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ON-FARM RESEARCH DIVISION
BANGLADESH AGRICULTURAL RESEARCH INSTITUTE
JOYDEBPUR, GAZIPUR 1701

# *Annual Research Report*

## *2001-02*

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# Preface

On-Farm Research Division (OFRD) of Bangladesh Agricultural Research Institute (BARI) is going to publish the research reports of experiments 2001-02 conducted at different farming systems research and development (FSRD) and multilocation testing (MLT) sites across the country. Major thrust during that period was given on the improvement of existing farming systems through introduction of improved varieties and soil management practices. Integrated farming and component technology studies were also conducted to improve the livelihood of the rural people of the country.

There has been a shift in the research approach for broadening the perspective of the cropping systems research towards a more comprehensive farming systems research by incorporating other farm components like homestead production systems, agroforestry and crop livestock interactions. These efforts were limited mainly within understanding of the existing situations and constraints. However, the works have suffered to some extent due to the lack of adequately trained human resources.

I hope this report will be useful to the researchers and extension personnel working in these fields.

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# A BENCH MARK SURVEY ON EXISTING HILL FARMING SYSTEMS IN BANDARBAN DISTRICT


## Abstract

The study was conducted to know socio-agro-economic conditions of hilly farmers and to identify the constraints/problem of crop production. Two villages namely Balagata and Raicha under sadar Upazilla of Bandarban were selected for the study. A total of 175 farmers were selected randomly for data collection. Besides this information from secondary sources were also incorporated. The soil is mainly reddish brown loam and strongly acidic in the area. The valley soils contain acid loam and clay subject to seasonal flooding. Soil $P^H$ ranges from 4.5 to 6.0. Land ownership is more complex as many villagers (used to) have customary rights to land. Major crops grown in the study area are cucumber, maize, sesame, sweet potato, potato, tomato, radish, brinjal, dherosh, sweet grourd, bitter gourd etc. Most of the varieties were local and yield was also lower. The fruit and timber tree species were found as mango, jackfruit, banana, guava, pamelo, lemon, amra, jujube, coconut, olive, papaya etc. and timber species like segon, karoi, mehagoni, gamari etc.

Jhuming or Shifting cultivation is widely practiced by the tribal people. The Jhum crops were included upland rice, maize, pigeon pea, sesame and cotton. Banana, jackfruit, pineapple, lemon, cucurbits, and leguminus vegetables dominate the horticultural crops. Jhuming enhances risk of soil erosion and fertility depletion. Per hectare yield of major crops were low because of lower level of input use and degraded soil quality. Non-availability of modern variety seed/seedling, lack of technical knowledge and cash money were the major constraints for sustainable agriculture in hilly areas.


## Introduction

Bangladesh is not only an alluvial plain. About 12 percent of its territory is occupied by hills. Chittagong hill tracts represents a region of Bangladesh with high potential for agricultural development (Sabjaluddin, 2000). The region has an area of 13,237 sq. km (Brammer,1997). Major agricultural activity in this area on unfavourable slopes is traditional rainfed farming popularly known as 'Jhum'. This type of farming commonly known as ' Shifting cultivation' or Slash and burn' farming system. About 1.0 million peoples in CHT of 13 different ethnic groups are directly or indirectly depend on Jhum. Crops like rice, maize, sesame, cotton, beans, cucumber, chillies, yam, ginger, banana, turmeric etc. are commonly cultivated (mostly dibbled) before the onset of monsoon (Shoaib, 2000). The practice of Jhum affects forest vegetation, because forest plants slashed and burned in an attempt to grow food crops. With increasing population, the practice of Jhum has been increasing while the area under forest and land productivity has been decreasing. Consequently, the socio-economic condition of the local inhabitants has been deteriorating. Liberal use of hills for agriculture without soil conservation measures has caused the valuable forest resources to diminish and soil quality to decline (Sabjaluddin, 2000). Agriculture continues to be the major source of income, although with rudimentary farming practices. In addition, collection of timber, firewood, and house-making material remain important as source of income (Farid and Mujibullah, 1990).

Bandarban lies between 21°11' and 22°30' North latitudes and between 92°04' and 92°41' East longitudes. The total area of the district is 4479.03 sq.km of which 3.16 sq. km. is revering and 2,730.48 sq. km. is under forest which covers 60.96% of the total area of the district (BBS, 2000).

The climate of the district is tropical in nature as it is situated in the tropical zone. The area is remarkable for its uniform temperature, high humidity and heavy rainfall from May to October. The climate is moist, warm and equable. The minimum and maximum temperatures vary between 14ºC and 36ºC.The level of humidity is around 91% from September through December and around 65% from December through February. The annual rainfall as recorded in 2000 was 2890.4 mm (SRDI, 2002).

The study was undertaken in recognition to the importance of reliable baseline information for research and development planning. Information about farming and natural resources in hilly areas are seriously lacking. So, this study will generate base line information on socio demographic characteristic of hilly farmers, general features of existing hill farming systems, level of input use and its pricing, cost and return of different major crops, marketing, problems and opportunities/possibilities in agricultural production systems in hilly areas of Bandarban. The study was, therefore designed to identify the existing socio-demographic characteristic of hilly farmers; to know the existing hill farming system; and to identify the actual agricultural production problem, opportunities so that research needs will be clarified and policy intervention may be made accordingly.

## Methodology

The study was conducted in two villages, namely, Balagata and Raicha in Sadar Upazila in Bandarban district. These villages were selected in consultation with agricultural extension officers of the respective district. A complete list of farmers (Tribal and Bengali) in each villages was prepared and sample farmers were selected randomly. The households were categorized according to Abedin *et al.*, (1990) as Small: 0.51-1.10 ha, Medium: 1.01 - 2.0 ha and Large above 2.0 ha.

A total of 175 sample farmers were selected for the study, out of which 65 were small, 60 were medium and 50 were large in both villages. The sample farmers were also categorized into two groups: tribal and bengali due to know their attitude of agricultural production systems. Data were collected using a pre-designed interview schedule. Interviews were conducted face to face at the residence of the respondents during June 2001 to April 2002. The distribution of sample farmers are shown in the table 1. In addition to the survey, data from secondary sources were also used in the study.

## Results and Discussion

### a. Physical features of the study area

**Location and area extent:** The site is lies between 21° 55' and 22° 22' North latitudes and between 92° 08' and 92°19' East longitudes. The site of Balagata is located about 6 k.m. away of west-northern side of Bandarban town and Raicha is located about 10 km. away of southern-west site of Bandarban town. The site represents AEZ -29. The area of Sadar Upazila was estimated 49490 ha, where single cropped area was 2632 ha., doubled cropped area was 1101ha., triple cropped area was 240 ha., net cropped area was 3976 ha. and current fallow land was 214.60 ha.(DAE,2002). The cropping intensity of this area was 146.58% in1998-99 (BBS, 1999).

**Demography:** The 1991census recorded a population of Sadar Upazila 49,711 persons, of them tribal was 26088 and Non-tribal was 23,623. The number of total farmer was 5675 where landless was 17.85%, marginal -16.55%, small-34.61%, medium- 25.51% and large- 6.48% (DAE, Bandarban, 2002). There are at least 13 tribes in the region. About 95% of the tribal population depend on agriculture for livelihood.

**Climate:** Annual rainfall ranges 1760-2890 mm. About 87% of the rainfall occurred during the months of May to October. Monthly maximum and minimum mean temperatures ranges from 27 to 36°C and 16 to 27 °C (SRDI, 2002).

**Soils:** The soil is mainly reddish brown loam and strongly acidic. The valley soil contains acid loam and clay subject to seasonal flooding. It is mainly used for rice cultivation. But the steep slopes with red hill soil make most of the area unsuitable for the crops (BBS, 2000). Soils $P^H$ ranges from 4.5 to 6.0.

**Agriculture:** In Balagata site vegetables are grown in hill valleys or in plain land and in Raicha horticultural crops are grown due to abandoned of hill. The major crops grown are rice, cucumber, maize, sesame, sweet potato, potato, tomato, radish, brinjal, dherosh, lau, sweet gourd, bitter gourd etc. with local variety. The fruits and timber trees are grown such as mango, jackfruit, banana, lichi, guava, pamelo, lemon, amra, jujube, coconut, olive, papaya, orange, supari, sapada, and timber species like segon, karoi, mehagoni, gamari etc. Ninety percent farmers depend on agriculture in the area.

**Land ownership:** Land ownership is more complex in the hilly areas, as many villagers (used to) have customary rights to land. Originally people settled where ever they found enough land. The area is divided in private property, Khas land, Reserved Forests, Protected Forests and Unclassified state Forest (USF). Initially in USF the people are allowed to practice Jhuming and to extract any forest produce to meet domestic requirements. Over time, more and more land were settled in the name of private persons for agriculture and horticulture, making them private property (Riessen, 2000).

**Existing Farming Systems:** According to a Asian Development Bank report the following farming system are observed in CHT.

1. Jhum only;
2. Jhum & Valley agriculture;
3. Jhum & Upland agriculture;
4. Upland agriculture only;
5. Upland & Valley agriculture;
6. Valley agriculture only.

**The traditional Jhum System:** The Jhum land usually cleared in February -March by cutting all the shrub and undergrowth vegetation, leaving the larger trees standing. After drying farmers burnt the vegetation and the land would be ready for planting with the early rains in April-May. All crops were planted at the same time in holes. Crops usually grown in jhum fields are rice, cucumber, kutchu, lady's finger, cotton, sesame, ginger, turmeric, banana etc.

**The current Jhum System:** The fallow-based system which is still prevalent in the hills is directly derived from jhum cultivation. Three aspects, crops and cropping patterns; land use intensity and economics of the system will be looked at to characterized the system:

In most areas the Jhum system now consists of a combination of three types of crops: short cycle crops, predominantly upland rice combined with minor crops such as sesame and maize; medium cycle crops which may include late maturing cotton (*Gossypium arboreum),* spices such as turmeric and ginger, various root and tuber crops such as cocoyam (*Colocasia esculenta*), cassava (*Manihot esculenta*), yams (*Dioscorea sp*.); long cycle crops, viz. banana and timber crops.

After slashing and burning the fallow vegetation, all crops are planted at a time at the beginning of the rainy season. The short cycle crops are harvested by the end of the rainy season (October) and the medium cycle crops in the course of the dry season. Bananas can be harvested twice or three times over a period of three years. If the land was initially cleared from well-developed fallow vegetation, little maintenance is required throughout the occupational period. After all crops have been harvested the land returns to fallow (Mutsaers, 2000).

**Upland and Valley Agriculture:** Upland is especially used for cultivation of cash crops, fruit trees, spices, timber trees and bamboo. Agriculture in hill valleys and flat lands has become normal plow agriculture much along the lines of plains agriculture, although with different soil and water regimes. Beside rice, sugarcane, maize, tuber crops and vegetables are grown (Reissen, 2000).

**b. Socio demographic characteristics of the area**

**Family size of sample farmers:** The average family size was found 7.5 for tribal and 8.6 for Bengali. Distribution of effective family members was found 3.0 for tribal and 2.7 for Bengali per family (Table 2). The family size was higher in the study area than that of national average family size.

**Education of sample farmers:** It revealed that out of 95 tribal farmers, 52.63 percent were illiterate and 47.37% were literate. Only 2% tribal had above HSC level education. On the other hand, out of 80 Bengali farmers, 26% were illiterate and 74% were literate. More than 12% respondent had above HSC level education (Table 3).

**Occupation of the selected farmers:** It was observed that agroforestry was the main occupation of the sample farmers. It appears that 45.26 percent tribal were involved in agroforestry as their main occupation while it was 32.5 percent in Bangali farmers (Table 4).

**Farm size of sample farmers:** The tribal farmers possessed 0.58 ha plain land and 0.76 ha. hills while it was 0.21 ha and 0.83 ha for Bengali farmers respectively (Table 5).

**Land utilization systems:** Severe deforestation during the last decade resulted in more open deciduous forests, grass, and scrub-lands that are not suitable for agriculture. Unrestricted cutting and felling have caused a serious decline. It revealed that in Bandarban district cropping intensity was 147 percent while in Bandarban sadar Upazilla it was 150 % (Table 6).

**Income and expenditure of sample farmers:** It was observed that the income source was vegetable, paddy, fruit, timber, livestock, business and day labourer and expenditure head was identified as food, cloth, house repair, education of children, family medicare and other costs. The family income per farm was recorded Tk.60417.00 and Tk.96700.00 for tribal and Bengali family respectively (Table 7).

**Homestead utilization pattern:** The average homestead size was found 0.08ha for tribal and 0.16ha for Bangali farmers. The largest portion of the homestead was occupied by trees and bushes. The area of vegetables garden was also larger in the large farm categories compared to the small and medium. Poorer farmers were seldom found to have ponds in their homesteads (Table 8).

**Involvement of family members in agricultural activities:** Participation of tribal women (42.10%) was greater than male (33.68%) members in agricultural activities like land preparation, planting/sowing, harvesting, processing, drying, storage of vegetables seeds etc. On the other hand in case of Bengali farmers it was 56.25 percent for male and 15 percent for female considering in all farm groups (Table 9).

**c. Cropping patterns in different slope classes:** Most of the crops are grown under rainfed conditions due to lack of irrigation facilities. A limited area in valley floors near a river or 'Charra' (a small water way or channel) may be irrigated, using indigenous methods. The major cropping patterns are:

1.Fallow-T.Aus- T.Aman
2. Boro- Fallow- T.Aman
3.Fallow - Fallow- T.Aman
4.Winter Vegetables- Aus- T.Aman
5.Winter Vegetables- Fallow- T.Aman
6.Vegetables- Vegetables- Fallow
7.Fallow- Jhum-Fallow
8.Vegetables- Vegetables- Vegetables

Slope percentage and soil types wise cropping patterns are presented in Table 10.

Three types of share cropping system was found in the study area such as sharing of output between share cropper and land owner was 50:50, 80:20 and 70:30 where cent percent of input (seed, fertilizer, pesticide, irrigation and human and animal power cost) was bearded by the share cropper.

**Agronomic practices of different major crops:** In the study area major crops were identified as Aus, Aman, Boro, Maize, Cucumber, Sweet potato, potato and Tomato etc. Farmers were followed indigenous method for cultivation with local variety as a result yield was low. They did not used recommended fertilizer dose due to lack of technical knowledge (Table 11).

**Cost and return of different crops:** The per hectare yield was found 2.4 ton for Aus, 3.3 ton for Aman, 4.5 ton for Boro, 35.7 ton for cucumber, 29.6 ton for sweet potato, 13 ton for potato and 7.05 ton for tomato. The per hectare gross margin was estimated Tk.527 for Aus, Tk.1071 for Aman, Tk.5809 for Boro, Tk.14053 for Maize, Tk.181175 for Cucumber, Tk.46603 for Sweet potato, Tk.36596 for Potato and Tk.8234 for Tomato. The Benefit Cost ratio was found 1.03, 1.05, 1.22, 4.74, 6.48, 2.10, 1.66 and 1.24 respectively (Table 12**).** Among the crops, cucumber was the highly profitable followed by maize and sweet potato.

**Cost and return of jhum or shifting cultivation:** An average balance sheet was prepared on the basis of average yield for each crop and value estimated from the farm door. Labour estimation was calculated as 1 male labour equivalent to 1.5 female labours and wage for one labour was taken as an average Tk.100. The total variable cost incurred for one hectare was approximately Tk.28057 where gross return from the different crops was Tk.37802. Therefore, the gross margin was calculated Tk.9745 per hectare. Practically total costs of jhum cultivation are much less because farmers are self-employed and works in general shared by the neighbors. It is important to note that the ty[ical Jhumias are normally do not go for purchasing seeds from the market. They use seeds already preserved from last Jhuming. Normally they share or make partnership with each other generally during slashing, weeding and harvesting (Table 13).

**Livestock Resources:** Livestock is one of the important components of the hill farming systems. Raising livestock and poultry is traditional with hill farmers. Average number of bullock was 2.17, Cow-1.48, Goat-3.4, Poultry-7.3, Duck-5.33 for Bengali farmers while it was 1.41, 1.19, 4.6, 8.3, and 9.16, respectively for tribal farmers. Only non-Muslims in the study area raise hog and consume pork. The average number of hog was found 0.76 per farm for tribal farmers (Table 14).

**d. Constraints to agricultural production:** The respondents mentioned mojor constraints to crop production. Sixty four percent of the farmers reported non-availability of MV seeds. About 78% farmers claimed that they have no technical knowledge about modern technologies. About 65% farmers reported lack of cash as a problem. About 89% farmers opined that irrigation problem in dry season was the major constraints for crop production. Land ownership was the other problem which claimed 55% of farmers. About 65% of farmers reported high price and non-availability of fertilizer and insecticides. Marketing of agricultural product is another problem especially for perishable goods which opined 68% of farmers. About 48% of farmers reported that natural hazard like heavy rainfall, flash flood and cyclone was the major constraints for crop production (Table 15).

There are some other constraints for agricultural development. These are steep slope on most of the land; low soil fertility, especially in areas used for Jhum cultivation; flash floods in valleys; unsuitability of most hill soils for terracing because of very steep slopes, heavy rainfall, the risk of landslide erosion and lack of suitable rock material for building terrace retaining walls; remoteness of interior areas from urban markets; tribal land ownership or illicit land ownership by plains people; heavy monsoon rainfall; difficulties to get loan from formal institutions; etc.

**e. Research Priorities**

The following aspects may be considered for the development of existing hill farming system in the hilly areas:

1. Socio-economic studies for need assessment of agroforestry research;
2. Study to promote market opportunities and processing of horticultural and forest products;
3. Improvement of indigenous fruit and timber tree species
4. Promotion of sustainable field crop production for hill farming;
5. Improvement of orchard crop production in the hill areas;

6. Improvement of intensive crop production in valleys and foot slopes;
7. Promotion of novel crops (black pepper, cloves, cinnamon, cardamom etc) for hill conditions.
8. Screening of rabi crops in hill slope/valleys in order to identify suitable high yielding varieties.
9. Effect of mulch on high value vegetables in hill valleys to overcome irrigation problem;
10. Adaptive trial with modern crop varieties should be undertaken.
11. Pomelo orchards with pineapple as long and short term mixed crop should be tried.
12. Jhum paddy, pineapple, lemon, summer tomato, sunflower, pulses, pumelo, jackfruit, cardamon, cinnamon, black pepper etc. crops needs further research.
13. Pineapple, baby corn, bamboo shoots, black pepper, cloves etc. needs attention for export possibilities.

**References**

Riessen, A. V. 2000. Chittagong Hill Tracts Region Development Plan, Interim Report -7: Sociology and Indigenous People, Published by Asian Development Bank.

BBS, 2000. Census of Agriculture-1996, Zila Series-Banbarban, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Dhaka, Bangladesh.

BBS, 1999. Year Book of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Dhaka, Bangladesh.

Brammer, H. 1997. Agricultural Development Possibilities in Bangladesh, University Press Limited.

Mutsaers, H. and A. H. M. O. Bari. 2000. Chittagong Hill Tracts Region Development Plan, Interim Report -2: Agriculture and Marketing, Published by Asian Development Bank.

Shoaib, J. U. M. 2000. Contract Research on " Development of sustainable cultivation practices for inimizing soil erosion on hill slope.

Sabjaluddin, M.; M. S. Kamal and M. H. Mollah. 2000. Hill Farming System and Resource Utilization in the Chittagong Hill Tracts, A Baseline Survey, Published by Hill Agricultural Research Station, Khagrachari.

Abedin, M. Z.; C. K. Lai and M. O. Ali, 1990. 'Homestead Plantation and Agroforestry in Bangladesh. Proceedings of a National Workshop held July 17-19, 1998 in Joydebpur, Bangladesh.

Table 1. Distribution of sample farmers

| Location | Farm categories | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Balagata | 25 | 20 | 15 | 15 | 10 | 10 | 50 | 45 |
| Raicha | 20 | 15 | 15 | 15 | 10 | 5 | 45 | 35 |
| Total | 45 | 35 | 30 | 30 | 20 | 15 | 95 | 80 |

Table 2. Family structure of sample farmers at sadar upazila, Bandarban

| Age group | Family members (no.) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| < 14 yrs | 2.0 | 3.6 | 3.5 | 3.5 | 2.0 | 3.2 | 2.5 | 3.0 |
| 14-60 yrs | 4.0 | 4.3 | 3.6 | 3.1 | 4.5 | 3.0 | 4.0 | 3.1 |
| > 60 | - | - | 2.0 | 3.6 | 1.0 | 1.4 | 1.0 | 2.5 |
| Effective labour | 2.0 | 2.6 | 3.6 | 2.7 | 3.6 | 2.9 | 3.0 | 2.7 |

Table 3. Education level of sample farmers at sadar upazila, Bandarban

| Education level | Numbers | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Illiterate | 32 | 11 | 14 | 9 | 4 | 1 | 50 (53) | 21 (26) |
| Upto class V | 11 | 17 | 12 | 10 | 12 | 3 | 35 (37) | 30 (38) |
| Upto SSC | 2 | 4 | 3 | 7 | 3 | 8 | 8 (8) | 19 (24) |
| Upto HSC | - | 2 | 1 | 3 | 1 | 2 | 2 (2) | 7 (9) |
| Above HSC | - | 1 | - | 1 | - | 1 | - | 3 (4) |

Figures in the parenthesis indicate percent of total

Table 4. Occupation level of sample farmers at sadar Upazilla, Bandarban

| Occupation level | Numbers | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Agroforestry | 21 | 11 | 13 | 10 | 9 | 5 | 43 (45) | 26 (32) |
| Agriculture | 14 | 16 | 11 | 13 | 6 | 7 | 31 (33) | 36 (45) |
| Ag. + Service | - | 2 | - | 2 | - | - | - | 1 (3) |
| Ag. + Business | 5 | 6 | 4 | 5 | 5 | 3 | 14 (15) | 14 (18) |
| Ag. + Housewife | 3 | - | 2 | - | - | - | 2 (5) | - |
| Day labourer | 2 | 4 | - | - | - | - | 1 (2) | 1 (3) |

Figures in the parenthesis indicate percent of total

Table 5. Farm size of households at sadar upazila, Bandarban

| Items | Land type | Area (ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Small | | Medium | | Large | | All | |
| | | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Own cultivated | P | 0.40 | 0.30 | 0.39 | 0.24 | 0.94 | 0.97 | 0.57 | 0.50 |
| | H | 0.32 | 0.57 | 0.85 | 0.81 | 1.60 | 1.70 | 0.92 | 1.03 |
| Shared out | P | - | - | 0.21 | - | - | - | 0.07 | - |
| | H | - | - | 0.16 | - | - | - | 0.05 | - |
| Shared in | P | - | - | - | - | 0.48 | - | 0.16 | - |
| | H | - | - | - | - | 0.20 | - | 0.07 | - |
| Leased in | P | - | - | 0.02 | - | 0.16 | 0.16 | 0.06 | 0.05 |
| | H | - | - | - | - | 0.08 | - | 0.03 | - |
| Leased out | P | - | 0.09 | 0.12 | 0.13 | 0.12 | - | 0.08 | 0.07 |
| | H | - | - | 0.20 | 0.30 | - | - | 0.07 | 0.10 |
| Fallow | P | 0.08 | - | - | 0.05 | - | - | 0.03 | 0.02 |
| | H | 0.06 | - | - | - | - | - | 0.02 | - |
| Total | P | 0.48 | 0.39 | 0.74 | 0.42 | 1.70 | 1.13 | 0.97 | 0.64 |
| | H | 0.38 | 0.57 | 1.21 | 1.11 | 1.88 | 1.7 | 1.16 | 1.13 |

P= Plain land, H=Hill

Table 6. Land utilization systems of Bandarba during 1998-99

| Utilization pattern | *Bandarban district (ha) | ** Sadar upazila (ha) |
|---|---|---|
| Total area | 448,178 | 49,490 |
| Not available for cultivation | 38,866 | 12,143 |
| Forest land | 323,482 | 32,892 |
| Cultivable waste | 56,275 | 3,184 |
| Current fallow | - | 215 |
| Single cropped area | 18,219 | 2,632 |
| Double cropped area | 8,907 | 1,101 |
| Triple cropped area | 1,482 | 240 |
| Net cropped area | 29,555 | 3,976 |
| Cropping intensity (%) | 147 | 150 |

