	107598	23975	83623	4.49
Lady's finger	15176	60704	21500	39204	2.82
Medium High Land (Low phase)					
Sesame	1140	17100	16513	587	1.03
Mungbean	860	25800	14270	11530	1.81
Hybrid Maize	6850	68500	39940	28560	1.72

Output (Tk./kg): Potato= 5/-, Bushbean= 5/-, Groundnut= 15/-, Brinjal= 5/-, Chilli= 30/-, Indian spinach= 3/-, Okra= 4/-, Sesame= 15/-, Mungbean= 30/- and Maize=10/-

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Screening of Different Rabi Crops against Tolerance to Varying Soil Salinity Level

Abstract

Different rabi crops specially vegetables were screened in saline area under rainfed condition at FSRD site, Hazirhat, Noakhali during rabi season 2005-06. Three farmers fields were used for the study. Among the vegetable crops batishak showed better performance followed by cabbage. In case of spices chilli was found to be more saline tolerance.

Introduction

Out of 2.83 million hectares in the 13 districts of coastal in 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. According to the SRDI soil testing report it was observed that salinity level vary 0->20 ds/m. During the rabi season salinity level is highly increased which is very difficult to grow rabi crops. So, this 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 FSRD site, Hazirhat, Noakhali. Three farmers field were used for the study. Vegetable crops namely batishak, cabbage, and brinjal; pulse crop cowpea spices crops viz. onion, garlic and chili and oil seed crops soybean, 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 5mX2m. Transplanting was done on 1st week of December 2005. 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 duration of the crops life cycle. Data on yield of different crops were recorded. During the experimental period salinity ranged from 1.74 to 14.95 ds/m. Partial irrigation was done on last week of December for vegetative growth and crop establishment.

Results and Discussion

Yield of different crops against varying degree of salinity are presented in table 1. Nine different crops were screened out. Among them batishak showed better performance in all the field crops which gave the highest yield (21.47 t/ha) followed by cabbage (11.60 t/ha.) and brinjal (9.72 t/ha.). Out of three spices crops onion produced highest yield and it was 6.12 t/ha and then garlic (1.88 t/ ha.).But yield of onion and garlic was very poor in compare with their yield potential. This indicates that this two crops are more susceptible in saline area. Soybean, cowpea and mustard produced 1.623, 1.00 and 1.27 t/ha respectively. Cowpea and mustard variety Dhali was found tolerant in rainfed saline area.

Conclusion

From the above result it can concluded that chilli, cowpea, batishak and cabbage can tolerate to soil salinity at a certain level. For more confirmation further research program should take including more crops or varieties.

Table 1. Yield performance of different rabi crops against tolerance to soil salinity

Crops	Varieties	Yield (t/ha)	Crops	Varieties	Yield (t/ha)
Chili	Local	1.30	Cabbage	Provati	11.60
Cowpea	BARI Felon-1	1.00	Soybean	Shohag	1.623
Batishak	BARI Batishak-1	21.47	Brinjal	BARI-4	9.72
Onion	Taherpuri	6.12	Mustard	Dhali	1.27
Garlic	Local	1.88			

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Screening of Different Rabi Crops in Saline Area

Abstract

An attempt to identify crops suitable to grow in the saline area of Patuakhali the experiment was initiated in rabi season of 2001-2002 and continued upto 2005-06 at MLT site Kalapara under Patuakhali. Salinity level in the area ranges between 6-14 ds/m during the dry period. Among the crops e.g. Chilli, Mungbean, Sesame, Cowpea, Sunflower and Maize crops were possible to grow successfully. Considering cost and return, Chilli, Mungbean and maize were found feasible and profitable.

Introduction

At present total saline area of the country is estimated to be about 0.88 million ha (annon, 1985) of which more than 0.22 million ha is in Patuakhali region. These lands are affected by salinity of varying degrees from 5-26 ds/m during dry period. Present land use in the coastal area is primarily limited within growing of T.aman rice crop in the wet season. During dry period (Nov.-March) a vast area of land remains fallow not only in the highly saline soils but also in the vary low to low saline soils due to ignorance about the crops those could be profitably grown.

Objective: To find out suitable crops those can be grown successfully in saline area of Patuakhali.

Materials and Methods

The experiment was conducted at Multi location testing (MLT) site Kalapara, Patuakhali during rabi 2001-02 and continued up to 2005-06. The experiment was laid out in a randomized complete block design with 4 replications. The unit plot size was 6x5m. Six crops were selected viz. Chilli, Mungbean, Sesame, Cowpea, Sunflower and Maize. Crops were irrigated two times. Salinity was measured month wise. Management practices for different crops, salinity of soil and irrigation water are given in Table 1 to 3.

Table 1. Management practice for the selected crops

Crops	Variety	Spacing (cm)	Fertilizer NPK kg/ha	Sowing time	Harvesting time
Chilli	Local	50 x 30	50-30-50	Dec. 8-15	Ap. 15 –May 15
Mungbean	BARI mung-2	30 x 5	8-6-8	Dec,8, -Jan.5	Ap.15-30
Sunflower	Kironi	50 x 25	92-40-60	Dec.8-15	Ap. 5-20
	ST-2250	50 x 25	92-40-60	Dec. 8-15	Ap. 5-20
Sesame	T-6	30 x 5	45-20-24	Dec. 10-20	May 15-20
Cowpea	BARI Felon-1	40 x 15	8-14-18	Dec. 15-20	Ap. 20-30
Maize	BARI hybrid maize-3	75 x 25	200-275-250	Jan. 1-5	May 1-7

Table 2. Average salinity level (ds/m) at different depth of soil at Kalapara, Patuakhali during rabi 2001-02 up to 2005-06

Month	Top soil	10cm	20cm	30cm
December	8.17	7.40	7.00	6.90
January	7.90	7.60	6.89	7.41
February	10.00	10.00	8.90	8.30
March	15.50	12.00	10.63	10.52
April	13.00	10.56	10.46	10.30

Table 3. Average salinity level (ds/m) of irrigation water and soil moisture of three years at Kalapara, Patuakhali.

Month	Salinity (ds/m)	Moisture (%)
January	0.53	21.4
February	0.59	16.4
March	0.64	14.6
April	-	19.0

Results and Discussion

Among the crop cowpea showed reasonable good yield in all the years of experimentation. Sunflower of both the variety responded better with an average yield of 1247 and 1480 kg/ha. Hybrid maize is grown only one year with reasonable yield 7.63 t/ha. Chilli and sesame showed acceptable yield. Though lower yield was obtained from mungbean but higher BCR among the crops. Maize yielded higher due to higher cobs it is less profitable than mungbean and chilli. Chilli also showed reasonable benefit.

So, result showed that chilli, mungbean and maize could be grown in saline area of Kalapara.

Table 4. Yield and yield contributing characters of different cultivars at Kalapara, Patuakhali during rabi 2005-06

Crops	Variety	Plant height (cm)	Plants/ m^2	Pods or capsule or cob/plant	Seed/pod or head	1000-seed or 100-capsule wt.g.	Yield kg/ha
Chilli	Local	53	15	22	-	35	610
Mungbean	BARI Mung-2	50	20	12	8	28	655
Sunflower	Kironi	116	6	-	380	58	1225
	ST-2250	95	7.6	-	392	57	1460
Sesame	T-6	83	25	35	41	3	930
Cowpea	BARI Felon-1	56	20.3	11.7	10	139	1350
Maize	BARI hybrid maize-3	180	6	1	560	289	7630

Table 5. Average yield of different crops (2001-05)

Crop	Variety	Yield (kg/ha)				
		2001-02	2002-03	2004-05	2005-2006	Mean
Chilli	Local	740	765	778	610	723
Mungbean	BARI Felon-1	1292	1300	1378	1350	1330
Sesame	T-6	1090	853	950	930	956
Sunflower	Kironi	1267	1260	1245	1225	1247
	ST-2250	-	-	1500	1460	1480
Maize	BHM-3	-	-	-	7630	7630

Table 7. Average cost and return analysis of Mungbean, Chilli, Cowpea, Sunflower, Sesame and Maize at Kalapara in irrigated condition

Crops	Yield (kg/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Chilli	723	25305	12250	13055	2.07
Cowpea	1330	17290	10467	6823	1.65
Mungbean	580	17400	8029	9371	2.17
Sesame	956	12428	9220	3208	1.35
Sunflower	1247	14964	9250	5715	1.62
Hybrid maize	7630	76300	39940	36360	1.91

Price (Tk/kg): Chilli= 35/-, Sunflower= 12/-, Cowpea= 13/- Mungbean= 30/-, Maize= 10/- and Sesame= 13/-

Screening of Potato Varieties/Lines for Saline Area

Abstract

The experiment was conducted at Multi Location Testing (MLT) Site, Kalapara, Patuakhali during rabi seasons of 2005-06. Fourteen varieties/lines were planted to evaluate their performance in saline area. Potato var. Asterix produced the highest tuber yield 19.92 t/ha followed by Roselta (19.43 t/ha).

Introduction

Southern region of Bangladesh is mainly rice based. Cultivation of vegetables is very low. It is a vegetable deficit area. Potato is a promising crop for this area. Potato is a vegetable and also is carbohydrate containing crop. Farmers are highly interested to cultivate potato. With this point of view 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 Multi Location Testing (MLT) Site, Kalapara, Patuakhali during rabi seasons of 2005-06. A good number of varieties and genotypes as shown in Table 2 were planted in RCB design with 3 replications on December 12, 2006. Seeds were sown with 60 x 30cm spacing in unit plots of 5 x 3m size. Irrigation was given thrice at 20 days interval of sowing. Crops were harvested on March, 20, 2006. Soil samples were collected from experimental plot for determining salinity level.

Table 1. Soil salinity of experimental plots at different dates

Salinity (0-15 cm depth of soil)					
Date of soil collection	Ds/m	Date of soil collection	Ds/m	Date of soil collection	Ds/m
20-11-2003	1.58	7.12.2004	4.25	1-12-2005	2.08
1-12-2003	2.01	22.12.2004	5.90	15-12-2005	3.15
30-12-2003	3.32	7.1.2005	6.50	1-1-2006	5.07
20-1-2004	4.55	22.1.2005	8.10	15.1.2006	6.45
30.1.2004	4.97	7.2.2005	9.80	1.2.2006	7.80
10.2.2004	6.43	22.2.2005	11.90	15.2.2006	9.35
1.03.2004	8.04	10.3.2005	13.80	1.03.2006	11.62
20.3.2004	8.91	-	-	5.03.2006	12.54
30.3.2004	10.16	-	-	-	-

Result and Discussion

Tuber yield was significantly affected by the variety. The variety Asterix showed higher yield followed by Roselta. Diamant and Markles also showed reasonable yield but Ultra, V52, V33 and Akira could not perform well. Average yield of all the varieties/genotypes were low due to late sowing and no rainfall during the growing period.

Table 2. Yield of potato varieties/genotypes at Kalapara, Patuakhali in 2005-06

Varieties/genotypes	Tuber yield (t/ha)	Varieties/genotypes	Tuber yield (t/ha)
Diamant	18.98b	Ultra	13.86g
TPS-364167	17.30c	Akira	14.70e
Remarka	19.42c	Roselta	19.43ab
V33	14.90c	Markles	18.62c
V52	15.31d	Asterix	19.92a

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

Screening of Potato Varieties for Saline Areas

Abstract

The experiment was conducted in the farmers' field at FSRD site, Hazirhat, Noakhali during the Rabi reason of 2005-06 under rainfed condition. Thirteen different potato varieties were screened in saline area to find out the suitable saline tolerant variety. Among the varieties, the line V-56 gave the highest yield (23.20 t/ha) which was followed by V-52 (21.60 t./ha) and Ailsha (21.20 t/ha).

Introduction

In Bangladesh, more than 30% of the cultivable area is in the coast. Out of 2.88 million hectares are affected by varying degrees of soil salinity (Karim and Iqbal, 2001). After harvesting of T. Aman vast land remain fallow. During Rabi season, the soil salinity levels increase through capillary movement. It is a production constraint common to all rain fed agriculture. In Bangladesh 1 lac 36 thousand ha land is under potato cultivation, which produce 15.58-lac ton potato. In Noakhali, the total potato cultivation area is 1,584 ha which is negligible (0.79%) in the context of total potato cultivated area in Bangladesh. So a large amount of potato should be purchased from other district of Bangladesh to meet up the demand. High soil salinity and lack of irrigation facilities are the major problems to cultivate potato in this area. BARI developed some potato varieties, which might influence the farmers to cultivate potato in this coastal area. The performances of the varieties of potatoes need to be evaluated in saline area. The present study was therefore, undertaken to find out the suitable varieties of potatoes in saline area.

Materials and method

The experiment was conducted at farmers field under Farming System Research and Development (FSRD) site, Hazirhat, Noakhali, during the rabi season of 2005-06.The soil was silt loam to clay under the Ramgati soil series of AEZ 18f (Young Meghna Estuarine Flood Plain). Thirteen varieties of potato (Almera, Cardinal, Lady rosenta, Diamont, Asterix, V-56, V-33, V-52, BARI TPS-1, Ultra, Hera, Dhira and Ailsa) were included in the study. The unit plot size was 3 m × 1.8 m. The experiment was conducted under RCBD with three replications. The crop was fertilized with N-P-K (100-24-100 kg/ha). All fertilizers were applied at the final land preparation as basal dose. The whole potato tubers were planted on 06. 12. 05 with 50 cm × 25 cm spacing. To check the loss of soil moisture, mulches were applied immediately after planting. Intercultural operations were done as and when necessary. Harvesting was done on 23. 02. 06. All the data were recorded at the time of harvest and statistically analyzed by MSTAT. The means were compared by Duncan's Multiple Range Test (DMRT). During the experimental period the salinity was ranges from 1.65 to 10.01 ds/m.

Results and Discussion

Thirteen potato varieties were tested to identify salt tolerant variety. The yield and yield contributing characters were shown in Table 1. The highest number of stem was found in line V-33. The highest plant height was recorded in Ultra (54.90 cm). The highest tuber yield was found in variety V-56 (23.20 t/ha), which was statistically different from other variety/line. Days to emergence, days to maturity and grading were shown in table 2. BARI TPS-1 needed 14 days where V-56, V-52, Dhera and Ailsha needed 13 days for 80% emergence. The variety Almera needed the lowest days (10) for 80% emergence.

Farmer's reaction

The farmers of this area opined that potato cultivation can be easily done if they get quality seed tuber and mulch material is used.

Conclusion

The result showed that line V-56 performed better in saline area followed by V-52 and Ailsha. The experiment needs another year trial for confirmation.

Reference

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

Table 1. Yield performance of different potato varieties (Hazirhat, 2005-06)

Varieties/line	Plant height (cm)	Number of stem/ plant	Number of tuber/ plant	Tuber yield (t/ha)
Almera	30.30 f	2.30 h	3.30 j	15.20 g
Cardinal	24.53 g	3.50 e	4.70 g	11.20 j
Lady rosenta	24.80 g	3.50 e	7.80 a	17.60 f
Diamont	34.50 d	3.30 e	5.90 d	20.80 d
Astetix	43.10 c	4.00 c	6.60 c	9.60 k
V-56	50.97 b	3.90 c	6.60 c	23.20 a
V-33	30.90 ef	8.60 a	7.70 a	12.80 i
V-52	35.20 d	3.10 f	7.00 b	21.60 b
TPS-1	33.60 de	2.50 g	4.40 h	12.80 i
Ultra	54.90 a	3.70 d	4.00 i	19.20 e
Hera	36.30 d	3.40 e	5.60 e	13.60 h
Dhera	29.60 f	3.00 f	5.80 d	15.20 g
Ailsha	35.50 d	7.10 b	4.90 f	21.20 c
CV (%)	4.52	2.78	1.53	0.45
LSD (0.05)	2.72	0.18	0.15	0.12

Table 2. Yield performances of different potato varieties/line

Varieties/line	Days to 80% Emergence	Foliage coverage (%) at 60 DAS	Grades (mm)		
			>55	28-55	<28
Almera	10	50	5	8	21
Cardinal	11	60	-	10	37
Lady rosenta	12	70	6	21	51
Diamond	10	70	7	10	42
Astetix	12	75	6	30	30
V-56	13	75	6	26	34
V-33	12	90	2	5	70
V-52	13	50	-	26	43
TPS-1	14	70	-	35	9
Ultra	11	75	7	20	13
Hera	12	50	1	14	41
Dhera	13	60	5	19	34
Ailsha	13	65	7	17	25

DAS = Days after sowing

Effect of Different Fertilizer Management Packages on Chilli

Abstract

The study was conducted at FSRD site Hazirhat, Noakhali and MLT site, Laxmipur during Rabi season of 2005-06. Chilli was evaluated with five different management practices. Among the five treatments the highest yield (1.31 t/ha) and (1.53 t/ha) was observed with the treatment T_1 (150% Recommended fertilizer dose) which was almost similar with T_2 (100% Recommended fertilizer dose) and the lowest yield (0.60 t/ha) and (0.65 t/ha) was recorded with the treatment T_5 in both the locations.

Introduction

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

Materials and Methods

The study were conducted at FSRD site Hazirhat, Noakhali and MLT site Laxmipur during Rabi season of 2005-06. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain (AEZ 18f) and Meghna Estuarine Floodplain (AEZ 18) respectively. The experiment was laid out in RCB design with four replications. Unit plot size was 3 m X 2 m. Seedlings were planted in lines maintaining 40 cm X 30 cm spacing. There were five treatments as follows: T_1 = 150% RD, T_2 = 100% RD i.e. 50, 32 and 50 kg/ha N, P and K respectively (FRG'97), T_3 = 50% RD, T_4 = Farmers practice (29 and 13 kg/ha N and P respectively) and T_5 = control. The whole amount of P, K and 1/3 of N were applied at the time of final land preparation and remaining N was applied in two installments at 25 and 50 DAT. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 3.67 to 11.31 ds/m.

Results and Discussion

Different fertilizer management packages showed a significant influence on different yield and yield contributing characters of chilli in both the locations (Table 1 and 2). plant height, branch /plant, length of fruit, breadth of fruit no. of fruit /plant, weight of fruit/plant and yield increased with the increasing of fertilizer dose.

FSRD site Hazirhat

Treatment T_1 gave the highest number of fruit/plant (38.86) and the lowest was found from T_5 (25.44). The highest weight of fruit /plant was obtained from treatment T_1(25.45 g) that was almost double of T_5. As the highest number and weight of fruit /plant were found from the treatment T_1 and the highest yield (1.31 t/ha) was also found from the treatment T_1. Control plots gave the lowest yield (0.60 t/ha).

From the economic point of view, the highest gross return (65500 Tk.) was observed in T_1 treatment where 1.5 times fertilizers were used of recommended dose (RD) and the lowest gross return (30000 Tk.) was found in T_5, i.e. control plots. The highest Benefit Cost Ratio (2.04) was obtained in T_2, i.e. RD of FRG'97 and the lowest BCR (1.15) was found in control plots.

MLT site, Laxmipur

Treatment T_1 gave the highest number of fruit/plant (51.45) and the lowest was found from T_5 (30.05). The highest weight of fruit /plant was obtained from treatment T_1 (29.82 g) that was more than double of T_5. As the highest number and weight of fruit /plant were found from the treatment T_1, the highest yield (1.53 t/ha) was also found from the treatment T_1. Control plots (T_5) gave the lowest yield (0.65 t/ha).

From the economic point of view, the highest gross return (75500 Tk.) was observed in T_1 treatment where 1.5 times fertilizers were used of recommended dose (RD) and the lowest gross return (32500 Tk.) was found in T_5, i.e. control plots. The highest Benefit Cost Ratio (2.22) was obtained in T_2, i.e. RD of FRG'97 and the lowest BCR (1.15) was found in control plots.

Farmers' reaction

Yield of chilli was highest in 150% fertilizer dose but it needed more capital to use to get highest economic benefit over the 100% recommended rate of fertilizer. So the farmers opined that existing recommended dose is best for them.

Conclusion

Therefore, from the results of the present study, it may be concluded that, though the yield and yield contributing characters are found to be best in T_1, the result found from the treatment T_2 is the best in case of yield and economic benefit with using optimum fertilizer in these areas.

Table 1. Yield, yield contributing characters and economic analysis of chilli at FSRD site, Hazirhat (2005-06)

Treatment	No. of fruit/plant	Wt. of fruit/ plant (g)	Fruit yield (t/ha)	Gross return (Tk./ha)	Total cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	38.86 a	25.45 a	1.31 a	65500	34000	31500	1.92
T_2	35.50 b	23.78 b	1.28 ab	64000	31300	32700	2.04
T_3	32.69 c	20.01 c	1.12 bc	56000	28600	27400	1.95
T_4	29.88 d	14.63 d	0.87 c	43500	28200	15300	1.54
T_5	25.44 e	13.84 d	0.60 d	30300	25900	4100	1.15
CV (%)	3.01	2.33	8.53	-	-	-	-
$LSD_{0.05}$	1.832	0.858	0.253	-	-	-	-

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

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

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Effect of Different Management Practices on Growth and Yield of Soybean

Abstract

The study was conducted at FSRD site Hazirhat, Noakhali during Rabi season of 2005-06. BARI soybean–5 was evaluated with five different management practices. Among the five treatments, the highest yield (1517 kg/ha) was obtained with the treatment T_2 (Recommended fertilizer dose + weeding at vegetative stage + NAA 100 ppm) and the lowest yield (743 kg/ha) was recorded with the treatment T_3 (Recommended fertilizer dose + no weeding).

Introduction

Soybean is a potential oil seed crop. In Bangladesh, it is used in different confectionery product and mainly used as poultry feed need-increasing production. Although potential yield of soybean is about 2.5 t/ha but in the farmer's field, its average yield is poor. Yield of seed is influenced by different management factors. Among the management factors, fertilizer application and weeding are the vital factors for crop production. Auxin induces and promoted synthesis of RNA and protein. It also enhances the cell enlargement and cell division by ausimic action. Therefore, this study was undertaken to evaluate the effect of different combination of fertilizer, weeding and growth regulators on growth and yield of soybean.

Materials and Method

The study was conducted at FSRD site, Hazirhat, Noakhali during Rabi season of 2005-06. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain under (AEZ 18 f). The experiment was laid out in RCB design with three replications. Unit plot size was 4.5 m X 3 m. There were five treatments as follows: T_1- Recommended fertilizer dose ($N_{30}P_{35}K_{60}S_{20}$ kg/ha) + Weeding at vegetative stage, T_2 -Recommended fertilizer dose + weeding at vegetative stage + NAA 100 ppm, T_3 - Recommended fertilizer dose + no weeding, T_4 – Half dose of recommended fertilizer + weeding at vegetative stage and T_5 – Half dose of recommended fertilizer + weeding at vegetative stage + NAA 100 ppm. The plants were completely drenched with 100-ppm (100 mg NAA per litre water) concentration of NAA by the sprayer. The soybean variety BARI soybean-5 was used as plant material. Seeds were sown in lines maintaining 30 cm X 5 cm spacing. Seeds were sown on the first week of January 2006 and harvesting was done in the 3rd week of April 06. Data on growth, yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 1.44 to 7.30 ds/m.

Results and Discussion

The highest number of plants/m^2 (57.01) was obtained in T_5 and the lowest number (55.42) was found in T_1 treatment, but there is no statistical difference among the treatments. Higher number of days (110) to maturity was obtained in T_2 and the lowest number of days (107) to maturity was observed in T_5. The highest plant height was found from treatment T_2 (56.72 cm) but it was statistically identical with T_5 (50.58 cm). The lowest plant height was found in T_3 (41.29 cm). Higher number of branch/ plant was found from treatment T_2 (4.83), which was statistically identical to T_1, T_4 and T_5. Higher pod/plant (35.37) was found in T_2, which was statistically at per to T_5. Treatment T_2 showed the longest pod length (3.85 cm), which showed identical result with T_1 and T_5. The number of seed /pod was not significantly varied among the treatments. Higher 1000 seed weight was observed in the treatment T_2 (93.57g), which was statistically similar with T_1 and T_5. Grain yield was significantly differed among the treatments. Higher seed yield was found in treatment T_2 (1517 kg/ha) but it was statistically at par to treatment T_1, T_4 and T_5. The lowest yield was obtained from no weeding though fertilizer was used.

Conclusion

The present study may be concluded that, though treatment T_2 (Recommended fertilizer dose + weeding at vegetative stage + NAA 100 ppm) produced higher yield but it was statistically similar to other doses except T_3 treatment. Since NAA is a costly chemical substance and difficult to apply, so it may not be economically feasible for the farmers level.

Table 1. Effect of different management practices on growth, yield and yield contributing Characters of soybean at FSRD site, Hazirhat, Noakhali during 2005-06

Treatment	No. of plant/m^2	Days to maturity	Plant ht. (cm)	Branch/ Plant	Pod/ Plant	Pod length (cm)	Seed / pod	1000 seed wt. (g)	Yield (kg/ha)
T_1	55.42	109	48.24b	4.50ab	31.92b	3.48ab	2.86	93.39a	1437a
T_2	56.31	110	56.72a	4.83a	35.37a	3.85a	3.00	93.57a	1517a
T_3	56.05	108	41.29c	3.91b	24.28c	3.31b	2.75	78.32b	743b
T_4	55.94	109	47.15b	4.36ab	30.95b	3.45b	2.78	88.46b	1240a
T_5	57.01	107	50.58ab	4.55ab	32.66ab	3.68ab	2.97	89.73a	1360a
CV (%)	5.21	4.93	9.79	9.94	6.97	5.50	9.09	4.10	12.04
LSD(0.05)	NS	NS	7.47	0.83	3.18	0.37	NS	3.74	476

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Performance of Different Sowing Time of Cowpea in Coastal Area

Abstract

The experiment was conducted at FSRD site, Hazirhat, Noakhali during Rabi season of 2005-06 to find out the optimum sowing time of Cowpea in saline area. Five different sowing dates viz. T_1- 01 January, T_2- 15 January, T_3- 01 February, T_4- 15 February and T_5-01 March were included. On an average, among the five treatments higher yield (1177 kg/ha) was recorded from the treatment T_2 (15 January) which was similar with T_3 (01 February). The lowest yield (833 kg/ha) was recorded from delay sowing but no yield was found in T_5 (01 March) due to drought.

Introduction

Cowpea (*Vigna unguiculata* L) is a comparatively cheap source of quality protein, iron and vitamin B and excellent substitute for meat, eggs and other protein yielding foods when served as grains and vegetables. Cowpea is moderately tolerant to salinity. Farmers are growing local variety in the middle of January. During the reproductive phase of the crop, soil moisture dries up and the crop suffers from drought as well as salinity stress. Sowing time is the most important factors to avoid the stress conditions. The optimum sowing time of cowpea in coastal region is not yet identified. Therefore, this study was undertaken to identify the optimum sowing time of cowpea for the coastal region.

Materials and Methods

The experiment was conducted at FSRD site Hazirhat, Noakhali during rabi season 2005-06. The design of the experiment was RCB with three replications. The unit plot size was 5m X 4m. The variety of cowpea was BARI Felon-1. Field was fertilized with 20, 26, 17 and 10 kg/ha of N, P, K and S Respectively. All fertilizers were applied as basal during each time of sowing. Five sowing time i.e., T_1- 01 January, T_2-15 January, T_3-01 February, T_4- 15 February and T_5- 01 March were included as treatment. Salinity of the field was recorded by collecting soil from the date of sowing and every 15-days interval up to harvesting. Data on yield and yield contributing characters were recorded from 10 randomly selected plants. The collected data were analyzed by computer program MSTAT-C. During the experimental period the salinity was ranged from 1.65 to 10.01 ds/m.

Results and Discussion

Plant height, branch/plant, pods/plant, length of pod, seeds/pod, 1000-seed weight and seed yield were significantly influenced by different sowing times. Higher plant height (53.37 cm) was found at T_1, which was statistically identical to T_2, other treatments were found at par. Branch/ plant was not found significant effect at different sowing time. Significantly the highest pod/plant (5.91) was obtained from T_2. But seeds/pod was found statistically similar except 15 February sowing. Seed weight showed higher in T_2 but statistically at par to treatment T_3. Seed yield increased with the advancement of date of sowing but after 01 February it was decreased. Higher seed yield (1177 kg/ha) was found at T_2, which was statistically identical to treatment T_3 and T_1.But delay sowing showed lower yield even no yield was obtained in March sowing.

Farmer's reaction

Farmers preferred the 15 January sowing time for cowpea (BARI Felon-1) as it produced the higher yield even delay harvest of T. aman rice.

Conclusion and Recommendation

From the study it was observed that sowing of 15 January performed better yield in coastal area. It could be concluded that 15 January to 1 February could be feasible for cowpea cultivation at saline area of Noakhali. For more confirmation, the experiment should be repeated in next year.

Table 1. Effect of different sowing time on yield and yield contributing characters of Cowpea

Treatment	No. of plant/m^2	Days to maturity	Plant height (cm)	No. of branch/ plant	No. of pod/ plant	Pod length (cm)	No. of seed/ pod	1000-seed wt. (g)	Seed yield (kg/ha)
T_1	10.89	126a	53.37a	4.36	5.59b	17.00a	14.30a	89.00b	1037ab
T_2	10.81	124a	53.19a	4.23	5.91a	17.58a	13.83a	92.33a	1177a
T_3	9.91	121b	50.80b	4.06	5.60b	15.78ab	12.91ab	91.00ab	1083a
T_4	10.45	117c	50.14b	4.00	4.93c	14.80b	10.53b	80.00c	833b
T_5	-	-	-	-	-	-	-	-	-
CV (%)	3.42	6.11	1.75	9.67	2.02	6.20	9.77	1.64	11.42
LSD(0.05)	NS	2.32	1.811	NS	0.218	2.000	2.515	2.83	235.6

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Intercropping of Onion and Garlic with Chilli

Abstract

The experiments were conducted at farmer's field of FSRD site, Hazirhat, Noakhali and MLT site of Laxmipur during 2005-06 to verify the performance of onion and garlic as intercrop with chilli. The onion intercropped with two rows produced the highest gross return of TK.132360 with LER of 1.19 at farmer's field of FSRD site, Hazirhat, Noakhali. The garlic intercropped with two rows produced the highest return of TK.116450 with the land equivalent ratio (LER) of 1.20. All the intercropped system earned highest return and LER than sole crop (chilli).

Introduction

In Bangladesh total spices production is about 4.5 lakh tons and 11.5 lakh tons are imported to fulfill the national demand. Chilli is at the major Rabi crop in FSRD site and MLT site of Noakhali. The farmers cultivate onion and garlic as sole crop and sometimes as mixed crop in the chilli field. They do not maintain the proper spacing, planting time and management. They also do not analyze the cost and return of these spice crops. If intercropping is done then LER and benefit will be increased. The present study was, therefore, taken in hand to know the LER and economic return of onion and garlic with chilli.

Materials and Method

The experiments were conducted at farmer's field of FSRD site, Hazirhat, Noakhali and MLT site of Laxmipur in the growing season of 2005-06. The soil of the experimental area belongs to Young Meghna Estuarine Floodplain (AEZ 18f) and Meghna Estuarine Floodplain (AEZ 18) respectively. The soils of the experimental plot were sandy loam in texture. The experiments were set in randomized complete block design with three replications. The experiment consisted of 7 treatments are as follows: T_1 = Sole garlic, T_2 = Sole onion, T_3 = Sole chilli, T_4 = 1 row onion with 100% chilli, T_5 = 1 row garlic with 100% chilli, T_6 = 2 row onion with 100% chilli and T_7 = 2 row garlic with 100% chilli. The seeds were sown on the third week of December 2005. The unit plot size was 3 m x 2 m. Spacing of chilli was maintained at 40 x 20 cm. The land was fertilized with 100- 60-30 kg/ha (N-P-K). The whole amount of P, K and 1/3 of N were applied at the time of final land preparation and remaining N was applied in two installments at 25 and 50 DAT. Data on yield and yield contributing characters were recorded and analyzed by computer program MSTAT-C. During the experiment period the salinity range was 4.33 to 9.31 ds/m.

Results and Discussion

Different intercropping system showed a significant influence on different yield, yield contributing characters, economic study and LER of chilli, onion and garlic in both the locations.

FSRD site Hazirhat

Chilli: The longest plant height (37.87 cm) was found from T_3, which was statistically identical with all other treatments except T_7 which showed shortest plant height. The length of fruit was not significantly influenced by the treatment. Treatment T_3 gave the higher number of fruit/plant (22.50) and the lowest from T_5 (21.37). The highest weight of fruit /plant was obtained from treatment T_3. Yield was statistically identical to all the treatments except T_6, which showed lower yield.

Intercropped yield: Onion & garlic was grown as intercropped in between chilli rows. There was significant reduction in onion yield in both intercropped situation but two rows of onion showed more yield than one row. Similar trend was followed in case of garlic.

Chilli equivalent yield: Higher chilli equivalent yield (2.65 t/ha) was found in T_6 followed by T_7 whereas T_5 showed the lowest groundnut equivalent yield (2.15 t/ha).

Cost of benefit analysis: The treatment T_6 where two rows onion inter cropped with chilli showed higher gross return, which was closely followed by treatment T_7. All the intercropping treatments showed higher gross return than sole situation of chili, onion & garlic. Similar trend was followed incase of gross margin though higher cost was involved in both the treatment. Land equivalent ratio also higher in treatment T_6.

MLT site, Laxmipur

Chilli: The longest plant height (54.08 cm) was found from T_3, which had statistically significant difference from other treatments. The shortest plant height was found from T_7 (48.72 cm). The highest number of branches/plant (5.12) was also found from T_3 which was statistically at par to different T_4. Length of fruit showed significant effect where higher was recorded in treatment T_3. The longest fruit (4.64 cm) was found from T_3. Treatment T_3 gave the highest number of fruit/plant (41.75) and the lowest was found from T_5 (36.00). But higher weight of fruit /plant was obtained from treatment T_3 (29.82 g) which was statistically identical with T_5 (27.61 g). The highest yield (1.25 t/ha) was obtained from the treatment T_3 due to highest fruit/plant, length of fruit & weight of fruit.

Intercropped yield: Similar trend was followed in case of onion & garlic yield as in Hazirhat.

Chilli equivalent yield: Higher chilli equivalent yield (2.33 t/ha) was found in T_7 and T_5 showed the lowest groundnut equivalent yield (1.91 t/ha).

Cost and benefit analysis: The treatment T_7 where two rows garlic inter cropped with chilli showed higher gross return, which was closely followed by treatment T_6. All the intercropping treatments showed higher gross return than sole situation of chili, onion & garlic. Similar trend was followed incase of gross margin though higher cost was involved in both the treatment. Land equivalent ratio also higher in treatment T_6.

Farmer's reaction

Though two rows of onion and two rows of garlic in between 100% chilli intercropping system is the most beneficial but higher cost was involved. So the farmers of these areas chose one row onion in between two rows of chilli and one row garlic in between two rows of chilli intercropping system.

Conclusion

It can be concluded from the result that, two rows of onion and two rows of garlic in between 100% chilli intercropping system is the most beneficial than the other treatments.

Table 1. Yield and yield components of chilli in sole and intercropped situation (FSRD site, Hazirhat, Noakhali 2005-06)

Treatment	Plant height (cm)	No. of branch/plant	Length of fruit (cm)	No. of fruit/ plant	Wt. of fruit/ plant (g)	Dry chilli yield (t/ha)
T_3	37.87 a	4.40 ab	5.73	22.50 a	25.45 a	1.29 a
T_4	36.84 ab	4.30 ab	5.50	22.20 a	20.01 c	1.19 ab
T_5	36.01 ab	4.16 b	5.56	21.37 ab	23.78 b	1.23 ab
T_6	36.46 ab	4.43 a	5.56	21.17 ab	13.84 d	1.08 b
T_7	34.74 b	4.30 ab	5.40	19.90 b	14.63 d	1.16 ab
$LSD_{(0.05)}$	2.26	0.23	NS	1.80	0.86	0.16
CV (%)	6.31	2.85	2.23	7.47	2.33	8.09

Table 2. Yield of chilli, onion, garlic with economic study and LER in different intercropping system at FSRD site, Hazirhat, Noakhali during rabi 2005-06

Treatment	Yield/ha			Chilli equivalent yield	Gross return	Total cost (Tk/ha)	Gross margin (Tk/ha)	BCR	LER
	Chilli	Onion	Garlic						
T_1	-	-	3.72 a	-	93000	37786	55213	2.46	1.00
T_2	-	8.83 a	-	-	105960	42118	63841	2.51	1.00
T_3	1.29 a	-	-	-	64500	33282	31218	1.93	1.00
T_4	1.19 ab	4.04 b	-	2.16	107980	45972	62008	2.34	1.08
T_5	1.23 ab	-	1.83 c	2.15	107250	48322	58927	2.21	1.04
T_6	1.08 b	6.53 c	-	2.65	132360	59011	73348	2.24	1.19
T_7	1.16 ab		2.92 b	2.62	131000	59387	71413	2.20	1.11

Table 3. Yield and yield components of chilli in sole and intercropped situation (MLT site, Laxmipur 2005-06)

Treatment	Plant height (cm)	No. of branch/plant	No. of fruit/plant	Length of fruit (cm)	Wt. Of fruit/ plant (g)	Dry chilli Yield (t/ha)
T_3	54.08 a	5.12 a	41.75 a	4.64 a	29.82 a	1.25 a
T_4	52.30 b	5.07 ab	37.50 b	4.59 b	23.45 b	1.08 c
T_5	51.50 c	5.02 bc	36.00 c	4.57 d	27.61 a	1.17 b
T_6	50.25 d	4.95 cd	31.75 d	4.55 bc	14.07 d	0.94 d
T_7	48.72 e	4.92 d	31.25 e	4.52 c	19.54 c	1.04 c
LSD	0.31	0.07	1.04	0.05	3.74	0.05
CV (%)	7.40	2.98	6.89	1.95	8.67	7.52

Table 4. Yield of chilli, onion, garlic with economic study and LER in different intercropping system at MLT site, Laxmipur during rabi 2005-06

Treatment	Yield/ha			Chilli equivalent yield	Gross return	Total cost (Tk/ha)	Gross margin (Tk/ha)	BCR	LER
	Chilli	Onion	Garlic						
T_1	-		3.68 a	-	92000	37380	55200	2.46	1.00
T_2	-	8.26 a	-	-	99120	42400	59720	2.33	1.00
T_3	1.25 a		-	-	62500	32250	30250	1.93	1.00
T_4	1.08 c	3.69 c	-	1.97	109878	45972	63906	2.11	1.16
T_5	1.17 b	-	1.48 c	1.91	107250	48322	58928	1.87	1.06
T_6	0.94 d	5.10 b	-	2.16	132360	59011	73348	1.95	1.33
T_7	1.04 c	-	2.57 b	2.33	131000	59387	71413	2.11	1.20

Price (Tk./kg): Garlic= 25/-, Onion = 12/- and Chilli = 50/-

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Performance of Relay Fieldpea and Grasspea in the Saline Area of Bangladesh

Abstract

The experiment was undertaken to observe field pea and grass pea as relay cropping after T.aman at FSRD site Hazirhat, Noakhali during the robi season 2005-06. The result showed that the highest yield (650 kg/ ha) of field pea was found at third farmer's plot due to the low salinity. On the other hand the highest yield (970 kg/ ha) of grass pea was found at third farmer's plot due to the same causes.

Introduction

Grass pea (*Lathyrus sativas* L) (Locally known as khesari) is the most important pulse crop in Bangladesh. The area under khesari cultivation remains high because of its drought resistance, its minimal managerial requirement, and it protein rich seeds. It may contain up to 35% protein diet. Khesari, therefore, provides a nourishing diet of good quality protein and carbohydrates (350 cal 100 g). Khesari is often a common ingredient of the menu of the daily diet of the people of Bangladesh, especially the poor. The urban and rural people also use Field pea verily. It is known to be a survival food item during famine. It covers more than 30% of the area and production of all pulses in Bangladesh. In our country, more then 30% of the cultivated area is in the cost. These areas are seriously affected by various degrees of salinity. After T. aman harvesting a vast land remain fallow. During rabi season, the soil salinity levels increase through capillary movement. Most of the rabi crops do not survive in these area due to higher salinity. The performance of pulse crop needs to be evaluated in this area. The present study was therefore undertaken to identity the feasibility to grow these pulse crops in the saline belt just after T. aman harvest as relay.

Materials and Methods

The experiment conducted at FSRD site Hazirhat, Noakhali during robi season 2005-06.There was no replication in this experiment. Unit plot size was 40 x 10 m. No fertilizer was applied. Seeds of both crops were sown in lines maintaining 30 cm x 5 cm spacing. Seed were sown at 30 day before T. aman harvesting (17-11-2005) and harvesting was done in the second week of February 06. Data on yield and yield contributing characters were recorded. During the experimental period the salinity was ranged from 1.85 to 8.43 ds/ m and 1.90 to 9.80 ds/m as field pea and grass pea respectively.

Result and Discussion

Plant/ m^2 (at 20 DAS and harvest), Plant height, branch / plant, pods/plant, seeds/pod, 1000-seed weight and seed yield were differed with different farmers plots at different salinity in the soil (Table 1). The highest plant/ m^2 at harvest was found in the plot of the third farmer. Plant height, branch / plant, pods / plant, seeds / pod, 1000 seed weight and seed yield were also showed the similar trend in the plot of third farmer as it contained the lowest salinity stress in the field which was between 1.85 and 4.30 ds/m. The highest yield (650 kg/ ha) of field pea was recorded from the third farmer's field. The high salinity stressed field produced the lowest yield of field pea (285 kg/ ha), which was found in first farmer's plot.

The yield and yield contributing characters of grass pea i.e. plant/ m^2 (at 20 DAS and harvest), plant height, branch / plant, pods / plant, seeds / pod, 1000 seed weight and seed yield were differed with different farmers plots at different salinity in the soil (Table 2). The highest plant/ m^2 at the time of harvest were found in the plot of the third farmer. Plant height, branch/plant, pods/plant, seeds/pod, 1000-seed weight and seed yield were also showed the similar trend in the plot of third farmer as it contained the lowest salinity stress in the field which was between 1.90 and 4.10 ds/m. The highest yield (970 kg/ ha) of grass pea was recorded from the third farmer's field. The high salinity stressed field produced the lowest yield of grass pea (455 kg/ ha) and it was found in second farmer's plot.

Farmer's reaction

The fallow land can be used as cultivable land and the farmers also would be benefited economically by growing field pea or grass pea as relay crop in T. aman rice.

Conclusion and Recommendation

From the results of the present study, it may be concluded that, though the yield and yield contributing characters are found to be best in the third farmer's field due to low salinity of the soil in both crops. So, it may be recommended that this kind of practice can help to utilize vast fallow land as a cultivated land by growing field pea and grass pea as relay crop in T. aman rice.

Table 1. Performance of relay field pea in the saline area of Bangladesh

Farmer/ Treatment	Plant / m^2 (20 DAS)	Plant/ m^2 (harvest)	Plant ht. (cm)	Branch/ plant	No. of pod/ plant	No of seeds/ pod	1000 seed wt.(g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Farmer-1	70	32	48.6	3.1	12.65	3.5	49.5	285	650
Farmer-2	69	51	50.7	3.0	13.48	3.8	51.2	490	1100
Farmer-3	72	65	51.3	3.0	14.50	4.0	53.3	650	1620

Table 2. Performance of relay grass pea in the saline area of Bangladesh

Farmer/ Treatment	Plant / m^2 (20 DAS)	Plant/ m^2 (harvest)	Plant ht. (cm)	Branch/ plant	No. of pod/ plant	No. of seeds/ pod	1000 seed wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Farmer-1	68	41	40.25	2.5	13.35	3.5	48.0	650	1950
Farmer-2	53	29	38.80	2.2	11.14	3.1	46.5	455	1135
Farmer-3	85	69	44.00	2.3	14.68	3.8	49.2	970	2570

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Effect of Date of Sowing on Growth, Yield and Yield Components of Mungbean

Abstract

An experiment was conducted at Agricultural Research Station, Daulatpur, Khulna and Kalapara, Patuakhali during rabi 2005-06 to investigate the effect of sowing date on the performance of mungbean varieties/line. Four varieties/line of mungbean (BM-01, BARI Mung-2, BARI Mung-5 and Local) were sown on different date under rainfed situation. The date of sowing had no significant effect on yield of mungbean. Among the varieties BM-01 produced higher yield from 07 January sowing followed by BM-01 of December 18 sowing at Khulna but BARI Mung-2 in both the sowing date at Patuakhali.

Introduction

Mungbean is the fifth important pulse crop of Bangladesh and contributes about 11.53% of total pulses production. Its area and production are increasing now days. About 65% of mungbean grow in the southern areas. In the coastal areas where soil salinity in minimum farmers are growing local mungbean cultivar with poor yield potential. It was observed that BM-01 performed better than local varieties in the area. Farmers are growing local variety in the middle of January. During the reproductive phase of the crop soil moisture dries up and the crop suffers from drought. Early sowing in December could save the crop from severe drought. So the present study was undertaken to find out optimum date of sowing for maximum growth and yield of mungbean.

Materials and Methods

The trial was conducted at Agricultural Research Sub-Station, Daulatpur, Khulna and Kalapara, Patuakhali during rabi season, 2005-06. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 2m×2m. There were three dates of sowing, namely, 18 December 2005, 28 December 2005 & 07 January 2006 at Khulna but 12 & 22 December, 2005 at Patuakhali. Four varieties/line of mungbean viz. BM-01, BARI Mung-2, BARI Mung-5 and Local were included in the study. The lands were fertilized with 20-40-20kg/ha of N, P_2O_5 and K_2O respectively before sowing. Four hand weeding done. Soil samples were collected at 15 days interval. Insecticide was applied to control insect. Data on different yield and yield attributes were collected and analyzed statistically.

Result and Discussion

Daulatpur, Khulna

Effect of sowing date: No significant difference among the treatments was observed in any character except number of pods/plant, plant height and plant population/m^2 (Table 01). The highest population was obtained from December 28 sowing. The tallest plant was obtained from 28 December sowing. Seed yield was not significantly influenced by sowing date. Similar trend was followed in case of straw yield.

Varietals performance: All the yield components under study differed significantly among the varieties (Table 1). Among the four varieties tested, higher plants/m2 was recorded from local variety followed by BM-1. But the highest plant height was obtained from BARI Mung-5. Pods/plant was not differed between three varieties except BARI Mung-5 which showed lower pod/plant. Seeds/pod was statistically identical among three varieties except BARI Mung-2. But bolder seed weight was recorded from BARI Mung-5 and small seed from local variety. Yield between BM01 and local were statistically at par and higher than other two varieties. Significantly the highest seed yield was recorded from BM01.

Interaction between sowing date and variety: Plant height was maximum from December sowing with variety local followed by BARI Mung of 1 January sowing and local variety of December 28 sowing. Higher plant/m2 was recorded from December 28 sowing of local variety followed by BARI Mung-5, BM01 and local of January and December 28 sowing. Local variety showed higher seeds/pod in local variety of all date of sowing. January 7 of BARI Mung-5 gave higher seed weight followed by BARI Mung-5 of December sowing. Higher seed yield was recorded from 7 January sowing of BM01 followed by December 18 sowing of same variety. Stover yield showed higher from local variety followed by BM01 of 7 January sowing.

Kalapara, Patuakhali

BARI mung-5 Gave statistically identical yield with BARI mung-2 in first sowing, but gave lower yield in 2nd sowing. This means BARI mung-2 is salt tolerant than BARI mung-5. Seedling establishment was hampered in Jan. 05, 2006 sowing; perhaps due to lack of moisture and/or increasing salinity (Table 2). Soil salinity increases with the increasing of dryness in saline areas. This is why early sowing in saline areas is recommended.

Conclusion

The line BM-01 showed higher seed yield from January 7 sowing followed by same line of 18 December sowing but BARI Mung-2 in the both date of sowing.

Table 1. Effect of sowing date on yield and yield components of four varieties/line of mungbean at ARS, Daulatpur, Khulna during rabi, 2005-06

Treatment	Plant /m^2	Plant height (cm)	Pod/ plant	Seed/ pod	1000-seed weight (g)	Seed yield (kg/ha)	Straw yield (kg./ha)
Sowing date							
18 December	51.87 b	26.80 c	7.93 b	9.39 a	28.65 a	977.34 a	979.69 a
28 December	56.75 a	31.97 a	7.43 a	9.32 a	28.91 a	933.59 a	1232.81 a
07 January	49.44 b	29.58 b	7.99 c	9.33 a	29.47 a	966.40 a	1251.56 a
Variety/line							
BARI Mung-2	49.25 b	25.34 c	7.99 a	8.57 b	34.68 b	963.54 b	997.92 b
BARI Mung-5	48.33 b	32.22 a	6.02 b	9.53 a	38.70 a	871.88 c	895.83 c
BM-01	54.83 a	29.72 b	8.59 a	9.38 a	23.51 c	1114.58 a	1327.08 a
Local	58.33 a	30.51 b	8.53 a	9.90 a	19.15 d	886.46 c	1397.92 a

Table 2. Interaction of variety/line and sowing date on the yield attributes of mungbean at ARS, Daulatpur, Khulna during Rabi 2005-06

Sowing date	Variety/line	Plant height (cm)	Plant/m^2	Pod/ Plant	Seed/ Pod	1000-seed wt.(g)	Seed Yield (kg/ha)	Stover yield (kg/ha)
December 18	BARI Mung-2	23.65f	50.25bc	7.75ab	8.00d	33.10c	900.00c	775.00h
	BARI Mung-5	31.60bc	47.00cd	6.83bc	9.48ab	38.60a	953.13c	687.50h
	BM-01	24.00f	54.75abc	8.45a	10.30a	23.93d	1187.50ab	1218.75cde
	Local	27.95e	55.00abc	8.70a	9.78ab	18.98f	868.75cd	1237.50cd
December 28	BARI Mung -2	27.63e	51.50bc	7.98ab	8.35cd	35.73bc	1125.00b	1168.75def
	BARI Mung -5	30.70cd	58.50ab	4.85d	9.55ab	38.13ab	781.25d	1031.25fg
	BM-01	34.10ab	54.75abc	8.65a	9.00bcd	23.60d	921.88c	1331.25bcd
	Local	35.45a	62.75a	8.23ab	10.38a	18.18f	906.25e	1400.00abc
January 07	BARI Mung -2	24.75f	46.00cd	8.25ab	9.35abc	35.20c	865.63cd	1050.00efg
	BARI Mung -5	34.35a	34.00d	6.38c	9.55ab	39.38a	881.25cd	968.75g
	BM-01	31.05c	55.50abc	8.68a	8.86bcd	23.00de	1234.38a	1431.25ab
	Local	28.15de	57.25ab	8.68a	9.55ab	20.30ef	884.38cd	1556.25a
CV(%)		6.10	11.13	11.50	7.21	6.50	7.20	10.07

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

Table 3. Effect of time of sowing on yield and yield contributing characters of mungbean variety/line in the saline area in 2005-06

Variety/line	Plant population /m^2	Plant height (cm)	No. of pods/plant	No. of grains/pod	Yield (kg/ha)
12.12.05					
Local	56	29	6.7	8.1	405 b
BM 01	51	24	5.8	9.2	390 b
BARI mung-2	53	22	8.2	7.8	460 a
BARI mung-5	47	28	8.5	8.6	450 a
22.12.05					
Local	51	24	5.8	6.6	370 c
BM 01	48	20	6.0	7.1	380 c
BARI mung-2	50	23	8.2	7.3	440 a
BARI mung-5	45	27	6.5	7.6	410 b
CV (%)					11.56

Same letter within a column do not differ significantly at 5% level of significance as per DMRT.

Soil salinity of experimental plots at different dates, Patuakhali

Date of soil collection	Soil salinity (ds/m)
01.12.05	2.08
15.12.05	3.15
01.01.06	5.07
15.01.06	6.45
01.02.06	7.80
15.02.06	9.35
01.03.06	11.62
05.03.06	12.54

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Performance of Cowpea under Different Sowing Time in Coastal Area

Abstract

An experiment was conducted at Banerpota Farm, Satkhira to investigate the effect of sowing time on the performance of cowpea. Five different date of sowing were included in the study. The dates of sowing had significant effect on the yield and yield attributes of cowpea. The highest seed yield was recorded from 4 January sowing due to high yield attributes.

Introduction

Cowpea (*Vigna unguiculata L.)* is a comparatively cheap source of quality protein, iron and vitamin B and excellent substitute for meat, eggs and other protein yielding foods when served as grains and vegetables. Cowpea is moderately tolerant to salinity. Farmers are growing local variety in the middle of January in southern belt. During the reproductive phase of the crop soil moisture dries up and the crop suffers from drought as well as salinity stress. Sowing time is one of the most important factors to avoid the stress conditions. The optimum sowing time of cowpea in coastal region is not yet identified. Therefore, this study has been undertaken to identify the optimum sowing time of cowpea for the coastal region.

Materials and Methods

The trial was conducted at Satkhira MLT site, Satkhira during Rabi season, 2005-2006 with five date of sowing (January 4, January 19, February 18 and March 5) of cowpea following RCB design with four replications. The unit plot size was 3m 52m. The experiment was initiated on 04 January, 2006 as line sowing. Line to line spacing was 30cm. Fertilizer were applied at the rate of 20-16-17-10kg/ha of N, P, K and S respectively. All Urea, TSP and MP were applied as basal. One irrigation was given at initial growth stage. All the intercultural operations were done as and when necessary. Data on yield and yield attributes were collected. The soil salinity level during 01 January'06, 15 January'06, 01 February'06, 15 February'06, 01 March'06, 16 March'06, 02 April '06, 17 April'06, 02 May'06 and 16 May'06 were 3.23, 3.22, 2.89, 6.49, 5.53, 9.18, 8.68, 7.00, 8.10 and 3.42, respectively.

Results and Discussion

Significant yield differences among the treatments were observed in the study (Table 1). Higher plant population was observed in February 3 sowing followed by January 4 sowing. The tallest plant was observed from February 3 sowing. The plant height gradually increases with the delay sowing. But pods/plant and seed/pod decrease gradually with the delay sowing. Higher number of seeds/pod was obtained from January 4 sowing followed by January 19 sowing. Higher seed weight was obtained from 4 January sowing. The date of sowing influenced seed yield significantly. Seed yield obtained from January 4 sowing showed significantly the highest than other date of sowing. The highest yield was obtained from January 4 sowing could be due to maximum plant/pod and seed/pod. Seed was not formed in February 18 and March 5 could be due to high temperature.

Conclusion

From one year result showed that early January sowing gave higher yield and decrease in delay sowing. It needs another year trial for confirmation.

Table 1. Effect of date of sowing on yield and yield attributes of cowpea at Banerpota Farm, Satkhira during 2005-06

Date of sowing	plant population/m^2	Plant height (cm)	Pod/plant	Seed/pod	1000 seed wt. (g)	Grain yield (kg/ha)
04January'06	20	59.50	12.75	10.00	81.50	1083
19January'06	19	64.00	9.75	9.00	74.75	917
03February'06	21	70.00	5.75	6.75	76.00	633
LSD (0.05)	1.63	1.91	3.26	2.21	3.37	131.1
CV (%)	4.75	1.71	20.02	14.91	2.52	8.63

Adaptive Trial of Salt Tolerant Mungbean Variety/Line in the Coastal Area

Abstract

The experiment was conducted at Satkhira MLT site, Satkhira during 2006 to select the salt tolerant variety of mungbean. The result showed that all the mungbean veriety performed better but disease was noticed in local variety. Further investigation in relation to screening and management practices needs 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 performance of the varieties of mungbean needs 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 Satkhira MLT site, Satkhira during 2006. Mungbean was sown on 08 February 2006 at Satkhira MLT site, Satkhira. Four varieties/lines of mungbean (BM-01, BARI Mung-2, BARI Mung-5 and local) were included in the study. The unit plot size was 2m51m. Seeds were sown in RCB design with three replications. The seeds were sown at a spacing of 30cm. Fertilizer @ 20-16-15 kg N-P-K/ha was applied as basal. Intercultural operations were done as and when necessary. The soil salinity level at the site were 07 Feb'06, 22 Feb'06, 09 Mar'06, 27 Mar'06 and 12 Apr'06 were 4.42, 5.84, 8.26, 6.88 and 8.99 mmhos/cm, respectively. Data on yield and yield attributes were collected and analyzed statistically.

Results and Discussion

Performance of mungbean varieties/lines has been presented in table-1. Plant population/m^2 at harvest, plant height, pod/plant, seed/pod and 1000 seed weight differed significantly by variety/line. The highest plants/m2 was recorded from local variety whereas other three varieties/lines were statistically identical. The variety BARI Mung-5 showed the highest plant height. BARI Mung-5 showed the lowest pods/plant and other three varieties statistically at par. Seeds/pod reveals higher in BARI Mung-5 followed by local. Bolder seed size was recorded from BARI Mung-5 and smaller size from local variety. There was no significant difference in seed yield among the variety/line but slightly higher yield from BARI Mung-5 followed by BM01. No viral disease infestation was observed in any variety except local one. Aphid infestation was observed in the field.

Farmer's reaction

Farmer's preferred BARI Mung-5 for bold seed. But dislike its pod harvesting system.

Conclusion

It was observed that all the mungbean variety showed reasonable yield but BARI Mung-5/BM01 showed better adaptability at Satkhira MLT site, Satkhira. Further investigation in relation to screening and management practices could be done to evaluate the performance of above mentioned crop.

Table 1. Yield and yield attributes of mungbean as affected by varieties/lines tested at Satkhira MLT site, Satkhira during rabi season, 2005-06

Variety/Line	Days to maturity	Plant/m^2 at harvest	Plant height (cm)	Pod/plant	Seed/pod	1000-seed weight (g)	Seed yield (kg/ha)
BM-01	63	43	43	9.60	9.13	31.33	970
BARI Mung-2	63	42	40	9.27	9.07	32.00	820
BARI Mung-5	63	44	49	7.70	9.90	38.67	975
Local	63	50	40	8.50	9.63	28.33	887
LSD (0.05)	--	1.79	1.75	1.14	0.55	2.80	227.1
CV (%)	--	2.00	2.04	5.98	2.93	4.30	12.45

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On-Farm Adaptive Trial of Advanced Lines of Groundnut

Abstract

An adaptive trial was conducted in the farmers' field of FSRD site at Hazirhat, Noakhali during the Rabi season of 2005-06 to evaluate the performance of some groundnut varieties in char area. Higher nut yield (3.15 t/ha) was recorded in ICGV 94322 that was statistically identical with BARI Chinabadam-6 (3.05 t/ha).

Introduction

Most of the farmers of the coastal area of Hazirhat 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 different selected materials need to be tested in the farmer's field before recommendation. So, the present study was undertaken to evaluate the performance of some advanced lines of groundnut under farmers' field condition.

Materials and Methods

The study was conducted at FSRD site, Hazirhat, Noakhali during the Rabi season of 2005-06. Six groundnut varieties/lines namely; JX 87015 SL-1, ICGV-94322, Jhigabadam(ACC-12), PK-1, BARI Chinabadam-6 and Dhaka-1 were included in the experiment. The experiment was laid out in RCB design with three replications. Unit plot size was 6m X 4m. Fertilizer dose 10, 32, 42, 5 and 1 kg/ha of N, P, K, S and B were applied respectively. All fertilizers were applied as basal dose during final land preparation. Seeds were sown in lines maintaining 30 cm X 10 cm spacing. Seed sowing was done at third week of January 2006 and harvesting was done in the third week of May 2006. During the experiment period salinity range was 1.2 to 8.2 ds/m.

Results and Discussion

Higher plant height (36.87 cm) was found in Jhigabadam (ACC-12) and the lowest plant height (32.09 cm) was found at PK-1. Higher number of branch/plant (4.93) was recorded in ICGV 94322 but it was statistically identical to other line/variety except PK-1 and the lowest number of branch/plant (4.40) was found in PK-1. The maximum pod per plant (23.5) was recorded in BARI Chinabadam-6 that was followed by ICGV 94322 (22.2) while the minimum number of pod per plant was recorded in PK-1 (18.4). The highest seed/pod (3.23) was recorded from ICGV 94322 that was followed by JX 87015 SL-1 while the lowest seed/pod (1.76) was found in PK-1. But in case of the weight of 1000 kernels higher kernels weight (535 g) was recorded from BARI Chinabadam-6, which was closely followed by ICGV 94322. Higher nut yield (3.15 t/ha) was recorded in ICGV 94322 that was statistically identical with BARI Chinabadam-6 (3.05 t/ha). This variety/line showed higher yield due to higher yield attributes, but yield was lower in line PK-1 which showed lowest yield.

Farmer's reaction

Farmers of the experimental site preferred ICGV 94322 for smooth & bigger nut/kernels along with higher nut yield. They also preferred BARI Chinabadam-6 due to its better germination and good market price. But they disliked Maijchar badam and PK-1 due to their smaller nut size, lower nut yield and market price.

Conclusion and Recommendations

From the study it was observed that ICGV-94322/BARI chinabadam-6 performed better yield in coastal area. For more confirmation the experiment should be repeated in next year.

Table 1. Performance of advanced groundnut varieties/lines in the coastal area of FSRD site, Hazirhat during 2005-06

Variety/line	No. of plant/m^2	Days to maturity	Plant ht (cm)	Branch/ Plant	No. of pod/plant	No. of seed/pod	1000 kernel wt (g)	Seed Yield (t/ha)
JX87015 SLI	34.12	122 b	34.89	4.83	19.6	3.03	480	2.95
ICGV94322	32.13	120 b	33.33	4.93	22.2	3.23	530	3.15
ACC-12 (Jhinga badam)	33.05	121 b	36.87	4.66	20.2	2.98	450	2.74
BARI chinabadam-6	33.45	125 a	33.86	4.86	23.5	3.00	535	3.05
PK-1	31.10	121 b	32.09	4.10	18.4	1.76	440	1.85
DHAKA-1 (Maijchar badam)	32.41	118 c	33.35	4.65	20.23	1.96	400	2.03
LSD (0.05)	NS	1.84	2.03	0.24	1.68	0.22	35.79	0.15

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Adaptive Yield Trial of Hull less Barley for Saline Area

Abstract

On-Farm performance of eight Barley lines/varieties namely BHL-10, BHL-11, BHL-13, BHL-15, BHL-18, BHL-19, BB-3 and BB-4 were evaluated at Satkhira MLT site, Satkhira during the rabi season 2005-'06. The line BHL-19 produced higher grain yield (875 kg/ha) followed by BB-4.

Introduction

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

Materials and Methods

The trial was conducted at Satkhira MLT site, Satkhira during Rabi season, 2005-2006 with eight Barley lines/varieties namely BHL-10, BHL–11, BHL –13, BHL –15, BHL –18, BHL –19, BB-3 and BB-4 following RCB design with three replications. The unit plot size was 3m 52m. The crop was sown on 28 December 2005 as line sowing. Line to line spacing was 30cm. Fertilizer were applied at the rate of 100-60-40 kg/ha of N, P and K respectively. All Urea, TSP and MP were applied. One irrigations was given at initial stage. All the intercultural operations were done as and when necessary. Data on yield and yield attributes were collected and analyzed statistically. The soil salinity level at the site during 27 Dec.'05, 12 Jan'06, 26 Jan'06, 12 Feb'06, 27 Feb'06, 16 Mar'06, 01 Apr'06 and 15 Apr'06 were 4.50, 5.13, 5.45, 9.19, 7.50, 8.00, 7.50 and 10.50mmhos/cm respectively.