Table 7. Income and expenditure of sample farmers at sadar upazila, Bandarban

| Income sources | Income (Tk./year/farm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Vegetable sale | 21000 | 25333 | 25000 | 32000 | 15750 | 39000 | 20583 | 32111 |
| Paddy sale | 10000 | - | 5000 | - | - | - | 5000 | - |
| Fruit sale | 8500 | - | 3000 | 21400 | 28000 | 25000 | 13160 | 15460 |
| Timber sale | - | 10000 | - | 2000 | 3000 | 3000 | 1000 | 5000 |
| Livestock | 2000 | 5000 | 20000 | 4500 | 4000 | 12000 | 8667 | 7167 |
| Business | - | 32666 | 6000 | 31200 | 20000 | 32000 | 13000 | 31955 |
| Day labour | 10000 | - | - | 15000 | - | - | 3333 | 5000 |
| Total income | 51500 | 72999 | 59000 | 106100 | 70750 | 111000 | 60417 | 96700 |
| | **Expenditure (Tk./year/farm)** | | | | | | | |
| Food | 24000 | 28000 | 17667 | 32126 | 24000 | 33500 | 20560 | 31208 |
| Clothing | 5000 | 7666 | 2600 | 6625 | 7250 | 8000 | 4950 | 7430 |
| House repair | 2000 | 5333 | 1200 | 4143 | 8333 | 3000 | 3844 | 4159 |
| Education of children | 6000 | 4500 | 3167 | 4313 | 2250 | 6000 | 3805 | 4937 |
| Medicare | 1500 | 9066 | 2800 | 4250 | 6000 | 5000 | 3433 | 6103 |
| Others | 3000 | 1000 | - | 3500 | 4000 | 4000 | 2333 | 2833 |
| Total expenditure | 41500 | 55565 | 27434 | 54956 | 51833 | 59500 | 38925 | 56670 |

P= Plain land, H=Hill

Table 8. Homestead utilization pattern at sadar upazila, Bandarban

| Items | Area (ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Homestead size (ha) | 0.08 | 0.17 | 0.09 | 0.15 | 0.07 | 0.16 | 0.08 | 0.16 |
| Housing | 0.02 | 0.03 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 |
| Cattle shed | - | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 |
| Pond/ditches | - | 0.02 | - | - | - | - | - | 0.007 |
| Trees & bushes | 0.04 | 0.06 | 0.03 | 0.04 | 0.01 | 0.03 | 0.02 | 0.04 |
| Drying floor | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 |
| Vegetable garden | 0.01 | 0.02 | - | 0.04 | 0.02 | 0.06 | 0.01 | 0.04 |
| Fallow | - | - | 0.01 | 0.02 | - | 0.01 | 0.003 | 0.01 |

Table 9. Involvement of family members in agricultural activities at sadar upazila, Bandarban

| Items | Percent responded | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Wife | 17 | 42 | 13 | 43 | 13 | 40 | 15 | 42 |
| Husband | 51 | 31 | 60 | 37 | 60 | 35 | 56 | 34 |
| Children | 31 | 27 | 27 | 20 | 27 | 25 | 29 | 24 |

Table 10. Cropping pattern in different slope classes in sadar upazila, Bandarban

| Slope class | % slope | Land & soil type | Cropping pattern |
|---|---|---|---|
| Very gentle slope | <5 | High land, hill valley, loamy soil with pH 4.0-6.5 | Boro – fallow- T.aman (I)<br>Vegetables-T.aus-T.aman (I)<br>Vegetables-fallow-T.aman (I)<br>Fallow – T.aman (RF)<br>Fallow – Aroid (RF)<br>Fallow-T.aus-T.aman (RF)<br>Cowpea-T.aus+Maize-T.aman (RF)<br>Sugarcane+cucurbits (RF) |
| Very gentle slope | <5 | High land, hill top, loamy soil with pH 5.0-6.0 | Fallow-Turmeric/ginger/aroid+maize (RF)<br>Fallow-summer vegetables (RF)<br>Fallow-T.aus+maize+cowpea (RF)<br>Vegetables- T.aus+maize/arhar/sesame (RF) |
| Gentle slope | 5-15 | High land, hill slope, loamy/sandy soil with pH 4.5-5.5 | Fallow-summer vegetables (RF)<br>Fallow-aroid/turmeric/ginger (RF)<br>Cowpea/arhar-T.aus+maize (RF)<br>Banana+pineapple (RF) |
| Medium slope | 15-30 | High land, hill slope, loamy/sandy soil with pH 4.5-5.5 | Fallow-Jhum crops (RF)<br>Fallow-Aroid/turmeric/ginger (RF)<br>Banana+cucurbits (RF)<br>Citrus/guava/banana/jackfruit+pineapple (RF) |
| Steep slope | 30-50 | High land, hill slope, loamy/sandy soil with pH 4.5-5.5 | Fallow-Jhum crops (RF)<br>Fruits+pineapple/pigeonpea/sesame (RF) |
| High steep slope | 50-70 | High land, hill slope, loamy/sandy soil with pH 4.5-5.5 | Jackfruit/tamarind/hard wood (RF) |
| Very high steep slope | >70 | High land, hill slope, loamy/sandy soil with pH 4.5-5.5 | Hard wood and forest species (RF) |

I = Irrigated RF= Rainfed

Table 11. Agronomic practices of different crops in sadar upazila, Bandarban

| Practices | Aus | Aman | Boro | Maize | Cucumber | Sweet potato | Potato | Tomato |
|---|---|---|---|---|---|---|---|---|
| Variety | Local | Local, BR-11, 18 | Local | Local | Local | Local | Local | Local |
| Plot size (ha) | 0.32 | 0.36 | 0.43 | 0.11 | 0.22 | 0.12 | 0.15 | 0.09 |
| Plowing (no.) | 4.2 | 3.3 | 4.4 | 3.4 | - | 3.6 | 3.3 | 3.7 |
| Sowing/planting period | Mar -April | July-Aug | Dec-Jan | Oct-Nov | Mar-Apr | Sept-Nov | Oct-Nov | Dec-Jan |
| Seedling age (day) | 25 | 31 | 30 | - | - | - | - | 25 |
| Fertilizer used (kg/ha): | | | | | | | | |
| Urea | 166 | 269 | 90 | 24 | 219 | 247 | 411 | 0 |
| TSP | 71 | 142 | 163 | 18 | 90 | 165 | 271 | 176 |
| MP | 100 | 42 | 38 | 18 | 75 | 82 | 137 | 159 |
| Cowdung | 2001 | 2119 | 512 | 176 | 6287 | 7410 | 8013 | - |
| Spacing (cm) | 6X8 | 7X8 | 6X8 | - | - | 6X18 | 7X15 | 12X18 |
| Irrigation (no.) | - | - | 7.7 | - | 3 | 2 | 3.1 | 3 |
| Weeding (no.) | 3 | 2 | 1.3 | - | 1.8 | 2 | 1.1 | 3 |
| Crop duration (day) | 110 | 115 | 111 | 144 | 73 | 148 | 98 | 93 |

Table 12. Yield, cost and return of different crops in sadar upazila, Bandarban

Tk/ha

| Items | Aus | Aman | Boro | Maize | Cucumber | Sweet potato | Potato | Tomato |
|---|---|---|---|---|---|---|---|---|
| Yield (t/ha) | 2. | 3.3 | 4.5 | 17810* | 35.7 | 29.6 | 13.0 | 7.05 |
| Variable costs: | | | | | | | | |
| Human labour | 12672 | 14467 | 15970 | 2952 | 25598 | 27500 | 18397 | 17900 |
| Animal power | 1853 | 2940 | 4145 | - | - | 6150 | 4088 | 6300 |
| Seed | 780 | 770 | 868 | 141 | 975 | 350 | 20800 | 4000 |
| Fertilizer | 3002 | 5081 | 3306 | 664 | 6468 | 8317 | 11693 | 5908 |
| Irrigation | - | - | 1612 | - | - | - | - | - |
| Total variable cost | 18307 | 23258 | 25901 | 3757 | 33041 | 42317 | 54978 | 34108 |
| Gross return | 18834 | 24329 | 31710 | 17810 | 214216 | 88920 | 91574 | 42342 |
| Gross margin | 527 | 1071 | 5809 | 14053 | 181175 | 46603 | 36596 | 8234 |
| BCR | 1.03 | 1.05 | 1.22 | 4.74 | 6.48 | 2.10 | 1.66 | 1.24 |

* = Number of cobs per hectare

Table 13. Yield, cost and return of Jhum or Shifting cultivation

| Crops | Paddy | Maize | Marfa | Sweet gourd | Cotton | Bottle gourd |
|---|---|---|---|---|---|---|
| Seed (kg/ha) | 51 | 7.41 | 0.98 | 0.50 | 16.5 | 0.61 |
| Fertilizers: | | | | | | |
| Urea (kg/ha) | | | | 125 | | |
| TSP (kg/ha) | | | | 67 | | |
| Human labour (m-d/ha) | | | | 228 | | |
| Yield (kg/ha) | 1838 | 190 | 864 | 780 | 217 | 548 |
| Gross return (Tk/ha) | 11026 | 1900 | 4322 | 6244 | 10472 | 3838 |
| Total operational cost (labour) (Tk/ha) | | | | 22850.00 | | |
| Total input cost (Tk/ha) | | | | 5208.00 | | |
| Gross return (Tk/ha) | | | | 37802.00 | | |
| Gross margin (Tk/ha) | | | | 9745.00 | | |

Table 14. Distribution of livestock and poultry at farm level of sadar upazila, Bandarban

| Items | Area (ha) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | All | |
| | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali | Tribal | Bengali |
| Bullock | 1.96 | 0.67 | 2.0 | 1.58 | 2.56 | 2.0 | 2.17 | 1.41 |
| Cow | 1.35 | 0.85 | 1.86 | 1.46 | 1.23 | 1.27 | 1.48 | 1.19 |
| Goat | 4.6 | 6.3 | 3.1 | 4.8 | 2.6 | 2.8 | 3.4 | 4.6 |
| Poultry | 10.0 | 12.5 | 7.3 | 8.2 | 5.1 | 4.0 | 7.3 | 8.3 |
| Duck | 5.0 | 6.3 | 6.2 | 4.8 | 5.3 | 13.4 | 5.3 | 9.2 |
| Hog | - | 0.42 | - | 0.69 | - | 0.80 | - | 0.76 |

Table 15. Constraint to agricultural production in hilly area at sadar upazila, Bandarban

| Constraint | Percent farmer responded | | | |
|---|---|---|---|---|
| | Small | Medium | Large | All |
| Non-availability of MV seed/seedling | 67 | 65 | 59 | 64 |
| Lack of technical know-how | 89 | 78 | 68 | 78 |
| Lack of cash | 88 | 65 | 43 | 65 |
| Lack of irrigation facilities | 94 | 88 | 85 | 89 |
| Land ownership problem | 63 | 59 | 42 | 55 |
| Lack of spray equipment | 46 | 44 | 29 | 37 |
| Lack of draft animal | 28 | 24 | 19 | 24 |
| Non-availability of fertilizer | 72 | 66 | 58 | 65 |
| High price of fertilizers and other inputs | 75 | 63 | 58 | 65 |
| High insect infestation in vegetables | 56 | 67 | 60 | 61 |
| Natural hazards like flash flood, heavy rainfall and cyclone etc. | 43 | 48 | 53 | 48 |

Note: Because of sample farmers reported more than one problem, addition of percentage will not necessarily equal to 100

# DIFFERENCES IN YIELD AND BENEFIT BETWEEN TWO MANAGEMENT PRACTICES OF T.AMAN RICE CULTIVATION IN JESSORE AREA


## Abstract

The study was carried out at farming systems research (FSR) site Bagherpara, Jessore to estimate the yield and benefit gap under different management practices of transplanted aman (T.aman) rice (Var. BR-11) cultivation during November 2001 to January 2002. The study revealed that better practiced farmers plots (BPFP) gave higher yield (4.71 t $ha^{-1}$) than the Average practiced farmers plots (APFP) (3.88 t $ha^{-1}$). The yield gap between BPFP and APFP was found 834 kg $ha^{-1}$ (18%) and that of benefit gap (gross margin) on full cost basis was found Tk.5472.00 $ha^{-1}$ (28%) while it was Tk.5515.00 $ha^{-1}$ (19%) on the basis of cash cost. Using Cobb-Douglas production function model, it was estimated that urea, TSP and draft power & power tiller cost played statistically significant role in yield gap between BPFP and APFP. The study suggested that the difference in yield and benefit could be minimized at farm level to increase use of urea and TSP fertilizers and draft power and power tiller cost in the APFP.


## Introduction

In the farmers fields the production efficiency of T.aman rice, like other crops is not satisfactory in the country. Varietal performance varied significantly from research station to farmers' field. Because the factors of production, both quality and quantity, are not maintained properly in the farmers' level. Amount and quality of different inputs used, sowing or planting time, seedling age, intercultural operations etc. varied from research station to farmers' practice and also varied among the farmers cultivating T.aman. These might be the causes of such yield differences. In the Jessore areas of Bangladesh most of the farmers cultivate BR-11 variety of T.aman with traditional management practices resulting low average yield compared to HYV. The farmers cultivating HYV of T.aman also do not follow the recommended practices. But there are some farmers whose management is better compared to the average farmers and thus they obtain better yield. In order to increase the production of T.aman rice to its maximum possible extent at farm level, it is necessary to identify the factors behind this yield gaps. The study is, therefore, designed to estimate the yield and benefit differences of T.aman rice under different management practices and to identify the factors behind yield differences of T.aman rice under different management practices.

## Materials and Methods

The study was carried out at Farming Systems Research (FSR) site, Bagherpara, Jessore (AEZ-11) to estimate the differences in yield and benefit of T.aman under different management practices. The farmers' management practices were classified into two groups. The first group consists of better-practiced 50% farmers (better practiced farmers' plot-BPFP) who got comparatively higher yield and the rest 50% were the average practiced farmers' plots (APFP). A total of 40 plots of 40 farmers with BR-11 were selected randomly to collect primary data. After collection of primary data the whole set were classified into above-mentioned two groups. Data for the study were collected during November 2001 to February 2002 through survey method by using a pre-tested schedule.

Cobb-Douglas production function was used separately in order to identify the relative contribution of different production factors to the yield gap. The Cobb-Douglas production function form of the multiple regressions for this study is as follows-

$$Y = aX_1^{b1}\, X_2^{b2}\, X_3^{b3}\, X_4^{b4}\, X_5^{b5}\, X_6^{b6}\, X_7^{b7}\, Ui$$

Transforming it into the logarithmic form the function was linearized as follows:

$$\text{Log } Y = \text{Log } a + b_1 \text{Log}X_1 + b_2 \text{Log}X_2 + b_3 \text{Log}X_3 + b_4 \text{Log}X_4 + b_5 \text{Log}X_5 + b_6 \text{Log}X_6 + b_7 \text{Log}X_7 + Ui$$

Where, $Y$ = Yield gap between BPFP and APFP
$X_1$ = Difference in use of FYM between BPFP and APFP
$X_2$ = Difference in use of Urea between BPFP and APFP
$X_3$ = Difference in use of TSP between BPFP and APFP
$X_4$ = Difference in use of MP between BPFP and APFP
$X_5$ = Difference in use of Gypsum between BPFP and APFP
$X_6$ = Difference in Human labour input
$X_7$ = Difference in Draft power & power tiller cost
a = Constant or intercept
$b_1, b_2, \ldots\ldots\ldots\ldots b_7$ = Co-efficient of relevant variables to be estimated
Ui = Disturbance term

## Results and Discussion

**Agronomic practices and technology employed:** It is evident from the study that there were differences in agronomic practices as well as input use levels between BPFP and APFP. Better practiced plots received more amount of chemical fertilizer (73-16-23-7 kg N-P-K-S ha$^{-1}$) than that of average practiced plots (58-12-18-3 kg N-P-K ha$^{-1}$). On the other hand, better practiced farmers used 1900 kg ha$^{-1}$ cowdung, but average practiced farmers used 1464 kg ha$^{-1}$ cowdung (Table 1). Planting period also differed. Farmers did not use fertilizer rationally and it might be due to lack of proper knowledge and cash. Better practiced farmers were found to use more amount of chemical fertilizers and this might be caused higher yield. For Boro-T.aman cropping pattern in the AEZ-11 (most of the surveyed plots belongs to this cropping pattern) the suggested fertilizer recommendation is 100-20-35-10 kg/ha NPKS for Boro and 70-6-20-4 kg/ha NPKS for T.aman (BARC, 1997). It is observed that any of the farmers' group do not follow the recommendation, but better practiced farmers' are closer to the recommendation.

**Cost of cultivation:** It was found that on full cost basis the average TVC was Tk.15991.00 and on the cash cost basis it was Tk. 6906.00 ha$^{-1}$ for the BPFP. In case of APFP per hectare TVC was Tk.15207.00 and Tk.6093.00 on full and cash cost basis, respectively. The higher cost incurred in T.aman cultivation under better practiced plots compared to average farmers' practices was mainly due to higher use of material inputs and improved management practices (Table 2). The grain yield of better-practiced plots was found higher (4715 kg ha$^{-1}$) than that of average farmers' practices (3881 kg ha$^{-1}$). The higher yield in better-practiced plots was observed may be due to higher fertilizer dose, which was close to recommendation.

**Yield difference between BPFP and APFP:** The yield difference was found 834 kg ha$^{-1}$ between BPFP and APFP, which was significant at 1% level of confidence (Table 3). The main causes of yield gap were that the farmers did not apply recommended dose of fertilizer, cultural management was not proper. It was noticed that 5 percent difference in variable cost on full cost basis caused 18 percent difference in grain yield and 28 percent difference in gross margin implying that the cost incurred for different inputs under average practiced farmers plots was not rational and gave relatively less benefit to the investment.

**Economics of T.aman cultivation:** The benefit cost ratio was found higher (2.2) in BPFP than that of APFP (1.9) on full cost basis (Table 3). On both full cost and cash cost basis, the better practiced farmers plots obtained higher gross margin than average practiced farmers' plots.

**Contribution of key factors to the yield gap of T.aman:** The Cobb-Douglas production function estimated the relative contribution of key factors in yield gap, which is presented in table 4. The relative contribution of specified factors influencing yield gap can be explained from the estimates of regression equation.

The coefficient of gap in use of urea was found 0.336 implying that one percent increase in urea by APFP, keeping other factors constant, would decrease the yield gap by 0.336 percent. Similarly the coefficient of gap in use of TSP and draft power & power tiller cost was found 0.187 and 0.208 respectively, implying that one percent increase in use of TSP by APFP, keeping other factors constant, would decrease the yield gap by 0.187 percent and one percent increase in draft power & power tiller cost by APFP, keeping other factors constant, would decrease the yield gap by 0.208 percent. These variables showed significant contribution to the yield gap of transplanted aman rice.

The above-mentioned results and discussions reveal that the production of T.aman rice can be increased by following recommended practices and yield gap can also be minimized. It was found that urea, TSP and cost for draft power & power tiller played significant role in yield gap of T.aman rice production. As a result the yield level of APFP can be increased by increasing use of urea, TSP and draft power & power tiller cost. The yield of average practiced farmers plots can be increased by increasing use of these inputs.

## References

BARC. 1997. Fertilizer Recommendation Guide-1997. Bangladesh Agricultural Research Council, Farmgate, Dhaka.

BBS. 1999. Statistical Yearbook of Bangladesh. Bangladesh Bureau of statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BES. 1999. Bangladesh Economic Survey, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Jabber, A. 1991. Adoption of modern rice varieties in Bangladesh. Proceedings of the workshop on experiments with modern rice cultivation on Bangladesh. 23-25 April, Bangladesh Rice Research Institute, Gazipur.

Table 1. Level of technology employed and yield obtained in T.aman rice cultivation under different management practices at Bagherpara, Jessore during 2001-02

| Sl.no | Management factor | Situations | |
|---|---|---|---|
| | | Better practiced farmers' plots | Average practiced farmers' plots |
| 01 | Variety | BR-11 | BR-11 |
| 02 | No.of ploughing | 3-4 | 3-4 |
| 03 | Transplanting time | July 16-Aug 6 | July 11 – Aug 10 |
| 04 | Planting method | Line | Line |
| 05 | Seed rate (kg $ha^{-1}$) | 50 | 52 |
| 06 | Seedling age (day) | 33 | 35 |
| 07 | Fertilizer used (kg $ha^{-1}$): | | |
| | Total (N-P-K-S) | 73-16-23-7 | 58-12-18-3 |
| | Basal | 8-16-23-7 | 6-12-18-3 |
| | 1st top dress (N) | 22 kg at 15 DAT* | 17 kg at 15 DAT |
| | 2nd top dress (N) | 24 kg at 35 DAT | 19 kg at 35 DAT |
| | 3rd top dress (N) | 19 kg at 50 DAT | 16 kg at 50 DAT |
| 08 | Cowdung (kg $ha^{-1}$) | 1900 | 1464 |
| 09 | Weeding (2 times) | After 1st & 2nd top dress | After 1st & 2nd top dress |
| 10 | Harvesting time | Nov.15-Dec.3 | Nov.16-Dec.12 |
| 11 | Crop duration (day) | 120 | 125 |
| 12 | Yield (kg $ha^{-1}$): | | |
| | Grain | 4715 | 3881 |
| | Straw | 4862 | 4027 |

*DAT= Days after transplanting

Table 2. Difference in average levels of variable costs per hectare between BPFP and APFP of T.aman rice cultivation at Bagherpara, Jessore during 2001-02

| Items | BPFP | APFP | % of total | | Difference |
|---|---|---|---|---|---|
| | | | BPFP | APFP | BPFP-APFP |
| Human labour: | | | | | |
| Owned (Tk) | 4690 | 5040 | 29 | 33 | -350 |
| Hired (Tk) | 2380 | 2450 | 15 | 16 | -70 |
| Sub total (Tk) | 7070 | 7490 | 44 | 49 | -420 |
| Draft power & Power tiller: | | | | | |
| Owned (Tk) | 3215 | 2980 | 20 | 20 | 235 |
| Hired (Tk) | 2049 | 1778 | 13 | 12 | 217 |
| Sub total (Tk) | 5264 | 4758 | 33 | 31 | 506 |
| Seed: | | | | | |
| Owned (Tk) | 700 | 728 | 4 | 5 | -28 |
| Purchased (Tk) | - | - | - | - | - |
| Sub total (Tk) | 700 | 728 | 4 | 5 | -28 |
| Fertilizer: | | | | | |
| N (Tk) | 964 | 766 | 6 | 5 | 198 |
| P (Tk) | 1056 | 792 | 7 | 5 | 264 |
| K (Tk) | 307 | 240 | 2 | 2 | 67 |
| S (Tk) | 155 | 67 | 1 | 0.4 | 88 |
| Sub total (Tk) | 2482 | 1865 | 16 | 12 | 617 |
| Cowdung: | | | | | |
| Owned (Tk) | 475 | 366 | 3 | 2 | 109 |
| Purchased (Tk) | - | - | - | - | - |
| Sub total (Tk) | 475 | 366 | 3 | 2 | 109 |
| Total variable cost: | | | | | |
| Full cost basis (Tk) | 15991 | 15207 | 100 | 100 | 784 |
| Cash cost basis (Tk) | 6906 | 6093 | 43 | 40 | 813 |

BPFP= Better practiced farmers' plots, APFP= Average practiced farmers' plots

Table 3. Situation wise average yield, yield gap, benefit and benefit gap per hectare of T.aman rice cultivation under different management practices

| Item | Situations | |
|---|---|---|
| | Better practiced farmers plots | Average practiced farmers plots |
| Gross return (Tk): | | |
| Grain | 33005 | 27167 |
| Straw | 2431 | 2013 |
| Total (Tk) | 35436 | 29180 |
| Variable cost (Tk): | | |
| Full cost basis | 15991 | 15207 |
| Cash cost basis | 6906 | 6093 |
| Gross margin (Tk): | | |
| Full cost basis | 19445 | 13973 |
| Cash cost basis | 28530 | 23015 |
| Benefit cost ratio: | | |
| Full cost basis | 2.22 | 1.92 |
| Gap in grain yield (kg) | 834** (18%) | |
| Gap in gross margin (Tk): | | |
| Full cost basis | 5472 (28%) | |
| Cash cost basis | 5515 (19%) | |
| Gap in variable cost (Tk/ha): | | |
| Full cost basis | 784 (5%) | |
| Cash cost basis | 813 (12%) | |

* * Significant at 1% level of confidence.

Table 4. Cobb-Douglas production function model estimate of determinants of yield gap in T.aman rice cultivation at Bagherpara, Jessore during 2001-02

| Variable | Co-efficient of determination |
|---|---|
| Intercept | 8.97 |
| $X_1$= FYM (kg) | -0.20 (0.126) |
| $X_2$ = Urea (kg) | 0.336* (0.95) |
| $X_3$ = TSP (kg) | 0.187** (0.48) |
| $X_4$ = MP (kg) | -0.118 (0.085) |
| $X_5$ = Gypsum (kg) | 0.102 (0.386) |
| $X_6$ = Human labour (hours) | 0.273 (0.218) |
| $X_8$ = Draft power & Power tiller cost (Tk) | 0.208* (0.186) |
| $R^2$ | 0.66 |
| F-statistics | 3.91 |
| Return to scale (E bi) | 0.80 |
| No. of observation | 20 |

Figures in the parenthesis indicate standard error of mean

** Significant at 1% level, * Significant at 5% level.

# YIELD GAP ANALYSIS OF WHEAT UNDER DIFFERENT MANAGEMENT SITUATION AT FSRD SITE, GOYESHPUR, PABNA


## Abstract

The study was carried out at farming systems research and development (FSRD) site Goyeshpur, Pabna to estimate the yield and benefit gap under different management practices of wheat cultivation. The study revealed that demonstration plots gave higher yield (3.31 t $ha^{-1}$) than farmers practice (2.08 t $ha^{-1}$). The yield gap between DP and FP was found 1223 kg $ha^{-1}$ and that of benefit gap (gross margin) was found Tk.8453.00 $ha^{-1}$. The study suggests that the difference in yield and benefit could be minimized at farm level to increase use of fertilizers in the farmers practice.


## Introduction

There exists a wide gap between farm level potential yield and actual farm yield of wheat. Production area of wheat is increasing day by day but the yield of wheat does not increase in the same rate. The national average yield of wheat was 2.27t/ha in 1997-98 and 2.19 t/ha in 1998-99 (BBS, 1999). There are some factors behind lower yield of wheat at farm level. Research conducted at experimental stations may not be adequate to suggest about the potential yields on farmers fields. Environmental condition may also not be similar between experimental station and farmers fields. To overcome the above-mentioned problems and to have an accurate estimation of different aspects of technology, experiments on farmer's fields are essential. The deference between the experimental station yield and actual farm yield is termed as the yield gap and the factors responsible for this yield gap is yield constraint. The difference between the experimental station yield and the potential farm yield is referred to as yield gap-I and the difference between the potential farm yield and the actual farm yield as yield gap-II. This study is aimed to study on yield gap-II.

It is therefore, urgently needed to know the yield gap between demonstration and farmers plot and to analyze the contribution of production factor to the yield gap. The study is therefore, designed to estimate the yield gap of wheat under farmers plots and demonstration plots, to identify the probable reasons for yield gap and to estimate the economic implications of yield gap.

## Materials and Methods

The survey was carried out during the production period of wheat crop in the year 2001-02 at FSRD site, Goyeshpur, Pabna. Purposive sampling technique was applied in selecting the sample farmers of farmer's plot and demonstration plots. A total of 40 farmers, 20 from farmers plot and 20 from demonstration plot were interviewed by using pre designed survey schedule. The collected data were then edited, summarized and analyzed in order to achieve the objectives of the study. Cobb - Douglas production function analysis was used to identify the individual effects of inputs of wheat under different management practices.

A Cobb- Douglas production function was selected to quantify the relative contribution of different production factors to the yield gap between the farmers plot and demonstration plot for being easy on logarithmic transformation. The function becomes a simple linear one and the co-efficient of the production factors are the elasticity of production.

The Cobb- Douglas functional form of the multiple regression is as followers:

$$Y = a\ Xi\ Ui$$

$$\text{or, } \ln Y = \ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+ b_5\ln X_5+b_6 \ln X_6+b_7\ln X_7+b_8\ln X_8+b_9\ln X_9+b_{10}\ln X_{10}+Ui$$

Where: Y = Yield gap between demonstration plot (DP) and farmers plot (FP) (Kg/ha )

$X_1$= Difference in Urea (kg/ha)

$X_2$= Difference in TSP (kg/ha)

$X_3$= Difference in MP (kg/ha)

$X_4$= Difference in Gypsum (kg/ha)
$X_5$ = Difference in Zn0 (kg/ha)
$X_6$= Difference in Borax (Kg/ha)
$X_7$ = Difference in Human labor (Tk/ha)
$X_8$ = Difference in Mechanical power (Tk/ha)
$X_9$ = Difference in Irrigation (Tk/ha)
$X_{10}$= Difference in weedicide (Tk/ha)
a = Constant or intercept, $b_1, b_2, b_3,$ ----,$b_{10}$ = Co efficient of respective variables and
Ui= Disturbance term

## Results and Discussion

Demonstration plots produced higher yield (3300 kg/ha) than that of farmers practice (2083 kg/ha). The yield gap was 1223 kg/ha. It was found that farmers applied less amount of fertilizer (136-128-33-74 kg/ha urea-TSP-MP-Gypsum) than that of recommendation (180-140-40-110-9.6-7.5 kg/ha Urea-TSP-MP-Gypsum-Zinc-Borax). This wide gap in fertilizer use might be the cause of such yield gap (Table 1).

The co-efficient of multiple determinations $R^2$ was found 0.56 implying that the explanatory variables included in the model explained 56 % of the variation in the yield of wheat. The summation of all production co-efficient (**Σ** bi) was found 0.008, means that the production function exhibits decreasing returns to scale. F value was found 1.124 indicated that all the included explanatory variables are important for explaining the gap in yield of wheat production.

The co-efficient of the variable urea was found 0.176 indicated that, at the mean level of Urea use gap a reduction of urea use gap by one unit (i.e. an increase of one unit of urea in farmers plot), resulted in 17.6 percent decreasing in yield gap. Similarly, a reduction of MP, Gypsum or zinc use gap by one unit (i.e. an increase of one unit of MP, Gypsum or zinc in farmers plot), resulted in 12.3, 3.02 or 3.0 percent decreasing in yield gap respectively. The contribution of human labour use to the yield gap was also found positive. That means the mean level of human labour use gap, an increase of human labour use by one unit in farmers plot, resulted in 2% decrease in yield gap. The co-efficient of the variable TSP was found -0.152 indicated that at the mean level of TSP use gap a reduction of TSP use gap by one unit.(i.e an increase of one unit of TSP in farmers plot), resulted in 15.2 percent increase in yield gap. The coefficient of the variable mechanical power, borax, weedicide and irrigation was also found negative. It means an increase of one unit of these variables in farmers plot, would increase the yield gap by 21.9, 24.8, 15.1 and 12.5 percent, respectively (Table 1).

It noticed that 15% gap in total cost caused 59% gap in grain yield and 112% gap in gross margin. It indicates that the cost incurred at farmers plot was not rational and provides less return to the farmers. It may be suggested that yield gap of wheat could be minimized if recommended practices can be ensured at farmers level. Especially, farmers do not apply recommended level of fertilizer and this might be the cause of such yield differences.

## Reference

BBS. 1999 Statistical Pocket Book of Bangladesh, Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh.

Table 1. Yield and input use gap of Wheat between Demonstration and farmers plot at FSRD site, Goyeshpur Pabna 2001-02

| Explanatory variable | Demonstration Plot (DP) | Farmers Plot (FP) | Gap between DP and FP | Co-efficient and $R^2$ |
|---|---|---|---|---|
| Product yields (kg/ha) | 3306 | 2083 | 1223 | $R^2$ =0.556 |
| Mechanical power (Tk/ha) | 1623 | 1520 | 103 | -0.219 |
| Human labour (Tk/ha) | 2521 | 2348 | 173 | 0.002 |
| Fertilizer : | | | | |
| Urea ( kg/ha) | 180 | 136 | 44 | 0.176 |
| TSP(kg/ha) | 140 | 128 | 12 | -0.152 |
| MP (kg /ha) | 40 | 33 | 7 | 0.123 |
| Gypsum (kg/ha) | 110 | 74 | 36 | 0.302 |
| ZnO (kg/ha) | 9.62 | 0 | 9.60 | 0.300 |
| Borax (kg/ha) | 7.5 | 0 | 7.50 | -0.248 |
| Weedicide (Tk/ha) | 274 | 235 | 38.00 | -0.151 |
| Irrigation (Tk/ha) | 1354 | 1240 | 114 | -0.125 |

Table 2. Per hectare cost and return of wheat in Demonstration and Farmers plot at FSRD site, Goyeshpur Pabna 2001-02

(Tk/ha)

| Variables | Demonstration Plot (DP) | Farmers Plot (FP) | Gap between DP and FP |
|---|---|---|---|
| Mechanical power | 1623 | 1520 | 103 |
| Human labor | 2520 | 2349 | 171 |
| Seed | 1750 | 1875 | -125 |
| Urea | 1080 | 819 | 261 |
| TSP | 1708 | 1568 | 140 |
| MP | 336 | 276 | 60 |
| Gypsum | 308 | 206 | 102 |
| ZnO | 385 | - | 385 |
| Borax | 285 | - | 285 |
| Irrigation Cost | 1354 | 1240 | 114 |
| Weedicide | 274 | 235 | 39 |
| Total Cost | 11623 | 10088 | 1535 (15%) |
| Main Product | 26450 | 16666 | 9784 (59%) |
| By Product | 1145 | 941 | 204 |
| Gross Return | 27595 | 17607 | 9988 |
| Gross Margin | 15972 | 7519 | 8453 (112%) |

# UTILIZATION PATTERN AND IMPACT OF GRANULAR UREA AND MIXED FERTILIZER ON DIFFERENT CROPS IN A SELECTED AREA OF BOGRA DISTRICT

## Introduction

Farmers are using different individual fertilizers included urea for producing crops and vegetables. Due to high volatilization rate of prilled urea application of granular Urea and mixed fertilizer is becoming popular day by day. Farmers of Sonatola upazilla under Bogra district are producing different crops by using granular urea and mixed fertilizer. Granular urea and mixed fertilizer were widely used in Boro and T.aman crops at Bogra. The rate of appling granular urea and mixed fertilizer, productivity of those crops and economic profitability were not known. The management practices for using granular urea and mixed fertilizer is not clear to the farmers. The study is, therefore, designed to know the existing utilization pattern of the granular urea and mixed fertilizer, to know the impact and productivity on different crops produced by granular urea and mixed fertilizer, to know the profitability and to identify the constraints and potentiality of granular urea and mixed fertilizer.

## Materials and Methods

The survey was conducted at MLT site, Gabtoli and Sonatola upazilla under Bogra district during May, 2002. Purposive sampling technique was applied in selecting the sample farmers. A total of 21 farmers on each crops were interviewed through pre-tested survey schedule The collected data was then edited, summarized and analyzed to achieve the objective of the study. The study covered Boro, T.aman, Wheat, Mustard, Banana and Potato.

## Results and Discussion

**Input use pattern and estimation of cost items:** Farmers in the study area used BR-14, BRRI Dhan-28 and 29 varieties for Boro and BR 11 and BRRI Dhan 32 for T.aman crops. In case of Wheat, Mustard, Banana and Potato, they used Kanchan, Sita, Anopam and Diamont variety, respectively.

Average use of human labor were 112,98,103, 93,143 and 135 man-days per hectare for cultivation of Boro, T.aman, Wheat, Mustard, Banana, and Potato crops respectively. It was observed that the highest 143 man-days per hectare was utilized for Banana and lowest 93 man-days for Mustard production.

Normally farmers used family supplied seed for crop production. Average per hectare seed rate was 75 kg, 37kg, 150kg, 7.5kg, 2250 numbers and 1035kg for Boro, T.aman Wheat, Mustard, Banana and Potato crops receptively. Per hectare seed cost was Tk. 1050, Tk. 592, Tk. 1875, Tk. 188 Tk. 11250 and Tk. 14490 for the same crops.

The rate of granular urea used by the sample farmers found 165kg, 150kg, 75kg, 122kg, 240kg and 112kg per hectare for Boro, T.aman, Wheat, Mustard Banana and Potato. Average rate of mixed fertilizer was 300, 300,225,262,562 and 525kg per hectare for Boro, Taman, Wheat, Mustard, Banana and Potato.

**Cost and return:** The cultivation cost of Boro, T.aman, Wheat, Mustard, Banana and potato were Tk 23538, Tk 14342, Tk 12425, Tk.10058, Tk. 33010 and Tk 35824 per hectare respectively. Gross return was found highest (Tk.151650/ha) from Banana. The gross margin was Tk 118640/ha and BCR was 4.59 showed that production of Banana was more profitable crops than Mustard, T.aman, Boro crops (Table 2) by applying granular urea and mixed fertilizer. Marginal benefit cost ratio of Boro and T.aman were found 5.15 and 1.69 considering only additional cost of labuor, granular urea and mixed fertilizers (Table 3).

The farmers mentioned some constraints regarding granular urea and mixed fertilizer. Granular urea and mixed fertilizers are not availability in local markets, high price and line sowing/planting is labour consuming which is necessary for the application of granular urea. Despite these problems there is ample scope to increase crop yield by ensuring availability of granular urea at farm level. Mixed fertilizer can ensure proper ratio of different fertilizer and thus provide higher yield of crops.

Table 1. Per hectare input use and cost in different crops at MLT site Gabtoli and Sonatola upazilla Bogra 2001-02

| Parameters | Crops | | | | | |
|---|---|---|---|---|---|---|
| | Boro | T.aman | Wheat | Mustard | Banana | Potato |
| Variety | BR-14, BRRIDhan28, 29 | BR-11 BRRI Dhan32 | Kanchan | Sita | Anopam | Diamant |
| Human labor | 5600 (112) | 4900 (98) | 5150 (103) | 4650 (93) | 7150 (143) | 6750 (135) |
| Seed rate | 1050 (75) | 592 (37) | 1875 (150) | 188 (7.5) | 11250 (2250) | 14490 (1035) |
| Fertilizer | | | | | | |
| Urea : | | | | | | |
| Basal | 1155 | 1050 | 525 | 840 | 840 | 784 |
| $TD_1$ | (165) | (150) | (75) | (122) | (120) | (112) |
| $TD_2$ | - | - | - | - | 840 (120) | - |
| Mixed Fertilizer | 4500 (300) | 4500 (300) | 3375 (225) | 3930 (262) | 8430 (562) | 7875 (525) |
| Insecticides/pesticides | 700 | 300 | - | 450 | 1500 | 2100 |
| Irrigation cost | 7830 | - | 1500 | - | 3000 | 2250 |
| Harvesting cost | 3000 | 3000 | - | - | - | 1575 |
| Total | 23835 | 14342 | 12425 | 10058 | 33010 | 35824 |

Figures in the parenthesis indicated Mandays for human labor and kg for amount of fertilizer applied.

Table 2. Yield performance and return obtained from different crops at MLT site Gabtoli and Sonatola upazilla Bogra 2001-02

(Tk./ha)

| Parameter | Crops | | | | | |
|---|---|---|---|---|---|---|
| | Boro | T.aman | Wheat | Mustard | Banana | Patato |
| Yield (kg/ha) | 7862 | 5405 | 2856 | 1653 | 1685(no.) | 19809 |
| Gross Return | 55034 | 37855 | 22848 | 33060 | 151650 | 74284 |
| Variable cost | 23835 | 14342 | 12425 | 10058 | 33010 | 35824 |
| Gross margin | 31199 | 23493 | 10423 | 23002 | 118640 | 38460 |
| BCR | 2.31 | 2.64 | 1.84 | 3.29 | 4.59 | 2.07 |

Table 3. Profitability of Boro and T.aman rice at MLT site Gabtoli and Sonatola upzilla, Bogra, 2001-02

| Items | Before using GU &MF | | After using GU & MF | | Difference | | MBCR | |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.aman | Boro | T.aman | Boro | T.aman | Boro | T.aman |
| Gross Return | 45731 | 31703 | 55034 | 37835 | 9303 | 6132 | | |
| Total cost | 9450 | 6832 | 11255 | 10450 | (-ve)1805 | (-ve) 3615 | 5.15 | 1.69 |
| Labour | 4875 | 4125 | 5600 | 4900 | (-ve)725 | (-ve) 775 | | |
| Fertilizer (GU&MF) | 4575 | 2707 | 5655 | 5550 | (-ve)1080 | (-ve) 2840 | | |

GU= Granular Urea, MF= Mixed fertilizer

# IMPACT ASSESSMENT OF INTEGRATED FARMING SYSTEMS AT FSRD SITE, GOYESHPUR, PABNA


## Abstract

The study was conducted to determine the extent of adoption of intervened technologies and to evaluate the impact of FSRD activities on resources use, productivity and socioeconomic development of the farmers. It was found that farmers of the non-project area used 8 technologies with traditional method while farmers of the project area were able to use 27 technologies in crop, homestead, livestock and fisheries sector. Farm income was higher (Tk. 44095/farm/year) with the project farmers then that of non-farm project (Tk. 37,770/farm/year). Cash balance of the project farmers was also fund higher than that of non-project farmers.


## Introduction

Poverty are the common feature in rural areas of Bangladesh. The causes of rural poverty are not independent rather than are integrated and holistic in nature. In the context of faster development, an effective mechanism has been developed by the Bangladesh Agricultural Research Institute (BARI) through Farming Systems Research and Development (FSRD) activities. This mechanism creates opportunities for participation of the farmers and researchers in developing and transfer of technologies. Impact studies of different FSRD activities indicated that traditional research systems failed to show any significant improvement in poverty elevations of the resource poor farmers (Khan et al., 1990b; Islam et al., 1990a).

In Bangladesh, there are increasing demands for evidence and documentation of adoption of technologies and the impact of Farming Systems Research and Development (FSRD) activities. In the past investigation made on only the rate of adoption of technologies and factors contributing to adoption by the farmers. But none of them attempted to determine the consequence of adoption in terms of increases or decreases in yield, income and farmers expenditure pattern. Therefore, the present study has been taken to determine the extend of adoption of FSRD activities and its impact on different farm families. The study was therefore, aimed to determine the extend of adoption of intervened technologies and to evaluate the impact of FSRD activities on resources use, productivity and socioeconomic development.

## Materials and Method

The survey was conducted during January to March, 2002 at FSRD site, Goyeshpur, for Project Farmers (PF) and at the village Baloghata, Pabna which was 8 km from the project area for Non Project Farmers (NPF). The stratified random sampling technique was applied in selecting the sample farmers from the three farm categories. All together, 15 farmers were selected and interviewed taking 5 farmers from each farm category. The selected farmers were categorized in marginal (0.21-0.05 ha), small (0.51-1.0ha) and medium (1.01-2.0ha) farm groups. The major interventions were done on crop, livestock, homestead, fisheries and household fuel management. In the crop sector, interventions were made on cropping patterns. In homesteads, interventions were dose on vegetable production in open sunny places, utilization of shady area by growing spices and introduction of multipurpose tree species for fruits. In the fisheries sector, backyard ditches were utilized for growing seasonal fishes. In the livestock sector, interventions were made on poultry, duck, pigeon, and apiculture. In household fuel management modification of the existing oven was made to save fuel. The changes occurred in different aspects were determined through monitoring and survey of both the group of farmers.

Necessary information was collected through face to face interview methods with pre-tested survey schedule. The collected data were then edited, summarized and analyzed to fulfil the objectives of the study. Tabular methods of analysis like mean, average, percentage, ratio etc were followed to explain the result.

## Results and Discussion

The average family size was 5.10 for Project Farmers (PF) and 4.87 for Non Project Farmers (NPF) considering all farm category, which was lower than national average (5.60) in Bangladesh (BBS 1999). Effective family member of all farm categories were 2.33 and 2.67 for project and non project farmer respectively. In the project area about 42.33 percent and 53.33 percent farmers were between I-V and VI-X education level respectively. About 64.33 percent and 18 percent farmers were between I-V and VI-X level education respectively and 17.67% farmers were reported to be illiterate in non project farm. Agriculture was the main occupation of the majority (71 percent) in non project area and on the other hand 62 percent was engaged with both agriculture and business in the project area. The marginal farmers of the project area and non project area attained in 6 and 1 training program to increase the knowledge of production technology respectively. Considering all farm categories the sample farmers of project area received more loan or credit (Tk 7661) than non project farmers from bank /NGOs for purchasing crop land and repairing of irrigation equipment (Table1).

### Technology adopted by the sample farmers

It was revealed that farmers of the non-project area used 8 technologies with traditional method (Table 2). Farmers of the project area were able to use 27 different technologies i.e. 6 for crop sector, 18 for homestead, 2 for livestock and one for fisheries sector. By using new technology they increased their productivity, income and standard of livings. Marginal farmers were used highest number of technologies in homestead area compared to small and medium farm category.

### Impact on resource use and productivity

The study look into ten resources or production units by which project farmers grow vegetables round the year while non project farmers grew four to five resources widely for producing vegetables. The resources were open land of homestead, house roof, fence, trelli, partially shady area, marshy land, tree support, waste land, house boundary, pond bank and road site etc which can be as a means of production unit for vegetable cultivation. Farmers of the non project area were found to use three to four production unit or resources with traditional method. Farmers of project area were able to use each and every possible production units efficiently for own consumption and surplus to sale for more cash income. It was found that the marginal farmers in project area got the highest yield 25kg, 152kg, 15gk, 120kg and 111kg from the production unit of fence, trelli, marshy land, backyard land and controlling of mango hopper (Table 3). On the other hand marginal, small and medium farmers of non-project area got the highest yield from the production unit of back yard land, open land of homestead and house roof respectively. Yield was found 217 percent higher from medium farm category in project farm (PF) than non project farmers (NPF) due to improved management and new technologies were used in different production units by the project farmers. The result indicated that higher yield was possible to the project farmers by adopting or using new technologies and effective use of resources.

### Impact on farm income and expenditure

Comparisons of income and expenditures were made on whole farm basis (Table 4). Farm income was found 42 percent, 83 percent and 68 percent of total income for marginal, small and medium farms respectively of project farms and whole the farm income was 28 percent, 49 percent and 57 percent of total income for marginal, small and medium farmers for non project farms. Farm income was the dominant source for small and medium farmers of project farm and non farm income was dominant of non project farms for marginal and small farmers. The marginal farmers of both project and non project farms spent their cash to meet up farm expenses. The result indicated that for small and medium farmers, farm income increased with the appropriate use of resource and adoption of high yielding modern technologies.

**Reference**

BBS. 1999 Statistical Pocket Book of Bangladesh, Statistics Division, Ministry of Planning, Govt of the People's Republic of Bangladesh.

Islam , Q.M.S: M.R. Amin and M.R. Amin. 1990a. An investigation into the farm resources and its utilization systems. Annual report 1989-90 OFRD, BARI, Tangail, PP. 38-69.

Khan, M.R., Q.M.S. Islam., M.M. Haque., M.R. Amin., M.A. Sadek and M.R. Shamim. 1990b. Whole farm research approach as an integrated research strategies for the devlopment of resource poor farmers. Annual report 1990-91, OFRD, BARI, Tangail, PP. 103-231.

Khan, M.M.R; Q.M.S. Islam: D.J.Costa and M.G. Moula. 1998. Bangladesh J. Agril. Res. 23(3): 573-584.

Table 1. Socio-economics characteristics of sample farmers by farm category at FSRD site, Goyeshpur, Pabna 2001-02

| Parameters | Project farms | | | | Non-Project farms | | | |
|---|---|---|---|---|---|---|---|---|
| | Marginal | Small | Medium | All | Marginal | Small | Medium | All |
| Educational level (%) | | | | | | | | |
| Illiterate | - | - | - | - | 20 | 13 | 20 | 17.67 |
| I-V | 80 | 33 | 14 | 42.33 | 60 | 80 | 53 | 64.33 |
| VI-X | 20 | 67 | 73 | 53.3 | 20 | 7 | 27 | 18.00 |
| Above X | - | - | 13 | - | - | 7 | - | - |
| Family size (no.) | 5.3 | 5 | 5 | 5.1 | 5.2 | 4.2 | 5.2 | 4.87 |
| Source of income (%) | | | | | | | | |
| Agriculture | 100 | 33 | 80 | 37.67 | 87 | 73 | 53 | 71 |
| Agril+Business | - | 67 | 20 | 62.33 | 13 | 27 | 33 | 24.33 |
| Agril + Service | - | - | - | - | - | - | 13 | 4.33 |
| Effective family member (no.) | 2 | 2 | 3 | 2.33 | 3 | 2 | 3 | 2.67 |
| Farm size (decimal) | | | | | | | | |
| Own land | 50.33 | 145.33 | 340 | 178.56 | 99.9 | 156.8 | 355.5 | 204.07 |
| Homestead | 27.60 | 24.3 | 36.5 | 29.47 | 14 | 18.6 | 17 | 16.53 |
| Pond /ditch | 8.67 | 23.9 | 15 | 15.86 | 18 | 11.2 | 12.8 | 14 |
| Training received | 5.2 | 4.6 | 3.3 | 4.37 | 1 | | | 0.33 |
| Credit received (Tk) | 2750 | 6900 | 13333 | 7661 | 4200 | 9800 | 3250 | 5750 |

Table 2. Number of technologies adopted by the farmer in project and non project by farm category at FSRD site, Pabna 2001-02

| Sector | Technology adapted | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Project farm | | | | Non project farm | | | |
| | Marginal | Small | Medium | All | Marginal | Small | Medium | All |
| Crop Sector | 2 | 8 | 7 | 6 | 2 | 7 | 6 | 5 |
| Homestead sector | 20 | 19 | 15 | 18 | 4 | 3 | 4 | 3 |
| Livestock sector | 2 | 2 | 2 | 2 | 1 | 0 | 0 | - |
| Fisheries sector | 1 | 1 | 2 | 1 | 0 | 0 | 0 | - |
| Total | 27 | 30 | 26 | 27 | 7 | 10 | 10 | 8 |

Table 3. Average yield from different resources of project and non project farmers by category at FSRD site, Goyeshpur, Pabna 2001-02

| Resources | Project farm (kg/ farm/year) | | | | Non-Project farm (kg/ farm/year) | | | |
|---|---|---|---|---|---|---|---|---|
| | Marginal | Small | Medium | All | Marginal | Small | Medium | All |
| Homestead garden | | | | | | | | |
| Bed | 149 | 144 | 161 | 151.33 | - | - | - | - |
| Open land | - | - | - | - | 47 | 105 | 32 | 61.33 |
| (Radish, Stem amaranth, Indian spinach, Cabbage, Brinjal, Tomato, Okra etc.) | | | | | | | | |
| House Roof (Pumkin, Ash gourd) | 111 | 258 | 67 | 145.33 | 46 | 103 | 71 | 73.33 |
| Fence (Bitter gourd, Yard long bean) | 25 | 18 | 11 | 18.00 | - | - | - | - |
| Triali (Bitter gourd Snake. gourd) | 152 | 107 | 69 | 109.33 | 55 | 84 | 60 | 66.33 |
| Shady Area (E. foot yam, Leaf aroid, Chilli) | 72 | 86 | 117 | -91.67 | - | 20 | 18 | 12.67 |
| Marshy Land (water taro) | 15 | 13 | 8 | 12.20 | - | - | - | - |
| Tree Support (Country bean, Sponge gourd, Ribbed gourd, Potato yam) | 12 | 38 | 22 | 24.00 | - | - | - | 15 |
| Waste Land / Back yard (Banana, Drum Stick) | 120 | 65 | 12 | 65.67 | 65 | - | - | 21.67 |
| House Boundary (Papaya, Guava) | 93 | 242 | 296 | 210.33 | 25 | 57 | 61 | 47.67 |
| Pond Bank (Bottle gourd, Country bean, Sponge gourd) | - | 211 | 108 | 106.33 | 28 | - | - | 9.33 |
| Control of Mango hopper | | | | | | | | |
| Modern | 111 | 83 | 79 | 91.00 | - | - | - | - |
| Traditional | - | - | - | - | 43 | 91 | 58 | 64.00 |
| Total | 860 (178%) | 1265 (150 %) | 950 (217%) | 1025 (176%) | 309 | 505 | 300 | 371.33 |

Table 4. Whole farm cash flow of project and non project farmers by farm category at FSRD site, Goyeshpur, Pabna 2001-2002

| Income/ Expenses | Project farm (Tk / farm/year) | | | | Non project farm (Tk / farm/year) | | | |
|---|---|---|---|---|---|---|---|---|
| | Marginal | Small | Medium | All | Marginal | Small | Medium | All |
| Total income: | 70049 | 62046 | 74143 | 68746 | 30376 | 46876 | 131645 | 69632 |
| Farm income | 29671 (42) | 51770 (83) | 50843 (68) | 44095 (64) | 8698 (28) | 23226 (44) | 75385 (57) | 35770 (43) |
| Non farm income | 40378 | 10276 | 23300 | 24651 | 22178 | 23650 | 56260 | 34029 |
| Total expenses: | 33351 | 31841 | 51859 | 39017 | 30010 | 32964 | 93948 | 52307 |
| Farm expenses | 15601 | 27845 | 38885 | 27444 | 11395 | 10112 | 56207 | 25905 |
| House hold expenses | 17750 | 3996 | 12974 | 11573 | 18615 | 22852 | 37741 | 26403 |
| Cash Balance | 36698 | 30205 | 22284 | 29729 | 866 | 13912 | 37697 | 17492 |

Figures in the parenthesis indicate percentage

1. Farm income includes: Income from crop livestock and fisheries sector 2. Non farm income includes -income from business, service, gift etc. 3. Household expense includes - food, cloth, education, medical, cosmetics etc. 4. Farm expense includes-purchase of inputs.