Results and Discussion

Plant height, spike/m^2 spike length, grain/spike, 1000-grain weight and grain yield were significantly influenced by varieties/lines. Performance of Barley lines/varieties have been presented in Table 1. Plan height maximum in BB-4 followed by BHL-19. Similar trend was followed in case of spikes/m^2. Spike length showed higher in BHL-19 followed by BB-4 & BHL-11. The line BHL-19 gave higher grains/spike followed by BB-4, BB-3, BHL-10 and BHl-13. The line BB-4 and BHL-19 showed similar seed weight. Grain yield was higher in BHL-19 followed by BB-4 due to yield attributes. Both the line performed better in saline area but low yield.

Farmer's reaction

Farmer's are interested to grow barley in small scale for medicinal purpose. Farmer's dislike its winnowing, threshing and processing procedure.

Conclusion

From the study it was observed that the variety BHL-19 or BB-4 performed better in saline area. Barley can be grown in Fallow-T. Aman -Fallow cropping pattern.

Table 1. Yield and yield attributes of barley as affected by different lines/variety at Satkhira MLT site, Satkhira during rabi season 2005-06

Line/Variety	Days to maturity	Plant height (cm.)	Spike/m^2	Spike length (cm)	Grains/ spike (no.)	1000-seed wt. (g)	Grain yield (kg/ha)
BHL-10	97	46.57	143	7.77	17.67	27.67	512
BHL-11	97	45.87	145	9.50	10.67	27.67	475
BHL-13	97	47.60	146	7.90	17.33	27.67	625
BHL-15	97	45.47	175	7.93	11.33	25.33	675
BHL-18	97	47.67	148	7.93	10.33	28.33	612
BHL-19	97	53.47	176	9.93	20.00	30.67	875
BB-3	97	45.60	149	8.13	18.00	24.67	600
BB-4	97	57.23	199	9.87	19.33	30.67	825
LSD (0.05)	-	7.42	24.01	0.86	4.03	2.80	207.7
CV (%)	-	8.70	8.56	20.55	14.79	5.76	18.24

C. RAINFED AREA'S CROPS

Integrated Nutrient Management for Chickpea with Coriander Mixed Cropping System

Abstract

An experiment on chickpea with coriander mixed cropping system was conducted in rainfed farmers field at FSRD site, Barind, Rajshahi (AEZ 26) during rabi 2005-06 to find out the suitable and economic fertilizer dose for maximizing the yield and to know the apparent nutrient balance in post harvest soil. There were 8 treatments comprising 2 sets of planting geometry (PG_1 & PG_2) and 4 doses (MN_1, NM_2, NM_3 and NM_4) of nutrient management approach were used in the study. The tested variety was BARI chola-5 for chickpea and BARI Dhania-1 for coriander. Integrated nutrient management package (NM_3) produced higher yield of chickpea over other doses while crop removal based fertilizer dose (NM_1) produced significantly higher yield for companion crop (Coriander). The effect of planting geometry was non significant for the main crop but significant for the companion crop although the yield of coriander was too low which might be due to poor germination probably caused by moisture stress.

Introduction

In areas where annual precipitation is less and uncertain and soils are less moisture retentive, crops like cereals, pulses, oilseeds and spices etc. are grown in a mixed stand. The mixed cropping system provides insurance against total crop failure in extremely dry areas (Rana, 1996). Growing chickpea along with coriander is a popular farmer practices in the greater Jessore, Kushtia, Pabna and Faridpur districts. There is common belief among the farmers that coriander acts as a repellant against the attack of pod borer in chickpea. The most common concern of mixed cropping is to increase the total yield per unit area compared to monoculture. But the yield of the said mixed cropping system is poor compared to the potential (Hasan, 1991). One of the main reasons for the low yield is the inadequate fertilizer management for the crop mix. To improve the yield as well as maintain/improve soil fertility it is felt necessary to use integrated approach i.e. inorganic fertilizers along with organic manures. Thus, nutrients present in the soil, added organic and inorganic fertilizer and the nutrient harvested by crops should be considered to develop a fertilizer recommendation for the mixed cropping systems.

Objectives

1. To find out the suitable and economic fertilizer dose for maximizing the yield of the said mixed cropping system.
2. To know the nutrient uptake by the crop mixes and apparent nutrient balance in post harvest soil.

Materials and Method

The experiment was conducted at the farmer's field of FSRD site, Barind Station, Rajshahi under AEZ-26 during 2005-2006 under rainfed condition. The initial soil fertility status of the experimental site has been presented in Table 1. The soil was moderately acidic and low in organic matter content. The status of the nutrient elements was far below the critical level, which revealed the low fertility of the initial soil. Based on the soil test values, the following treatment combinations were formulated and used in the experiment (Table 2). The experiment was conducted yield RCB (Factorial) design with 4 replications. There were 2 sets of planting geometry viz. PG_1= 100% main crop + 20% companion crop and PG_2= 100% main crop + 30% companion crop and 4 sets of nutrient management package (NM_1, NM_2, NM_3 & NM_4) used for the study. The tested chickpea and coriander varieties were BARI Chola-4 and BARI Dhania-1, respectively. Seeds of chickpea were sown in line maintaining a spacing of 30 cm x 10 cm on 14 November 2005. The seeds of coriander were also sown in line on the same day in between the chickpea rows for 20 and 30% population. The germination of coriander was poor due to moisture stress. Intercultural operations were done as and when necessary. Crops were harvested at the right stage of maturity. Plant samples were collected and are under laboratory analysis. Yield data were recorded and analyzed statistically.

Table 1. Initial soil test values of the experimental site for Chickpea and Coriander mixed cropping systems at FSRD site, Barind Station, Rajshahi during *rabi* 2005-2006

Test crops	pH	OM (%)	Total N (%)	Ca	Mg	K	P	S	Zn	B
				(meq/100 g)			(Micro gram/g)			
Chickpea and coriander	5.7	0.86	0.046	4.2	2.1	0.10	6.0	9.0	0.72	0.20
Critical level	-	-	-	2.0	0.8	0.2	14.0	14.0	2.0	0.20

Table 2. Treatment combinations for Chickpea with Coriander mixed cropping system at FSRD site, Barind Station, Rajshahi during *rabi* 2005-2006

Treatment	Nutrients (kg/ha)						CD (t/ha)
	N	P	K	S	Zn	B	
$NM_1 \times PG_1$	80+32	11+1.8	50+12	13+3.2	2+0.4	1+0.2	0
$NM_1 \times PG_2$	80+48	11+2.7	50+18	13+4.8	2+0.6	1+0.3	0
$NM_2 \times PG_1$	21+21	32+5.3	35+11.6	17+2.8	1.4+0.48	0.67+0	0
$NM_2 \times PG_2$	21+32	32+7.9	35+17.4	17+4.2	1.4+0.72	0.67+0	0
$NM_3 \times PG_1$	14+14	28+4.3	26+8.6	14.5+2.3	1.1+0.38	0.57+0	5
$NM_3 \times PG_2$	14+25	28+6.9	26+14.4	14.5+3.7	1.1+0.62	0.57+0	5
$NM_4 \times PG_1$	0	0	0	0	0	0	0
$NM_4 \times PG_2$	0	0	0	0	0	0	0

PG_1 = 100% main crop + 20% companion crop
PG_2 = 100% main crop + 30% companion crop

NM_1 = Estimated nutrient dose based on crop removal
NM_2 = Present recommendation based on FRG 2005
NM_3= IPNS (inorganic + organic) based dose (i.e. NM_2 contribution of cowdung)
NM_4 = Control (Native fertility)

Results and Discussion

Effect of planting geometry: Significantly higher yield of coriander was obtained with 30% plant population over 20%, which did not affect the yield of the main crop (Chickpea). Therefore, accommodation of 30% plant population for the companion crop for the present crop mix may be suitably adjusted (Table 3).

Effect of nutrient management: Different nutrient management packages significantly increased the yield of both main crop and companion crop (Table 3). Incase of chickpea (main crop), the highest grain yield was obtained from NM_3 package (IPNS based dose), which was significantly higher over rest of the treatment. Similar trend of results was observed incase of stover yield. However, for coriander, the treatments varied significantly following the order of $NM_1 > NM_2 > NM_3 > NM_4$ both the case of seed and grain yield.

Interaction effect: The interaction effect between nutrient management and planting geometry was found statistically non-significant (Table 4). However, for main crop (chickpea) the yield varied from 0.62 to 1.12 t/ha where the highest result was observed in $NM_3 \times PG_1$ and the lowest in $NM_4 \times PG_2$ but this variation was mainly governed by nutrient management packages not due to the interaction between planting geometry and nutrient management.

Nutrient balance: An apparent nutrient balance sheet will be estimated after completed of the laboratory analysis.

Table 3. Yield of chickpea with coriander as influenced by nutrient management and planting geometry under mixed cropping system at FSRD site, Barind Station, Rajshahi during rabi, 2005-06

Treatments	Main crop Chickpea yield (t/ha)		Inter crop Coriander yield (kg/ha)	
	Grain	Stover	Grain	Stover
A. Planting Geometry				
PG_1	0.91	1.51	127 b	162 b
PG_2	0.86	1.41	160 a	199 a
Significance level	NS	NS	**	**
CV (%)	12.0	11.30	11.0	10.2
B. Nutrient Management				
NM_1	0.82 c	1.36 c	180 a	227 a
NM_2	0.97 b	1.59 b	154 b	198 b
NM_3	1.10 a	1.78 a	147 c	179 c
NM_4	0.65 d	1.11d	93 d	117 d
Significance level	**	**	**	**
CV (%)	12.0	11.30	11.0	10.2

PG_1 = 100% main crop + 20% companion crop

PG_2 = 100% main crop + 30% companion crop

NM_1 = Estimated nutrient dose based on crop removal

NM_2 = Present recommendation based on FRG 2005

NM_3 = IPNS (inorganic + organic) based dose (i.e. NM_2 contribution of cowdung)

NM_4 = Control (Native fertility)

Table 4. Interaction effect of nutrient management and planting geometry on the yield of chickpea with coriander mixed cropping system at FSRD site, Barind Station, Rajshahi during rabi, 2005-06

Treatments	Main crop Chickpea yield (t/ha)		Mixed crop Coriander yield (kg/ha)	
	Grain	Stover	Grain	Stover
NM_1 x PG_1	0.84	1.40	164	211
NM_1 x PG_2	0.79	1.32	196	244
NM_2 x PG_1	0.98	1.63	136	176
NM_2 x PG_2	0.95	1.55	172	220
NM_3 x PG_1	1.12	1.85	125	156
NM_3 x PG_2	1.08	1.71	169	203
NM_4 x PG_1	0.68	1.16	81	104
NM_4 x PG_2	0.62	1.05	105	131
Significance level	NS	NS	NS	NS
CV (%)	12.0	11.3	11.0	10.2

PG_1 = 100% main crop + 20% companion crop

PG_2 = 100% main crop + 30% companion crop

NM_1 = Estimated nutrient dose based on crop removal

NM_2 = Present recommendation based on FRG 2005

NM_3 = IPNS (inorganic + organic) based dose (i.e.NM_2 contribution of cowdung)

NM_4 = Control (Native fertility)

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Farmers' Participatory Variety Selection of Chickpea in the High Barind Tract

Abstract

A field experiment was conducted in the farmer's field of FSRD site, Kadamshahar, Rajshahi during rabi 2005-06 to select the suitable variety (s) of chickpea for High Barind Tract (HBT). Five advanced lines of chickpea viz. BCX-91010-1, ICCV-93158, ICCV-97004, BCX-910109-3, ICCV-96020 and one check variety BARI chola-5 were tested in the farmer's field of high Barind Tract. Among the entries tested ICCV-97004 gave higher seed yield (1.34 t/ha) followed by ICCV-93158. The entries BCX-91010-1 and BCX-910109-3 gave moderate yields (1.17 and 1.16 t/ha). The lowest yield (0.71 t/ha) was obtained from ICCV-96020 and the check variety BARI Chola-5 gave 0.96 t/ha seed yield.

Introduction

Chickpea (*Cicer arietinum* L) is an important pulse crop in Bangladesh. In high Barind tract, it is normally cultivated after harvesting T.aman rice. Chickpea is found to be a very suitable dry land *rabi* crop in residual soil moisture condition. It has contributed the highest yield potentiality under favourable environment. On the other hand, low productivity of chickpea might be attributed due to lack of higher yielding and disease resistance varieties, inadequate fertilizer use and proper management practices. Under Barind stress condition it can be successfully grown after harvesting short duration T. aman rice. Keep the view in mind, the present experiment was undertaken to select the suitable line (s) of chickpea of high yield potential in Barind condition.

Materials and Methods

The field trial was conducted at FRSD site, Kadamshahar, Rajshahi during *rabi* 2005-06. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 6 rows x 4 m. The seeds were sown in 40 cm row to row distance and seed to seed 10 cm. Five advanced lines/varieties viz. BCX-91010-1, ICCV-93158, ICCV-97004, BCX-910109-3, ICCV-96020 and one check variety BARI Chola-5 were included in the study. Seeds were sown on 14 November 2005. The seed rate was used 50 kg/ha. The land was fertilized with 20-40-20 N, P_2O_5, K_2O kg/ha in the form of urea, triple super phosphate and muriate of potash, respectively. All fertilizers were applied as basal during final land preparation. The crop was harvested on 15 March 2006. The seed yield and yield components of chickpea were recorded and analyzed statistically.

Results and Discussion

Experimental results revealed that all yield components and yields were statistically significant except plant population, plant height and number of branches/plant (Table 1). The line ICCV-93158 showed higher pods/plant followed by ICCV-97004 and BCX91010-1. Similar trend was followed in case of seeds/pod. The line ICCV-97004 gave higher seed weight followed by BCX910109-3. Among the entries ICCV-97004 gave higher seed yield (1.34 t/ha) followed by ICCV-93158 (1.29 t/ha) while BCX-91010-1 and BCX-910109-3 gave the moderate yield (1.17 and 1.16 t/ha). The lowest yield (0.71 t/ha) was obtained from ICCV-96020 compared to check variety. The check variety BARI Chola-5 produced 0.96 t/ha seed yield. The entry ICCV-97004 contributed about 39.58% higher yield than that of check variety BARI Chola-5 (0.96 t/ha).

Farmers' opinion

Most of the farmers of the high Barind Tract (HBT) showed positive response to chickpea entry ICCV-97004 and ICCV-93158 due to its high yield potentiality. Therefore, it may be selected for further evaluation in the next year.

Table 1. Yield components and yield of chickpea entries under participatory variety selection at HBT

Entries	Plant pop./m^2	Plant height (cm)	Pods/ Plant	Branch/ plant	Seeds/ pod	HSW (g)	Seed yield (t/ha)	Straw yield (t/ha)
BCX-91010-1	20.55	48.07	45.67	3.80	1.57	19.90	1.17	0.90
ICCV-93158	20.56	48.87	47.60	3.63	1.67	19.97	1.29	0.93
ICCV-97004	20.89	48.73	47.27	3.63	1.63	20.70	1.34	0.88
BCX-910109-3	19.11	49.47	39.33	3.60	1.53	20.43	1.16	0.83
ICCV-96020	20.11	46.73	36.20	3.20	1.40	18.17	0.93	0.71
BARI Chola-5 (chk.)	19.55	46.40	40.20	3.20	1.40	18.73	0.96	0.72
CV (%)	7.59	8.42	7.81	7.49	4.29	4.55	9.97	10.29
LSD (0.05)	NS	NS	8.64	NS	0.16	1.63	0.30	0.15

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Regional Yield Trial of Chickpea in the High Barind Tract

Abstract

A field trial was conducted in the farmer's field of FSRD site, Kadamshahar, Rajshahi during *rabi* 2005-2006 with a view to select the suitable variety (s) of chickpea for high Barind Tract (HBT) condition. Five promising entries of chickpea viz. BCX-91010-1, ICCV-93158, ICCV-97004, BCX-910109-3 and ICCV-96020 were sown in the farmer's field of high Barind Tract where BARI chola-5 was used as a check variety. Among the five entries ICCV-93158 showed similar yield followed by ICCV-97004. The entries BCX-91010-1 and BCX-910109-3 gave the moderate seed yield (1.22 and 1.17 t/ha respectively). The lowest yield (0.92 t/ha) was obtained from ICCV-96020 followed by the check variety BARI Chola-5 (1.02 t/ha).

Introduction

Chickpea (*Cicer arietinum* L) is an important pulse crop in high Barind tract. It is generally cultivated after harvesting T.aman rice in high Barind Tract when the proper sowing time of chickpea is gone over. The residual soil moisture, remain after harvesting long duration T.aman rice, is not sufficient for standard plant establishment of chickpea. That is why the productivity of chickpea is in decreasing trend. In Barind area, chickpea sown in proper time (late October to first November) with proper management practices may obtain the highest yield potentiality under favourable environment. On the other hand, low productivity of chickpea may cause due to lack of higher yielding and disease resistance chickpea varieties, inadequate fertilizer use and proper management practices. Under Barind stress condition it can be successfully grown after harvesting of short duration T. aman rice. Keep the view in mind, the present experiment was undertaken to select the suitable entry (s) of chickpea for high yield potential in high Barind condition.

Materials and Methods

The field trial was conducted at FRSD site, Kadamshahar, Rajshahi during *rabi* 2005-2006. The experiment was laid out in a randomized complete 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. The trial consists of five promising entries/varieties viz. BCX-91010-1, ICCV-93158, ICCV-97004, BCX-910109-3 and ICCV-96020. The variety BARI chola-5 was used as check. Seeds were sown on 9 November 2005. The seed rate was used 50 kg/ha. The land was fertilized with 20-40-20 N, P_2O_5, K_2O kg/ha in the form of urea, triple super phosphate and muriate of potash, respectively. All fertilizers were applied as basal during the final land preparation. The crops were harvested on 8 March 2006. The seed yield and yield components of chickpea were recorded and analyzed statistically.

Results and Discussion

Experimental results revealed that the plant height, number of pods/plant, hundred seed weight (HSW) and seed yield were statistically significant (Table 1). The line BCX910109-3 showed higher plant height followed by BCX91010-1 and shortest plant height from BARI Chola-5. But higher pods/plant was recorded from line ICCV-93158 followed by ICCV-97004. Seed yield was similar in line ICCV-93158 and ICCV-97004 which showed higher yield among the lines and variety. The moderate seed yield obtained by the entries BCX-91010-1 and BCX-910109-3 (1.22 and 1.17 t/ha, respectively). The lowest yield (0.92 t/ha) was produced from ICCV-96020 followed by the check variety BARI Chola-5 (1.02 t/ha).

Farmers' opinion

Most of the farmers of the high Barind Tract (HBT) showed positive response to promising chickpea entries ICCV-93158 and ICCV-97004 because the entries are free from disease and contributed better yield potential. Therefore, the trial may be repeated in the next year for further evaluation.

Table 1. Plant characters of chickpea entries under regional yield trial in the HBT

Entries	Plant pop./m^2	Plant height (cm)	Pods/ Plant	Branch/ plant	Seeds/ pod	HSW (g)	Seed yield (t/ha)	Straw yield (t/ha)
BCX-91010-1	30.22	44.80	36.20	3.00	1.33	16.85	1.22	1.08
ICCV-93158	31.00	39.60	39.53	2.97	1.43	17.77	1.36	1.02
ICCV-97004	30.77	39.13	38.80	2.93	1.43	17.44	1.35	1.01
BCX-910109-3	27.44	45.13	34.60	2.93	1.30	16.71	1.17	0.90
ICCV-96020	28.11	40.20	33.07	2.73	1.27	13.47	0.92	0.88
BARI chola-5 (chk.)	29.22	36.33	32.07	2.73	1.33	13.35	1.02	0.93
CV (%)	9.88	7.83	8.60	7.19	5.87	4.17	8.11	10.78
LSD (0.05)	NS	5.11	5.18	NS	NS	2.66	0.11	NS

On-Farm Adaptive Trial of Advanced Lines of Mustard in High Barind Tract

Abstract

The field trial was conducted in the farmer's field of FSRD site, Kadamshahar, Rajshahi during *rabi* 2005-2006 to evaluate the performance of some advanced lines of mustard under high Barind condition. The trial consists of two line (BJ-536, BJ-66Y) and two variety (Daulat and BARI Sarisha-11). The variety Daulat and BARI Sarisha-11 were used in the trial as checks. BJ-536 gave higher seed yield (991.25 kg/ha) as well as matured early (90 days) followed by BJ-66Y (841.25 kg/ha, 91 days). The lowest seed yield was obtained from Daulat (718.50 kg/ha) followed by BARI Sarisha-11 (746.25 kg/ha).

Introduction

Mustard is the major oil seed crop in Bangladesh. It covered about 70% of the total oil seed production. In the high Barind tract, a vast area of land remains fallow after harvesting T.Aman rice. Traditionally, farmers' of Barind area harvested their T.Aman rice after mid November when proper sowing time of mustard is already gone over. The mustard crops were grown after mid November causes low productivity that is not profitable for the farmers. In this situation, the farmers can accept high yielding late mustard variety (s). Hence, the study was undertaken to evaluate some performance of advanced lines of mustard under high Barind condition.

Materials and Methods

The trial was conducted at FSRD site, Kadamshahar, Rajshahi during rabi 2005-06 in the farmers' field of high Barind Tract. The design of the experiment was RCBD with four replications. The advance lines (BJ-536, BJ-66Y) and the varieties (Daulat and BARI Sarisha-11) were used. The variety Daulat and BARI Sarisha-11 were used in the trial as checks. The unit plot size was 10 rows and 5 m long. The seed rate was 7 kg/ha. Seed was sown on 17 November 2005 with a spacing 30 cm between rows and 5 cm between plants. The experimental plot was fertilized with 260-170-90-160-5-10 kg/ha urea, TSP, MP, gypsum, zinc oxide and boric acid, respectively. All the fertilizers were applied as basal except urea. Urea was applied as top dress on 20 and 45 days after sowing (DAS), respectively. One weeding cum thinning operation was done at 20 DAS. The crop was harvested according to their maturity during 17-23 February 2006. The data on different plant characters were collected from 10 plants selected at random in each plot and yield was recorded plot wise.

Result and Discussion

Among the plant characters, only the numbers of siliqua/plant and seed yield were statistically significant. Higher siliqua/plant was obtained from line BJ536 followed by BJ664. Among the varieties/line, higher seed yield was recorded from BJ536 but it was statistically identical to BJ66. The released variety did not perform well under rainfed condition. The line BJ536 showed higher yield and matured one week earlier than the existing variety (Daulat and BARI Sarisha-11).

Conclusion: The mustard entries BJ-536 and BJ-66Y can be grown in the farmers' field of high Barind Tract but it needs to another year trial for confirmation.

Table 1. Plant characters of different mustard entries tested at high Barind Tract

Entries	Plant pop./m^2	Plant height (cm)	Siliqua/ plant	Seed/ siliqua	TSW (g)	Seed yield (kg/ha)	Straw yield (kg/ha)	Field duration (Days)
BJ-536	78.75	113.60	76.50	10.35	3.00	991.25	2040.00	90
BJ-66Y	75.75	117.90	70.35	10.05	2.54	841.25	1742.50	91
Daulat	68.00	107.10	64.80	9.81	2.71	718.50	1800.00	96
BARI Sarisha-11	77.25	112.40	65.90	9.98	2.66	746.25	1687.50	97
CV (%)	8.30	6.84	9.35	5.26	7.88	10.06	11.02	-
LSD (0.05)	NS	NS	8.53	NS	NS	159.00	NS	-

Adaptive Yield Trial of Hull less Barley for Rainfed Condition in High Barind Tract

Abstract

The field experiment was conducted at the farmer's field of FSRD site, Kadamshahar, Rajshahi in High Barind Tract during rabi 2005-06 with a view to select high yielding lines/variety for drought areas. The trial consists of eight genotypes of hull-less barley viz., BHL-11, BB-3, BHL-15, BB-6, BHL-12, BHL-10, BHL-13 and BHL-19. The results revealed that all the plant characters studied statistically differed significantly. Of the eight barley genotypes BHL-13 gave the higher seed yield (696.67 kg/ha) followed by BB-6 (663.33 kg/ha), BHL-19 (650.00 kg/ha) and BHL-10 (610.00 kg/ha). The lowest seed yield was produced by BHL-12 (390.00 kg/ha).

Introduction

Barley is the most adaptive cereal crop in different environment. It is used for making various delicious foods like baby food, horlicks, ovaltin etc. It contents about 12-14% protein. In respect of nutrient quality barley is better than wheat. In Bangladesh, the total area under barley cultivation is about 4000 hectare of land and the production is about 3000 metric ton (BBS, 2004). It has potentiality to grow under water stress condition. Therefore drought barley variety can be considered as beneficial crop in the drought prone areas such as high Barind Tract. In high Barind water-stressed environment it can be grown successfully after harvesting of short duration T.aman rice. Therefore, the field trial was under taken to select high yielding lines/variety for drought areas.

Materials and Methods

The field trial was conducted at FSRD site, Kadamshahar, Rajshahi during *rabi* season of 2005-2006. The trial comprised of eight hull-less barley genotypes viz., BHL-11, BB-3, BHL-15, BB-6, BHL-12, BHL-10, BHL-13 and BHL-19. The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 5 m x 3 m. Fertilizers were applied at the rate of 100-60-40-1 kg N, P_2O_5, K_2O and B/ha in the form of urea, triple super phosphate, muriate of potash and boric acid, respectively. All the fertilizers were incorporated with soil during final land preparation. The crop was sown on 9 December 2005. The spacing was line-to-line distance 25 cm with continuous sowing and seed rate was maintained 120 kg/ha. The crop was harvested on 9 March 2006. Weeding and plant protection measures were done as and when required. Data were collected on different yield and yield components and analyzed statistically.

Results and Discussion

From the experimental results it showed that all the plant characters under study were differed significantly. Plant height was taller in line BHL-10 and BB-6 whereas shorter in line BHL-11. The line BB-66 showed higher tiller/m^2 followed by BHL-19 and BHL-13. Similar trend was followed in case of grains/spike and seed weight. Overall grain yield was lower in all the lines but higher seed yield was given by BHL-13 (696.67 kg/ha) followed by BB-6 (663.33 kg/ha), BHL-19 (650.00 kg/ha) and BHL-10 (610.00 kg/ha). The genotype BHL-12 contributed lowest seed yield (390.00 kg/ha). Beside this, the genotypes BHL-11 (443.33 kg/ha) and BHL-15 (453.33 kg/ha) also produce comparatively lower yield under rainfed condition.

Conclusion

The hull-less barley genotypes BHL-13 and BHL-19 may be promising in the high Barind area that can be tested in the next year for further conformation.

Table1. Performance of different hull-less barley genotypes under rainfed condition at HBT

Genotypes	Plant height (cm)	Effective tillers/m^2	Spike length (cm)	Grains/ spike	TSW (g)	Seed yield (kg/ha)	Straw yield (kg/ha)
BHL-11	45.40	56.87	6.47	30.07	25.73	443.33	1236
BB-3	47.17	55.40	6.37	32.40	25.60	556.67	1126
BHL-15	55.30	52.77	6.40	34.80	27.00	453.33	1281
BB-6	60.23	71.87	6.98	41.57	29.60	663.33	1540
BHL-12	56.30	57.73	6.03	29.40	25.67	390.00	1186
BHL-10	60.40	68.30	6.77	39.67	27.77	610.00	1350
BHL-13	57.93	70.30	7.00	41.20	29.67	696.67	1533
BHL-19	55.77	71.17	6.87	39.27	28.00	650.00	1578
CV (%)	6.32	8.40	5.19	6.49	4.92	10.70	11.93
LSD (0.05)	8.42	12.88	0.60	5.69	3.27	172.90	228.30

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D. HILLY AREA'S CROPS

Performance of Intercropping Hybrid Maize with Fieldpea (BARI Motor-1)

Abstract

A performance trial of hybrid maize (pacific-11) with BARI motor-1 was conducted at Chemee dolo para hill valleys in Bandarban sadar areas during rabi season, 2005-06 with view to determine the agro-economic performance of intercropping and to increase vegetable production at hiily areas. Results revealed that highest grain yield was recorded 8.36 t/ha from sole maize but highest gross margin and benefit cost ratio was received Tk. 44895/ha and 2.06 from maize with field pea intercropping.

Introduction

Intercropping is one of the techniques of vertical expansion of crop justification production. It increases total productivity per unit area than sole cropping. Maize is a cereal crop, which is used as food, feed and fodder. It requires high amount of chemical fertilizer of exploiting its maximum yield potentiality. Vegetable production is much less than the requirement. On the contrary, pea being a leguminous crop needs lower fertilizer dose for its cultivation. Usually short duration crops are grown as component crops with maize. Among the different short duration crop pea is one of them. Intensive cropping without green manuring or continuous of chemical fertilizers produces detrimental effect on physical and chemical properties of soil and also reduces organic matter of the soil. Generally most of the soils of Bangladesh are poor in organic biomass can be incorporated in the maize field, which may increase the soil fertility and also uplift soil organic matter content. With this view, the present experiment will be undertaken to verify the suitable intercrop combination for higher yield and better economic return in farmers. The soil fertility of Bandarban is low due low organic matter content in soil. So, incorporated bio-mass in the soil, fertility would be increased. The vegetable production in Bandarban is comparatively lower than other areas. So, it is necessary to increase vegetable production in that area. With this justification, the experiment has been undertaken with the following objectives:

i) To determine the agro-economic performance of intercropping pea with maize.
ii) To increase vegetable production of the locality.

Materials and Methods

The performance trial of intercropping hybrid maize with pea was conducted at Chemee dolo para, Bandarban sadar areas at hill district Bandarban during rabi season, 2005-06. The soil of the experimental field was sandy loam having pH 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 Nirdishika, Bandarban). The site represents the area of AEZ-29. The variety of maize was pacific-11 and pea was BARI Motor-1. The unit plot size was 4.5m x 4m with maintaining the spacing 75cm x 20cm of maize and 30cm x 10cm of BARI field pea. The sowing date was 01 December, 2005. Fertilizers were applied for maize and intercrop 250-53-100-40 kg N, P, K and S/ha, for sole pea 20-18-17-10 kg N,P,K and S/ha, Basal: $^1/_3$ N and full amount of other fertilizer, rest of $^1/_3$ topdress at 30 DAS and $^1/_3$ N at 60 DAS in maize rows only. The green pods of pea were harvested after 70 days of its sowing date. The maize was harvested 10-15 April, 2006. The yield contributing character data of maize were recorded from ten randomly selected plants.

Results and Discussions

Highest plant height, number of grains/cobs and 1000-grain wt. was recorded from sole maize and it was significantly different from rest of the treatments (Table 1).

Highest number of plants/m^2 and number of green pods were recorded in sole pea. and it was significantly different from other treatments. The lowest number of green pod harvested and wt. of 50-green pods were recorded from maize + 2 line motor (Table 2).

Due to highest number of grains/cob and highest wt. of 1000-grain, sole maize gave highest grain yield. But the highest maize equivalent yield was recorded from maize with 4 line motor as intercrop. On the other hand, highest green pod was recorded from sole pea due to higher number of plant, number of green pod/ plant and highest wt. of 50-green pods (Table 3).

Cost and return analysis

Highest gross return was recorded from maize with 4 line pea followed by maize with 2 line pea whereas lowest gross return was found form sole pea. The gross margin and benefit cost ratio was also the highest in maize with 4 line pea and the lowest was in sole maize.

Field observation

No diseases were found in maize and pea combination

Farmers reaction

Farmers are agreed to cultivate this inter-cropping system but pea is a new crop in this area. For creating more demand of pea as vegetable it need to be motivated by extension people or through training or field day orientation.

Conclusion

It is evident that inter-cropping maize with pea is a profitable practice for higher return. For valid recommendation it should be repeated in next year in farmers field.

Table 1. Effect of intercrop combination on yield components of maize

Treatments	Plant height (cm)	Plant/m^2	Number of cobs/m^2	Number of grains/ cobs	1000-grain wt. (gm)
Sole Maize (75cm x 20cm),	292	4.8	5.5	467	376
Maize normal row +2 rows BARI Motor-1	271	5.0	6.5	465	319
Maize paired row + 4 rows BARI Motor-1	275	4.7	5.5	467	337
CV (%)	9.11	-	7.13	-	-
LSD (0.05)	14.56	NS	1.23	NS	NS

Note: After harvesting of pods plant biomass was incorporated in to the soil

Table 2. Effect of intercrop combination on yield components of pea (BARI Motot-1)

Treatments	Plant/m^2	No. of green pod arvested/plant	50-green pods wt. (gm)
Pea sole	64	9	155
Maize + 2 line pea	25	5	120
Maize + 4 line pea	48	6	180
LSD (0.05)	14.23	19.56	1.23

Table 3. Yield and equivalent yield of maize and intercrop

Treatment	Yield of maize (t/ha)		Intercrop green pods yield (t/ha)	Maize equivalent yield (t/ha)
	Grain yield	Straw yield		
Sole maize	8.36	16.63	-	-
Sole pea	-	-	8.33	-
Maize + 2 line pea	8.25	14.66	2.33	9.71
Maize + 4 line pea	7.79	14.00	4.25	10.45
CV (%)	7.65	-	11.25	-
LSD (0.05)	0.97	NS	19.21	-

Table 3. Cost and return analysis of hybrid maize - BARI Motor-1 inter-cropping system in Bandarban, 2005-06

Treatment	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Sole maize	71038	40,123	30915	1.77
Sole pea	41650	21,110	20540	1.97
Maize + 2 line pea	81315	42,175	39140	1.93
Maize + 4 line pea	87070	42,175	44895	2.06

Note: Market price of maize (dry grain)= Tk.8/kg and Stover= Tk. 0.25/t and Green pods of pea @ Tk.5/kg

Feasibility Study of Pointed gourd

Abstract

A feasibility study of pointed gourd cultivation was carried out at hill valleys in Bandarban sadar areas during 2005-06 to examine feasibility of pointed gourd cultivation at hilly areas and to estimate economic return of this new crop. Results revealed that highest yield was recorded 14.75ton/ha from line PG025.The gross margin received Tk.149967 ha^{-1} and benefit cost ratio was 3.07. No major diseases were found in pointed gourd variety. As a new economic crop its acceptability to the farmers was remarkable.

Introduction

Pointed gourd high yielding vegetables are usually grown in northwestern parts of Bangladesh. It can be grown in south-eastern parts of Bangladesh mainly on hill foot high lands where large amount of areas remains fallow. Moreover, there is a high demand of summer vegetables like pointed gourd in this region and vegetable deficit may be overcome by introducing it. In Bandarban district, pointed gourd is a new crop. It has high local demand. Unfortunately, pointed gourd was not cultivated in previous day in this region or no research work has been done. In order to fulfill the local demand, the crop should be introduced at farmer's level. In this context, an experiment has been under taken with the following objectives;

i) To observed the yield performance of pointed gourd
ii) To quantify the cost benefit analysis of pointed gourd cultivation at hilly areas in Bandarban
iii) 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 2005-06 at farmer's field. The experiment was set up RCB with 7 dispersed replications. Two line/varieties, PG 025 and PG020 are used with support system of Bamboo trellis. The bed size was 4.5m x 1.5m where pit to pit distance 1.5 m. No. of pit/bed was 3 and plant/pit was one. The ratio male and female was 1: 8. Fertilizer application per pit was used Cowdung- 5 kg (22 t/ha), TSP - 50 gm (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 (311 kg/ha). The Vine was planted on 02-06 December 2005 and harvesting was started on 25 March 2006 and till now. Yield data was recorded from per plot and converted to per hectare. The yield was harvested in each 4-6 days interval and data was recorded by monitoring technique in each harvesting days. Irrigation, top dressing, weeding and spraying was done as and where necessary.

Results and Discussion

By this time 11 times of harvest was completed up to 15 May 2006 but fruit harvesting will be continued till October 2006. Yield was obtained 14.75 t/ha from the variety of PG-025 with maintaining the support of bamboo trellis. The line PG-025 showed higher yield due to higher individual wt., length and diameter of fruit. In case of line PG-020, fruit yield was found 12.35 t/ha comprising lower weight of individual fruit (Table 1). The age of crop is now 6 month and it would be continue till October 2005. Next year it would be continued on the basis of existing vine.

Cost benefit analysis

Cost item was included such as cost of vine and their land preparation, weeding, fertilization, spraying, making bamboo trellis and harvesting cost. The higher gross return and gross margin was recorded from PG-025 with BCR 4.28 (Table2).

Field observation

- No major disease was found yet, but fruit fly was attack. So, poison trap (1.3 ml Sabicron with100g sweet gourd) was used for controlling and it was found effective.
- Ridomile gold was used for controlling fungal diseases.

Farmer's reaction

- Farmers are highly interested to grow pointed gourd as a new crop in Bandarban and its local demand and market price is always high
- Between the two lines, PG-025 was more attractive colour, dwarf in nature and big size of fruit. So, farmers are highly interested to grow it in large scale.

Conclusion

Pointed gourd is a promising new economic crop for hilly region. Extension personnel should come take initiative for disseminates it in large-scale production at farmers field.

Table 1. Yield and yield contributing character of pointed gourd cultivation at hilly areas in Bandarban, 2005-06

Variety	Support system (bamboo trellis)			
	Diameter of fruit (cm)	Length of fruit (cm)	Individual wt. of fruit (gm)	Fruit yield (t/ha)
PG-025	13.14	9.79	89.30	14.75
PG-020	11.41	8.76	38.80	12.35

Table 2. Cost and return of pointed gourd cultivation at hilly areas in Bandarban, 2005-06

Variety	Gross return (Tk./ha)	Total cultivation cost (Tk/ha)	Gross margin (Tk/ha)	Benefit Cost Ratio (BCR)
PG-025	2,06500	48,333	158167	4.28
PG-020	172900	48,333	124567	3.57

Sales price of pointed gourd @ Tk.14/kg in local market.

Observation Trial of Bilatidhonia (*Eryngium foctidum* L.)

Bilatidhonia (*Eryngium foctidum* L.) is a popular horticultural crop in the hilly region of Bangladesh as mentioned in Shabji Biggan (Rashid, 1999). It belongs to the group of spices and condiments. Bilatidhonia (*Eryngium foctidum* L.) belongs to the family Umbelliferae. Its cultivation started long long ago in the South-East hilly region of Bangladesh. Its cultivation is wide spread in Wagga,Ghagra, Hapchari, Jaganachari of Kaptai Upazila and also in Betbunia and Ranirhat of Kaukhali Upazila under Rangamati district. It is also grown in little scale in Bandarban and Khagrachari districts. It has great demand not only in local market but also in foreign markets of Bengali hotels of Middle-Eat, London and Scotland. Its leaves and tender stems are used as vegetable, salad, spices in the cooked curry, dal, fry, vegetarian food for increasing smell and taste of food. It is also used after smashing the leaves in making Singara, Piaju and vegetable rolls to increase the smell and taste. In the recent years its popularity is increasing to the consumers and exporters encouraged the farmers to increase its production not only for local market but also for expert. Thus, it got the potentiality as a cash crop. From a small piece of land, a farmer can earn a lot of cash money. But the reality is that there is no improved method of cultivation for Bilatidhonia. The farmers are following the traditional method of cultivation. So, an observation trial was conducted to see the yield performance and economic return of Bilatidhonia cultivation and to know the farmers feedback about the crops

An observation trial of Bilatidhonia was conducted at Bandarban Sadar areas during 2005-06 at farmer's field with non-replicated. The plot size was 2 decimal. The date of sowing was 13 December, 2005.Broadcasting method was followed for seed sowing. Recommendation dose of fertilizers was used. The 1st harvest was on 83 DAS. The yield contributing characters were recorded from ten randomly selected plants (Table 1).

Table 1. Yield performance of Bilatidhonia (*Eryngium foctidum* L.) in Bandarban, 2005-06

Treatment	Seed rate (gm/dec.)	No. of plant/m^2	Wt. of 10-plant (gm)	Length of plant (cm)	Days to 1st harvest	Leaf yield (kg/dec.)	Leaf yield (t/ha)
Bilatidhonia	125	388	45	16.25	83	69.84	17.5

Gross return, gross margin and BCR indicate that the Bilatidhonia is a profitable and economic viable crop (Table 2)

Table 2. Cost and return of Bilatidhonia (*Eryngium foctidum* L.) in Bandarban, 2005-06

Treatment	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Bilatidhonia	7,66,668 (3104)	1,60,303 (649)	6,06,385 (2455)	4.78

Parentheses indicate cost and return of Tk./decimal, Seed cost was Tk. 2000/kg

Stem rot diseases was observed which was controlled by spraying Babestin DF (2 gm/litre water) and it was recovered.

Farmers reaction: Farmers are interested to grow it but the farmer gave emphasis for seed production instead of leaf sell due to high price of seed.

Conclusion

Pointed gourd is a promising economic crop for hilly region. So, extension personnel should come forward for disseminate it in large scale at farmer’s field.

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Bread Wheat Adaptive Line Trials

Abstract

The experiment was conducted at Tangail, Jessore, Narail, Pabna, Faridpur and Comilla during rabi season 2005-06. The experiment was laid out in RCBD with three replications. Three wheat lines viz. BAW-1064, BAW-1035, BAW-1059 and one variety Shatabdi was used as check. Grain yield was not significantly influenced by variety but higher grain yield was obtained from BAW-1059. The line BAW-1035 produced higher grain yield than the check variety Shatabdi at Tangail and Pabna but Shatabdi performed better at Fardipur.

Introduction

Wheat is the second-most important cereal crop in Bangladesh. It ranks second in acreage and production among the cereal crops grown in the country. Next to rice wheat is the popular cereal food item to the people in Bangladesh. It is a common food item in the daily diets to almost the whole population throughout the country. Wheat grows well in the high and medium high lands. It is one of the major food crops grown in the study area. Agro-climatic condition of the area is favorable for growing wheat.

Bangladesh Agricultural Research Institute (BARI) is involved in doing research to develop and improve wheat varieties and to look after the over all performance of the crop in the country. The Institute has already released a number of wheat varieties. There are many BARI-released varieties, now being cultivated in the field and they are performing well. However, some of the varieties released long ago have been degenerated already and some are on the way. Bangladesh Agricultural Research Institute is continuing its effort to replace the degenerated popular varieties with the new ones with high yield potentials. Recently the Institute has developed some new lines with high yield potentials and some other good qualities. These lines performed will in the research stations. Before releasing them as varieties their performance in the farmer's field across the location throughout the country needs to be verified. Present study was therefore conducted with the following objectives:

Objectives

1. To assess the yield performance of bread wheat lines in different agro-climatic zones and determine their potentiality to be released as varieties.
2. To see the yield performance of new wheat lines in comparison to standard variety.

Materials and Methods

The experiment was conducted at FSRD site, Ellenga, Tangail, MLT site Jhikorgacha and Tularampu during rabi season 2005-06. The experiment was laid out in RCBD with three replications. Three wheat lines, BAW-1064, BAW-1035 and BAW-1059 were studied with Shatabdi as check. The unit plot size was 4 x 5 m. Seeds were sown in 20 cm is solid rows on 9 December at Tangail, 8-12 December at Jessore 7-11 December at Pabna, 5 December at Faridpur and 12 December 2005 at Comilla. The crop was weeded once at all side and irrigated thrice. Fertilizers were applied at the rate of 100-60-40-20 kg NPKS/ha. All of P, K, S and two-third of N were applied as basal and the remaining N was applied as top dress at 22 DAS followed by irrigation. Other intercultural operations were done as and when necessary. The crop was harvested 20 March at Tangail, 20-28 March at Jessore, 25-27 March at Pabna, 28 March at Faridpur and 20 April 2006 at Comilla after maturity. Data on yield and yield components were recorded and analyzed statistically.

Results and Discussion

Ellenga, Tangail: Yield and yield attributes of different varieties/lines were significantly influenced the treatments (Table 1). Higher plant height was recorded from BAW-1059, which was statistically identical to BAW-1064 and shatabdi, where as lowest from BAW-1035. The result showed that shatabdi was matured 7 days earlier than BAW-1035. Variation was observed with spike length. Significant variation was not found in case of number of spikelet of spike. The higher number of grain/spike was obtained from shatabdi, which was statistically identical to BAW-1064 and BAW-1035. The line BAW-1059 gave the lowest number of grain/spike among the tested varieties/lines. Significantly highest 1000-grain weight was recorded in BAW-1035 and the lowest in shatabdi. Grain yield was statistically difference to among the lines/variety but line BAW1064 produced higher grain yield than other lines and shatabdi.

Jhikargacha, Jessore: There was no significant difference among the yield of the lines comparing with check variety. Similar result was found from MLT site, Tularampur. Plant height and grains/spike were significantly influenced by the variety. Plant height was higher in BAW-1053 but statistically identical to BAW-1069. The variety Shatabdi showed significantly the highest grains/spike. Though grain yield was not significantly influenced by the variety/line but higher grain yield was obtained from line BAW-1035. Similar trend was followed in case of straw yield.

Tularampur, Narail: Grains/spike and straw yield were significantly influenced by the lines/variety. The variety Shatabdi showed higher grain yield/spike but statistically at par to BAW-1064 and BAW-1035. Higher grain weight was recorded from BAW-1035 but it was statistically identical but higher yield was recorded from line BAW-1035. Significantly higher straw yield was obtained from line BAW-1059. The line BAW-1038 reveals higher grain yield due to length of spike and grain weight.

Pushpapara, Pabna: The line BAW-1064 took 2-4 days earlier than other variety/lines. The longest plant height was observed in the line BAW-1064 and shortest in the variety Shatabdi, which was identical to BAW-1035 and BAW-1059. Higher plant population was attained by the line BAW-1035 which was identical to BAW-1059 followed by BAW-1064 and the lowest from Shatabdi. The longest panicle length was observed at the line BAW-1064 and lowest in BAW-1059. Grains/spike was found identical except Shatabdi which showed the lowest grains/spike. The maximum weight of 1000-grain was obtained from the line BAW-1064 followed by BAW-1059. Higher grain yield was obtained from BAW-1064 but it was statistically identical to BAW-1059 and BAW-1035. The cumulative positive effect of tiller/hill, panicle length, grains/spike and 1000 grain weight might be attributed to higher grain yield in line BAW-1064. The lowest yield was obtained from the variety Shatabdi.

Sujanagar, Pabna: The result revealed that Shatabdi took the minimum days to heading which 2-4 days earlier than the other lines. The longest plant height was found in the line BAW-1059 and the shortest in Shatabdi. Plant population was statistically identical to all lines/variety. The similar trend of response was observed in tiller/hill, panicle length and grain/spike. Higher weight of 1000-grain was recorded in BAW-1064 which was identical to Shatabdi and the lowest from BAW-1059. Higher grain yield was obtained from BAW-1035 that was statistically identical to Shatabdi followed by BAW-1064. Yield contributing characters like plant population, tiller/hill, panicle length and grains/spike might be resulted higher grain yield in BAW-1035. The lowest grain yield was obtained from BAW-1059. Grain yield was lower in FSRD site than MLT site, Sujanagar, which might be due to late sowing and deficit of residual soil moisture in the field of FSRD site during initial stage of crop establishment.

Ishan Gopalpur, Faridpur: In Farmer 1 yield and number of spikes/m^2 and 1000-grain weight were significantly influenced by different varieties/lines. Plant height and number of grains/spike was insignificant among the varieties/lines. The highest number of spikes/m^2 was found in Shatabdi and other three were statistically identical. Higher 1000-grain weight was obtained from BAW-1064 (45.54 g) but Shatabdi produced significantly highest grain yield from other lines and yield of all other lines were at par. In Farmer 2, the highest number of spikes/m^2 and grains/spike were obtained from Shatabdi by grain weight was highest in BAW-1064. Shatabdi gave significantly the highest grain yield due to higher spikes/m^2 and grains/spike. In both the sites, Shatabdi variety performed better than the advanced lines.

Chandina, Comilla: No of spikes/m^2, no grains/spike and grain yield was significantly differed among the lines but plant height and thousand-grain weight does not differed. Highest spikes/m^2 was recorded in BAW-1059 that was statistically similar with BAW-1035. The lowest spikes/m^2 was recorded in Shatabdi, which was identical with BAW-1064. Highest grains/spike was recorded in Shatabdi that was identical with BAW-1035 and BAW-1059.The lowest grains/spike was recorded in BAW-1064. Higher grain yield was recorded in BAW-1059 but this was not significantly different from Shatabdi and BAW-1035. The lowest grain yield was recorded in BAW-1064. On an average, grain yield was lower in all the lines/variety.

Farmers reaction

Tangail : Positive reaction was also observed on the line BAW1064 and BAW1059 for its higher yield and shorter duration.

Pabna : Farmers of the respective sites expressed their satisfaction with the new wheat lines and newly released variety Shatabdi. They opined that they would preserve seed for growing crops in the next season They also expressed that winter season is becoming shorter and sudden rising of trumpeter badly affected wheat yield, so late sown that tolerant variety is needed.

Jessore : Farmer's of this area were so much impressed with the wheat line BAW 1035 for its high yield potential, bold and white colour of seeds. They are interested to grow this line because of disease resistance and higher yield for both the sites. This variety may be recommended for released as a variety.

Faridpur : Farmers' are happy to get high yield from Shatabdi. The yield performance of other lines is also good comparative to the Kanchan variety grown by other farmers. All the farmers are interested to grow Shatabdi in the next year and they have preserved seed.

Comilla : The line BAW 1059 can use in that locality depending on availability of seed.

Conclusion

The line BAW-1059 performed slightly better than Shatabdi. Overall due to unfavorable environmental condition yield of wheat was comparatively lower than the previous year. The experiment should be repeated in next year.

Table 1. Yield and yield contributing characters of newly bread wheat at Tangail, 2005-06

Treatment	Plant height (cm)	Crop duration (Days)	Spike length (cm)	Spike let/spike	Grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)
BAW-1064	96.47	107	11.80	20.67	40.33	41.33	3.47
BAW-1035	85.67	102	12.63	19.33	41.00	47.00	2.97
SHATABDI	92.13	100	9.57	18.33	46.67	39.00	2.40
BAW-1059	96.53	105	10.13	18.00	32.00	43.00	3.03
LSD (0.05)	4.66	-	1.91	NS	7.55	5.44	0.75
CV (%)	2.52	-	8.69	7.81	9.46	6.40	12.74

Table 2. Performance of wheat varieties/lines at Jessore during rabi 2005-06

Variety/lines	Plants/ m^2	Plant height (cm)	Spike length (cm)	Grains/ spike (no)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BAW 1064	264	87.00a	11.00	45.67b	36.47	3.47	4.42
BAW 1035	260	80.00b	11.30	46.00b	37.13	3.92	4.50
BAW 1059	292	88.67a	9.50	47.00b	35.23	2.98	4.08
Shatabdi	218	79.67b	10.60	50.33a	36.07	3.28	3.96
CV (%)	19.95	6.99	5.02	5.76	8.74	21.91	15.40
F-test	NS	*	NS	*	NS	NS	NS

Table 3. Performance of wheat varieties/lines at Narail during rabi 2005-06

Variety/ lines	Plants/m^2	Plant height (cm)	Spike length (cm)	Grains/ spike (no)	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BAW 1064	391	82.27	9.57	40.83ab	39.87	3.70	4.33b
BAW 1035	364	79.17	10.13	40.50ab	44.47	3.96	3.87b
BAW 1059	410	85.33	9.37	34.87b	40.13	3.06	4.53a
Shatabdi	371	79.23	9.80	47.33a	39.33	3.50	4.00b
CV (%)	10.16	5.91	5.39	10.10	6.95	8.37	10.61
F-test	NS	NS	NS	*	NS	NS	*

Table 4. Performance of advanced wheat lines/varieties at FSRD site, Pushpapara, Pabna during 2005-06

Treatment	Days of heading	Days of maturity	Plant height (cm)	Plants/ m^{-2}	Tiller/ hill	Panicle length (cm)	Grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Shatabdi	61	104	77.5b	173.7b	2.7	10.2ab	36.8b	39.67b	2.33b	3.50b
BAW-1035	61	104	78.5b	186.7a	2.7	10.4ab	38.5a	40.33b	2.45a	3.65a
BAW-1059	63	104	81.0b	185.3a	2.8	9.7b	38.5a	40.67ab	2.47a	3.61ab
BAW-1064	59	104	89.0a	177.3ab	2.8	10.8a	39.3a	41.67a	2.51a	3.72a
CV (%)	-	-	4.11	3.02	7.31	3.77	2.02	1.47	1.92	1.39
LSD (0.05)	-	-	6.693	10.92	NS	0.77	1.55	1.19	0.09	0.11

Table 5. Performance of advanced wheat lines/varieties at MLT site, Sujanagar, Pabna during the year 2005-06

Treatment	Days of heading	Days of maturity	Plant height (cm)	Plants/ m^{-2}	Tiller/ hill	Panicle length (cm)	Grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Shatabdi	60d	99	86.0b	247.3	4.80	10.17	39.20	42.00a	3.12a	2.56b
BAW-1035	63b	100	86.6b	249.3	4.75	10.47	43.00	41.03b	3.29a	2.84ab
BAW-1059	64a	103	97.0a	247.6	4.53	09.93	41.00	39.57c	2.89b	3.08a
BAW-1064	62c	101	94.0a	236.3	4.50	10.13	38.07	42.50a	3.05ab	3.23a
CV (%)	0.80	1.74	2.46	3.30	4.68	2.15	14.30	1.04	5.68	6.69
LSD (0.05)	1.00	NS	4.46	NS	NS	NS	NS	0.86	0.36	0.39

Table 6. Yield and yield contributing characters of bread wheat lines at FSRD site, Ishan Gopalpur, Faridpur

Variety/line	Days to maturity	Plant height (cm)	Spikes/ m^2	Grains/ spike	1000-grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
Farmer-1							
Shatabdi	102	89.9	312	35.8	39.80	2.88	3.21
BAW 1035	107	89.4	288	31.7	41.96	2.54	2.87
BAW 1059	105	91.6	297	35.6	40.56	2.61	2.92
BAW 1064	102	89.5	278	33.9	45.54	2.54	2.90
LSD (0.05)	NS	NS	28.5	NS	3.6	0.22	0.31
Farmer-2							
Shatabdi	105	89.0	297	38.2	39.33	2.84	2.98
BAW 1035	104	88.4	274	35.0	39.13	2.31	2.64
BAW 1059	101	90.6	281	31.5	41.26	2.43	2.55
BAW 1064	101	91.6	247	33.8	45.33	2.36	2.65
LSD (0.05)	NS	NS	32.5	4.2	3.0	0.34	0.26

Table 7. Yield and yield attributes of bread wheat lines at Chandina, Comilla during rabi 2005-06

Lines/ Variety	Plant height (cm)	Spikes/ m^2	Grains/ spike	1000- seed wt. (g)	Maturity (Days)	Grain Yield (t/ha)
BAW 1064	65.97	255b	313.3b	35.9	97	1.65b
BAW 1035	70.10	293a	385.7ab	36.2	97	1.73ab
BAW 1059	67.63	322a	363.0ab	35.7	97	1.97a
Shatabdi	97.60	235b	459.7a	36.1	94	1.86ab
LSD (0.05)	NS	37.06	132	NS	-	0.29
CV (%)	6.79	6.72	17.37	3.14	-	8.18

Performance Trial of Hull less Barley under Rainfed Condition

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 cannot be grown 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 five advance lines viz. BHL-03, BSHL-04, BHL-07 BHL-08, BHL-18 with BARI Barley-05 as local check variety at MLT site Tularampur, Narail and Jhikargacha, Jessore during rabi 2005-06. Seeds of different entries were sown on 9 and 13 December 2005 at Tularampur and Jhikargacha, respectively. The unit plot size was 5m x 5m maintaining a spacing of 20cm 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. Thinning was done at 30 DAS. Other inter cultural operations were done as and when necessary. Data on plant height, plant population, spike length, number of grains per spike, 1000-grain weight, grain yield t/ha, straw yield t/ha were collected.

Results and Discussion

Performances of different barley varieties/lines are shown in Table 1 and 2. The highest grain yield (4.03 t/ha) was produced by BSHL-04 followed by BHL-8 (3.87 t/ha), BHL-07 (3.80 t/ha) and BB-5 (3.50 t/ha). The lowest grain yield (2.80 t/ha) was produced by BHL-03 at MLT site Tularampur. On the other hand at MLT site Jhikargacha the highest yield (2.04 t/ha) was produced by BHL-07 followed by BHL-08 (2.00 t/ha. The lowest yield (0.96 t/ha) was obtained from BHL-18. The yield of barley variety/lines of MLT site Jhikargacha was lower than MLT site Tularampur. It may be, due to lower population and other yield contributing characters. Moreover, timely intercultural operation was not done which hamper the yield of barley at MLT site Jhikargacha.

Farmers reaction

The yield of barley is satisfactory. But due to lack of marketing facilities the farmers are not interested to cultivate barley.

Conclusion

Most of the advanced lines exhibited superiority over the check variety BB-05 except line BHL-03 at Narail. But grain yield was not satisfactory at Jhikargacha. So, the experiment needs another year trial for confirmation.

Table 1. Yield and yield contributing characters of barley at MLT site, Tularampur, Narail during rabi 2005-06

Entries	Plant Pop./m^2	Plant height (cm)	Length of spike (cm)	Grains/ spike	1000- gr. wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BHL-03	348	58.4	6.6	40.1	33.2	2.80	3.40
BSHL-04	380	68.8	8.6	54.9	33.8	4.03	4.06
BHL-07	356	69.8	7.0	48.2	34.4	3.80	3.97
BHL-08	336	78.1	8.4	56.9	34.2	3.87	3.00
BHL-18	303	70.5	8.3	55.4	32.6	3.10	3.10
BB-05	326	76.5	7.4	52.0	35.0	3.50	4.23

Table 2. Yield and yield contributing characters of barley at MLT site, Jhikargacha, Jessore during rabi 2005-06

Entries	Plant Pop./m^2	Plant height (cm)	Length of spike (cm)	Grains/ spike	1000- gr. wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
BHL-03	239	71.0	7.58	26.0	32.0	1.34	3.96
BSHL-04	214	77.5	8.38	36.0	24.0	1.38	3.84
BB-05	165	98.0	8.66	32.0	28.5	1.10	4.96
BHL-07	268	75.5	9.26	38.5	32.6	2.04	4.29
BHL-08	243	75.5	8.87	38.5	28.0	2.00	4.00
BHL-18	163	76.5	8.81	29.5	25.5	0.96	2.84

Adaptive Trial of Improved Varieties of Sweet Potato

Abstract

An experiment was conducted at Bogra, Kushtia, Kishoreganj, Jessore, Pirojpur, Chandpur, Patuakhali, Noakhali and Feni during Rabi 2005-06 to compare the performance of newly developed improved sweet potato varieties by Bangladesh Agricultural Research Institute (BARI) with farmer's own ones. Among the varieties, the highest tuber yield was found from BARI SP-7 at Bogra, Kishoreganj and Jessore, BARI SP-5 at Kushtia and Patuakhali, BARI SP-4 at Pirojpur and BARI SP-6 at Noakhali and Feni. All of the improved varieties produced higher gross return and benefit cost ratios as compared to that of local variety except Chandpur.

Introduction

Sweet potato is the fourth largest crop of Bangladesh after rice, wheat and potato. The crop is mainly cultivated by the marginal farmers in a sporadic way in different river belts, charlands, deltas and seasonally inundated flood plains. Sweet potato covers about 0.7% of the total cropped area. The area under sweet potato is about 41 thousand hectares and its production is about 40 thousand tones i.e. the average production is 9.75 t/ha. This production is very low compared to some developed and even developing countries. This low yield may be due to the cultivation of low yielding cultivars, poor quality seeds, lack of technical know-how, etc. On the other hand, vit-A deficiency is a serious problem in the rural people of Bangladesh due to which 30000 children suffering from night blindness in each year. High yielding and vit-A rich sweet potato varieties may play an important role in this regard. Recently BARI has developed some new high yielding varieties of sweet potato. So an experiment was undertaken to see the performance of sweet potato varieties developed by BARI in the farmer's fields.

Materials and Methods

An experiment was conducted at Bogra, Kushtia, Patuakhali, Kishoreganj, Pirojpur, Jessore, Chandpur Noakhali and Feni. There were (four) improved varieties developed by BARI along with the local one. Improved varieties were BARI SP-4, BARI SP-5, BARI SP-6 and BARI SP-7. The experiment was laid out in RCBD with 4 (four) dispersed replications. The unit plot size was 60cm× 30 cm. Manures and fertilizers were applied @ 10 tons of cowdung, 150 kg of urea, 130 kg of TSP and 160 kg of MP per hectare. Entire amount of cowdung TSP, MP and half of urea were applied and incorporated in soil at final land preparation. Remaining urea was applied as a top dress after 35 days of planting followed by irrigation. Furadan @ 17 kg/ha were applied after irrigation and this was very helpful in controlling pest attack, throughout the whole crop was weeded two times. The crops were planted on 8 December at Bogra, 15 November at Kushtia, 28 December at Patuakhali, 16 November at Kishoreganj, 15 December at Barind, 31 November at Jessore, 7 December at Comilla and 3rd week of December at Noakhali and Feni, 2005. The crop was harvested on 12 April at Bogra, 11 April at Kushtia, 18 May at Patuakhali, 23 March at Kishoreganj, 22 May at Barind, 10 April at Jessore, 12 April at Comilla and last week of April to first week of May at Noakhali and Feni, 2006. Data on yield and yield contributing characters were collected and analyzed statistically.

Results and Discussion

Gabtali, Bogra: Vine length, tuber/plant, weight of vine and tuber yield were significantly influenced by variety. Higher length of vine (155 cm) was recorded from BARI SP-5 which was identical with BARI SP-7 (146 cm). Higher number of tuber per plant (4.45) was recorded with BARI SP-7 and that was statistically identical to BARI SP-4 (4.35) and BARI SP-5 (4.15). Weight of vine showed the highest tuber yield (37.00 t/ha) in BARI SP-4 was recorded from BARI SP-7 that was statistically identical with BARI SP-4 (33.74 t/ha). The lowest tuber yield (22.16 t/ha) was obtained from local variety. The highest gross return (Tk. 259000/ha) and benefit cost ratio (5.69) were also obtained from

BARI SP-7. All the newly developed improved varieties gave higher yield and benefit than local one. The similar results were also obtained from the last two years study at the MLT site Gabtali, Bogra.

Bheramara, Kushtia: Number of tuber/plant was similar to BARI SP-7 and BARI SP-4 whereas the lowest in local one. The highest tuber weight was recorded from BARI SP-1. But higher tuber yield as obtained from BARI SP-5. The variety also showed higher net return and BCR.

Rajakhali, Patuakhali: Higher tuber/plant was recorded from BARI SP-4 but the highest tuber/plant was obtained from Tripti. Tuber yield was higher in BARI SP-5 followed by Tripti due to higher weight of tuber/plant.