It was observed that small and medium farmers earned higher income from farm income in project farms and non project farms. Therefore, step should be taken for wider adoption of modern technology in agriculture and ensure efficient use of resources through extension services to the resource poor farmers of project and non project farmers.

# ECONOMICS OF HOMESTEAD VEGETABLES PRODUCTION AND UTILIZATION SYSTEM AT ATKAPALIA FSRD SITE, NOAKHALI


## Abstract

The study was carried out at Atkapalia FSRD site, Noakhali to assess the profitability of homestead vegetable production and utilization system. Data were collected from 85 homestead vegetables producing households. The finding revealed that farmers practicing homestead vegetables are : Tomato, Brinjal, Radish, Chilly, Bottle gourd, Sweet gourd, Dherosh and Red amaranth, etc. Among the vegetables higher gross margin (Tk 4873/ha) was found from Radish followed by Tomato (Tk. 47992/ha) and Bottle gourd (Tk. 4025/ha). The finding showed that production of homestead vegetables is highly profitable if modern inputs and production technology can be made available to farms in time.


## Introduction

Homestead is defined as the land owned and occupied by the dwelling units of the households and immediate area surrounding the dwelling units including yard, pond, road space around, homesteads, space used for cultivation of trees and vegetables and unutilized space (Abdullah, 1986). The climate and soil of Bangladesh are favourable for the production of vegetables, where 70 percent of vegetables are produced in winter and 30 percent in summer and rainy season. Vegetables are rich sources of nutrients. Every homestead produces more or less some vegetables.

In the char areas most of the families produced vegetables in their homestead area. It was observed in the char areas, most of homestead area was densely populated and it was remaining under utilized and unutilized. Thus there seems have a tremendous potential for the improvement of homestead production system by applying recommended package of technologies. Considering this view, homestead production and utilization system should be studied. Hence, the study was under taken to evaluate the profitability of different vegetables grown in the homestead areas and to know the utilization pattern of homestead vegetables.

## Materials and Methods

To attain the objectives of the present study, a survey was conducted in two villages' i.e. Char Jabber and Char Jublee at FSRD site, Atkapalia in Noakhali district during 1999-2000. A total of 85 sample farmers were selected purposively for the study, out of which 25 farmers were marginal, 25 were small, 20 were medium and 15 were large farmers. The necessary data were collected by the help of a pre-tested survey schedule. The collected information were summarized and presented in tables.

## Result and Discussion

Farmers were found to produce number of vegetables in their homesteads. Tomato, Brinjal, Radish, Chilli, Bottlegourd, Sweet gourd, Lady's finger and Red amaranth were the main vegetables in the homestead. The highest yield (15182 kg/ha) was recorded with radish followed by tomato (12083 kg/ha). The yield of other vegetables was also satisfactory (Table 1). The highest gross margin (Tk. 48734 /ha) was recorded with radish followed by tomato (Tk. 47991/ha) and bottle gourd (Tk. 40254/ha). The highest BCR was found with bottle gourd (3.82) followed by sweet gourd (3.33) for their lower level of variable cost. The utilization pattern of homestead vegetables of spices are also shown in table 1. It was found that major portion (65%) of the homestead vegetable and spices were sold to the local market and 25 percent were consumed by the family. The rest amount was distributed to the relatives and a portion were wastage for not harvesting in time and for some other reason.

**Profitability of homestead vegetables production**

Some problems were identified regarding homestead vegetables cultivation. These area lack of good quality of seeds, lack of knowledge of improve management practices of farmers and poor management of trees and vegetables.

Table 1. Yield cost return and utilization of homestead vegetables and spices at char areas in Noakhali

| Vegetable product | Yield (kg/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR | Utilization pattern (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Consumption | Sale | Distribution | Wastage |
| Tomato | 12083 | 24504 | 47992 | 2.95 | 21 | 60 | 7 | 11 |
| Brinjal | 6571 | 20920 | 11935 | 1.57 | 22 | 677 | 7 | 4 |
| Radish | 15182 | 27178 | 48734 | 2.79 | 21 | 70 | 6 | 3 |
| Chilli | 4965 | 19349 | 30303 | 2.56 | 25 | 67 | 3 | 5 |
| Bottlegourd | 7791p | 14283 | 40254 | 3.82 | 29 | 63 | 5 | 3 |
| Sweet gourd | 4632p | 13834 | 32462 | 3.33 | 30 | 60 | 6 | 4 |
| Dherosh | 5208 | 18574 | 23090 | 2.24 | 32 | 63 | 3 | 2 |
| R.amanath | 3741 | 9544 | 9160 | 1.95 | 25 | 67 | 7 | 1 |
| All | - | - | - | - | 25 | 65 | 6 | 4 |

# YIELD GAP ANALYSIS OF GROUNDNUT AT FSRD SITE, ATKAPALIA, NOAKHALI


## Abstract

The study was conducted at FSRD site, Atkapalia, Noakhali during 2000-01 to find out the causes of differences between yield level that obtained with farmers field and demonstration plot. Yield gap between demonstration and farmers' practice plot was found 769 kg (40%) per hectare as well as gross margin gap was Tk. 4646 per hectare. It was estimated that the key factors behind yield gap were Seeds, Urea, TSP and MP, which significantly influenced in yield gap of groundnut. The research suggest this apparent yield and economic gap can be minimized at farm level to follow recommended package of technologies.


## Introduction

Groundnut is grown in a vast area in Noakhali district especially at Char Jabber and Char Jublee villages. It is usually observed that the yield of groundnut in farmers field differ from that obtained in research station or demonstration plot. This might be due to some variations in cultural practices. So, the study has been undertaken to identify the factors that behind the yield gap. The objectives of the study were to estimate the yield and benefit gap of groundnut between demonstration plot and farmers practice plot and to identify the factors that are responsible for yield gap of groundnut.

## Materials and Methods

A total of 30 farmers plot were selected for the study which 15 plots were farmers practices and 15 were demonstration plot. The data were collected through monitoring technique with the help of a pre-designed survey schedule. The collected data were edited, summarized and analyzed in order to achieve the objectives of the study.

Cobb-Douglas production function was selected to quantify the relative contribution of different production factors to the yield gap between farmers' practices and demonstration plot. For being easy on logarithmic transformation, the function becomes a simple linear one and the co-efficient of the production factors is the elasticity of production.

The Cobb-Douglas functional form of the multiple regressions is as follows:

$$Y= a X 1b1 X 2b2 X 3b3 X 4b4 X 5b5 X 6b6$$

The function can be linearised by transforming it into the logarithmic form

$$\text{Log } Y= \text{Log } a + b1\text{Log}X1 + \ldots\ldots\ldots\ldots\ldots\ldots + b6\text{Log}X6$$

Where,

$Y$= Yield gap between the farmers practices and demo plot
$X_1$= Difference in Animal power input (pair-day/ha)
$X_2$= Difference in Human labour input (man-day/ha)
$X_3$= Difference in Seed used (kg/ha)
$X_4$= Difference in Urea (kg/ha)
$X_5$= Difference in TSP (kg/ha)
$X_6$= Difference in MP (kg/ha)
$b_1$.......$b_6$= Co-efficient of the respective variables.

## Results and Discussion

The level of input used varied between two management practices. In case of farmers practices no urea and MP was applied, but a small amount of TSP was used.

It was observed that higher yield was found with demo plot (1.9 t/ha) while farmers practice gave less yield (1.17 t/ha). The gross margin obtained was Tk. 8273.0 per hectare in demonstration plot while it was Tk. 3620.0 for farmers practice. The benefit cost ratio was found 1.44 for demo plot and it was 1.32 for farmers practice.

**Regression analysis**

It was found that the coefficient of multiple determinations, $R^2$ is 0.78, which means that the explanatory variables included in the model explained 78% of the variation in the yield gap. The relative contribution of specified factors influencing yield gap can be seen from the estimates of regression equation. The elasticity of coefficient (Ebi) was found 0.74 means that the production function exhibits decreasing returns to scale, it means if all the inputs specified in the functions are increased by 1 percent, yield would have increased by 0.74 percent (Table 3).

It is suggested that in order to enhance yield, the farmers should increase the use of urea, TSP and MP and decrease the use of human labour. The co-efficient of gap in use of urea, TSP and MP was found 0.222, 0.270 and 0.233, respectively implies that one present increase in the use of urea, TSP on MP in the farmers practices, keeping other factors constant, would decrease the yield gap by 0.222, 0.270 on 0.233 percent, respectively. These three variables showed significant contribution to the yield gap of groundnut. As a result the yield level of farmers practice can be increased by increase use of urea, TSP and MP.

Table 1. Level of technology employed and input used in demonstration plot and farmers practice plot

| Input/technology used | Demo plot | Farmers practice |
|---|---|---|
| Variety | Dhaka-1 | Dhaka-1 |
| Number of ploughing | 4.0 | 3.0 |
| Number of laddering | 4.0 | - |
| Date of sowing (ranges) | 03-11 January | 01-15 January |
| Planting method | Line | Line |
| Seed rate (kg/ha) | 98.62 | 82.09 |
| Fertilizer used (kg/ha): | | |
| Urea | 29.41 | - |
| TSP | 167.83 | 53.54 |
| MP | 88.67 | - |
| Number of weeding | 2.0 | 2.0 |
| Time of harvesting | 20-26 May | 10-28 May |

Table 2. Cost and return of groundnut production at FSRD site, Atkapalia, Noakhali

| Variable cost item (Tk./ha) | Demo plot | Farmers practice |
|---|---|---|
| Human labour cost | 9949.0 | 6932.0 |
| Animal power cost | 2768.0 | 2459.0 |
| Seed cost | 2772.0 | 2299.0 |
| Fertilizer cost: | | |
| Urea | 176.0 | - |
| TSP | 2349.0 | 750.0 |
| MP | 887.0 | - |
| Total variable cost | 18901.0 | 12440.0 |
| Yield (t/ha) | 1.94 | 1.17 |
| Price (Tk./kg) | 14.00 | 14.0 |
| Gross return | 27174.0 | 16408.0 |
| Gross margin | 8273.0 | 3968.0 |
| B. C. R. | 1.44 | 1.31 |
| Yield gap (kg/ha) | 769 (40%) | |

Table 3. Cobb-Douglas production model estimate of determinants of yield gap in groundnut production

| Explanatory variables and output | Demo plot | Farmers practice plot | Gap between DP and FP | Coefficient of determination |
|---|---|---|---|---|
| Yield (kg/ha) | 1941.0 | 1172.0 | 769.0 | - |
| $X_1$ = Animal power (pair-day) | 18.45 | 16.39 | 2.06 | 0.011 (0.008) |
| $X_2$ = Human labour (man-day) | 99.49 | 69.32 | 30.17 | -0.067 (0.007) |
| $X_3$ = Seed (kg/ha) | 98.62 | 82.09 | 16.53 | 0.071 (0.080) |
| $X_4$= Urea (kg/ha) | 29.41 | - | 29.41 | 0.222* (0.21) |
| $X_5$= TSP (kg/ha) | 167.83 | 53.54 | 114.29 | 0.270** (0.11) |
| $X_6$= MP (kg/ha) | 88.67 | - | 88.67 | 0.233* (0.09) |
| $R^2$ | | | | 0.78 |
| Ebi | | | | 0.74 |

* denoted 1% level of significance

** refers to 5% level of significance

# AN AGRIBUSINESS STUDY ON LIVESTOCK PRODUCTION AND UTILIZATION PATTERN


## Abstract

The study was conducted at Farming System Research and Development (FSRD) site Narikeli, Jamalpur to evaluate the livestock production and their utilization pattern during November 2000 to March 2001. The average number of cattle, goat and poultry was recorded 1.91, 0.86 and 19.7 per farm, respectively. The fidings revealed that male and female members spent 3.91 and 2.17 hrs./day for livestock rearing. During feed crisis period farmers used leaves of different trees, water hyacinth, rice bran, etc. for cattle feed. Farmers mentioned some problem regarding livestock rearing. These are lack of grazing land, feed, fodder, medicare facilities, etc. Lack of modern technology for livestock rearing and livestock disease are some other problems in this regard.


## Introduction

Livestock has been an important component of the mixed farming systems practised in Bangladesh for centuries. Other then meat, milk and egg, manure for crop fields and fuel for domestic use is also derive from livestock. Both animals and birds are fed mostly on crop by-products and residues, which have little other alternative use for human beings (Jabber, 1983). Livestock plays an important role to the income generation to the rural household, particularly for poor farmers. Livestock enterprise is highly interacted with the cropping systems. Sometimes it leads to change farmers' decision about cropping systems. To meet nutritional requirement and to strengthen national economy improvement of livestock production is extremely important (Akbar, 1985). It contributes 6.5 percent in GNP, 11.5 percent in GDP, 13 percent in export earning, 80 percent of nutrition supply, 20 percent of fuel, 20 percent in employment opportunities and 95 percent to draft power (BSS, 1998).

Livestock enterprise is highly integrated in the farming systems of Bangladesh. It is strongly felt that improvement in the cropping systems is largely dependant on the livestock system in many occasion. Therefore, it is essential to improve the livestock system simultaneously with the cropping system. To be able to conduct research for development of the livestock system, it is necessary to identify its present situation, constraints and prospect of it, hence the study was undertaken, to identify the existing livestock resources, to find out the production and utilisation system of livestock, to identify the constraints and potentials of livestock production.

## Methodology

Five villages under Farming Systems Research and Development (FSRD) site, Narikeli, Jamalpur, were selected for this study. Data were collected during November 2000 to March 2001. A total of 80 livestock households were interviewed for the study, out of which 20 from landless (0.0-0.2 ha), 20 from marginal (0.21- 0.50 ha), 20 from small (0.51- 1.0 ha), 10 from medium (1.01-2.50 ha) and 10 from large (above 2.50 ha). Stratified random sampling method was used for this study. The necessary data were collected from the selected farmers of different farm categories with the help of a pre-tested survey schedule.

## Results and Discussion

**Existing livestock resources:** The average, number of cattle, goat, duck, pigeon, poultry (local) and poultry (improve) were 1.91, 0.86, 1.48,1.33, 15.91and 0.98 respectively. Nobody among the sample farmers reared sheep and buffalo in the study area. It was observed that number of cattle increased with the increased in farm size (Table 1). But this trend was not followed in case of goat or poultry. Baksh et *al.* (1987) found that the average number cattle, goat, poultry (local), poultry (improve), duck, and pigeon were 1.36, 0.17, 1.10, 0.56, 0.54 and 0.79 respectively in the Lahrikanda FSR site during 1985-86. Poultry rearing in the Farming Research and Development site, Narikeli, Jamalpur was increased due to FSRD intervention.

**Time spent for animal care:** Although large farmer kept more number of livestock head but small farmers spent more time for animal care (8.44 hrs/day) (Table.2). Large farmers were depended on hired labour for animal rearing compared to small farmers. Hired labour was not used in landless and marginal farms. Baksh *et al.* (1987) reported that small farmers spent more times 6.06 hrs/day. It was found that participation of female member for animal care was increased towards smaller farms. Female members played dominant role for rearing poultry, duck, goat and cattle.

**Animal feeding practices during crisis period:** During fodder crisis period, farmer try to fed their cattle, buffalo and goat by different grasses, leaves of different trees like green grass, Jack fruit, rice bran, mander, banana and bamboo leaves, water hyacinth, sugarcane leaves, straw, etc., were also used as animal feed with dry straw (Tables 3).

**Utilization pattern of livestock:** Farmers reared their cattle for draft power, milking, profit sharing, meat and transportation purposes. It was found that 80 percent respondents used cattle for draft power, 70 percent for draft and milk and 60 percent for milk. The major purpose of cattle and goat rearing was profit sharing, which was 68 and 75 percent, respectively. The purpose of poultry rearing was for egg (75%), meat (50%) and family nutrition (65%). The major objectives of the livestock rearing identified as for draft, profit earning through sharing systems, meat, transport and family nutrition and cash.

**Diseases of livestock and their treatment:** Diarrhoea, FMD, HS, pox were the major diseases of cattle while diarrhoea and HS (Gholafolla) were reported for goat. Ranikhet, Gumboro, Cholera, Fowl Pox were the major diseases of poultry in the study area (Table 5).

**Income generation:** In the study area it has been found that the farm families derived highest average annual income from the crop sector (Tk.7340/farm/year), followed by livestock (Tk.6320/farm/year) and business (Tk.4100/farm/year) and the lowest income was obtained from poultry (Tk.1080/farm/year). Farmers reported that livestock rearing was more profitable but in recent time it was less profitable due to lack of feed, lack of improved breed and diseases prevalence (Table 6).

**Constraints of livestock rearing :** There was several constraint identified by the respondent for livestock rearing (Table 7). Farmer reported that lack of grazing land and grass (90%), lack of veterinary surgeon (87.50%), shortage of fodder in rainy seasons (78.75), shortage of straw (61.25%), lack of modern technology for livestock rearing (83.75%), out break of diseases (60%), (78.75%), etc. were the major constraints to livestock rearing.

Table 1. Average number of livestock per farm at Narikeli, FSRD, Site, Jamalpur during 2001

| Farm categories | Number per farmer | | | | | |
|---|---|---|---|---|---|---|
| | Cattle | Goat | Duck | Pigeon | Poultry | |
| | | | | | Local | Exotic |
| Landless | 0.36 | 0.38 | 1.55 | - | 9.34 | 0.69 |
| Marginal | 1.40 | 0.84 | 0.84 | 0.59 | 12.6 | 0.32 |
| Small | 2.00 | 0.60 | 1.20 | 1.30 | 16.45 | - |
| Medium | 2.40 | 0.90 | 1.70 | 3.20 | 16.60 | 3.10 |
| Large | 3.40 | 1.60 | 2.12 | 1.60 | 24.60 | 0.80 |
| All | 1.91 | 0.86 | 1.48 | 1.33 | 15.91 | 0.98 |

Table 2. Time spent for animal care by family members at FSRD site, Narikeli, Jamalpur 2001

| Farm categories | Time spent for animal care (hrs/day) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Adult above 60 yrs | | Adult (13-60yrs) | | Children (below13 yrs) | | Total | | Permanent hired labour | |
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| Landless | - | 0.04 | 0.98 | 1.96 | 0.75 | 0.30 | 1.73 | 2.30 | - | - |
| Marginal | - | - | 3.26 | 1.89 | 0.99 | 1.06 | 4.25 | 2.95 | - | - |
| Small | 0.35 | 0.60 | 4.25 | 1.09 | 0.90 | 1.25 | 5.50 | 2.94 | 1.06 | - |
| Medium | 1.60 | - | 2.60 | 1.26 | - | .0.20 | 4.20 | 1.46 | 3.60 | - |
| Large | - | - | 3.68 | 0.60 | 0.20 | 0.60 | 3.88 | 1.20 | 6.50 | - |
| All | 0.39 | 0.12 | 2.95 | 1.36 | 0.56 | 0.68 | 3.91 | 2.17 | 2.23 | |

Source: Field Survey, 2001

Table 3. Feed supply to the animal during crisis period by farm category

| Types of feed | Percent of respondent | | | | | |
|---|---|---|---|---|---|---|
| | Landless | Marginal | Small | Medium | Large | All |
| Bamboo leaves | 20 | 32 | 15 | 10 | 40 | 23.40 |
| Banana leaves | 30 | 36 | 38 | 35 | 30 | 27.20 |
| Green grass | 28 | 60 | 82 | 100 | 70 | 68.00 |
| Water hyacinth | 5 | 20 | 5 | 30 | 30 | 14.80 |
| Sugarcane leaves | 10 | 26 | 12 | - | 20 | 35.50 |
| Mango leave | 7 | - | 6 | - | 14 | 5.40 |
| Straw | 5 | 8 | 15 | 20 | 40 | 17.60 |
| Rice bran | 25 | 30 | 60 | 60 | 60 | 47.00 |
| Mander leaves | 30 | 22 | 50 | 30 | 36 | 33.60 |
| Jack fruit leaves | 50 | 52 | 43 | 58 | 44 | 49.50 |
| Other tree Leaves | 22 | 28 | 30 | 20 | 20 | 24.00 |

Table 4. Utilization pattern of livestock at the FSRD site, Narikeli, Jamalpur during 2001

| Enterprise | Utilization pattern of livestock (% respondent) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Draft | Milk/egg | Draft &milk | Profit sharing | Meat | Transport | Family Nutrition |
| Cattle | 80 | 60 | 70 | 68 | 36 | 30 | 25 |
| Goat | - | - | - | 75 | 50 | - | 5 |
| Poultry | - | 75 | - | - | 50 | - | 65 |
| Duck | - | 36 | - | 30 | - | - | 45 |
| Pigeon | - | 30 | - | 12 | - | - | 38 |

Source: Field Survey, 2001

Table 5. Incidence and prevalence of livestock diseases at FSRD Site, Narikeli, Jamalpur during 2001

| Livestock | Major disease | Prevalence | Death (no)* | Month of death |
|---|---|---|---|---|
| Cattle | 1. FMD | June-Aug. | 2 | July |
| | 2.HS(Ghalafolla) | June-Aug. | 1 | July |
| | 3. Diarrhoea | Nov.- Feb. | 3 | January |
| | 4. Titanus | Nov.- Feb | 1 | December |
| | 5. Pox | March-June | - | - |
| | 6. Dysentery | Oct.- Nov | - | - |
| Goat | 1. Diarrhoea | March-June | 2 | - |
| | 2. HS( Ghola folla) | June-Sept. | 1 | - |
| Poultry | 1 Raniket | July-Aug | 63 | June to Aug |
| | 2. Gumboro | March-June | 11 | April to June |
| | 3. Cholera | March-June | 17 | May to June |
| | 4.Fowl pox | March-June | 29 | April to June |

Source: Field Survey, 2001

* Death during 2000

Table 6. Income from livestock in 2001 at FSRD site, Narikeli, Jamalpur

| Farmers categories | Source of income (Tk./Year) | | | | | |
|---|---|---|---|---|---|---|
| | Poultry | Field crops | Livestock | Fisheries | Business | Day labour |
| Landless | 400 | - | 4000 | - | 5000 | 4400 |
| Marginal | 800 | 5900 | 4100 | - | 4000 | 1150 |
| Small | 1000 | 8200 | 6200 | 4000 | 1000 | 1800 |
| Medium | 1400 | 10600 | 8000 | 6000 | 4200 | - |
| Large | 1800 | 12000 | 9300 | 8000 | 6300 | - |
| All | 1080 | 7340 | 6320 | 3600 | 4100 | 1470 |

Source: Field survey, 2001

Table 7. Problem of livestock rearing faced by the sample farmers in Narikeli, FSRD, Jamalpur 2000

| Constraints | Respondent (No.) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Landless | Marginal | Small | Medium | Large | All groups | |
| | | | | | | | Percent |
| Lack of grazing land and grass | 20 | 20 | 18 | 8 | 6 | 72 | 90.00 |
| Lack of veterinary surgeon | 20 | 19 | 19 | 7 | 5 | 70 | 87.50 |
| Shortage of fodder in rainy seasons | 18 | 16 | 17 | 6 | 6 | 63 | 78.75 |
| Shortage of straw | 15 | 13 | 12 | 5 | 4 | 49 | 61.25 |
| Lack of modern technology for livestock rearing | 20 | 18 | 16 | 8 | 5 | 67 | 83.75 |
| Home produced feed not enough for whole year | 18 | 16 | 14 | 7 | 8 | 63 | 78.75 |
| Housing condition not good | 19 | 17 | 15 | 8 | 9 | 68 | 85.00 |
| Poor heath condition due to lack of nutrition | 20 | 19 | 18 | 6 | 5 | 68 | 85.00 |
| Medicine not available for preventing diseases | 19 | 18 | 16 | 6 | 4 | 63 | 78.75 |
| Diseases break out | 15 | 11 | 10 | 7 | 5 | 48 | 60.00 |
| Inadequate knowledge of diseases | 19 | 18 | 17 | 5 | 4 | 63 | 78.75 |
| Lack of Hybrid | 20 | 13 | 16 | 6 | 5 | 60 | 75.00 |
| High price of oilcake and wheat bran | 15 | 14 | 13 | 8 | 9 | 59 | 74.00 |

Source: Field Survey, 2001

# YIELD GAP ANALYSIS OF MUNGBEAN AND WHEAT AT BARISAL


## Abstract

An experiment was conducted at Babuganj near RARS, Rahmatpur, Barisal and MLT site Jhalokati during Rabi season, 2001-02 to find out the causes of yield difference of wheat and mungbean between farmers practice and demonstration plots. Demonstration plots produced higher yield for both the crops. An yield difference of 0.393 t/ha (81 %) for mungbean and 1.78 t/ha (90%) for wheat was recorded mainly due to lower level of input used by the farmers practice.


## Introduction

It is usually observed that the yield of wheat and mungbean in farmers field differ from that obtained in research station or demonstration plot. This might be due to some variations in cultural practice and level of input use. So, the study was undertaken to identify the factors that lead the yield gap of the concerned crops.

## Materials and Methods

A total of 10 farmers owing 10 plots were selected for each crop from Babuganj Upzila of Barisal district and MLT site Jhalokati for collection of necessary data on farmers' practice. The data was collected through monitoring technique with the help of a pre-design schedule. In addition 3 demonstration plots were established with concerned monitoring crops applying recommended package. The varieties used for the experiment were Protiva for wheat and BARI mung-5 for mungbean. The collected information were edited, summarized and presented his tabular form using average and percentage.

## Results and Discussions

**Mungbean:** There exits a wide gap in yield between demonstration plots and farmers practices. Demonstration plots gave higher yield (0.88 t/ha) than farmers practice (0.487 t/ha). The yield differences stands 0.393 t/ha and gap is gross margin stands Tk. 5200.00/ha. Required management practice was done in demonstration plots but farmers practice were in lacking of proper management. Input use level was also different. Demonstration plots received 40 and 60 kg/ha urea and TSP, respectively, but farmers plots received no fertilizer. Sowing time was also late for farmers practice by 2 weeks. Weeding and insect/pest or disease control measures were also nil in the farmers practice. As a result there yield differences might be occurred.

**Wheat:** Demonstration plots produced higher yield (3.76 t/ha) than farmers practice (1.98 t/ha). The yield gap was found 1.98 t/ha and gap in gross margin was found Tk. 6793.00/ha (73%). The main reasons for yield in farmers practice might be late sowing, lower level of fertilizer use and use of no weeding and irrigation. Sowing time for demonstration plots were December 5-10, 2001 but farmers sown the wheat last week of December, 2001 to first week of January, 2002. Irrigation and weeding were carried out twice for demonstration plots but in farmers plots received no irrigation and weeding. Balanced fertilizer dose of 100-30-30 kg NPK/ha were applied in the demonstration plots but farmers used only N and P at the rate of 50 kg/ha and 25 kg/ha, respectively.

Table 1. Input use level and yield obtained for mungbean cultivation in different management practice

| Items | Demonstration plots | Farmers practice |
|---|---|---|
| Sowing period | February, 12 | February, 23 |
| Spacing | 30x10 cm | Broadcast |
| Plants/m$^2$ | 25 | 15.45 |
| Weeding (no.) | 1 | - |
| Input/pest control (no.) | 2 | - |
| Fertilizer used (kg/ha) | | |
| Urea | 40 | - |
| TSP | 60 | - |
| Seed yield (t/ha) | 0.880 | 0.487 |
| Yield gap (t/ha) | 0.313 (81%) | |

Table 2. Cost and return analysis of mungbean cultivation in different management practice

| Particulars | Demonstration practices | | Farmer practices | |
|---|---|---|---|---|
| | Quantity | Value (Tk) | Quantity | Value (Tk) |
| Plaughing | 3 | 700.00 | 1 | 300.00 |
| Seed (kg) | 30 | 1200.00 | 40 | 1600.00 |
| Labour required for plaughing | | | | |
| sowing | 7 | 490.00 | 3 | 210.00 |
| weeding | 8 | 560.00 | 2 | 140.00 |
| spray of pesticide and | 8 | 560.00 | - | - |
| harvesting | 2 | 140.00 | - | - |
| Fertilizer used (kg/ha) | 20 | 1400.00 | 20 | 1400.00 |
| Urea | | | | |
| TSP | 40 | 240.00 | - | - |
| Pesticide | 60 | 900.00 | - | - |
| | | 120.00 | - | - |
| Total variable cost | | 6310.00 | | 3650.00 |
| Seed yield (t/ha) | 880 | 17600.00 | 487 | 9740.00 |
| Gross return (Tk/ha) | | 24225.00 | | 13760.00 |
| Gross margin (Tk/ha) | | 17080.00 | | 10110.00 |
| Gap in gross margin (Tk/ha) | | 5200.00 (85%) | | |

Table 3. Input use level and yield obtained for wheat cultivation in different management practices.

| Input/technology used | Demonstration practices | Farmers practices |
|---|---|---|
| Planting time | 5-10 December 2001 | 25, December, 2001 to 5, January, 2002 |
| Spacing (cm) | 30 cm x 10 cm | Broadcast |
| Seed rate (kg/ha) | 125 | 130 |
| Plants/m2 | 301 | 245 |
| Plaughing (No) | 4 | 4 |
| Weeding (No) | 2 | 0 |
| Irrigation (No) | 2 | 0 |
| | | |
| Fertilizer used | | |
| Urea (kg/ha) | 217 | 110 |
| TSP (kg/ha) | 152 | 52 |
| MP (kg/ha) | 60 | - |
| Grain yield (t/ha) | 3.76 | 1.98 |
| Yield gap (t/ha) | 1.78 (90%) | |

Table 4. Cost and return analysis different management practice for wheat cultivation

| Particulars | Demonstration practices | | Farmer practices | |
|---|---|---|---|---|
| | Quantity | Value (Tk) | Quantity | Value (Tk) |
| Plaughing | 4 | 700.00 | 4 | 700.00 |
| Seed (kg/ha) | 125 | 1500.00 | 130 | 1560.00 |
| Labour required for plaughing | | | | |
| sowing | 3 | 210.00 | 2 | 140.00 |
| weeding | 5 | 350.00 | 1 | 70.00 |
| Irrigating | 10 | 700.00 | 5 | 350.00 |
| harvesting | 10 | 700.00 | - | - |
| Fertilizer used (kg/ha) | 8 | 560.00 | 8 | 560.00 |
| Urea | | | | |
| TSP | 217 | 1302.00 | 110 | 660.00 |
| Pesticide | 152 | 2280.00 | 127 | 1905.00 |
| | 60 | 540.00 | - | - |
| Total variable cost | | 8642.00 | | 5945.00 |
| Grain yield (t/ha) | 3.76 | 22560.00 | 1.98 | 11880.00 |
| Gross return (Tk/ha) | | 24785.00 | | 13390.00 |
| Gross margin (Tk/ha) | | 16143.00 | | 9350.00 |
| Gap in gross margin (Tk/ha) | 6793.00 (73%) | | | |

# HOUSEHOLD ORGANIC MATERIALS AND CROP RESIDUE MANAGEMENT AT RAJSHAHI AND NOAKHALI AREAS


## Abstract

The survey was conducted at farming systems research and development (FSRD) site, Chabbishnagar, Barind, Rajshahi and Atkapalia, Noakhali to estimate the production, utilization and documentation of household organic materials and crop residues at the farm level. Cowdung, cattle feed waste, kitchen waste, ash and poultry litter from poultry case were the main sources of organic materials available at all survey conducted locations. On the other hand, major crop residues were found straws of aman, boro rice and wheat and mustard/pulse stover. Farmers used most of the cowdung, cattle feed waste, kitchen waste and ash as farm yard manure and rice straw as cattle feed and fuel. But significant portions of poultry litter and kitchen wastes are throwing out without any meaningful use.


## Introduction

The organic matter content of our soils is declining with time due to poor attention to its improvement and maintenance. This declining of soil fertility is aggravated due to deficiency of more and more micronutrients in the soil. Thus it has become a priority to improve soil fertility in the agricultural production system. Soil organic matter improves soil physical, chemical and biological properties and is the storehouse of almost all plant nutrients. In this context, to combat crisis, micronutrient deficiencies and to increase the efficiency of applied fertilizers as well as to substitute the fertilizer requirement organic materials and crop residues available at farm level may be a boon for agricultural production particularly for increasing organic matter content of the soil. In improving crop productivity, improvement of soil organic matter content in very essential.

A major portion of the organic materials is produced at the household level. These materials at the household level, if processed for recycling, can generate a substantial amount of organic manure for soil fertility replenishment. As such the study was undertaken to estimate the production, utilization and documentation of household organic materials and crop residues at the farm level.

## Methodology

The survey was conducted at two FSRD sites, Chabbishnagar, Barind, Rajshahi and Atkapalia, Noakhali during October – December 2001. A total of 60 farmers from Barind and 65 farmers from Noakhali were selected using simple random sampling technique for primary data collection. The survey was conducted with the help of a pre-designed schedule by direct interviewing the selected farmers. The collected information was edited, summarized and local units and measurements were converted into standard ones. The results were presented in tabular form.

## Results and Discussion

**Annual production of organic materials and their uses:** Cowdung, cattle feed wastes, kitchen wastes, ash and poultry litter were the main organic materials available at the farm level. On an average 3648 kg/farm/year cowdung was available with the farmers at Barind and 3331 kg/farm/year at Noakhali (Table 1). On the other hand, the amount of cattle feed wastes, kitchen wastes, ash and poultry litter available with the farmers at Barind was 410 kg, 209 kg, 327 kg and 308 kg/farm/year respectively. On the other hand, at Noakhali more or less similar amount of organic materials were available at household level. It was revealed that amount of all kind of organic materials increased with the increase of farm size.

It was found that the highest amount of cowdung was used as farm yard manure at both the sites (52% at Barind and 35% at Noakhali respectively). But a significant portion of cowdung was burnt as domestic fuel (42% at Barind and 24% at Noakhali respectively). A small portion of the cowdung was also used directly to the vegetable garden. Major portion of the cattle feed wastes being used as domestic fuel at Barind (55%) but largest amount (74%) at Noakhali being used as FYM. Most of the kitchen wastes (45% at Barind and 65% at Noakhali) being used as farm yard manure. A portion of the kitchen wastes being used as cattle feed (28% at Barind and 25% at Noakhali) and the rest amount is dropped out without any meaningful use. In case of ash, the major amount (67%) is being used in farm yard manure at Barind but at Noakhali the major portion (64%) being used at vegetable garden. The big amount of poultry litter (45%) being dropped out and a significant portion (46%) as FYM at Barind (Table 2). Poultry manure is an important organic manure world over and proved to be superior as compare to cowdung of its higher nutrient content (Farid *et al*., 1998). It was found that 138 kg poultry litter /farm/year dropped out which may be used as manure. Stewart (1991) suggested that the use of household wastes in crop production instead of throwing these away and use of organic manure like livestock and poultry manures could improve soil tilth and organic matter content of the soil significantly.

**Annual production of crop residues and their uses:** A number of crop residues were available at the farm level. The major crop residues were the straws of aman, boro rice and wheat, rice bran and mustard/pulse stover were also available at farm level. Among the crop residues available aman rice straw was recorded to be the highest at both the locations (1859 kg and 2400 kg/farm/year respectively) followed by that of wheat straw (1352 kg/farm/year) at Barind and boro rice straw at Noakhali (1070 kg/farm/year). Area coverage of aman is the largest and the amount of straw available at homestead was also the highest for the same crop (Table 1). The amount of wheat straw was nil because of less or no cultivation of wheat at Noakhali. The amount of mustard/pulses stover (479 kg at Barind and 71 kg at Noakhali/farm/year) was also small for the same reason.

It was found that most of the straw of aman (60% at Barind and 84% at Noakhali) and boro rice (55% at Barind and 83% at Noakhali) was used as cattle feed (Table 3). On the other hand, most of the wheat straw (55%) and mustard/pulses stover (62%) were used as fuel at Barind. A portion of the aman (28%) and boro rice straw (37%) was also burnt as domestic fuel at Barind. It was found that less amount of crop residue was burnt at Noakhali compared to Barind.

A good amount of organic materials and crop residues are produced at the farm level. However farmers are using their household organic materials mostly in making farm year manure, rice straw as cattle feed and mingled the crop residue mostly in the soil. This indicated a favourable condition to the organic recycling. But a considerable portion of the household organic materials were not used for any productive purposes specially those of poultry litter and kitchen waste were dropped out. Farmers should be motivated to use their household wastes in their crop production instead of throwing these away. This organic manure would be valuable input to improve soil fertility. Therefore preservation of organic materials at the household level be encouraged for enrichment of potential soil organic matter content of the soil.

## References

BBS. 2001. 1999 Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics, Ministry of Planning, Dhaka.

Farid, A. T. M.; M. Rahman; K. H. Talukder, M. Shahidullah and M. S. Islam. 1998. Efficiency of poultry manure and cowdung alone and in combination with mineral fertilizers on the yield of cabbage. *Bangladesh J. Agril. Res.* 23 (1):157-165.

Stewart, B.A. 1991. Effect of animal manure as soil physical and chemical properties. In. Proc. National Workshop on Livestock, poultry and aquaculture waste management held 29-31, March, Missore, USA.

Table 1. Annual production of organic materials and crop residues at farm level in FSRD site Chabbishnagar, Barind and Atkapalia, Noakhali

(kg/farm/year)

| Items | Barind | | | | | | Noakhali |
|---|---|---|---|---|---|---|---|
| | Landless | Marginal | Small | Medium | Large | All | |
| Cowdung | 3048 | 3367 | 3663 | 3828 | 4336 | 3648 | 3331 |
| Cattle feed waste | 247 | 369 | 482 | 466 | 475 | 410 | 860 |
| Kitchen waste | 170 | 187 | 208 | 229 | 253 | 209 | 280 |
| Ash | 230 | 295 | 361 | 365 | 382 | 327 | 400 |
| Poultry litter | 325 | 318 | 280 | 226 | 392 | 308 | - |
| Aman straw | 750 | 1125 | 2006 | 2381 | 3033 | 1859 | 2400 |
| Boro straw | 498 | 627 | 855 | 1300 | 1407 | 937 | 1070 |
| Wheat straw | 682 | 1185 | 1192 | 1630 | 2172 | 1352 | - |
| Pulse/mustard stover | 190 | 410 | 455 | 610 | 732 | 479 | 71 |

Table 2. Use of household organic materials at FSRD site Barind and Noakhali

| Items | Amount used (kg/farm/year) | |
|---|---|---|
| | Barind | Noakhali |
| Cowdung: | | |
| Farmyard manure | 1897 (52) | 1166 (35) |
| Fuel | 1532 (42) | 799 (24) |
| Vegetable garden | 219 (6) | 933 (28) |
| Others | 73 (2) | 433 (13) |
| Cattle feed waste: | | |
| Farmyard manure | 152 (37) | 636 (74) |
| Fuel | 226 (55) | 52 (6) |
| Vegetable garden | 12 (3) | 172 (20) |
| Others | 20 (5) | - |
| Kitchen waste: | | |
| Farmyard manure | 94 (45) | 182 (65) |
| Cattle feed | 59 (28) | 70 (25) |
| Drop out | 56 (27) | 28 (10) |
| Ash: | | |
| Farmyard manure | 219 (67) | 144 (36) |
| Vegetable garden | 62 (19) | 256 (64) |
| Others | 46 (14) | - |
| Poultry litter: | | |
| Farmyard manure | 142 (46) | - |
| Vegetable garden | 28 (9) | |
| Drop out | 138 (45) | |

Figures in the parentheses indicate percentage

Table 3. Use of crop residue at Chabbishnagar, Barind and Atkapalia, Noakhali

| Items | Amount (Kg/farm/year) | |
|---|---|---|
| | Barind | Noakhali |
| Aman straw: | | |
| Fuel | 521 (28) | 312 (13) |
| Cattle feed | 1115 (60) | 2016 (84) |
| Fencing | 186 (10) | - |
| Others | 38 (2) | 72 (3) |
| Boro straw: | | |
| Fuel | 347 (37) | 96 (9) |
| Cattle feed | 515 (55) | 888 (83) |
| Fencing | 28 (3) | - |
| Others | 47 (5) | 86 (8) |
| Wheat straw: | | |
| Fuel | 744 (55) | - |
| Cattle feed | 379 (28) | |
| Fencing | 230 (17) | |
| Others | - | |
| Mustard/pulse stover: | | |
| Fuel | 297 (62) | 14 (20) |
| Cattle feed | 163 (34) | 57 (80) |
| Others | 19 (4) | |

Figures in the parentheses indicate percentage

# FERTILIZER MANAGEMENT IN MAJOR CROPPING PATTERNS AT FSRD SITE, BARIND AND NOAKHALI


## Abstract

The study was carried out at farming systems research and development (FSRD) site Chabbishnagar, Barind and Atkapalia, Noakhali to identify the existing fertilizer management practices in major cropping patterns during October-December 2001. Fallow-T.aman, Chickpea-T.aman and Wheat-T.aman were identified as three major cropping patterns at Barind whereas Fallow-T.aman, B.aus-T.aman and Groundnut-T.aman were identified as three major cropping patterns at Noakhali. The study revealed that farmers do not apply recommended dose of fertilizer to their crop field. No general trend was found for using inorganic fertilizer to the crops. The amount of fertilizers varied among the crops but the recommendation was not followed in most of the cases. The farmers were found to apply higher amount of P in all the T.aman crops at both the locations. But application of other fertilizers was less than recommendation.


## Introduction

The rice-rice cropping systems with unbalanced use of inorganic fertilizer have deleterious effects on soil health. Application of fertilizers especially NPK, in balanced quantities is often advocated for sustaining high yields of crops (Bhuiyan *et al.*, 1991; Singh *et al.* 1973). In intensive rice cultivation with high yielding varieties, however, phosphate and potash application may be needed along with nitrogen for satisfactory rice yields. With the gradual spread of high yielding varieties (HYVs) of different crops in Bangladesh, it is necessary to assess the contribution of fertilizer elements to the grain yield of the crops. Among the factors that affect crop production, fertilizer is the single most important one that plays a crucial role in yield increased. Of the total nutrients used in the soil, nitrogen alone constitutes about 80 percent, which may lead to nutrient imbalance in soil-plant systems.

Significant carry over effects of different chemical fertilizers was observed in different studies (Balla, 1974; Gupta *et al.*, 1986). The first task for this purpose is to identify present fertilizer management practices in major cropping patterns. The study is, therefore, undertaken to identify the existing fertilizer management practices in major cropping patterns.

## Methodology

The study was conducted at farming systems research and development (FSRD) site Chabbishnagar, Barind and Atkapalia, Noakhali. A total of 60 farmers at Barind and 65 farmers at Noakhali were selected using simple random sampling technique for primary data collection. The survey was conducted with the help of a pre-designed schedule by direct interviewing the selected farmers. The collected information was edited, summarized and local units and measurements were converted into standard ones. The results were presented in tabular form. Adoption index was used to identify the major cropping patterns such as –

Adoption index = (Percent farmer responded X Percent area covered)/100

## Results and Discussions

**Major cropping patterns:** The major cropping patterns, which were identified by using adoption index revealed that all three major cropping patterns at the location was sequenced with T.aman rice. The first pattern was a single crop pattern (Fallow-T.aman) and the rest two was Chickpea-T.aman and Wheat-T.aman at Barind. In Noakhali Fallow-T.aman, B.aus-T.aman and Groundnut-T.aman were identified as major cropping patterns. This signified a low cropping intensity of less than 200%. T.aman rice was common in all the cropping patterns either it sequenced with single or two crops. (Table 1).

Table 1. Major cropping pattern identified at Barind and Noakhali during 2001

| Cropping pattern | Adoption index |
|---|---|
| Chabbishnagar, Barind: | |
| Fallow-T.Aman | 9.83 |
| Chickpea-T.Aman | 2.73 |
| Wheat-T.Aman | 1.95 |
| Atkapalia, Noakhali: | |
| Fallow -T.Aman | 4.64 |
| Aus -T.Aman | 3.32 |
| Groundnut -T.Aman | 2.06 |

Adoption index = (% farmer responded X % area covered)/100

**Fertilizer management and crop performance:** Organic manure like farmyard manure (FYM) was found to use in all major cropping patterns. Farmyard manure was applied in all the three first crops of the cropping patterns at Barind. T.aman did not receive any kind of organic manure when it is sequenced with either chickpea or wheat (Table 2). The inorganic (NPKS) dressing as basal dose with T.aman was 11-9-17-3 kg/ha in the Fallow-T.aman cropping pattern. Top dressing of nitrogen @ 27 kg/ha was done for T.aman in first installment, whereas 17 kg N/ha was applied in the second installment (Table 2). Farmers used higher amount of P but lower amount of other inorganic fertilizers like N, K and S. The farmers did not apply any Zn for T.aman though it was recommended 1 kg/ha. In the chickpea-T.aman cropping pattern chickpea received 0-10-8-1 kg/ha NPKS against a recommendation of 20-20-40-15 kg/ha NPKS. The other crop of the pattern, T.aman received 46-13-13-1 kg/ha NPKS against a recommendation of 65-8-40-5-1 kg/ha NPKSZn (Table 3). It was found that farmers applied less amount of NKS but more amount of P in T.aman. Similar situation was observed in case of T.aman in the wheat-T.aman cropping pattern. The crop wheat received 87-18-19-3 kg/ha NPKS where 90-25-65-20-1.5 kg/ha NPKSZn was recommended. The amount of N applied to wheat is close to recommendation but P, K and S was much below than that of recommendation. Farmers were found to apply no zinc fertilizers in any of the crops in the three major cropping patterns. Farmers received satisfactory level of yield of T.aman in all the cropping patterns. But yield level of chickpea and wheat was much lower.

In Noakhali, farmers used cowdung in a small amount to all the crops except fallow-T.aman pattern. Irrespective of cropping patterns, the amount of P used by the farmers was higher than that of recommendation. But farmers used less amount of other fertilizers (Table 3).

**Determination of fertilizer rates:** Farmers resort to five sources to determine fertilizer rates for their crops. These are i) Farmers indigenous/local knowledge, ii) Advice from the neighbour, iii) Block supervisor, iv) Printed materials like booklet or leaflet and v) Dealer. Most of the farmers (48%) are dependent on self-knowledge and a large portion of the farmers (25%) took advice from the neighbour. Block supervisors and printed materials also helped farmers to determine fertilizer rate (Table 5).

Farmers do not apply recommended dose of fertilizer to their crop field. No general trend was found for using inorganic fertilizer to the crops. The amount of fertilizers varied among the crops but the recommendation was not followed in most of the cases. The farmers were found to apply higher amount of P in all the T.aman crops of the major cropping pattern. But application of other fertilizers was less than recommendation. The crop chickpea received very few amount of fertilizers, as a result the yield is not satisfactory. Wheat also received less amount of required fertilizers. The unbalanced use of all the nutrient may lead to nutrient imbalance in soil plant systems and yield goal could not be achieved in most cases. Use of organic manure is negligible which may lead to a degradation of soil nutrient status. Leguminous or fibre crop is not included in the major cropping patterns, which is also enhancing the degradation of soil nutrient status. Strong extension service and result demonstration with recommended fertilizer application might be suggested.

## References


Balla, H. 1974. The value of residual fertilizer NPK and phosphorus in a long-term experiment. *Soils and Ferts. Abst.* 38:292.