Hossainpur, Kishoreganj: The result showed that vine length/plant, weight of tuber/plant and tuber yields were significantly different in sweet potato varieties. The highest vine length/plant was recorded from variety BARI SP-6 which was statistically at par BARI SP-7. Local variety produced statistically shorter vine length. Higher tuber wt./plant was recorded from variety BARI SP-7 followed by BARI SP-4. Significantly highest tuber yield (29.13 t/ha) was obtained from BARI SP-7. The farmers' variety gave the lowest tuber yield (17.14 t/ha) due to closer spacing (30 x 10 m). As a result, population was more than double and yield was lower than other varieties. Among the BARI developed varieties BARI SP-7 gave the highest yield (29.13 t/ha) due to higher tuber/plant and tuber weight/plant. The highest gross return (Tk.87390 ha^{-1}) and benefit cost ratio (4.06) was calculated from BARI SP-7 which was much higher than any other variety in the trial. The local variety gave the lowest gross return due to lower yield than BARI developed varieties.

Nazirpur, Pirojpur: Same number of vines of each variety was trasplanted but at harvest higher number of plants were found in BARI SP-5 (3.34) and it was lower in BARI SP-7 (1.96). Vines of BARI SP-4 were taller (144.90 cm) than other varieties. Weight of vine in BARI SP-5, tubers/hill was higher in check variety that was statistically similar with BARI SP-4. Marketable size of tuber (>150 g) was higher in Daulatpuri (18.02/m^2) and lower in BARI SP-7 (12.11/m^2). Tubers of BARI SP-4 were larger (22.70 cm) in length followed by Daulatpuri (20.67 cm). The tubers of BARI SP-7 were bigger in diameter (19.80 cm) than other varieties. Among the varieties BARI SP-4 produced heavier size tuber (126.5 g) which results the highest yield (29.61 t/ha) that was closely followed by BARI SP-5 (29.47 t/ha).

Kaliganj, Jessore: The highest yield (31.66 t/ha) was obtained from BARI SP-4 followed by BARI SP-7 and BARI SP-5. The lowest yield (16.66 t/ha) was obtained from local variety. Higher yield was achieved due to higher number of tubers/plant and weight of tubers/plant.

Shahrasti, Chandpur: Local variety of sweet potato produced higher root yield of 23.92 t/ha than the BARI developed varieties. The BARI sweet potato-4 produced higher yield among the BARI varieties while BARI sweet potato-7 gave the lowest root yield (11.57 t/ha). Farmers did not irrigate the field during the vegetative stage, even there was no rainfall at that period due to climatic condition overall root yield is low.

Hazirhat, Noakhali: Yield and yield performance of sweet potato varieties are presented in Table 1. Higher number of root per plant (4.57) was found in BARI sweet potato-6 that was statistically identical with BARI sweet potato-5 (4.50) and BARI sweet potato-7 (4.47). The lowest number of root per plant was recorded in local variety (2.82). The highest root weight per plant was found in BARI sweet potato-6 (0.68 kg) that was statistically different from all varieties of BARI and local variety. Higher root yield was showed by BARI sweet potato-6 (23.04 t/ha), which was statistically equal to all other BARI varieties. The lowest root yield was recorded in local variety (14.82 t/ha), which was statistically different from other variety.

MLT Site, Feni: Root yield and yield performance of sweet potato varieties are presented in Table 2. Higher number of root per plant (4.63) was found in BARI sweet potato-6 that was statistically similar to BARI sweet potato-7 (4.36). The lowest number of root per plant was recorded in local variety

(2.71). Highest root weight per plant was found in BARI sweet potato-6 that was statistically significant with others varieties. The lowest root weight per plant was observed in local variety. BARI sweet potato-6 showed the highest root yield (23.85 t/ha) because it produced the highest number of root per plant and root weight per plant.

Farmers reaction

Bogra: Higher yield of improved varieties encouraged the farmers. But the lower market price and less sweetness of the improved varieties disappointed the farmers very much.

Kushtia: Among the six varieties, BARI Sweet potato-5 performed better yield and popular to the farmers for its attractive colour.

Patuakhali: BARI SP-4 & BARI SP-5 has no taste sweet like local and Daulatpuri. BARI SP-4 gets racked on boiling whereas local and Daulatpuri do not. Yield was very low due to no rain in the season.

Kishoreganj: BARI varieties are less preferable to the local farmers due to bigger tuber size as well as lower market price than local variety. Moreover, local variety had better keeping quality than the BARI released varieties when preserved under normal condition. Among BARI developed varieties they prefer BARI SP-7 due to its higher yield. Farmer's also opined that there was no incidence of insect and diseases in the new varieties.

Barisal: Though the yield of BARI SP 6 and in low but farmers are interested to cultivate it for their sweetness, color and taste. Market prices of BARI SP varieties are higher than Daulatpuri.

Jessore : BARI sweet potato varieties are less tasty though yield was double than local but farmers are not interested to grow these varieties.

Noakhali: The yield of BARI varieties is higher than that of local variety. But these varieties are not as tastier as the local variety. Their size and colour are not so attractive. Nevertheless their durability in storehouse and market prices are less than local variety. So, they could not get fair acceptance by the farmers of these locations.

Conclusion

If possible, research program may be taken to increase the sweetness of the newly developed improved sweet potato varieties and this is very important for farmer's acceptance.

Table 1. Agro-Economic Analysis of yield and yield attributes of sweet potato varieties at MLT site Gabtali, Bogra during 2005-06

Tests/ Variety	Length of vine (cm)	No. of tuber/ plant (no.)	Wt. of vine (t/ha)	Tuber yield (t/ha)	GR (Tk./ha)	TVC (Tk./ha)	BCR
BARI SP-4	134 b	4.35 a	60.90 b	33.74ab	236180	45550	5.19
BARI SP-5	155 a	3.35 b	64.43 a	29.71 b	207970	45550	4.57
BARI SP-6	139 b	4.15 a	62.00 b	30.52 b	213640	45550	4.69
BARI SP-7	146ab	4.45 a	62.17 b	37.00 a	259000	45550	5.69
Local	105 c	3.25 b	55.47 c	22.16 c	177280	45550	3.89
LSD (0.05)	12.35	0.39	1.73	6.35	-	-	-
CV (%)	4.21	4.7	1.31	9.62	-	-	-

Local @ Tk. 8/kg, HYV @ Tk. 7/kg

Table 2. Effect of different varieties on yield and yield attributes of sweet Potato at Bharamara, Kushtia during 2005-06

Treatment	No. of tuber /plant (no.)	Tuber wt./ plant (kg)	Tuber wt. (t/ha)	Total variable cost (Tk/ha	Net return (Tk/ha)	BCR
BARI SP-1	6	1.80	31.75	32,768	94,232	4.84
BARI SP-4	11	1.18	35.50	32,768	1,08,256	5.42
BARI SP-5	10	1.24	43.50	32,768	1,38,175	6.64
BARI SP-6	9	0.88	41.25	32,768	1,29,761	6.29
BARI SP-7	11	0.92	28.00	32,768	80,207	4.27
T6 (local)	8	0.85	22.00	32,768	57,767	3.36
CV (%)			4.39			
LSD			3.55			

Price: 4 Taka per kg.

Table 3. Effect of different varieties on yield and yield attributes of sweet Potato at Rajakhali, Patuakhali during 2005-06

Treatment	No. of tuber /plant (no.)	Tuber wt./plant (g)	Tuber wt. (g)	Yield (t/ha)
BARI SP-4	5.2	72	350	16.3
BARI SP-5	4.5	81	398	17.1
BARI SP-6	4.6	67	308	11.8
BARI SP-7	4.2	70	290	9.7
Tripti	4.0	93	365	16.6
Daulatpuri	4.8	68	310	12.8
Local	3.9	46	200	6.8

Table 4. Performance of sweet potato varieties at Hossainpur, Kishoregonj during rabi 2005-06

Variety	Vine length/ plant (cm)	Tuber/plant (no.)	Tuber wt./ plant (g)	Tuber yield (t/ha)
BARI SP-4	110c	5.26	413a	23.71ab
BARI SP-5	147b	5.14	385b	22.43b
BARI SP-6	176a	5.42	418a	26.12a
BARI SP-7	166a	5.61	448a	29.13a
Local	92c	5.10	203c	17.14c
LSD (0.05)	11.27	ns	57.68	1.34
CV (%)	10.17	11.62	15.21	6.52

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

Table 5. Cost and return analysis of sweet potato varieties developed by BARI (MLT site, Hossainpur during 2005-06)

Variety	Gross return (Tk./ha)	Total Variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI SP-4	71130	21520	49610	3.31
BARI SP-5	67290	21520	45770	3.13
BARI SP-6	78360	21520	56840	3.64
BARI SP-7	87390	21520	65870	4.06
Local	68560	21520	47040	3.19

Price (Tk./kg): Sweet potato (local) = 4/-, BARI variety = 3/-

Table 6. Yield and yield contributing characters of Sweet potato varieties at MLT site, Nazipur, Pirojpur during rabi 2005-06

Variety	Plants/m^2	Vine length/ plant (cm)	Weight of vine/m^2 (kg)	Tuber/ hill	Tuber/m^2 (>150 g)	Single tuber wt. (g)	Tuber yield (t/ha)
BARI SP-4	3.34a	144.90a	2.50b	3.63a	16.14b	126.5a	29.61a
BARI SP-5	3.31a	134.30b	2.96a	3.30c	16.20b	120.6b	29.47a
BARI SP-6	2.53ab	119.10c	1.85c	2.73d	13.70c	107.6c	19.08b
BARI SP-7	1.96b	111.60d	1.93c	3.37b	12.11c	120.2b	18.37b
Daulatpuri	3.17a	103.50e	1.86c	3.77a	18.02a	107.3c	19.79b
CV (%)	17.34	1.24	4.37	4.59	5.35	4.50	5.50

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

Table 7. Performance of sweet potato tested at MLT site, Kaligonj, Jhenaidah during 2005-06

Variety	Tubers/plant (no.)	WT of Tuber/ plant (g)	Yield (t/ha)
BARI SP-4	2.00	570	31.66
BARI SP-5	3.00	500	27.77
BARI SP-6	3.00	425	23.61
BARI SP-7	4.00	537	29.83
Local	5.00	300	16.66

Table 8. Yield of sweet potato varieties tested at Shahrashti, Chandina during rabi, 2005-06

Name of variety	No of tubers/plant	Weight of tubers/plant (kg)	Yield (t/ha)
Local	3.3	0.46	23.92
BARI sweet potato -7	3.4	0.23	11.57
BARI sweet potato -6	3.8	0.24	11.88
BARI sweet potato -5	2.7	0.26	13.52
BARI sweet potato -4	5.7	0.37	18.98

Table 9. Root Yield and yield attributes of Sweet Potato as influenced by different varieties at FSRD, Hazirhat site of Noakhali during 2005-06

Variety	No. of root/plant	Root wt/plant (kg)	Root yield (t/ha)
BARI sweet potato-4	3.63 ab	0.482 c	20.76 a
BARI sweet potato-5	4.50 a	0.597 b	21.49 a
BARI sweet potato-6	4.57 a	0.684 a	23.04 a
BARI sweet potato-7	4.47 a	0.543 bc	22.34 a
Local variety	2.82 b	0.377 d	14.82 b
CV (%)	11.70	9.22	7.08
LSD (0.05)	0.88	0.08	2.73

Table 10. Root Yield and yield attributes of sweet potato as influenced by different varieties at MLT site, Feni during 2005-06

Variety	No. Of root/plant	Root wt/plant (kg)	Root yield (t/ha)
BARI sweet potato-4	3.92 ab	0.57 b	17.69 b
BARI sweet potato-5	4.28 a	0.59 b	19.66 b
BARI sweet potato-6	4.63 a	0.69 a	23.85 a
BARI sweet potato-7	4.36 a	0.60 b	19.29 b
Local variety	2.71 b	0.38 c	13.26 c
CV(%)	11.83	6.86	10.70
LSD (0.05)	1.168	0.092	3.77

Adaptive Trial of Improved Stolon Producing Panikachu Varieties

Abstract

A field experiment was conducted at Trishal MLT site, Mymensingh and Tularampur, Narail to test the comparative performance of three panikachu varieties during Kharif season of 2005. Out of the three varieties Latiraj gave the highest stolon yield both the sites but Joypurhat variety gave the highest curd yield (40.35 t/ha) at Mymensingh. The variety Joypurhat also gave the highest gross return (Tk.324870 t/ha), gross margin (Tk.29629 t/ha) and benefit cost ratio (11.37) at Mymensingh.

Introduction

Panikachu is a very popular aroid crop in the greater Mymensingh area. Farmers are using the traditional local varieties for long time. Tuber Crop Research centre of BARI has developed one variety and some advance lines are awaiting for release. There is one popular variety of panikachu in Joypurhat area which may also perform better in Mymensingh area. It is therefore, necessary to study the adaptability of the improve varieties and identity better ones for Mymensingh region. So, the experiment was conducted to compare the adaptability of panikachu varieties and recommend better varieties for Mymensingh region.

Materials and Methods

The experiment was conducted at farmers field of Birampur village under Trishal MLT site of OFRD, Mymensingh during 24 February to 19 September 2005. The design of the experiment was randomized complete block with five dispersed replications. The treatments of the experiment were three varieties of panikachu i.e., Latiraj, Joypurhat and Trishal local at Mymensingh but Narial included PK-176 instead of Joypurhat variety. The unit plot size was 6.0m x 4.5 m. The seedlings were transplanted during 19 January at Narial and 24–27 February at Mymensingh, 2005 with the spacing of 60 x 45 cm. Fertilizers were applied @ 150-125-175 kg of urea, TSP and MP along with 10 t/ha of Cowdung. Full amount of Cowdung, TSP and MP were applied as basal during final land preparation. One-third of urea was applied as Ist to dress at 30– 5 DAP and rest two-third were also applied at top dress in five equal splits at 15-days interval after Ist top dress. Other intercultural operations were done as and when necessary. Harvesting of stolon was started from 1st week of May and continued up to 2nd week of September with an interval of 7–10 days. The rhizome (curd) was harvested on 19 September 2005. Data on yield and yield contributing characters were recorded and analyzed statistically and mean differences were adjudged by LSD. Data related to cost and return and farmers' reaction were also recorded. Economic analysis was done on the basis of prevailing market price of input and out put.

Results and Discussion

Mymensingh: All the yield and yield contributing characters of panikachu varieties varied significantly except plant height. Number of stolon/plant, length of stolon, weight of stolon/plant and stolon yield were significantly highest in Latiraj but weight of curd/plant, diameter of curd, length of curd and curd yields were highest in Joypurhat variety. However, wt. of curd/plant, length of curd yield of Joypurhat and Local were statistically identical. Stolon yield of local variety was the lowest (11.81 t/ha) but the curd yield was the lowest (25.61 t/ha) in Latiraj. However, the Latiraj gave significantly the highest (18.64 t/ha) stolon yield but highest curd yield (40.35 t/ha) was obtained from Joypurhat which was statistically identical to Local variety. The result clearly indicated that Latiraj is better for stolon followed by Joypurhat but both Joypurhat and Local varieties are better for curd production.

Cost and return analysis: From table 2 it is evident that the panikachu variety Joypurhat gave highest gross return (Tk.324870/ha) gross margin (Tk.29629/ha) and benefit cost (11.37) due to higher curd yield and good stolon yield. Latiraj gave the lowest gross return (Tk.225950/ha), gross margin (Tk.197371/ha) and benefit cost ratio (7.91). Local variety also gave higher BCR than Latiraj due to higher curd yield as well as reasonable yield of stolon.

Narail: Among the varieties Latiraj produced the highest yield (23.6 t/ha) followed by local. The line PK-176 produced the lowest yield (18.10 t/ha). Higher yield from Latiraj was due to higher yield contributing characters.

Farmers reaction

Mymensingh: Farmers are very much interested to grow the variety Joypurhat because of its dual production of stolon and curd. Though Latiraj gave better stolon yield, its curd quality and yield was not satisfactory. The quality of curd of Joypurhat and Local was preferred by the farmers.

Narail: Farmers are more satisfied with yield of Latiraj comparing with others.

Recommendation: The variety Joypurhat may be recommended for its wide spread cultivation in Mymensingh area. So, block demonstration program could be undertaken for its extension in the next year.

Table 1. Yield and yield parameters of panikachu varieties at Trishal upazila during Kharif, 2005

Varieties	Plant height (cm)	No. of stolon/ plant	Length of stolon (cm)	Wt. of stolon/ plant (g)	Wt. of curd/ plant (kg)	Diameter of curd (cm)	Length of curd (cm)	Stolon yield (t/ha)	Curd yield (t/ha)
Latiraj	158.9	20.2a	70.0a	639a	0.69b	18.5c	32.2b	18.64a	25.61b
Joypurhat	162.2	18.5b	54.9b	494b	1.08a	24.6a	41.5a	15.39b	40.35a
Local	157.0	19.6b	45.9c	380c	1.04a	21.9b	40.9a	11.81c	37.61a
LSD(0.05)	NS	1.98	7.51	52.33	0.113	1.46	2.87	3.11	3.78
CV (%)	8.0	6.76	9.05	7.11	8.36	5.60	5.15	12.50	7.51

Table 2. Cost benefit analysis of panikachu varieties at Trishal upazila during Kharif, 2005

Varieties	Gross return (Tk./ha)	*TVC (Tk./ha)	Gross margin (Tk./ha)	B/C ratio
Latiraj	225950	28579	197371	7.91
Joypurhat	324870	28579	296291	11.37
Local	282530	28579	253951	9.89

*TVC includes cost of seedlings, fertilizers, man and animal labour cost.

Price: Stolon of all varieties: Tk. 8/kg, Curd of Latiraj: Tk. 3/kg, Curd of Joypurhat and Local: Tk. 5/kg

Table 3. Performance of yield and yield contributing characters of panikachu at MLT site, Tularampur, Narail during 2005-06

Variety/lines	Stolon/plant (no.)	Length of stolon (cm)	Weight of stolon/ plant (g)	Yield/plot (kg)	Yield (t/ha)
PK-176	28.6	48.2	679	109	18.10
Latiraj	34.5	64.2	862	142	23.60
Local	27.9	56.4	715	127	21.20

Adaptive Trial of Improved Variety of Mukhikachu

Abstract

The performance of mukhikachu varietes viz. Bilashi and local were evaluated in the farmers' field at FSRD Site, Kushumhati, Shepur and MLT site, Melandah and Mymensingh during the Kharif-I season of 2005 in the farmers fileld of SAIP farmers. The highest yield was obtained from Bilashi (18.33 t/ha and 20.24 t/ha from Sherpur and Melandah and 21.98 t/ha from Fulbari, Mymensingh respectively) which produced 64, 49 and 35% higher yield than the local variety (11.12, 13.53 and 16.34 t/ha). The variety Bilashi preferred by the farmers because of higher yield, good shape, tolerant to water logged condition than the local variety. This variety also showed much higher benefit than the local one in all sites.

Introduction

Mukhikachu (*Colocasia esculenta*) is an important edible aroid in Bangladesh and it contributes to the total supply of bulky vegetables during the late summer when the vegetable becomes scarce in the market. It also plays an important role in the daily diet in other countries of the world. It also compares favourably in terms of nutritional value with other root crops, such as cassava, yam, sweet potato and other edible aroids. Such important vegetable needs improvement in variety aspects. Monitoring of cultivation practices of mukhikachu revealed that all the farmers got very poor yield by using local varieties. Recently, Bangladesh Agricultural Research Institute (BARI) has developed high yielding of Mukhikachu, viz Bilashi. Keeping the views in mind the experiment was undertaken during the Kharif season 2004 in the farmers' field of SAIP area under Multilocation Test Site, Sherpur under AEZ 9.

Materials and Methods

The performance of mukhikachu varietes viz. Bilashi and local were evaluated during the Kharif-I season of 2005 in the farmers field of SAIP farmers to compare the yield performance of high yielding and local varieties at FSRD Site, Kushumhati, Shepur and MLT site, Melandah, Jamalpur and Fulbaria, Mymensingh. In each location the experiment were replicated six times in dispersed farmers' field. The unit plot site was 6 m x 4.5 m. The recommended fertilizer dose 60-40-80 kg/ha of NPK with 2000 kg/ha of cowdung and spacing 60 cm x 40 cm was considered. The full dose of cowdung, phosphorus and potash were applied at the time of final land preparation. The nitrogen was applied after 40 and 90 days after planting. The seeds were planted from March 11-16, 2005 at Sherpur and Jamalpur whereas planted at Mymensingh on 7 April 2005. The crop was harvested from October 12-19, 2005 at Sherpur and Jamalpur and 15-22 October 2005 at Mymensingh. Data were collected on the plant height, number of plants/m^2, number of cormels/plant, weight of cormels/plant. Finally the means were averaged and presented in the table.

Results and Discussion

Fulbaria, Mymensingh: Table 1 and 2 represent the agronomic and economic performance of the two varieties. Plant height, number of tillers/plant, number and weight of primary and secondary rhizome/plant and rhizome yield were better in 'Bilashi' than the local. Plant height of Bilashi was 92 cm compared to 55 cm in local. Number of tillers/plant was 6 in Bilashi which was 36% higher than the local. Number of primary rhizome was more than the number of secondary rhizome but weight of primary rhizome was less than the secondary rhizome. It might be due to accumulation of more photosynthates in the less numbered of rhizome, ultimately giving the higher weight. Weight of rhizome/plant of Bilashi was 34% higher than the local. Similarly, the highest rhizome yield (21.98 t/ha) was obtained in the Bilashi and it was 35% higher than the local. Higher yield in Bilashi might be due to contribution of higher yield attributes.

Cost and return analysis: Higher gross return (Tk. 219800/ha) and gross margin (Tk. 199490/ha) were obtained from Bilashi and it was 35 and 39%, respectively higher than the local. Similarly, higher benefit cost ratio (10.82) was recorded from Bilashi variety.

Sherpur, FSRD site: Plant height and cormel weight/plant was recorded from variety Bilashi but higher no. of cormel/plant was obtained from local variety. Plants/m^2 were similar for both the variety. The higher yield from Bilashi could be due to higher cormel weight/plant. Cost of cultivation was similar for both the varieties but gross return was much higher in Bilashi which resulted higher benefit cost ratio.

Melandah, MLT site: Similar trend was followed in case of plant height and yield attributes as in Sherpur site but yield was slightly higher due to more plants/m^2 and higher cormel/plant and cormel weight/plant. The variety Bilashi showed higher yield which resulted higher net return and benefit than the local one.

Farmers reaction

Farmers liked the variety Bilashi for its higher yield and economic return. They also opined that it is tasty due to its softness after cooking. They will expand its cultivation in the next year if they are provided with enough support for its cultivation.

Table 1. Yield and yield contributing characters of Mukhikachu at Fulbaria, Mymensingh

Treatment	Plant height (cm.)	Tillers/plant (no.)	Primary rhizome/plant	Secondary rhizome/plant	Cormel wt./plant (g)	Yield (t/ha)
Bilashi	92 (67)	6.0 (36)	7.0 (75)	22.6 (33)	536 (34)	21.98 (35)
Local	55	4.4	4.0	17.0	401	16.34

Figures in parenthesis indicate % increase over local.

Table 2. Cost and return analysis of Mukhikachu at Fulbaria, Mymensingh

Treatment	Gross return (Tk/ha)	TVC (Tk./ha)	Gross margin (Tk/ha)	B/C ratio
Bilashi	219800 (35)	20310	199490 (39)	10.82
Local	163400	20310	143090	8.05

Price Tk. 10/kg, Figures in parenthesis indicate % increase over local.

Table 3. Yield and yield contributing characters of Mukhikachu at FSRD site, Sherpur

Treatment	Plant height (cm.)	Plants/m^2 (no.)	Cormels/ plant (no.)	Cormel wt./plant (g)	Yield (t/ha)
Bilashi	128.2	6.2	17.2	289.8	18.33
Local	109.7	6.1	19.6	226.6	11.12

Table 4. Cost and return analysis of Mukhikachu at FSRD site, Sherpur

Treatment	Gross Margin (Tk/ha)	Cultivation cost (Tk./ha)	Net Return (Tk/ha)
Bilashi	1,46,640	35,775	1,10,865
Local	88960	35,775	53,185

Price Tk. 8/kg

Table 5. Yield and yield contributing characters of Mukhikachu at MLT site, Melandah

Treatment	Plant height (cm.)	Plants/m^2 (no.)	Cormels/ plant (no.)	Cormel wt./plant (g)	Yield (t/ha)
Bilashi	113.6	7.2	20.6	302.8	20.24
Local	97.3	6.8	25.4	258.2	13.53

Table 6. Cost and return analysis of Mukhikachu at MLT site, Melandah

Treatment	Gross Margin (Tk/ha)	Cultivation cost (Tk./ha)	Net return (Tk/ha)
Bilashi	1,61,920	38,975	1,22,945
Local	1,08,240	38,975	69,265

Price Tk. 8/kg

On-Farm Trial of BARI Summer Hybrid Lines of Tomato

Abstract

An experiment was conducted in the farmers field of SAIP at Nakla, Sherpur and Mymensingh sadar during Kharif I season, 2005 with the objectives were to find out on-farm performance of BARI summer hybrid tomato lines. There were four varieties viz. C-55, C-67, C-36 and C-38. In all the locations except Sherpur, the 1st sowing was damaged due to heavy rainfall during the growth period (about 736 mm from July 13 to19). A growth hormone "Tomatone" were applied just after flower initiation. The result obtained from the study indicated that the highest yield was recorded from C-55 (24.73 t/ha) which was statistically different from other varieties. At Mymensingh sadar, higher yield was also recorded from C-55 with higher BCR (3.13).

Introduction

Tomato is a high value cash crop grown throughout the country. It contains various type of vitamins and minerals. In Bangladesh tomato is mainly grown in the winter season. For optimum fruit setting tomato requires night temperature 15 to 20°C which does not prevail any where in Bangladesh during May to September. So year round tomato production is constraint. Seasonality and multiple diseases problem are the two main barriers of year round tomato production. Considering these factors recently BARI has developed some modern heat tolerant hybrid tomato variety. Keeping the views in mind, the experiment was under taken during the Kharif I season, 2005 in the farmers field of SAIP of Nakla, Sherpur and Sadar, Mymensingh.

Materials and Methods

The experiment was conducted at Sabjipara village, Shambhuganj under Mymensingh sadar Upazila and Nakla, Sherpur during Kharif 2005 to evaluate the performance of four summer tomato lines. The design of the experiment was randomized complete block with four replications. The treatments of the experiment were four summer hybrid tomato lines viz.. C-36, C-38, C-55 and C-67. Unit plot size was 4.0 m x 1.0 m. A polythene tunnel was made to protect the tomato plants from rain water. The size of the tunnel was 8.5 m x 2.3 m to accommodate 4 beds of size 4.0 m x 1.0 m. Bed to bed distance was 30 cm. The height of the tunnel was 180 cm in the middle and 135 cm in the two edges. Fertilizers were applied @ 450-250-150 kg/ha of urea, TSP and MP, respectively along with 10 t/ha of cowdung. Half of cowdung and MP and full amount of TSP was applied during final land preparation. The remaining cowdung was applied during pit preparation. The entire amount of urea and remaining MP were applied in three equal instalments at 10, 25 and 40 days after transplanting. Four hybrid tomato seedlings of age about 35 days were transplanted as first planting on 18 June 2005 and second planting on 26 July 2005. The spacing used was 60 cm x 40 cm. Intercultural operations like weeding, watering and pest control were done as and when necessary. The "Tomatone" hormone was applied 2-3 times on the blooming flowers for better setting of fruits. The second planting was severely attacked by virus from seedling stage to growing stage and only in a few plants fruiting was observed which was not acceptable. So, data were not collected from second planting plots. The 1st planting bas less attack of virus but suffered from severe drought as temperature was very high in the month of August. In the first planting, harvesting of fruits started from 13-16 August and continued up to 23 September 2005 in both sites. At maturity data on yield and yield contributing characters were recorded.

Result and Discussion

Sadar, Mymensingh: Among the four tested lines significant variation was observed for both yield contributing characters and yields (Table 1). Due to varietal differences all yield contributing characters did not equally contributed to the yield. Number of fruits/plant (17.15) was significantly highest in the line C-67 but it gave the lowest yield (13.88 t/ha) might be due to individual fruit weight (369 g/fruit). Plant height was significantly highest in C-55. Other lines had identical plant height. Thought number of fruits/plant was higher in C-67 but it was statistically identical to C-36 and C-38. Number of fruits/plant was lowest in C-55 but it gave the highest weight of fruit/plant (562 g) might be due to accumulation of more photosynthates in the individual fruits. Higher fruit yield (21.10 t/ha) was obtained from the line C-55 and it was statistically identical to line C-38. Other two lines gave similar yield but lower than C- 55 and C-38 lines.

Cost and return analysis: Out of the four tested summer tomato lines highest economic return was obtained from the line C-55 followed by C-38. Gross return, gross margin and benefit cost ratio from line C-55 were Tk. 1,055,000/ha, Tk. 7,18,050/ha and 3.13, respectively. The line C-38 also gave reasonable returns with benefit cost ratio of 2.76.

Nakla, Sherpur: The highest plant was recorded from the line C-67 (1.50 m) while the shortest plant height from C-38 (1.39 m). The maximum number of fruits/plant was found C-55 (12.20) which was statistically different from the other lines. The minimum fruits/plant were noted from C-36 (6.40). The highest fruit weight was recorded from C-55 (43.20 g) which was statistically different from other three lines. But these three lines were statistically identical. The lowest fruit weight was found by C-67 (29.80 g) but it was statistically identical to C-36 and C-38. The maximum fruit diameter was obtained from the line C-55 (4.41 cm) while the minimum from C-36 (4.20 cm). The line C-38 produced the longest fruit (4.78 cm) and the shortest fruit length was from in C-67 (4.37). The highest yield was recorded from C-55 (24.73 t/ha) but it was statistically different from other varieties. The average yield was lower due to heavy rainfall, caused fruit rot of the crop.

Farmers' reaction: Farmers opined that there is great demand of summer tomato and they faced no problem of selling it, rather they obtained a reasonable price of average Tk. 50.00/kg. Besides, farmers are interested to adopt the technology but they are afraid of its high production cost and disease infestation. Farmers proper hybrid line C-55 due to attributive colour and high yield.

Table 1. Agronomic performance of different hybrid lines of summer tomato at Mymensingh Sadar during Kharif, 2005

Tomato Lines	Plant height(cm)	No. of branches/plant	No. of fruits/plant	Wt. of fruits/plant(g)	Fruit yield (t/ha)
C-36	92.45b	3.78	15.78ab	410c	15.40b
C-38	93.18b	3.83	13.69ab	493b	18.55a
C-55	99.20a	3.88	12.47b	562a	21.10a
C-67	93.22b	4.03	17.15a	369c	13.88b
LSD(0.05)	5.60	NS	3.98	66	2.63
CV (%)	3.71	5.02	16.83	8.96	9.53

Table 2. Cost benefit analysis of hybrid lines of summer tomato at Mymensingh Sadar during Kharif, 2005

Tomato Lines	Gross return (Tk./ha)	*TVC (Tk./ha)	Gross margin (Tk./ha)	B/C ratio
C-36	770000	336950	433050	2.29
C-38	930000	336950	593050	2.76
C-55	1055000	336950	718050	3.13
C-67	695000	336950	358050	2.06

*TVC includes cost of seedling, fertilizer, cowdung, insecticide/fungicide, hormone, man and animal labour cost along with cost of poly tunnel. Price of tomato: Tk. 50.00/kg.

Table 3. Yield and yield contributing character of summer hybrid tomato for the 1st sowing (Sherpur, Kharif, 2005)

Treatment	Plant height (cm)	Fruit/plant (no.)	Fruit weight (g)	Fruit diameter (cm)	Fruit length (cm)	Yield (t/ha)
C 55	1.48	12.20a	43.20a	4.41	4.57	24.73a
C 67	1.50	8.80b	29.80b	4.24	4.37	11.34b
C 36	1.37	6.40c	33.40b	4.20	4.58	11.39b
C 38	1.39	7.40bc	32.80b	4.23	4.78	10.85b
F	NS	**	**	NS	NS	**
CV (%)	5.89	11.87	14.54	4.65	7.80	30.20

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

On-Farm Trial of BARI Tomato Varieties

Abstract

Performance of four tomato varieties was studied at farmers field of Farming system Research and Development (FSRD) site, Kushumhati, Sherpur and Jamalpur (Sadar) and Trishal MLT site, Mymensingh during rabi season of 2005-06. At Sherpur, maximum fruit yield was recorded from BARI Tomato 8 (50.94 t/ha) which was followed by BARI tomato 2 (50.06 t/ha). At Jamalpur Sadar, higher yield was also recorded from BARI tomato 8 with higher BCR (2.77). BARI tomato 8 (Shila) was preferred by the farmers because of their shorter plant size and for its higher yield. At Trishal, BARI Tomato-3 gave the highest yield with BCR 6.99.

Introduction

Tomato is the most important and very widely popular vegetable in Bangladesh. It is moderately high in vitamin A and C, high in cash value and has a high potential for value added in processing. BARI has developed a good number of high yielding tomato varieties with several high quality parameters. These varieties have potential to help generate farmers' income in a very short period time. The present study aims at evaluating the performance of some BARI developed varieties in farmers' field condition and popularize them among farmers' to promote their adoption in SAIP area.

Materials and Methods

The experiment was conducted at Jamalpur Sadar and FSRD site, Kushumhati, Sherpur and MLT site, Trishal, Mymensingh during Rabi season of 2005-06. Four varieties viz. BARI Tomato-2 (Roton), BARI tomato-3, BARI, Tomato-8 (Shila) and BARI Tomato-12 were tested in the farmers' field. The experiment was laid out in RCB design with six replications. The unit plot size was 4.8 m x 1m. with a plant spacing of 60 cm x 40 cm. Twenty five days old seedling were transplanted in the field from December 4-5, 2005. Manures and fertilizer were applied at the rate of 10 tons cowdung/ha, Urea 550 kg/ha, TSP 450 kg/ha and MP 250 kg/ha . Half quantity of cowdung was applied during land preparation. The remaining half of cowdung, the entire amount of TSP and $^1/_3$ each of urea and MP were applied during pit preparation. The rest of urea and MP were applied in two equal installments 21 and 35 days after transplanting. All intercultural operations were done as and when necessary. Tomato harvesting was started February 15 and continued up to March 25, 2006 at Sherpur and Jamalpur whereas at Trishal from 24 February to 21 March 2006. Data were recorded on plant height, no of branch per plant, no of fruits per plant, fruit length, fruit diameter, fruit weight, yield per plant and yield ton per hectare. Data were analyzed statistically and means were separated as DMRT.

Result and Discussion

Jamalpur Sadar

Among the tested varieties significant variation was observed in yield and yield contributing characters (Table1). Due to varietal differences all yield contributing characters did not equally contributed to the yield. The number of fruits/plant (25.17) was significantly highest in BARI Tomato2 (Raton). The plant height was significantly highest in BARI Tomato-12 but BARI Tomato-2 (Raton) produced the lowest (73.00 cm) plant height. BARI Tomato-8 (Shila) produced lowest number of fruits/plant but it gave the highest weight of fruit/plant (1.18 kg). Higher fruit yield (58.99 t/ha) was obtained from the variety BARI Tomato-8 (Shila) and it was statistically identical to the verity BARI Tomato-2 and BARI Tomato-3. The variety BARI Tomato-12 gave the lowest yield (52.50t/ha) but the variety gave reasonable good yield.

Cost and return analysis: Out of the tested tomato varieties highest gross return was obtained from the variety BARI tomato-8 (Shila) which also showed higher gross margin. Higher BCR was recorded from BARI Tomato-8 due to higher yield and benefit. But other variety also showed reasonable yield and benefit.

Kushumhati, Sherpur

Data on different yield and yield contributing characters are presented in table 3. The longest plant was produced by the variety BARI tomato-12 (112.9 cm) but shortest in BARI tomato-8 (Shila). Maximum number of fruits per plant was found in BARI tomato 2 (24.50) and the minimum in BARI tomato-8 (21.00). The weight of fruit per plant was significant and ranged from 0.96 -1.02 (BARI tomato12- BARI tomato-8), respectively. Fruit size varied from 3.14 to 3.48 cm in length and 3.90 to 4.23 cm in diameter. There was no significant difference among the fruit diameter. Fruit yield was maximum in BARI tomato-8 (50.94 t/ha) which was followed by BARI tomato-2 (50.06 t/ha) and the minimum yield was produced by BARI tomato 12 (48.37 t/ha). All the variety performed better with reasonable yield.

Cost and return analysis: Out of the four tested tomato varieties highest gross return was obtained from BARI Tomato-8 (Shila) followed by BARI Tomato-2. Gross margin and benefit cost ratio also higher from BARI Tomato-8 followed BARI Tomato-2. All the verities showed reasonable yield as well as benefit (Table 4).

Trishal, Mymensingh

From the result, it is evident that all the yield contributing characters and yield of the tomato varieties differed significantly. The variety BARI tomato-3 gave significantly better yield and yield contributing parameters except plant height. Plant height was maximum (106.23 cm) in BARI Tomato-12 whereas BARI Tomato-2 was the shorter (73.27 cm) variety. Number of branches/plant was higher in BARI Tomato-3 which was identical to BARI Tomato-2 and BARI Tomato-12. In BARI Tomato-8, number of branches/plant was the lowest (3.03). Number of fruits/plant was higher in BARI Tomato-3 and 2 but BARI Tomato-12 gave the lowest number of fruits/plant (11.5). Weight of fruits/plant was higher (1.22kg) in BARI Tomato-3 which was statistically identical to BARI Tomato-12. But the other varieties gave lower but identical fruit weight. Higher fruit yield was obtained from variety BARI Tomato-3 closely followed by BARI Tomato-12. The former variety showed higher yield due to higher fruits/plant and weight of fruits/plant.

Cost and return analysis: Out of the four tested varieties, BARI Tomato-3 gave higher gross return (Tk.294250/ha), gross margin (Tk.252200/ha) and benefit cost ratio (6.99). Other varieties also gave satisfactory benefit cost ratio (5.12-5.49).

Farmers' reaction

Jamalpur : Farmers are interested to grow BARI tomato 2 because of their better yield and low disease and insect infestation but BARI tomato 8 (Shila) was more preferred by the farmers because of their shorter plant size and for its attractive fruit shape.

Mymensingh : The farmers preferred the variety BARI Tomato-3 for its high yield, good size (elongate), colour, suitable for marketing, transporting, less damage in carrying and handling. The variety BARI Tomato-2 also preferred but its yield was lower than the BARI Tomato-3.

Table 1. Agronomic performance of different BARI tomato varieties at Jamalpur Sadar during 2005-06

Variety	Plant height (cm)	Branch/ plant	Fruit/plant	Fruit length (cm)	Fruit disorder (cm)	Per fruit wt (gm)	Fruit wt/ plant (kg)	Yield (t/ha)
BARI Tomato-2	73 d	2.90	25.17a	4.45c	5.33a	33.51c	1.14a	56.08a
BARI Tomato-3	100b	3.00	23.34b	4.88c	4.04b	35.90b	1.13ab	55.99a
BARI Tomato-8	84.87c	3.01	21.37c	5.38a	4.06b	41.31a	1.18a	58.99a
BARI Tomato-12	137.57a	3.07	23.23b	4.98b	3.96b	33.89c	1.06b	52.5-b
F-test	**	NS	**	**	**	**	**	**
CV (%)	3.44	4.73	6.10	7.77	5.80	4.56	5.40	5.04

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

Table 2. Cost and return analysis of BARI tomato varieties at Jamalpur Sadar during 2005-06

Variety	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
BARI Tomato-2	448640	170000	278640	2.64
BARI Tomato-3	447920	170000	277920	2.63
BARI Tomato-8	471920	170000	301920	2.77
BARI Tomato-12	420000	170000	250000	2.47

TVC includes cost of seedlings, fertilizer, cowdung, insecticide, man and animal labour cost.
Price of tomato: Tk. 8.00/kg

Table 3. Agronomic performance of different BARI tomato varieties at FSRD site, Kushumhati, Sherpur during 2005-06

Treatment	Plant height	Branch/ plant	Fruits/ plant	Fruit length (cm)	Fruit dia. (cm)	Per fruit wt (gm)	Fruit wt/plant (kg)	Fruit yield (t/ha)
BARI Tomato-2	79.67c	2.7c	24.50a	3.14b	4.23	30.53c	0.99ab	50.06ab
BARI Tomato-3	98.89b	3.00b	23.16a	3.35ab	4.04	31.56bc	0.97bc	48.75b
BARI Tomato-8	74.56d	3.27a	21.00b	3.48a	4.00	36.42a	1.02a	50.94a
BARI Tomato-12	112.9a	3.33a	22.58ab	3.39ab	3.90	32.13b	0.96c	48.37b
F-test	**	**	**	*	NS	**	**	**
CV (%)	4.27	6.92	6.78	5.80	7.25	3.67	6.01	6.06

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

Table 4. Cost and return analysis of BARI tomato varieties at Sherpur FSRD Site.

Treatment	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
BARI Tomato-2	400480	170000	230480	2.35
BARI Tomato-3	390000	170000	220000	2.29
BARI Tomato-8	407520	170000	237520	2.39
BARI Tomato-12	386960	170000	216960	2.27

TVC includes cost of seedling, fertilizer, cowdung, insecticide/fungicide, man and animal labour cost.
Price of tomato: TK.8.00/kg

Table 5. Yield and Yield contributing characters of BARI developed high yielding Tomato varieties (Trishal, 2005-06)

Varieties	Plant height	No. of branches /plant	No. of fruits /plant	Wt. of fruits /plant (kg)	Marketable yield (t/ha)
BARI Tomato-2	73.27 c	3.50 a	21.0 a	1.03 b	46.18 b
BARI Tomato-3	96.50 b	3.80 a	21.8 a	1.22 a	58.85 a
BARI Tomato-8	75.23 c	3.03 b	16.5 b	0.97 b	43.05 b
BARI Tomato-12	106.23 a	3.50 a	11.5 c	1.12 ab	54.68 a
LSD (0.05)	4.63	0.44	2.69	0.17	4.79
C V (%)	4.28	10.25	12.34	12.60	7.67

Table 2. Cost and return analysis of different tomato varieties

Varieties	Gross return (Tk./ha)	TVC (Tk./ha)	Gross return (Tk./ha)	BCR
BARI Tomato-2	230900	42050	188850	5.49
BARI Tomato-3	294250	42050	252200	6.99
BARI Tomato-8	215250	42050	173200	5.12
BARI Tomato-12	218720	42050	176670	5.20

AT

On-Farm Trial of Tomato Varieties

Abstract

Six BARI developed Tomato varieties were evaluated for their yield potential at FSRD site Jalalpur and MLT site Moulvibazar during 2005-06. The variety BARI Tomato-8 produced the highest yield at both the locations. The variety has good keeping quality with thick skins.

Materials and Methods

The experiment was conducted at FSRD site Jalalpur and MLT site Moulvibazar during 2005-06. Six Tomato varieties were tested viz. BARI Tomato-2, BARI Tomato-3, BARI Tomato-6, BARI Tomato-7, BARI Tomato-8 and BARI Tomato-12. The seedlings were transplanted on 27-29 November 2005 at FSRD site, on 28-30 November 2005 at MLT site, Moulvibazar.

Results and Discussion

Jalalpur, Sylhet

Higher fruits/plant was recorded from BARI Tomato-2 followed by BARI Tomato-6 and the lowest from BARI Tomato-12. But weight of fruit/plant was obtained from BARI Tomato-7 followed by BARI Tomato-8. Higher yield/plant showed in variety BARI Tomato-8 which resulted higher yield among the variety.

MLT site, Moulvibazar

The variety BARI Tomato-8 showed higher fruits/plant and lowers from BARI Tomato-12 followed by BARI Tomato-6. But the highest weight of fruits/plant was recorded form BARI Tomato-7. The variety BARI Tomato-8 gave higher yield/plant followed by BARI Tomato-7. This two variety showed close and higher yield among the variety.

Conclusion: BARI Tomato-8/7 could be cultivated for higher yield at Sylhet area.

Table 1**.** Yield and yield contributing characters of Tomato varieties during rabi 2005-06

Variety	Marketable fruits/plant	Marketable weight/ fruits (g)	Marketable yield/plant (kg)	Marketable yield (t/ha)
FSRD site, Jalalpur				
BARI Tomato-2	34	81	2.88	88
BARI Tomato-3	26	104	2.83	85
BARI Tomato-6	31	83	2.72	76
BARI Tomato-7	25	122	3.20	96
BARI Tomato-8	29	115	3.45	109
BARI Tomato-12	25	88	2.21	65
MLT site, Moulvibazar				
BARI Tomato-2	23	79	1.93	61
BARI Tomato-3	27	89	2.50	74
BARI Tomato-6	21	80	1.61	51
BARI Tomato-7	24	119	2.95	91
BARI Tomato-8	31	98	3.14	95
BARI Tomato-12	20	83	1.59	47

Adaptive Trial of Improved Varieties of Turmeric

Abstract

The experiment was conducted at Jamalpur and Sherpur during 2005-06 to find out the suitable variety of turmeric. The result showed that both the variety of turmeric (BARI Halud-2 and 3) performed better than BARI Halud-1 and local at both the sites.

Introduction

Turmeric is a very important crop in the vast areas of Jamalpur and Sherpur districts- the operational areas of SAIP. The farmers are still using the traditional varieties of the crop throughout the area. During the recent years, BARI has developed some high yielding varieties of the crop. These varieties, if adopted by the farmers, will help to increase the production of the crops and farmers' income. To evaluate the location specific performance of recommend improved varieties viz. BARI Halud-1, BARI Halud-2, BARI Halud-3 as compared to local one at farm level at FSRD site, Kushumhati, Sherpur and at Jamalpur sadar under SAIP programme during Kharif-I, 2004-05.

Materials and Methods

The trial was conducted at farm level at Farming System Research and Development site, Kushumhati, Sherpur and farmers' field at Jamalpur Sadar under SAIP programme during Kharif-I, 2005-06. Four turmeric varieties viz. i) BARI Halud 1, ii) BARI Halud 2, iii) BARI Halud 3 and iv) Local were planted from 21-27 March, 2005 at different farmer's field across the locations. The plot size was 6.0 x 5.0 m. The seeds were planted in 50 cm x 25 cm apart rows. The trial was set at randomised complete block design with four dispersed replication. Fertilizer was used at the rate of 240, 190, 180, 120, 3, 6000 kg/ha of Urea, TSP, MP, gypsum, Zinc oxide and cowdung, respectively. Half of the amount of urea and the entire amount of cowdung, TSP, MP, gypsum, Zinc were applied at final land preparation. The rest urea was top dressed at 80 and 110 days after planting. Harvesting of the crops was started from 16-27 February, 2006. The recorded data were analysed statistically and means were separated as per DMRT.

Result and discussion

Sherpur: The result obtained from the study indicated that the highest plant height was recorded from BARI Halud-3 and it was statistically similar to BARI Halud-2. BARI Halud-1 and the local varieties produced identical plant height. The number of fingers/plant was found higher in BARI Halud-3 which was similar to that of BARI Halud-2. Though slight higher yield was recorded from BARI Halud-3 but it was statistically at per to BARI Halud-2. But higher yield was recorded from the two varieties than local one.

Jamalpur: Plant height, fingers/plant, yield/plant and yield was significantly influenced by variety. The highest plant height was recorded from BARI Halud-3. There was no significant difference in finger/plant between the two varieties i.e. BARI Halud-2 and BARI Halud-3 but higher than other variety. Similar trend was followed in yield/plant and yield though slightly higher yield was obtained from BARI Halud-2.

Conclusion

Both the variety (BARI Halud-2 & 3) performed better than BARI Halud-1 and local one.

Table 1. Yield and yield contributing characters of turmeric varieties at Sherpur, 2005-06

Variety	Plant height (cm)	Fingers/plant (no.)	Finger yield/plant (g)	Yield (t/ha)
BARI Halud-1	59.7 c	13.3 b	271.1 b	17.73 b
BARI Halud-2	78.4 ab	17.3 a	295.2 a	20.63 a
BARI Halud-3	92.2 a	17.9 a	307.3 a	21.60 a
Local	63.5 bc	10.8 c	201.3 c	12.03 c
CV (%)	**	**	**	**
F	6.85	9.31	9.10	8.63

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

Table 2. Yield and yield contributing characters of turmeric varieties at Jamalpur, 2005-06

Variety	Plant height (cm)	Fingers/plant (no.)	Yield/plant (g)	Yield (t/ha)
BARI Halud-1	61.4 c	11.3 b	225.8 b	15.90 b
BARI Halud-2	75.9 b	17.5 a	291.9 a	19.03 a
BARI Halud-3	93.7 a	15.5 a	267.9 a	18.13 a
Local	61.9 c	9.8 c	188.7 b	10.73 c
CV (%)	**	**	**	**
F	9.36	8.77	10.13	7.73

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

On-Farm Trial of BARI Motorshuti Varieties

Abstract

The experiment was conducted at Melandah, Kushumhati-Sherpur and Mymensingh during the rabi season, 2005-06. The result showed that BARI Motorshuti-3 performed better with higher return in all sites.

Introduction

Motorshuti is a very short duration high value winter crop suitable for generating farmers income in short time. It is a highly liked vegetable both in rural and urban markets. Considering its economic importance BARI made efforts to develop high yielding varieties of the crops and so far recommended three varieties for farmers use. The present study aims at evaluating the performance of BARI developed varieties in farmers field condition and promote their adoption by the farmers is SAIP area during rabi season 2005-06.

Materials and Method

The experiment was conducted at farmers' field of MLT site, Malancha, Melandah and FSRD Site, Kushumhati, Sherpur during the rabi season, 2005-06. Three varieties of Motorshuti were included in the study for evaluating their performance. The seed of the variety IPSA Motorshuti-1 was not available during the experimental period, therefore the experiment was set up with 2 varieties viz. BARI Motosrshuti-1 and BARI Motorshuti-3. But the variety BARI Motorshuti-1 was not germinated. The experiment was laid out in a RCB design with six replications. The unit plot size was 5.0 m x 3.0m with a plant spacing of 20 cm x 15 cm. The seeds were sown on November 21-26, 2005 at Melandah and 17 December at Trishal. Manure's and fertilizer were applied at the rate of 10 tons cowdung/ha, Urea 60kg/ha, TSP 150kg/ha and MP 100 kg/ha. Full cowdung, TSP and half of Urea and MP were applied during land preparation. The rest Urea and MP were top dressed after 20 and 30 days of sowing. All intercultural operations were done as and when necessary. Motorshuti was harvested from 25-30 January, 2006 at Melandah and 23 February 2006 at Trishal.

Results and Discussion

Malancha, Melandah: At Malancha, Melandah 17 plants were germinated per square meter. There was 4.59 pods/plant. Per plant pot weight was 17.60 g. The 100 green pod weight was 210.52 g. and the yield of green pod of BARI Motorshuti 3 was 5.36 t/ha. Gross return, net return and benefit cost ratio from BARI Motorshuti were Tk. 80,400, Tk. 49,293 and 2.58, respectively.

Kushumhati, Sherpur: At Sherpur 25 plants were germinated per square meter. There was 6.40 pods/plant. Per plant pod wt was 24.00 g. The 100 green pod weights was 375.00 g. The yield of green pod of BARI Motorshuti 3 was 6.00 t/ha. Gross return, net return and benefit cost ratio from BARI Mortorshuti-3 were Tk. 90000 Tk. 58894 and 2.89, respectively.

Trishal, Mymensingh: As the germination percentage of BARI Motorshuti-1 was very low which resulted lower plant population. So, yield data and economic data of the variety were not shown in the Tables. Days to maturity of BARI Motorshuti-3 variety was 67 days. It gave higher number of pods/plant and higher pod weight/plant than BARI Motorshuti-1. BARI Motorshuti-3 gave average pods/plant (8.7), weight of pods/plant (275 g) and pod weight (2735). Green pod yield was 5.40 t/ha with net return of Tk. 88100/ha and BCR was 5.43.

Farmers' reaction

Farmers were very much interested to grow the BARI Motorshuti-3 for its higher yield and reasonable economic benefit. Farmers are interested to grow BARI Motorshuti-3 in the next year if seeds are available.

Table 1. Performance of BARI Motsorshuti 3 at MLT site, Malancha, Melandah during 2005-06

Treatment	Plants/ m^2 (no.)	Pods/ plant (no.)	Wt. of 100 green pod (g)	Wt. of 100- green pod (g)	Yield of green plds/ plot (g)	Yield of green pods/ plot (g)
BARI Motorshuti-3	17	4.59	17.6	210.5	8.05	5.36

Table 2. Cost and return analysis of BARI Motorshuti 3 at Malancha, Melandah

Treatment	Gross return (Tk/ha)	TVC (Tk/ha)	Net return (Tk/ha)	BCR
BARI Motorshuti-3	80,400	31,106	49,293	2.58

TVC includes cost of seed, fertilizer, cowdung, insecticide/fungicide, man and animal labour cost.
Price: Motorshuti =Tk.15/kg

Table 3. Performance of BARI Motorshuti-3 at Sherpur FSRD Site during 2005-06

Treatment	Plant/m^2 (no.)	Pods/plant (no.)	Wt. of pods/plant (g)	Wt. of 100 green pod (g)	Yield of green pods/ plot (kg)	Yield of green pod (t/ha)
BARI Motorshuti -3	25.00	6.40	24.00	375.00	9.00	6.00

Table 4. Cost and return analysis of BARI Motorshuti-3 at Sherpur FSRD Site

Treatment	Gross return (Tk/ha)	TVC (Tk./ha)	Net return (Tk./ha)	BCR
BARI Motorshuti-3	90,000	31,106	58894	2.89

TVC includes cost of seed, fertilizer, cowdung, insecticide/fungicide, man and animal labour cost.
Price: Motorshuti Tk. 15/ha

Table 5. Yield and yield contributing characters of BARI Motorshuti (Trishal, 2005-06)

Treatment	Days to maturity	Plant height (cm)	No. of pods/ plant	Wt. of pods/plant (g)	Wt. of 100 green pod (g)	Green pod yield (t/ha)
BARI Motorshuti -1	Harvested before maturity	38.7	4.3	11.83	170	-
BARI Motorshuti -3	67	57.0	8.7	27.17	273	5.40

Table 6. Cost and return analysis of BARI Motorshuti-3 at Trishal

Treatment	Gross return (Tk/ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
BARI Motorshuti-1	-	-	-	-
BARI Motorshuti-3	108000	19900	88100	5.43

On-Farm Trial of Carrot Varieties/Lines at Different Locations

Abstract

An experiment was conducted at Naodhar village of Trishal MLT site under Mymensingh district during rabi 2005-06 to find out the performance of the imported carrot varieties. Out of the three tested varieties, Yellow Roket was agro-economically better than other two varieties (T. Summer and SB-Kurada). It gave 16.70 t/ha of root yield with gross return Tk.167000/ha, gross margin Tk. 114506/ha and benefit cost ratio 3.18. The farmers showed their interest to grow the Yellow Roket variety of carrot for its good economic return.

Introduction

Carrot is one of the most important winter vegetable in Bangladesh. The vast floodplain and the char area of Jamuna and Brahmaputra rivers is specially suitable for the crop. In the recent years, carrot cultivation is becoming popular in this area. Though there is no variety recommended by BARI, some imported varieties are performing well in Bangladesh condition. The present study aims at evaluating the performance of available imported varieties in farmers` field to popularize them among the farmers to promote their adoption in SAIP area. The objectives of the study were:

i) To evaluate the performance of the varieties under farmers field condition
ii) To popularize and promote adoption of suitable varieties in SAIP area.

Materials and Methods

The experiment was conducted at Naodhar village of Trishal MLT site under Mymensingh district during rabi 2005-06 to evaluate the performance of carrot varieties. The design of the experiment was randomized complete block with three replications. The treatments of the experiment were three Japanese carrot varieties namely: i) Yellow Roket ii) T. summer and iii) SB-Kurada. The unit plot size was 4 × 3 m. Seeds were sown on 15 December 2005 at spacing 25× 15 cm following a seed rate of 5 kg/ha. Fertilizers were applied at the rate of 173-30-125 kg / ha of N P K and 10 t/ha of cowdung. The entire quantity of cowdung, P and half each of N and K were applied during final land preparation. The rest of N and K were applied in two equal installments at 3 and 5 weeks after sowing. Intercultural operations were done as and when necessary. The crop was harvested on 7 March., 2006. Data on yield and yield contributing characters were recorded and mean data are presented in the tables. Economic analysis was done on the basis of prevailing market price of input and out put.

Results and discussions

Plant height of the varieties ranged from 31.0-34.5 cm. Length of leaf/plant varied from 22-25 cm and leaf weight/plant varied from 20-21 g. However, length of root varied from 9.0-10.0 cm. Higher root length (10.0 cm) was in the variety Yellow Rocket and lower was in the variety SB-Kurada. The crop was harvested earlier due to picking of the roots by the children. Weight of roots/ plant ranged from 70.0-75.0g. The Yellow Rocket variety had maximum (75g) root weight and SB-Kurada had the lower (70.0 g) root weight/plant. The variety Yellow Rocket had also maximum root diameter (9.0 cm) and root yield (16.70 t/ ha). The variety T.Summer was intermediate in root yield. But the variety SB-Kurada gave the lowest root yield of 14.10 t/ ha.

Out of the three tested varieties, Yellow Rocket gave better economic return than other two varieties. Gross return, gross margin and benefit cost ratio from the Yellow Rocket variety were Tk. 167000/ha, Tk. 114506 / ha and 3.18, respectively which were higher than other two varieties. Due to lower yield in SB-Kurada it also gave the lower (2.68) benefit cost ratio.

Farmers reaction

Farmers were satisfied with the yield of carrot. They also got better price of it (Tk. 10.0 / kg). The farmers faced a problem uprooting of carrot by the small boys and girls to eat when it was not fully matured. They opined that if large scale cultivation initiated then this problem can be overcame. However, the farmers are interested to grow the carrot crop as it has a good price and demand in the local market.

Table 1. Yield and yield contributing characters of different carrot varieties(Trishal, 2005-06)

Varieties	Plant height (cm)	Length of leaf / plant (cm)	Wt. of leaf/ plant (g)	Length of root (cm)	Wt. of root/ plant (g)	Diameter of root/plant (cm)	Root yield (t/ha)
Yellow Roket	33.0	23.0	20.0	10.0	75.0	9.0	16.70
T. Summer	34.5	25.0	21.0	9.5	71.0	8.0	15.20
SB-Kurada	31.0	22.0	20.0	9.0	70.0	7.5	14.10

Table 2. Cost and return analysis of different carrot varieties

Varieties	Gross return (Tk./ha)	TVC (Tk./ha)	Gross margin (Tk./ha)	BCR
Yellow Roket	167000	52494	114506	3.18
T. Summer	152000	52494	99506	2.89
SB-Kurada	141000	52494	88506	2.68

TVC includes cost of seed, fertilizer, insecticide, human labour cost., Price: Carrot= Tk. 10 /kg.

AT

On-Farm Trial of Brinjal Varieties at Different Location

Abstract

The trial was conducted at Melandah, Sherpur and Trishal, Mymensingh during rabi 2005-06 with the objective to find out the suitable variety of brinjal. The result showed that Kazla variety performed better with high yield and BCR at all the sites.

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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 will be put under trial at different locations for their adaptability and acceptability at farmer's level. BARI has already developed early varieties-Kazla and Noyantara. The trial was conducted to observe the performance of brinjal varieties in the farmer's field.

Materials and Methods

The trial was conducted at Multilocation Test Site, Jhenaigati and Melandah and Trishal, Mymensingh during rabi 2005-06. Two brinjal varieties viz. Kazla and Noyantara were transplanted from 9-17 November, 2005 at different farmer's field across the location. The plot size was 5 m x 6 m. The trial was set in six dispersed farmers' field at each location. Fertilizer was used at the rate of 374, 150, 250 kg/ha and 10 t/ha of Urea, TSP, MP and cowdung, respectively. The entire amount of cowdung, 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. Harvested of the fruits were started from 15.02.06 and continued up to 27.04.06. Data were recorded from whole plot basis.

Result and Discussion

Melandah, Jamalpur: Plant height and fruit diameter was higher in Nayantara but other characters were higher in Kazla. Fruits /plants and fruit length was much higher in Kazla which resulted higher yield. Higher gross income and net profit was higher in Kazla.

Jhenaijati, Sherpur: Fruits/plant, fruit length and fruit weight was higher in Kazla but only fruit diameter showed higher in Nayantara. Fruits/plant, length of fruit and diameter resulted higher fruit yield in Kazla. Similarly, gross return as well as gross margin was higher in Kazla variety.

Trishal, Mymensingh: It is evident that out of the three varieties, Kazla gave better yield attributes and yields. Nayantara was intermediate among the varieties. Plant height was the highest (75.9 cm) in Nayantara which was close to Kazla. Number of branches/plant was the highest in Kazla and lowest (5.5) in local. The variety Kazla also gave highest number of fruits/plant (25.8), fruit weight /plant (1.42) and marketable yield (22.05 t/ha). The local variety gave the lowest number of fruits/plant (6.3), fruit weight /plant (0.79 kg) and marketable yield (11.83 t/ha). Brinjal fruit and shoot borer is a common problem in brinjal. However, it was controlled with the application of insecticide. The mature healthy fruits/plot was the highest (839) in Kazla, however it also gave more number of infested fruits/plot (131). In local variety both healthy fruits and infested fruits/plot was lowest (192 healthy and 28 infested) but the Nayantara was intermediate among the varieties. Out of the three varieties, Kazla gave the highest gross return (Tk.176400/ha), gross margin (Tk.138767/ha) and benefit cost ratio (4.69). The Nayantara variety also gave better economic return with benefit cost ratio of 4.19. But the local variety gave the lowest benefit cost ratio of 2.51.

Farmer's reaction

Jamalpur: Farmer's at both sites were satisfied with higher yield in both the variety. But it should be planted early in November for early market.

Mymensingh: The farmers preferred the variety Kazla for its good blackish colour, elongate size and good taste. The colour of local variety is green which is not so preferable. The farmers are interested to grow the BARI varieties specially Kazla in the Trishal area.