Bhuiyan N I, A L Shah and G M Panaullah. 1991. Effect of NPK fertilization on the grain yield of transplanted rice and soil fertility-A long-term study. *Bangladesh J soil Sci.* 22 (1&2): 41-49.

Haque, M M, M Z Abedin, M F Islam, S M Altaf Hossain and M Eaqub. 1991. Study on the sequences of fertilization on T.aus rice-T.aman rice-Wheat cropping pattern in calcareous dark grey flood plain soil. *Bangladesh Agronomy J.* 4(1&2): 1-6.

Gupta, V K, A P Gupta and J C Katyal. 1988. Direct and residual effect of zinc in pearl millet-wheat-pearl millet and cowpea-wheat-cowpea cropping pattern sequences. *J. Indian Soc. Soil Sci.* 34:92-96.

Singh, Y P, R M Upadhya and B B Sharma. 1973. Effect of N, P and K on rice yield in the tarai agro-climatic conditions of Uttar Pradesh. *Indian J. Agril. Sci.* 42 (9): 808-809.


Table 2. Agronomic performance of major cropping patterns at Barind, Rajshahi

| Items | Cropping pattern 1 | Cropping pattern 2 | | Cropping pattern 3 | |
|---|---|---|---|---|---|
| | T.aman | Chickpea | T.aman | Wheat | T.aman |
| Plot size (ha) | 0.18 | 0.12 | 0.12 | 0.13 | 0.13 |
| Irrigated/Rainfed | R | R | R | Ir | R |
| Variety used | BR11(33) Sharna (67) | Nobin (38) BARI Chola (32) Local (30) | BR11(42) Sharna (58) | Kanchan (100) | BR11(46) Sharna (54) |
| Sowing/Planting period | July 12- Aug. 13 | | July 15 – August 10 | Nov 7-Dec 5 | July 14 – Aug. 10 |
| Organic manure (kg/ha): | | | | | |
| FYM | 2519 | 1657 | - | 3229 | - |
| Basal fertilizer (kg/ha): | | | | | |
| N | 11 | - | 3 | 10 | 4 |
| P | 9 | 10 | 13 | 18 | 15 |
| K | 17 | 8 | 13 | 19 | 16 |
| S | 3 | 1 | 1 | 3 | - |
| 1st top dress of N (kg/ha) | 27 | - | 26 | 48 | 33 |
| 2nd top dress of N (kg/ha) | 17 | - | 17 | 29 | 24 |
| Harvesting period | Nov. 5- 30 | March18 – April 4 | Nov. 8- Dec. 5 | March 12-30 | Nov. 3-30 |
| Grain yield (kg/ha) | 3795 | 901 | 3800 | 3137 | 3543 |
| Byproduct (kg/ha) | 4633 | - | 4940 | 3078 | 4547 |

Table 3. Agronomic management practices of major cropping patterns at Atkapalia, Noakhali

| Items | Cropping pattern I | | Cropping pattern II | | | Cropping pattern III | |
|---|---|---|---|---|---|---|---|
| | Fallow | T.aman | Fallow | Aus | T.aman | Groundnut | T.aman |
| Av. Plot size(dec/farm) | | 64.5 | | 82.2 | 59.0 | 45.0 | 37.3 |
| Variety used | | local | | local | local | Local | local |
| Sowing/planting period | | July-Aug | | April-May | July-Aug | Nov-Dec | July-Aug |
| Cow-dung | | - | | 701 | 265 | 1921 | 1192 |
| Basal fertilizer used (kg/ha): | | | | | | | |
| Urea | | - | | - | - | - | - |
| TSP | | 13 | | 18 | 11 | 31 | 12 |
| MP | | 17 | | 13 | 31 | 5 | 20 |
| GYP | | 8 | | 4 | - | - | - |
| Urea(kg/ha): | | | | | | | |
| 1st top dress | | 17 | | 9 | 25 | - | 36 |
| 2nd top dress | | 17 | | - | 12 | - | 14 |
| Harvesting period | | Nov-Jan | | Aug-Sept | Nov-Jan | | Nov-Jan |
| Main product(t/ha) | | 1.8 | | 2.0 | 1.3 | 1.39 | 0.974 |
| By product(kg/ha) | | 3578 | | 3719 | 3393 | 2378 | 3121 |

Table 4. Nutrient application and productivity of the crops as compared to recommendation at Rajshahi and Noakhali

| Practice | Nutrient used (kg/ha) | | | | | | Yield (kg/ha) | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | Zn | B | Main product | By product |
| Barind, Rajshahi | | **Fallow-T.aman CP** | | | | | | |
| T.aman: | | | | | | | | |
| FP | 55 | 9 | 17 | 3 | - | - | 3795 | 4633 |
| Recom. | 65 | 8 | 40 | 15 | 1 | - | 3300 | - |
| **Chickpea-T.aman CP** | | | | | | | | |
| Chickpea: | | | | | | | | |
| FP | - | 10 | 8 | 1 | - | - | 901 | - |
| Recom. | 20 | 20 | 40 | 15 | - | 0.5 | 1200 | - |
| T.aman: | | | | | | | | |
| FP | 46 | 13 | 13 | 1 | - | - | 3800 | 4940 |
| Recom. | 65 | 8 | 40 | 5 | 1 | - | 3300 | - |
| **Wheat-T.aman CP** | | | | | | | | |
| Wheat: | | | | | | | | |
| FP | 87 | 18 | 19 | 3 | - | - | 3137 | 3078 |
| Recom. | 90 | 25 | 65 | 20 | 1.5 | - | 3500 | - |
| T.aman: | | | | | | | | |
| FP | 61 | 15 | 16 | - | - | - | 3543 | 4547 |
| Recom. | 75 | 12 | 40 | 5 | - | - | 3500 | - |
| Atkapalia, Noakhali | | **Fallow-T.aman CP** | | | | | | |
| T.aman: | | | | | | | | |
| FP | 34 | 13 | 17 | 8 | - | - | 1800 | 3478 |
| Recom. | 40 | 8 | 20 | 2 | - | - | 2400 | - |
| **Aus-T.aman CP** | | | | | | | | |
| Aus: | | | | | | | | |
| FP | 9 | 18 | 13 | 4 | - | - | 2000 | 3719 |
| Recom. | 30 | 10 | 20 | 2 | - | - | 2200 | - |
| T.aman: | | | | | | | | |
| FP | 37 | 11 | 31 | - | - | - | 1300 | 3393 |
| Recom. | 40 | 4 | 20 | 2 | - | - | 2400 | - |
| **Groundnut-T.aman CP** | | | | | | | | |
| Groundnut | | | | | | | | |
| FP | 0 | 31 | 5 | - | - | - | 1390 | 2378 |
| Recom. | 20 | 20 | 25 | 12 | - | - | 1800 | - |
| T.aman: | | | | | | | | |
| FP | 50 | 12 | 20 | - | - | - | 1974 | 3121 |
| Recom. | 40 | 4 | 20 | 2 | - | - | 2400 | - |

FP= Farmers practice, Recom.= Recommendation adopted from BARC (1997)

Table 5. Trend of crop yield during last 5 years as reported by the farmers at Barind, Rajshahi

| Yield status | Farmer responded (%) | Reasons |
|---|---|---|
| Stable | 32 | Fertilizer use, regular intercultural operation |
| Increasing | 48 | Fertilizer use, regular intercultural operation, maintaining crop rotation, modern variety, |
| Decreasing | 20 | No or less use of organic manure, insect pest infestation, lack of quality seed, lack of irrigation, decreasing soil fertility etc. |

Table 6. Amount and type of fertilizer determination for crops as reported by the farmers

| Items | Number | Percent |
|---|---|---|
| Self, considering crop condition & experience | 29 | 48 |
| Advice from other farmers | 15 | 25 |
| Block supervision | 8 | 13 |
| Booklet/ leaflet | 5 | 9 |
| Dealer | 3 | 5 |

# STUDY ON THE PERFORMANCE OF WHEAT VARIETIES DEVELOPED BY BARI


## Abstract

On-farm performance of wheat varieties was evaluated at Gangni and Damurhuda multilocation testing sites during rabi seasons of 2000 to 2002 to find out suitable variety of wheat. Five varieties viz. Satabdi, Protiva, Gourab, Sourav and Kanchan were evaluated in RCB design with three dispersed replication in each site. Results revealed that Satabdi produced the significantly highest yield in all sites. No significant yield difference was observed among the varieties but Satabdi gave the highest yield in Damurhuda site.


## Introduction

Wheat is successfully grown in about 18000 ha area in Meharpur and Chuadanga district. These are the most potential area for wheat cultivation. Wheat is grown in this area intensively following the improved cropping pattern Wheat-Jute /Aus-T.Aman rice. But most of the farmers use the variety Kanchan at all sites. The yield of Kanchan is decreasing gradually. Recently the Wheat Research Center (WRC) of BARI has developed four new varieties with considerable yield advantage over Kanchan. It is therefore necessary to test the performance of these new varieties against Kanchan for improvement of the cropping pattern.

## Materials and Method

The experiment was conducted at Damurhuda and Gangni MLT sites at the farmers field in rabi season of 2001-2002. The experiment was laid out in randomized complete design with three dispersed replications in each site. The tested varieties were Satabdi, Kanchan, Protiva, Sourav and Gourab. The seeds were sown in line at 20 cm apart. Sowing date was 22 Nov to 18 Dec. 2001 at Damurhuda and Gangni. Fertilizer used at the rate of 120-60-40-20-5-1 kg N, $P_2O_5$, $K_2O$, S, Zn and B from urea, triple super phosphate, muriate of potash, gypsum zinc sulphate and boric acid and 5 ton cowdung per hectare. Full amount of P K S Zn and B and half of the urea was applied at the time of land preparation and the rest of the N was applied at first irrigation time. Three times irrigation was given. Plant protection measure was taken. The crop was harvested at 3-29 March, 2002. Necessary data were collected and analyzed.

## Results and Discussion

### Site: Gangni and Damurhuda, MLT

At, Gangni, number of grains/spike, spikes/$m^2$ and grain yield and straw yields were significantly influenced by variety (Tables 1). Crop duration varied only 4 days but plant height was statistically identical. The variety Satabdi and Protiva showed similar no. of grains/spike and significantly higher than other varieties. Grain weight was not influenced by different variety. Significantly highest grain yield was obtained from variety Satabdi. But straw yield between Satabdi and Protiva were statistical identical.

At Damurhuda, Crop duration and plant height were statically significant. Other yield and yield attributes were statistically identical. The variety Satabdi and Sourav took longer duration. Plant height was statistically identical except variety Gourab. Though grain yield was not significant but higher yield was obtained from variety Satabdi and also straw yield higher from same variety.

### Farmers Reaction

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

Table 1. Yield and yield attributes of different wheat varieties at Gangni MLT site in 2001-2002

| Variety | Crop duration (days) | Plant height (cm) | No. of grains /spike | Spike/m$^2$ (No.) | 1000 grain wt (gm) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Satabdi | 102 | 107.3 | 32.33a | 352.6a | 45.00 | 4.57 a | 6.64a |
| Protiva | 102 | 107.3 | 32.33a | 349.0ab | 44.67 | 4.47 b | 6.51ab |
| Gourab | 100 | 104.3 | 30.67b | 337.3abc | 43.67 | 4.27 c | 6.25bc |
| Sourav | 100 | 104.3 | 30.33b | 328.3bc | 42.67 | 4.20 d | 6.09cd |
| Kanchan | 104 | 104.3 | 30.33b | 327.3bc | 42.67 | 4.00 e | 6.00d |
| CV (%) | 2.0 | 2.5 | 2.1 | 1.8 | 2.0 | 0.7 | 1.5 |
| F-test | NS | NS | ** | * | NS | ** | ** |

Table 2. Yield and yield attributes of different wheat varieties at Damurhuda MLT site in 2001-2002

| Variety | Crop duration (days) | Plant height (cm) | No. of grains /spike | Spike/m$^2$ (No.) | 1000 grain wt (gm) | Grain yield (t/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Satabdi | 109 a | 90.0a | 34.67 | 326.3 | 37.22 | 3.61 | 5.50 |
| Protiva | 106b | 91.0a | 32.00 | 320.3 | 37.21 | 3.44 | 5.10 |
| Gourab | 106b | 86.0b | 31.33 | 300.0 | 44.05 | 3.45 | 4.33 |
| Sourav | 108a | 87.6ab | 34.00 | 316.7 | 38.25 | 3.29 | 5.33 |
| Kanchan | 106b | 89.0ab | 32.00 | 325.7 | 37.22 | 3.17 | 4.33 |
| CV (%) | 0.7 | 2.1 | 6.7 | 4.9 | 6.2 | 8.8 | 12.3 |
| F-test. | ** | * | NS | NS | NS | NS | NS |

# EFFECT OF CUTTING STAGE ON FORAGE AND GRAIN YIELD OF BARLEY


## Abstract

The experiment was conducted at the Regional Agricultural Research Station, Jamalpur during the rabi season of 2001-2002 to find out the optimum cutting times for obtaining maximum forage besides grain yield of barley (var. BARI Barly-1). Four treatments viz. no cutting (control); cutting at 40 DAE and grain production; cutting at 55 DAE and grain production; cutting at 40 + 55 DAE and then production were studied. It may be concluded from two year result that highest grain yield (2.39 t/ha) was obtained from no cutting but cutting at 40 DAE + grain production showed 29% lower yield with forage yield 8.61 t/ha.


## Introduction

Barley is a winter season, short duration cereal crop mainly grown for the grain yield. But observational trial indicated that it not only produces grain but also produces substantial bio-mass making it suitable for forage and offering farmers fresh animal feed during scarcity period. This dual use of cereal for forage and grain production has led to starting with management practices including number and period of cutting. Therefore, its cultivation could be extended to supplement animal feed during January to February when there is acute shortage of green fodder. The present study was undertaken to find out the optimum cutting times for obtaining maximum forage besides grain yield under AEZ 9.

## Materials and Methods

The experiment was conducted at the RARS, Jamalpur during the rabi season of 2001-2002. The experimental area was an irrigated medium highland of clay loam soil having $P^H$ value of 6.8 under Old Brahmpathra Floodplain AEZ 9. There were four treatments which were as: $T_1$= No cutting (Control), $T_2$= Cutting at 40 DAE + grain production, $T_3$= Cutting at 55 DAE + grain production, $T_4$= Cutting at 40 + 55 DAE + grain production. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 3m x 5m. The land was fertilized with 80-60-40 N, $P_2O_5$, $K_2O$ kg/ha through Urea, TSP and MP, respectively. Half of urea along with the entire amount of TSP and MP were applied one day before planting and were incorporated thoroughly by spading. The remaining urea was splited to every cutting followed by a light irrigation. The crop was irrigated at 20 days after sowing. Sowing was done in 20 cm row distance with continuous seeding on November 25, 2001. The variety BARI barley-1 was used. Cutting was done at 10 cm above the ground level. The green forage yield was taken plot wise after every cutting. Finally, the crop of no cutting treatment was harvested on March 16, 2002, cutting at 40 DAE treatments were on March 21, 2002 and the other two treatments were on March 29, 2002. The yield data were collected from 10 randomly selected plants prior to harvest from each plot. The grain and straw yield were obtained plot wise after harvest. The collected data were analyzed statistically and the means were separated as per LSD test.

## Results and Discussion

The production of green bio-mass as influenced by different cutting stages of barley is presented in Table 1. Considering the total forage yield it was observed that the significantly highest fodder production (14.20 t/ha) was obtained from the single cutting at 55 days after emergence (DAE) which was statistically different from other treatments. The highest dry matter was produced by single cutting at 55 DAE (2.25 t/ha) which was statistically different from those of other two cuttings. The plant height was found significantly highest in cuttings at 40 + 55 DAE while the lowest was in 40 DAE cutting.

The yield and yield contributing characters as influenced by different cutting stage is presented in Table 2. The result revealed that plant population at initial stage (10 days after sowing) was not differed significantly due to treatment variation. But the number of spikes/m$^2$ at harvest was found highest in the no cutting plot which at par to $T_2$ treatments. The highest plant height was recorded in no cutting treatment which was similar to the cutting at 40 DAE. The treatment cutting at 55 DAE and cutting at 40+55 DAE produced shortest plant and were also identical to each other. The longest spike was recorded from no cutting treatment which was statistically differing from other treatments. Significantly highest number of spikelets/spike was found in no cutting treatment. The number of grains/spike was found highest in no cutting treatment which was statistically differing from other treatments. The highest 1000 grain weight was noted from no cutting treatment which was similar to cutting at 40 DAE. However, the highest grain yield was obtained from no cutting treatment (2.33 t/ha) mainly attributed for higher number of spikes/m$^2$, number of grains/spike and 1000-grain weight. From the result it has been observed that for a single cut at 40 DAE only 29% grain yield was reduced compared to no cutting treatment. The similar trend of grain yield was also obtained in 2000-2001.

However, from the result it may be concluded that grain yield was higher in no cut treatment but yield was lower in cutting at 40 DAE than the no cutting treatment, but there was the production of substantial amount of green fodder which could supply farmers fresh animal feed during scarcity period.

Table 1. Fodder yield, dry matter and plant height of barley as influenced by different cutting stages

| Treat. | Fodder yield (t/ha) | | | Dry matter (t/ha) | | | Plant height at cutting (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 40 DAE | 55 DAE | Total | 40 DAE | 55 DAE | Total | 40 DAE | 55 DAE | Total |
| $T_1$ | - | - | - | - | - | - | - | - | - |
| $T_2$ | 8.61 | - | 8.61 c | 1.14 | - | 1.14 b | 52.5 | - | 52.5 c |
| $T_3$ | - | 14.20 | 14.20 a | - | 2.25 | 2.25 a | - | 80.1 | 80.1 b |
| $T_4$ | 9.27 | 1.24 | 10.51 b | 1.21 | 0.11 | 1.32 b | 51.1 | 38.5 | 89.6 a |
| F | - | - | * | - | - | * | - | - | * |
| CV(%) | - | - | 9.17 | - | - | 10.54 | - | - | 6.46 |

Figure in a column having similar letter do not differ significantly

Table 2. Yield and yield contributing characters of barley as influenced by different cutting stages

| Treatment | Plant pop/.m$^2$ (no.) | Spikes/m$^2$ at harvest (no.) | Plant height (cm) | Spike length (cm) | Spikelets /spike (no) | Grains/ spike (no.) | 1000 grain wt.(g) | Grain yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 01-02 | 00-01 | Average |
| $T_1$ | 289 | 215a | 101.5a | 12.0a | 13.4a | 41.3a | 39.6a | 2.33a | 2.45a | 2.39 |
| $T_2$ | 284 | 183ab | 92.5a | 10.3b | 10.6b | 30.0b | 37.9a | 1.79b | 1.77b | 1.78 |
| $T_3$ | 285 | 146b | 66.8b | 8.1c | 8.4c | 22.5bc | 34.5b | 0.69c | 0.59c | 0.64 |
| $T_4$ | 288 | 138b | 67.9b | 7.5c | 7.5c | 17.8c | 31.9c | 0.56c | 0.63c | 0.59 |
| F | NS | ** | * | * | ** | * | * | * | * | - |
| CV(%) | 3.62 | 11.74 | 5.59 | 7.02 | 8.58 | 12.64 | 3.07 | 11.39 | 10.01 | - |

Figure in a column having similar letter do not differ significantly

# SUPPER IMPOSED VARIETY TRIAL OF T.AMAN RICE


## Abstract

The experiment was conducted at the Farming Systems Research and Development (FSRD) site, Syedpur Pirgacha, Rangpur for three successive years (1999, 2000 and 2001) and Madaripur in 2001-02. The objective was to evaluate the performance of BRRI released T.Aman rice varieties and to fit in the existing cropping pattern (s). The variety BRRIDhan30, BRRIDhan32, and BRRIDhan33 were tested with BR11 as cheek. But BRRIDhan31 and BRRIDhan39 were tested only in two year and BRRIDhan34 in one year. At Rangpur, among the tested varieties, BRRIDhan30 and BRRIDhan31 produced significantly identical yields to BR11 except 1999. The grain yields of the three varieties range from 4.14-5.11 t/ha over the years. The yield of BRRIDhan33 and BRRIDhan39 produced the significantly lower yields than the BRRIDhan30, BRRIDhan31 and BR11 in each year and their range yields from 3.52-3.78 t/ha but their field duration was statistically lower. BRRIDhan32 also produce significantly lower yields (3.87-4.01 t/ha) in 2000 and 2001). But it gave statistically identical yield (4.79t/ha) to BRRIDhan30 and BRRIDhan31 in 1999. The lower yields of BRRIDhan32 were due to lodging. BRRIDhan34 gave the lowest yield (3.02 t/ha) in 1999, but due to fine grain quality with aromatic flavor it was like by limited number of farmers. Although BR11 produced lowest yield (3.48t/ha in 1999) due to infestation of different pests and diseases. The variety BR-11 still now is liked by the farmers for wide ranging ability for transplantation in every type of lands. At Madaripur, BRRIDhan39 gave the highest yield with 111 days to mature.


## Introduction

Rice is usually grown by the farmers of Farming Systems Research and Development site, Syedpur, Rangpur during different seasons of the year. The major cropping pattern is Boro rice-T.Aman rice, followed by Potato-Rice-Rice, Wheat/Potato-Jute-T.Aman and Mustard-Boro-T.Aman. The patterns are more o less followed by the farmers under irrigated condition. During monsoon T.Aman rice is widely grown by the farmers. Almost 90% farmers used BR11 at that period with average yield of around 3.0 t/ha. The variety BR11 long duration and its yield potential have declined over time. Bangladesh Rice Research Institute has developed several varieties, which could be grown during monsoon. The varieties need to be tested under farmers' condition to i) observe the yield performance and ii) know farmers reaction regarding the suitability of those varieties.

## Materials and Methods

The experiment was conducted in the farmers' field for three successive years at the FSRD site Syedpur, Rangpur during the kharif-II season of 1999, 2000 & 2001 and MLT site Madaripur, 2000-01. The soil was sandy loam under Tista Meander Flood plain (AEZ # 3). The experiment was laid out in RCB design with six dispersed replications each year. Six varieties viz. BRRIDhan30, 31 (2 year), 32, 33, 34 and 39 (2 year) were evaluated against the check variety BR11 during the 1st year The variety BRRIDhan39 was included in the study 2nd year but BRRIDhan31 was dropped (seeds were not available) during the second year also BRRIDhan34 (seeds were not available) during the 2nd and 3rd year. But at Madaripur, BRRIDhan32, BRRIDhan33, BRRIDhan39 and BR11 were used. The unit plot size was 10m x 8m. Seedling age 42-45 days were transplanted in lines during July in both the years maintain spacing of 25cm x 15cm. Fertilizer was applied at the rate of 82/68-20-35-11-4 kg N-P-K-S-Zn/ha respectively. Whole quantity of P, K, S and Zn were applied as basal and N (82kg,N/ha for BRRIDhan30, BRRIDhan31 and BR11 & 68 kg N/ha for other verities) was applied as top dress in three equal splits at 15, 30 and 45 days for BRRIDhan32, BRRIDhan33, BRRIDhan34 & BRRIDhan39 and 15, 30 and 50 for other varieties after transplantation. Plant protection measures and other inter cultural operation were done as and when required. The crops were harvested during last part of October to early part of November in both the year. Data on the yield and yield contributing characters were recorded and analyzed statistically.

## Results and Discussion

At Rangpur, field duration, plant height, yield and yield attributes were significantly influenced by different varieties (Table 1). The longest and shortest field duration was observed from BRRIDhan29 and BR11. Significantly highest plant height was recorded from BRRIDhan32 and shortest from BRRIDhan33 and BRRIDhan39. Effective tiller/plant was statistically identical among the varieties except BRRIDhan39 which showed lowest tiller/plant. The BRRIDhan31 revealed higher no. of grains/panicle but statistically identical to variety BR11. The 1000-grain weight was statistically at par to variety BRRIDhan31 and BRRIDhan30. The variety BR11 gave similar yield to BRRIDhan31 but later variety showed 8 days earlier than former variety (BR11). Though BRRIDhan33 and BRRIDhan39 revealed shorter duration but yield was not comparable to BRRIDhan31. The variety BRRIDhan31 showed higher yield than BR11 in average of three year. But straw yield was higher in variety BRRIDhan34 but at par to BRRIDhan32 of T.Aman rice (Table 3).

At Madaripur, The result showed that highest grain yield (5.46 t/ha) was obtained from BRRIDhan39 (Table 3). All the tested varieties earlier than check variety (BR11). The check variety produced lower yield due to incidents of pests and disease.

### Farmer's reaction

The cooperator farmers and their neighbours of Rangpur were encouraged to observe the performance of BRRIDhan30 and BRRIDhan31. Some of the cooperator farmers preserved the seeds of those varieties for next year cultivation. Mixed reaction was observed towards BRRIDhan32 due to its lodging tendency in some cases. Although BRRIDhan33 and BRRIDhan29 matured earlier but its lower yield potential and pest infestation at flowering stage failed to draw the attention of the farmers. The aromatic flavour with fine grain quality and good market price of BRRIDhan34 attracted the attention of limited number of farmers. The cooperator farmers still heavily rely on the performance of BR11 during T.Aman season in spite of its susceptibility to different disease, which is increasing at an alarming rate over time. The farmers of Madaripur were encouraged to see the performance of BRRIDhan39.