Table 1. Yield and yield attributes of brinjal varieties in the farmer's field at MLT site, Melandah, Jamalpur, 2005-06

Treatment	Plants/m^2 (no.)	Plant height (cm)	Fruits/ plant (no.)	Fruit length (cm)	Fruit dia. (cm)	Fruit/ plant wt (kg)	Yield (t/ha)
Kazla	2	70.2	31.3	12.6	3.88	1.82	37.27
Noyantara	2	78.3	17.3	7.2	7.59	1.66	34.10

Table 2. Cost and return performance at Melandah

Varity	Gross return (Tk/ha)	Production cost (Tk/ha)	Gross margin (Tk/ha)
Kazla	2,04,985	56,720	1,48,265
Noyantara	1,87,550	56,720	1,30,830

Price: Tk.5.50/kg

Table 3. Yield of brinjal varieties in the farmer's field at MLT site, Jhenaigathi, Sherpur

Treatment	Plants/m^2 (no.)	Plant height (cm)	Fruits/plant (no.)	Fruit length (cm)	Fruit dia. (cm)	Fruit/plant wt (kg)	Fruit yield (t/ha)
Kazla	2	74.6	36.5	13.3	4.22	2.20	42.86
Noyantara	2	81.4	21.2	8.6	8.76	1.98	38.20

Table 4. Cost and return analysis of brinjal at Jhenaigathi, Sherpur

Varity	Gross return (Tk/ha)	Cultivation cost (Tk/ha)	Gross margin (Tk./ha)
Kazla	2,35,730	62,350	1,73,380
Noyantara	2,10,100	62,350	1,47,750

Table 5. Yield and Yield contributing characters of BARI developed brinjal varieties (Trishal, 2005-06)

Varieties	plant height (cm)	No. of branches/ plant	No. of fruits/ plant	wt of fruits /plant (kg)	Marketable yield (t/ha)	No. of healthy fruits/ plot	No. of infested fruits/ plot
Nayantara	75.9 a	6.7 b	12.0 b	1.29 a	19.73 a	414 b	69 b
Kajla	73.2 a	10.8 a	25.8 a	1.42 a	22.05 a	839 a	131 a
Local	64.8 b	5.5 b	6.3 c	0.79 b	11.83 b	192 c	28 c
LSD (0.01)	8.0	3.25	4.65	0.34	3.38	10.9.9	31.24
CV (%)	4.28	16.17	12.08	10.77	7.23	8.70	15.76

Table 2. Economic performance of different brinjal varieties

Varieties	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Nayantara	157800	37633	120167	4.19
Kajla	176400	37633	138767	4.69
Local	94600	37633	56967	2.51

On-Farm Adaptive Trial of Advanced Lines of Turnip Rape (*Brassica campestris*)

Abstract

The experiment was conducted at Manikganj, Pabna, Jessore, Brahmanbaria, Hathazari, Tangail and Sherpur during rabi 2005-06 to evaluate the performance of advanced promising variety/lines of turnip rape mustard under farmer's field condition. Among the tested variety/lines BCWY-03 gave higher yield at Manikganj, similar yield at Pabna, higher yield in all lines at Jessore, line OTBC-1097 at Tangail and Sherpur and BCWY-03 at Hathazari.

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 Center (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.

Materials and Methods

The experiment was conducted at Manikganj, Pabna, Jessore, Brahmanbaria, Hathazari, Tangail and Sherpur during rabi 2005-06. The design of the experiment was RCBD with 4 replications. Tested variety/lines were BARI Sarisha-9, OTBC-2193, OTBC-1097 (yellow) and BCWY-03. Plot size was $15m^2$. The seed rate was 7 kg/ha. Seeds were sown on 16 November at Manikganj, 16-18 November at Pabna, 20-23 November at Jessore, 21 November at Tangail, 10-14 November at Sherpur and 11 December at Hathazari, 2005 with a spacing of 30cm × 5cm. Fertilizer doses were 120-34-45-29-4-2 kg N-P-K-S-Zn-B/ha. 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 operation was done 18 DAS. The crops were harvested variety wise during 20-27 January at Manikganj, 12-18 February at Pabna, 8-12 February at B. Baria, 8-12 February at Sherpur and 28 February to 3 March at Hathazari, 2006. 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

Manikganj: The variety BARI Sarisha-9 took the shortest time in days to flowering (24) and days to maturity (65). The line BCWY-03 took the longest duration for flowering and OTBC-2193 took the longest time to maturity (Table 1). Plant height was found significantly shorter in BARI Sarisha-9 and the longest in BCWY-03. Plant population was higher in BARI Sarisha-9 and lower in OTBC-2193 and OTBC-1097. Number of pods per plant was found maximum in BARI Sarisha-9 which was statistically identical to BCWY-03 and OTBC-2193. But seeds/pod was the highest in BCWY-03. Thousand seeds weight was not significantly influenced but higher weight from line OTBC-1097 and OTBC-2193. The highest seed yield was obtained from BCWY-03. This yield was clearly influenced by the number of seeds/pod. So, in respect of yield performance the advance line BCWY-03 was found to be superior than that of check variety and others lines.

Jhikargacha, Jessore: Significant differences were observed in case of plant height, number of pods/plant, number of seeds/pod and seed yield except plant population and straw yield among the genotype. There was no significant difference in plant height among the BCWY-03, OTBC-2193 and BARI Sarisha-9 and the lowest from line OTBC-1097. Higher pods/plant was obtained from BARI Sarisha-9 but it was statistically at par to BCWY-03. Significantly the highest seeds/pod was recorded from line OTBC-1097 but higher grain weight was obtained from line OTBC-2193 which was statistically at par to OTBC-1057. Though higher seed yield was recorded from line BCWY-03 but it was statistically identical to OTBC-2193.

Ellenga, Tangail: The result showed that BARI Sarisha-9 and OTBC-1097 was 04 days earlier than that of other two lines. Highest plant height was recorded in line OTBC-1097, which was significantly different from other variety/lines. Significant variation was not observed in plants/m^2. Higher plants/m^2 was counted in the line OTBC-1097 it was significantly was statistically similar to other line /variety. Similar number of pods/plant was recorded from other line and variety except line OTBC-1097. Though lower number of pods/plant was recorded from OTBC-1097 but higher number of seeds/pod was recorded. The line OTBC-1097 showed lowest number of seeds/pod. Significant variation was not observed 1000-grain weight but BARI Sharisa-9 showed lowest seed weight. The line OTBC1097 produced higher grain yield (1.70 t/ha) followed by line BCWY-03 and BARI Sarisha-9. The line OTBC 2193 produced lowest grain yield (1.30 t/ha). The yield was recorded form OTBC 1097 due to higher seed/pod and seed weight. The variety BARI sharisa-09 failed to show higher yield due to lower seeds/pod and grain weight.

Atgoria, Pabna: The line OTBC-2193 took the shortest days to flowering and it was identical to other lines and check variety. The line BCWY-03 and OTBC-1097 took the shortest days to maturity while BARI Sarisha-9 attained maturity with the maximum days (Table 4). Statistically similar response was also observed in case of plant height, plant population, pods/plant, seeds/pod and seed yield. The maximum weight of 1000 grain was recorded in OTBC-1097 which was statically identical to OTBC-2193 followed by BCWY-03. The seed yield obtained from different lines and check variety was similar.

Brahmanbaria: Significant variation was observed in the yield attributes of Turnip rape. Higher plant height was found in OTBC-2193 (98.1 cm), which was identical with BCWY-03 (93.3 cm), lowest plant height was found in OTBC-1097 that was at par with BARI Sarisha-9 (81.1 cm). Pods per plant were also higher in OTBC-2193 that was identical with OTBC-1097. Seeds/pod was highest in OTBC-1097 (30.6) and lower in BARI Sarisha-9. Among the lines OTBC-1097 gave higher seed yield but significant difference was not found.

RARS, Hathazari: Varieties/lines showed significant difference incase of plant height, pods/plant, seeds/pod and seed yield. Plant population was the highest in BCWY-03 line. Number of pods/plant was the highest in OTBC-2193but number of seeds/pod was the highest in OTBC-1097. The highest seed yield was found BCWY-03 with minimum days to maturity.

Kushumhati, Sherpur: The longest plant recorded from OTBC-2193 was similar to OTBC-1097 and differed from other varieties. The highest number of pods/plant was recorded from OTBC-2193. The second highest was from OTBC-1097 and BCEY-03 produced the lowest pods/plant. But the seeds/pod was found highest in OTBC-1097. The similar number was obtained in BCEY-03. However, among all the varieties OTBC-1097 produced the highest yield and was early to mature than the other varieties.

Farmers' reactions

Manikganj : Farmers were shown interest with new high yielding line BCWY-03. Farmers expressed their satisfaction with high yield and non lodging tendency against wind. They were satisfied with the uniform maturity of the line which they could harvest at a time.

Tangail : Farmers showed interest to BARI Sarisha-9 for its short duration and reasonable grain yield. They react positively to OTBC-1097due to higher yield.

Pabna : Farmers shown interest with new high yielding line OTBC-1097 for short duration. Farmers expressed their satisfaction with high yield and non lodging tendency against wind. They were satisfied with the uniform maturity of the line which they could harvest at a time.

B. Baria : Farmers showed better interest to the line OTBC-1097 for its higher yield.

Table 1. Yield and yield contributing characters of different turnip rape mustard varieties/line at MLT site, Manikganj, 2005-06

Variety/line	Days to 50% flowering	Days to 80% maturity	Plant pop. /m^2	Plant height (cm)	No. of pods/ plant	Seeds /pod	1000-grain wt.(g)	Seed yield (kg/ha)	Stover yield (kg/ha)
OTBC-1097	29	69	77	83.2b	60.02b	20.83b	2.90a	822c	1809b
OTBC-2193	29	75	77	83.2b	66.93ab	12.33c	2.90a	878b	1964b
BCWY-03	34	71	78	92.7a	68.25ab	22.53a	2.61b	965a	2177a
BARI Sarisha-9	24	65	83	75.4c	73.7a	11.78c	2.57b	813c	1819b
LSD (0.05)			NS	2.82	10.29	0.89	0.26	55.48	186.4

Table 2. Yield and yield contributing characters of turnip rape at MLT site, Jhikargacha, Jessore during rabi 2005-06

Entries	Plant height (cm)	Plant Pop./m^2 (no.)	Pods/plant (no.)	Seeds/pod (no.)	1000-grain wt. (g)	Seed yield (t/ha)	Straw yield (t/ha)
BCWY-03	109.50a	76	121.00ab	23.75b	2.55bc	1.65a	3.30
OTBC-2193	113.75a	71	93.50b	18.00c	3.03a	1.61ab	2.86
OTBC-1097	90.00b	76	70.00b	32.50a	2.80ab	1.52bc	2.72
BARI Sarisha-9	104.50a	70	167.00a	16.25c	2.30c	1.44c	2.83
CV (%)	5.92	15.64	28.07	5.37	7.71	8.35	25.00
F-test	**	NS	*	**	**	**	NS

Table 3. Seed yield and yield contributing characters of rape Turnip varieties at FSRD site, Ellenga, Tangail, 2005-06

Treatments	Plant height (cm)	Days to maturity	Plants/m^2	Pods/ plant	Seeds/ pod	1000 seeds wt. (g)	Seed yield (t/ha)
OTBC-1097	104	77	105	36	23	4.53	1.70
OTBC-2193	88	80	96	49	12	4.47	1.30
BCWY-03	96	82	114	47	21	4.40	1.50
BARI Sarisha-9	97	77	104	48	21	4.27	1.41
LSD (0.05)	2.58	-	17.97	7.09	2.75	NS	0.39
CV (%)	1.18	-	7.37	6.57	5.87	9.58	12.08

Table 4. Seed yield and yield contributing characters of advanced lines of Turnip Rape at MLT site, Atghoria, Pabna during the rabi season, 2005-06

Treatment	Days to flowering	Days to maturity	Plant height (cm)	Plants/ m^2 (no.)	Pods/ plant (no)	Seeds/ pod (no.)	1000-seed weight (g)	Seed yield (t/ha)
OTBC-1097	38	84 c	88.53	63.7	74.0	31.5	3.8 a	1.32
OTBC-2193	37	90 b	88.05	62.0	75.0	31.5	3.7 a	1.29
BCWY-03	38	84 c	88.05	62.2	75.0	30.2	3.6 ab	1.30
BARI Sarisha-9	37	92 a	88.93	62.5	74.2	30.0	3.4 b	1.31
CV (%)	2.81	0.55	4.17	3.88	3.23	3.43	4.28	4.11
LSD (0.05)	NS	0.765	NS	NS	NS	NS	0.247	NS

Table 5. Seed yield and yield contributing characters of different lines and varieties of turnip rapes at B. Baria during rabi 2005-06

Variety/Line	Population/m^2	Plant height (cm)	Pods/plant	Seeds/pod	Seed yield (t/ha)
OTBC-1097	61	80.10 b	51.90 a	30.60 a	1.42
OTBC-2193	60	98.10 a	56.30 a	20.10 bc	1.33
BCWY-03	60	93.30 a	43.30 b	21.70 b	1.37
BARI Sarisha- 9	61	81.10 b	45.70 b	18.20 c	1.27
LSD (5%)	NS	9.162	5.112	2.633	NS
CV (%)	2.00	5.20	5.19	5.82	6.46

Table 6. Yield and yield contributing characters of different turnip rape mustard at Kushumhati, Sherpur during 2005-06

Treat	Maturity (days)	Plant ht (cm)	Plants/m^2 (no.)	Pods/plant (no.)	Seeds/pod (no.)	1000 seed wt (g)	Seed yield (kg/ha)
OTBC-1097	90	93.30b	65.85	79.85a	22.15a	2.90	1385a
OTBC-2193	91	106.7a	71.15	81.15a	16.20b	2.80	1345a
BCWY- 03	92	104.4a	69.80	69.80b	20.57a	2.75	1253b
BARI Sarisha-9	91	95.32b	76.70	76.70ab	16.35b	2.60	1305a
F	NS	**	NS	**	**	NS	**
CV (%)	4.13	8.32	12.78	12.56	8.76	9.52	9.44

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

Table 7. Seed yield and yield attributes of turnip rape lines and variety at RARS, Hathazari in 2005-06

Variety/line	Plants /m^2	Plant height (cm)	Pod/ plant	Pod length (cm)	Seeds/ pod	1000-seed wt. (g.)	Days to maturity	Seed yield (kg/ha)
OTBC-1097	105.75	91.5b	84.2b	5.2	29.6 a	2.70	76	1225c
OTBC-2193	114.00	118.2a	162.8a	5.5	13.4 c	2.64	83	1662b
BCWY - 03	137.25	114.6a	138.4a	5.3	23.3 b	2.38	77	1812a
BARI Sarisha-9	126.25	109.9a	145.0a	5.4	16.8 c	2.81	78	1650b
CV (%)	12.43	4.70	12.09	7.29	12.69	3.48	2.67	9.12

On-Farm Adaptive Trial of Yellow Seeded Advanced Lines of Mustard (*Brassica juncea*)

Abstract

The study was carried out at Pabna, Jessore, Barisal, Hathazari, Faridpur, Kushtia and Sherpur during the rabi season 2005-06 to evaluate the performance of advanced lines of mustard at different locations. At Pabna Daulat and BARI Sarisha-11 showed similar yield but Daulat 5 days earlier but at Jessore and Barisal the line BJ536 reveals higher yield followed by BARI Sarisha-11, at Hathazari Daulat followed by BJ536, at Kushita and Sherpur, BARI Sarisha-11 performed better.

Introduction

Mustard is one of the most important oil seed crops in Bangladesh giving 65% production among all oil crops (Sufian, 2004). It occupies the highest (812405) acres of land with an annual production of 249080 tons (Anonymous, 2000). Bangladesh is deficit in edible oil, which cost valuable foreign currency for importing seeds and oils every year. The average yield of mustard is only about 740 kg per hectare (Mondal & Wahab, 2001). The reason behind low yield is genetically low yield potential of local varieties and poor management practices. Thus, Oilseed Research Centre, BARI developed different new varieties/lines of mustard to meet the demand. These lines are needed multilocation adaptability test to fit them in specific situation of farming systems before release as variety. Therefore, the study was undertaken with view to evaluate the performance of advanced lines of mustard at different locations of Bangladesh.

Materials and Methods

The study was carried out at Pabna, Jessore, Barisal, Hathazari, Faridpur, Kushtia and Sherpur during the rabi season 2005-06. Two advanced lines BJ-536, BJ-66 (Y) with check variety Daulat and BARI Sarisha-11 were used in the study. The experiment was laid out in randomized complete block design with four replications. The unit plot size was 5m × 3m. The crop was fertilized with 120, 34, 47, 29, 4 and 1.70 kg/ha N, P, K, S, Zn and B, respectively. Half of N and full amount of other fertilizers were applied during final land preparation. Rest half of N was used as top dress. The seeds were sown on 16 November at Pabna, 18 November at Jessore, 11 December at Hathazari, 18 November at Barisal, 30 October to 6 November at Faridpur and Kushtia and 10-13 November at Sherpur, 2005 with 30cm × 5cm spacing. The crop was harvested during 16-22 February at Pabna, 28 February at Barisal, 22 February to 4 March at Hathazari, 21-28 February at Faridpur, 20 February at Kushtia and 8-12 February at Sherpur, 2006.

Results and Discussion

Khaloibhara, Pabna: Significant variation was observed among the advanced lines/varieties regarding yield and yield attributes. The line BJ-66 (Y) took the maximum days to maturity and attained the highest plant height while the shortest days to maturity and the lowest plant height was observed in Daulat. Plant populations were statistically similar in case of all the tested lines/varieties. The highest pod/plant was recorded in Daulat. The lowest pods/plant with maximum no. of seeds/pod was attained in BJ-66 (Y). The lowest number of seeds/pod achieved with BARI Sarisha-11. The bold size seed might have contribution to maximum weight of 1000-seed in BARI Sarisha-11. Higher seed yield was obtained from Daulat which was statistically identical to BARI Sarisha-11 followed by BJ-536. Maximum number of pods/plant might be contributed to higher seed yield in Daulat. The lowest seed yield was attained in BJ-66 (Y).

Kuadabazar, Jessore: Only seed yield and grain weight of different varieties/lines were found significantly different. Higher seed yield (1.60 t/ha) was recorded from BJ-536 followed by BARI Sarisha-11 (1.50 t/ha). The lowest yield (1.18 t/ha) was obtained from Daulat which was identical with BJ-66 (Y). Similar trend was followed in case of grain weight.

Babuganj, Barisal: The maximum plant population were found in BARI Sarisha-11 (52). Significant variations were found in plant height. BARI Sarisha-11 produced the tallest plants (171.50 cm) over other varieties/lines. Flowering was also earlier in BARI Sarisha-11. BJ-66 takes about 7 days more to complete 50% flowering than BARI Sarisha-11. Pod bearing was the highest in BARI Sarisha-11 (256) that was statistically identical with BJ-536 (201) and Daulat (229). The number of seed/pod was the highest in BJ-536 (10.45). Seeds of BJ-536 were bolder (2.72 g/1000-seed) than other varieties/ lines. The yield of BJ-536 (1.61 t/ha) was statistically identical with BARI Sarisha-11 (1.67 t/ha). The yellow seeded lines BJ-66 (1.30 t/ha) performed lower than BARI Sarisha-11 and even Daulat (1.32 t/ha). The released variety BARI Sarisha-11 showed better performance than advanced line and Daulat.

RARS, Hathazari: Plants/m2, plant height, yield and yield attributes were not signficantly influenced by the variety but only seed weight showed signficant effect. Higher seed weight was recorded from BARI Sarisha-11 followed by BJ-536. Though seed yield is lower in BARI Sarisha-11 but 8-11 days earlier than other two lines and Daulat. The variety Daulat and line BJ-536 showed similar and higher yield than line BJ-66 and BARI Sarisha-11.

Kushtia: Among the yield contributing characters, highest no. of siliqua/plant was obtained from BARI Sharisha-11. Seed yield showed higher in BARI Sarisha-11 followed by Daulat. Similar trend was followed in case of BCR

Ishan Gapalpur, Faridpur: Plant height, Plants/m^2, yields and yield attributes was significantly influenced by variety/lines. Plants/m^2 varied significantly where higher population from Daulat followed by BARI Sarisha-11 and the lowest from BJ-66. The highest plant height was obtained from line BJ-66 and other variety/lines were at par. The highest siliqua/plant was recorded from Daulat but line BJ-536 showed higher seed/siliqua followed by Daulat. BARI Sarisha-11 showed higher seed yield weight and this character influence the highest seed yield. Daulat took 5-10 days earlier than other variety/lines but the lowest yield among the tested variety/lines.

Kushumhati, Sherpur: Results obtained from the study indicated that all most all the yield contributing characters were influenced due to variety trial. The highest seed yield was found BJ-535 were similar to BJ-11 and also to BJ-536 and BJ-66. The lowest yield was produced by Daulat. The variety Daulat matured 2-3 days early than the other varieties.

Farmer's reaction

Pabna: Initially the new lines appeared promising but at later stage it does not attract the farmers due to delayed maturity. Sudden rising of temperature hampered grain formation and pod became dry prior to maturity.

Table 1. Yield and yield contributing characters of yellow seeded mustard (*Brassica juncea*) at MLT site, Khaloibhar, Pabna during the rabi season, 2005-06.

Treatments	Days to maturity	Plant height (cm)	Plants/m^2 (no.)	Pods/plant (no.)	Seed/pod (no.)	1000-seed weight (g)	Seed yield (kg/ha)
BJ-536	95b	177 b	96	94.3 b	13.8 b	3.0 b	1863ab
BJ-66 (Y)	98a	189 a	94	88.1 c	14.7 a	2.8 c	1668b
Daulat	83d	150 c	94	139.8a	13.7 b	2.2 d	1990a
BARI Sarisha-11	88c	177 b	95	95.3 b	12.7 c	3.2 a	1915a
CV (%)	0.55	2.30	6.23	3.05	2.40	4.13	7.56
LSD (0.05)	0.80	6.37	NS	5.09	0.53	0.18	224.80

Table 2. Performance of yield and yield contributing characters of mustard varieties/lines at MLT site, Kuadabazar, Jessore during rabi 2005-06

Entries/varieties	Plant Pop./m^2 (no.)	Plant height (cm)	Branch/ plant (no.)	Pods/ plant (no)	Seeds/ pod (no)	1000-gr. wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
BJ-536	64	139.00	3.78	131.50	13.50	2.73a	1.60a	4.13
BJ-66 (Y)	65	161.50	3.75	141.50	13.50	2.10c	1.28b	4.55
Daulat	63	142.25	3.75	132.25	13.25	2.28bc	1.18b	4.67
BARI Sarisha-11	63	139.25	3.25	130.00	13.75	2.45ab	1.50a	4.25
CV (%)	10.13	8.23	18.88	8.96	7.27	7.55	4.96	17.87
F-test	NS	NS	NS	NS	NS	**	**	NS

Table 3. Seed yield and yield contributing characters of mustard varieties/lines at Babuganj, Barisal during rabi 2005-06

Entries/varieties	Days to 50% flowering	Plant/m^2 (no.)	Plant height (cm)	Pods/plant (no)	Seeds/ pod (no)	1000- seed wt. (g)	Seed yield (t/ha)
BJ-536	54	43a	160.67	201ab	10.45a	2.72	1.61ab
BJ-66 (Y)	56	49a	154.33	152b	10.42a	2.45	1.30b
Daulat	51	47ab	159.00	229a	9.85a	1.76	1.32b
BARI Sarisha-11	49	42a	171.50	256a	8.30b	2.56	1.67a
CV (%)	-	5.02	-	4.30	3.53	1.05	6.37

Table 4. Seed yield and yield attributes of rape seed lines and variety at RARS, Hathazari in2005-06

Variety	Days to maturity	Plants /m^2	Plant height (cm)	Pods/plant (No.)	Pod length (cm)	Seeds/pod (No.)	1000-seed wt. (g.)	Seed yield (kg/ha)
BJ-536	81	79.75	200.5	352.3	5.2	14.4	2.92 ab	1941
BJ-66	82	75.75	212.4	349.1	5.1	13.8	2.85 b	1250
Daulat	83	100.75	209.9	334.1	4.8	15.3	2.42 c	1950
BARI Sarisha-11	73	84.25	199.0	310.5	5.2	14.4	3.21 a	1381
CV (%)	4.37	12.80	7.30	8.27	4.26	8.50	3.94	9.87

Table 5. Effect of different varieties on yield and yield components of yellow seeded Mustard at Kushtia during, 2005-06

Treatment	Field duration	Plants /m^2	Plant height (cm)	Siliqua /plant (wt).	Seed / siliqua (No)	1000-seed wt. (gm).	Seed yield (kg/ha)	BCR
BJ-536	106	42	157	125	12	3.23	1.39	1.73
BJ-66	106	43	161	128	12	3.49	1.56	1.90
Daulat	106	43	161	130	13	3.45	1.76	2.12
BARI Sarisha-11	108	44	158	138	13	3.59	1.82	2.20
LSD (5%)	NS	NS	NS	3.5	NS	NS	0.06	

Table 6. Yield and yield attributes of different advanced lines and varieties of yellow seeded Mustard at Faridpur during, 2005-06

Treatment	Plants/ m^2	Plant height (cm)	Siliqua/ plant	Seeds/ siliqua	1000-seed wt. (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
BJ-536	63	140.67	77	10.70	2.52	1362	3210
BJ-66 (Y)	57	176.42	120	12.60	2.05	1124	3230
Daulat	80	134.02	127	12.32	1.82	1062	2530
BARI Sarisha-11	77	135.22	110	11.52	2.87	1745	3099
LSD (0.05)	4.07	4.85	3.14	0.98	0.30	3.09	6.27
CV (%)	12.40	14.90	12.30	2.52	2.05	9.78	12.82

Table 7. Yield and yield contributing characters of different yellow seeded mustard at Kushumhati, Sherpur during 2005-06

Treatment	Maturity (days)	Plant ht (cm)	Plants/m^2 (no.)	Pods/plant (no.)	Seeds/pod (no.)	1000-seed wt (g)	Seed yield (kg/ha)
BJ-535	91a	132.8c	55.9	136.5a	14.7a	3.40a	1321a
BJ-536	91a	137.5b	58.4	137.6a	11.2c	2.80bc	1275ab
BJ-11	91a	141.0a	60.8	117.7c	13.0a	2.55cd	1290a
BJ-66	90a	143.5a	58.6	126.9ab	12.3b	2.30d	1154abc
BARI Sarisha-11	92a	133.7c	55.2	134.5a	11.7bc	3.25ab	1116bc
Daulat	89b	124.7d	51.9	123.9b	12.7b	2.57cd	1093c
F-test	**	**	NS	**	**	**	**
CV (%)	4.26	5.96	9.97	12.92	5.74	8.17	.9.28

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

On-Farm Adaptability Trial of Advanced Lines of Rape Seed (*Brassica napus*)

Abstract

The experiment was conducted at Tangail, Jessore, Pabna, B.Baria, Faridpur and Jamalpur during rabi 2005–2006 to evaluate the performance of advanced promising variety/lines of rape seed under farmer's field condition. Among the tested variety/lines Nap-2001gave significantly higher grain yield (2.13t/ha). The line Nap-179 and BARI Sharisa-9 gave statistically similar grain yield. The results showed that line Npa-2001 and Nap179 were three days earlier than BARI Sharisa-13.

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 Center (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, Ellenga, Tangail during rabi 2005-2006 in farmer's field. The design of the experiment was RCBD with three replications. Tested variety/lines were BARI Sarisha-13, Nap-179 and Nap 2001. Plot size was 6m × 4m. The seed rate was 7 kg/ha. Seeds were sown on 21st November at Tangail, 16 November at Pabna & B. Baria and 10-14 November at Sherpur 2005 with a spacing of 30cm × 5cm. Fertilizer doses were 120–34–45–29–4–2 kg NPKSZnB/ha. 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 operation was done 18 DAS. The crops were harvested variety wise during 17-20 February at Tangail, 17-20 February at Pabna, 13-16 at B. Baria and 8-12 February at Sherpur, 2006. 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

Ellenga, Tangail: Yield and yield attributes were significantly influenced by different lines/variety. The result showed that line Nap-179 and Nap 2001 were three days earlier than that of BARI Sarisha-13. No significant variation was observed in plants/m^2. Initial plants/m^2 was recorded highest from line Nap-179 but Nap-2001 showed lower plants/m^2. Maturity per cent of plants by Nap-179 is more than the other two lines. Highest length of pod was obtained from the line Nap-2001, which was statistically similar to that of line Nap-179. Higher number of pods/plant was recorded from the line Nap-2001, which was statistically different from others, but the line Nap-2001 showed the highest number of seeds/pod. The line Nap-179 showed higher seed weight, but which was statistical identical to other lines/variety. The line Nap-2001 produced higher grain yield (2.13 t/ha) due to higher yield attributes.

Jhikargacha: Plant height and grain weights were significantly influenced by lines/variety. Significantly the highest plant height was recorded from NaPp-179 and other two line/varieties were identical. Though seeds/pod was found insignificant but higher seeds/pod was obtained from line Nap-179. Though seed yield was statistically identical but slightly higher yield was recorded from Nap-179 than BARI Sarisha-13.

Atgoria, Pabna: The result revealed that similar days to flowering were observed in the new lines and check variety. BARI Sharisha-13 took the maximum days to maturity, which was similar to line Nap-2001. Nap-179 took the minimum days to maturity. Plant height and other yield attributes such as plant population, pod/plant, seed/pod and 1000 seed weight were statistically similar for all the tested lines/variety. Similar response was observed in seed yield. However, NAP-179 and BARI Sharisha-13 showed little better performance regarding yield compared to others lines.

Sultanpur, B. Baria: Yield and yield attributes of rapeseed differed significantly among the tested lines except seeds/pod. Plants/m^2 showed higher in Nap-2001 followed by BARI Sarisha-13. But significantly the highest plant height was recorded from BARI Sarisha-13. BARI Sharisha-13 produced highest seed yield (1.82 t/ha) that was statistically identical with Nap-179. Similar trend was noticed in plant height, and pods/plant. The lowest seed yield was recorded in Nap -2001 which was at par with the line NAP-179.

Kushumhati, Sherpur: Results obtained from the study indicated that some of the yield contributing characters was found significant. The highest numbers of pods/plant were noted from Nap-2001. Significantly the lowest numbers were found from BARI Sharisha-13. The similar behaviour were also noted in number of seeds/pod. However, significantly the highest yield was recorded from Nap-2001 and statistically similar to Nap-179. BARI Sharisha-13 produced the lowest yield.

Farmers' reactions

Tangail **:** Farmers showed sought interest to Nap-2001 for its short duration. They react positively to Nap-2001 due to higher yield.

Pabna **:** Farmers' chosen the new lines variety for higher yield and bold seed compared to other local varieties.

B. Baria : Farmers showed better interest to the variety BARI Sharisha-13 for its higher yield.

Table 1. Yield and yield contributing characters of rape mustard varieties at FSRD site, Ellenga, Tangail, 2005-06

Treatments	Plant/m^2		Crop duration (days)	Pod length (cm)	Pods/ plant	Seeds/ pod	1000-seed wt. (g)	Seed yield (t/ha)
	Initial	At harvest						
Nap-179	192	112	84	8.83	105	27	3.90	1.98
Nap-2001	153	120	84	9.20	114	34	3.60	2.13
BARI Sarisha-13	141	92	87	8.30	100	26	3.53	1.90
LSD (0.05)	NS	18.43	-	0.52	5.15	4.60	NS	NS
CV (%)	17.42	7.52	-	2.62	2.14	6.97	4.45	2.63

Table 2. Performance of yellow seeded advanced lines of rape seed (*Brassica napus*) at MLT site, Jhikorgacha during rabi 2005-06

Entries/ variety	Plant/m^2 (no.)	Plant height (cm)	Branch/ plant (no.)	Pods/ plant (no)	Seeds/ pod (no)	1000-seed wt. (g)	Seed yield (t/ha)	Stover yield (t/ha)
Nap-2001	82	112.75b	3.50	86.25	22.00	2.93c	1.65	4.78
Nap-179	83	126.00a	3.25	96.00	27.50	3.20b	1.87	4.34
BARI Sarisha-13	77	113.75b	3.50	93.50	22.50	3.35a	1.82	3.99
CV (%)	20.07	14.55	16.18	15.78	14.30	9.42	10.25	14.24
F-test	NS	*	NS	NS	NS	**	NS	NS

Table 3. Seed yield and yield contributing characters of tested rape seed lines/variety at MLT site, Atghoria, Pabna during the rabi season 2005-06

Treatment	Days to flowering	Days to maturity	Plant height (cm)	Plant/m^2 (no.)	Pods/ plant (no.)	Seeds/ pod (no.)	1000- seed wt. (g)	Seed yield (t/ha)
Nap-179	37.5	93.7b	113.1	65.5	71	32.5	3.6	1.38
Nap-2001	37.0	94.0ab	113.2	63.7	70	33.0	3.7	1.35
BARI Sharisha-13	36.5	95.7a	113.0	65.0	73	32.5	3.6	1.39
CV (%)	2.41	1.16	1.07	1.87	5.45	3.68	4.06	2.81
LSD	NS	1.891	NS	NS	NS	NS	NS	NS

Table 4. Seed yield and yield attributes of different lines and variety of rapeseed at Sultanpur, B. Baria during rabi 2005-06

Variety/Line	Population /m^2	Plant ht. (cm)	Pod/plant	Seeds/pod	Seed yield (t/ha)
NAP-179	59	100.9b	48.97b	25.27	1.60ab
NAP-2001	62	103.7b	48.23b	26.07	1.50b
BARI Sarisha-13	60	108.1a	54.80a	25.30	1.82a
LSD (5%)	2.20	2.88	5.09	NS	0.29
CV(%)	1.61	1.22	4.43	7.04	7.59

Table 5. Yield and yield contributing characters of different rapeseed mustard at Kushumhati, Sherpur during rabi 2005-06

Treatment	Plant ht (cm)	Plants/m^2 (no.)	Pods/plant (no.)	Seeds/pod (no.)	1000 seed wt (g)	Seed yield (kg/ha)	Maturity (days)
Nap-2001	93.7	80.7	80.3 a	27.9 a	3.15	1612 a	89
Nap-179	95.5	80.8	67.9 b	24.5 b	3.35	1548 a	89
BARI Sarisha-13	94.6	79.5	61.6 b	23.7 b	3.62	1427 b	89
F-test	NS	NS	**	**	NS	**	NS
CV (%)	6.33	5.14	11.81	6.13	9.09	10.70	3.12

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

On-Farm Trial of Different Variety of Mustard

Abstract

An on-farm trial was carried out at the FSRD site Golapganj, Sylhet to find out suitable rapeseed mustard varieties for higher yield. Five rapeseed mustard varieties (Tori-7, Rai-5, BARI Sarisha-9, 10 & 11) were evaluated for their yield and other agronomic characters. Higher yield (1260 kg/ha) was recorded from BARI Sarisha-11 followed by BARI Sarisha-10 (1160 kg/ha) and BARI Sarisha-9 (1105 kg/ha). The variety BARI Sarisha-9 showed earlier variety than the other variety.

Materials and Methods

The trial was carried out at the FSRD site Jalalpur, Sylhet during November, 2005 to March, 2006. Five rapeseed/mustard varieties viz. V_1= Tori-7, V_2= Rai-5, V_3= BARI Sarisha-9, V_4= BARI Sarisha-10, V_5= BARI Sarisha-11 were used in the experiment. The plot size was 4m $\times$3m. Fertilizer were applied at the rate of 120-30-60-24-1 kg/ha of N, P, K, S and B, respectively. The seeds are sown on 25 November, 2005. Seeding was in line sowing maintaining 30 cm row to row distance. The crop was harvested during 2nd week of February to 1st week of March, 2006. Data were collected on yield and attributes of rapeseed and mustard.

Results and Discussion

The variety BARI Sarisha-10 and 11 showed higher siliqua/plant as compared to other variety. But higher seeds/siliqua showed in BARI Sarisha-9 followed by Tori-7. Among the variety seed weight reveals higher in BARI Sarisha-11 followed by Tori-7. Seed yield among three varieties BARI Sarisha-9, 10 & 11 gave higher yield and close to each other. Though seed yield was slightly higher but duration 10 days less in BARI Sarisha-9. In Sylhet area, mustard followed by T.Aus so all the tree varieties (BARI Sarisha-9, 10 & 11) could be grown for higher and reasonable yield.

Table 1. Yield and yield contributing characters of mustard varieties at FSRD site, Jalalpur, Sylhet

Variety	Days to maturity	Plant height (cm)	Siliqua/plant (No.)	Seeds/ Siliqua (No.)	1000 seed wt.(g)	Seed yield (kg/ha)
Tori- 7	75	75.65	48.97	15.10	2.97	820
Rai-5	92	119.60	78.12	12.20	1.97	905
BARI Sarisha-9	80	79.48	87.50	16.10	2.82	1110
BARI Sarisha-10	88	98.23	113.52	11.50	2.72	1160
BARI Sarisha-11	98	109.57	104.52	13.43	3.15	1260

On-Farm Adaptive Trial of Advanced Lines of Groundnut

Abstract

The experiment was conducted at farmers' filed at Kishoreganj, Pabna, Faridpur and Rangpur during rabi 2005-06 to evaluate the performance of advanced lines (JX-87015 SL1, ICGV-94322, PK-1, BARI Badam 6 and Dhaka-1) groundnut. The variety BARI Badam-6 and ICGV-94322 showed better performance in yield at Kishoreganj, line JX-87015SL1 at Pabna and Rangpur but all the three variety performed better than line at Faridpur.

Introduction

Groundnut (*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 varieties and advanced lines groundnut on the basis of their performance in the regional yield trials. The yield performance of the selected materials needs to be tested in the farmer's field before recommendation as a variety for cultivation. So, the present study was undertaken to evaluate the performance of these advanced lines of groundnut under farmer's condition.

Materials and Methods

The experiment was conducted at farmers' filed at Kishoreganj, Pabna, Faridpur and Rangpur during rabi 2005-06 to evaluate the performance of advanced lines (JX-87015 SL1, ICGV-94322, PK-1, Jhinga Badam, BARI Badam-6 and Dhaka-1) groundnut. The experiment was conducted in RCB design with four replications. The groundnut varieties were sown at 12 December at Kishoreganj, 30 November at Pabna and 27 December at Faridpur and Rangpur, 2005. The unit plot was 30 m^2 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 earthing up and plant protection measure were done properly. The crop was harvested 5-18 May at Kishoreganj, 15-19 May at Pabna, May at Faridpur and 12-20 May at Rangpur, 2006. 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

Hossainpur, Kishoreganj: The result showed that plant height, pod/plant, kernel/pod, 100-kernel wt., shelling percentage and pod yield were significantly different in groundnut varieties/lines. The higher plant height was recorded from JX-87015 SL1 which was statistically identical to other two lines. Local variety (Dhaka-1) showed higher pods/plant. Shelling percent was statistically at par in all advanced groundnut lines/variety. Higher 100-kernel weight was recorded from BARI Badam-6 which was statistically identical to other two lines of groundnut. Higher pod yield (3.19 t/ha) was obtained from BARI Badam-6 followed by ICGV94322. BARI Badam-6 gave the highest pod yield due to higher 100-kernel weight and shelling percent. The highest gross return (Tk.95700/ha) and benefit cost ratio (2.43) was also recorded from BARI Badam-6. All the three lines failed to show higher yield than existing variety BARI Badam-6.

Kashinathpur, Pabna: The result showed that plant height, pods/plant, seeds/pod, 100-seed wt. and pod yield were significantly different among the groundnut varieties/lines. The highest plant height was recorded from JX-87015 SL1 which was statistically different from other varieties. Cheek variety (Jhinga badam) showed significantly the highest pods/plant but seeds/pod was statistically identical with line JX870155 SL1. Higher 100-seed weight was recorded from variety BARI badam-6 which was statistically different from other varieties. Higher pod yield (3.05 t/ha) was obtained from JX-87015 SL1 which was followed by Jhinga badam.

Ishan Gopalpur, Faridpur: The tested varieties/lines took 129 to 138 days to mature. Dhaka 1 and PK-1 are shorter than other varieties/lines. Plants/m^2, pods/plant, seeds/pod, 100 seed weight and pod yield differed significantly among different varieties/lines of groundnut. The variety Dhaka-1 showed higher pods/plant followed by other lines except Jhinga badam. Seeds/pod was similar in line JX87015 SL1 and Jhinga badam which were higher than other lines/variety. The variety BARI badam-6 showed higher seed weight than all other lines/variety. Pod yield was very close to each other but slightly higher yield was recorded from Dhaka-1.

ARS, Rangpur: The highest plant height (93.13 cm) was found in Jhingabadam that was followed by other variety/lines. The maximum pod per plant was recorded in JX87015-SLI followed by other varieties or line but there was no statistical difference between JX870-SL1 and Dhaka-1. BARI badam-6 (Check varieties) produced lowest pods per plant. In case of seeds per pod and 100-kernel wt there was no statistical difference between JX 470 SLI and Jhingabadam (check). The higher nut yield was recorded in JX 870 SLI that was statistical identical with Jhingabadam (check) and BARI badam-6 (check) while the lowest nut yield was found in Dhaka-1 (check) that was statistical identical with ICGV-94322 and PK-1. ICGV-94322, PK-1 Dhaka-I was very much susceptible to tikka disease and BARI Badam-6, Jhingabadam was less susceptible but JX 870 SLI was very less susceptible to tikka disease.

Farmer's reaction

Kishoreganj : Farmers preferred BARI Badam-6 due to its taste, pod size and colour and less incidence of insect and disease.

Pabna : Farmers opined that some varieties/lines especially PK-1 seed germinations was very poor and also opined that there was incidence of insect and diseases in the new varieties. They said that the taste, pod size and color of ICGV94322 are very good. They choose Jhinga badam and new line JX87015 SL1 for its higher yield.

Conclusion

Existing varieties still shows good performance. So the trial should be conducted further with good quality seed.

Table 1. Performance of advanced groundnut varieties/ lines at Hossainpur MLT site, Kishoreganj, 2005-06

Variety	Plant height (cm)	Pod/plant (no.)	Kernel/pod (no.)	100-kernel wt. (g)	Shelling %	Days to maturity	Pod yield (t/ha)
JX-87015 SL1	58.40a	17.96	2.07	37.67ab	68.33	160a	2.55bc
ICGV-94322	54.70ab	17.40	1.93	31.67b	63.33	158a	2.98ab
PK-1	51.80ab	18.00	1.97	35.66ab	64.33	156a	2.29c
BARI Badam-6	49.30b	16.60	2.33	42.00a	72.00	149b	3.19a
Dhaka-1	52.50ab	21.53	1.93	32.00b	65.67	144b	2.16c
LSD (0.05)	7.32	ns	ns	7.46	ns	2.13	0.53
CV (%)	7.28	7.49	15.52	11.07	6.58	4.68	10.66

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, Hossainpur during 2005-06

Variety	Gross return (Tk./ha)	Total Variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
JX-87015 SL1	76500	39351	37149	1.94
ICGV-94322	89400	39351	50049	2.27
PK-1	68700	39351	29349	1.77
BARI Badam-6	95700	39351	56349	2.43
Dhaka-1	64800	39351	25449	1.67

Price: Groundnut Tk. 30/kg

Table 3. Performance of different varieties/lines of groundnut at Khaloibhara, Kashinathpur, Pabna during 2005-06

Treatments	Plant height (cm)	Plants/m^2	Branches/ plant	Seeds/pod (no.)	Pods/ plant (no.)	100-seed wt. (g)	Pod yield (t/ha)
JX87015 SL1	69.87a	20.00c	5.83ab	2.70a	21.23ab	39.33bc	3.84a
ICGV94322	33.67d	20.67c	6.70a	1.87b	17.03b	45.67b	2.41b
PK-1	42.87c	2.67d	5.70ab	1.60bc	16.73b	40.33bc	0.82c
Jhinga badam (check)	54.60b	33.00a	5.00b	2.80a	30.73a	30.67d	3.05a
Dhaka-1 (check)	45.80c	27.00b	5.43b	1.70bc	15.67b	33.33cd	2.38b
BARI badam-6 (check)	45.53c	18.33c	4.77b	1.47c	14.17b	59.00a	2.15b
CV (%)	8.11	16.25	11.51	7.37	31.56	9.04	25.52
LSD (0.05)	7.18	5.99	1.16	0.27	11.06	6.80	1.29

Table 4. Yield and yield contributing characters of different varieties/lines of groundnut at Ishan Gopalpur, Faridpur during 2005-06

Variety/lines	Days to maturity	No. of plants/m^2	Plant height (cm)	No. of pods/ plant	No. of seeds/ pod	100- seed weight (g)	Pod yield (kg/ha)	Shelling %
JX 87015-SL1	138	106	47.3	16.4	2.62	28.72	1866	33.8
ICGV 94322	138	100	48.5	16.02	1.72	39.45	1820	29.2
PK-1	129	136	54.0	15.32	1.82	33.80	1890	28.4
Jhingabadam	138	144	54.5	14.67	2.62	29.05	1950	32.0
Dhaka 1	129	146	57.5	17.12	1.72	31.70	2010	28.5
BARI badam 6	134	100	49.7	16.35	1.67	43.90	1930	34.2
LSD (0.05)	-	14.0	-	2.3	0.52	3.6	112.0	-

Table 5. Yield and yield attributes of different groundnut varieties /lines at ARS,BARI, Rangpur during Rabi, 2005-06

Varieties/lines	Plant height (cm)	Pods/Plant	Seeds/pod	100-Kermel wt(g)	Shelling (%)	Nut yield (t/ha)
JX870 SLI	92.67a	39.47a	2.62a	48.2a	29.72	3.10a
ICGV94322	56.00d	28.13bc	1.77bc	47.33a	28.16	2.16cd
PK-1	72.06b	27.73bc	1.93b	36.86ab	30.09	2.29bcd
Jhingabadam(check)	92.86a	24.00c	2.53a	47.33a	31.27	2.99ab
Dhaka –1 (check)	64.20c	34.47ab	2.04b	36.86aaa b	29.75	1.85d
BARI china badam-6	64.87bc	21.73c	1.47c	47.03ab	33.09	2.72abc
LSD (0.05)	7.40	9.7	0.39	6.47	NS	0.68
CV (%)	7.5	18.2	10.1	15.5	9.1	14.8

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AT

On-Farm Adaptability Trial Pioneer Hybrid Mustard

Abstract

The experiment was conducted in medium high land at FSRD site of BARI, Ellenga, Tangail during rabi 2005–06 to evaluate the performance of pioneer hybrid mustard under farmer's field condition. Among the tested hybrids including local check, pioneer 45J19 gave significantly highest grain yield (1.93 t/ha) followed by pioneer 15J51 (1.88 t/ha). The local check produced lower yield due to lower yield attributes.

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. Some advanced promising varieties/lines of mustard which possess the high yield and less diseases susceptible and high oil content was imported by Industry identify group. Hence, the study was undertaken to evaluate the performance of advanced lines under farmer's field condition.

Materials and Methods

The trial was conducted at FSRD site, Ellenga, Tangail during rabi 2005-06 in farmer's field. The design of the experiment was RCBD with three replications. Tested lines were Pioneer 15J51, Pioneer 45J19 and local one. The plot size was 6 m × 4 m. The seed rate was 7 kg/ha. Seeds were sown on 14th November 2005 with a spacing of 30cm × 5 cm. Fertilizers such as urea, TSP, MP, Gypsum, Zinc-sulphate and boric acid @ 260-170-90-160-10-10 kg/ha were applied. 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 operation was done 18 DAS. The crops were harvested variety wise during 12-15 February 2006. 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

Yield and yield attributes were significantly influenced by different lines/ variety (Table 1). No significant variation was observed in plant population/m^2. Local check variety of mustard exhibited maximum plant population in both initial and at harvest stage. The higher length of pod was obtained from the line pioneer 45J19 and also produced higher number of pod/plant. No significant variation was observed in case of number of seeds per pod and of 1000-seeds weight but lower 1000-grain weight was produced by local check. The line pioneer 45J51 produced the highest grain yield (1.93 t/ha) among the lines/variety. The line pioneer 45J19 produced higher yield due to higher length of pod, pods/plant and 1000-seed weight. Local check produced lower yield due to lower yield attributes. Both the lines showed almost similar yield and yield attributes with same crop duration.

Farmers' reactions: Farmers react positively to pioneer 45J19 due to higher yield

Table 1. Yield and yield contributing characters of Pioneer (Hybrid) mustard, 2005-06

Treatments	Plant/m^2		Crop duration (days)	Pod length (cm)	Pods/ plant	Seeds/ pod	1000-grain wt. (g)	Seed yield (t/ha)
	Initial	at harvest						
Pioneer 45J19	171	143	93	4.45	122	13	3.65	1.93
Pioneer 15J51	188	139	93	4.30	117	12	3.50	1.88
Local	192	147	90	4.15	98	12	3.20	1.63
LSD (0.05)	NS	NS	-	NS	NS	NS	NS	0.04
CV (%)	2.26	0.76	-	1.69	5.57	2.86	3.13	4.05

Effect of Bio-pesticides in Controlling Leaf Curl Virus of Chilli

Abstract

The experiment was conducted at ARS, Bogra during 2005-06 to find out the effect of biopesticides in controlling vector as well as leaf curl virus of chilli. The maximum infected plants (26.85%) were recorded in untreated control and the minimum infected plants (14.75%) were in Malathion (0.2%). The highest disease reduction (45.13%) over untreated control was obtained from Malathion (0.2%) and the lowest (26.37%) was obtained from cow milk (1:2). The highest yield (18.33 t/ha) was recorded in Malathion (0.2%) and the lowest (11.28 t/ha) was recorded in untreated control. The highest yield (62.53%) increased over untreated control was obtained from Malathion (0.2%) and the lowest (31.93%) was obtained from cow milk (1:2). All the biopesticides resulted least disease incidence and higher yield than control. Among the biopesticides, cow urine (1:1), cow milk (1:1) and neem extract (1:2) showed comparatively better results.

Introduction

Chilli is one of the important spice crop. It is widely grown year long in different areas of Bangladesh. Green and dried fruits of chilli are used as spice in making curries. Different diseases are present in chilli. Yield and cultivated areas of chilli are decreasing day by day due to diseases. Among the diseases, leaf curl virus is a serious disease which is transmitted by white fly (*Bemisia tabaci*). The disease is assumed to cause profuse yield loss. Because of this, the farmers face financial loss every season. So far it is known that the effective control measure of the same is still unknown. The disease may be reduced through vector control. Hence, biopesticides may be used for controlling vector as well as virus of chilli avoiding environmental pollution and health hazards through chemical pesticides. So, the experiment was undertaken to find out the effect of biopesticides in controlling vector as well as leaf curl virus of chilli.

Materials and Methods

The experiment was conducted at ARS, Bogra during 2005-06. The experimental land was well ploughed and properly leveled before bed preparation. Weeds and stubbles were removed from the field. Cow dung @ 10 t/ha, Urea @ 210 kg/ha, TSP @ 330 kg/ha, MP @ 200 kg/ha and Gypsum 110 kg/ha were applied. The experiment was carried out following Randomized Complete Block Design with three replications. Size of the plots was 2.0 m × 2.0 m. BARI marich 1 (Bangla lanka) was used in this experiment. The plants were transplanted on November 16, 2005. Plant spacing was 50 cm x 40 cm. Nine treatments including control were cow urine (1:1) spray, cow urine (1:2) spray, cow milk (1:1) spray, cow milk (1:2) spray, chilli dust (100g/L water) spray, neem extract (1:2) spray, garlic extract (1:2) spray, Malathion (0.2%) spray and untreated control. The treatments were sprayed four times at an interval of 15 days. Intercultural operations were done as per needed and to maintain the normal hygienic condition of crop in the field. The last harvest was performed on May 8, 2006. Data were recorded on percent of infected plants, number of fruits per plant, weight of fruits per plant, plant height at harvest and yield. The recorded data were analyzed statistically to find out the level of significance and the variations among the respective data were compared following Duncan's New Multiple Range Test (DMRT).

Results and Discussion

Results of biopesticides in reducing leaf curl virus of chilli are presented in Table 1. Infected plants were significantly affected by biopesticides. Infected plants ranged from 14.75 to 26.85%, where the maximum infected plants were recorded in untreated control which was significantly different from all other treatments. The minimum infected plants were in Malathion (0.2%). The highest disease reduction (45.13%) over untreated control was obtained from Malathion (0.2%) and lowest (26.37%) from cow milk (1:2).

Results of biopesticides on number and weight of fruits per plant and plant height of chilli are presented in Table 2. Biopesticides showed significant effect on number and weight of fruits per plant of chilli during harvest. The highest number of fruits per plant (95.67) and weight of fruits per plant (119.58 g) were recorded in Malathion (0.2%) which were significantly different from other treatments. The lowest of these parameters were in untreated control. Plant height was not statistically significant among the treatments. Maximum plant height (55.30 cm) was obtained from cow urine (1:2) and the lowest (52.60 cm) from control.

Yield was significantly influenced by the biopesticides from the control plot. The yield of chilli ranged from 11.28 to 18.33 t/ha, while higher yield was obtained from Malathion (0.2%) followed by cow urine and neem extract. The lowest was obtained from untreated control. The highest yield (62.53%) increased over untreated control was recorded in Malathion (0.2%) and the lowest (31.93%) from cow milk (1:2).

Relationship between disease incidence and yield using biopesticides against leaf curl virus of chilli are shown in Figure 1. The relationship of yield was negatively correlated (r= -0.9816**) with disease incidence. The regression lines indicate that with the increase of disease incidence decreases the yield of chilli. The relationships were also expressed in the form of regression equation y= -0.5759x + 26.576.

Conclusion

It is revealed that from the study, all the biopesticides resulted least disease incidence and higher yield than control. The highest disease reduction was obtained from Malathion (0.2%) and the lowest from cow milk (1:2). As a result, higher yield was recorded in Malathion (0.2%) followed by cow urine (1:1), cow milk (1:1) and neem extract (1:2). So, the cow urine (1:1), cow milk (1:1) and neem extract (1:2) may be sprayed for controlling vector as well as leaf curl virus of chilli.

Table 1. Effect of biopesticides in reducing leaf curl virus of Chilli

Treatment	% infected plants	Disease reduction over control (%)
Cow urine (1:1) spray	16.45 bc (4.05)	38.79
Cow urine (1:2) spray	18.89 b (4.34)	29.69
Cow milk (1:1) spray	17.55 bc (4.19)	34.69
Cow milk (1:2) spray	19.78 b (4.44)	26.37
Chilli dust (100g/L water) spray	17.25 bc (4.15)	35.81
Neem extract (1:2) spray	16.90 bc (4.10)	37.11
Garlic extract (1:2) spray	17.77 bc (4.21)	33.87
Malathion (0.2%) spray	14.75 c (3.84)	45.13
Control	26.85 a (5.18)	--

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance, Data indicate in parenthesis square root transformation of % infect plants of chilli

Table 2. Effect of biopesticides plant height, yield attributes and yield of Chilli (ARS, Bogra, 2005-06)

Treatment	No. of fruits/plant	Wt. of fruits/plant (g)	Plant height at harvest (cm)	Fruit yield (t/ha)	Yield increased over control (%)
Cow urine (1:1) spray	86.95 b	110.18 b	53.67	17.47 a	54.91
Cow urine (1:2) spray	85.70 b	107.24 c	55.30	15.76 a	39.74
Cow milk (1:1) spray	87.25 b	109.06 b	52.95	16.76 a	48.61
Cow milk (1:2) spray	83.33 b	104.16 d	53.26	14.88 a	31.93
Chilli dust (100g/L water) spray	85.34 b	107.08 c	54.25	15.77 a	39.83
Neem extract (1:2) spray	88.45 b	110.56 b	54.39	16.98 a	50.56
Garlic extract (1:2) spray	85.29 b	106.20 c	54.80	16.25 a	44.08
Malathion (0.2%) spray	95.67 a	119.58 a	53.49	18.33 a	62.53
Control	69.95 c	89.44 e	52.60	11.28 b	--
F-Test	*	*	NS		

Means bearing same letter(s) within same column do not differ significantly at 5% level of significance, NS=Not significant

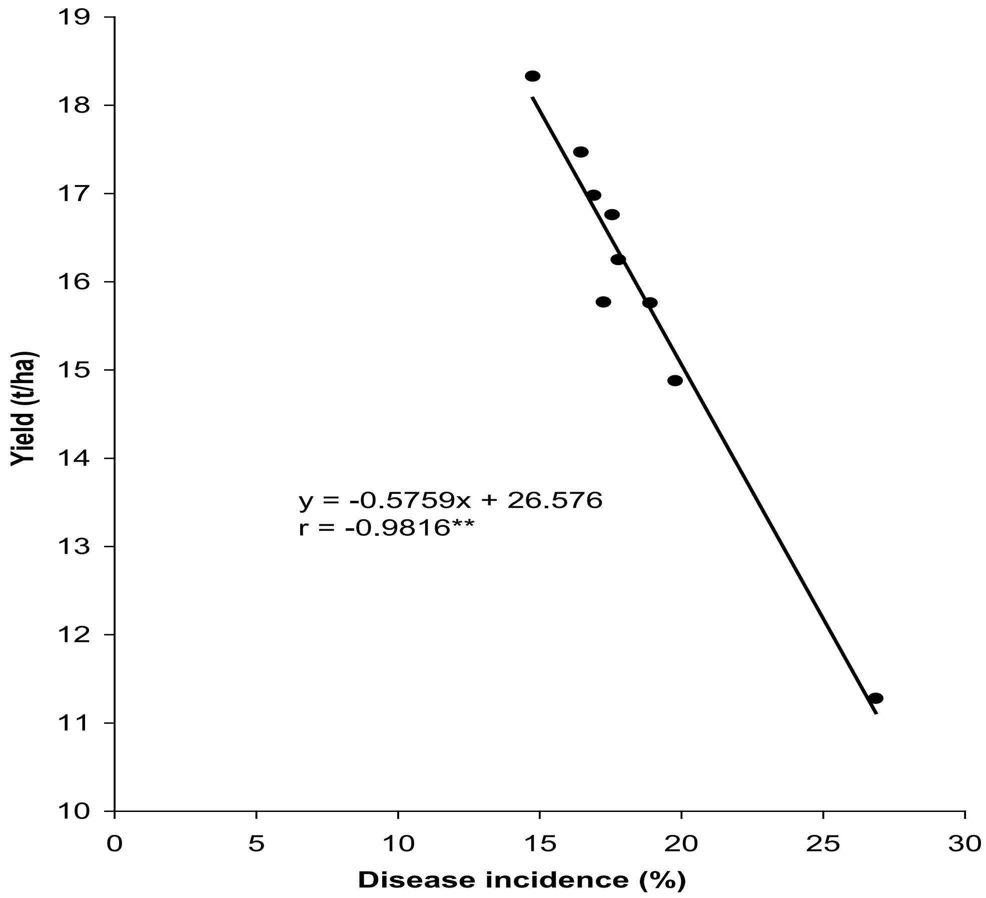

Figure 1. Relationship between disease incidence and yield using biopesticides against leaf curl virus of chilli

Cucurbit Fruit Fly (*Bactrocera cucurbitae*) Management with the Joint Effort of Poison Bait and Pheromone Mass Trapping

Abstract

The trial was conducted in medium high land at MLT sadar, Tangail under Agro Ecological Zone-8 during November to May 2005-2006 to observe the performance of pheromone and bait trap on cucurbit at farmers field condition. Highest number of fresh fruits was obtained from treatment T_1 and also gave highest BCR. Than other treatment less percent of infested fruit was produced by the treatment T_1.

Introduction

Fruit fly is the major insect-pest of cucurbits in Bangladesh. Due to the attack of this insect-pest, 10 to 60% crop losses may occur. Therefore, the present study has been initiated to develop the management tactics against cucurbit fruit fly with the following objectives-

1. To reduce fruit fly infestation
2. To increase marketable yield by reducing fruit fly infestation in cucurbit
3. To conserve natural enemy population by reducing insecticide use in cucurbit field

Materials and Methods

The experiment was undertaken in medium highland under irrigated condition at farmer's field of MLT site, Tangail sadar during kharif 2005-2006. Local cultivator of sweet gourd, ash gourd and cucumber were used in this trial. The experiment was laid out in randomized complete block design with 3 replications. Three treatments viz. T_1 = 50% Bati trap + 50% pheromone trap, T_2 = Farmers practices and T_3 = Absolute control were in this experiment. The plot size was 5× 4 m^2 and spacing was 2 m × 2 m between rows and hills, respectively. Seeds of all three crops were sown on 11–12th November 2005. Three times irrigation and two times weeding were done. Harvesting was done on 15th April to 16th May 2006. The data on different plant characters and yield components were collected from 5 plants selected at random and yield was calculated plot wise. Data were analyzed and compiled tabular from to present.

Results and Discussions

Sweet gourd*:* Significantly variation was found among the treatments. Maximum number of fresh fruits was produced by the treatment T_1, which was statistically difference from other two treatments. The lowest number of fresh fruit produced by the treatment T_3 (absolute control). The lowest number of infested fruits was produced by treatment T_1 but absolute control treatment produced minimum number of infested fruits. Minimum per cent of infested fruits was harvested from the treatment $T_{1.}$ but at par to T_2.

Ash Gourd: Treatment T_1 (50% bait trap + 50% culture trap) gave maximum number of fresh fruit and minimum number of infested fruit, ultimately less percent of infestation was observed in the same treatment. Treatment T_3 (Absolute control) performed badly in the field condition and produced maximum number of infested fruit and highest per cent of infestation was observed.

Cucumber: Less percent of infestation, minimum number of infested fruits and good number of fresh fruits was produced by the treatment T_1, which was statistically difference from other treatments.

Cost and return analysis

Cost and return was calculated crop wise and only benefit cost ratio was presented in Table 2. Among the three treatments, T_1 treatment gave higher benefit cost ratio than other treatments in case of all three crops. Though, variable cost was higher in T_1 but due to higher gross return and margin it gave higher BCR.

Table 1. Effect of pheromone on the production of sweet gourd, ash gourd and cucumber

Treatments	Sweet gourd			Ash gourd			Cucumber		
	Fresh fruits/ plot	Infested fruits/ plot	% Infestatio n	Fresh fruits/ plot	Infested fruits/ plot	% Infestation	Fresh fruits/ plot	Infested fruits/ plot	% Infestation
T_1	32	2	6	224	35	16	223	11	5
T_2	25	4	16	142	46	32	158	29	18
T_3	20	9	45	97	66	68	98	54	55
LSD (0.05)	2.72	1.52	-	38.58	8.36	-	9.82	10.37	-
CV (%)	4.53	11.64	-	11.01	7.55	-	2.71	14.55	-

Table 4. Benefit cost ratio of treatments in different crops

Treatments	Benefit Cost Ratio		
	Sweet gourd	Ash gourd	Cucumber
T_1	2.71	3.57	3.10
T_2	2.56	3.00	2.80
T_3	2.53	2.50	2.25

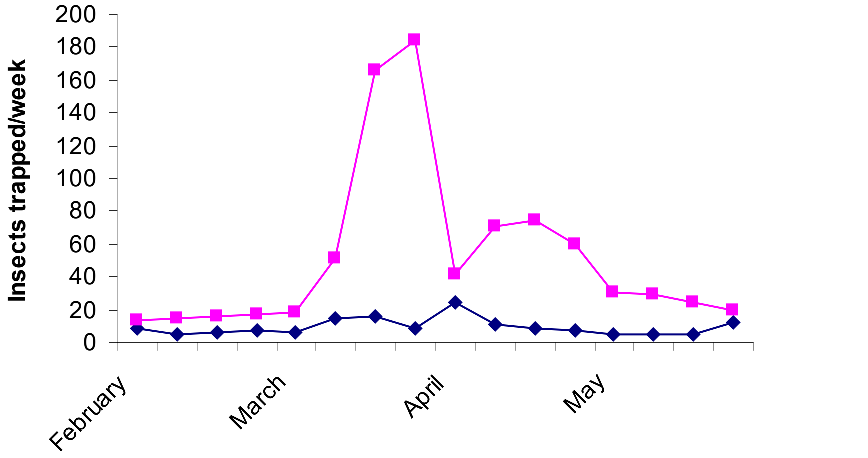

Fig. Trapping performance of bait and pheromone trap

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Effect of Rovral on the Disease Free Quality Seed Production of Onion

Abstract

An experiment was conducted at Faridpur during 2005-06 to find out the disease free onion seed production. The result showed that score or rovral colane with redomil is effective to control purple blotch for onion seed production.

Introduction

Although onion is an important spice crop, its production is not enough to meet the country's need. Every year huge amount of onion is being importedfrom neighbouring countries with exchange of foreign currency. Seed is one of the major critical input for onion cultivation. Alternaria leaf blotch caused by *Alternaria porii* is responsible for the low per acre seed production of onion. It can be efficiently managed by the application of fungicide rovral. However the technology is still not widely adopted by the farmers. So, large scale demonstration of rovral use on farmers's field will help to disseminate the technology to the farmer's level. With this view in mind, the trial was conducted with the objectives to produce disease free healthy seed in farmer's field and to disseminate the technology among the onion seed producers.

Materials and Methods

The experiment was conducted at FSRD site, Ishan Gopalpur, Faridpur during the rabi seasons of 2005-06 in RCB design with 4 dispersed replication. The soil of the experimental field belongs to AEZ 12 of Low Ganges River Floodplain soil with loamy to clay loam texture. Four treatments were used in the experiment, viz. i) Rovral applied @ 2 g/ litre water at 10 days intervals, ii) Rovral @ 1g /litre + Redomil @ 1 g /litre of water, iii) Score 1 ml in 5 litre water for 5 deci. land (only in 2005-06) and iv) Control. The unit plot size was 4m x 4m. The chemicals were sprayed 4 times during the growing period. Fertilizers were applied @ 160-96-80-18-5-1 kg N-P-K-S-Zn-B/ha. The onion bulb was transplanted on 23 Nov., 2005 and harvested on 28 March, 2006.

Results and Discussion

Plants/m2 and plant height was not significantly influenced by the treatment. But seed weight and seed yield showed significant effect on fungicide spraying. There was significant different in seed weight among fungicide spray but lower seed weight from control treatment. Treatment T_1, T_2 and T_3 showed similar and identical yield which were higher than control. Seed yield increased 27, 27 and 20% from treatment T_2, T_3 and T_1, respectively. Both the fungicide (score or rovral) are effective in controlling leaf blotch disease in onion for seed production.

Farmers reaction: Farmers are positive response in applying fungicide for onion seed production and they like score fungicides.

Table 1. Seed yield of onion as affected by spraying of different fungicides at Ishan Gopalpur, Faridpur during 2005-06

Treatments	No. of plants/m^2	Plant height (cm)	1000-seed wt. (g)	Seed yield (kg/ha)	Yield increase (%)	Disease score (1-9)
T_1= Rovral @ 2 g/litre water	62.25	68.60	3.05a	418.3a	20	3
T_2= Rovral 1 g/litre + Redomil 1 g/litre water	59.25	64.35	3.08a	445.5a	27	2
T_3= Score (Syngenta)	59.50	66.67	3.08a	446.0a	27	2
T_4= Control	59.00	72.45	2.83b	350.8b	--	6
CV (%)	3.6	20.6	4.9	3.4		

Disease free Radish Seed Production

Abstract

The experiment was conducted at OFRD, Rangpur during rabi 2005-06 to control the disease and as well as production of quality seed. The combination of Rovral 50 WP (@ 2 gm/lit. water) spraying at 10 days interval with Boric Acid (10 kg/ha) and $ZnSO_4$ (10 kg/ha) produced 1979.11 kg seed producing higher quantity seed yield of radish while Rovral 50 WP (@ 2 gm/lit. water) at 15 days interval with. Boric acid (10 kg/ha) & $ZnSO_4$ (10 kg/ha) and Rovral 50 WP combination with no boron & Zinc produced 1844.93 kg/ha and 544.60 kg/ha seed respectively.

Introduction

Alternaria leaf spot of radish caused by *Alternaria raphani* is an important disease of radish. The yield and quality of seeds is reduced due to its attack. On the other hand, Agro ecological zone # 3 in very much boron and zinc deficit area which affects the quality radish seed production also. So disease free as well as quality seed production is important for the commercial production of radish. That's why, the study was undertaken to control the disease as well as production of quality seed.

Materials and Methods

The experiment was conducted at OFRD, Rangpur during rabi 2005-06. The design was Randomized Complete Block Design with three replications. The unit plot size was 3m × 3m. The variety was Tasakisun with spacing 50cm × 30cm. Seeds were sown on 02 November, 2005 at seed bed and transplanted on 13 December, 2005 in main field. The treatments were : i) No Rovral 50 WP + B_0 Zn_0, ii) No Rovral 50 WP + B Zn, iii) Rovral 50 WP (spraying at 15 days interval) + B_0Zn_0, iv) Rovral 50 WP (spraying at 15 days interval) + B Zn, v) Rovral 50 WP (spraying at 10 days interval) + B_0 Zn_0, vi) Rovral 50 WP (spraying at 10 days interval) + B Zn. The dose of boric acid as boron source 10 kg/ha and $ZnSO_4$ for Zinc source 10 kg/ha which were applied during final land preparation along with other fertilizers.

Results and Discussion

Effect of B & Zn: There was no effect of B and Zn in controlling Alternaria leaf spot of Radish but 1000 seed Weight and seed yield was positively influenced by boron and zinc.

Effect Rovral 50 WP: Rovral 50 WP effectively controlled Alternaria leaf spot disease as a result the life span of crop become longer which increased the 1000 seed weight as well as yield. Rovral 50 WP at 10 days interval spraying performed better compared to 15 days interval spraying.

Effect Rovral 50 WP + B Zn: Combination of Rovral 50 WP with B Zn effectively controlled the disease. It increased significantly the life span of crop, 1000 seed weight and seed yield. The spraying of Rovral 50 WP at 10 days interval with B and Zn showed the highest performance in controlling disease and production of quality seed.

Conclusion

The combination of Rovral spraying at 10 days interval with boric acid (10 kg/ha) and $ZnSO_4$ (10 kg/ha) could be recommend to Alternaria leaf spot disease control for producing higher quantity of quality seed yield of radish.

Table 1. Effect of different combinations (Rovral 50 WP + B Zn) for Alternaria disease free radish seed production

Treatment	% Leaf area Infection	% Siliqua surface area infection	Days to maturity	1000-seed wt. (g)	Seed yield (kg/ha)
R_0 B_0 Zn_0	85.00a	77.00a	124c	8.80d	544.60e
R_0 B Zn	82.00a	74.00a	130c	11.24c	710.38d
R_{15} B_0 Zn_0	2.60b	2.20b	143b	11.58bc	761.03cd
R_{15} B Zn	1.66b	1.14b	147b	15.05a	1844.93b
R_{10} B_0 Zn_0	0.86b	0.79b	150b	12.06b	817.22c
R_{10} B Zn	0.70b	0.58b	162a	15.70a	1979.11a
CV (%)	11.40	9.6	2.8	3.4	3.8
LSD (5%)	5.99	4.55	7.26	0.78	76.38

Field Performance Evaluation of Power Tiller Operated Inclined Plate Planter

Abstract

A field performance evaluation of power tiller operated inclined plate planter was tested at MLT site, Sherpur, Bogra for maize planting. BARI hybrid maize-3 was planted during the Rabi season of 2005-06. It was observed that the use of inclined plate planter was highly profitable as compared to traditional hand planting method of Maize planting.

Introduction

Line sowing of different field crops contributes to higher yield and involves less cost. Still the farmers of Bangladesh practicing traditional broadcast method of sowing for different crops. To take the full advantage of line sowing a seeder of good performance is also very important which can reduce seeding cost significantly. Considering all these, BARI has developed a power tiller operated inclined plate multicrop planter. The planter has been tested for planting maize and wheat at BARI experimental plot, Joydebpur, Gazipur. The performance of the planter is satisfactory. Now it needs to be tested in farmer's field at different soil type and field condition. So the present study has been taken to

1. Evaluate the field performance of the planter,
2. Compare the planter performance with traditional method and
3. Compare the cost of cultivation by different methods

Materials and Methods

The inclined plate planter is tested at MLT site, Sherpur to plant maize seeds during the Rabi season of 2005-06. To compare the performance of plate planter with traditional practice of maize production with mechanical method, control (check) treatment also included in the program. The land area under study was 104 decimal of which 90 decimal for plate planter and 14 decimals for mechanical or traditional method. Seeds were sown by plate planter and mechanical/traditional method (line sowing) on 28-29 Dec.05. The crop was fertilized with 75-105-90-105 kg urea, TSP, MP and Gypsum per hectare. Intercultural operations were applied as and when necessary. The crop was harvested on 2nd may/2006.

Results and Discussion

The higher grain yield (7.74 t/ha) was obtained from inclined plate planter planting which was about 9% higher than the traditional hand planting (7.13 t/ha) method. Economic analysis revealed that higher gross return (77090 Tk/ha), gross margin (73363 Tk./ha) and marginal rate of return (20.68 Tk./Tk invest) were obtained from inclined plate planting method. It was also observed that total variable cost (Tk. 3727/ha) for inclined plate planter method was about 83% less then that of traditional planting method (Tk. 6829/ha). So from the above discussion it is clear that the use of inclined plate planter operated by power tiller for maize planting is profitable as compare to traditional hand planting method.

Farmer's reaction

The farmer's were very much impressed with performance of BARI developed inclined plate maize planter and they showed their eager to have the planter.

Table 1. Comparative statement of different variable operations/material for the methods of seedling maize at MLT site, Sherpur, Bogra

Treatment	Quantity of seed (kg/ha)	Depth of seedling (mm)	Days to emergence	Gap filling (%)	Thinning (%)	Remarks
Inclined plate planter (IPP)	52	50	11	5	78	
Traditional hand planting (THP)	63.5	62	12	2	-	

Table 2. Comparative statement of the performance of inclined plate planter and tradition production practice at MLT site Sherpur, Bogra

Treatment	Area covered (ha)	plant height (cm)	Plants/ m^2	Cob length (cm)	1000 grain wt.(g)	Grain yield (t/ha)	Stover yield (t/ha)	Yield increase (%)
Inclined plate planter (IPP)	0.36	262.3	6.33	20.4	284	7.74	7.43	9%
Traditional hand planting (THP)	0.05	246.2	5.33	19.2	282	7.13	6.47	-

Table 3. Partial Budgeting of different planting method of maize at MLT site, Sherpur, Bogra

Item		Inclined plate planter	Traditional hand planting	Remarks
1. Planting cost (Tk./ha)		215.00	1985.00	Labour, power etc.
2. Seed cost (Tk./ha)		2600.00	3175.00	
3. Cost of Gap filling (Tk./ha)	Seed	130.00	62.00	
	Lab.	268.00	107.00	
4. Cost for Thinning (Tk./ha)		300.00	-	
5. Cost for earthing up (Tk./ha)	Fuel	64.00	-	
	Lab.	150.00	1500.00	
		3727.00	6829.00	
6. TVC (Tk./ha)		3727.00	6829.00	
7. Gross return (product + by product) (Tk../ha)		77090.00	70640.00	
8. Gross margin (Tk./ha)		73363.00	63811.00	
9. MRR (Tk./Tk. investment)		20.68	10.80	

Field Performance Evaluation of BARI Developed Power Tiller Operated Maize Planter and Power Operated Maize Sheller

Abstract

The on-farm verification of BARI developed power tiller operated maize planter and power operated maize Sheller compared with farmers' practice were evaluated at the farmers' practice at Jamalpur and Sherpur districts during Khafif-1 season, 2005 and Rabi season, 2005-06 under the SAIP farmers of the project area. The soils of Sherpur were lighter soil than the soils of Jamalpur. Due to the soil variation and relatively less time required for the crop, the yield was also lower than Jamalpur. During Kharif-I season in Jamalpur all the yield and yield contributing characters were higher than Sherpur. The yield obtained at Jamalpur was about 6.88 t/ha in mechanical method while the farmers' practice produced 6.02 t/ha. The percent of yield increased over farmers' practice by the mechanical method was about 14.29. The gross return was higher in mechanical method compared to farmers' practice. Besides, variable cost was also lower in mechanical method than the farmers' practice due to less labour a less time required in cultivating the crop. On the other hand, in farmers' practice, more labour was required both for planting and shelling of the crops. As a result benefit cost ratio was higher in mechanical method than the farmers practice. But at Sherpur the same phenomenon accused but the yield increased by mechanical method was 7.98% over farmers practice. But in rabi season, 2005-06 the yield obtained at Jamalpur was lower due to partially damaged by hailstorm at pre-mature stage. The Gross return and net return was higher in mechanical method compared to farmers' practice in both the sides. Besides, variable cost was also lower in mechanical method than the farmers' practice due to less labour and less time required in cultivating the crop. In participatory research and development (PR&D) programme, there was needed farmers motivation through group discussion, field day and rally.

Introduction

Maize is one of the most important cereal crops in the world both as food for human and feed for animals. It is very high yield potential crop. It is most efficient crop which can give high biological yield as well as grain yield relatively in a shorter period of time due to its unique photosynthetic mechanism. It is the third important cereal crop in Bangladesh after rice and wheat. This crop has been included in the crop diversification and intensive cropping programme. Its area and production is increasing sharply day by day due the revolutionary success in the poultry industry where it is used as concentrate feed for poultry birds.

Line sowing of maize contributes to higher yield and involves less cost. Still the farmers of Bangladesh practicing traditional line sowing method. To take the full advantage of line sowing. BARI has developed a power tiller operated inclined plate maize planter, a upland weeder and power maize Sheller. This machine has already been tested in farmers field and performance of the planter was found satisfactory. Now it needs to be tested in farmers filed at different soil type and field condition extensively. Keeping this view in mind, the trial was undertaken with SAIP farmers of Jamalpur and Sherpur districts to evaluate the field performance of power tiller operated inclined plate planter for planting maize, to compare the machine performance with traditional method and also to compare the cost of cultivation and shelling by different methods during the summer (Kharif- 1) season, 2005 and Rabi season, 2005-06.

Materials and Method

The on-farm verification of BARI developed power tiller operated maize planter and power operated maize Sheller was conducted at the farmers' field at Jamalpur and Sherpur districts during the Kharif-1 season, 2005 and Rabi season, 2005-06. Six farmers were selected from two districts. In selecting the farmers, a group meeting was arranged where the farmers were informed about the advantages of the machine planting with the comparison of the farmers' practice. They were convinced and finally the farmers were selected. The trial plot was about of 1500m^2 which was divided in two equal parts in which one plot was planted by the farmer of his own method. In the machine planted method, a special device was made in which maize planter was attached with the power tiller and calibrated seeds were sown at a spading 75cm × 25 cm. A special device was also made by a roller to cover the seeds just after sowing. In this method 2-3 seeds were put in each plant distance. So, the seeds required per hectare as about 12kg. In the farmers practice, farmers made the row by the country plough and the seeds were sown by manually and covered by hand. The seed rate for this method was about 9 kg/ha. The planting material was hybrid maize variety (Pacific 11). The higher seed rate for machine planting was due to wrong calibration of planter. The crop was fertilized with 256-280-280-190-18-12 kg/ha urea, TSP, MP, Gypsum, Zinc and Boron, respectively. One third of urea and all others fertilizer were used at final land preparation. Remaining part of urea was top dressed in tow equal splits at 30 and 55 DAS. During the Kharif-I season, the seeds were sown in Jamalpur on 27 March, 2005 and Sherpur on 30 March, 2005 and in Rabi season, 2005-06, the sseds were sown on December 18, 2005 in both the places. Finally the crop was harvested on July 12, 2005 at Laherikanda, Jamalpur and on July 6, 2005 at Kushumhati, Sherpur during Kharif-I season and in Rabi season the crops were harvested on April 29, 2006 at Sherpur and on May 6, 2006 at Jamalpur.

Result and Discussion

During Kharif-I, 2005

Leaherikanda, Jamalpur: Higher number of plants/m^2 was recorded form farmers practice and lower number from mechanical method. Plant height was slightly higher in mechanical method than farmer practice. Similar trend was obtained in ear height. Husk coverage showed better in mechanical method which can protect from rain and bird damage. Length of cob was also higher in mechanical method. Kernel row/cob, grain/cob and 1000- grain weight also higher in mechanical method which resulted higher grain yield. Stover yield also showed similar behaved as in grain yield.

The cost return analysis showed that higher gross return was obtained from mechanical method. This method also showed less cost in operation than farmers' practice. As a result higher net return and BCR was recorded from mechanical method . It calculate cost then it showed higher labour involvement in farmers practice where as seed and shelling cost in higher in mechanical method. Overall high cost was involved in farmers practice.

Kushumhati, Sherpur: Plant/m^2 and plant between mechanical and farmer practice were very close to each other. Length of cob, on. of grains/cob and grain weight was higher in mechanical method which resulted higher grain yield. Grain yield was lower than Laherikanda, Jamalpur due to lower yield attributes but plant/m^2 were higher. On an average, Stover yield was much lower as its potential.

Cost and return analysis showed higher cost was involved in farmer practice due to higher labour. Overall, higher gross net return and BCR was obtained from mechanical method and less cost was involved . Reasonable grain yield was obtained mechanical method in Kharif-1 season. So, this technology can be advocated to larger farmer.

Table 1. Yield and yield contributing character of hybrid maize as planted by maize planter and farmers' practice at Laherikanda, Jamalpur during Kharif-I, 2005

Treatment	Plant /m^2 (no.)	Plant height (m)	Ear height (cm)	Husk coverage (%)	Cob length (cm)	Kernel row/cob (no.)	Grains/ cob (no.)	1000- grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
Mechanical	4.0	2.29	127.1	83.3	17.7	15.3	563.3	318.3	6.88	5.77
Farmers'	5.3	2.15	120.0	73.3	16.6	14.6	483.3	299.0	6.02	5.00

Table 2. Cost and return analysis between machine planting and farmer's practice at Laherikanda, Jamalpur during Kharif-I, 2005

Treatment	Yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk.ha)	Net return (Tk/ha)	Benefit cost ratio
	Grain	Stover				
T_1	6.88	5.77	57370	30068	27302	1.91
T_2	6.02	5.00	50150	33836	16314	1.48

T_1= Mechanical method, T_2 = Farmers' practice, Price : Maize (grain) = Tk. 7.50/kg, Stover = Tk.1.00kg

Item	Mechanical method (Tk/ha)	Farmers' (Fk/ha)
Fertilizer	14.257	14,257
Irrigation	2,500	2,500
Labour	8,120	12,250
Shelling	1,204	1,054
Seed	1,487	1,275
Insecticide	2,500	2,500
Total	30,068	33,836

Price (Tk/ha): Urea=6.30, TSP=16.40, MP=14.40, Gyosyn= 3.50, Zinc sulphate= 65.00, Borc powder= 120.00

Table 3. Yield and yield contributing characters of hybrid maize as planted by maize planter and farmers' practice at Kushumhati, Sherpur during Kharif-I, 2005

Treatment	Plant /m^2 (no.)	Plant height (m)	Ear height (cm)	Husk coverage (%)	Cob length (cm)	Kernel row/cob (no.)	Grains/ cob (no.)	1000 grain wt.(g)	Grain yield (t/ha)	Stover yield (t/ha)
Mechanical	5.0	2.06	109.8	98.4	1.1	13.9	318.5	300	5.55	4.45
Farmers'	5.4	1.98	106.7	98.0	1.1	13.2	284.1	290	5.14	4.29

Table 4. Cost and return analysis between machine planting and farmer's practice at Kushumhati, Sherpur during Kharif-I, 2005

Treatment	Yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk.ha)	Net return (Tk/ha)	Benefit cost ratio
	Grain	Stover				
T_1	5.55	4.45	46075	29835	16240	1.55
T_2	5.14	4.29	42840	33682	9158.	1.27

Price: Maize (grain) = Tk.7.50/kg, Stover = Tk. 1.00/kg

Item	Mechanical method (Tk/ha)	Farmers' (Fk/ha)
Fertilizer	14257	14,257
Irrigation	2500	2,500
Labour	8120	12,250
Shelling	971	1,054
Seed	1487	1,275
Insecticide	2500	2,500
Total	30068	33,836

Price (Tk/ha): Urea=6.30,TSP=16.40, MP=14.40, Gypsum= 3.50, Zinc sulphate= 65.00, Boric powder= 120.00, Additional cost= 728.00

During Rabi season, 2005-06

Kushumhati, Sherpur: Plant/m^2 and plant height between mechanical and farmer practice were very close to each other. Length of the cob (16.7 cm), no. of grains/cob (496) were slightly higher in mechanical method which resulted only higher % grain yield (Table 1). Yield was more or less similar in both the practices . But cost return analysis showed that higher cost was involved in farmers' practice due to higher labour. Overall, higher gross (Tk. 1,15,720/ ha), net return (Tk.86,895/ha) and BCR (4.01) were obtained from mechanical method (Table 2) .

Jamalpur sadar: Higher number of plant/m^2 (5) was recorded from farmers' practice and lower number from mechanical method (4) shown in Table 3. Plant hight was higher in mechanical method than farmers' practice. Length of cob (17.7cm), kernel row/cob (14.5), grain /cob (457) and 1000 grain weight (342 gm) were also higher in mechanical method which resulted higher grain yield. The yield was slightly low due to partially damaged by hailstorm at pre-mature stage. The cost and return analysis showed that higher gross return (Tk.76,200/ha) was obtained from mechanical method (Table-4) . This method also showed less cost in operation than farmers' practice. As a result higher net return (Tk.43,225/ha) and BCR (2.31) was recorded from mechanical method. Overall high cost was involved in farmers' practice.

Conclusion and Recommendation

Maize seeding by maize planter is easier method, time saving and cost effective compare to farmers' practice. But the calibration of seeding should be adjusted accurately and the machine should be handle carefully for proper planting. Mechanical method is more profitable to the farmers'. The planter machine should be available to the farmers.

Table 1. Yield and yield contributing characters of hybrid maize as planted by maize planter and farmer's practice at FSRD site Kushumhati, Sherpur (Rabi, 2005-06)

Treatments	Plant /m^2 (no)	Plant height (m)	Ear height (cm)	Husk coverage (%)	Cob length (cm)	Kernel row/cob (no)	Grain/ cob (no)	1000 grain wt(g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	6.4	2.31	109	96.2	16.7	14.6	495.6	330	10.90	6.72
T_2	6.4	2.28	110	96.0	16.5	14.4	486.8	330	10.78	6.59

Table 2. Cost and return analysis between machine planting and farmer's practice at FSRD site Kushumhati, Sherpur (Rabi, 2005-06)

Treatment	Yield (t/ha)		Gross return (Tk/ha)	Variable cost (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio
	Grain	Stover				
T_1	10.90	6.72	1,15,720/-	28,825/-	86,895/-	4.01
T_2	10.78	6.59	1,14,390/-	32,400/-	81,990/-	3.53

Item	Mechanical method (Tk/ha)	Farmers practice (Tk/ha)
Fertilizer	14,210/-	14,210/-
Irrigation	1,360/-	1,360/-
Labour	8,480/-	12,055/-
Hand shelling	1,165/-	1,165/-
Seed	2,410/-	2,410/-
Insecticide	1,200/-	1,200/-
Total	28,825/-	32,400/-

Table 3. Yield and yield contributing characters of hybrid maize as planted by maize planter and farmers' practice at Jamalpur Sadar

Treat	Plant populaton/m^2 (no)	Plant height (m)	Cob length (cm)	Kernel row/cob (no)	Grain/cob (no)	1000 grain wt.(g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	4	2.03	17.7	14.5	457	342	7.22	4.0
T_2	5	1.83	14.8	13.0	300	300	4.58	4.5

Table 4. Cost and return analysis between machine planting and farmer's practice at Jamalpur Sadar

Treat	Yield (t/ha)		Gross return (Tk./ha)	Variable cost (Tk./ha)	Net return (Tk./ha)	Benefit cost ratio
	Grain	Stover				
T_1	7.22	4.0	76,200/-	32,975/-	43,225/-	2.31
T_2	4.58	4.50	50,300/-	35,750/-	14,550/-	1.41

T_1= Mechanical method; T_2 = Farmers practice

Item	Mechanical method (Tk./ha)	Farmer's practice (Tk./ha)
Fertilizer	14,210/-	14,210/-
Irrigation	2,440/-	2,440/-
Labour	10,200/-	12,800/-
Hand shelling	1,450/-	1,450/-
Seed	2,410/-	2,585/-
Insecticide	2,265/-	2,265/-
Total	32,975/-	35,750/-

Price : Maize (Grain) Tk.10.00/kg
Stover Tk. 1.0/kg

Input (Tk./kg): Urea : 6.30
TSP : 16.40
MP: 14.40
Gypsum: 4.00
Zinc sulphate: 65.00

Conclusion and Recommendation

Farmers were very much interested in both sites provided they should be ensured of the machine and the seeds. The farmers were also impressed with the hush coverage of the cob .There were less chance of bird attack due to compact husk coverage about 90-100% of the cob. In participatory research and development (PR&D) programme, there was farmers motivation needed thought group discussion, field day and rally.

Field Performance of Wheat through Power Tiller Operated Wheat Seeder

Introduction

Wheat in the second cereal crop of Bangladesh. It has to compete with other important winter crops like boro, maize, pulses, oilseeds and vegetables. Afrer harvest of T.aman rice lands remain fallow in Sylhet region. Limited area in this region is utilized in wheat cultivation and mainly in rainfed condition. Wheat is cultivated at Goyanghat and Jaintapur upazilla as a single crop in a year. Ploughing cost is the major production cost of wheat. CIMMYT and WRC developed power tiller operated seeder machine which is able to furrow, line sowing and leveling of soil at a time and also reduces production cost. Hence, to popularize wheat cultivation and to demonstrate wheat power seeder, a production program was initiative with joint collaboration of CIMMYT and WRC.

Materials and methods

A production program was conducted at Radhanagar at Goyanghat upzilla under Sylhet district during rabi 2005-2006. The program was conducted under rainfed condition with variety Shatabdi and Kanchan. The area covered under production programme was 2 hectares of land, out of which 1.7 hectares by power seeder and rest 0.8 hectare by conventional broadcast method. The seeds were sown on 27 November – 2 December 2006. The crop was fertilized @ 55-22-15-12 kg/ha of N, P, K and S respectively. Intercultural operations were done properly. Crop was harvested on 15-22 March 2006.

Results and Discussion

In this region wheat cultivation is delayed due to post monsoon raining which cause excess soil moisture exists in the field. Weed infestation is serious problem of the land. Farmers of the locality minimized the excess soil moisture and weed infestation by open the land upto 7-8 days. The highest grain yield (3.58 t/ha) was found from Shatabdi with power driven wheat seeder, which was 12.93% higher than traditional broadcast method. But Kanchan yield was not influenced by the method. Gross return and gross margin was higher in variety Shatabdi with power tiller operated seeder showed less cost than broadcast method. As a result higher BCR was recorded from variety Shatabdi with power tiller operated seeder and even Kanchan variety reveals higher BCR in power tiller operated seeder.

Farmers reaction

Farmers showed positive response with new mechanical seeder. They opined that this power seeder machine reduces production cost as well as seed rate. Labour cost is minimized by using power seeder machine as the labour cost and crisis is very high in Sylhet region.

Conclusion: The variety Shatabdi with power tiller operated seeder could be used for higher yield and benefit in Sylhet area.

Table 1. Comparative performances of wheat in power seeder and traditional production method

Method	Farmers involved (no.)	Variety	Area covered (ha)	Grain yield (t/ha)	Gross return (Tk/ha	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Seeding with power seeder	15	Shatabdi	1.2	3.58	42960	8790	34170	4.89
		Kanchan	0.5	3.16	37920	8790	29130	4.31
Seeding with traditional broadcast method	5	Shatabdi	0.5	3.17	38040	9690	28350	3.93
		Kanchan	0.3	3.10	37200	9690	27510	3.84

Price of wheat per kg is Tk. 12.00

Adaptation of High Speed Rotary Tiller for Dry Land Cultivation

Abstract

A field demonstration was conducted at Multilocation Testing (MLT) site, Khaloibbara, Kashinathpur, Pabna during 2005-06 to observe the performance of high-speed rotary tiller under dry land cultivation for onion production compared to traditional method. The findings indicated that bulb yield and net return was higher in high speed rotary tiller cultivation land than that of traditional power tiller cultivated land. It was observed that bulb yield increased 6.01 % over conventional method.

Introduction

Onion is one of the most important spices crop in Bangladesh. Pabna is famous for onion production. .But successful onion production mainly depend on tilth condition. For onion land preparation, farmer of this area used power tiller driven by Sifang engine, which required 7-8 times tillering for fine tilth. It is very costly and time consuming. Wheat Research Centre and CIMMYT Bangladesh have a good program to introduce Chinese made power tiller operated minimum tillage seeder for sowing wheat earlier. Similar to wheat seeder the scientist of BARI developed a high speed rotary tiller for onion land preparation. Due to its high speed rotary action of soil surface, tilth quality is very fine in sandy to clay loam soil for dry land crop cultivation, use of this high speed rotary tiller can be a good option for land preparation. The tiller was used for ploughing onion and garlic field. The study was conducted with following objectives:

1. To modify the CHT seeder as high speed rotary tiller.
2. To test the high speed rotary tiller for ploughing dry land of this area.
3. To compare the machine performances with traditional practice on cultivation of dry land crop (onion and garlic).

Materials and Methods

The trial was conducted at MLT site, Khaloibhar, Pabna during 2005-06. Farmers fertilized their land with recommended dose (135-197-86 kg/ha N, P and K respectively) of fertilizer. Generally S fertilizer is not used at this location. Traditionally Sifang power tiller is used for land preparation and needed 7-8 times ploughing cross ploughing. But high speed Rotary tiller driven by Dongfang was needed only one time for ploughing and its tillage condition is better than normal power tiller. Three farmers ploughed their land initially with traditional tiller and then one ploughing with rotary tiller (One traditional cultivation + One rotary tiller cultivation). Other three farmers ploughed their land initially with traditional tiller followed by two times ploughing with rotary tiller (one traditional cultivation + Two rotary tiller cultivation). One farmer was selected who cultivated his land seven times with traditional tiller. Onion seedlings were planted on first week of January 2006.The crop was grown under rain fed condition. Intercultural operations were done when required. The crop was harvested on first week of April, 2006. Yield and yield contributing characters were recorded and mean data were presented in Table 1.

Results and Discussion:

Higher bulb yield (15.5 t ha^{-1}) was obtained from the land where one ploughing was provided with high speed rotary tiller. Second higher yield was achieved with two ploughing by the same tiller. Lower bulb yield (14.48 t ha^{-1}) was obtained from traditionally prepared land. The result clearly indicated that additional yield advantage was observed by high speed rotary tiller over conventional power tiller. Average yield increased by high speed rotary tiller was 6 % and it might be due to deep ploughing, less clod and fine and leveled soil. Higher net return was also recorded in high speed rotary tiller operated land. Comparatively lower return was obtained from traditional power tiller operated land where higher cost was involved for intensive and repeated ploughing provided by the same tiller.

Farmer's reaction

Farmer's of that location were very pleased for the performance of high speed rotary tiller for their onion land preparation. Because it needs less time, labour, fuel but land preparation quality is better than traditional power tiller. They also opined that it should be made available with lower price in the market and modify the present model with less weighty so that it can be easily used Sifang power tiller.

Conclusion

Land prepared by high speed rotary tiller is very well and it leads to increase onion yield. Land can be prepared by rotary tiller timely within short period and fine and good tilth condition is achieved with less ploughing which is economically viable. But at this location, farmers have no Dongfang engine. So, it should be modified to fit with Sifang engine for the popularization of rotary tiller.

Table 1. Performance of Onion production by high speed rotary tiller in comparison to traditional tiller method during the year 2005-06 at MLT site, Khaloibhar, Pabna

Cultivation method	Bulb length (cm)	Bulb breadth (cm)	Bulb/ m^{-2}	Individual bulb Wt. (gm)	Yield (t/ha)	Yield increase (%)	Cost of cultivation (Tk)	Gross return (Tk.)	Net return (Tk.)
One traditional culti.+ One lotary tiller cultivation	3.14	3.25	80	19.32	15.50	7.04	39950	232500	192550
One Traditional culti.+ Two lotary tiller cultivation	3.38	3.24	80	19.07	15.20	4.97	40650	228000	187350
7 times traditional cultivation	3.08	3.0	80	18.12	14.48	-----	43550	217200	173650

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Field Performance of Mango Harvester

Introduction

In Bangladesh mango harvester is not made commercially. For harvesting mango, farmers make net harvesting device of there own by pleated bamboo and net made of jute rope. This device is fastened on top of a bamboo pole. When mangoes are harvested with this device, mangoes ate detached from the end of pedicel. To avoid this problem, mangoes are harvested with 1 to 1.5 cm of pedicel attached to the fruit in other countries. In Bangladesh about 20 to 25 percent post harvest losses of mango occur because of the harvesting problem. The post harvest losses occur mainly due to stem end rot disease, faulty packaging and transportation. Use of good mango harvesters can save this loss to a great extent. A mango harvester has been developed and tested at Joydebpur by Farm Machinery Division of BARI. The harvester can cut the peduncle keeping 1 to 2 cm with mango if the peduncle is kept then stem end rot disease, which is responsible for major post harvest loss, dose not occurs. In this context, a demonstration trial was conducted at Pabna with the objectives to test the performance of the mango harvester in farmers garden and to modify the harvester, if necessary.

Materials and Methods

The experiment was carried out at FSRD site, Pushpapara, Pabna during the kharif season 2006. For this site, two units of harvester were used at farmer's field to test the efficiency of the harvester compared with the traditional one. Traditional harvester and BARI harvester were used in this experiment. The treatments were replicated three times. It is observed that by using BARI developed harvester stem end rot disease was not occurred, which reduced post harvest loss. The mango was harvested on 6-7 June 2006. Necessary data were collected.

Results and Discussion

The average efficiency of BARI developed harvester was higher (41%) than the traditional harvester. The average fruit droppings during harvesting was lower (3.7%) by BARI developed harvester than traditional harvester which causes less infection of stem end rot disease. The average highest number (223) of mango was harvested per hour by BARI developed harvester and the lowest (157) harvested by traditional harvester.

Farmer's reaction

BARI developed harvester is very good and efficient instrument which helps to collect mango easily. It is very quick method to collect mango. Farmers desired to buy this instrument with low cost**.**

Conclusion

From one-year result, revealed that BARI developed harvester showed better performance than traditional harvester. The experiment needs to be continuing for another year trial for confirmation.

Table 1. Performance of BARI developed mango harvester at FSRD site, Pushpapara during the kharif season, 2006

Cooperators farmers	Harvested tree (no.)	No. of fruit drops during harvest (%)		Harvest of mango $hour^{-1}$		Harvesting increased over traditional harvester (%)
		Traditional harvester	BARI developed harvester	Traditional harvester	BARI developed harvester	
Farmer-1	1	20	3	168	240	43
Farmer-2	1	17	5	156	222	40
Farmer-3	1	12	3	148	208	41
Mean		16	3.7	157	223	41

Adaptability Trial of BARI Summer Onion

Abstract

An experiment on the adaptability trial of summer onion was conducted at Moulvibazar MLT site during Karif-1 season. Eight farmers were selected for this program. The onion seedling was transplanted on 8 April, 2005 and harvested on 21 June, 2005. The average yield of this type of summer onion was found 16.49 t/ha. Farmers were very much interested to cultivate summer onion in this location.

Introduction

Summer onion is a newly introduced spices crop in our country. Bangladesh faces a great crisis of onion during the off period of onion and a large amount of money was ingrate to import onion from neighbouring country. To meet up this demand onion production should must be increased and to develop new variety of this crop. For this goal BARI has already developed two varieties of summer onion and some improved and promising lines of summer onion is under trial. This trial was also undertaken to test the adaptability and the performance of summer onion in Sylhet region.

Materials and methods

The experiment was conducted at Moulvibazar MLT site during 2006. Numbers of farmers were 9 as a dispersed plot. Plot size was 4 m x 5 m (2 bed per dm). The crops was transplanted from 02.03.2006 to 09-03-2006 and harvested from 0.5.06.2006 to 11.06.2006. Weeding was done 3-4 times and pest was controled by using rubral and redomil 2 gram of each fungicide in 1 litre of water, sprayed every 7-10 days interval to control purple blotch.

Result and Discussions

From table 1 it was found that highest yield was obtained from Md. Mahbubur Raman's plot which was 23.33 t/ha and the average yield was found from 9 farmers plot are 16.49 t/ha which is good enough for this rainy season area.

Farmers reaction: Farmers are very much interested to cultivate this crop. Extension people were very much impressed to see the performance of the crop and motivated to explore this technology to the farmer. They need seed and seedling in proper time. More training for the production technology of summer onion is needed. Purple bloss is a problem for this crop. Pesticide is not available in the local market.

Conclusion

The yield performance of summer onion is promising in this area, its yield will be more if proper management practices is applied. A large scale production program should be taken to explore this technology in this area. So, further trial should be conducted in this area.

Table 1. Yield performance of summer onion at Moulvibazar during April-June, 2006

Sl. No.	Farmers name	Area (dm)	Yield (kg/dm)	Yield (t/ha)	Average yield (t/ha)
1	Nipendra kapali	1.0	68.12	16.829	
2	Abinash kapali	1.0	54.49	13.458	
3	Md. Muktar Miah	0.5	62.08	15.335	
4	Md Mahbubuir Rahman	2.0	94.48	23.335	
5	Md Mutaleb Miah	1.0	75.10	18.550	16.49
6	Md. Fakrul Islam	0.5	66.13	16.333	
7	Md. Habiz uddin	0.5	62.55	15.450	
8	Md Sulaiman	0.5	53.88	13.250	
9	Md. Osman Gani	0.5	63.38	15.650	

Collaborative Research Program: OFRD, BARI-CIMMYT

Intercropping Maize with Different Vegetable

Abstract

Field experiment was conducted during rabi season of 2005-06 to observe the productivity and economic feasibility of Maize + Vegetable intercropping systems. The intercropping systems were Maize + Coriander, Maize + Spinach, Maize + Red amaranth and Sole Maize, but for Bandarban site additionally Maize + Potato and Maize + Bushbean were tested. For Rangpur site along with the above four treatments Maize + Napashak was included. Also for Jamalpur three other intercropping systems such as, Maize + Potato, Maize + Radish and Maize + Bushbean were included as treatment. The result indicated that in general grain yield of Maize was slightly reduced due to intercropping systems. The highest Maize equivalent yield was obtained from Maize + Bushbean intercropping systems at Jamalpur, Maize + coriander (as vegetable) at Pabna, Maize + Red amaranth at Kushtia and Manikganj, Maize + Spinach at Jessore, Bandarban, Mymensingh and Rangpur.

Introduction

Cereal-legume intercropping is one of the most popular in the tropical and subtropical regions of the world. Among the cereals, Maize is considered as one of important and high yield potential crops which need to be popularized in Bangladesh to increase production and income of the poor farmers. As Maize competes for land with a number of rabi crops during winter season, intercropping with its contemporary vegetable may be an alternative way of its accommodation in the existing cropping system.

Intercropping system, however, becomes more productive and economical when component crops differ with genetic make up, photosynthetic pathway, growth habit, growth duration and demand of different growth resources. It also depends on the light availability within the canopy of components crops. The productivity of undestroyed vegetable, however, varied with variation of species itself. Furthermore, scenario of total intercrop productivity and economic viability may be changed due to growing of Maize in association with different vegetables. The present study, therefore, is aimed to determine the most productive and economically feasible Maize + vegetable intercropping system at different Farming Systems Research and Development/Multilocation Testing sites of OFRD, BARI.

Materials and Methods

The experiment was conducted at the Multilocation Test Site, Sherpur, Pabna, Kushtia, Kishoreganj, Mymensingh, Rangpur and Manikganj during the rabi season 2005-06. The experiment consisted of seven treatments for Sherpur viz. i) Maize + Potato, ii) Maize + Radish, iii) Maize + Coriander, iv) Maize+Bushbean, v) Maize + Spinach, vi) Maize + Red amaranth and vii) Maize sole. However for Bandarban site except Maize + Radish and Maize + Coriander other above other five treatments was tested. Again for Jessore, Pabna, Kushtia and Mymensingh only four treatments (Maize + Spinach, Maize + Red amaranth, Maize + Coriander and Sole Maize) were investigated. Maize seeds were sown in a planting configuration of 75 x 20 cm spacing and fertilized at the rate of 256-55-138-3-1 kg/ha of NPKSB and cow dung at the rate of 5 t/ha. Full amount of PKSB and 1/3rd of N along with full amount of cow dung were applied at the time of final and preparation. The rest N was applied into two equal splits at 8-10 leaves stage and at tasselling stage. Seeds of Maize and all other vegetables were sown on November 28, 2005 at Sherpur, 15 December, 2005 at Pabna, 22 November, 2005 at Kushtia, 4 December, 2005 at Bandarban, 6 December, 2005 at Mymensingh and 30 December, 2005 at Rangpur. Intercropped vegetables were harvested depending on the maturity of the individual crops ranging from December 28, 2004 to February 6, 2005. Finally Maize was harvested on April 19, 2006at Sherpur, 12 May 2006 at Pabna, 20 April, 2006 Kushtia, 15 April, 2006 at Bandarban and 24

May, 2006 at Mymensingh. Intercultural operation was done as and when necessary. For determination of yield components of Maize, ten plant were randomly selected from each plot and plant height, number of cobs/plant, seeds/cob and 1000 kernel weight were recorded. Grain yield of Maize was determined by harvesting an area of 7.5 m^2 and converted into t/ha at 14% moisture content. Different vegetable was harvested at different times and their yield

Equivalent yield of component corps crops were determined following the method of Anjaneyulu *et al*. (1982). For example

$$\text{Maize Equivalent Yield (MEY)} = Ym + \frac{Yi \times Pi}{Pm}$$

Where,

Ym = Yield of Maize (t/ha)
Yi = Yield of intercrop vegetable (t/ha)
Pi = Price of intercrop vegetables (Tk/ha)
Pm = Price of Maize (Tk/ha)

Data recorded on the different parameters were analysed and means were separated as per LSD/DMRT test

Results and Discussion

Jessore: Sole Maize along with other intercrop combinations produced identical Maize grain yield. All the intercrop combinations gave higher MEY compared to sole Maize. Maize+Spinach have the highest MEY (17.97 t/ha) which was almost double than sole Maize (Table 1).

Pabna: All the yield attributes and grain yields of Maize were significantly affected by the treatments. Higher grains/cob, 100-seed weight and grain yields were significantly affected where higher grains/cob and 100-seed weight were recorded from sole Maize which was reflected in higher grain yield. Sole Maize gave significantly the highest grain yield and it might be due to non-sharing of resources with vegetable crops. Maize with Bushbean gave the lowest yield. Maize with any of the vegetable crops gave lower yield than sole Maize and it was mainly due to competition of nutrient and space among the crops. But all the three Maize + vegetable intercropping combinations gave higher Maize equivalent yield (MEY) in comparison to sole Maize (Table 2-3). Highest MEY, gross return and BCR were obtained from Maize + Coriander (as vegetable) followed by Maize + Spinach.

Kushtia: Grains/cobs and grain yield varied by treatment (Table 4). Sole Maize gave lower grain yield due to lower grains/cob. Higher grain yield was obtained from Maize+Red amaranth and it was identical with Maize +coriander and Maize +Spinach. MEY was highest from Maize+Spinach. All the intercropped combinations gave higher MEY than sole Maize (Table 4). The highest BCR was obtained from Maize + Spinach intercropping system (Table 5).

Bandarban: Highest grain yield was obtained from sole Maize because of higher plant population, cobs/m2 and grains/cob (Table 6). Among the vegetable crops, Potato yield was a bit higher but it was much lower than national average. Maize+Spinach gave the highest MEY and all the intercrop combination gave higher MEY compared to sole Maize. Maize+Spinach also fetched the highest gross return and BCR (Table 7-8).

Mymensingh: Sole Maize gave similar yield with other intercrop combinations except Maize + Spinach. All the intercrop combinations produced higher MEY in comparison to sole Maize and which was 12.29 to 72.81% higher than sole Maize. Maize+Spinach gave the highest MEY, gross return and BCR (Table 9-10) though slightly lower Maize yield was obtained.

Sherpur, Jamalpur: The result indicated that yield attributes were not significantly influenced due to Maize vegetable intercropping. The higher plant height was recorded from Maize sole treatment but it was statistically identical to all other treatments except Maize + Radish treatment (Table 11). The higher grain yield was recorded from sole Maize which was statistically identical to all other treatments except Maize + Potato treatment which gave the lowest grain yield (9.70 t/ha). The highest MYE was recorded from Maize + Bushbean intercrop combination & other treatment was very close to each other but much lower than Maize + Bushbean. Similar trend was followed in case of gross return but higher cost was involved in Maize+Potato treatment. But over all, higher benefit cost ratio was recorded from Maize+Bushbean combination & only this treatment showed higher benefit than sole Maize. Other treatment failed to show higher benefit than sole Maize (Table 12 & 13).

Rangpur: Grain yield of Maize was not significantly influenced by the treatments but all the intercrop combinations gave higher MEY compared to sole Maize. Highest Maize equivalent yield was obtained from Maize + Spinach intercropping systems. It also fetched higher gross return and BCR. All the intercropping system showed higher BCR than the sole maize (Table 14-15).

Manikganj: Grain yield of maize in sole and intercrop with red amaranth showed identical yield. Grain yield of maize was lower in other combination due to lower plants/m^2. The highest maize equivalent yield was obtained from Maize + Red amaranth intercrop combination. Higher gross margin and BCR were also given by Maize + Red amaranth. Sole Maize gave the lowest MEY.

Farmers' reaction

Farmers of all the locations showed their keen interest to cultivate vegetable as intercropping, as this practice gave them quick and extra economic benefit without or with very small amount of lose of Maize grain yield.

Conclusion

Two years result showed that Maize+Bushbean, Maize+coriander, Maize+Spinach, and Maize+Red amaranth could be grown as intercrop instead of sole Maize.

Table 1. Performance of Maize intercropped with different vegetables at MLT-site Jhikorgacha, Jessore during 2005-06

Treatment	Pl.pop./15m^2 (no)	Grains/cob (no)	100 Grain wt. (g)	Grain yield (t/ha)	Vegetable yield (t/ha)	Maize equivalent yield (t/ha)
Sole Maize	85	490	27.50a	9.00	-	9.00
Maize + Spinach	80	482	27.33a	8.67	10.70a	17.97
Maize + Coriander	84	500	26.45b	8.57	1.15c	11.45
Maize + Red amaranth	82	436	25.32c	8.63	3.50b	11.26
CV (%)	6.53	8.22	4.59	5.08	11.05	-
F-test	NS	NS	**	NS	**	-

Product price (Tk./kg): Maize = 8/-, Spinach = 7/-, Coriander = 20/-, Red amaranth = 6

Table 2. Yield attributes of Maize and yield of Maize & vegetables in different Maize + vegetable intercropping systems at FSRD site, Pushpapara, Pabna during the year 2005- 06

Treatments	Plant height (cm)	No. of cobs plot^{-1}	No. of grains cob^{-1}	Cob length (cm)	100 grain wt (g)	Yield (t ha^{-1})		Straw yield (t ha^{-1})
						Maize grain	Vegetables	
Maize+Red amaranth	126.5ab	39.3a	591.0a	17.9b	29.43a	8.6b	5.4	5.6b
Maize+Spinach	148.4b	37.7b	513.3b	17.3c	28.73a	8.3b	10.0	5.1c
Maize+Coriander	169.2ab	39.3a	513.3b	16.6d	27.88a	8.6b	2.1	5.7b
Sole Maize	172.7a	38.3ab	596.7a	18.8a	29.34a	9.2a	-	6.4a
CV (%)	6.40	1.98	2.47	1.72	3	2.04	-	4.68
LSD (0.05)	20.85	1.52	27.37	0.60	1.72	0.35	-	0.53

Table 3. Agronomic productivity and cost return analysis of Maize + vegetables intercropping systems at FSRD site, Pushpapara, Pabna, during the year 2005-06

Treatments	Maize equivalent yield (t ha^{-1})	Gross return (Tk ha^{-1})	Production cost (Tk ha^{-1})	Benefit cost ratio (BCR)
Maize+ Red amaranth	12.25	110250	29595	3.73
Maize +Spinach	13.84	124560	31095	4.01
Maize+ Coriander	15.62	140580	29970	4.69
Sole Maize	9.24	83160	28470	2.92

Price (Tk/Kg) : Maize=9.00, Red amaranth=6.00, Spinach=5.00, Coriander=30.00

Table 4. Performance of different vegetables as intercropped with Maize at MLT site Bharamara, Kushtia, during 2005-06

Treatment	Plants/ m^2	Grains/ cob	100-grain wt. (g)	Maize yield (t/ha)	Vegetables yield (t/ha)	Moisture content
Maize+ Red amaranth	6	564	34	7.39	1.07	13.00
Sole	6	556	33	6.53	-	13.00
Maize + Coriander	6	576	33	6.85	0.72	13.00
Maize + Spinach	7	588	34	7.22	2.10	13.00
CV (%)				6.55		
LSD (0.05)				0.78		

Table 5. Cost and return analysis of different vegetables as intercropped with Maize at MLT site Bharamara, Kushtia, during 2005-06

Treatments	Maize equivalent yield (t/ha)	Variable cost (Tk./ha)	Gross return (Tk./ha)	Net return (Tk./ha)	Benefit cost ratio (BCR)
Maize+ Red amaranth	8.25	38408	489500	51092	2.33
Maize + Coriander	8.29	39273	89900	50627	2.30
Maize + Spinach	8.90	39023	96000	56974	2.46
Sole Maize	6.53	37791	72300	34509	1.91

Table 6. Yield components of Maize in sole and intercrop combination at Bandarban during 2005-06.

Treatments	Plant height (cm)	Plants/ 15m^2	Number of cobs/15 m^2	Number of grains/cobs	1000-grain wt. (gm)
Maize + Potato	268	76	97	414	319
Maize + Red amaranth	287	80	108	436	382
Maize + Spinach	274	76	87	440	324
Maize + Bushbean	267	77	93	462	389
Maize sole	296	87	115	521	388
CV (%)	8.17	9.13	10.11	9.53	7.17
LSD (0.05)	19.95	11.12	13.12	33.61	39.12

Table 7. Yield of Maize and vegetables intercrops, at Bandarban, 2005-06

Treatment	Yield of Maize (t/ha)		Inter-crop (vegetable) yield (t/ha)	Maize equivalent yield (t/ha)
	Grain yield	Straw yield		
Maize + Potato	7.49	17.19	5.32	12.97
Maize + Red amaranth	8.21	14.54	3.81	13.19
Maize + Spinach	8.17	13.21	3.95	13.41
Maize + Bushbean	7.88	14.00	4.73	10.83
Sole Maize	9.13	18.20	-	-
CV (%)	7.16	-	8.12	6.31
LSD (0.05)	0.21	NS	1.11	0.98

Table 8. Cost and return analysis of Maize-vegetables inter-cropping system in Bandarban, 2005-06

Treatment (Crop combination)	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Maize + Potato	1,06,777	51,325	55452	2.08
Maize + Red amaranth	1,07,415	43,235	64180	2.48
Maize + Spinach	1,16,062	44,113	96232	2.63
Maize + Bushbean	9,0190	42,175	48015	2.18
Sole Maize	77,590	40,123	37467	1.93

Note: Market price of Maize (dry grain)= Tk. 8/kg and Stover = Tk. 250/t, Vegetable crops: Potato @ Tk. 8/kg, Red amaranth @Tk. 10/kg, Spinach @ Tk. 12/kg, Bushbean @Tk. 5/kg as farm gate price during harvest time.

Table 9. Yield and yield contributing characters of intercrop Maize at Mymensingh

Crop combinations	Plant height (cm)	No. of cobs/ plant	No. of grains/ cob	1000- grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)
Maize + Red amaranth	222.4 c	1.04	538	327	9.84 a	14.50
Maize +Coriander	227.2 b	1.08	533	322	9.47 ab	14.30
Maize + Spinach	220.8c	1.04	532	323	9.18 b	14.20
Sole Maize	241.7 a	1.08	541	325	9.93 a	15.20
LSD (0.05)	2.86	NS	NS	NS	0.52	NS
CV (%)	3.0	9.98	4.5	6.95	4.73	7.09

Table 10. Maize equivalent yield and economic analysis of Maize + vegetable intercropping at Mymensingh

Crop Combinations	Grain yield of Maize (t/ha)	Yield of intercrops (t/ha)	Maize equivalent yield (t/ha)	Gross return (Tk./ha)	*TVC (Tk./ ha)	Gross margin (Tk. /ha)	BCR
Maize + Red amaranth	9.84	6.70	11.86 b	125750	31959	93791	3.93
Maize +Coriander	9.47	1.68	11.15 c	119150	32159	86991	3.71
Maize +Spinach	9.18	15.96	17.16 a	178700	34159	144541	5.23
Sole Maize	9.93	-	9.93 d	107400	29059	78341	3.70
LSD (0.05)	0.52	-	0.57	--	--	--	--
CV(%)	4.73	-	2.50	--	--	-	-

*TVC includes cost of seed, fertilizer, insecticide, man and animal labour cost.
Price (Tk./kg): Maize (seed)= 50/-, Maize (non seed)= 10/-, Maize (stover)= 0.50/-, Red amaranth= 3/- Coriander= 10/-, Spinach= 5/-, N= 13.32, P=75/-, K= 28/-, S= 27.50, Zn= 112/- & B= 600/-

Table 11. Yield attributes and grain yield of Maize in different Maize +vegetable intercropping system at Sherpur, 2005-06

Intercropping system	Plant height (cm)	Plants/ m^2	Cobs/ m^2	Cobs/ plant	Grains/ cob	1000- grain wt. (g)	Yield (t/ha)		Stover yield (t/ha)
							Maize	Intercrop	
Maize+Potato	229.6ab	6.42	7.04	1.10	415.3	320.33	9.70b	10.08	5.50ab
Maize+Radish	228.0b	6.42	6.82	1.06	427.9	320.00	9.92ab	8.12	4.87b
Maize+Coriander	230.4ab	6.49	6.91	1.06	450.4	320.33	10.54ab	0.64	5.62ab
Maize+Bushbean	229.6ab	6.51	6.93	1.06	439.3	320.67	10.57ab	6.27	5.73ab
Maize+Spinach	237.9a	6.40	7.09	1.11	434.7	320.00	10.50ab	5.08	5.54ab
Maize+Red amaranth	231.7ab	6.33	7.16	1.30	453.2	320.33	10.69ab	3.31	6.03a
Sole Maize	237.4a	6.49	7.04	1.08	432.3	330.00	10.90a	-	6.37a
F	**	NS	NS	NS	NS	NS	*	-	*
CV (%)	1.33	1.70	3.05	3.67	5.99	1.43	5.39	-	8.96

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

Table 12. Total cost involved in Maize+ vegetables intercropping systems at Sherpur, 2005-06

Intercropping system	Cost of fertilizer, irrigation and labour (TK./ha)	Seed cost (Tk/ha)	Additional cost (Tk/ha)	Total cost (Tk/ha)
Maize+Potato	26557	13166	2800	42523
Maize+Radish	26557	1766	1050	29373
Maize+Coriander	26557	2766	1750	31073
Maize+Bushbean	26557	2166	1050	29773
Maize+Spinach	26557	3566	1050	31173
Maize+Red amaranth	26557	1366	1050	28973
Sole Maize	26557	1166	-	27723

Table 13. Agronomic productivity and economics of Maize-vegetables intercropping systems at Sherpur, 2005-06

Intercropping system	Maize equivalent yield (t/ha)	Gross return (Tk/ha)	Total cost (Tk/ha)	Benefit cost ratio
Maize+Potato	10.16	76200	42523	1.79
Maize+Radish	10.81	81075	29373	2.76
Maize+Coriander	10.66	79950	31073	2.57
Maize+Bushbean	14.04	105300	29773	3.54
Maize+Spinach	11.32	84900	31173	2.72
Maize+Red amaranth	11.06	82950	28973	2.86
Sole Maize	10.90	81750	27723	2.95

Total cost considered seeds, fertilizer, labour, irrigation and additional cost only.

Seed price (kg): Potato=Tk.15.00, Radish= Tk.200.00, Bushbean=Tk.50.00, Red amaranth= Tk.500.00, Spinach= Tk.30.00, Coriander= Tk. 40.00, Maize= Tk. 106.00

Sell price/kg: Potato=Tk.4.00, Radish= Tk.1.00, Bushbean=Tk.7.00, Red amaranth= Tk.3.00, Spinach= Tk.2.50, Coriander= Tk. 15.00, Maize= Tk. 7.50

Table 14. Yield attributes and grain yield of Maize in different Maize + vegetable intercropping systems at Mithapukur, Rangpur, 2005-06

Treatment	Days to maturity	Plant height (cm)	Cobs/m^2 (no.)	Grains/Cob (no.)	100-grain wt. (gm)	Grain yield (t/ha)
Maize +Red Amaranth	148	198	7.10	478 b	32.9	9.96
Maize +Indian Spinach	147	197	6.79	524 a	33.1	9.40
Maize + Napashak	146	197	6.74	504 a	33.9	9.01
Maize +Coriandershak	148	198	6.91	510 a	33.6	9.54
Sole Maize	149	198	7.22	515 a	32.8	10.05
LSD (5%)	NS	NS	NS	28.3	NS	NS
CV (%)	2.5	1.0	5.0	3.0	1.7	7.3

Table 15. Grain yield, equivalent yield and economic analysis of Maize in different intercropping combination at Mithapukukur, Rangpur, 2005-06

Treatment	Yield (t/ha)		Maize equivalent yield (t/ha)	Gross return (Tk./ha)	Total cost (Tk./ha)	Net return (Tk./ha)	BCR
	Maize	Vegetable					
Maize+Red amaranth	9.96	3.69	11.22	98218	32092	66126	3.06
Maize+Indian Spinach	9.40	12.48	14.39	125930	32762	93168	3.84
Maize+Napashak	9.01	7.72	11.66	102025	32832	69193	3.10
Maize+Coriandershak	9.54	3.84	11.84	103600	33232	70368	3.11
Sole Maize	10.05	-	10.05	87937	30812	57125	2.85

Table 16. Plant height, yield attributes of Maize as affected by different intercropping combination at MLT site, Manikganj, 2005-06

Intercropping system	Plant height (cm)	Plants/ m^2	Grains/ cobs	1000- grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
Maize + Red amaranth	217.67	5.24	666	270	8.99	16.33
Maize + Spinach	207.67	4.78	630	260	7.43	14.32
Maize + Coriandershak	208.67	4.43	642	260	7.21	13.27
Sole Maize	214.00	5.20	624	287	9.09	15.60
LSD (0.05)	19.53	1.35	94.03	45.0	2.42	4.0

Table 17. Grain yield equivalent yield and economic analysis of maize in different intercropping combination at MLT site, Manikganj, 2005-06

Intercropping system	Yield (t/ha)			Maize equivalent yield (t/ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
	Maize		Vegetables				
	Grain	Stover					
Maize + Red amaranth	8.99	16.33	4.083	11.03	118475	74903	2.72
Maize + Spinach	7.43	14.32	3.542	9.55	102710	58540	2.33
Maize + Coriandershak	7.21	13.27	0.958	8.36	90255	46803	2.08
Sole Maize	9.09	15.60	-	9.08	90830	48555	2.15

Price (Tk./kg): Spinach= 6/-, Coriandershak= 12/- & Maize= 10/-

Synchronization of N Application with Growth Stages of Maize

Abstract

An experiment was under taken to verify the effect of N application at different growth stages of Maize at Pabna, Kishoreganj, Jessore, Comilla, Bogra, Rangpur and Kushtia during 2005-06. Three urea application treatments were, T_1= $^1/_3$ as basal + $^1/_3$ at 8 leaves stage + $^1/_3$ at tasseling stage (present recommendation), T_2= ½ as basal + ½ at 8 leaves stage and T_3= 30% as basal + 70% at 8 leaves stage. There was no significant difference (except one location, Kushtia) for grain yield among the treatment irrespective of all locations. But numerically in most of the locations either application of urea 30 % as basal + 70 % at 8 leaves stage or ½ as basal + ½ at 8 leaves stage gave higher yields in comparison to present recommendation for urea application. The present results across locations clearly indicate that in hybrid Maize urea should be applied either 30% or 50% as basal and rest 70% or 50% at 8 leaves stage instead of $^1/_3$ as basal + $^1/_3$ at 8 leaves stage + $^1/_3$ at tasseling stage. Apparently the present findings could save labor cost and particularly it also relieve the farmers from health hazard of applying urea at tasseling stage.

Introduction

Maize, a multipurpose cereal crop is very popular to people now a days. In the present recommendation urea-N is applied as top-dress at 8 leaves and at tasseling stage. However, at tasseling stage, most of the Maize farmers do not apply urea because at that time it is difficult to enter Maize field because by leaves injury of skin and eye occurred. Thus, the recommendation needs verification to find out alternative package of urea application at different growth stages of Maize.

Materials and Methods

The experiment was conducted at Pabna, Kushtia, Comilla, Kishoreganj, Jessore, during 2005-06. Two new N fertilizer application methods were tested against the present recommendation. Treatment T_1 was the present recommendation of urea N application method where N applied as basal and two topdress at 8 leaves stage and at tasseling stage. Treatment T_2 was the new one where N was applied as basal and one topdress at 8 leaves stage. Treatment $T_{3'}$ 30% as basal and 70% as top dress at 8 leaves stages. The experiment was designed in RCB (Dispersed) design with 4 replications. Seeds of Maize (var. BARI Hybrid Maize 5) were sown at 6 December at Pabna, 22 November at Kushtia, 12 December at Comilla, 14 December at Kishoreganj, 24 November at Jessore and 4 December at Rangpur of 2005 maintaining a spacing of 75cm × 20cm. Fertilizer nutrients were used @ 255, 56, 144, 34, 13.5, 1.3 kg N, P, K, S, Zn, B and 6 ton cowdung ha^{-1}. Two irrigations were provided at January 9 and February 26, 2006. Other intercultural operation was done when necessary. The crop was harvested during April 15 to May 8, 2006. Data on different parameter were collected and analyzed statistically.

Result and Discussion

Comilla: From the results it was observed that among the treatments there was no significant difference for grain yield as well as yield attributes. However, apparently treatment 50% N as basal + 50 % N at 8 leaves stage gave higher yield (Table 1).

Bogra: Results showed that there was no significant difference among the treatments for grain yield and yield attributes. Apparently, treatment 50% as basal + 50 % at 8 leaves stage gave higher grain yield (Table 2).

Jessore: There was no significant difference among the treatments for grain yield and yield attributes. Thus urea-N could be applied as topdress one time at 8 leaves stage either 50% or 70% of total urea (Table 3).

Rangpur: Higher grain yield was obtained from treatment T_2 but it was statistically at par with T_1. The highest gross margin and BCR were also found in T_2.

Kishoreganj: All the three urea application treatments gave similar grain yield. However, apparently higher grain yield was obtained from 30% urea as basal + 70% urea as topdress at 8 leaves stage (Table 6-7).

Pabna: From the result it was found that grain yield and yield attributes did not differ significantly due to different treatment. So, it was revealed that among single top dress of N at 8 leaves stage(50% or 70%) and two top dress at 8 leaves stage and tasseling stage had no significant difference (Table 8-9). But slightly higher net return and BCR was obtained from Treatment T_2.

Kushtia: Results revealed that highest grain yield was obtained from the treatment 30% urea as basal + 70 % at 8 leaves stage, however it was statistically identical with the application rate of 50% at basal and 50% at 8 leaves stage, and superior to $^1/_3$ as basal + $^1/_3$ at 8 leaves stage + $^1/_3$ at tasseling stage (present recommendation) (Table 10). Slightly higher BCR was recorded from treatment T_3 i.e. 30% urea as basal + 70% urea at 8 leaves stage.