## Conclusion and Recommendation

The performance of BRRIDhan30 and BRRIDhan31 appeared to be promising among the varieties, tested at the FSRD site, Syedpur, Rangpur during the study period. These two varieties may be recommended to fit in the Boro-T.Aman cropping pattern only. The experiment needs further trial at Madaripur.

Table 1. Filed duration and Yield contributing characters of Different varieties of T.Aman rice (FSRD site, Syedpur, Rangpur during Kharif-II, 2001)

| Variety | Field duration (day) | Plant height (cm) | Effective tillers/hill (no.) | Filled grain/ Panicle (no.) | 1000 seed wt (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|
| BRRIDhan30 | 106b | 122b | 10.2a | 102c | 24.6ab | 4.33b |
| BRRIDhan31 | 105b | 120b | 10.0ab | 111a | 24.9a | 4.93a |
| BRRIDhan32 | 98c | 129a | 9.7ab | 104bc | 24.5b | 4.01c |
| BRRIDhan33 | 84d | 112c | 9.9ab | 103bc | 24.4b | 3.78c |
| BRRIDhan39 | 86d | 110c | 9.3b | 103bc | 24.5b | 3.64c |
| BR11 (Check) | 113a | 117b | 10.2a | 110ab | 24.5b | 4.96a |
| CV (%) | 2.5 | 4.1 | 7.8 | 7.0 | 1.8 | 7.5 |

Table 2. Yield of different varieties of T.Aman rice (FSRD site, Syedpur, Rangpur during Kharif-II, 1999, 2000 & 2001)

| Verity | Grain yield (t/ha) | | | | Straw (t/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2001 | 2000 | 1999 | Average | 2001 | 2000 | 1999 | Average |
| BRRIDhan30 | 4.43b | 4.14ab | 4.97a | 4.51 | 5.20b | 5.56bc | 5.00b | 5.25 |
| BRRIDhan32 | 4.01c | 3.87bc | 4.79a | 4.72 | 6.13a | 6.01ab | 5.57a | 5.90 |
| BRRIDhan33 | 3.78c | 3.52c | 4.32b | 3.87 | 5.29b | 4.64d | 4.68c | 4.87 |
| BRRIDhan31 | 4.93a | - | 5.11a | 5.02 | 6.10a | - | 5.18b | 5.84 |
| BRRIDhan39 | 3.64c | 3.70bc | - | 3.67 | 5.56ab | 5.01cd | - | 5.64 |
| BRRIDhan34 | - | - | 3.02c | - | 3.02c | - | 5.80a | 5.28 |
| BR11 (Check) | 4.96a | 4.57a | 3.48c | 4.34 | 5.86a | 6.47a | 5.20b | 4.41 |
| CV (%) | 7.5 | 9.2 | 5.6 | - | 10.2 | 10.4 | 9.2 | - |

Table 3. Grain yield and days to maturity of T.Aman rice varieties (MLT site, Madaripur, 2001-02)

| Variety | Grain yield (t/ha) | Days to maturity |
|---|---|---|
| BRRIDhan32 | 4.10 | 125 |
| BRRIDhan33 | 4.55 | 106 |
| BRRIDhan39 | 5.46 | 111 |
| BR11 (Check) | 3.72 | 143 |

# PERFORMANCE OF DIFFERENT CHICKPEA VARIETIES


## Abstract

An experiment was carried out at FSRD site Golapgonj, Sylhet and Ishan Gopalpur, Faridpur to find out the yield and suitability of chickpea variety(s) after harvest of T. aman rice in the Sylhet and Faridpur region. Six BARI developed Chickpea varieties (BARI Chola 2, 3, 4, 5, 6 & 7) were evaluated. At Golapgonj, BARI Chola-3 gave significantly highest yield (1406 kg/ha) which attributed maximum pods/plant and relatively bigger seed size. But at Ishan Gopalpur, all the varieties performed better but Annigeri showed highest yield of 1.89 t/ha followed by BARI Chola-7 (1.75 t/ha).


## Introduction

Pulses can utilize limited soil moisture and nutrients more efficiently than cereal. 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, so which can play a major role in acquisition of both water and nutrient from below the soil surface. In order to increase pulse production, chickpea may be introduced in the existing fallow period. Therefore, the present experiment was undertaken to find out the yield and suitability of chickpea variety(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 Golapgonj, Sylhet and Ishan Gopalpur, Faridpur during the period from November, 2001 to March, 2002. Six chickpea varieties viz. BARI Chola-2, BARI Chola-3, BARI Chola-4, BARI Chola-5, BARI Chola-6 and BARI Chola-7 at Sylhet but at Faridpur two more varieties (Annigeri and Local) were used in the experiment. Treatments were arranged in the RCB design with three replications. The plot size was 4 m$\times$ 3 m. Fertilizers were applied at the rate 20-40-20kg/ha of N, $P_2O_5$ and $K_2$ O, respectively. The seeds were sown on 25 November, 2001 at Sylhet and 11 December at Faridpur. Spacing was 40 cm $\times$ 10 cm. Insecticides were applied twice at Faridpur and crops harvested on 14 March 2002.

## Results and Discussion

### Site: Golapgonj, Sylhet

The results revealed that there were significant variations in all the characters under studied except seeds/pod. The days to maturity ranged from 118 DAS to 124 DAS. The earliest variety was BARI Chola-6 which closely followed by BARI Chola-2. Significantly highest pods/plant was recorded from BARI Chola-3 and lowest from BARI Chola-7. There was no significant difference among the varieties in terms of seeds/pod. The seed weight significantly highest from BARI Chola-2 but minimum weight from BARI Chola-7, which was identical to BARI Chola-4 and BARI Chola-5.

The variety BARI Chola-3 gave the highest yield at 1406 kg/ha which was significantly different among the varieties. The highest seed yield might be due to maximum no. of pods/plant and 100- seed weight. Among the varieties tested, BARI Chola-3 may be considered as high yielder. The experiment was conducted first time at the region. Further study will be needed for given any conclusion.

### Site: Ishan Gapalpur, Faridpur

The yield performances of chickpea are presented in Table 2. The result revealed that plant population/m$^2$, 1000 seed weight, seed yields, differed significantly by treatments. Maximum plant population was found in BARI chickpea-4 (14.2) whereas minimum plant population was observed in local variety. BARI Chola 6 and BARI-Chola-7 were statically identical in respect of 100-seed weight. This two variety showed higher seed weight and significantly lowest seed weight from local variety. Though all the varieties showed statistically similar seed yield except local variety but BARI Chola-7 revealed higher seed yield. The experiment needs further trial for confirmation.

Table 1. Yield and yield contributing characters of six chickpea varieties (FSRD site, Golapgonj, Sylhet during Rabi 2001-2002)

| Variety | Popl/m$^2$ | Days to maturity | Pod/plant | Seeds/ plant | 100 seed wt (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|
| BARI Chola-2 | 26 | 119 | 22 | 1.21 | 14.2 | 856 |
| BARI Chola-3 | 27 | 122 | 29 | 1.21 | 18.1 | 1406 |
| BARI Chola-4 | 24 | 122 | 24 | 1.18 | 12.8 | 782 |
| BARI Chola-5 | 27 | 124 | 27 | 1.30 | 12.4 | 1010 |
| BARI Chola-6 | 23 | 118 | 23 | 1.19 | 15.5 | 858 |
| BARI Chola-7 | 24 | 123 | 21 | 1.26 | 12.3 | 702 |
| $LSD_{0.05}$ | 1.79 | 2.28 | 1.49 | NS | 0.50 | 112 |

Table 2. Yield and yield attributes of chickpea at FSRD site, Ishan Gopalpur, Faridpur 2001-2002

| Variety | Plant population/m$^2$ | Pods/plant | Seeds/plant | 1000 seed weight (g) | Seed yield (t/ha) |
|---|---|---|---|---|---|
| BARI Chola-2 | 12.7ab | 51.2 | 1.85 | 140.7c | 1.48ab |
| BARI Chola-3 | 13.5ab | 50.5 | 1.82 | 115.2e | 1.55ab |
| BARI Chola-4 | 14.2a | 46.0 | 1.87 | 135.0d | 1.64ab |
| BARI Chola-5 | 13.5ab | 48.2 | 1.93 | 117.0f | 1.47ab |
| BARI Chola-6 | 12.3ab | 49.2 | 1.75 | 155.8a | 1.65ab |
| BARI Chola-7 | 13.8ab | 44.8 | 1.88 | 1.54a | 1.79ab |
| Local | 10.8bc | 39.5 | 1.65 | 106.0g | 0.75c |
| Annigeri | 14.0ab | 50.3 | 1.77 | 150.0b | 1.87a |
| CV (%) | 19.0 | 18.7 | 13.3 | 2.2 | 8.3 |

# INFLUENCE OF DIFFERENT TILLAGE METHODS ON THE PERFORMANCE OF CHICKPEA UNDER T.AUS-T.AMAN-FALLOW CROPPING PATTERN


## Abstract

A field experiment was conducted at FSRD site Golapgonj, Sylhet during rabi season 2001-02 to evaluate effect of tillage methods on two chickpea varieties in fallow periods. Treatments included were (a) variety two: BARI Chola-2 and Annigeri and (b) tillage practice viz conventional and deep. The variety Annigeri coupled with deep tillage produced the highest yield (1405kg/ha). Deep tillage performed 15% higher yield than that of conventional tillage. Tillage treatment did not show appreciable difference in soil moisture.


## Introduction

In Bangladesh chickpea is grown primarily as a rainfed crop. The success of this crop depends on the exploitation of residual soil moisture. Farmers usually broadcast seeds, which leads to irregular germination due to less seed soil contact and soil moisture stress. Generally chickpea is often established with conventional tillage. In the Surma-Kushyara floodplain the soil is characterized by hard pan beneath the plough layer. In the post rainy season only the residual soil moisture above the plough pan is available for crop growth and at this situation soil water is limited to support the requirement of any crop. In this contest, breaking of plough pan might allow penetration of roots down the profile and thereby, allow extraction of greater volume of water and nutrient from the deeper zone. This study was undertaken to evaluate the feasibility of growing chickpea in post rainy season fallow period and to investigate the effect of tillage methods on two chickpea genotypes.

## Materials and Methods

A field experiment was conducted at FSRD site, Golapgonj, Sylhet during rabi season of 2001-2002. There were two treatment viz. methods of tillage and varieties of chickpea in the experiment. Methods of tillage were conventional and deep. Conventional tillage was done by country plough while deep tillage was done by spading. About 7-8 cm deep ploughing was maintained by country plough but in case of deep ploughing 18-20 cm depth was maintained two varieties of chickpea BARI Chola-2 and Annigeri were used in the experiment. The experiment was conducted using a RCB (control) design with four replications. Unit plot size was 4m×3m. Spacing was 40 cm×10 cm. Fertilizer at the rate of 20-40-20-20 kg/ha of N, $P_2O_5$, $K_2O$ and S was applied .The seed was sown on 29 November, 2001. The crop was grown under rainfed condition. The rainfall occurred during October and November, 2001 was 308.9 mm and 21 mm, respectively and during crop growing period (December-March) was 83 mm (Figure 1). Pod borer was minimized by spraying of insecticides and also by hand picking of larvae. Soil moisture was monitored by 10 days interval throughout the crop growth period up to a depth of 45 cm with intervals of 15cm. The crop was harvested on 24-25 March, 2002.

## Results and Discussion

Soil moisture percentage varied at sowing to harvest but storage moisture tended to increase with depth (Figure 1). It also showed that with the increment of time soil moisture status within the same depth moved to decrease gradually. Moisture decreased sharply after 62DAS particularly on 0-15 cm and 15-30 cm soil depths. The difference between the moisture curves of conventional and deep tillage is narrow.

### Effect of tillage method

Pods/plant and seed yields were significantly influenced by tillage method but maturity days, plant height and 100-seed weight were at par. Deep tillage showed significantly higher yield due to higher no. of seeds/pod.

## Effect of variety

Plant height, pods/plant, 100-seed weight and seed yields were significantly affected by different variety. The BARI Chola-2 showed significantly higher plant height than Annigeri but pods/plant and 100-seed weights were significantly higher than BARI Chola-2. Significantly highest seed yield was recorded from variety Annigeri due to higher pods/plant and 100-seed weight (Table 1).

## Interaction between tillage method and variety

Plant height, pods/plant, 100-seed weight and seed yields were significantly influenced by different tillage method and variety. Plant height was higher from $M_1V_1$ and $M_2V_1$ which was statistically at par. The variety Annigeri with deep tillage showed higher pods/plant but statistically identical to same variety with conventional tillage. But 100-seed weights were significantly highest from deep tillage with variety Annigeri but other treatments were at par. Higher seed yield was recorded from deep tillage with Annigeri method but at par$M_1V_2$. The highest yield could be attributed to high number of pods/plant and higher 100-grain weight and this advantage were achieved through better utilization of soil moisture and nutrients. This is the 1st year experiment. More details study will be needed for given any conclusion.

Table 1. Yield and yield contributing character of chickpea as affected by variety and tillage methods (Rabi 2001-2002)

| Treatment | Maturity (days) | Plant height (cm) | Pod/plant (No.) | 100-seed weight (g) | Yield (kg/ha) |
|---|---|---|---|---|---|
| Tillage Method | | | | | |
| $M_1$-Conventional | 116 | 36.50 | 31.50 | 15.60 | 1076 |
| $M_2$-Deep | 115 | 38.25 | 34.75 | 16.07 | 1236 |
| $LSD_{0.05}$ | NS | NS | 2.64 | NS | 105.8 |
| Variety | | | | | |
| $V_1$-BARI Chola-2 | 115 | 40.75 | 29.75 | 14.50 | 979 |
| $V_2$-Annigeri | 116 | 34.00 | 36.50 | 17.17 | 1333 |
| $LSD_{0.05}$ | NS | 3.12 | 2.64 | 1.14 | 105.8 |
| Tillage method × Variety | | | | | |
| $M_1V_1$ | 116 | 40.00 | 28.00 | 14.40 | 890 |
| $M_2V_1$ | 115 | 41.50 | 31.50 | 14.60 | 1068 |
| $M_1V_2$ | 116 | 33.00 | 35.00 | 14.80 | 1262 |
| $M_2V_2$ | 116 | 35.00 | 38.00 | 17.54 | 1405 |
| $LSD_{0.05}$ | NS | 4.42 | 3.75 | 1.62 | 211.6 |

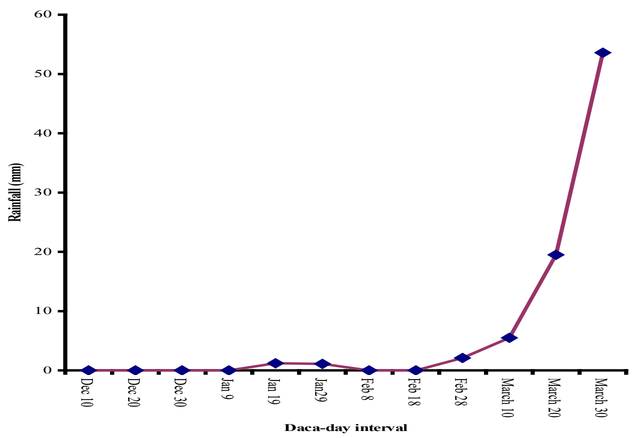



Fig1: Deca-day rainfall pattern during crop growing season

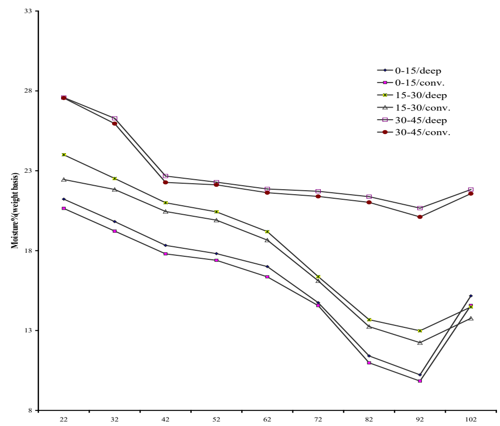



Fig2: Depthwise soil moisture dynamics at 10 days intervals during crop growing season.

# PERFORMANCE OF MANAGEMENT PRACTICES ON THE YIELD OF SESAME UNDER OLD BRAHMAPUTTRA FLOODPLAIN SOILS OF AEZ 9


## Abstract

Package of management practices viz. sowing without post care; one hand weeding at 20 days after sowing; and fertilizer application along with one hand weeding at 20 days after sowing for higher yield of sesame (T-6) was conducted at farmers' field during the Kharif-1 season of 2001. The result revealed that the highest seed yield was obtained where fertilizer was applied along with one hand weeding at 20 days after sowing (964 kg/ha) which was equivalent to 131% higher yield compared to sowing without post care. The lowest seed yield was obtained from sowing without post care (417 kg/ha) whereas yield of one hand weeding at 20 days after sowing was also nominal (537 kg/ha).


## Introduction

Sesame (*Sesamum indicum*) is the second largest sources of edible oil in Bangladesh. The yield of sesame is very low due to poor management practices under field condition such as improper use of fertilizer, seeds, poor weed control etc. Proper package of improve management practices can increase the productivity of sesame up to a considerable extent (Mukherji, 1982). However, findings like improve package of production practices based on agro-ecological zones at farmers' field is meagre in the country. Hence, the present study was undertaken at the Farming Systems Research and Development Site, Narikeli, Jamalpur during the Kharif-1 season of 2001 to determine the package of improve management practices for higher yield of sesame under Old Brahmaputtra floodplain soils of AEZ 9.

## Materials and Methods

The experiment was conducted at FSRD, Site, Narikeli, Jamalpur during the Kharif-1 season of 2001 to determine the package of improve management practices for higher yield of sesame under AEZ 9. The experimental area was a rainfed medium highland of clay loam soil having the $p^H$ value of 5.9. The treatment include in study were i) sowing without post care; ii) one hand weeding at 20 days after sowing (DAS) and iii) fertilizer and one hand weeding at 20 DAS. The variety used was T-6 and the seed rate was 6 kg/ha. The experiment was conducted in a randomized complete block design with six dispersed replication. The unit plot size was 3m x 5m. The land was fertilized was 60 kg N, 55 kg $P_2O_5$ and 40 kg $K_2O$ per hectare through urea, Triple super phosphate and muriate of potash. The entire amount of fertilizer was applied at the time of final land preparation. The seeds were broadcasted on March 19-April 4, 2001 and the crops were harvested from June 7-11, 2001. The data on the yield attributes were collected from 10 randomly selected plants collected prior to harvest from each plots. The grain yield was recorded plot wise. The collected data were analyzed statistically and means were separated with LSD test.

## Results and Discussion

All the characters except plants/m$^2$ and 1000 seed weight differed significantly due to variation in management practices (Table 1). The highest plant height, branches/plant, seeds/capsule and seed yield (964 kg/ha) were recorded by the management levels where fertilizer was applied along with one hand weeding at 20 days after sowing. The possible causes of highest seed yield might be due to efficient use of nutrients and moisture caused the plants to have higher number of branches/plant, capsule/plant and seeds/capsule which eventually resulted in higher seed yield. On the other hand, only hand weeding at 20 days after sowing, the yields were nominal (537 kg/ha). The lowest yield was found in the treatment without post sowing care (417 kg/ha). The result might appear due to competition between weeds and crops for moisture and nutrients resulting in significant reduction in yield components. Similar results were also reported by Gaur and Trehan (1974). Jain *et al*. (1985) opined that weeds offered a serious competition to sesame plants and caused a reduction in yield to the extent of 46% to 76% which was more or less concurrent with the present findings (29%). However, from the result it may be concluded that higher yield could be obtained when fertilizer was applied along with one hand weeding at 20 days after sowing which was equivalent to 131% higher yield compared to sowing without post care. Similar findings were also reported by Moula *et al*. 2000.

## References

Gaur, B.L. and K.B. Trehan. 1984. Effect of spacing and fertilization on the rainfed sesame (*Sesamum indicum)*. Indian J. Agron. 19(3):217-219.

Jain, G.L., S.M. Singh., M.P. Sahu and G.K. Sharma. 1985. Sesame production in Rajastan. Oilseed production. Constarins and Opportunities, New Delhi. pp. 181-198.

Mukherji, D.K. 1982. Pulses and Oilseeds in West Bengal. Directorate of Agriculture. Government of West Bengal, Calcutta. p. 323.

Table 1. Yield and yield contributing characters of sesame influenced by different management practices

| Treat | Plant height (cm) | Plants/ $m^2$ (no.) | Branches/ plant (no.) | Capsule/ plant (no.) | Seeds/ capsule (no.) | 1000 seed weight (g) | Seed yield (kg/ha) | Increased over control (%) |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 72.6c | 41.4 | 2.18b | 23.8c | 35.6c | 3.38 | 417c | - |
| $T_2$ | 86.2b | 41.0 | 2.52b | 31.4b | 45.0b | 3.30 | 537b | 29% |
| $T_3$ | 101.4a | 41.6 | 3.24a | 41.8a | 54.4a | 3.30 | 964a | 131% |
| F | ** | NS | * | ** | * | NS | ** | - |
| CV (%) | 4.08 | 7.61 | 6.13 | 9.75 | 8.28 | 5.68 | 10.90 | - |

Figures in a column having similar letter do not differ significantly

# ADAPTABILITY TRIAL OF NEWLY RELEASED POTATO VARIETIES


## Abstract

An adaptability trial of newly released potato variety Heera along with Dheera, Cardinal, Ailsha, Chamak and Diamont was tested at farmers field at Chandina MLT site during rabi, 2001-2002. In the medium high land of Meghna flood plain soil with four dispersed replication. Cardinal gave the highest yield (22 t/ha) followed by Chamak (21.2 t/ha) and Heera (20.0 t/ha) whereas Ailsha produced the lowest yield (18.6 t/ha). The early harvest due to heavy rain reduces the tuber yield of all the varieties in general.


## Introduction

Potato is an important vegeta bles of Bangladesh. The yield of potato in Bangladesh is low in comparison to that of other countries of the world. But it has a great potentiality to increase its hectareage as well as yield per unit area. In this regard Tuber Crop Research Centre (TCRC) of BARI under its varietal improvement program developed a good number of high yielding varieties. The newly released varieties by TCRC showed promising performance at Chandina in Comilla. To evaluate performance of some other varieties under farmers' condition at Chandina, Comilla the present study was undertaken.

## Materials and methods

The experiment was conducted in medium high land of Meghna flood plain soil at Chandina, Comilla during rabi 2001-2002. Six varieties were used viz : Heera, Dhera, Cardinal, Chamak, Ailsha and Diamont The unit plot size was 4m x 5m. RCB design was followed with four replication. The recommended fertilizer dose were used as 95-20-56-8 N-P-K-S kg/ha respectively. Half of urea and all other fertilizer were applied at the time of final land preparation. Rest half of urea was top-dressed in two equal splits. Sowing of seed was completed from 15-18 Dec. 2001. The crop was irrigated three times. Dithane M-45 was applied three times at 15 days interval as preventive measure against late blight. There was no insect and pest attack during growth period. Earthing up and other intercultural operations were done timely. Potato was harvested from 18 March to 5 March 2002.

## Results and discussion

The result showed that no. of shoot/plant, no. of tuber/plant and wt. of tuber/plant were significantly influenced by different varieties but yield was significantly at par. Higher shoot/plant was recorded from variety cardinal but statistically identical to variety Hera, Alisha and Diamont. The variety Dheera showed higher no. of tuber/plant which were statistically identical to cardinal and Chamak. Higher tuber weight was recorded from variety cardinal which was at par to Dheera and Alisha. Tuber yield was not significantly influenced by different variety but higher yield was obtained from variety Cardinal followed by Chamak.

### Farmers reaction

Though higher yield was obtained from variety cardinal but farmers did not prefer due to its colour (reddish) and poor market price. They mostly prefer Diamont for its good shape and smooth surface. Heera is also preferred by the farmers. This trial should be repeated in the next year for confirmation.

Table 1.Yield and yield contributing character of diff. Potato varieties rabi, 2001-2002

| Varieties | No shoot/plant | No tuber/plant | Wt. Of tuber per plant (kg) | Tuber yield (t/ha) |
|---|---|---|---|---|
| Heera | 3.6 | 6.50 | 0.30 | 20.0 |
| Cardinal | 4.0 | 9.00 | 0.56 | 22.0 |
| Dheera | 1.4 | 10.4 | 0.50 | 19.2 |
| Ailsha | 3.4 | 8.50 | 0.50 | 18.6 |
| Diamont | 3.4 | 4.80 | 0.28 | 19.4 |
| Chamak | 2.0 | 9.20 | 0.53 | 21.2 |
| LSD $_{(0.05)}$ | 0.5 | 2.50 | 0.20 | ns |

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


## Abstract

On farm performance of sweet potato viz Tripti, BARI Sweet Potato-4, BARI Sweet Potato-5, Kamalasunduri and Daulatpuri were evaluated against the farmers' local variety at multiplication test site of Melandah, Comilla, Jhenaidah & Magura (Jessore) and Faridpur during the rabi season of 2001-2002. The result from Melandah showed that Tripti gave highest tuber yield 25.0 t/ha. On the contrary, the performance of local variety was very poor which yielded only 13.9 t/ha. Highest gross return and benefit cost raio was obtained from variety Tripti. At Comilla, highest yield and gross return was obtained from variety Tripti. But variety Tripti was not included in the study at Jessore so Kamalasunduri gave the highest yield at Kamalasunduri at Magura but Kamalasunduri and BARI SP-4 same yield at Jhenaidah. At Faridpur, similar yield was obtained from Daulatpuri BARI SP-4 & BARI SP-5. At Lebukhali, Patuakhali all the variety performed better except Kamalasunduri which produced lowest yield among the varieties.