Farmers' reaction: Farmers are pleased and prefer to apply urea topdress only at 8 leaves stage.

Conclusion

From two years result across locations it was proved that single time of Urea-N fertilizer application as topdress at 8 leaf stage of Maize is cost effective and helps to avoid health hazard.

Table 1. Yield and yield contributing characters of Maize at Comilla during rabi 2005-2006

Treatment	Plant height (cm)	Plant population /15 m^2	No. of cobs/15 m^2	No. of grains/cob	100 grain wt. (g)	Grain yield (t/ha)	Straw yield (t/ha)
T_1	193	84	102	514	25.67	7.50	6.90
T_2	202	86	109	502	25.33	8.00	8.02
T_3	199	83	104	518	25.23	7.72	7.13
LSD (5%)	NS	NS	NS	NS	NS	NS	NS
CV (%)	3.64	6.24	12.24	7.49	3.49	12.60	10.89

T_1 = Urea $^1/_3$ basal + $^1/_3$ at 8 leaves stage + $^1/_3$ at tasseling, T_2 = Urea ½ basal + ½ 8 leaves T_3 = 30 % urea as basal + 70 % urea at 8 leaves stage

Table 2. Effect of different methods of N application on Maize at Sherpur, Bogra during 2005-06

Treatment	No. of plants/m^2	Plant height (cm)	No. of Cob/ m^2	No. of filled grain/cob	Unfilled grain/cob	100 seed weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
T_1	6	239.10	6.25	508.0	7.33 ab	39.75	8.16	7.99
T_2	6	246.88	5.75	550.0	6.43 b	40.25	8.27	8.12
T_3	6	237.23	5.83	485.0	9.10 a	39.50	8.00	7.88
CV (%)	3.57	5.30	8.82	8.28	15.25	-	2.55	2.72
LSD(0.05)	NS	NS	NS	NS	*	NS	NS	NS

Table 3. Effect of fertilizers on the yield and yield contributing characters of Maize at MLT site Kaliganj, Jhenaidah during 2005-06

Treatments	Plants/15 m^2	Plant height (cm)	Length of cob (cm)	Grains/cob (no)	100 grain wt. (g)	Grain yield (t/h)	Straw yield (t/h)
T_1	80	203	16.93	532	33.10	8.62	8.19
T_2	80	202	17.07	524	32.70	8.31	7.20
T_3	80	190	16.73	519	32.83	8.22	6.75
CV (%)	0.00	5.62	6.76	7.38	8.54	9.62	8.45
F-test	NS	NS	NS	NS	NS	NS	NS

Table 4. Effect of split application of nitrogen on yield and yield attributes of hybrid Maize at Rangpur, during rabi season of 2005-06

Treatment	Days to maturity	Plant height (cm)	Plants/m^2	Cobs/m^2 (No.)	Grains / cob	100-seed weight (g)	Grain yield (t/ha)
T_1	154 a	199	6	6.16	516	33.9 a	9.90a
T_2	146 b	192	6	6.40	514	33.0 a	10.34a
T_3	152 a	195	6	6.14	503	31.9 b	8.21 b
LSD (0.05)	2.0	NS	NS	NS	NS	1.1	0.94
CV (%)	1.0	2.7	13.6	6.2	11.1	1.9	5.7

Table 5. Cost and return of Maize as influenced by split application of urea at Rangpur, during rabi season of 2005-06

Treatment	Gross return (Tk./ha)	Total variable cost (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	76725	30972	45753	2.47
T_2	82720	30412	52308	2.71
T_3	64653	30992	33661	2.08

Table 6. Yield and yield contributing characters of Maize at Sadar MLT site, Kishoreganj, during rabi 2005-06

Treatment	Plant height (cm)	Cobs/plant (no.)	Grains/ cob (no.)	100-grains wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	215	1.06	419	26	7.76	8.39
T_2	227	1.15	464	27	8.34	9.24
T_3	223	1.07	481	27	8.71	8.68
LSD (0.05)	NS	NS	NS	NS	NS	NS
CV (%)	5.16	3.50	11.92	2.65	12.08	12.18

Table 7. Cost and return analysis of Maize at Sadar MLT site, Kishoreganj, during rabi 2005-06

Treatment	Gross return (Tk ha^{-1})	Total Variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	BCR
T_1	96857	27625	69232	3.51
T_2	104865	27625	77240	3.80
T_3	106607	27625	78982	3.86

Table 8. Effect of different methods of N fertilizer application on Maize at FSRD site, Pushpapara, Pabna during 2005-06

Treatment	Plant height (cm)	Cob length (cm)	No. of Grain cob^{-1}	100 grain wt (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	187.60	18.45	567.95	31.20	8.50	7.30
T_2	198.30	19.55	578.15	30.98	8.94	9.40
T_3	191.70	19.67	593.35	30.90	8.33	9.50
CV (%)	3.96	6.96	4.93	2.79	4.13	25.41
LSD(0.05)	NS	NS	NS	NS	NS	NS

Table 9. Economic analysis of different N application at FSRD site, Pabna during 2005-06

Treatment	Cultivation cost (Tk./ha)	Gross return (Tk./ha)	Net return (Tk./ha)	BCR
T_1	28200	80150	51950	2.84
T_2	28000	85160	57160	3.04
T_3	28000	79720	51720	2.84

Table 10. Yield and Yield attributes of Maize as affected by different level of N- Application at Bharamara, Kushtia, during Rabi 2005-06

Treatment	Plant/ m^2	Grains/cob (No.)	100-seeds wt. (g)	Grain yield (t/ha)	BCR	Moisture content (%)
T1	7	442	33	7.22b	2.63	13
T2	6	481	33	7.58ab	2.75	13
T3	7	552	35	8.75a	3.14	13
CV (%)	-	-	-	20.02		
LSD (5%)	NS	30.5	-	1.96		

Relaying of Hybrid Maize with Potato across Environments

Abstract

The experiment was conducted at Farming System Research and Development (FSRD) site, Pushpapara, Pabna and Mithapukur, Rangpur during 2005-06 to find out appropriate relaying time of Maize with Potato. It was observed that in both locations highest Maize equivalent yields were obtained from Maize sowing at 35 days after planting (DAP) of Potato. The highest gross margin was obtained from Maize sowing at 35 days after planting of Potato in both locations.

Introduction

Maize is the third important cereal crop in our country. Now a day's Maize is cultivating about ninety three thousand-hectare in our country. Maize mainly used as feed, fodder, fuel and bakery industry. Maize is a long duration crop intercropping of short duration Potato cultivar could help the farmer to earn a quick return. However, to get maximum benefit from intercropping, time and plant population should be optimized. Therefore, an experiment was undertaken to observe i) the intercropping and relay time of Maize along with Potato plant population and ii) quick return from Potato and intercropping effect of Potato on Maize yield.

Materials and Methods

The experiment was conducted at FSRD site, Pushpapara, Pabna and Sherudanga, Mithapukur, Rangpur during the Rabi season of 2005-06. The experiment was laid out in RCB design with 4 replications. The treatments were- T_1 = same day planting of Maize and Potato, T_2 = Maize sowing at 20 days after planting (DAP) of Potato, T_3 = Maize sowing at 35 DAP of Potato and T_4 = Sole Maize. The unit plot size was 10 m × 8 m. The Maize variety was BARI Hybrid Maize-5. Maize seeds were sown maintaining a spacing of 75 cm x 25 cm. The land was prepared accordingly and Potato seeds (var. Diamant) were sown on December 8, 2005 at Pabna and November 30, 2005 at Rangpur. Potato seeds were sown in between two Maize rows having 20 cm spacing from tuber to tuber. Maize seeds were sown on 8, 28 December 2005 and 12 January 2006 at Pabna as per treatment respectively. The fertilizer doses were 550-280-280-187-17-12-kg Urea-TSP-MP-Gypsum-$ZnSo_4$-Boric Acid per ha. One third of Urea and all other fertilizer were applied at final land preparation and rest amount of Urea was applied at 8-10 leaf stage and tasseling stage. No additional fertilizer was applied for Potato cultivation. Earthing up was done during split application of fertilizer. The experimental plot was irrigated twice. Other cultural practices were done as and when required. Potato was harvested on February 16, 2006 at Pabna and 15 February 2006 at Rangpur, while Maize was harvested at 14 (T_1 & T_4), 18 (T_2), and 24 (T_3) May, 2006 at Pabna and during April 28 to May 23, 2006 at Rangpur. Blight and virus diseases were observed in Potato plants. Plant protection measures were done when required. The data on grain yield was collected and mean values were determined.

Results and Discussion

Pabna: Performance of relaying of Hybrid Maize with Potato is presented in Table 1 and 3. The result revealed that the maximum tuber yield of Potato was attained in T_3 treatment where Maize sowing at 35 DAP which was followed by T_2 treatment, where Maize sown at 20 DAP. At early stage of Potato growth there was less competition with 35 DAP of Maize regarding nutrients and other growth-promoting factor which might causes higher yield of Potato. The minimum tuber yield, which was achieved with (T_1) treatment, where Maize and Potato were sown at the same time, might be more competition of nutrients between the two crops. The maximum grain yield of Maize was obtained from sole cropping (T_4) followed by the same time planting of both the crops (T_1). It was clearly observed that grain yield of Maize declined gradually with 20 and 35 days delayed sowing respectively, while, the tuber yield progressively increased. The maximum Maize equivalent yield was recorded in T_3 treatment might be due to the increased production of Potato tuber. The highest gross margin was obtained from T_3 treatment while the lowest from sole Maize.

Rangpur: Yield attributes were not significantly influenced by the treatments but grain yield was higher in sole maize followed by treatment T_2 & T_3. Tuber yield of potato was similar in treatment T_3 and T_2 but higher than T_1. All the intercropping systems showed higher MEY than sole maize and the highest in treatment T_3. Higher gross return and gross margin was recorded from treatment T_3 but this treatment failed to show higher BCR than treatment T_4 due to higher cost was involved in treatment T_3. In this situation sole maize gave higher BCR.

Farmers' reaction

Farmers expressed their satisfaction to get higher benefit from relaying of Maize with Potato at Pabna.

Conclusion

At Pabna, relaying of Maize with Potato after 35 days of Potato planting is profitable but at Rangpur relaying of potato is not economical viable than sole maize due to high cost of potato.

Table 1. Performance of Maize as relay crop with Potato at Pushpapara, Pabna during 2005-06

Treatments	plant popul^n	Plant height (cm)	No. of grain cob^{-1}	Days to maturity (days)	Cob length (cm)	100 grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
T_1	38.50a	176.55ab	607.55a	150.50a	18.95a	29.00a	8.72ab	6.69a
T_2	37.75b	177.15ab	525.80a	144.00b	18.65a	28.18a	8.07bc	6.43b
T_3	37.75b	162.68b	491.10a	130.50c	16.70b	28.65a	7.25c	5.73c
T_4	38.75a	192.98a	523.60a	148.50a	19.10a	29.85a	9.19a	6.92a
CV (%)	0.65	7.84	14.57	1.81	2.46	4.94	6.79	2.39
LSD (0.05)	0.40	22.25	125.1	4.16	0.72	2.29	0.902	0.25

Table 2. Economic analysis of Maize as relay with Potato at Pushpapara, Pabna during 2005-06

Treatments	Potato Tuber yield (t/ha)	Maize equivalent yield (t/ha)	Variable cost (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	BCR
Same day planting of Maize and Potato (T_1)	10.92a	18.43	47850	165870	118020	3.47
Maize sowing at 20 DAP of Potato (T_2)	12.42a	19.11	49075	171990	122915	3.50
Maize sowing at 35 DAP of Potato (T_3)	15.42a	20.96	49075	188640	139565	3.84
Sole Maize (T_4)	----	9.19	24000	82710	58710	3.44

DAP = Days after plant

Table 3. Yield and yield contributing characters of Maize as affected by relay with Potato at Rangpur during rabi 2005-06

Treatment	Days to Maturity	Plant height (cm)	Plants /m^2	Cobs /m^2	Grain/ cob (No.)	100-seed weight (gm)	Grain yield (t/ha)
T_1	152 a	204.30 b	6.38	6.73	469	32.15	8.340 b
T_2	143 bc	210.10ab	6.42	6.80	459	32.38	9.906 a
T_3	140 c	200.10 b	6.33	6.75	438	32.11	9.410ab
T_4	148 ab	219.40 a	6.51	6.78	488	33.35	10.444a
CV (%)	1.7	2.8	7.1	11.7	5.6	2.6	7.0
LSD (5%)	5.1	11.87	NS	NS	NS	NS	1.34

Table 4. Cost and return analysis of relaying of hybrid Maize with Potato at Rangpur, 2005-06

Treatment	Tuber yield of potato (t/ha)	MEY (t/ha)	Gross return (Tk./ha)	Total cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	BCR
Same day planting of Maize and Potato (T_1)	15.79b	17.90	147675	71800	75875	2.06
Maize sowing at 20 DAP of Potato (T_2)	17.68ab	21.69	162675	72750	89925	2.23
Maize sowing at 35 DAP of Potato (T_3)	20.06a	22.57	169275	75300	93975	2.25
Sole Maize (T_4)	-	10.44	86130	30960	55170	2.78
LSD (0.05)	3.36					

On-Farm Evaluation of BARI Hybrid Maize at Three Dates of Seeding

Abstract

An on-farm experiment was conducted at Rangpur and Bandarban during the rabi season of 2005-06 to evaluate the performance of BARI released hybrid Maize varieties (BHM-2, BHM-3 & BHM-5) along with check variety Pacific-11 at three dates of sowing viz. 30 November, 15 December and 30 December. BHM-3 produced the highest grain yield in all the three dates of sowing but yield reduction occurred due to late sowing for all varieties. While at Bandarban Pacific 11 and BHM-5 gave higher yield for 30 November and 15 December seeding. On the other hand, at 30 December seeding Pacific-11 and BHM-3 gave reasonable yield but much lower yield than early sowing. BHM-5 or Pacific-11 gave similar BCR while sown from 30 November to 15 December.

Introduction

There are different types of hybrid Maize in the market. BARI has also developed three hybrid Maize varieties such as BHM-2, BHM-3 & BHM-5. Some of imported varieties perform better in early date of seeding but some are well adapted to wide range of seeding time in rabi season. So, an experiment was under taken to evaluate the BARI released hybrid Maize at three dates of seeding compared to widely used variety Pacific-11.

Materials and Methods

The experiment was conducted at Serudanga, Mithapukur of Rangpur and Tumbro, Naikhongchari, Bandarban during rabi 2005-06. There were three dates of sowing (Nov.30, Dec.15 and Dec.30) and varieties were BHM-2, BHM-3, BHM-5 and Cheek Variety Pacific-11. The experiment was sown in factorial RCBD with three dispersed replications. The unit plot size was 2 decimal having spacing 75 cm × 20 cm with recommended fertilizer dose. Intercultural operations were done as and when necessary.

Results and Discussion

For both locations all the yield attributes and yield were higher in early sowing (Nov. 30) than late sowing (December 30). At Rangpur, among the variety higher grain yield was recoded from BHM-3 in all dates of sowing followed by BHM-5 and Pacific-11. In all dates of seeding BHM-2 produced the lowest yield (Table-1). Plant population of BHM-3 was the lowest at late season. However, at Bandarban, Pacific-11 and BHM-5 produced superior yield for early two dates of seeding (30 November and 15 December). But at late seeding (30 December) Pacific-11 and BHM-3 gave reasonable yield but much lower yield than sowing from 30 November to 15 December.

Farmers feedback

Farmers are very interested to cultivate BHM-3 and BHM-5 if seeds are available in the market. But they also opined that BHM-3 variety is risky at late sowing due to taller growth habit.

Conclusion

For Rangpur area (Northern side of Bangladesh) BHM-3 or BHM-5 could be recommended for both early and late seeding. On the contrary, for Bandarban area (Eastern hilly areas) BHM-5 could be recommended for early seeding (up to 15 December) but for late seeding (30 December) BHM-3 performed better. At Bandarban Pacific-11 produced higher yield for all dates of seeding except 15 December sowing.

Table 1. Interaction table on yield and yield attributes of different hybrid Maize at three dates of seeding at Rangpur during rabi season of 2005-06

Date of sowing	Variety	Days to Maturity	Plant height (cm)	Plant/m² (No.)	Grains/cob	100-grain wt.(gm)	Grain yield (t/ha)
30 November	BHM-2	143 de	237bc	6.11	454bc	38.37ab	8.303b
	BHM-3	150 c	254a	6.20	510ab	39.01 a	10.277a
	BHM-5	154 b	201d	6.27	519a	34.02 d	9.890ab
	Pacific-11	159 a	228c	6.19	472b	37.41 b	8.897ab
15 December	BHM-2	137 f	198de	6.00	428c	36.22 bc	8.223b
	BHM-3	142 e	221c	6.00	490ab	37.42 b	8.920ab
	BHM-5	146 d	189e	6.04	484a	32.97 de	8.84ab
	Pacific-11	150 c	199de	6.02	443b	36.04 c	8.43b
30 December	BHM-2	130 g	190e	5.86	406c	35.33 c	6.60c
	BHM-3	138 f	202d	5.73	448bc	36.05 c	7.92bc
	BHM-5	140 ef	182e	5.97	472b	32.11 e	7.86bc
	Pacific-11	145 de	195de	5.88	437bc	35.52 c	7.82c
CV (%)		2.9	2.9	4.2	5.1	2.1	10.70
LSD (0.05)		3.34	10.07	NS	39.86	1.25	1.542

Table 2. Yield and yield attributes of different hybrid Maize at three dates of sowing in Bandarban, 2005-06

Date of sowing	Variety	Plant height (cm)	Plant/ $15m^2$	Cobs/ $15m^2$	Grains/ cob	1000-grain weight(g)	Grain yield (t/ha)	Straw yield (t/ha)
30 November	Pacific-11	279	77	87	542	289	8.54	15.01
	BHM-2	295	76	94	531	309	7.69	12.80
	BHM-3	288	79	70	577	250	7.18	11.11
	BHM-5	270	86	89	570	282	8.29	13.14
15 December	Pacific-11	268	77	90	490	294	8.18	14.98
	BHM-2	271	66	71	554	130	7.51	12.30
	BHM-3	270	66	64	520	256	6.47	9.66
	BHM-5	272	82	85	609	326	8.54	15.04
30 December	Pacific-11	245	72	72	443	249	6.81	8.34
	BHM-2	272	73	73	493	263	5.91	7.37
	BHM-3	259	68	68	534	262	6.67	8.27
	BHM-5	265	75	75	511	400	5.51	6.05
LSD(0.05)		5.12	NS	NS	9.35	0.88	0.32	0.44

The seeding date D_1= 01 December, D_2= 15 December and D_3= 30 December, 2005.
The variety of V_1 = Pacific-11, V_2 = BARI hybrid Maize-2, V_3 = BHM-3 and V_4= BHM-5.

Table 3. Per hectare cost and return of different hybrid Maize at three dates of sowing in Bandarban, 2005-06

Date of sowing	Variety	Gross return (Tk./ha)	Total cultivation cost (Tk./ha)	Gross margin (Tk./ha)	BCR
Nov. 30	Pacific-11	72072	40123	31949	1.80
	BHM-2	64720	40123	24597	1.61
	BHM-3	60216	40123	20093	1.50
	BHM-5	69605	40123	29482	1.73
Dec. 15	Pacific-11	69185	40123	29062	1.72
	BHM-2	63155	40123	23032	1.57
	BHM-3	54175	40123	14052	1.35
	BHM-5	72080	40123	31957	1.79
Dec. 30	Pacific-11	45593	40123	16442	1.40
	BHM-2	49123	40123	9000	1.22
	BHM-3	55428	40123	15305	1.38
	BHM-5	56565	40123	5470	1.14

The farm gate prices of Maize grain @Tk 8000/t and Straw @Tk 250/t.

On-Farm Verification of BARI Hybrid Maize

Abstract

The experiment was conducted in the farmer's field of Comilla, Rangpur, Mymensingh, Patuakhali, Kushtia, Jhenaidah, Tangail, Faridpur, Barind, Rajshahi and Manikganj during rabi season of 2005-06 to study the field performance of BARI hybrid Maize-2, BARI hybrid Maize-3 and BARI hybrid Maize-5. But in three locations Pacific11 were also compared. Result revealed that in most of the locations there were no significant differences among the tested varieties. Apparently in most of the locations higher grain yield was obtained from BARI hybrid Maize3. But in two locations numerically higher yield was recorded from BARI hybrid Maize 2. Yield variation among the cultivars across locations was large (6.33-12.5 t ha^{-1}). Among three locations, Pacific 11 gave numerically higher yield only at Tangail, and in other locations it produced inferior grain yield to BARI hybrids. However, in most of the locations farmers preferred BARI hybrid Maize 5 due to its deep yellow-Red color and BARI hybrid 3 for higher yield.

Introduction

Maize is the third important cereal crop in our country. Now a day's Maize production increases for the poultry industry as well as fodder purposes. Farmer's uses hybrid seeds from the commercial market like as Pacific -11. Considering the importance of Maize, BARI developed some hybrid variety like BARI Hybrid Maize-2, BARI Hybrid Maize-3, and BARI Hybrid Maize-5. On station research results indicated that BARI hybrid Maize-3 had comparable/higher yield potential than Pacific 11 or other Hybrid Maize cultivars. However, before mass recommendation it needs on-farm evaluation across the country. So BARI hybrid Maize-3 needs to verify with other high yielding Maize varieties across different environments of the country.

Materials and methods

The experiment was conducted in the farmer's field of Comilla, Rangpur, Mymensingh, Patuakhali, Kushtia, Jhenaidah, Tangail, Faridpur and Barind area, Rajshahi during rabi, 2005-06. The experiments had three replications with RCB design but in some location non-replicated trial were conducted. The tested varieties were BARI hybrid Maize-3, BARI hybrid Maize-2, and BARI hybrid Maize-5. The land was well prepared and seeds were sown on 11 December at Comilla, 12 December at Rangpur, 6 December at Mymensingh, 22 November at Kushtia, 27 November at Jhenaidah, 16 November at Tangail, 2 December at Faridpur, 8 December at Rajshahi, 9 December at Manikganj of 2005 and 1 January 2006 at Patuakhali. Unit plot size was 200m^2 per replication and spacing was 75 cm × 20cm. The fertilizer doses were 550-260-220-260-15 kg urea, TSP, MP Gypsum and $ZnSO_4$ per ha respectively. 1/3 urea and other fertilizer were applied at land preparation. Rest of the urea was applied twice as top dress. The experimental plot was irrigated once at 20 February 2006. Two weeding was given at 20 and 45 DAS. Other cultural practices were done as per whole family Maize training manual. The crop was harvested during April 16 to May 13, 2006.

Results and discussion

Yield and yield attributes of different Maize varieties did not vary significantly (the locations where statistical analysis was done). However, in most of the locations higher apparent grain yields were recorded from BARI Hybrid Maize-3. But in few locations BARI hybrid Maize-2 produced numerically higher yield. Among three locations Pacific 11 gave inferior yield in two locations in comparison to BARI Hybrid Maize. However, in some locations lodging tendency of BARI hybrid Maize-2 and 3 were observed.

Farmers' reactions

In most of the locations farmers opined that BARI hybrid Maize is quite comparable to most popular commercial hybrid Pacific 11. However, to popularize the BARI hybrids its seed should be made available to farmers' door-step in proper time and at reasonable price.

Table 1. Yield and yield attributes of different Maize varieties at Comilla, 2005-06

Treatment	Plant /15 m^2	Plant height (cm)	Cobs/15 m^2	Grains/ cob	100-grain wt. (g)	Stover yield (t/ha)	Grain yield (t/ha)
BARI Hybrid Maize -3	91	238	100	501	28	8.51	7.34
BARI Hybrid Maize-2	89	213	122	504	30	7.41	8.13
BARI Hybrid Maize-5	90	244	95	444	27	7.80	6.33
LSD (5%)	NS	NS	NS	NS	NS	NS	NS

Table 2. Yield and yield performance of different variety of BARI Hybrid Maize at Serudanga, Mithapukur, Rangpur

Variety	Plants/m_2	Plant height (cm)	Cobs/ m^2	Grains/ cob	100-grain wt. (g)	Grain yield (t/ha)	Days to maturity
BHM-2	6	220.29 b	6.0	414 b	38.9 a	7.29 b	143 b
BHM-3	6	236.81 a	6.0	532 a	36.22 a	10.11 a	147 ab
BHM-5	6	197.23 c	6.46	498 a	33.21 b	9.46 a	150 a
CV (%)	8.2	2.9	9.5	4.7	3.60	10.8	2.0
LSD (5%)	NS	11.03	NS	39.4	2.27	1.6	5.0

Table 3. Yield and yield contributing characters of BARI hybrid Maize varieties, Mymensingh, 2005-06

variety	Plant height (cm)	Ear height (cm)	Plants /15m²	Cobs/ 15m²	Cobs/ plant	Diameter of cob (cm)	Length of cob (cm)	No of grain/ cob	100-grain weight (g)	Grain yield (t/ha)	Stover yield (t/ha)
BHM-2	253.2	111.3	80	86	1.08	15.58	20.5	482	41.8	10.33	15.76
BHM-3	256.7	119.7	80	83	1.04	15.33	19.5	534	35.6	9.93	14.48
BHM-5	238.5	120.4	80	83	1.04	15.11	18.7	550	32.7	9.80	14.22

BHM= BARI Hybrid Maize

Table 4. Yield and yield attributes of different Maize varieties at Patuakhali, 2005-06

Treatment	Plant /10m²	Plant height (cm)	No. of Cobs/plant	No. of Grains/cob	100- grain wt. (g)	Grain yield (t/ha)
BARI Hybrid Maize -2	63	210	1	552	28	9.74
BARI Hybrid Maize-3	64	196	1	615	29	11.41
BARI Hybrid Maize-5	63	192	1	589	27	10.02

Table 5. Effect of different varieties on yield and yield components of Maize at Kushtia during 2005-06

Treatments		Plant height (cm)	No. of plants/15m²	Grains/cob	100-grain wt. (g)	Grain yield (t/ha)	BCR
BHM-2	Gangni	233	86	556	34.0	8.60	2.47
	Damurhuda	226	81	545	33.0	7.47	2.19
BHM-3	Gangni	254	88	505	35.5	7.76	2.25
	Damurhuda	248	85	511	34.8	7.20	2.16
BHM-5	Gangni	220	89	556	34.7	8.84	2.53
	Damurhuda	206	87	547	34.3	8.06	2.35
Paciffie-11	Gangni	244	85	446	34.1	7.55	2.19
	Damurhuda	249	81	440	33.6	7.13	2.09

Price = 10 Taka per kg

Table 6. Yield and yield attributes of Maize varieties at MLT site, Kaligonj, Jhenaidah during 2005-06

Variety	Plant height (cm.)	Grains/ cob (no.)	Pl.pop./m^2 (no)	Grain yield (t/ha)	100-grain wt. (g)	Straw yield (t/ha)
BHM-2	153	545	80	9.17	34.2	6.84
BHM-3	143	535	80	9.45	34.4	8.78
BHM-5	183	525	80	8.15	32.2	6.77

Table 7. Yield and yield contributing characters of hybrid Maize, Ellenga, Tangail, 2005-06

Variety	Ear height (cm)	Cob length (cm)	Grains/cob	1000 grain Wt (g)	Grain yield (t/ha)
BHM-2	95.93	18.23	399	375	8.71
BHM-3	101.00	19.13	489	364	9.28
BHM-5	94.10	17.33	471	431	8.67
Pacific-11	86.33	17.60	467	430	10.09
LSD (0.05)	NS	1.24	NS	NS	1.33
CV (%)	17.27	3.46	9.92	14.56	7.26

Table 8. Yield and yield contributing characters of BHM-2, BHM-3 and BHM-5 at FSRD site, Ishan Gopalpur, Faridpur, 2005-06

Variety	Plants/ 15m^2	Ear height (cm)	No. of cobs/15m^2	No. of grains/cob	100 grain wt. (g)	Grain yield (t/ha)	Stover yield (t/ha)
BHM-2	67	129	76	479	33.2	12.51	9.17
BHM-3	76	137	79	502	32.9	11.87	8.97
BHM-5	76	123	75	476	28.9	11.45	8.70
Pacific 11	75	110	76	480	33.0	11.50	8.5

Table 9. Yield and yield performance of different variety of BARI Hybrid Maize at Kadamshahar, Barind, Rajshahi, 2005-06

Variety	Plants/m^2	Plant height (cm)	No. of cobs/ plant	No. of grain/Cob	100 grain wt. (gm)	Grain yield (t/ha)	Days to maturity
BHM-2	4	178	1.2	448	32.5	6.95	143
BHM-3	4	195	1.2	495	36	8.54	143
BHM-5	4	198	1.2	440	30	6.25	143

Table 10. Yield and yield attributes of different varieties of BARI Hybrid Maize at Manikganj, 2005-06

Variety	Days to maturity	Plants/m^2	Plant height (cm)	Cobs/m^2	Grains/ cob	100 grain wt. (gm)	Grain yield (t/ha)	Stover yield (t/ha)
BHM-2	142	3.73	211	4.2	527	42.3	5.50	13.08
BHM-3	142	5.13	207	5.2	647	36.1	8.90	16.76
BHM-5	146	5.13	172	5.3	598	32.5	9.02	16.67

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On-Farm Verification of BARI Hybrid Maize-5

Abstract

On-farm performance of BARI Hybrid Maize-5 was evaluated at MLT site Sherpur, Bogra and FSRD site Kusumhati, Sherpur during 2005-06. The objective was to observe the performance of BARI Hybrid Maize-5 in farmer's field. The result showed that BARI Hybrid Maize-5 gave 8.27 t/ha and 9.47 t/ha grain yield at Bogra and Sherpur respectively. Farmers showed their interested to grow the BARI hybrid Maize 5 due to high yield potential and good taste for eating as bread mixed with wheat flour.

Introduction

Maize ranks third globally among the cereal crops next to rice and wheat in terms of the area and production. The yield potential of the existing varieties is lower in comparison to hybrid Maize. In Bangladesh hybrid Maize is being cultivated for the last few years. Farmers in this area mainly grow hybrid variety imported from abroad. BARI already developed BARI hybrid Maize which needs to popularize among the farmers at present situation. In this context a trial was. undertaken by OFRD, BARI at different location of Bangladesh to evaluation its potential yield at farmer's field.

Materials and Methods

The on-farm verification of BARI hybrid Maize -5 was tested at the farmer's fields of MLT site Sherpur, Bograand FSRD site, Kushumhati, Sherpur during rabi season of 2005-06. A discussion meeting was arranged with co-operator farmers for implementation of the program. Farmer were motivated and agreed to co-operate with the site team. The site team supplied good quality seeds of BARI hybrid Maize-5 to the farmers. The seeds were planted at the spacing 75 cm×20cm. The area was fertilized with 240-50-100-44-4.5-1.0 kg/ha N-P-K-S-Zn-B and 5 ton cow dung per hectare respectively. One third of urea and all others fertilizer were used at final land preparation. Remaining part of urea was top dressed in two equal splits of 40 and 65 DAS. The seeds were sown on December 2, 2005 at Bogra and 11 November, 2005 at Sherpur. and the crop was harvested on April 24, 2006 at Bogra and April 23, 2006 at Sherpur

Results and Discussion

The result showed that reasonable good yield was obtained from BARI hybrid Maize-5. It was shown in table-1

Table 1. Yield and yield attributes of BARI hybrid maiz-5 at MLT site Bogra and Sherpur during 2005-06

Location	Plant height (cm)	Plants / m^2	Cobs/m^2	Grains/cob	100-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)
Bogra	213	7	7	427	35	8.27	6.00
Sherpur	221.6	6.4	6.5	494	27	9.47	5.76

Conclusion

Farmers showed their keen interest to grow the BARI hybrid Maize-5 due to high yield potential and good taste for eating as bread.

On-farm verification of BARI Hybrid Maize -5 with Red amaranth at hill valleys in Bandarban

Abstract

A verification trial of BARI hybrid Maize-5 + Red amaranth (Red king) was conducted at Chemee dolo para hill valleys in Bandarban sadar areas during rabi season, 2005-06 with a view to evaluate the adaptability and yield potentiality of this variety. The trial revealed that Maize grain yield was 8.33 t/ha and Red amaranth was 3.24 t/ha. The gross margin was Tk. 58644/ha and benefit cost ratio was found 2.33. The obtained yield was accepted by the farmers.

Introduction

In Bandarban hill district, plain land is limited, so, it is essential to intensive use of land by introducing inter-crop in order to obtain highest yield and income. BARI has developed some hybrid Maize variety, BHM-5 is one of the important variety which is it called QPM (quality protein Maize). Before mass recommendation of this developed variety, it needs on-farm evaluation. Hence forth, Bandarban is an area that has an ample opportunity to produce Maize as a great local demand of tribal people and the owner of mini poultry/dairy farm. With view this, a verification trial has been under taken at hill valleys in Bandarban.

Objectives

- To evaluate the adaptability, yield potentiality of BARI hybrid Maize-5 intercropped with Red amaranth
- To know the economic performance of BARI hybrid Maize-5 with Red amaranth
- To know the farmers reaction

Materials and Methods

The verification trial was conducted at Bandarban sadar areas at hill valleys during rabi season, 2005-06.The soil of the experimental field was sandy loam having p^H 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 Nirdishika, Bandarban). The site represents the area of AEZ-29. The variety was BARI hybrid Maize-5 with non-replicated. The unit plot size was 28m x 25m. With maintaining the spacing 75cm x 20cm.The sowing date was 02 December 2005. Fertilizers were applied for Maize @ N-256, P-55, K-138, S-3, B-1 $kgha^{-1}$ $tonha^{-1}$. One third N and all other fertilizer were applied as basal and rest 2/3N; 1/3N were applied at 8-10 leaves stage and rest 1/3N at tussling stage. The Maize was harvested 10-15 April 2006.The yield contributing character data of Maize were recorded from ten randomly selected plants. The yield data was calculated by using the following yield conversion formula for Maize:

Adjusted yield = CF x Plot yield, CF= M-03(N)/M–N, CF= Conversion factor, M= Optimum number of plants, N= Number of missing plants, 0.3= Constant factor

Yield (t/ha) = Adjusted plot yield x $10000m^2$/Area x 100- MC%/85 x 0.8, i.e. MC= 18%

Results and Discussions

Plant height, number of plant /$15m^2$, number of cobs/$15m^2$, number of grains/cobs and 1000-grain wt. and yield are presented in Table 1. It is seen from the table that all yield attributing character was reasonable and additional yield of intercrop was also satisfactory.

Cost and return analysis

The cost and return analysis of BARI hybrid Maize-5 with Red amaranth is shown in Table 2. The total cost of cultivation (excluded fixed cost) was estimated at Tk. 44221/ha. The gross return was accounted as Tk. 102865/ha. The gross margin was obtained as Tk. 58644/ha while benefit cost ratio was 2.33.

Farmer's feedback

® Farmer's are interested to grow BARI hybrid Maize-5 with Red amaranth for its quick return.
® Its acceptability was higher than sole Maize cultivation.

Conclusion

Yield of Red amaranth can be improved in future to maintaining proper management in farmer's field. This trial can be expanded throughout the farmer's field.

Table 1. Yield and yield contributing character of BARI hybrid Maize-5 with Red amaranth (Bandarban, 2005-06)

Variety	Plant height (cm)	No. of plant /15m^2	No. of cobs/ 15m^2	No. of grains/ cobs	1000-grain wt.	Grain yield (t/ha)	Stover yield (t/ha)	Yield of Red amaranth (t/ha)
BARI hybrid Maize-5	274	71	100	491	316	8.33	15.30	3.24

Table 2. Economic performance of BARI hybrid Maize-5 + Red amaranth cultivation at hill valleys (Bandarban, 2005-06)

Treatment	Gross return (Tk./ha)	Cost of cultivation (Tk./ha)	Gross margin (Tk./ha)	Benefit-cost ratio (BCR)
BARI hybrid Maize-5 + Red amaranth	102865	44,221	58644	2.33

Note: Market price of Maize Tk.8/kg &, Price of stover Tk. 0.25/t & Red amaranth @ Tk. 10/kg

Integrated Home Gardening for Food Security, Family Nutrition and Poverty Alleviation

Abstract

An experiment was conducted on growing vegetables round the year in homestead of three farmers' of SAIP group at Farming Systems Research and Development Site, Kushumhati, Sherpur during the period from Kharif 2005 to Rabi 2006 with a view to find out a profitable sequence of vegetables pattern and to utilize the unused places of homestead. Five vegetable patterns were tested in this context. Indian spinach-Data-Tomato gave the highest net return and benefit cost ratio. The lowest was obtained from Chilli-Spinach+Garlic and the pattern Kangkong-Kangkong-Lalsak+Cabbage gave the lowest benefit cost ratio. 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 of three farmers' of SAIP group at Farming Systems Research and Development Site, Kushumhati, Sherpur during the period from Kharif 2005 to Rabi 2006 with a view to find out a profitable sequence of vegetables pattern and to utilize the unused places of homestead.

Materials and Methods

Trials on different vegetables growing patterns at homestead round the year started at Farming Systems Research and Development (FSRD) Site, Kushumhati, Sherpur from Kharif 2005 to Rabi 2006 with a view to find out a profitable sequence of vegetable patterns and to utilize the unused 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	Kangkong	Kangkong	Lalsak + Cabbage
Plot 3	Okra	Broad leaf coriander	Coriander + Onion
Plot 4	Chilli		Spinach+ Garlic
Plot 5	Latiraj kachu		Carrot+ Bitter gourd

A total sample of ten farmers was selected 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, Kangkong, Okra, in 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 on 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): Latirajkachu took maximum field duration i.e. 180 days (sowing to final harvest) and Kangkong took manimum 60 days (Table 1).

Yield: The highest yield was obtained from Kangkong (96 kg/dec.) while the lowest from Latirajkachu (27 kg/dec.). But the highest net return was recorded from Indian spinach (Tk.255/dec.) and the lowest from Latirajkachu (Tk. 104/dec.) The highest benefit cost ratio was found in Indian Spinach (2.21) and the lowest from Latirajkachu (1.72). The maximum benefit cost ratio (2.2) was recorded from Indian Spinach (Table 1).

Kharif-II

Field duration (days): Maximum field duration was taken by Latiraj Kachu 180 days (sowing to final harvest) and the minimum was 52 days by Kangkong (Table 2).

Yield: The highest yield was recorded from Kangkong (141.68 kg/dec.) while the lowest from Chili (6.07 kg/dec.). Data produced the second highest yield (231.44 kg/dec.) and Latirajkachu gave the second lowest yield (117.39 kg/dec.). The highest gross benefit was obtained from latiraj kachu (Tk.821.73 /dec.) which followed by Kangkong (Tk. 566.72/dec.). The lowest gross benefit was obtained from Chili (Tk. 212.45/dec.). The maximum benefit cost ratio was recorded from Latiraj kachu (3.8) and lowest (1.7) was from Chili (Table 2).

Rabi

Field duration (days): Maximum days required for Tomato (112) followed by Garlic and Bitter gourd (110) while the minimum days required for Lalshak (30) at the field (Table 3).

Yield: The highest yield was obtained from Tomato (350.82 kg/dec.) which followed by Lalsak+ Cabbage (48.57+183.50 kg/dec.) and Spinach+Garlic (72.86+24.28 kg/dec.). The lowest yield was obtained from Coriander+Onion (27.98+59.36 kg/dec). The highest net return (Tk. 3022.50/dec.) and benefit cost ratio (7.2) were obtained from Tomato. Ahmed (1995) reported that Tomato+Batisak gave the highest net return and BCR. The lowest net return (Tk.586.32/dec.) was obtained from the plot Coriander + Bitter gourd. The lowest benefit cost ratio (2.9) 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 pattern Indian spinach-Data-Tomato performed better than the other patterns. This pattern gave the highest gross and net return (Tk.4337.58/dec.) and (Tk. 3447.52/dec.), respectively. The BCR (4.8) was also the highest in this pattern. The lowest gross return Tk. 1645.13/dec. and net return Tk. 1159.37/dec. The lowest BCR (2.6) was found in Kangkong-Kangkong-Lalshak+cabbage vegetable sequence.

Conclusion

Among the five vegetable patterns, Indian spinach-Data -Tomato gave the highest net return (Tk. 3447.52/dec.). All of the patterns might be benefited for the farmer both in nutritional and economic point of view as the source of vitamin and minerals which most essentials for the farmers health and cash earning.

Table 1. Yield, cost and return analysis of different vegetables of Kharif-I at FSRD site, Kushumhati, Sherpur, 2005

Crop	Field duration (days)	Yield (kg/dec.)	Total return (Tk/dec.)	Total variable cost (Tk/dec).	Net return (Tk/dec.)	Benefit cost ratio
Indian Spinach	70	93	465.00	210	255	2.2
Kangkong	60	96	384.00	220	164	1.7
Okra	90	34	408.00	210	198	1.9
Chilli	-	-	-	-	-	-
Latiraj kachu	180	27	216.00	125	104	1.7

Price: Indian Spinach - Tk.5.00/kg, Kangkongl - Tk.4.00/kg, Okra - Tk12.00/kg Latiraj kachu-TK.8.00/Kg

Table 2. Yield, cost and return analysis of different vegetables of Kharif-II at FSRD site, Kushumhati, Sherpur, 2005

Crop	Field duration (days)	Yield (t/dec.)	Total return (Tk/dec.)	Total variable cost (Tk/dec.)	Net return (Tk/dec.)	BCR
Data	70	121.44	364.32	194.30	170.02	1.8
Kangkong	52	141.68	566.72	242.88	323.44	2.3
Broad leaf coriander	-	-	-	-	-	-
Chili	145	6.07	212.45	121.44	91.01	1.7
Latiraj kachu	180	117.39	821.73	242.88	578.85	3.8

Price : Data - Tk.3.00/kg, Kangkong - Tk.4.00/kg, Chilli -Tk.35.00/kg, Latiraj kachu-Tk .7.00/kg

Table 3. Yield, cost and return analysis of different vegetables of Rabi at FSRD site, Khushumhati, Sherpur, 2005-06

Crop	Field duration (days)	Yield (t/dec.)	Total return (Tk/dec.)	TVC (Tk/dec.)	Net return (Tk/dec.)	BCR (TVC basis)
Tomato	112	350.82	3508.26	120000	3022.50	7.2
Lalsak +Cabbage	30	48.57	1500.41	115000	1034.89	3.2
	95	183.50				
Coriander +Onion	80	27.98	1575.76	80000	1251.92	4.8
	97	59.36				
Spinach + Garlic	60	72.86	1432.68	90000	1068.36	3.9
	110	24.28				
Carrot + Bitter gourd	90	53.57	889.92	75000	586.32	2.9
	110	40.38				

Price: Tomato - Tk. 8.00/kg, Coriander - Tk. 20.00/kg, Lalsak - Tk. 4.00/kg, Onion - Tk. 8.00/kg, Cabbage- Tk. 5.00/kg, Spinach- Tk. 4.00/kg, Garlic- Tk.25.00/kg, Carrot -Tk. 6.00/kg, Bitter gourd - Tk.6.00/kg

Table 4. Cost and return analysis of different vegetables pattern round the year at FSRD site, Khushumhati Sherpur 2005-06

Patterns	Total return (Tk/dec.)	TVC (Tk/dec.)	Net return (Tk/dec.)	BCR
Indian spinach -Data- Tomato	4337.58	890.06	3447.52	4.8
Kangkong -Kangkong- Lalsak + Cabbage	2451.13	928.4	1522.73	2.6
Okra-Broad leaf coriander- Coriander + Onion	1983.76	533.84	1449.92	3.7
Chilli- Spinach+ Garlic	1645.13	485.76	1159.37	3.3
Latiraj kachu - Carrot+ Bitter gourd	1927.65	671.48	1256.17	2.8

List of interventions in each sub-system

Crop Sector

- Mukhikachu, Ginger, Turmeric

Homestead

- Homestead vegetable production model
- Sweet gourd on roof
- Bitter gourd on the fence
- Bottle gourd on pond trails
- Latiraj Kachu in marshy land
- Potato yam on the tree and on the vertical bamboo support
- BARI Shim-1 on the trail's
- Management and fertilization of different fruit trees
- Plantation of fruit trees like mango (Amrapali, Litchi and tissue culture banana.)

Mymensingh sadar

Table 1 shows the agro-economic performance of different vegetables whereas the Table 2 shows the utilization pattern of the homestead produce. Field duration of the rabi vegetables varied from 29-111 days. Lalshak was the most short duration crop whereas tomato required the maximum days to harvest. Yield of different vegetables were: Tomato 42 kg, Lalshak 8.17kg, Cabbage 35 kg, Coriander 2 kg, Onion 6.5kg, Spinach 10kg, Garlic 3.16kg and Carrot 9.4Kg. Net return varied from Tk. 46-378 /bed. Highest net return was obtained from tomato and lowest was from onion. However, BCR was highest (13.33) in coriander. Table 2 shows the utilization pattern of the homestead vegetable grow in the homegarden. Farmer 1, 2 and 3 produced 109.70kg, 117.30kg and 122.45kg vegetables, respectively. They consumed 75-85kg, distributed to the neighboured 10-15 kg and sold in the market 17.7-27.45 kg. Consumption period ranged from 65-70 days. After harvesting the Kharif crops, complete pattern wise result could be given and conclusion can be drawn on the homestead vegetable production model.

Farmers reaction

Farmers are very happy with the homestead vegetable production model because they are harvesting different fresh vegetables with a few days intervals. They can eat the vegetables when they feel need.

The women and children can participate in the home gardening. They can also distribute some vegetables to the neighbourer and can also sell some portion of their produce in the local market to earn cash money.

Table 1. Yield, cost and return analysis of different vegetables at Sabjipara, Shambhuganj, Mymensingh (Rabi' 2005-06)

Crop	Field duration (day)	Yield/bed (kg)	Total return (Tk./bed)	Total variable cost (Tk./bed)	Net return (Tk./bed)	BCR
Tomato	111	42.00	420	42	378	10.00
Lalshak	29	8.17	82	30	52	2.73
Cabbage	91	35.00	175	35	140	5.00
Coriander	33	2.00	400	30	370	13.33
Onion	87	6.50	78	32	46	2.44
Spinach	33	10.00	80	33	47	2.42
Garlic	96	3.16	158	36	122	4.39
Carrot	89	9.40	94	35	59	2.69

Table 2. Utilization pattern of homestead vegetables grown in the home garden at Sabjipara, Shambhuganj, Mymensingh (Rabi' 2005-06)

Farmer	Total production (kg)	Consumption (kg)	Distribution (kg)	Sell (Kg)	Consumption period (days)	Production period (days)
1. Md.Jamshed Ali	109.70	75	15	17.7	65	133
2. Md. Nazim uddin	117.30	85	10	22.3	68	136
3. Md. Shahidul Islam	122.45	80	15	27.45	70	131

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Utilization of Fisheries Gher Boundary through Vegetable and Fruit Production in Coastal Area

Abstract

An experiment was initiated to find out suitable vegetable and fruit species for planting in the bund around fisheries gher at Bagerhat MLT Site. Four vegetable patterns were designed in this context. Different crops within pattern were evaluated of which Tomato-Gimakolmi pattern performed better with high benefit cost ratio also found feasible and profitable.

Introduction

The medium lowland and lower portion of medium high land occupies a considerable available area of the district. The dominant cropping pattern in such land types is Fallow–T.Aman–Fallow. Because of low productivity from the land, farmers of the area are shifting over to fish production. A number of fisheries gher has cropped up around district of Khulna, Bagerhat and Satkhira. The bunds around the ghers occupy a reasonable area and are underutilized. The area is deficit in vegetables and there is acute shortage of fuel and fruit. Attempt was made to utilize the bunds through crop culture and tree plantation to increase the local production by utilizing the gher bunds. The present study was undertaken to find out suitable vegetable and fruit species for planting in the bund around fisheries gher and to increase production and consumption of vegetables and fruits round the year.

Materials and Methods

Trials on different vegetables and fruit growing patterns at fisheries gher area round the year started at Bagerhat MLT Site during rabi 2004-’05 with a view to find out suitable vegetable and fruit species and to utilize the unused under utilized places of gher. Four different patterns were included in the study. The pattern are as follows:

Pattern		Rabi	Kharif	Edge
Pattern-1	:	Brinjal	Okra	Papaya
Planting date		14 Dec’04	16 June ‘05	
Pattern-2	:	Tomato	Indian spinach	Country bean
Planting date		03-16 Nov’04	18 July ‘05	
Pattern-3	:	Water Melon	Bottlegourd	Munkachu
Planting date		08 Feb.’05	20 July ‘05	
Pattern-4	:	Sweet gourd	Bitter gourd	
Planting date		12-27 Nov.’05	26 June ‘05	

The experiment was conducted in four farmer’s field. The unit plot size was 6m 5 1.5m. Recommended spacing and fertilizer dose were used. Data on yield, cost and returns were recorded.

Results and Discussion

From the results, Tomato-Gimakolmi pattern performed better than other patterns. Tomato-Gimakolmi pattern performed better with higher benefit cost ratio. Although tomato involved higher cost of cultivation but due to its higher market price higher gross return was achieved. Water melon was damaged at February. From the above results it was shown that Tomato-Gimakolmi pattern could be grown at gher area.

Farmer's reaction

Tomato should be planted within October to get better market. Farmer's prefer white big size Brinjal. Farmer's preferred Gimakolmi as a new crop and tasty. Farmers dislike bottle gourd due to less tasty.

Conclusion

Yield as well gross return and gross margin showed higher with reasonable benefit cost ratio (2: 62: 2.00) in Tomato-Gimakalmi pattern in Gher area.

Table 1. Yield and return analysis of different vegetables patterns at Bagerhat MLT site during 2004-05

Pattern		Field durations (days)		Yield (t/ha)		Gross return (Tk./ha)		TVC (Tk./ha)		Gross margin (Tk./ha)			BCR
Rabi	Kharif	c_1	c_2	c_1	c_2	c_1	c_2	c_1	c_2	c_1	c_2	Total	
Brinjal-Okra		130	110	2.50	8.33	12500	66640	98000	60000	85500	6640	-78860	--
Tomato-Gimakolmi		110	110	49.10	24.44	294600	97760	105000	45000	189600	52760	242360	2.62
Water melon-Bottle gourd		-	120	-	26.66	--	79980	--	66000	--	13980	13980	1.21
Sweet gourd-Bitter gourd		125	125	35.00	8.78	142000	87800	68600	70000	71400	17800	89200	1.64

Price: Brinjal: Tk 5.00/kg, Tomato: Tk 6.00/kg, Sweet gourd: Tk 4.00/kg, Okra: Tk.8.00/kg, Gimakalmi: Tk. 4.00/kg, Bottle gourd: Tk. 3.00/kg. Bitter gourd: Tk. 10.00/kg.

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Crop-Fish-Livestock Integrated Farming in Crop Field of Ganges Tidal Floodplain

Abstract

Two 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 during 2002. One alternate module called Gher module was tested for two consecutive years. Another alternate module called Modified Sorjan Module was tested from 2004. Total production, gross return and gross margin was higher in both alternate modules than that of farmers' practice. Though the operational cost was higher in alternate modules, Gher module and Modified Sorjan Module produced BCR of 2.94 and 3.21, respectively. Gross benefit over farmers' practice was 1023% in Modified Sorjan module and 183% in Gher module. over farmers' practice. Crop diversification specially vegetables and fish production was an important benefit from alternate modules. The experiment should be continued for further detailed study.

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 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 joy 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:

To develop a module(s) of integrated farming in the crop field for:

a) Maximum utilization of available resources.
b) Higher economic return.
c) Diversification of production system with sustainability.

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. One alternate module named Gher Module was tested with existing cropping pattern during 2002 and 2003. From 2004-2005, another alternate module named Modified Sorjan Module was tested with existing cropping pattern.

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 ”

The Gher was completed within March 2002 with a cost of Tk 12,000/=

Integration of components in the Gher:

a) Crop field: Mungbean (15 dec.)-T.aus (MV)-T.aman (MV) and
   Zero tillage potato (7 dec.)-T.aus (MV)-T.aman (MV)
b) Canal: Stocking / rearing of fish
c) Embankment top: Banana plantation + vegetables
d) Embankment slope: Creeper vegetables.

Description of Modified Sorjon: A Sorjon is an alternate ridges and furrows system to produce vegetables and fruits in low lying areas. The Sorjon system previously developed by OFRD, BARI, Patuakhali had only 1.5m wide furrows and 2.0m wide ridge beds. The Modified Sorjon was designed for much wider furrows (canal) and beds so that fish could be reared in furrows and water reserved in furrow could be used for vegetables grown in the beds. A total area of 80m X 27m was taken for the Modified Sorjon module in which area distribution as follow:

Canal (Furrow): 80 m X 9 m X1.83 m.

Bed: 80 m × 18 m.

The Sorjan was completed within May 2004 at a cost of Tk. 16,000/=. Then dhaincha as green manure was grown. Before vegetable cultivation, cow dung at a rate of 10 t/ha was applied during land preparation.

Integration of components in the Sorjon:

Canal : Stocking/rearing fish and creeper vegetables.
Bed : 1. Dhaincha- Lal Shak-Radish-Brinjal
2. Dhaincha- Lal Shak-Cabbage-Brinjal
3. Dhaincha- Lal Shak-Tomato-Ladies finger

All management practices for the crops in both alternate modules were given as per recommendation.

Results and Discussion

Despite the production of some vegetable in Sorjon module yet to be added, total production was increased remarkably in both alternate modules in compare to farmers' existing practice. Total variable cost was higher in alternate modules but gross margin was also higher with BCR 2.94 for Gher module, 3.21 for Modified Sorjon module and 1.97 for farmers' practice. Gross margin over farmers' practice was 1023% for Modified Sorjon module and 183% for Gher module. It was seen that the total potential of the Gher and sorjon could not be exploited due to some unavoidable circumstances. Only 80% area of the embankment was cultivated to grow vegetables. Live-stock components in both modules and creeper vegetables are in Sorjon module yet to be tested.

Benefits derived from alternate modules were:

* More production.
* Diversified production especially fruits, vegetables and fish.
* More economic return.
* Income generation round the year.
* Maximum utilization of the resources.
* Better water management.

Shortfall:

* Long-tern effect on soil fertility specially of embankment.
* Not yet fully utilized the resources for potential maximum production (creeper vegetables, livestock and fish).

Disadvantage:

* More labour requirement.
* Requires intensive care, management and planning.
* Requires high initial cost.
* Requires higher operational cost.

Conclusion

The Modified Sorjon was carried out for one year only and it needs further details study. It was expected that both the alternate modules could be excellent technology to increase production and income of the farmers of the region sustainably.

Table 1. Production practices and production of different commodities in Modified Sorjan Modules and farmers' practices

Commodities	Total area (dec.)	Sowing/ planting date	Harvesting started	Yield (kg)	Yield (ton/ha)
Modified Sorjan Module					
Red amaranth	15	20.10.05	28.11.05	522	8.60
Radish	10	30.10.05	25.12.05	1870	46.20
Bitter gourd	Canal slope	2 times	2 times	230	-
sweet gourd	Canal slope	25.12.05	25.03.06	130 pc	-
Tomato	10	07.11.05	03.03.06	2846	70.30
Brinjal	15	26.12.05	05.04.06	2502	41.20
Lady's finger	10	25.03.06	10.05.06	46	11.50
Potato	15	18.11.05	15.02.06	1136	18.70
Bush bean	5	18.11.05	03.01.06	198	9.80
Coriander leaf	5	30.10.05	25.11.05	16	0.80
Summer onion	3	05.02.06	02.05.06	119	9.80
Indian spinach	10	02.04.06	10.05.06	870	21.50
Fish in canal	17.9	25.05.05	24.02.06	172	-
Farmers' practices					
T. aus	50	20.05.05	15.08.05	566	2.80
T. aman	50	01.09.05	28.12.05	708	3.50
Mungbean	50	01.02.06	25.04.06	113	0.56

Table 2. Cost and return of alternate modules and farmers' practice

Practices	Gross return	TVC	Gross margin	BCR	Gross margin over FP (%)
Modified Sorjon module (53 dec.)	102500/-	31900/-	70600/-	3.21	1023
Gher module (50 dec.)	25500/-	8669/-	16831/-	2.94	183
Farmers' practice (1 ha.)	59500/-	30200/-	29300/-	1.97	-

Output price: Bushbean= Tk. 8-10/kg, Sweet gourd: Tk. 10/piece, Bitter gourd: Tk. 12-15/kg, Red amaranth: Tk. 6-8/kg, Radish: Tk. 3-4/kg, Fish: Tk. 35-60/kg , Potato: Tk. 5-7/kg, Tomato: Tk. 4-10/kg, Brinjal: Tk. 8-10/kg, Lady;s finger: Tk. 10-12/kg, Coriander leaf: Tk. 20-30/kg , Summer onion: Tk. 12-14/kg, Indian spinach: Tk. 4-6/kg, Mungbean: Tk. 25-30/kg, Rice: Tk. 6-7/kg.

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COLLABORATIVE PROGRAM: BARI-IC SAAKTI

Intensified Use of Homestead Spaces for Increased Production of Vegetables and Fruits

Summary

The study was undertaken in three different locations viz. Rangpur, Pabna and Barind during the rabi season of 2005-06 to intensify the use of homestead spaces for increased vegetable production and to meet the demand of family nutrition. A total of 100 households were selected mostly from small, marginal and landless farmers. In each location there were two sites, namely FSRD site and CBO site. From each site 15 households were selected for Rangpur and Barind, however in Pabna from each site 20 households were under study. Round the year vegetable patterns were selected for different niches (such as open sunny land) based on farmers options/agreement. Only vegetable seeds and some critical inputs were freely distributed to initiate the program, all other inputs and labors were provided by the farmers.

The study revealed that per homestead highest (247 kg) amount of vegetables were produced in Rangpur, while 135 kg/homestead was obtained from Pabna and the lowest from Barind (123 kg) in 120 days. Harvested vegetable utilization patterns were similar among the sites. In all the three sites, farmers sold (average 43-46 %) greater amount of vegetables in comparison to intake. On the contrary, consumption ranged from 37-45 %, while free distribution among relatives and neighbors were 8-18 %. However, there were wide variations among the household regarding disposal patterns of produced vegetables. Only farmers of Rangpur succeeded to consume (188 g/head/day) almost near to recommended amount (200 g/head/day) considering five members in a family. On the other hand farmers of Pabna consumed 88 g/head/day and Barind farmers took only 75 g/head/day. Due to harsh climatic and soil conditions along with irrigation water problem Barind homestead produced the lowest. Despite that, the program created a significant impact on the improvement of health and availability of vegetables in the local areas. Because the utilized homestead spaces were mostly fallow or underutilized previously and farmers intake of vegetable was not more than 25-40 g/head/day for want of cash money. Additionally averaged over locations, farmers earned a cash income of Tk. 521/homestead by selling the products. From the preliminary analysis it was observed that except first opening of land, collection of seed/seedlings and partially selling of products, mostly the females and children of household performed the daily work of vegetable gardens. However, the above results indicate that nutritional education is needed for the farmers for ensuring increased consumption of produced vegetables.

Introduction

Landless, marginal and small households comprises of >70% of the rural population and among them 34% have only homestead. Homesteads are the resources that provide major share of livelihood especially for poor farmers. Those resource poor farmers (RPF) get about 50% of their food and cash from homestead. In these circumstances, OFRD of BARI initiated homestead vegetable production model known as "Kalikapur model" in 1984. Later on it was felt to modify the model based on the existing eco-systems (niches) of each homestead, along with vegetables different fruits were also included. Thus productivity and nutrition supplying capacity of each homestead increased to a significant level (3-4 times than previous).

The BARI scientists exposure visit and need analysis of CBOs in IC-LEAF programme area revealed that homestead spaces available for cultivation of fruits and vegetables are in partial use by space and time. Such short comings can be over come by using different niches (7-9 spaces) with fruits and vegetables organized in patterns as indicated by the farmers promoting BARI varieties and tested pattern technologies among the farmers.

However, it was observed that sustainability of the production program was fragile due to scarcity of quality seeds/seedlings/saplings and also due to lack of proper motivation. In reality the developed production models were formulated mostly through researcher's managed trial. It is needless to say that for greater motivation it should mostly be participatory. However, those developed vegetables/fruits patterns would be a valuable basis for creating a homestead productivity revolution.

In this context, it expected that active cooperation of IC with BARI could enhance the efforts in making the technology viable and sustainable. Such an interaction would be very effective in improving the livelihood of RPFs of northern Bangladesh, where poverty and malnutrition are more prevalent.

Considering the above facts, homestead space utilization program was initiated from rabi season of 2005 at Rangpur, Pabna and Barind area of Rajshahi

Program objectives

- To utilize maximum resources of the homestead for growing vegetables and fruits in relation to agroforestry systems
- To enhance intake of vegetables and fruits ,thereby to ensure family nutrition

Expected outcome

- Use of homestead spaces round the year by farmers
- Income from homestead crops increased
- Increased intake of fruits and vegetables by farm family members
- High quality seedlings/saplings/graft will be developed and distributed

Materials and Methods

1. Thirty small, marginal and landless farmers were selected from both the FSRD and CBO sites based on prefixed criteria from Rangpur and Barind and 40 from Pabna.
2. Farmers' homestead available resources, needs and choice assessment were done with active participation of the family members (both male and female) through several informal sitting between farmers, researchers and NGO workers.
3. Program planning was done on year round vegetable production pattern and also a work plan was made in this regard. Pre sowing farmers training was conducted on 24 September to 25 November 2005 on production and management of pattern basis vegetable cultivation in different niches of a homestead. In the trainings, 200 farmers (50 % male and 50% female) participated from three locations.
4. OFRD, BARI supplied the critical inputs like fruit and vegetable seed/seedlings, net (for fencing), watering cane etc. Primarily, the seeds were supplied on free of cost to the farmers with condition to produce and preserved it for next year use.
5. OFRD personnel provided technical support to the FSRD and CBO farmers group as per local need.
6. The data on total production per homestead were collected and documented in a register.
7. For technology transfer field day and hand-on training was arranged
8. Nutritional education was given through showing pictures and drama

Different vegetable patterns were tested in different locations as per the need of the farmers. For the open sunny place and other places round the year vegetable pattern were as follows:

Rangpur

Before intervention	After intervention
A. Open sunny place	
Fallow	**Present status** Bed No. 1: Spinach + Tomato – Indian spinach - Red Amaranth Bed No. 2: Turnip + Red Amaranth –Kangkong – Kangkong Bed No. 3: Radish – Indian spinach – Red Amaranth Bed No. 4: Cabbage+ Napashak-Okra+ Juteshak – Danta Bed No. 5: Brinjal+ Coriandershak + Kangkong – Kangkong
B. Partial shady place	
Fallow	- Turmeric and Zinger cultivation with proper management
C. Fence crop	
Never used	i) Bitter gourd: 4 pits ii) Ribbed gourd: 5 pits iii) Snake gourd: 3 pits iv) Cucumber: 3 pits
D. Roof Top: 1	
Country bean + Fallow with traditional management	Under proper management RT1: Country bean + Sweet gourd
E. Marshy Land: 1 dec.	
Aroid cultivation without proper management	Aroid cultivation with proper management (Planting distance and fertilizer)
F. Timber Trees	
Neem: 14, Suktani: 1 Without management	With proper management Sponge gourd: 2 pits
G. Fruit Tree	
Mango: 3, Jackfruit: 2 Guava: 1 Without management	Under proper management (Pruning, Training, Pest control, Fertilizer and Irrigation)
H. Trellis: 2	
Country bean + Ash gourd Country bean + Ash gourd Under traditional management No crop under trellis	Country bean + Ash gourd Country bean + Ash gourd Under Trellis: Ginger, Turmeric Under recommended management
I. Ditch:	
Seasonal pisi culture	Vegetable (Bottle gourd, Ribbed gourd cultivation on the bank of the ditch

Bed = 4 × 1 m

Pabna

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

Barind, Rajshahi

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

Table 1. Vegetable production and utilization patterns in homestead of three locations during the rabi season of 2005-06

Location	Mean amount harvested in 120 days /farm (kg)	Mean amount consumed in 120 days /farm (kg)	Mean amount consumed/head/day (g)	Mean amount sold in 120 days/farm (kg)	Mean amount free distributed in 120 days/farm (kg)	Mean cash income in 120 days/farm (Tk)
Rangpur	247	113(46)	188	114(46)	20(8)	810**
Pabna	135	53(39)	88	58(43)	24(18)	194
Barind	123	45(37)	75	56(45)	22(18)	560
Mean	168.33	70.33 (40.66)*	117	76(44.66)	22(14.66)	521

*Figure in parenthesis indicates percentage, ** Price of vegetables were different across locations

Results and Discussion

From the results it was observed that highest amount of vegetables were produced from the homestead of Rangpur, followed by Pabna and the lowest from Barind area. In Rangpur favorable soil type, comparatively long winter and availability of irrigation water facilitated higher yields of winter vegetables. On the other hand in Pabna at the initiation of rabi season planting was delayed due to excess soil water and at later stage it was hampered by water scarcity. While at Barind initiation of vegetable planting was early but from mid February serious water scarcity and high temperature hampered establishment and growth of most vegetables.

In general across locations consumption was less than selling, probably because of cash money was urgently needed for the family and/or due to lower habit of vegetable consumption. Only Rangpur farmers took 188 g/head/day which were almost near to required 200 g/head/day. This might be due the fact that Rangpur farmers produced more and they were comparatively poorer section of people in comparison to Pabna and Barind. It may be mentioned that nutritional deficiency symptoms were wide spread in Rangpur particularly in children. Rangpur farmers distributed the lowest amount while both Pabna and Barind farmers distributed 18 % of their produce. Each household of Rangpur earned a cash income of Tk. 810/season, while Barind farmers got Tk. 560/season and Pabna farmers got only Tk. 194/season due to low price of vegetable in Pabna. The results indicate that more nutritional education is needed to convince the farmers about taking higher amount of vegetable for their family nutrition.

Conclusion

A lot of mature technologies were introduced in the selected households according to the farmers need. A good impact has created among the farmers to adopt the modern technologies in homestead space utilization. It was observed that the applied technology was spreading among the neighboring farmers. A considerable amount of cash income has generated through the adoption of the technologies. Side by side, food habit of farm families is also changing day by day in a positive direction. Nutrition deficiency problems of a good number of family members were reduced/recovered due to intake of increased amount of vegetables from their homestead. For sustainability of the interventions following activities/actions are needed: i) quality seed supply chain should be developed, ii) more training of women and male farmers are needed on crop production and protection, seed production and storage along with market chain development, iii) easy nutritional education, and iv) continuation of the program at least for another one year.

Impact of the vegetable gardening (not quantified for qualitative data)

Sl. No.	Area of consideration	Impacts created
01.	Income	- Net income is increasing considerably
02.	Family nutrition	- Consumption of vegetables and fruits increased - Change consumption habit - Reduced disease infestation
03.	Resource use pattern	- Introduction of new crops - Homestead area utilized properly - Use of farm yard wastage
04.	Education and knowledge	- Increased knowledge of family member
05.	Social status	- Social status increased - Improved mental strength - Increased acceptability to people
06.	Micro environment	- Household waste used for composting - New plantation improve environment - Irrigation to crop and trees improve environment
07.	Others	- More utilization of family labor - Improve the cattle health
08	Women empowerment	Major participation by women

Limitations at Rangpur

- Collaboration of PNGO personnel at CBO site was not satisfactory because they were very busy in their other organizational work
- Most of the farmers of CBO site, Untapara, Badarganj were not marginal and poor. So that, they have little interest in home gardening. For this reason we have changed the CBO site at Amrulbari, Badarganj with the understanding of PNGO.
- Budget allocation for oil-fuel and mobility is not satisfactory.
- No fund allocation for training program during kharif season.

Future plan of Rangpur

Have interest to continue the project activities if.

- PNGO personnel's are more available at CBO site.
- More fund allocation for oil-fuel and mobility.
- Ensure the fund for training program in both season.
- Ensure farmers promoter honorarium for CBO site.

Farmers reaction at Pabna

Farmers are more interested to economic crops with high cash return. They are less aware about nutritional need and the contribution of mini production unit (2-3 decimal unused) of homesteads. As the program was production based more motivation needed for them towards consumption and utilizing the potential contribution of the model and safe foods for their health and nutrition.

Problems encountered -Pabna

1. Tidious, laborious and continuous work, needing skills in production techniques of huge number of crops. Needs one/two year of practice to start as a regular work by farmers.
2. Women farmers were not ready to cooperate spontaneously with the male scientific assistants in the implementation process.
3. Creeper crop got less emphasizes with lack in adequate amount of organic matter, size of pit, fertilization and other cares.
4. Long drought and water scarcity drastically reduced production of many crops like brinjal,okra, bitter gourd etc.
5. Lack in easy analytical tool to interpret data comfortably. (Needs a computer programming on Analysis of results)

Limitations at Barind

a) At farmers' level

i) Quality seed of improved variety is not available to the farmers.
ii) Usually farmers collect the seed of local variety from the local market
iii) Drought and high temperature hampered the program.
iv) Lack of sufficient water for growing vegetables in drought season.
v) Most of the cowdung is being used as cooking fuel due to severe fuel crisis in the Barind area.
vi) Lack of proper knowledge in preparing compost.

b) From PNGO

Less participation of PNGO personnel in CBO site due to their pre-occupation to other jobs

c) Financial

- Lack of sufficient fund for oil-fuel and transport
- Lack of sufficient fund for training, farmers motivation etc

Future plan

1. The project should be continued for sustaining the ''year round homestead vegetable production technology''.
2. The program should be extended in other location of Barind area to ensure the family nutrition of the poor farmers family.

Annexure

Table 2. Production, Intake, Distribution & Income from Home gardening at Ranpur

Name of vegetable	Total production (kg)	Vegetable utilization (kg)			Cash Income (Tk.)	Total Income (Tk)	Total Cost (Tk.)
		Intake (kg)	Distribution (kg)	Sell (kg)			
Garden pea	2	2	-	-	-	24	6
Cabbage	15	8	2	5	30	90	20
Napashak	5	4	1	-	-	40	8
Brinjal	10	5	-	5	50	100	24
Carrot	2	2	-	-	-	24	10
Radish	42	8	2	32	128	168	15
Turnip	40	6	4	30	300	400	18
Tomato	80	5	3	72	576	640	35
Spinach	17	8	2	7	42	102	8
Country bean	202	72	10	120	960	1616	30

Table 3. Distribution of labour in Homestead space utilization at Rangpur

Activities	Male (%)	Female (%)	Children (%)
Land preparation	80	20	-
Seeding/planting	25	75	-
Intercultural operation	20	70	10
Harvesting	10	85	5
Cooking	-	100	-
Marketing	90	10	-
Others	-	-	-

Table 4. Average performance of vegetable crops with inorganic management of Medium farmers group under homestead production model at FSRD site, Pushpapara, Pabna, during 2005-06

Crops	Amount harvested (kg)	Amount consumption (kg)	Return (Tk)	Amount distributed (kg)	Amount sold (kg)	Cash income (Tk)
A. Open place	147	77	784	49	21	180
B. Trellis	94	52	544	13	28	111
Total	241	129	664	62	49	291
Average	120.5	64.5	1328	31	24.5	145.5

Table 5. Average performance of vegetable crops with inorganic management of Small farmers group under homestead production model at FSRD site, Pushpapara, Pabna, during 2005-06

Crops	Amount harvested (kg)	Amount consumption (kg)	Return (Tk)	Amount distributed (kg)	Amount sold (kg)	Cash income (Tk)
A. Open place	101	60	552	14	27	191
B. Trellis	54	26	381	11	17	170
Total	155	86	933	25	44	361
Average	77.5	43	466.5	12.5	22	180.5

Table 6. Average performance of vegetable crops with inorganic management of Marginal farmers group under homestead production model at FSRD site, Pushpapara, Pabna, during 2005-06

Crops	Amount harvested (kg)	Amount consumption (kg)	Return (Tk)	Amount distributed (kg)	Amount sold (kg)	Cash income (Tk)
A. Open place	381	86	502	50	245	347
B. Trellis	31	17	248	5	9	164
Total	412	103	750	55	254	511
Average	206	51.5	375	27.5	127	255.5

Table 7. Vegetables production per homestead at Barind, Rajshahi during rabi 2005-06

Month	Vegetable production/bed (kg/5m^2)					B. gourd	Bean	Total
	Red Ama	Spinach	Radish	Ch. cab.	Bushbean			
Kar. (16O-14N)	1.9	-	-	-	-	-	-	1.9
Agh. (15N-14D)	14.4	12.63	16.83	5.4	5.23	2.83	4.1	61.42
Pou. (15D-13J)	8.26	9.26	5.06	3.79	2.36	7.07	9.99	45.79
Magh (14J-12F)	1.83	0.93	1.23	-	3.36	1.8	2.53	11.68
Fal. (13F-14M)	-	-	-	-	0.33	0.4	0.73	1.46
Total =	26.39	22.83	23.12	9.19	11.28	12.1	17.35	122.25

Table 8. Vegetables intake per family at Barind, Rajshahi during rabi 2005-06

Month	Vegetable intake/family (kg) (4 family members)					B. gourd	Bean	Total
	Red Ama	Spinach	Radish	Ch. cab.	Bushbean			
Kar. (16O-14N)	0.9	-	-	-	-	-	-	0.9
Agh. (15N-14D)	5.96	4.96	6.75	2.4	1.76	0.73	1.4	23.96
Pou. (15D-13J)	2.96	3.8	2	1.06	0.83	2.07	2.66	15.38
Magh (14J-12F)	0.86	0.53	0.5	-	1.36	0.46	0.93	4.64
Fal. (13F-14M)	-	-	-	-	0.06	0.02	0.33	0.41
Total =	10.68	9.29	9.25	3.46	4.01	3.28	5.32	45.29

Table 9. Vegetables distributed by a family at Barind, Rajshahi, during rabi 2005-06

Month	Vegetable distributed by a family (kg)					B. gourd	Bean	Total
	Red Ama	Spinach	Radish	Ch. cab.	Bushbean			
Kar. (16O-14N)	0.13	-	-	-	-	-	-	0.13
Agh. (15N-14D)	2.53	2.46	3.76	1.16	1.2	0.76	0.73	12.57
Pou. (15D-13J)	1.93	1.93	0.73	0.66	0.4	1.2	1.03	7.88
Magh (14J-12F)	0.3	0.2	0.33	-	0.6	0.13	0.13	1.69
Fal. (13F-14M)	-	-	-	-	-	-	0.13	0.13
Total =	4.89	4.59	4.82	1.82	2.2	2.09	2.02	22.43

Table 10. Vegetables sold by a family at Barind, Rajshahi, during rabi 2005-06

Month	Vegetable sell/family (kg)					B. gourd	Bean	Total
	Red Ama	Spinach	Radish	Ch. cab.	Bushbean			
Kar. (16O-14N)	0.8	-	-	-	-	-	-	0.8
Agh. (15N-14D)	6.2	4.6	7.03	1.43	2.13	1.73	2	25.12
Pou. (15D-13J)	3.86	4.33	2.33	1.46	1.8	3.13	6.8	23.71
Magh (14J-12F)	0.93	0.2	0.4	-	1	1.2	1.86	5.59
Fal. (13F-14M)	-	-	-	-	0.26	0.2	0.26	0.72
Total =	11.79	9.13	9.76	2.89	5.19	6.26	10.74	55.76

Table 11. Economic return per homestead at Barind, Rajshahi, during *rabi* 2005-2006

Vegetables name	Total vegetable production (kg/bed)	Vegetable price (Tk./kg)	Gross return (Tk.)	Total cost (Tk.)	Net return (Tk.)
Red amaranth	26.39	8	211.12	120.00 (Without family labour)	1104.74
Spinach	22.82	10	228.20		
Radish	23.12	6	138.72		
China cabbage	9.19	10	91.90		
Bush bean	11.28	20	225.60		
Bottle gourd	12.10	10	121.00		
Country bean	17.35	12	208.20		
		Total =	1224.74		

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Farm Level Production of Active Compost with Homestead and Poultry Waste and Its Application for Safer Fruits and Vegetable in Homestead

Abstract

A study was undertaken at Farming Systems Research and Development (FSRD) site, Pushpapara, Pabna for observing the feasibility of growing homestead crop production under organic system during the rabi season of 2005-06. The result revealed that the highest cash income was recorded in small farm group (Tk. 391.00) and the total return was higher in the marginal farm group (Tk.1149). Out of the produce, 54.45 % was consumed by medium, 49.26 % by marginal and 52.22 % by small group of farmers. The highest consumption (173 g/head/day) was observed in medium farm group and the lowest (157 g/head/day) was recorded in small farm group considering a family member of 5 in 120 day's period.

Introduction

There are many production technologies under way for organic farming with different types of crops including vegetables. A high efficiency composting method has been developed and no yield loss was experienced under organic condition, even with its lowest dose of 7.5 tons per hectare for modern rice and stem amaranth. The lands are gradually improved in quality and normally no risk involved with organic production systems. The demand and price of organic produce is always higher in world market including few places of Dhaka. But for getting a good price, market demand need to be created. Thus some organic produce must go to market and there should be a continuous supply in the market to create a persistent demand. On the other hand, since it needs about three years under consecutive organic cropping to get accreditation for acceptance to international markets as organic food. Local people should consume the produce during the interim period. Thus as a step for popularizing organic farming technologies and creating the market for its produce, some production program is essential. It is assumed that homestead is the easiest environment with reach soil for starting the organic farming. It also contains most of the common fruits and vegetable, which meet up most part of daily needs and are responsive to organic fertilizers. Therefore, a production program with a total homestead production system under organic farming was under taken at FSRD site, Pushpapara, Pabna.

Objectives

1. To evaluate possibility of conversion of chemical based homestead farming into organic system agriculture
2. To popularize organic agriculture and create market opportunities
3. To increase income and improve family nutrition

Materials and Methods

The Goyeshpur model of homestead utilization system was used. It included nine production units under following patterns

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

Initiative of homestead farming has been taken very recently at FSRD site Pushpapara, Pabna. Before initiation of the homestead program a bench marks survey was carried out to identify the resource base and potentials of different farm categories. It was generally observed that the farmers of the locality had no concept about Goyeshpur model for year round vegetable production and organic farming. However, finally 15 farmers were selected for the program. The selected farmers were categorized as under organic management group. The crop was selected according to the preference of the farmers through participatory innovation method. Training was provided on vegetable and fruit production following the Goyeshpur model and compost preparation at farmers' level for better cooperation among the group farmers two farmer leaders were selected for group management and input supply and information dissemination. The FSRD team provided technical assistance to the co-operator farmers for compost preparation, method of application, and other cultural management under organic homestead farming. The crops were grown at homestead under organic management during the rabi season 2005-06. The data were recorded and analyzed as par farm categories.

Results and Discussion

Crop yield: The output of the model harvested during the rabi season (120 days) has been presented (Table 1). The amount of vegetables harvested from open sunny place was 145,128 and 168 kg under medium, small and marginal farm respectively. The vegetables harvested from trellis were 46,52 and 35 kg under the same category. The result indicated that the production of vegetables was higher at open place than that of trellis for all categories of farm. It was also observed that the total production of vegetables was higher in marginal farm category than that of small and medium farm might be due to intensive management and utilization of homestead area with utilization of their own labor.

Consumption by family members: The highest consumption 54.45 % was observed in medium farm group and the lowest was in marginal group (49.96 %). The small farm group consumed 52.22 % of total vegetable. The highest 173 g/head /day were consumed by the medium farm group and the lowest 157 g /day /person in the small farm group. The highest consumption /head/day in medium farm might be due to moderate production and less selling of vegetables.

Cash income: Beside the nutritional contribution, the growers earned cash money of Tk 283 per family which would be considered as liquid cash. Though small amount but it has a good contribution towards mitigation of day to day family needs.

Farmers reaction

Farmers are more interested to grow economic crops with high cash return. They are less aware about nutritional need and the contribution of mini production unit (2-3 decimal unused) of homesteads. As the program was primarily family nutrition based, more motivation is needed for them for increased consumption of safe foods for their health and nutrition.

Impact at farmers level

⇒ Meet up the daily required vegetables
⇒ Fulfill nutrition
⇒ Cash generation
⇒ Employment opportunity
⇒ Learn scientific vegetables, fruit, production technologies
⇒ Create friendly environment
⇒ Entrepreneurship development at local level.
⇒ Development of market channel
⇒ Development of service provider at village level

Opportunity created from the program

1. Supplementary support for the mandatory activities
2. Capacity building of staff member
3. Formulation of farmers need based program/ activities
4. Access to learn farmers group based approach for technology transfer
5. Opportunity to know the farmers real problems.
6. Participatory technology development innovation
7. Give continuous effort for livelihood development, So that farmers can solve their problem by themselves

Problems encountered

i) Tidies, 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.

ii) Women farmers were not ready to cooperate spontaneously with the male scientific assistants in the implementation process.

iii) Creeper crop got less emphasizes with lack in adequate amount of organic matter, size of pit, fertilization and other cares.

iv) Long drought and water scarcity drastically reduced production of many crops like brinjal, okra, bitter gourd etc.

v) Lack in easy analytical tool to interpret data comfortably. (Needs a computer programming on

vi) Analysis of results)

Conclusion

To produce crop fully organically and also for transferring of technology for making active compost need several years of need serious motivation along with the development of market chain. Hence, at the initiation, the program should continued for several years in a particular location.

Table 1. Mean amount of vegetable production and utilization patterns per farm in rabi season of 2005-06 under organic farming at Pushpapara, Pabna.

Farm category	Amount harvested/farm (kg)	Amount consumed/head/day (g)	% consumed	% distributed	% sold	Cash income/farm (Tk.)	Total return Tk/farm
Medium	191	173	54.45	31.41	14.14	167	1014
Small	180	157	52.22	12.22	35.56	391	1009
Marginal	203	167	49.26	27.59	23.15	292	1149
Mean	191	166	51.98	23.74	24.28	283	1057

Annexure

Table 2. Average performance of vegetable crops of Medium farmers group under homestead production model at FSRD site, Pushpapara during 2005-06

Crops	Amount harvested (kg)	Amount consumption (kg)	Return (Tk)	Amount distributed (kg)	Amount sold (kg)	Cash income (Tk)
A. Open place	145	78	779	56	11	77
B. Trellis	46	26	235	4	16	90
Total	191	104	1014	60	27	167
Average	95.5	52	507	30	13.5	83.5

Table 3. Average performance of vegetable crops of Small farmers group under homestead production model at FSRD site, Pushpapara during 2005-06

Crops	Amount harvested (kg)	Amount consumption (kg)	Return (Tk)	Amount distributed (kg)	Amount sold (kg)	Cash income (Tk)
A. Open place	128	74	642	14	40	258
B. Trellis	52	20	367	8	24	133
Total	180	94	1009	22	64	391
Average	90	47	504.5	11	32	195.5

Table 4. Average performance of vegetable crops of Marginal farmers group under homestead production model at FSRD site, Pushpapara during 2005-06

Crops	Amount harvested (kg)	Amount consumption (kg)	Return (Tk)	Amount distributed (kg)	Amount sold (kg)	Cash income (Tk)
A. Open place	168	90	965	46	32	217
B. Trellis	35	10	184	10	15	75
Total	203	100	1149	56	47	292
Average	101.5	50	574.5	28	23.5	146

Technology transfer activities under BARI-IC collaborative program, 2005-06

Location	Farmers' training (no.)	Field day (no.)	DAE/NGO visit (no.)	Participatory monitoring and evaluation (no.)
Rangpur	4	1	4	1
Pabna	6	1	4	1
Barind	6	1	5	1

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Fertilizer Management Practices of Existing Intercropping System at Farmers Level

Abstract

The study was conducted at MLT sites, Gaibandha and Polashbari under OFRD, Rangpur during November–December 2005 to identify the existing fertilizer management practices of multiple cropping at farmers levels. A total of 50 farmers who practiced in intercropping systems were selected randomly with the help of pre–designed interview schedule. The study revealed that about 50 percent farmers practiced Banana+Potato intercropping in the study area. They applied 2-3 t/ha organic matters in the crop field of inter cropping practice in the study area. They used less amount of inorganic fertilizer compare to single crops. Potato with Bitter gourd intercropping practice gave the highest gross margin (Tk.110538/ha) and benefit cost ratio (2.99). The study also revealed that lack of knowledge on production technology of intercropping, lower yield and difficult to do intercultural operations were identified as major constraints.

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 gave 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 two MLT sites under the district of Gaibandha and Rangpur respectively during November–December 2005 to identify the existing fertilizer management practices of multiple cropping at farmers levels. In this report, inter cropping is denoted by the sign of '+'. A total of 50 farmers who practiced in inter cropping were selected randomly. The required data were collected with the help of pre–designed and pre–tested interview schedule. Collected data were then summarized, analyzed and presented in a tabular form. The land equivalent ratio (LER) and equivalent yield (EY) of the multiple cropping were also calculated according to Willey, (1979).

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.

$$\text{LER} = \frac{\text{Intercrop yield of crop A}}{\text{Sole crop yield of crop A}} + \frac{\text{Intercrop yield of crop B}}{\text{Sole crop yield of crop B}}$$

$$EY = \text{Yield of main crop} + \frac{\text{Yield of intercrop x Price of intercrop (Tk./kg)}}{\text{Price of main crop (Tk./Kg)}}$$

Results and Discussion

Existing intercropping practices

Seven major intercropping systems were identified at two MLT sites. The intercropping banana + potato, potato + maize – T.aman, pointed gourd + ginger and banana + khira were grown at Palashbari, Rangpur. On the other hand banana + bitter gourd – T.aman, potato + sweet gourd – T.Aman and banana + sponge gourd were practiced at Gaibandha. It was observed that about 50% farmers of Palashbari, Rangpur practiced banana + potato followed potato + bitter gourd – T.aman (15%) at Gaibandha and potato + maize – T.aman (12%) at Palashbari, Rangpur.

Management practice of different intercropping systems

Location: Polash bari, Rangpur

Banana + Potato: Most of the farmers were mainly practiced banana + potato as intercropping in the study area. They planted banana during 2nd week of September and potato in 2nd week of November. Meher sagor and Cardinal varieties were used for banana and potato extensively by the farmers, respectively. They used average 2570 swords per hectare for banana and 1482 kg/ha seeds for potato. Farmers mainly used fertilizer in their main crops (banana). Average of 2284 kg cowdung, 741 kg urea, 296 kg DAP, 198 kg MP and 120 kg Gypsum were found to apply in banana + potato intercropping. The average yield of banana and potato was 94.68 ton and 9.87 ton respectively while the sole crop yield was 109.05 ton for banana and 17.34 ton for potato. The land equivalent ratio (LER) was calculated 1.42 in banana + potato intercropping.

It indicates that by intercropping of banana with potato, farmers could produce 94.68 ton banana and 9.77 ton potato from one hectare of land instead of growing them separately in 1.92 hectare of land to obtain the same yield (Table 2).

The equivalent yield of banana was estimated 144.05 t/ha. The gross return was obtained Tk. 144048 and total variable cost was Tk. 57630 per hectare with gross margin of Tk. 86418/ha. Benefit cost ratio (BCR) was found 2.50 (Table 3).

Potato + Maize: Farmers were found to cultivate potato with Maize as intercropping in the study area under potato + maize – T.Aman cropping pattern. The used cardinal for potato and pacific 11 for maize with 1.65 t/ha and 20 kg/ha seed rate respectively. Sowing date was recorded 2nd week of November for potato and 1st week of December to maize crop.

Farmers used average 3.17 t/ha cowdung as organic manure in their field. They used 329 kg, 164 kg, 148 kg and 123 kg urea, DAP, MP and Gypsum per hectare respectively in this intercropping. One half of urea and all other fertilizer were incorporated at the time of final land preparation by broadcast method. Remaining urea was found to apply at the side of the row and covered with soil after 45–50 DAS of potato. In case of maize remaining urea was applied by the farmers in two equal installments as top dress at knee high and silking stages in the study area.

Harvesting date of potato was recorded 2nd week of March while 3rd week of April for maize. Average intercropping yield was estimated 13.22 t/ha for potato and 7.21 t/ha for maize. Sole crop yield was 15.66 t/ha and 7.21 t/ha for potato and maize, respectively. LER was 1.84 which indicated profitable in intercropping.

The equivalent yield of potato was estimated 24.75 t/ha. Gross return and total variable cost was calculated Tk. 123770 and Tk. 55846 per hectare respectively. Gross margin was found Tk. 67924 per hectare. Benefit cost ratio was found 2.22 (Table 3).

Location: Gaibandha

Potato + Bitter gourd: Farmers cultivated potato and bitter gourd as intercropping mainly under potato + bitter gourd–T.aman cropping pattern in medium highland. They sow potato on 2nd week of November and bitter gourd on 1st week of December with 1580 kg and 4.40 kg per hectare seed rate, respectively. They use cardinal for potato and matia variety for bitter gourd.

Farmers were found to apply average of 2694 kg/ha cowdung as organic manure in this intercrop. They applied 300 kg urea, 246 kg DAP and MP and 93 kg Gypsum per hectare in the intercropping. One half of urea and all other fertilizer were broadcast and incorporate during the final land preparation. The remaining urea was applied at the side of the row and covered with soil after 45–50 DAS of potato.

Farmers pointed out that potato was harvested on 2nd week of March and bitter gourd on 2nd week of June. The intercrop yield of potato and bitter gourd were found 17.96 t/ha and 15.30 t/ha respectively. On the other hand, sole yield of potato and bitter gourd were obtained 19460 kg/ha and 15.30 t/ha respectively. The land equivalent ratio (LER) was estimated 1.92 which indicates profitable in intercropping (Table 2).

The equivalent yield of potato was calculated 33.21 t/ha. Gross return and total variable cost were Tk. 166050 and Tk. 55511 per hectare respectively. Gross margin was found Tk. 110538 while BCR was 2.99 in potato + bitter gourd intercropping in the study area (Table 3).

Potato + Sweet gourd: Potato and sweet gourd intercropping was practiced by the farmers mainly under potato + sweet gourd–T.Aman cropping pattern in medium high land. They sown potato 2nd week of November and sweet gourd on 3rd week of November with 1378 kg and 3.50 kg seed per hectare respectively. They used cardinal variety for potato and local for sweet gourd.

Farmers used average 2830 kg cowdung as organic manure in this system. They applied 378 kg, 240 kg, 270 kg urea, DAP and MP respectively. One half of urea and all other fertilizer were broadcast and incorporated during final land preparation. The remaining area was applied at the side of the row after 50–55 DAS of potato.

According to the respondent potato was harvested on 2nd week of March and sweet gourd on last week of July. The intercropping yield was recorded 17.30 t/ha for potato and 26.65 t/ha for sweet gourd. On the other hand, sole crop yield of potato and sweet gourd were 18.11 t/ha and 26.65 t/ha respectively. The land equivalent ratio was estimated 1.96 which indicated profitable is intercropping.

The equivalent yield of potato was calculated 27.96 t/ha. Gross return and total variable cost were Tk. 139790 and Tk. 52338 per hectare respectively. Gross margin was obtained Tk. 87452 while BCR was 2.67 (Table 3).

Advantage of intercropping: Farmers Reaction

1. Cost of cultivation is less.
2. Additional crops can be harvested from the same piece of land.
3. One crop can minimize the loss of other crops.
4. Additional fertilizer and irrigation is not required for multiple cropping.

Constraints to intercropping

Rangpur:

According to the sample farmers, lack of knowledge on production technology of intercropping was identified by 84 percent farmers as a major constraint. The second most problems were intercropping made lower yield by 80 percent farmers while third most constraint was identified by 73 percent respondents as to perform intercultural operation in the crop field is difficult sometime.

Gaibandha:

About 76 percent farmers opined that lack of knowledge on production technology was the main constraint to them. The second most problem was identified by 74 percent farmers as difficult to do intercultural operation in crop field while third most problems to the farmers (68 percent)were getting lower yield of field crop.

Considering the above problems, the following steps could 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 intercropping.

Conclusion

Intercropping system is the farmers' traditional practice. They used mainly local varieties and own seeds. They followed traditional method of cultivation which caused lower yield. They also practice it for additional crop from the same land for their need basis. In the study area, it was found that farmers applied organic manure with a little amount in intercropping systems. They used less amount of chemical fertilizer compare to single crops. They did not follow the modern production technology with proper management practices. There is a great scope to increase the cropping intensity through practicing multiple cropping on the basis of soil and climatic condition in the study area. By increasing the technical knowledge of the farmers, proper management practices could be ensured in intercropping system of the study area. So, it should give more attention on intercropping for its boost production as well as higher yield.

Table 1. Existing intercropping and cropping patterns at MLT site Polashbari, Rangpur and Gaibandha, 2005

Location	Cropping patterns	% Farmers practiced
Rangpur	Banana+Potato-Banana	50
	Potato+Maize–T.Aman	12
	Pointed gourd +Ginger-Pointed gourd	6
	Banana+Khira- Banana	4
Gaibandha	Potato+Bitter gourd–T.Aman	15
	Potato+Sweet gourd–T.Aman	10
	Banana+Sponge gourd- Banana	3

Table 2. Agronomic performance of intercropping practices at MLT site Polashbari, Rangpur and Gaibandha, 2005

Items	Existing intercropping systems							
	Rangpur				Gaibandha			
	Banana* + Potato		Potato* + Maize		Potato* + Bitter gourd		Potato* + Sweet gourd	
Variety	Mehersagor	Cardinal	Cardinal	Pacific 11	Cardinal	Matia	Cardinal	Local
Seed rate (kg/ha)	2570 (N)	1482	1652	20	1580	4.9	1378	3.50
Sowing time	2nd wk of Sept.	2nd wk of Nov.	2nd wk of Nov.	1st wk of Nov.	2nd wk of Nov.	1st wk of Dec.	2nd wk of Nov.	3rd wk of Nov.
Organic manure (kg/ha)	2284		3165		2694		2830	
Fertilizer (kg/ha)								
Urea	741		329		300		378	
TSP	296		164		246		240	
MP	198		148		246		270	
Gypsum	120		123		93		–	
Irrigated/Rainfed	Irrigated		Irrigated		Irrigated		Irrigated	
Harvesting time	2nd wk of Sep	2nd March	2nd March	3rd April	2nd March	2nd June	2nd March	Last July
Intercrop yield (t/ha)	94.68	9.87	13.22	7.21	17.96	15.30	17.30	26.65
Sole yield (t/ha)	109.05	17.34	15.66	7.21	19.46	15.30	18.11	26.65
LER	1.92		1.84		1.92		1.96	

*= Main crop

Table 3. Equivalent yield and economic performance of intercropping at MLT site Polashbari, Rangpur and Gaibandha, 2005

Location	Multiple cropping	Equivalent yield (t/ha)	Gross return (Tk/ha)	TVC (Tk/ha)	Gross margin (Tk/ha)	BCR
Rangpur	Banana + Potato	144.05	144048	57630	86418	2.50
	Potato + Maize	24.75	123770	55846	67924	2.22
Gaibandha	Potato + Bitter gourd	33.21	166050	55511	110538	2.99
	Potato+ Sweet gourd	27.96	139790	52338	87452	2.67

Price (Tk/kg): Banana= 1, Potato= 5, Bitter gourd= 5, Maize= 8, Sweet gourd= 3.

Table 4. Problems faced by the farmers in intercropping at MLT site Polashbari, Rangpur and Gaibandha, 2005

Sl. no.	Problems	% Farmers responded	
		Rangpur	Gaibandha
1.	Difficult to do intercultural operation	73	74
2.	Lack of knowledge on production technology	84	76
3.	Attack of insects and diseases	48	51
4.	Obtained lower yield	80	68

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Change in Cropping Pattern and Fertilizer Application in Crops Overtime in Different Areas of Bangladesh

Abstract

The study was conducted at two Farming Systems Research and Development (FSRD) sites of Narikeli, Jamalpur (AEZ-9) and Atkapalia, Noakhali (AEZ-18) to assess the change in cropping pattern and fertilizer management practices in crops under different cropping patterns. A total of 100 farmers (50 farmers from each location) were selected randomly by using random sampling to collect necessary information. The study revealed that the highest adoption index was found 37.30 in Fallow-Fallow-T.Aman in Noakhali followed by Boro-T.Aman in Jamalpur (24.14) under 1998. On the other hand, adoption index of Boro-T.Aman was found highest (30.91) in Jamalpur under 2003 followed by Soyabean-T.aus-T.Aman (27.87) in Noakhali. N use rate was found closer to recommended dose in all crops of three major cropping patterns in both the year of 1998 and 2003.Farmers used 1.5 times lower dose of P and 2.5-5 times lower dose of K in major crops except potato in the study area. Farmers applied 3-3.5 times higher amount of K in Potato crops compared to recommended dose. It was also observed that use of cow dung as organic manure and chemical fertilizer had been increased in all major cropping patterns during the year 2003 compare to 1998.

Introduction

Cropping systems in Bangladesh are essentially rice-based systems. The crop sector of Bangladesh agriculture is trying to produce more food to meet the requirements of ever growing population. The need of the hour is to achieve substantially higher crop yield than the present yield levels from our limited land resources on a sustainable basis. A crop production system with high yield targets cannot be sustainable unless nutrient inputs to soil are at least balanced against nutrient removal by crops. Proper soil fertility management, therefore, is of prime importance in an endeavor to increase crop productivity. Available data indicate that the fertility of most of our soils has deteriorated over the years which are responsible for stagnating and, in some cases, even declining crop yields. The use of chemical fertilizers as a supplement source of nutrients has been increasing steadily in Bangladesh, but usually they are not applied in balanced proportions by most of our farmers. It is now well known that S and Zn deficiencies occur especially in wetland rice soils in many parts of the country due to imbalanced fertilization. The organic matter content of our soils is declining with time due to poor attention to its improvement and maintenance.

So, imbalanced use of chemical fertilizers is a serious problem in our country. Previous studies reveal that farmers of many areas of Bangladesh applying nitrogenous fertilizers in higher amount in many crops than that of recommended dose. Recent studies identified some other nutrients like N and P also be applied in higher amounts in some crops in some areas. But neither of these nutrients or other essential elements is applied in a proportionate balanced way in anywhere of the country. It is assumed that yield gap of different crops area reducing day by day in between farmers and demonstration practices for more conscious use of fertilizer and other management practices. For further recommendation and improvement of present situation, it is, therefore, undertaken the present study with a view to assess the change in cropping pattern over time and to identify fertilizer application in crops under different cropping patterns

Methodology

The study was conducted at two Farming System Research and Development (FSRD) sites under BARI during December-January, 2005-06 to assess the change in cropping pattern and fertilizer application in crops under different cropping patterns. The FSRD sites were Narikeli, Jamalpur (AEZ-9) and Atkapalia, Noakhali (AEZ-18). A total of 100 sample farmers (50 from each location) were selected randomly to collect necessary primary data with the help of pre-designed survey schedule through participatory and survey method. Data were collected from each farmer for the year of 1998 and 2003 based on major cropping pattern. Farmers delivered the primary information from their own memories during interview. The collected data were tabulated, summarized, analyzed and presented in a tabular form. Farmers were interviewed by the researcher himself and Senior Scientific Assistants or Scientific Assistants who were employed in the FSRD sites. An adoption index of cropping pattern was used to calculate the adoption status of the cropping pattern practiced by the farmers in the study areas with the following formulas as Hasan *et al.* (2003).

$$\text{Adoption Index} = \frac{\%\text{ farmers responded} \times \%\text{ area reported}}{100}$$

$$\%\text{ Farmer responded} = \frac{\text{Number of farmers in a particular cropping pattern}}{\text{No. of farmer surveyed}} \times 100$$

$$\%\text{ Area reported} = \frac{\text{Area under a particular cropping pattern}}{\text{Total area under different cropping pattern}} \times 100$$

Table 1. Changes in major cropping pattern of the FSRD sites in different locations during the last five years (1998-2003)

FSRD sites/ Location	1998		2003	
	Major cropping pattern	Adoption index	Major cropping pattern	Adoption index
Jamalpur (AEZ-9)	Boro-Fallow-T.Aman	24.14	Boro-Fallow-T.Aman	30.91
	Mustard-Boro-T.Aman	2.74	Potato-Boro-T.aman	0.93
	Wheat-Jute-T.Aman	1.28	Potato-Jute-T.aman	0.87
	Potato-Boro-T.aman	1.17	Wheat-Jute-T.Aman	0.65
	Potato-Jute-T.aman	0.05	Mustard-Boro-T.Aman	0.55
Noakhali (AEZ-18)	Fallow-Fallow-T.Aman	37.30	Soybean-T.aus-T.aman	27.87
	Khesari-Fallow-T.Aman	4.56	Chilli-T.uas-T.aman	14.64
	Fallow-T.aus-T.aman	1.69	Groundnut-T.Aus-T.Aman	1.86
	Khesari-T.aus-T.aman	0.84	Soybean-Fallow-T.Aman	0.71
	Chilli-T.Aus-T.aman	0.60	Mungbean-T.aus-T.aman	0.59

Results and Discussion

Change in cropping pattern at different locations over the year of 1998 and 2003

About five major cropping patterns have been identified from each location. T.Aman rice was the major crops in all the cropping patterns either it sequence with two or three crops.

Jamalpur: Five major cropping patterns were identified by the sample farmers in both the years of 1998 and 2003. The cropping patterns were found same in both the years. Mustard and wheat crops were mainly replaced with potato after five years from 1998. The cropping patterns were Boro-Fallow-T.Aman, Mustard-Boro-T.Aman, Wheat-Jute-T.Aman, Potato-Boro-T.Aman and Potato-Jute-T.Aman. Most of the farmers practiced Boro-Fallow-T.Aman in both the years 1998 and 2003 (Table 1).

Noakhali : Five major cropping patterns were identified as T.Aman, Khesari-T.Aman, T.Aus-T.Aman, Khesari-T.aus-T.aman and Chilli-T.aus-T.aman where its adoption index were found 37.30, 4.56, 1.69, 0.84 and 0.60, respectively in 1998. On the other hand Soybean-T.aus-T.aman, Chilli-T.aus-T.aman, Groundnut-T.aus-T.aman, Soybean-T.Aman and Mungbean-T.aus-T.aman were the major cropping patterns in 2003 and their adoption indexes were 27.87, 14.64, 1.86, 0.71 and 0.59

respectively in the year 2003. Most of the farmers were practiced Soybean-T.aus-T.aman followed by Chilli-T.aus-T.aman (Table 1).

It was observed that among the major cropping pattern, all the patterns of Jamalpur and one cropping pattern (Chilli-T.aus-T.Aman) of Noakhali were found unchanged during the last five year (1998-2003).

Fertilizer Management practices under different major cropping patterns and locations overtime (1998-2003)

Location : FSRD site, Narikeli, Jamalpur
Period : 1998

Boro-Fallow-T.Aman: It was identified as first major cropping pattern in the study area where farmers used BRRI dhan 29 as a variety of Boro and BR11 as T.Aman. They applied Cowdung as organic manure @ 1200 kg/ha and @ 1104 kg/ha ash in Boro crop. Fertilizer application rate was observed 116-17-24-13 kg NPKS/ha in Boro and 53-8 kg NS/ha in T.Aman. N was applied in three splits in Boro and two splits in T.Aman. Average yield was recorded 5093 kg/ha for Boro and 3645 kg/ha for T.Aman. It was noticed that farmers were using higher dose of all nutrients except K in Boro and lower dose in T.Aman compared to recommended dose (100-15-40-10-1 kg NPKSZn/ha for Boro and 60-8-30-4 kg NPKS/ha for T.Aman: Source FRG97) (Table 2).

Mustard-Boro-T.Aman: It was identified as second major cropping pattern in the study area by the sample farmers. Tori-7, BRRI dhan 28 and BR11 were used as variety of Mustard, Boro and T.Aman crops respectively. Cowdung was applied @ 1354 kg/ha as organic manure in Mustard. Fertilizer application rate was recorded 65-17-31-15 kg NPKS/ha in Mustard, 84-15-30-10 kg NPKS/ha in Boro and 60-4-10 kg NPS/ha in T.Aman crop. All nutrients and one-half of N was applied in final land preparation and remaining N was applied at the time of flower initiation as top dressing for Mustard. Incase of Boro and T.Aman N was applied in two installments. Average yield was estimated 812 kg, 3960 kg and 3564 kg per hectare for Mustard, Boro and T.Aman, respectively.

The study revealed that farmers used higher dose in mustard and lower dose in Boro and T.Aman and yield was recorded lower in all crops compared to recommended dose and yield. Recommended fertilizer dose was 55-10-20-10-1 kg NPKS Zn/ha for Mustard. 100-12-40-7 kg NPKS/ha for Boro and 60-8-30-4 kg NPKS/ha for T.Aman : Source – FRG'97 (Table 2).

Wheat-Jute-T.Aman : It was identified as third major cropping pattern in the study area by the sample farmers. They used @ 2921 kg/ha Cowdung in wheat and 531 kg/ha ash in Jute as organic manure. Fertilizer application rate was 95-10-21-10 kg NPKS/ha for wheat, 89-29 kg NK/ha for Jute and 61-7 kg NS/ha for T.Aman crop. N was applied in three splits in wheat and jute crops. Average yield was recorded 2204 kg, 1845 kg and 3783 kg per hectare from Wheat, Jute and T.Aman, respectively. It was observed that farmers used higher dose of N in this cropping pattern but average yield was found low compared to recommended dose and yield. Recommended dose was 50-10-25-7-0.5 kg NPKSZn/ha for Wheat, 30-4-15kg NPK/ha for Jute and 35-4-15-3 kg NPKS/ha for T.Aman Crops: Source- FRG'97 (Table 2).

Location : FSRD site, Narikeli, Jamalpur
Period : 2003

Boro-T.Aman: Most of the farmers practiced this cropping pattern in the study area. They used BRRI dhan 29 and BR-11 as a variety of Boro and T.Aman rice, respectively. They used 1548 kg/ha Cowdung in Boro rice as organic manure. They applied 128-15-25-10 Kg NPKS/ha in Boro and 46 kg/ha N and 6 kg/ha P in T.Aman rice. Farmers did not use N as basal dose in T.Aman but 23 kg/ha in Boro. Average yield was estimated 5605 kg/ha from Boro and 3720 kg/ha from T.Aman rice. They did not use any Zn in this pattern. They used higher dose of N and lower dose of K in Boro rice compared to recommendation (100-15-40-10-1 kg NPKSZn/ha for Boro and 60-8-30-4 kg NPKS/ha for T.Aman) (Table 2).

Potota-Boro-T.aman : It was the second major cropping pattern in the study area. Farmers used Dimont/Cardinal, BR-28 and BR-11 as variety of Potato, Boro and T.Aman rice, respectively. They applied average 1794 kg/ha Cowdung in potato. Fertilizer application rate was 113-24-52-12 kg NPKS/ha for Potato, 94-12-46-10 kg NPKS/ha for Boro and 70 kg/ha N for T.Aman. N was applied in three splits in potato, Boro and T.Aman crops. Average yield was recorded 18936 kg, 3483 kg and 3362 kg per hectare from potato, Boro and T.Aman, respectively. Farmers used higher dose of all nutrients in potato and lower dose in T.Aman compared to recommended dose. (Recommended dose 90-15-50-10-1 kg PLKSZn/ha for potato, 100-15-40-10-1 kg NPKSZn for Boro and 60-8-30-4 kg NPKS/ha for T.Aman) (Table 2).

Potato-Jute-T.Aman: It was the third major cropping pattern in the study area during 2003. Farmers used Diamont/Cardinal, Falguni tosa and BR-11 as a variety of Potato, Jute and T.Aman, respectively. They used average 2694 kg/ha Cowdung in potato and 1727 kg/ha ash in Jute as organic manure. They used 136-27-63-17 kg NPKS/ha in Potato, 56-22 kg NP/ha in Jute and 64-22 kg NK/ha in T.Aman. N was applied in three splits in potato and two splits in jute and T.Aman rice. Average yield was recorded 14543 kg, 1761 kg and 3523 kg per hectare from potato, Jute and T.Aman, respectively. It was observed that farmers used higher dose of all nutrients in potato but yield was found lower compared to recommended dose and yield (Recommended dose was 90-15-50-10-1 kg NPKSZn/ha for potato, 100-15-40-10-1 kg NPKSZn/ha for Jute and 60-8-30-4 kg NPKS/ha for T.Aman. Source: FRG'97) (Table 2).

Location : FSRD site, Atkapalia, Noakhali
Period : 1998

Fallow-Fallow-T.Aman: Most of the farmers practiced this cropping pattern in the study area. They use kajalsail and local as a variety of T.Aman. Average 617 kg/ha Cowdung was found to apply in T.Aman as organic manure. They did not use any chemical fertilizer in T.Aman except 24 kg N/ha as top dressing. Average yield was recorded 1.86 t/ha while recommended yield was 2.40 t/ha (Table 3).

Khesari-Fallow-T.Aman: It was identified as the second major cropping pattern. Farmers used local variety in both crops. They did not use any organic manure and chemical fertilizer in this pattern. They used 13 kg and 29 kg N/ha in khesari and T.Aman as a first top dressing. Average yield was estimated 1135 kg/ha and 2156 kg/ha from khesari and T.Aman, respectively. It was observed that average yield was found lower compared to recommended yield (Table 3).

Fallow-T.aus-T.aman: It was identified as third major cropping pattern by the sample farmers. They used local variety in both crops. They did not use any organic manure. They applied 30 and 14 kg NP/ha in T.Aus while 34kg and 12 kg NP/ha in T.Aman which was lower compared to recommendation. Average yield was also found lower in both crops (Table 3).

Location : FSRD site, Atkopalia, Noakhali
Period : 2003

Soybean-T.aus-T.aman: It was identified as in major cropping pattern in the study area. Farmers used Sohag as a variety of soybean, Haria for T.Aus and BR-32 for T.Aman. They applied @ 1295 kg Cowdung and 162 kg/ha ash in soybean crops and 137 kg/ha ash in T.Aman crop as an organic manure. Fertilizer application rate was 19-8-4 kg NPK/ha in soybean, 37-7-10 kg NPK/ha in T.Aman. They applied N as first top dressing in soybean and T.Aus but two splits in T.Aman. It was revealed from the study that farmers did not use recommended dose of fertilizer which caused lower yield compared to recommendation (Table 3).

Chilli-T.aus-T.aman : It was the second major cropping pattern in the study area. Farmers used local variety in chilli, Haria in T.Aus and BR-32 and Kajalshail in T.Aman crops. They applied 1335 kg/ha

Cowdung in chilli crop as organic manure. They mainly used N in two splits in chilli, T.Aus and T.Aman crops that were lower dose compared to recommendation. Average yield was found lower (Table 3).

Groundnut-T.aus-T.aman: It was identified as third major cropping pattern in the study area. Farmers used Dhaka-1 as a variety of Groundnut. Haria for T.Aus and Kajol shail, BR-32 for T.Aman crops. Average 1274 kg/ha Cowdung was used by the farmers in groundnut as organic manure. They applied 22-12-8 kg NPKS/ha in groundnut, 25 kg N/ha in T.Aus as topdressing with two splits and 29 kg N/ha with 10 kg P/ha in T.Aman crops. Average yield was recorded 1715 kg, 1866 kg and 2495 kg per hectare from groundnut, T.Aus and T.Aman, respectively. It was observed that they did not follow the recommended dose of fertilizer caused lower yield (Table 3).

Farmers reaction

Reason for changing the Cropping patterns:

1. Adopting new varieties
2. Decrease salinity area
3. For getting more yield as well as more production
4. Intensive use of land
5. Getting inspiration from extension personnel.

Reasons for changing the use of fertilizer:

1. Use of high yielding varieties
2. To obtain higher yield
3. Advice from the extension workers
4. Increase knowledge about the use of fertilizer
5. Reducing the soil fertility.

Conclusion

According to the statement of the sample farmers, the productivity and the soil fertility in the study area were found declining or at stagnation stage. The yield of major crops under different cropping patterns has been changed over time. The cause of change was identified as intensive cropping, low organic matter content of the soil and imbalance application of fertilizer. Most of the farmers were not aware of productivity and soil fertility of their crop field. They used higher amount of chemical fertilizer in many areas. Potato growers applied 3-3.5 times higher dose of K in their crops. Most of the farmers did not maintain recommended dose of fertilizer. Irrigation facilities, higher yield, demand and market price were the causes of change in cropping patterns by the farmers. Cropping pattern may be changed with proper use of organic and inorganic fertilizer by the farmers for maintaining soil health. Improve of technical knowledge, modern use of technology, strengthen of extension service as well as linkage between farmers, extension workers and researchers may reduce the imbalance use of fertilizer in crops under different cropping patterns.

Table 2. Fertilizer management practices and yield performance of major cropping pattern at Narikeli, Jamalpur between the year 1998 and 2003.

Item	1998							
	Cropping pattern-1		Cropping pattern-2			Cropping pattern-3		
	Boro	T.Aman	Mustard	Boro	T.Aman	Wheat	Jute	T.Aman
Variety	BR-29	BR11 Local	Tori-7	BR-28	BR11	Kanchan	Tossa	BR11
Rainfed/Irrigated	Irr.	R	R	Irri.	R	R	R	R
Organic manure (kg/ha)								
CD	1200	-	1354	-	-	2921	-	-
FYM	-	-	-	-	-	-	-	-
Ash	1104	-	-	-	-	-	531	-
Chemical fertilizer (kg/ha)								
N	30	-	31	-	-	22	16	-
P	17	-	17	15	4	10	-	-
K	24	-	31	30	-	21	29	-
S	13	8	15	10	10	10	-	7
Zn	-	-	-	-	-	-	-	-
Top Dressing of N (kg/ha)								
1st	46	30	34	46	29	49	42	38
2nd	40	23	-	38	31	24	31	23
Estimated yield (kg/ha)	5093	3645	812	3960	3564	2204	1845	3783
Recommended yield (t/ha)	4.5-5	3.5-4.0	1.10	5.0	3.50-4.0	2.50	3.30	4.0

Table 2. Contd.

Item	2003							
	Cropping pattern-1		Cropping pattern-2			Cropping pattern-3		
	Boro	T.Aman	Potato	Boro	T.Aman	Potato	Jute	T.Aman
Variety	BR-29	BR 11	Diamont/ cardinal	BR-28	BR11	Diamont/ cardinal	Falguni	BR11
Rainfed/Irrigated	Irr.	R	Irr.	Irr.	R	Irr.	R	R
Organic manure (kg/ha)								
CD	1548	-	1794	-	-	2694	-	-
FYM	-	-	-	-	-	-	-	-
Ash	-	-	-	-	-	-	1727	-
Chemical fertilizer (kg/ha)								
N	23	-	34	15	11	44	-	-
P	15	6	24	12	-	27	-	-
K	25	-	52	46	-	63	22	-
S	10	-	12	10	-	17	-	-
Zn	-	-	-	-	-	-	-	-
Top Dressing of N (kg/ha)								
1st	63	19	53	48	32	51	31	34
2nd	42	27	26	31	27	41	25	30
Estimated yield (kg/ha)	5605	3720	18936	3483	3362	14543	1761	3523
Recommended yield (t/ha)	5.0	4.0	25.0	5.0	4.0	25.0	2.80	4.0

Table 3. Fertilizer management practices and yield performance of major cropping pattern at Atkapalia, Noakhali between the year 1998 and 2003.

Item	1998				
	Cropping pattern-1	Cropping pattern-2		Cropping pattern-3	
	T.Aman	Khesari	T.Aman	T.Aus	T.Aman
Variety	Local (Kajolshail)	Local	Local	Local (Haria)	Local
Rainfed/Irrigated	R	R	R	R	R
Organic manure (kg/ha)					
CD	617	-	-	-	-
FYM	-	-	-	-	-
Ash	-	-	-	-	-
Chemical fertilizer (kg/ha)					
N	-	-	-	26	-
P	-	-	-	14	12
K	-	-	-	-	-
S	-	-	-	-	-
Zn	-	-	-	-	-
Top Dressing of N (kg/ha)					
1st	24	13	29	14	19
2nd	-	-	-	-	15
Estimated yield (kg/ha)	1861	1135	2156	2119	2293
Recommended yield (t/ha)	2.40	1.20	2.40	3.50	2.40

Table 3 Contd.

Item	2003								
	Cropping pattern-1			Cropping pattern-2			Cropping pattern-3		
	Soybean	T.Aus	T.Aman	Chilli	T.Aus	T.Aman	G.nut	T.Aus	T.Aman
Variety	Sohag	Haria	BR-32	Local	Haria	BR-32, Kajolshail	Dhaka-1	Haria	Kajorshail & BR32
Rainfed/Irrigated	R	R	R	R	R	R	R	R	R
Organic manure (kg/ha)									
CD	1295	-	-	1335	-	-	1274	-	-
FYM	-	-	-	-	-	-	-	-	-
Ash	162	-	137	-	-	-	-	-	-
Chemical fertilizer (kg/ha)									
N	-	-	-	-	-	-	-	-	-
P	8	-	7	14	9	8	12	-	-
K	4	-	10	24	-	-	8	-	10
S	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-
Top Dressing of N (kg/ha)									
1st	19	23	29	28	26	24	22	16	18
2nd	-	-	8	28	13	16	-	9	11
Estimated yield (kg/ha)	1767	1814	2536	1235(dry)	2034	2495	1715	1866	2495
Recommended yield (t/ha)	2.00	3.50	3.50	2.20	2.20	3.50	1.80	3.50	3.50

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Adaptability and Impact of Fertilizer Management Practices on Major Cropping Pattern in Some Selected Areas of Bangladesh

Introduction

Soil fertility is an important factor for crop production. It varies with intensive cultivation of high yielding crop varieties and improved cropping pattern. The study revealed that farmers of our country do not use balanced fertilizer in their crops. Imbalanced use o fertilizer creates nutrient imbalance in soil plant system and affect the soil fertility seriously. Researcher and extension workers are trying to motivate the farmers to use balanced fertilizer and maintain soil fertility by adding organic manure in different crops of major cropping pattern through soil fertility and fertilizer management project since 1996 over the country. At present, it is necessary to know how farmers are adopting the balanced dose of fertilizer with proper management technologies and its impact on productivity, soil fertility as well as soil health improvement.

Objectives

i) To determine the extent of adoption of the technology by the farmers
ii) To evaluate the impact of fertilizer management technologies on crop productivity, soil fertility and socioeconomic aspects.

Methodology

The study was conducted at six locations of Bogra, Pabna, Rangpur, Mymensingh, Chittagong and Barisal during November- December 2005 to evaluate the impact of fertilizer management on major cropping patterns. A total of 300 sample farmers (50 from each location of them 25 from project farmers and rest 25 from non project farmers) were selected randomly to collect necessary primary data with the help of pre-designed survey schedule through participatory and face to face interview method. Data were collected from two categories of farmers those who are directly involve with all activities of the SFFP project was indicated as project farmers (PF) and other one out side the project activities indicated as non-project farmers (NPF) from each location. Purposive sampling technique was followed for selecting sample farmers. The farmers delivered the information from their own memories during interview. The collected data were tabulated summarized, analyzed and presented in a tabulate form.

Results and Discussion

Socio-economic profile

Farm size and tenure arrangement may influence the optimum resource use and productivity. Considering all locations, average farm size was found 176 decimal in project farmers (PF) and 154 decimal in non-project farmers (NPF). Average family size was 5 in both PF and NPF. Age of responded farmers was recorded 38 years in project and 42 years in non-project area. Education on level was found same in both criteria. Farmer experience was the highest (23 years) in Bogra followed by Pabna and Chittagong under project farmers while it was 21 years in non-project farmers considering all locations. Yearly income was estimated Tk. 79248 for project farmers and Tk. 69004 for non-project farmers. About 3 training was received by the project farmers while the farmers of Bogra, Pabna and Mymensingh received average 1 training under non-project farmers. It was observed that project farmers received less amount of credit than non project farmers (Table 1).

Technology adopted by the sample farmers

The resource poor farmers generally have very little risk bearing capacity and they lack enough confidence in new technologies until it is successfully tried in own situation (Khan *et al.*, 1998). The study identified three types of experiments as well as technologies these were cropping pattern based fertilizer management, crop response to added nutrients and verification of fertilizer management practice over six locations. Considering all locations, project farmers of each location used one technology on cropping pattern based fertilizer management and one on crop response to added nutrients. Project farmers at Pabna location used highest (5) technologies on verification of fertilizer management practices followed by Rangpur (4) and Mymensingh (2). It was noticed that practices followed non project farmers of each location did not involve in any SFFP activities as because they were out of the project area (Table 2).

Major cropping pattern in the study area

The SFFP activities were executed on major cropping pattern in all locations. The major cropping pattern was same for the project farmers and non-project farmers in each location (Table 3). The cropping patterns were identified as Mustard-Boro-T.Aman for project and non-project farmers in Bogra, Wheat-Jute-T.Aman in Pabna, Potato-Boro-T.Aman in Rangpur, Mustard-Boro-T.Aman in Mymensingh, Chilli-T.Aman in Chittagong and T.Aus-T.Aman in Barisal location (Table 3).

Nutrient management practice in different major cropping pattern over different locations by the project and non-project farmer

Bogra: Mustard-Boro-T.Aman was identified as major cropping pattern in Gabtali MLT site, Bogra. Farmers in the project area used average 3116 kg/ha cowdung as organic manures in mustard crop. They applied 71-26-36-16 kg NPKS/ha in mustard, 109-21-51-7 kg NPKS/ha in Boro and 74-11-38-7 kg NPKS/ha in T.Aman crops. Yield was obtained 880 kg, 5420 kg and 3600 kg per hectare from Mustard, Boro and T.Aman crops (Table 4).

Incase of non project farmers, average 2880 kg/ha cowdung was used in mustard crop. They applied 59-24-30-11 kg NPKS/ha in Mustard, 74-18-38-5 kg NPKS/ha in Boro and 61-16-30-3 kg NPKS/ha in T.Aman crops. Average yield was estimated 719 kg from mustard, 5106 kg from Boro and, 2851 kg from T.Aman. It was observed that yield level was satisfactory in project area compared to the recommendation may be due to use of inorganic fertilizer closed to recommendation (Table 4).

Pabna: Wheat-Jute-T.Aman cropping pattern was major in Goyeshpur, Pabna for both project and non project area. Farmers in the project area used average 1830 kg/ha cowdung as organic manure in wheat crop. The nutrient application rate was 82-25-36-13 kg NPKS/ha in wheat, 66-14-28-8 kg NPKS/ha in Jute and 70-24-31-17 kg NPKS/ha in T.Aman crops. The average yield was recorded 1549, 3122 and 3120 kg/ha from Wheat, Jute and T.Aman crops respectively. On the other hand, Farmers of the non project area used 1411 kg/ha cowdung in wheat. The average yield level was obtained 1203 kg, 2731 kg and 3271 kg per hectare from Wheat, Jute and T.Aman, respectively. It was revealed from the study that project farmers were using closer dose of fertilizer compared to recommendation in this cropping pattern and yield also satisfactory than non project farmers(Table 4).

Rangpur: Potato-Boro-T.Aman was the major cropping pattern at FSRD site, Syedpur, Rangpur. The project farmers used 3862 kg/ha and 1131 kg/ha Cowdung as organic manure in Potato and T.Aman, respectively. The fertilizer application rate was 122-46-144-25-5 kg NPKSZn/ha in Potato, 93-22-38-10 kg NPKS/ha in Boro and 80-16-32 kg NPK/ha in T.Aman. Average yield was obtained 22114 kg/ha from Potato, 4031 kg/ha from Boro and 3422 kg/ha from T.Aman. Incase of non-project farmers, they used 2531 kg/ha Cowdung in Potato. They applied 113-41-21-2 kg NPKSZn/ha in Potato, 84-15-31-8 kg NPKS/ha. In Boro and 80-18-30 kg NPK/ha in T.Aman crop. Average yield was recorded 18330 kg/ha 4125 kg/ha and 3012 kg/ha from Potato, Boro and T.Aman, respectively. It was noticed that farmers of the project and non project area applied 2-3 times higher dose of P and K in Potato (Table 4).

Mymensingh: Mustard-Boro-T.Aman was the major cropping pattern at Muktagacha, Mymensingh. The project farmers used 960 kg/ha cowdung and little amount (187 kg /ha) of ash in Mustard. They applied 61-28-23-13 kg NPKS/ha in Mustard, 92-17-44-5 kg NPKS/ha in Boro and 83-11-28-8 kg NPKS/ha in T.Aman. Average yield was found 601 kg, 4476 kg and 2552 kg per hectare in Mustard, Boro and T.Aman crops, respectively. On the other hand, the non project farmers used only 870 kg/ha cowdung in Mustard. They applied 55-21-28-10 kg NPKS/ha in Mustard, 88-15-35-8 kg NPKS/ha in Boro and 71-16-25-6 kg NPKS/ha in T.Aman. Yield was estimated 543 kg, 4310 kg and 2509 kg per hectare in Mustard, Boro and T.Aman respectively. It was observed that fertilizer rate was closer in project area in this pattern compared to recommendation than non project farmers (Table 4).

Chittagong: Chilli-T.Aman was the major cropping pattern at Hathazari, Chittagong. Farmers in the project area did not use any organic manure in this pattern. They applied 99-53-86 kg NPK/ha in Chilli and 48-10-18 kg NPK/ha in T.Aman. The yield was found 1152 kg/ha from Chilli and 3421 kg/ha from T.Aman. The non project farmers applied 74-30-50 kg NPK/ha in Chilli and 40-15-15 kg NPK/ha in T.Aman. Average yield was obtained 1090 kg/ha from Chilli and 3091 kg/ha from T.Aman. It was revealed from the study that the project and non-project farmers applied higher amount of fertilizer compared to recommendation but higher yield was obtained from chilli and T.Aman than non project farmers (Table 4).

Barisal: Rice-Rice cropping pattern i.e. T.Aus-T.Aman was the major cropping pattern at Jhalokathi of Barisal. The project and non-project farmers did not use any organic manure in the study area. The project farmers applied 60-16-32 kg NPK/ha in T.Aus and 48-1128 kg NPK/ha in T.Aman. Average yield was recorded 2680 kg/ha and 2831 kg/ha from T.Aus and T.Aman crops respectively. The non project farmers applied 54-11-18 kg NPK/ha in T.Aus and 36-16 kg NP/ha in T.Aman rice. Yield was obtained 2511 kg/ha T.Aus and 2600 kg/ha from T.Aman rice. It was observed that project and non project farmers used more fertilizer compared to recommendation in this pattern (Table 4).

Farmers technical knowledge

Farmers were asked five questions related to nutrient and its deficiency in each location to know their technical knowledge. They replied from their own memories. According to the respondents most of the farmers (89% PF and 67% NPF) knew how the organic manure helped to make the soil fertile. On the other hand 32% PF and 82% NPF were poor in grade to able to identify the nutrient deficiency system of the crops (Table 5).

Problems for adapting technologies

The respondents mentioned some major constraints for adapting technologies. Considering all locations 62 percent project farmers reported that they are reluctant to maintain ail and small plots in experimental field. About 53 percent farmers opined that they do not have sufficient knowledge on disease and pest. High cost of inputs was the major problems which claimed 50%. About 48% farmers reported that complexity in fertilizer calculation. About 40% farmers claimed for lack of good quality seeds and 35% farmers reported that they obtained lower yield from the experimental plot.

In case of non project farmers, 77 percent farmers reported that lack of quality seed was major constrain to them. About 64% farmer claimed that input price were very costly. About 62% farmers reported that complexity in fertilizer calculation. Lack of knowledge on disease and pests was a constraint which claimed 60% farmers and about 47% farmers reported that they obtained lower yield from their crop field.

Table 1. Socio economic characteristics of Project farmers (PF) and Non project farmers (NPF) at different locations

Parameter	Locations						
	Bogra	Pabna	Rangpur	Mymensingh	Chittagong	Barisal	All
			Project farmer				
Farm size (decimal)	208	154	218	175	130	170	176
Family size (No.)	6	5	5	5	5	6	5
Age of respondent (year)	35	47	38	36	34	38	38
Education level	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Farm experience (Yrs)	23	20	15	17	18	16	18
Yearly income (Tk.)	97270	78220	134500	48600	53500	63400	79248
Training received (No.)	34	8	6	4	3	4	5
Credit received (Tk.)	-	-	-	3000	-	1300	717
			Non project farmers				
Farm size (decimal)	171	160	156	149	151	136	154
Family size (No.)	5	5	4	6	4	6	5
Age of respondent (year)	37	42	40	46	38	51	42
Education level	Primary	Primary	Primary	Primary	Primary	Primary	Primary
Farm experience (Yrs)	15	28	17	21	20	25	21
Yearly income (Tk.)	85300	57115	93400	59110	41000	78100	69004
Training received (No.)	1	1	-	1	-	-	-
Credit received (Tk.)	1750	-	3200	-	-	1125	1012

Table 2. Number of technologies adopted by the PF and NPF at different locations

Location	Cropping pattern based fertilizer management		Crop response to added nutrients		Verification of fertilizer management practice	
	PF	NPF	PF	NPF	PF	NPF
Bogra	1	-	1	-	-	-
Pabna	1	-	1	-	5*	-
Rangpur	1	-	1	-	4**	-
Mymensingh	1	-	1	-	2***	-
Chittaong	1	-	1	-	-	-
Barisal	1	-	1	-	-	-
All	1	-	1	-	2	-

*= Bio-fertilizer, sulphur, USG, Boron and N, **= USG, Mg, Boron and NPKS ***= Nutrients management and boron

Table 3. Major cropping pattern practiced by the PF and NPF at the different locations.

Location	**Project Farmer**	**Non Project Farmer**
Bogra	Mustard-Boro-T.aman	Mustard-boro-T.aman
Pabna	Wheat-Jute-T.aman	Wheat-Jute-T.aman
Rangpur	Potato-Boro-T.aman	Potato Bo-ro-T.aman
Mymensingh	Mustard-Boro-T.aman	Mustard-Boro-T.aman
Chittagong	Chilli-Fallow-T.aman	Chilli-Fallow-T.aman
Barisal	Fallow-T.aus-T.aman	Fallow-T.aus-T.aman

Table 4. Application of organic manure, nutrient and yield (kg/ha) obtained in different major cropping pattern over different locations

Locations	Cropping pattern	CD	Poultry litter	Ash	N	P	K	S	Zn	Yield
Project farmers (PF)										
Bogra	Mustard	3116	-	-	71	26	36	16	-	880
	Boro	-	-	-	104	21	51	7	-	5420
	T.aman	-	-	-	71	11	38	7	-	3600
Non-project farmers (NPF)										
	Mustard	2880	-	-	59	24	30	11	-	719
	Boro	-	-	-	74	18	38	5	-	5106
	T.aman	-	-	-	61	16	30	3	-	2851
Project farmer (PF)										
Pabna	Wheat	1830	-	-	82	25	36	13	-	1549
	Jute	-	-	-	66	14	28	8	-	3122
	T.aman	-	-	-	70	24	31	17	-	3120
Non-project farmers (NPF)										
	Wheat	1411	-	-	59	20	26	12	-	1203
	Jute	-	-	-	60	11	21	5	-	2731
	T.aman	-	-	-	53	18	24	10	-	3271
Project farmer (PF)										
Rangpur	Potato	3862	-	-	122	46	144	25	5	22114
	Boro	-	-	-	93	22	38	10	-	4031
	T.aman	1131	-	-	80	16	32	-	-	3422
Non-project farmers (NPF)										
	Potato	2531	-	-	113	41	130	21	2	18330
	Boro	-	-	-	84	15	31	8	-	4125
	T.aman	-	-	-	86	18	30	-	-	3012
Project farmers (PF)										
Mymensingh	Mustard	960	-	187	61	28	23	13	-	601
	Boro	-	-	-	92	17	44	5	-	4476
	T.aman	-	-	-	83	11	28	8	-	2552
Non-project farmers (NPF)										
	Mustard	810	-	-	55	21	28	10	-	543
	Boro	-	-	-	88	15	35	8	-	4310
	T.aman	-	-	-	71	16	25	6	-	2509
Project farmer (PF)										
Chittagong	Chilli	-	-	-	99	53	86	-	-	1152
	T.aman	-	-	-	48	10	18	-	-	3421
Non-project farmers (NPF)										
	Chilli	-	-	-	74	30	50	-	-	1090
	T.aman	-	-	-	40	15	15	-	-	3091
Project farmer (PF)										
Barisal	T.aus	-	-	-	60	16	32	-	-	2680
	T.aman	-	-	-	48	11	28	-	-	2831
Non-project farmers (NPF)										
	T.Aus	-	-	-	54	11	18	-	-	2511
	T.aman	-	-	-	36	16	-	-	-	2600

Table 5. Farmers technical knowledge about organic and inorganic fertilizer of PF and NPF at different locations

Technical Knowledge	Weight	% Farmers responded													
		Bogra		Pabna		Rangpur		Mymensingh		Chittagong		Barisal		All	
		PF	NPF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	PF	NPF
What are the GM crops and its importance	Good	29	25	61	-	50	15	53	21	37	-	42	-	45	10
	Average	64	60	30	80	47	73	40	68	49	10	39	13	45	51
	Poor	7	15	9	20	3	12	7	11	14	90	19	87	10	39
Organic manure helps to make the soil fertile	Good	40	29	45	-	44	41	54	9	44	7	43	-	45	14
	Average	50	51	47	83	52	47	37	51	39	21	37	66	44	53
	Poor	10	20	8	17	4	12	9	40	17	72	20	34	11	33
Amount and types of fertilizer to be used in crops	Good	65	12	52	-	47	-	52	8	44	-	43	-	51	3
	Average	27	60	38	69	42	84	36	66	42	64	35	69	37	67
	Poor	8	28	10	31	11	16	12	26	14	36	22	41	12	30
Cause of split of N applied	Good	41	18	62	11	51	10	66	40	46	6	50	14	53	17
	Average	47	31	38	82	49	72	34	51	44	57	40	68	42	61
	Poor	12	51	-	7	9	18	-	9	10	37	10	8	5	22
Able to identify nutrient deficiency symptoms of crops	Good	15	11	25	-	20	-	31	-	11	4	16	-	20	3
	Average	49	16	31	10	43	21	44	14	38	21	50	-	48	15
	Poor	36	73	14	90	37	79	25	86	51	75	34	91	32	82

PF = Project farmer, NPF= Non-project farmer

Table 6. Problems faced by the PF and NPF for adopting the technologies at different locations

Problems	% farmers responded													
	Project Farmers							Non project Farmers						
	Bog	Pab	Rang	Mym	Chitt	Bari	All	Bog	Pab	Rang	Mym	Chitt	Bari	All
Lack of good quality seed	44	41	53	39	28	36	40	68	76	81	84	71	83	77
High cost of inputs	53	48	54	40	48	56	50	68	62	72	64	57	61	64
Obtained lower yield	36	39	42	33	34	27	35	48	42	31	58	53	51	47
Lack of knowledge on disease and pest	56	45	53	58	54	49	53	53	48	60	68	70	61	60
Complexity of fertilizer calculation	29	37	49	47	44	39	48	63	47	73	61	58	71	62
Reluctant to maintain ail and small plots	77	73	51	69	46	58	62	-	-	-	-	-	-	-

Bog= Bogra, Pab= Pabna, Rang= Rangpur, Mym= Mymensingh, Chitt= Chittagong & Bari= Barisal

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Production Utilization and Marketing Systems of Olive at Madhupur Tract

Abstract

The study was conducted at MLT site Madhupur, Tangail under OFRD, BARI, Tangail during April- May, 2006 to assess the existing production practices, utilization pattern and to identify marketing channel, problems as well as potentiality of olive. A total of 30 farmers were selected randomly to collected necessary primary data. The study showed that per farm possessed two bearing olive trees between the age of 6-15 years and 16-25 years. They did not use any chemical fertilizer rather than 20 kg cowdung as manure during plantation. On an average highest amount of olive (378 kg) were harvested from the tree under the age of 16-25 years followed by between 6-15 years aged trees (165 kg). At the 12% discounted rate, gross cost and gross return were Tk.1708.57 and Tk. 23768.47, respectively. BCR (13.31), NPV (Tk.22060) and IRR (59%) indicated profitability of olive production. According to the farmers no bearing, alternate bearing, dropping of flowers and fruits at booting stage of olive were identified as production problems. On the other hand, excess toll and low price of olive were the marketing problems in the study area.

Introduction

Olive is one of the important fruit crops grown in Madhupur Tract. It is enriched with vitamin C. It has multipurpose use and intensively grown by the farmers. There is a big scope to increase its production and improve marketing system in the study area. It is necessary to identify the profitability of this crop as well as its utilization systems. Marketing is also one of the most vital factors that allow farmers getting reasonable price of a crop. So, there is a need to identify the existing marketing channel as well as constraints of marketing of Olives in that area. To meet up the above requirements the following objectives have been selected.

Objectives

- To find the existing production practices as well as profitability and utilization of olive
- To identify the marketing channel of olive in the study area
- To identify problems and potentials of growing and marketing of olive.

Methodology

The study was conducted at MLT site Madhupur, Tangail under OFRD, BARI, Tangail during April-May, 2006 to assess the existing production practices, utilization pattern and to identify marketing channel, problems as well as potentiality of olive. A total of 30 farmers (1 farmer from each farm or household) were selected randomly to collected necessary primary data with the help of pre-tested survey schedule by group discussion, participatory approach and face to face interview method. Purposive sampling technique was followed for selecting sample farmers. Data were collected from 3 types of farmers those who had the olive tree below 5 years aged, between 6-15 years aged and 16-25 years aged tree. The collected data were then tabulated, summarized, analyzed and presented in a tabular form.

In order to evaluate the profitability of the olive production system, investment analysis was applied. The profitability indicators were used as BCR, NPV and IRR (Gittinger, 1982).

$$\text{Benefit Cost Ratio (BCR)} = \frac{\sum B_t(1+i)^{-t}}{\sum C_t(1+i)^{-t}}$$

$$\text{Net Present Value (NPV)} = \sum B_t(1+i)^{-t} - \sum C_t(1+i)^{-t}$$

$$\text{Internal Rate of Return (IRR)} = i, \text{ when } \sum B_t(1+i)^{-t} - \sum C_t(1+i)^{-t} = 0$$

Where, B_t= Gross benefit in i^{th} year
C_t = Total cost in i^{th} year
t = Number of years (1,2,3,... ...,n)
i = Interest (discounted) rate (assuming 0.12)

Results and Discussion

Production practice of olive at Madhupur tract

Madhupur tract is suitable for olive production. Farmers are getting interest to grow olive due to its demand and good production. They used local variety which was purchased from the local market. They planted the sampling on June-July by maintaining 15 feet x 15 feet spacing with the sampling age of one year. They did not use any chemical fertilizer rather than 20 kg cowdung as manure during plantation. Pruning time was observed on February-March after harvest of olive during January-February.

The farmers opined that 6-15 yrs aged olive tree can produce 20-165 kg olive, 2-8 kg fuel wood and 20-21 kg leaves. Leaves were also used by the farmers as fuel and mulching materials of ginger or turmeric intensively in the study area. About 8-10cft timber could be produced from 15 years aged olive tree. Farmers usually did not use any insecticides or pesticides though the trees and fruits were infested with pest or insects due to lack of knowledge. They did not apply any additional fertilizer or manure during its life time. So, immense scope and prospects exists for increasing the productivity of the olive production (Table 1).

Per farm Olive trees

The total olive trees were divided into three categories as below 5 years aged, 6-15 years aged trees and 16-25 years aged trees. In most cases olive trees bear fruit at the age of 6 years. So the output from the olive trees was considered from the age of 6 years.

It was evident from the table that per farm numbers of total trees were 4.30 while the number of bearing trees was 2.10. The table also showed that about 51 percent trees did not produce any olive in the study area. On an average highest amount of olive (378 kg) were harvested from the tree under the age of 16-25 years aged followed by between 6-15 years aged trees (165 kg) (Table 2).

Input use and output of olive trees

The farmers used different inputs which were used in the production system. The inputs were valued at the prevailing market price. To calculate the production cost, the cost component of human labor, sapling, manure, support pole were considered. Table-2 showed that half man-day was required for preparing land, pit and planting the sapling. One sapling was planted and applied 20 kg manure in a pit on 1st year. Only labor was considered during next 2-5 years. One labor was considered every year during 6-15 years aged tree and it was 2.50 man-days during 16-25 years aged tree. Farmers did not use any chemical fertilizer during planting period as well as next life time. So, only labor cost was considered as one man-day in every year during 6-15 years aged tree and 2.50 man-days every year during 16-25 years aged tree. Gross cost per farm was calculated Tk. 134 in < 5 years, Tk. 180 in 6-15 years and Tk. 450 in 16-25 years aged tree.

Olive trees start bearing after 6 years. So there is no output before 5 years. Average 10 kg/tree leaves were recorded from the 5 years aged tree in every year. Average 20-165 kg olive was harvested from 6-15 years aged tree while it was 165-378 kg from 16-25 years aged tree. Average 2-8 kg fuel wood, 20-25 kg leaves were collected from 6-15 years aged tree every year. On the other hand 8-20 kg fuel wood and 30-35 kg leaves could be collected from 16-25 years aged tree every year.

Average gross return per farm was estimated Tk. 10 from each year during < 5 years, Tk. 1882 from every year during 6-15 years aged tree and Tk. 18090 from every year during 16-25 years aged tree in the study area (Table 3).

Consumption and utilization pattern of olive

Production, consumption and utilization pattern of olive was presented in the Table 4. It was found that the large portion (80%) of the total olive production was sold by the farmers. About 10 percent olive was wasted during harvesting, transportation and damaged by the animal (bat, rat and squirrel). About six percent olive was distributed to the relatives, neighbors and others while four percent for own consumption or kept store for future use as pickle (Table 4).

Investment analysis of olive tree

Investment analysis of olive tree was presented in Table 5. All costs incurred and benefits accursed from the trees have been taken into consideration for investment analysis. Costs and benefits were increased with the increase of the tree age. It was low in < 5 years aged trees while it was highest in 16-25 years aged tree. The table showed that the cash flow at the first year was negative but it became positive from sixth year and it was continued. At the 12% discounted rate, gross cost and gross return were Tk. 1708.57 and Tk. 23768.47, respectively. BCR (13.31), NPV (Tk. 22060) and IRR (59%) indicated profitability of olive production. The IRR indicated if farmers invest Tk. 100, they would get Tk. 159.

Marketing of olive in Madhupur tract

Olive is a short-durated seasonal fruit in Bangladesh. There is a suitable soil and climatic condition for producing olive in Madhupur tract. Farmers were planted more olive tree in the study area due to the intervention of some NGOs and extension personals. Most of the olive growers sold their product to the nearer local market. Some of them sold the whole tree in bearing stage to Bepari (intermediaries) before maturity of olive by a reasonable price. In that case the Bepari had to pay of bear every expense as harvesting costs, transportation costs loading costs etc.

Transportation cost:

The farmers had to pay Tk.8-10 for every 40 kg olive as transportation cost. It depends on the distance from the production area to sell area or market.

Market toll: The farmers had to pay Tk.2 for every 40 kg olive as market toll to the lessee agent of the market.

Broker cost:

The buyer agent or wholesaler had to pay Tk.8 per 40 kg olive to the intermediaries or brokers for purchasing a large amount of products.

Sweeping cost:

The farmers had to pay Tk.1 per 40 kg olive to the agent of the sweeper in the market.

Weighting cost:

The buyers had to pay Tk.2.50 per 40 kg olive to the people who weight his products in the market.

Bagging cost:

The buyers or wholesaler had to pay Tk.15 per 100 kg olive as bagging cost.

Loading cost:

The buyer had to pay Tk.20 per 100 kg olive to load on a truck as loading cost to the labor in the local market.

Marketing channel of olive at Madhupur

The sample farmers were asked to identify the marketing channel of olive in the study area. They identified four types of marketing channel of olive. Most of the farmers (70%) expressed that olive was marketed by the channel of ***Farmer-Bepari-Wholesaler-Industry***. Abuot 15 percent respondents opined that they sold the olive by the channel of ***Farmer-Bepari-Industry.*** About 10 percent farmers pointed out that they sold olive through the channel of ***Farmer-Bepari-Consumer*** and about 5 percent respondents opined that they also sold their products through the channel of ***Farmer-Consumer*** in the study area (Table 6).

Problems faced by the olive growers

The sample farmers identified the major problems of olive during production and marketing of their products. In case of production aspect, about 86 percent farmers opined that no bearing as well as alternate bearing of olive was a big problem to them. Dropping of flowers and fruits at booting stage was identified as second most problems to 74 percent farmers in the study area. About 45 percent farmers claimed that deformation of olive was a constraint for getting quality fruits. Brown spot on the surface of olive was observed as a problem by the 43 percent farmers. About 29 percent farmers opined that dieback in olive branches was a problem to them in the study area.

In case of marketing aspect, about 78 percent farmers claimed that excessive toll system exist in the market. About 63 and 51 percent farmers opined that low market price of olive and limited buyer exists in the market, respectively during the olive season and they controlled the selling price in the market (Table 7).

Potential aspect of olive

Focus group discussion (FGD) was done to identify the potentiality of olive fruits at Madhupur. Farmers were very much attentive and actively participated during the discussion. Five potential aspects of olive were identified by the farmers through FGD as

1. Scope to develop agribusiness industry.
2. Favorable soil for growing olive.
3. Scope to make olive oil from its seeds.
4. Huge demand of olive and
5. Exporting potentiality of olive to abroad.

Conclusion

Olive has a great importance for its fruits, timber, fuel wood and leaves. It is enrich in vitamin C. It can help to improve the socioeconomic condition of the farmers. It has huge market demand. Investment analysis showed the profitability of olive production though it has some limitations. It has more potentiality and scope to improve its management practice and marketing structure by following the modern production technology and government intervention. Training and extension service can develop their knowledge as well as production of olive. So, GO and NGO should come forward for its improvement.

Table 1. Existing management practice of olive at MLT site, Madhupur, 2005-06

Items	Olive
Variety	Local
Spacing: Plant to plant	15′
Line to line	15′
Sapling age (age)	1 yrs
Planting time	June-July
Fertilizer (kg/tree)	
Cowdung	20
Urea	-
TSP	-
MP	-
Pruning	Feb-March
Harvesting time	January-February
Output (kg/tree of 6-15 years aged):	
Fruits	20-165
Fuel wood	2-8
Leaf	20-25
Timber (cft)	8-10

Table 2. Per farm olive trees at MLT site, Madhupur tract by age group, 2005-06

Age group	Total tree (no)	Bearing tree (no)	Yield (kg/tree)
< 5 yrs	1.10	-	-
6-15 yrs	2.00	1	165
16-25 yrs	1.20	1.10	378
Total	4.30	2.10 (49%)	543

Table 3. Per farm input use and output of olive tree at MLT site, Madhupur, 2005-06

Items	< 5 yrs	6-15 yrs	16-25 yrs
Input use (per tree)			
Labor (Man-day)	0.50	1	2.50
Sapling (No)	1	-	-
Manure (kg)	20	-	-
Urea (kg)	-	-	-
TSP (kg)	-	-	-
MP (kg)	-	-	-
Case/support pole (No)	1	-	-
Cross cost (Tk/tree)	67	90	225
Cross cost (Tk/farm)	134	180	450
Out put (kg/tree)			
Fruit	-	20-165	165-378
Fuel wood	-	2-8	8-20
Leaf	10	20-25	30-35
Timber	-	-	21
Cross return (Tk/tree)	5	941	9045
Cross return (Tk/farm)	10	1882	18090

Input cost (Tk./kg) : Labor (Tk./manday)= 90/-, Sapling= 10/-, Manure=0.50, Urea= 6/-, TSP=14/-, & MP=12/-, Support pole= Tk. 30/No.

Output cost (Tk./kg) : Fruit=10/-, Fuel wood=1/- & Leaf= 0.50, Timber= Tk. 300/CFT & Bearing tree per farm = 2

Table 4. Per farm consumption and utilization pattern of Olive at MLT site, Madhupur

Age group	Total production (kg)	Own consumption (kg)	Sold (kg)	Gift (kg)	Wastage (kg)	Store for later use (kg)
< 5 yrs	-	-	-	-	-	-
6-15 yrs	165	5	120	13	25	2
16-25 yrs	378	10	316	18	30	4
Total	543 (100)	15 (3)	436 (80)	31 (6)	55 (10)	6 (1)

Figure in the parenthesis indicate percentage.

Table 5. Per farm investment analysis of Olive at MLT site, Madhupur, 2005-06

Tree Age	Gross cost	Gross return	Cash flow	Discounted gross cost at 12% DR	Discounted gross return at 12% DR	Discounted CF at 55% DR	Discounted CF at 60% DR
1	134	10	-124	134	10	-124	-124
2	134	10	-124	119.662	8.93	-79.98	-77.5
3	134	10	-124	106.798	7.97	-51.584	-48.484
4	134	10	-124	95.408	7.12	-33.356	-30.256
5	134	10	-124	85.224	6.36	-21.452	-18.972
6	180	1332	1152	102.06	755.244	129.024	109.44
7	180	1332	1152	91.26	675.324	82.944	69.12
8	180	1332	1152	81.36	602.064	54.144	42.624
9	180	1332	1152	72.72	538.128	34.56	26.496
10	180	1332	1152	64.98	480.852	21.888	17.28
11	180	1332	1152	57.96	428.904	13.824	10.368
12	180	1332	1152	51.66	382.284	9.216	6.912
13	180	1332	1152	46.26	342.324	5.76	4.608
14	180	1332	1152	41.22	305.028	3.456	2.304
15	180	1332	1152	36.9	273.06	2.304	1.152
16	450	16360	15910	82.35	2993.88	15.91	0
17	450	16360	15910	73.35	2666.68	0	0
18	450	16360	15910	65.7	2388.56	0	0
19	450	16360	15910	58.5	2126.8	0	0
20	450	16360	15910	52.2	1897.76	0	0
21	450	16360	15910	46.8	1701.44	0	0
22	450	16360	15910	41.85	1521.48	0	0
23	450	16360	15910	37.35	1357.88	0	0
24	450	16360	15910	33.3	1210.64	0	0
25	450	16360	15910	29.7	1079.76	0	0
Total				1708.572	23768.47	62.658	-8.908

DR= Discounted rate,
Result: BCR at 12% = 13.31, NPV at 12%= Tk. 22060, IRR is 59%

Table 6. Marketing channel identified by the supple farmers at MLT site, Madhupur, 2005-06

Marketing channel	% Farmers responed
Farmer-Bepari-wholesale-Industry	70
Farmer-Bepari-Industry	15
Farmer-Bepari-Consumer	10
Farmer-Consumer	5

Table-7 Problems faced by the farmers during Olive production at MLT site, Madhupur, 2005-06

Problems	% Farmers responded
Production aspect	
1. No bearing as well as alternate bearing	86
2. Dropping of flowers and fruits at booting stage	74
3. Deforming of olive	45
4. Brown spot on the surface of olive	43
5. Die back of olive branches	29
Marketing aspect	
1. Excessive toll system in market	78
2. Low price of olive	63
3. Limited whole seller/buyer	51

❋ ❋ ❋

A. PRODUCTION PROGRAM

1. Faridpur

Crops	Variety	No. of farmers	Date of sowing	Yield (t/ha)	Gross return (Tk./ha)	Net return (Tk./ha)	Remarks
Wheat	Gourab	03	29.11.05 to 30.11.05	2.81	42150	15840	Farmers choose new variety
	Sourav	04	-do-	2.67	40050	20040	
Mustard	BARI Sarisha-9	03	27.11.05 to 30.11.05	1.38	27600	12190	Farmers like due to its higher yield
	BARI Sarisha-11	18	27.11.05 to 30.11.05	2.03	40600	25190	
Radish							
	BARI Mula-1	2	21.11.05 to 24.11.05	47.13	188520	165250	
	BARI Mula-2	2	22.11.05 to 24.11.05	41.5	166080	132930	
	BARI Mula-3	1	22.11.05	39.9	159600	126450	
Potato							
	Cardinal	01	12.12.05	27.9	223200	172350	
	Diamand	01	12.12.05	21.9	175200	124350	
	Hira	03	11.12.05 to 07.12.05	22.1	177066	126216	
	Dhira	03	11.12.05 to 09.12.05	22.2	177600	126750	

2. Kushtia

Crops	Variety	Area (hectare)	Sowing date	Sowing method	Farmers involved (no.)	Yield (t/ha)
Mustard	BARI Sarisha 11	1.0	6 November, 2005	Broadcast	6	1.8
Wheat	Shatabdi	3	15-30 Nov. 2005	do	30	4.40
	Gourab	1	15-30 Nov. 2005		7	3.5
Hybrid maize	BHM 3	15	15 Nov. 15 Dec. 04	line	112	8.0
Lentil	BARI Masur		7 November		10	0.9
Lentil	Prime		15 Nov. 2005	Line		1.65
	Non prime					1.20

B. BLOCK DEMONSTRATION

1. Pabna: Mustard

Name of site	No. of cooperator farmers	Area under cultivation (ha)	Crop management	Grain yield (kg ha^{-1})	Total variable cost (Tk ha^{-1})	Gross return (Tk ha^{-1})
MLT site Atghoria	10	5	Research management	2276	17775	48742
			Farmer's management	1065	14775	21252

2. Barind

Crops	Variety	Area (*Bigha*)	No. of farmer	Date of sowing	Date of harvesting	Seed yield (kg/ha)
FSRD site, Kadamshahar, Rajshahi:						
Chickpea	BARI Chola-5	5	5	1-10 Nov. 2005	1-4 Mar. 2006	1020
Mustard	Improved Tori-7	5	4	4-7 Nov. 2005	3-8 Feb. 2006	750
	BARI Sarisha-9	3	2	7-10 Nov. 2005	12-15 Feb. 2006	1035
	BARI Sarisha-11	2	1	8 Nov. 2005	20 Feb. 2006	1270
Wheat	Sourav	2	2	25-27 Nov. 2005	18-20 Mar. 2006	2725
	Gourab	2	2	24-26 Nov. 2005	17-19 Mar. 2006	2640
Lentil	BARI Masur-4	4	4	5-7 Nov. 2005	18-20 Feb. 2006	1150
MLT site, Amnura, Chapainawabgonj:						
Chickpea	BARI Chola –5	3	2	28-30 Nov. 2005	25-30 Mar. 2006	915
Mustard	BARI Sarisha-11	4	5	7-10 Dec. 2005	10-12 Mar. 2006	790
Mohadebpur, Naogaon:						
Mustard	BARI Sarisha-11	40	17	15-24 Nov. 2005	27 Feb.-10 Mar. 2006	1170
Wheat	Shatabdi	35	30	5-27 Dec. 2005	22 Mar.-14 April 2006	475
	Sourav	50	35	Do	Do	265
	Gourab	15	14	Do	Do	375

C. SEED EXCHANGE PROGRAM

1. Barind, Rajshahi

Crops	Variety	Area (*Bigha*)	No. of farmer	Supplied seed (kg)	Collected seed (kg)	Mean yield (kg/ha)
FSRD site, Kadamshahar, Rajshahi:						
Chickpea	Nabin	6	4	62	22	655
	BARI Chola-4	1	1	7.5	-	735
	BARI Chola –5	28	15	167	105	1070
	BARI Chola –8	1	1	5	5	740
	Sub total =	36	21	241.5	132	-
Mustard	BARI Sarisha-9	35	9	34	22	1025
	BARI Sarisha-11	10	6	10	7	1270
	Sub total =	45	15	44	29	-
Wheat	BARI Gam 20 (Shatabdi)	12.5	9	250	240	2750
	BARI Gam 21 (Gourab)	2.5	3	50	30	2540
	Sub total =	15	12	300	270	-
MLT site, Amnura, Chapainawabgonj:						
Chickpea	Nabin	13	3	78	85	625
	BARI Chola-2	5	1	30	30	850
	BARI Chola –5	12	4	72	55	1110
	Sub total =	30	8	180	170	-

2. Faridpur

Crops	Variety	Area (ha)	Seed distributed (kg)	Collected seed (kg)	Average yield (kg/ha)
Wheat	Shatabdi	8.0	950	750	2256
	Shourav	05	600	500	2145
	Protiva	02	250	200	2050
	Gourav	1.05	125	150	2164
Chickpea	BARI Chola 5	04	150	180	960
Mustard	BARI Sharisha 9	0.8	6	10	1260
	BARI Sharisha 11	01	8	12	1620

D. CROP MUSEUM

1. Faridpur

Name of crop	Name of variety	Date of sowing	Date of harvesting	Yield (t/ha)	Cost cultivation (Tk./ha)	Net return (Tk./ha)
Wheat	Protiva	26.11.05 to 29.11.05	15.3.06 to 19.3.06	2.93	20010	23940
	Gaurab			2.91	20010	23640
	Shourav			3.06	20010	30390
	Shatabdi			3.4	20010	30990
Chickpea	BARI Chola-4	02.12.05	28.03.06	1.44	7725	21075
	BARI Chola-5	02.12.05	22.03.06	1.45	7725	21275
Coriander	BARI Dhania-1	16.11.03	15.03.04	0.86	10500	6700
Mustard	BARI Sarisha-6	21.11.05	20.02.06	1.85	15410	21590
	BARI Sarisha-8	21.11.05	20.02.06	2.05	15410	25590
	BARI Sarisha-9	21.11.05	21.02.06	1.23	15410	9150
	BARI Sarisha-11	21.11.05	23.02.06	1.78	15410	20250
Radish	BARI Mula 1	21.11.05	12.01.06	52.80	33150	178050
	BARI Mula 2	21.11.05	15.01.06	48.00	33150	158850
	BARI Mula 3	21.11.05	12.01.06	45.00	33150	146850
Tomato	BARI Tomato 2	25.11.05	05.03.06	76.5	40620	341880
	BARI Tomato 3	25.11.05	12.03.06	60.02	40620	260380
	BARI Tomato 8	25.11.05	05.03.06	83.65	40620	377580
	BARI Tomato 9	25.11.05	14.03.06	64.68	40620	282780
	BARI Tomato 12	25.11.05	15.03.06	61.20	40620	265380

2. Pabna

Crop	Variety	Seed Rate (kg ha^{-1})	Date of sowing	Plant popn. m^{-2}	Date of harvest	Yield (t ha^{-1})	Cultivation cost (Tk.ha^{-1})	Net return (Tk ha^{-1})
Potato	Cardinal	3500	13/12/05	8	02/03/06	21	34500	70500
	Hira	4000	13/12/05	8	02/03/06	23.75	34500	84250
Onion	BARI Peaz-1	5	26/01/06	50	29/03/06	8	32625	83375
Coriander	BARI Dhania-1	8	13/12/05	36	19/03/06	1.13	9375	10400
Sunflower	BARI Sunflower--2	10	13/12/05	8	02/04/06	1.5	12250	18750
Wheat	Sourav	120	13/12/05	203	22/03/06	3	14025	27225
	Gourab	120	13/12/05	201	18/03/06	2.8	14025	24475
Mustard	BARI Sarisha-11	7.5	13/12/05	56	17/03/06	1.6	10500	20700

E. BARI TECHNOLOGY VILLAGE

1. FSRD site, Barind, Rajshahi

Crops	Crop variety	Date of sowing /transplanting	Time of harvesting	Mean yield (kg/ha)
Wheat	Shourav	7 Dec. 2005	18 Mar. 2006	2317
	Gourab	Do	Do	2526
	Shatabdi	Do	Do	2684
Chickpea	BARI chola-2	Do	21 Mar. 2006	845
	BARI chola-5	Do	Do	1025
	BARI chola-8	Do	Do	853
Mustard	BARI Sharisa-11	Do	20 Mar. 2006	1162
Niger	Shova	Do	25 Mar. 2006	957
Lin seed	Nila	Do	24 Mar. 2006	875
Sunflower	Kironi	Do	Do	978
Barley	BARI Barley-3	Do	18 Mar. 2006	1334
	BARI Barley-4	Do	Do	1276
Maize	BARI Hybrid Maize-2	Do	22 Apr. 2006	6528
	BARI Hybrid Maize-3	Do	Do	7615
	BARI Hybrid Maize-5	Do	Do	7268
Lentil	BARI Masur-4	Do	20 Mar. 2006	1275
Coriander	BARI Dhania-1	Do	22 Mar. 2006	1284
Methi	BARI Methi-1	Do	24 Mar. 2006	675
Soybean	Bangladesh Soybean-4	Do	30 Mar. 2006	1350
	BARI Soybean-5	Do	Do	1260
Garden pea	BARI Motorshuti-1	8 Dec. 2005	15 Feb.-14 Mar. 2006	13.65 t (vegetable)
	BARI Motorshuti-2	Do	14 Feb.-16 Mar. 2006	11.6 t (vegetable)
	BARI Motorshuti-3	Do	Do	9.45 t (vegetable)
Red amaranth	BARI Lalshak-1	Do	24 Mar. 2006	750 (seed)
Spinach	Kopi palong	Do	24 Mar. 2006	1250 (seed)
Bush bean	BARI Jharseem-1	Do	20 Feb.-12 Mar. 2006	12250 (vegetable)
China cabbage	BARI Batishak-1	Do	20 Mar. 2006	750 (seed)
Onion	BARI Piaj-1	Do	20 Mar. 2006	7850
Radish	BARI Mula-1(Tasakisan)	Do	10-15 Feb. 2006	45 t (with leaf)
	BARI Mula-2 (Pinki)	Do	Do	37 t
	BARI Mula-3 (Druti)	Do	Do	35 t
Brinjal	BARI Begun-4 (Kajla)	Do	20 Feb.-15 Apr. 2006	32 t
	BARI Begun-5(Nayantara)	Do	Do	28 t
Potato	Cardinal	Do	7 Mar. 2006	12 t

2. Pabna

Crop	Variety	Seed Rate (kg ha^{-1})	Date of sowing	Plant popn./ m^2	Date of harvesting	Yield (t ha^{-1})	Cultivation cost (Tk ha^{-1})	Net return (Tk ha^{-1})
Wheat	Sourav	120	01/12/05	181	17/03/06	2.84	14000	25050
	Gourab	120	01/12/05	208	13/03/06	2.17	14000	15837
	Sourav	120	01/12/05	287	17/03/06	2.67	14000	22712
	Gourab	120	01/12/05	184	13/03/06	2.08	14000	14600
Mustard	BARI Sarisha-8	7.5	07/12/05	47.67	28/02/06	1.83	10500	25185
	BARI Sarisha -9	7.5	20/12/05	90	05/03/06	1.20	10500	12900
	BARI Sarisha -11	7.5	20/12/05	101	17/03/06	1.33	10500	16100
Lentil	BARI Masur-4	3.0	09/12/05	168	25/03/06	1.5	7800	44700
	BARI Masur -4	30	04/12/05	160	09/03/06	1.4	7800	41200
Chick pea	BARI Chola-7	200	14/12/05	16	02/04/06	0.3	8400	2100
	BARI Chola -5	200	14/12/05	15	30/03/06	0.400	8400	5600
Potato	Diamant	3000	14/12/05	6	08/03/06	7.00	34500	500
	Cardinal	3500	14/12/05	8	08/03/06	8.00	34500	5500
	Alisa	3500	14/12/05	5	08/03/06	7.33	34500	2150
	Dhira	3000	15/12/05	6	12/03/06	11	34500	20500
	Dhira	3000	14/12/05	8	08/03/06	12	34500	25500

3. Noakhali

Name of crops	Name of variety	Unit price (Tk/kg)	Yield (t/ha)	Gross return (Tk/ha)	Farmers' reaction
Radish	BARI Mula-1	5	31. 38	156900/-	Early mature, production is good for leafy vegetable due to softness of leaf.
	BARI Mula-3	5	26.38	131900/-	Root length is short- farmers did not like it.
Batishak	BARI Batishak -1	4	37.27	149080/-	New crop, more tasty and high production.
Cauliflower	Rupa	8	11.40	31200/-	Farmers' dislike it because curd size is small and early flowering.
	Boltoly	8	8.14	65120/-	Farmers' dislike it because curd size is small and early flowering.
Cabbage	BARI-1	5	16.21	81050/-	Not accepted by the farmers
Tomato	BARI Tomato-2	5	29.7	148500/-	Tasty and production is satisfactory.
	BARI Tomato -3	5	26.5	1132500/-	Fruits become soften after ripening
	BARI Tomato-8	5	19.6	98000/-	Fruit skin is hard accepted by the farmers.
	BARI Tomato-12	5	25.4	127000/-	Fruits size is small
Brinjal	BARI Begun -4	6	15.33	91980/-	Fruits size and yield is good, tasty.
Mustard	Dhali	25	1.525	38125/-	Dholi is more accepted
	BARI Sarisha-8	25	1.361	34025/-	
	BARI Sarisha-11	25	1.167	29175/-	
Sunflower	Kironi	9	5.25	47250/-	Head is damaged by Parrot.
Wheat	Shatabdi	15	3.25	48750/-	Yield is satisfactory and market price is also good
	Saurov	15	2.85	42750/-	
	Gourob	15	2.95	44250/-	
Grass pea	BARI Khesari-1	15	1.5	22500/-	Production satisfactory.
Field pea	BARI Mortorshuti-1	17	1.6	27200/-	New crop, pod is long, production satisfactory.
Potato	Cardinal	8/-	18.37	146960/-	Farmer is interested for potato cultivation with mulch. But seed is not available.
	Diamant	8/-	22.81	182400/-	
	Hera	8/-	20.35	162800/-	
	Dhera	8/-	17.95	143600/-	
	Ailsha	8/-	18.60	148800/-	

4. Patuakhali

Crops	Varieties	No. of farmer	Area (dec.)	Date of sowing/ planting	Harvesting started	Yield range (t/ha)	Average yield (t/ha)
Radish	BARI Mula-1	6	12	21/10/05	30/12/05	30-35	32
	BARI Mula-2	6	12	21/10/05	30/12/05	30-35	31
	BARI Mula-3	6	12	21/10/05	30/12/05	25-30	26
Bushbean	BARI Jharseem-1	10	20	18/11/05	20/01/06	6-10	7.5
Motorshuti	BARI Motorshuti -1	5	10	18/11/05	15/2/06	6-8	6.5
	BARI Motorshuti -2	5	10	18/11/05	1/2/06	8-10	8.9
Cauiflower	BARI Fulcopy-1	7	12	20/11/05	20/1/06	12-14	13
Cabbage	BARI Badhacopy-2	8	12	20/11/05	5/2/06	20-27	25
Tomato	BARI Tomato-2	8	12	21/11/05	15/2/06	52-60	56
	BARI Tomato-3	8	12	21/11/05	25/2/06	54-62	56.5
	BARI Tomato-8	8	12	21/11/05	20/2/06	56-63	57
	BARI Tomato-9	8	12	21/11/05	15/2/06	45-52	47
Brinjal	BARI Begun-4	6	12	22/11/05	15/2/06	45-48	47
	BARI Begun -5	6	12	22/11/05	15/2/06	28-33	30
Potato	Diamant	10	100	2-6/12/05	8/3/06	22-25	24
	Cardinal	10	100	2-6/12/05	8/3/06	23-25	23.5
	Heera	10	50	2-6/12/05	8/3/06	20-26	22.5
Wheat	Shatabdi	15	250	1-8/12/05	15/4/06	1.9-2.3	2.1
Maize	BMH-3	10	50	1-6/1/06	2/5/06	6.5-9.2	7.6
Mustard	BARI Sarisha-9	5	15	2/12/05	27/2/06	0.9-1.1	1.0
Mungbean	BARI Mung-5	6	100	1-5/2/06	15/5/06	1.3-1.6	1.42

5. Faridpur

Crops	Variety name	Farmers involved (no)	Supplied seed/ seedling (g/no)	Stored seed (g)	Remarks
Radish	BARI Mula 1	22	460	50	--
	BARI Mula 2	04	130	150	Farmers like more due to use as 'shak' and tasty with color
	BARI Mula 3	05	90	60	--
Red amaranth	BARI Lalshak 1	12	270	400	--
Spinach	BARI palongshak 1	12	280	1000	--
Coriander	BARI dhania 1	03	125	--	--
Tomato	BARI tomato 3	03	1500	200	--
	BARI tomato 8	05	500		--
	BARI tomato 9	05	500	300	Farmers choose more for keeping quality
	BARI tomato 12	08	800	--	--
Potato	Dhira	03	50	--	Farmers like it for more no. of eyes & long days stored.
	Hira	09	110	--	--
	Ailsa	05	50		--
	Diamond	04	140	--	--
Wheat	Sourav	04	50	80	--
	Gourav	03	50	60	Farmers like Gourav due to higher yield
	Protiva	10	70	1600	--
Mustard	BARI sarisha 6	02	1000	1000	--
	BARI sarisha 9	03	2300	3000	--
	BARI sarisha 8	02	1500	1000	Farmers like it due to more yield
	BARI sarisha 11	06	5450	6000	--
Chilli	BARI marich 1	05	250	100	Good

Fruit Seedling distribution (BTV)

1. Kadamshahar, Godagari, Rajshahi

Sl. no.	Name of fruit	Fruit saplings distributed	Plant establishment (%)	Present Status
1.	Mango	130	82	Active growing stage
2.	Litchi	30	90	Do
3.	Guava	40	90	Do
4.	Seedless lemon	30	95	Do
5.	Pummelo	15	85	Do
6.	Pear	8	20	Do
7.	Coconut	240	95	Do
8.	Betel nut	40	50	Do
	Total =	**533**	**-**	**-**

2. Hatgovindapur, Faridpur

Sl. no	Name of fruit	Varieties	No of seedlings	No of cooperators	Remarks
1	Mango	BARI Aam-3 (Amrapali)	30	30	3 seedlings damaged and rest good
		BARI Aam-2 (Mallika)	15	15	
		Mahananda	15	15	
2	Litchi	BARI litchi 1	08	08	6 dead and 24 are in good condition
		BARI litchi 2	12	12	
		BARI litchi 3	10	10	
3	Guava	Kazi peara	30	30	Dead 5 & rest good condition
4	Coconut	BARI coconut 1 & 2	5+5=10	10	All are in good condition
5	Lemon	BARI lebu 1, 2 and 3	30	30	6 seedlings damaged and rest good

3. Pushpapra, Pabna

Name of fruit (BARI developed)	No of cooperators	No of supplied seedlings	No. of dead plants	Mortality rate (%)	Remarks
Mango	19	29	4	14	Supplied seedling very weak and poor quality
Coconut	14	14	3	21	Good condition
Citrus	26	39	4	10	Sapling was poor quality
Nashpati	13	13	3	23	New fruit at the site.
Litchi	10	10	2	20	Initially the seedling condition was poor. Now in good condition

BTV, Taratpara, Gazipur

Name of crop	Variety	Date of sowing	Date of harvest	Yield (t/ha)
Summer tomato	BARI Tomato-4	7-6-05 to 12-6-05	25-8-05 to 15-9-05	8 to 17.33
	BARI Tomato-5	7-6-05 to 22-6-05	25-8-05 to 15-9-05	14.6 to 15.45
Wheat	Sourav & Gourab	7-12-05 to 13-12-05	9-2-06 to 9-3-06	1.5 to 2.55
Mustard	BARI Sarisha-11	15-11-05	20-2-06	1.24
	BARI Sarisha-9	20-11-05	26-2-06	0.6
Lentil	BARI Mashur-4	18-11-05	26-2-06	1.4
Chilli	BARI Morich-1	12-12-05 to 16-12-05	10-6-06 to 20-6-06	8 to 11.13
Potato	Diamant, Cardinal, Dheera, Ailsha	19-11-05	28-2-06	12 to 17.5
Turmeric	BARI Halud-3	15-4-05 to 25-4-05	19-2-06 to 1-3-06	12.85 to 20
Ginger	Local	2-5-05 to 11-5-05	28-11-06 to 8-4-06	5.7 to 12
Brinjal	BARI Begun-4	13-11-05 to 14-11-05	25-05-06 to 18-6-06	28.5 to 37.2
Onion	BARI Peaj-1	9-12-05 to 11-12-05	2-4-06 to 4-4-06	7.5 to 8
	OF-4 (Ad. line)	22-2-06	21-5-06	12.5
Panikachu	Latiraj	15-2-06 to 22-5-06	Vegetative stage	
Mukhikachu	Bilashi	11-4-06 to 8-5-06	Vegetative stage	
Amaranth	BARI Data-1	2-3-06 to 20-4-06	13-4-06 to 20-5-06	
Radish	BARI Mula-1	15-11-05	17-1-06	31.29
	BARI Mula-2			20.3
	BARI Mula-2 (Seed)			250
Gimakalmi	BARI Gimakalmi- 1	12-3-06	Harvesting going	3.7 to 4.89
Maize	BARI Maize 5	3.4.05	20.6.05	1.2

F. TRAINING AND FIELD DAYS, 2005-06

Project: SFFP

a. Farmers' Training

Location	Date	No. of farmers
Barind	13 November, 2005	18
Jamalpur	17 November, 2005	24
Kishoreganj	20 November, 2005	24
Sylhet	22 November, 2005	12
Khulna	29 November, 2005	18
Comilla	29 November, 2005	24
Patuakhali	29 November, 2005	21
Pabna	29 November, 2005	20
Jessore	29 November, 2005	24
Rangpur	29 November, 2005	24
Mymensingh	29 November, 2005	24
Kushtia	30 November, 2005	10
Tangail	30 November, 2005	18
Noakhali	30 November, 2005	24
Joydebpur	4 December, 2005	24
Faridpur	5 December, 2005	15
Rajshahi	15 December, 2005	18
Narsingdi	19 December, 2005	10
Bogra	16 January, 2006	24
Dinajpur	18 January, 2006	12
	Total	**388**

b. Field Days

Location	Date	No. of participants				
		Farmer	BARI	DAE	NGO	Total
Barind, Rajshahi	11 October, 2005	32	07	09	2	50
Barind, Rajshahi	19 October, 2005	32	07	09	2	50
Barind, Rajshahi	23 October, 2005	32	07	09	2	50
Shyampur, Rajshahi	18June, 2006	32	07	09	2	50
Shyampur, Rajshahi	19 June, 2006	32	07	09	2	50
Shyampur, Rajshahi	20 June, 2006	32	07	09	2	50
Shyampur, Rajshahi	19 February, 2006	32	07	09	2	50
Mymensingh	30 October, 2005	32	07	09	2	50
Mymensingh	14 November, 2005	32	07	09	2	50
Mymensingh	3 January, 2006	32	07	09	2	50
Jessore	22 November, 2005	32	07	09	2	50
Jessore	21 March, 2006	32	07	09	2	50
Jessore	23 March, 2006	32	07	09	2	50
Jessore	25 June, 2006	32	07	09	2	50
Comilla	28 November, 2005	32	07	09	2	50
Pabna	15 November, 2005	32	07	09	2	50
Pabna	22 March, 2006	32	07	09	2	50
Pabna	18 April, 2006	32	07	09	2	50
Pabna	14 June, 2006	32	07	09	2	50
Kishoreganj	4 December, 2005	32	07	09	2	50
Kishoreganj	19 February, 2006	32	07	09	2	50
Kishoreganj	3 January, 2006	32	07	09	2	50
Kishoreganj	4 March, 2006	32	07	09	2	50
Kishoreganj	5 March, 2006	32	07	09	2	50
Sylhet	20 November, 2005	30	08	10	2	50
Sylhet	4 June, 2006	30	08	10	2	50
Sylhet	11 June, 2006	30	08	10	2	50
Jamalpur	22 November, 2005	32	07	09	2	50
Jamalpur	24 November, 2005	32	07	09	2	50
Faridpur	4 December, 2005	32	07	09	2	50
Faridpur	24 May, 2006	32	07	09	2	50
Faridpur	30 May, 2006	32	07	09	2	50
Rangpur	1 December, 2005	28	10	10	2	50
Rangpur	21 December, 2005	28	10	10	2	50
Rangpur	23 February, 2006	28	10	10	2	50
Khulna	7 May, 2006	32	07	09	2	50
Khulna	12 May, 2005	32	07	09	2	50
Khulna	20 May, 2005	28	10	10	2	50
Khulna	25 May, 2005	31	10	7	2	50
Noakhali	26 June, 2006	33	08	7	2	50
Hathazari	7 December, 2005	31	10	7	2	50
Hathazari	21 December, 2005	28	10	10	2	50
Hathazari	7 January, 2006	32	10	8	2	50
Patuakhali	2 January, 2006	33	08	7	2	50
Bogra	1 February, 2006	31	10	7	2	50
Tangail	23 February, 2006	33	08	7	2	50
Gazipur	23 February, 2006	31	10	7	2	50
Gazipur	24 February, 2006	28	10	10	2	50
Gazipur	7 May, 2006	32	10	8	2	50

Project: Agricultural Technology Transfer (JIBC-BARC)

a. Training on On-Farm Technology transfer through farmers' participation

Place of training	Date	Category of participants	No. of participants		
			Male	Female	Total
FSRD site, Faridpur	25 June, 2006	Farmers	13	13	26
FSRD site, Faridpur	26 June, 2006	SAAO/SSA/SA	29	1	30
FSRD site, Faridpur	27 June, 2006	Farmers	12	12	24
RARS, Jamalpur	24 June, 2006	Farmers	20	5	25
RARS, Jamalpur	25 June, 2006	Farmers	19	6	25
RARS, Jamalpur	28 June, 2006	SAAO/SSA/SA	28	2	30
FSRD site, Noakhali	20 June, 2006	Farmers	12	13	25
FSRD site, Noakhali	21 June, 2006	Farmers	10	15	25
FSRD site, Noakhali	27 June, 2006	SAAO/SSA/SA	28	2	30
FSRD site, Tangail	25 June, 2006	Farmers	22	3	25
OFRD, BARI, Tangail	26 June, 2006	SAAO/SSA/SA	28	2	30
FSRD site, Tangail	28 June, 2006	Farmers	20	5	25
FSRD site, Pabna	19 June, 2006	Farmers	20	5	25
FSRD site, Pabna	20 June, 2006	Farmers	22	3	25
FSRD site, Pabna	29 June, 2006	SAAO/SSA/SA	30	-	30
MLT site, Moulvibazar	21 June, 2006	Farmers	23	2	25
FSRD site, Sylhet	26 June, 2006	Farmers	25	-	25
FSRD site, Sylhet	29 June, 2006	SAAO/SSA/SA	30	-	30
FSRD site, Patuakhali	27 June, 2006	SAAO/SSA/SA	25	5	30
FSRD site, Patuakhali	28 June, 2006	Farmers	15	10	25
FSRD site, Patuakhali	29 June, 2006	Farmers	15	10	25
FSRD site, Barind, Rajshahi	20 June, 2006	Farmers	13	13	26
FSRD site, Barind, Rajshahi	21 June, 2006	Farmers	12	12	24
FSRD site, Barind, Rajshahi	22 June, 2006	SAAO/SSA/SA	29	1	30
OFRD, BARI, Rangpur	27 June, 2006	SAAO/SSA/SA	27	3	30
OFRD, BARI, Rangpur	28 June, 2006	Farmers	12	12	24
OFRD, BARI, Rangpur	29 June, 2006	Farmers	13	13	26
OFRD, BARI, Mymensingh	26 June, 2006	Farmers	25	5	30
UAO office, Mymensingh	27 June, 2006	SAAO/SSA/SA	28	2	30
RARS, Jessore	18 June, 2006	Farmers	30	-	30
RARS, Jessore	20 June, 2006	SAAO/SSA/SA	29	1	30
Shibpur, Narsingdi	20 June, 2006	SAAO/SSA/SA	28	2	30
Shibpur, Narsingdi	20 June, 2006	Farmers	25	5	30
OFRD, Gazipur	15 June, 2006	Farmers	25	5	30
OFRD, Gazipur	18 June, 2006	SAAO/SSA/SA	28	2	30
OFRD Bandarban	27 June, 2006	SAAO/SSA/SA	27	3	30
OFRD Bandarban	28 June, 2006	Farmers	25	5	30
RARS, Hathazari	25 June, 2006	Farmers	15	15	30
RARS, Hathazari	26 June, 2006	SAAO/SSA/SA	26	4	30
ARS, OFRD, Bogra	19 June, 2006	Farmers	28	2	30
ARS, OFRD, Bogra	26 June, 2006	SAAO/SSA/SA	28	2	30
Total			**797**	**193**	**990**

(SAAO/SSA/SA : 480, Farmers : 510)

b. Training on Summer onion production technologies (ATT)

Place of training	Date	Category of participants	No. of participants		
			Male	Female	Total
OFRD, Comilla	17 June, 2006	Farmers	12	-	12
OFRD, Gazipur	18 June, 2006	Farmers	13	5	18
OFRD, Rangpur	19 June, 2006	Farmers	12	-	12
FSRD site, Jessore	19June, 2006	Farmers	9	3	12
OFRD, Bogra	20 June, 2006	Farmers	12	-	12
OFRD, Shibpur, Narsingdi	21 June, 2006	Farmers	24	-	24
MLT site, Manikganj	23 June, 2006	Farmers	12	-	12
OFRD, Mymensingh	24 June, 2006	Farmers	12	-	12
MLT site, Munshiganj	24 June, 2006	Farmers	12	-	12
FSRD site, Barind, Rajshahi	25 June, 2006	Farmers	12	-	12
FSRD site, Patuakhali	26 June, 2006	Farmers	11	1	12
FSRD site, Tangail	27 June, 2006	Farmers	10	2	12
MLT site, Moulvibazar	27 June, 2006	Farmers	12	-	12
OFRD, Kishoreganj	27 June, 2006	Farmers	12	-	12
MLT site, Feni	28 June, 2006	Farmers	12	-	12
MLT site, Laxmipur	27 June, 2006	Farmers	12	-	12
RARS, Jamalpur	28 June, 2006	Farmers	12	-	12
FSRD site, Noakhali	26 June, 2006	Farmers	12	-	12
FSRD site, Pabna	29 June, 2006	Farmers	12	-	12
RARS, Hathazari	29 June, 2006	Farmers	12	-	12
FSRD site, Faridpur	29 June, 2006	Farmers	12	-	12
Fulgazi, Feni	30 June, 2006	Farmers	12	-	12
HRC, BARI, Gazipur	22 June, 2006	Agril. Extn. Personnel & BARI Scientists	45	2	47
HRC, BARI, Gazipur	25 June, 2006	SAAO/SSA/SA	77	5	82
RARS, Ishurdi	28 June, 2006	Agril. Extn. Personnel & BARI Scientists	28	2	30
RARS, Ishurdi	29 June, 2006	SAAO/SSA/SA	36	-	36
Total			**457**	**20**	**477**
(Agril. Ext. Personnel & BARI Scientists **: 77, SAAO/SSA/SA : 118, Farmers : 282)**					

Project: OFRD, BARI- CYMMYT collaboration project

a. Farmers' Training: Whole family maize production

Location	No. of Family	Total No. of farmers trained
Rangpur	200	640
Pabna	112	448
Faridpur	112	448
Kushtia	112	448
Noakhali	48	192
Tangail	48	192
Kishoreganj	48	192
Patuakhali	48	192
Total	688	2752

b. Field day on whole family maize production

Location	No. of participants
Rangpur	200
Rangpur	200
Pabna	250
Faridpur	300
Faridpur	300
Kushtia	100
Noakhali	100
Kishoreganj	100
Patuakhali	100

Project: BARI-IC collaborative program

Location	Farmers' training (no.)	Field day (no.)	DAE/NGO visit (no.)	Participatory monitoring and evaluation (no.)
Rangpur	4	1	4	1
Pabna	6	1	4	1
Barind	6	1	5	1

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Mr.Asia Khatun, SA, Sadar
Mr.Jannatul Ferdouse, SA, Sadar

Hathazari, Chittagong
M Abul Kasem
M Shahidul Alam
M Mujibur Rahman
M Ear Hossain
Salma Begum

Jessore
Mr. S M Anisur Rahman, SSA
Mr. M Anser Ali, SSA
Mr. M Abul Hossain, SSA
Mr. M Abdur Razzak, SSA
Mr. Bimol Kumar Roy, SSA
Mr. M Mokades Khan, SSA
Mr. Kazi Abdus Salam, SSA
Mr. M Roknuzzaman, SSA
Mr. Aghni Kumar Sikder, SSA
Mr. M Sahabuddin, SA
Mr. M Abdur Rouf, SA
Mr. A B S M Sobhan, SA
Mr. M Nazmul Kabir, SA

Khulna
Mr. M Tabibur Rahman, SSA, MLTS, Dumuria
Mr. Amaresh Chandra Sarker, SA, MLTS, Satkhira.
Mr. M Moshiur Rahaman, SA, ARS, OFRD, Daulatpur
Mr. S M Assaduzzaman, SA, MLTS, Dumuria
Mr. Swapan Ray, SA, ARS, OFRD, Daulatpur.
Mr. A M Khairul Anam, SA, MLTS, Dumuria
Mr. M Moniruzzaman, SA, MLTS, Bagerhat
Mr. M Abdus Samad, SA, MLTS, Satkhira
Mr. S M Motiur Rahaman, SA, Banerpota Farm.
Mr. S M Delowar Hossain , SA, MLTS, Bagerhat
Mr. M Mahabubur Rahaman, SA, Banerpota Farm.
Mr. M Sadequr Rahman, SA, Banerpota Farm,
Mr. Gajendra Nath Mondal, SA, MLTS, Satkhira
Mr. Dipankar Kumar Nath, SA, Banerpota Farm

Kushtia
Mr. M Atiul Islam,, SSA
Mr. M Sorour Uddin,, SA
Mr. Sk. Yousuf Harun,, SA
Mr. M Rashel Kabir Tarafder,, SA
Mr. M Dipongkar Biswas,, SA
Mrs. Salma Islam,, SA

Faridpur
Mr. M Nurul Islam, SSA
Mr. M Jamal Uddin, SA
Mr. M Abu Bakar Siddique, SA
Mr. M Humayan Kabir, SA
Mr. M Farid Ahmed, SA
Mr. K M Golam Mostafa, SA
Mst. Sumaya Begum, SA
Mr. M Enamul Huq, SA
Mr. M Masud Rana, SA
Mr. M Alauddin, SA
Mr. Mohammad Alauddin, SA
Mr. M Samsul Alam Akanda, SA
Mr. M Harun-or-Rashid, SA
Mr. M Rezaul karim, SA

Rajbari, Dinajpur
Mr. M Lutfor Rahman, SA
Mr. M Mojnun Naher, SA, MLTS, Sadar
Mr. M Abul Hossain, SA, MLTS, Biral

FSRDS = Farming System Research and Development Site and MLTS = Multilocation Testing Site

List of FSRD and MLT sites

A. FSRD SITES

1. Kushumhat, Sherpur sadar, Sherpur
2. Jalalpur, Sylhet sadar, Sylhet
3. Ellenga, Kalihati, Tangail
4. Lahirirhat, Rangpur
5. Pushpapara, Pabna sadar, Pabna
6. Hat Gobindapur, Faridpur sadar, Faridpur
7. Rajakhali, Dumki, Patuakhali
8. Hazirhat, Noakhali sadar, Noakhali
9. Kushum Shahor, Godagari, Barind, Rajshahi

B. MLT SITES

Region-1

Pabna	:	Pakshi, Sadar, Bhabanipur-Sujanagar, Khaloibhara-Sathia, Atgoria
Shyampur, Rajahahi	:	Noudapara-Paba, Baneshar-charagata, Rajshahi
Barind, Rajshahi	:	Aamnura-Chapai nawabganj sadar
Rangpur	:	Domar-Nilphamari, Ulipur-Kurigram, Gobindaganj-Gaibandha
Bogra	:	Sherpur, Shibganj, Joypurhat, Gabtali
Rajbari, Dinajpur	:	Biral, Sadar (Takurgaon)

Region-2

Jamalpur	:	Tatultala-Jhenaigati, Maloncha-Melandah
Tangail	:	Gatail, Madhupur, Gobindadasi-Bhuyapur
Mymensingh	:	Trishal, Netrakona sadar, Mymensingh sadar
Kishoreganj	:	Karimganj, Pirijpur, Sadar, Hossenpur

Region-3

Jessore	:	Tularampur-Narail, Shalikha-Magura, Kaliganj-Jhenaidah, Jikargacha-Jessore, Kuadabazar-Monirampur
Khulna	:	Satkhira sadar (Gopinampur Magura), Bagherhat sadar (Srighat), Dumuria (Sajiara)
Kushtia	:	Bamondi, Alamdanga, Kazirhat-Bharamara
Faridpur	:	Rajbari sadar, Mostafapur-Madaripur
Patuakhali	:	Aamtali, Alipur/Mohipur
Barisal	:	Goranadi-Barisal, Dakkin Ratanpur-Bhola, Nazirhat-Pirojpur

Region-4

Hathazari	:	Rasangiri, Samitirhat-Fatikchari, Kharan, Junglekhail-Patiy, Jilonja-Cox's bazar, Sadaha-Satkanya
Noakhali	:	Dagonbhuiya-Celumia, Turapganj & Laxmipur sadar
Comilla	:	Sadar, Chadpur sadar, B. Baria sadar, Debidder, Borura, Choddagram
Sylhet	:	Sadar, Jahangirnagar-Sunamganj, Islampur-Moulvibazar
Bandarban	:	Lemujiri-Buhalong

Region-5

Gazipur	:	Manikganj sadar, Munshiganj sadar, Dhirashram, Gazipur sadar
Shibpur, Narsingdi	:	Shibpur, Narsingdi

THE END


Compost & FYM
Crop residues
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Inorganic Fertilizer
Green Manure & BNF