## Introduction

Sweet potato a carbohydrate rich root crop can be used as a substitute of cereals in Bangladesh to meet up the food shortage. Generally, poor people are the consumers of sweet potato. It is the main source of carbohydrate and carotene for their survival. Farmers are using local variety, which is low yielded, and contain less carotene. Bangladesh Agricultural Research Institute (BARI) has developed two sweet potato varieties viz. BARI sweet potato-4 (SP-4) and BARI sweet potato -5 (SP-5) which has high yield ability and also contain high amount of carotene. These varieties need on-farm trial to evaluate their performance and also to get feed back from the farmers. Keeping the views in mind the experiment was under taken to evaluate their performance of recently developed sweet potato varieties developed by BARI.

## Materials and Methods

The on farm validation trial of sweet potato were conducted at MLT site, Melandah, Comilla, Magura and Jhenaidah, Faridpur and Lebukhali during rabi season of 2001-2002. Five varieties viz. Tripti, Sp-4, SP-5, Kamalasunduri, Daulatpuri and the local were tested in the farmers' field. The vine was planted at the spacing 60 x 30 cm. The plot size was 6m x 9m per variety at each farmer's field. The crop was fertilized with 40-20-50-7-1.5 kg N-P-K-S-Zn/ha respectively. Half of urea & all others fertilizer were used at final land preparation. Remaining part of N fertilizer was top dressed in two equal splits 15 & 35 DAT. The vines were planted within 23-28 November, 2001 at all sites except Lebukhali (13 December). One weeding was done during the period of 15-30 DAT. There was no incidence of disease and pest attack. The crop was harvested during 10-14 April, 2002 at Melandah, 29-30 March at Comilla and 26 April at Lebukhali.

## Results and Discussion

### Site: Melandah

The results showed that the maturity period of them ranges 122-130 days. Variety was significantly affected the tuber yield of sweet potato (Table 1). The highest tuber yield (25.0 t/ha) was obtained from Tripti which was statistically similar to Kamalasunduri and BARI SP-4. Local variety gave the lowest tuber yield and it was statistically similar to Daulatpuri and BARI SP-5. Highest gross return and BCR was recorded from variety Tripti followed by Kamalasunduri.

### Site: Comilla

Highest tuber yield was recorded from variety Tripti. Same variety also showed higher gross return.

**Site: Magura and Jhenaidah**

At Magura, highest yield was obtained from variety Kamalasunduri due to higher no. of tubers/plant and weight of tubers/plant (Table 3). But at Jhenaidah, Kamalasunduri and BARI SP-4 showed similar yield.

**Site: Ishan Gopalpur, Faridpur**

Tuber yield was not significantly different among the varieties but BARI variety showed higher yield than local variety.

**Site: Lebukhali, Patuakhali**

All the characters were almost same but statistical analysis was not done. Yield was within ranged from 30-35 t/ha except Kamalasunduri which produced 26 t/ha.

**Farmers' reaction**

Farmers of Melandah opined that after boiling both the new varieties became very soft so farmers do not like. Moreover, local variety had better keeping quality than the released varieties when preserved under normal condition. These new varieties may harvest few days earlier than the local which sale is higher price. The local people prefer the yellow color of BARI SP-5. At Comilla and Faridpur BARI SP-4 was performed by farmers due to its taste and colour. But Jessore area local farmers are not prefers the BARI variety due to its less late. Farmers' of Lebukhali prefer Daulatpuri due to its taste whereas BARI SP-4 and BARI SP-5 get cracked on boiling and less tolerant to water logging.

Table 1. Effect of different varieties on yield and yield components of sweet potato (Site: Melandah)

| Variety | Branches/ plant (no.) | Leaves/ plant (no.) | Vines/ plant (no.) | Tuber/ plant (no.) | Tuber wt./plant (kg) | Tuber length (cm) | Bredth of tuber (cm) | Boiling duration (Min.) |
|---|---|---|---|---|---|---|---|---|
| Tripti | 11.20c | 139.20e | 224.67f | 3.6c | 681.00a | 14.0d | 19.4b | 33.0c |
| BARI SP-4 | 8.67e | 110.00f | 288.00e | 4.0b | 508.00c | 14.2c | 16.3d | 28.7d |
| BARI SP-5 | 18.40b | 143.37d | 442.00b | 4.8a | 617.00b | 15.2b | 19.0c | 42.0a |
| Kamalasunduri | 13.03d | 174.20c | 483.00a | 3.6c | 604.00b | 15.6b | 21.6a | 25.0e |
| Daulatpuri | 12.50d | 290.20a | 385.00c | 2.4e | 284.00e | 13.6e | 15.0e | 42.0a |
| Local | 21.60a | 184.80b | 311.33d | 3.4d | 342.00d | 12.0f | 13.6f | 40.0b |
| F-test | ** | ** | ** | ** | ** | ** | ** | ** |
| CV (%) | 3.00 | 10.01 | 9.27 | 8.00 | 3.23 | 8.47 | 9.27 | 5.67 |

Figure in a column having similar letters do not differ significantly

Table 2. Economic performance of sweet potato varieties developed by BARI at MLT Site, Melandah and Comilla during 2001-2002

| Variety | Tuber yield (t/ha) | | Gross return (Tk/ha) | | Variable cost (Tk/ha) | BCR |
|---|---|---|---|---|---|---|
| | L1 | L2 | L1 | L2 | | |
| Tripti | 25.0a | 22.3 | 43750 | 66900 | 13162 | 3.32 |
| BARI SP-4 | 21.0a | 20.0 | 36750 | 50000 | 13162 | 2.79 |
| BARI SP-5 | 16.1b | 17.0 | 28175 | 42500 | 13162 | 2.14 |
| Kamalasunduri | 23.7a | 18.2 | 41475 | 54600 | 13162 | 3.15 |
| Daulatpuri | 15.5b | 16.5 | 34875 | 49500 | 13162 | 2.65 |
| Local | 13.9b | 12.0 | 34750 | 24000 | 13162 | 2.64 |

L1= Melandah, Jamalpur, L2- Comilla

**Price (Tk/kg):**

Site: Comilla

Tripti = 3.00, Kamalasunduri= 3.00, Daulatpuri= 3.00, BARI SP 4 & 5 = 2.50, Local= 2.00

Site: Melandah

Tripti, BARI SP-4, BARI SP-5, Kamalasunduri Tk. 1.75/-, Daulatpuri & local Tk. 2.25/-

Table 3. Mean performance of sweet potato (MLT site Magura and Jhenaidah, Jessore, (2001-02) and Ishan Gopalpur (Av.1998-2002) and Lebukhali, Patuakhali (2001-02)

| Location | Variety | No. of tuber/plant | Weight of tubers/plant (kg) | Tuber yield (t/ha) |
|---|---|---|---|---|
| Magura | Kamalasunduri | 4.55 | 0.54 | 24.50 |
| | BARI SP-4 | 4.48 | 0.39 | 18.17 |
| | BARI SP-5 | 4.38 | 0.43 | 19.33 |
| | Local | 4.00 | 0.29 | 12.17 |
| Jhenaidah | Kamalasunduri | 2.70 | 0.27 | 14.27 |
| | BARI SP-4 | 6.50 | 0.27 | 14.54 |
| | BARI SP-5 | 4.35 | 0.23 | 12.29 |
| Ishan Gopalpur, Faridpur | Kamalasunduri | - | - | 37.64 |
| | BARI SP-4 | | | 37.74 |
| | BARI SP-5 | | | 36.20 |
| | Local | | | 29.12 |
| Lebukhali Patuakhali | Daulatpuri | 5 | 0.12 | 35.00 |
| | Kamalasunduri | 4 | 0.11 | 26.00 |
| | Tripti | 4 | 0.13 | 30.00 |
| | BARI SP-4 | 5 | 0.12 | 34.00 |
| | BARI SP-5 | 4 | 0.11 | 30.00 |

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


## Abstract

An experiment was conducted at RARS, Jamalpur during kharif-1 season of 2001 to find out the cormel seed size with optimum spacing for higher yield of Mukhikachu. The result showed that highest cormel yield (28.08 t/ha) was obtained from cormel seed size (small 20±5g) with closer spacing 60 cmx15 cm. This treatment also showed higher gross return than other treatments.


## Introduction

Mukhikachu *(Colocasia esulenta* L. Schott.) is a popular indigenous vegetable of Bangladesh. The crop is extensively grown in the summer season, and is considered as an important vegetable, particularly in the months of September, October and November when the supply of other vegetables is scarce in the market. But till now, there has been no scientific development on the production of this crop in Bangladesh. It is well documented that seed size and plant spacing have significant influence on the growth and yield of different crops (Purewal and Daragan, 1957; Enyi, 1972; Tabeb *et al.,* 1973; Byuyan *et al.,* 1982; Mannan and Rashid, 1983), and it is like that both the factors have similar effects on the yield of Mukhikachu. The present investigation was, therefore, undertaken with a view to find out the optimum size of seed cormel, proper plant spacing and method of planting for the production of Mukhikachu.

## Materials and Methods

The experiment was conducted at RARS, Jamalpur, in the growing season of 2001. The treatment consisted of 3 levels of seed cormel size (small, medium and large weighing 20±5 g, 30± 5g and 40±5g per seed respectively), and 4 levels of plant spacing (60 cm x 15 cm 60cm x30 cm, 60 cm x 45 cm and 60 x 60 cm). The experiment was set up in randomized complete block design with 3 replications. Seed cormels of Mukhikachu variety Bilashi were planted on February 26, 2001. The unit plot size was 6m x 1.8 m. The crop received 10 tons cowdung, 140 kg urea, 100 kg triple super phosphate and 120 kg muriate of potash per hectare. Cowdung and triple super phosphate were applied during land preparation. Urea and muriate of potash were side dressed in two equal splits 40 and 90 days after planting. The crop was harvested on November 3, 2001, (248 days after planting).

## Results and Discussion

Both seed size and plant spacing had significant effect on the yield of Mukhikachu per hill and per hectare. The yield of cormels per hill increased significantly when small sized seed cormels were used instead of medium and large sized seed cormels (Table 1). Though weight of cormel/hill was significantly highest from large seed size but due to higher number of cormel/hill in small cormel size resulted higher yield in small cormel size.

In case of spacing, closer spacing showed highest cormel yield although significantly higher cormel/hill and weight of cormel/hill was recorded from 60 x 30 cm. The closer spacing revealed higher yield might be due to higher plant/$m^2$.

Interaction between cormel size and spacing showed significant effect on plant height, cormel/hill, weight of cormel/hill and yield of cormel. Significantly highest plant height was obtained from small cormel size with spacing 60 x 15 cm but cormel/hill was from same size with spacing 60 x 60 cm. The large cormel size with spacing 60 x 30 cm showed significantly higher from large size with 60 x 30 cm but significantly highest cormel yield was recorded from small cormel size with closer spacing 60 x 15 cm. These treatments also recorded highest gross return than other treatment. So, small cormel size with 60 x 15 cm is required for higher yield and gross return in Mukhikachu of Jamalpur region.

Table 1. Yield and yield contributing characters of Mukhikachu at Jamalpur

| Treatment | Plant height (cm) | Leaves/ plant (no.) | Suckers/ hill (no.) | Cormel/hill (no.) | Wt. of cormel/hill (g) | Yield of cormels (t/h) |
|---|---|---|---|---|---|---|
| **Cormel size** | | | | | | |
| Small (20±5 g ) | 86.97 c | 4.58 | 6.92 | 20.14 a | 655.8 c | 18.25 a |
| Medium(30±5 g) | 98.09 a | 4.75 | 7.17 | 17.58 c | 659.2 b | 17.98 b |
| Large (40±5 g ) | 97.00 b | 4.83 | 7.33 | 18.74 b | 708.3 a | 17.28 c |
| F-test | ** | ns | ns | ** | ** | ** |
| **Spacing** | | | | | | |
| 60cm x 15cm | 98.18 a | 4.67 | 6.67 | 17.33 d | 570.0 d | 22.63 a |
| 60cm x 30cm | 96.56 b | 4.44 | 7.11 | 20.33 a | 761.1 a | 19.85 b |
| 60cm x 45cm | 91.33 c | 4.89 | 7.11 | 18.19 c | 663.3 c | 14.81 c |
| 60cm x 60cm | 90.00 d | 4.89 | 7.67 | 19.44 b | 703.3 b | 14.04 d |
| F-test | ** | ns | ns | ** | ** | ** |
| CV (%) | 10.06 | 8.65 | 11.75 | 10.30 | 10.25 | 10.01 |

Figure in the column having similar letter do not significantly

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

| Interaction | | Plant height (cm) | Leaves/ plant (no.) | Suckers/ hill (no.) | Cormel/ hill (no.) | Wt. of comels/hill (g) | Yield of cormel (t $ha_{-1}$) |
|---|---|---|---|---|---|---|---|
| Small | 60cmx15cm | 94.22 f | 4.67 | 6.33 | 20.00 c | 590.0 I | 28.08 a |
| | 60cmx30cm | 89.00 i | 4.33 | 7.33 | 21.33 b | 720.0 e | 16.66 f |
| | 60cmx45cm | 78.67 k | 4.67 | 6.67 | 17.56 f | 593.3 I | 14.81 h |
| | 60cmx60cm | 86.00J | 4.67 | 7.33 | 21.67 a | 720.0 e | 13.43 J |
| Medium | 60cmx15cm | 107.00 a | 4.67 | 7.33 | 16.00 g | 520.0 J | 20.37 c |
| | 60cmx30cm | 94.67 e | 4.33 | 6.67 | 18.33 e | 733.3 d | 24.07 b |
| | 60cmx45cm | 96.00 d | 5.00 | 7.00 | 17.67 f | 623.3 g | 14.20 I |
| | 60cmx60cm | 94.67 e | 5.00 | 7.67 | 18.33 e | 760.0 c | 13.27 k |
| Large | 60cmx15cm | 93.33 g | 4.67 | 6.33 | 16.00 g | 600.0 h | 19.44 d |
| | 60cmx30cm | 106.00 b | 4.67 | 7.33 | 21.33 b | 830.0 a | 18.83 e |
| | 60cmx45cm | 99.32 c | 5.00 | 7.67 | 19.33 d | 773.3 b | 15.43 g |
| | 60cmx60cm | 89.33 I | 5.00 | 8.00 | 18.33 e | 630.0 f | 15.43 g |
| F-test | | ** | NS | NS | ** | ** | ** |
| CV (%) | | 10.06 | 8.65 | 11.75 | 10.30 | 10.25 | 10.01 |

Figure in the column having similar letter do not significantly

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

| Spacing (cm) | Seed cormel size (g/seed) | | |
|---|---|---|---|
| | Small (20±5 g ) | Medium (30±5 g ) | Large (40±5 g) |
| | Seed cormels required (kg $ha^{-1}$) | | |
| 60 x15 | 2220 | 3332 | 4440 |
| 60x30 | 1110 | 1666 | 2220 |
| 60 x45 | 740 | 1110 | 1480 |
| 60 x60 | 550 | 833 | 1108 |
| | Cost of seed cormels (Tk $ha^{-1}$) | | |
| 60 x15 | 13320 | 19992 | 26640 |
| 60x30 | 6660 | 9996 | 13320 |
| 60 x45 | 4440 | 6660 | 8880 |
| 60 x60 | 3324 | 4998 | 6648 |
| | Gross return from harvested cormels (Tk $ha^{-1}$) | | |
| 60 x15 | 112320 | 81480 | 77760 |
| 60x30 | 66640 | 96280 | 75320 |
| 60 x45 | 59240 | 56800 | 61720 |
| 60 x60 | 53720 | 53080 | 61720 |

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

# EFFECT OF SOWING TIME AND SPACING ON THE PERFORMANCE OF BUSHBEAN AT FSRD SITE, PALIMA, TANGAIL


## Abstract

Sowing time and spacing were studied at Palima, Tangail FSRD site for two consecutive years 2000-01 and 2001-02. The result showed that vegetable yield significantly highest from Nov.-10 with spacing 25 x 10 cm in 2000-01 whereas in 2001-02. Nov.-10 with all spacing showed higher yield. On an average, highest vegetable yield was recorded from early planting (10 Nov.) with spacing 25 x 10 cm. On an average, highest cost benefit analysis was obtained from early planting (10 Nov.) with spacing 25 x 10 cm at Palima, Tangail region.


## Introduction

Bush bean a newly introduced vegetable is grown in a limited scale. The only variety BARI Bush bean-1 is a short duration crop with highly synchronous bearing. Palima area of Tangail is a vegetable growing area and its demand is also high. But the people of this locality are quite unknown about Bush bean. The present study was undertaken to find out the optimum time of planting and spacing of bush bean and popularize the crop as a vegetable crop in this locality.

## Materials and Methods

The experiment was carried out at Palima FSRD site, Tangail during 2000-2002 in the medium highland under AEZ-8. The experiment was designed in factorial RCB with 3 dispersed replications. Unit plot size was 5 x 4 m. The variety was BARI Bush bean-1. The trial consisted of four levels of sowing date viz. 10 November, 20 November,30 November, 10 December and three levels of spacing 30 x 15 cm, 20 x 15 cm and 25 x 10 cm. Fertilizers were applied at the rate of 45-140-140 kg/ha Urea, TSP and MP respectively. Seeds were treated with Vitavax-M before sowing for better germination. Intercultural operations such as thinning, weeding and irrigation were done whenever required. Observations were made on plant height, number of pods/plant, pod length, pod weight/plant, and yield. Necessary data were collected and analyzed statistically using MSTATC.

## Results and Discussions

Plant height, pods/plant length of pod, weight of pod and yield were significantly influenced by different treatments (Table 1). Plant height was much higher on 2001-02 than 2000-01. In both the years, wider spacing showed higher plant height in early planting and there was trend to decrease height with the decrease of spacing. Pods/plant was also showed higher number in second year than first year. There was no systematic trend of decrease or increase of pods/plant but early planting showed higher number of pods/plant. Pod length and pod weight was not recorded in 2000-01 but in 2001-02 pod length was statistically identical except treatment $D_4S_1$. In case of pod weight, higher weight was recorded from early planting in all spacing. In 2000-01, vegetable yield showed significantly highest from treatment $D_1S_3$ whereas in 2001-02, $D_1S_3$ treatment revealed similar yield with the treatments $D_2S_3$, $D_3S_3$ and $D_4S_3$. In all the treatments wider spacing gave higher yield in early planting. On an average, higher vegetable yield was recorded from early planting (November 10) with spacing 25 x 10 cm in both the years.

Cost and benefit analysis showed that highest gross return was recorded from $D_1S_3$ in both the years. Similar trend was observed in case of gross margin. The treatment $D_1S_3$ also showed higher benefit cost ratio. But on an average, higher benefit cost ratio was revealed from spacing (25 x 10cm) in early sowing (November 10). It may be concluded that bushbean could be sown in November 10 with spacing (25 x 10 cm) for Tangail region.

Table 1. Effect of sowing time and spacing on plant height, yield and yield attributes of Bushbean

| Sowing time x Spacing | | Plant height (cm) | | No. of pod/ plant | | Pod length (cm) | Pod wt. (g) | Veg. yield (t/ha) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 00-01 | 01-02 | 00-01 | 01-02 | 01-02 | 01-02 | 00-01 | 01-02 |
| $D_1$ | $S_1$ | 47.33a | 63.77a | 11.80b | 17.73c | 12.93ab | 8.20a | 8.51c | 11.08c |
| | $S_2$ | 45.69ab | 58.67ab | 13.33a | 18.53bc | 12.27ab | 7.87ab | 12.28b | 12.82b |
| | $S_3$ | 44.20bc | 62.13ab | 13.40a | 18.93bc | 12.20ab | 7.28ac | 14.37a | 16.73a |
| $D_2$ | $S_1$ | 39.33d | 65.80a | 10.00cd | 20.17ab | 12.87ab | 7.50ac | 6.57ef | 11.33c |
| | $S_2$ | 39.00d | 57.47ab | 10.67bc | 21.33a | 12.93ab | 6.50c | 8.27cd | 12.49b |
| | $S_3$ | 37.80de | 60.63ab | 11.27bc | 19.50ab | 13.33a | 7.00bc | 8.63c | 17.13a |
| $D_3$ | $S_1$ | 37.83de | 65.93a | 9.13d | 20.60ab | 12.40ab | 6.90bc | 5.89f | 11.13c |
| | $S_2$ | 35.73ef | 58.60ab | 10.60bc | 20.60ab | 12.40ab | 6.57c | 7.47cd | 12.27b |
| | $S_3$ | 34.80f | 66.00a | 11.33bc | 19.83ab | 12.47ab | 6.77bc | 8.60c | 16.20a |
| $D_4$ | $S_1$ | 42.67c | 61.87ab | 9.99cd | 19.93ab | 12.13b | 7.00bc | 6.61ef | 11.94c |
| | $S_2$ | 39.93d | 54.93b | 9.99cd | 19.20bc | 12.47ab | 7.00bc | 7.06de | 12.05b |
| | $S_3$ | 39.73d | 60.53ab | 11.00bc | 18.58bc | 12.47ab | 7.20ac | 8.23c | 16.06a |
| LSD(.05) | | 2.02 | 7.68 | 1.33 | 1.86 | 1.01 | 0.97 | 1.22 | 1.51 |
| CV (%) | | 2.89 | 7.22 | 6.97 | 5.50 | 4.66 | 7.85 | 8.23 | 4.06 |

Means followed by same letter is not significantly different at 5% level by DMRT test.

$D_1$= 10 November    $D_2$= 20 November    $D_3$= 30 November    $D_4$= 10 December
$S_1$= 30 x 15 cm    $S_2$= 20 x 15 cm    $S_3$= 25 x 1 cm

Table 2. Cost and benefit analysis of sowing time and spacing of bush bean (average, 2000-01& 01-02)

| Sowing time x Spacing | | Gross return (Tk/ha) | | Average | TVC (Tk/ha) | | Average | BCR | | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 00-01 | 01-02 | | 00-01 | 01-02 | | 00-01 | 01-02 | |
| $D_1$ | $S_1$ | 85050 | 64316 | 74683 | 16485 | 14443 | 15464 | 5.16 | 4.45 | 4.81 |
| | $S_2$ | 122833 | 91300 | 107067 | 16640 | 14562 | 15601 | 7.38 | 6.67 | 7.03 |
| | $S_3$ | 143733 | 106933 | 125333 | 16886 | 14690 | 15788 | 8.51 | 7.28 | 7.90 |
| $D_2$ | $S_1$ | 52520 | 65340 | 58930 | 16485 | 14443 | 15464 | 3.19 | 4.52 | 3.86 |
| | $S_2$ | 66173 | 89980 | 78077 | 16640 | 14562 | 15601 | 3.98 | 6.18 | 5.08 |
| | $S_3$ | 69066 | 106533 | 87799 | 16886 | 14690 | 15788 | 4.09 | 7.25 | 5.67 |
| $D_3$ | $S_1$ | 35310 | 60500 | 47905 | 16485 | 14443 | 15464 | 2.14 | 4.19 | 3.17 |
| | $S_2$ | 44800 | 89100 | 66950 | 16640 | 14562 | 15601 | 2.69 | 6.12 | 4.41 |
| | $S_3$ | 51620 | 104800 | 78210 | 16886 | 14690 | 15788 | 3.06 | 7.13 | 5.10 |
| $D_4$ | $S_1$ | 33033 | 59766 | 46400 | 16485 | 14443 | 15464 | 2.00 | 4.14 | 3.07 |
| | $S_2$ | 35283 | 88193 | 61738 | 16640 | 14562 | 15601 | 2.12 | 6.06 | 4.09 |
| | $S_3$ | 42625 | 104240 | 73433 | 16886 | 14690 | 15788 | 2.52 | 7.10 | 4.81 |

# PERFORMANCE OF ONION VARIETIES IN FARMERS FIELD


## Abstract

On-farm performance of onion variety namely BARI Piaj-1 was evaluated against local HYV Taherpuri, Sukshagar and Zitka at Kushtia sadar multilocation testing site during rabi season of 1999 to 2002 to find out the suitable variety of onion for Kushtia area. Results revealed that BARI Piaj-1 produced significantly highest bulb yield than all other varieties. Taherpuri gave higher bulb yield than Sukhsagar and Zitka variety. But these varieties produced identical yield. In 1999-2000, BARI Piaj-1 also gave the significantly highest yield but in 2000-2001, no significant yield difference was observed among the varieties. Among the varieties the lowest weight loss was observed in BARI Piaj-1.


## Introduction

The medium high land under Ganges Floodplain in AEZ 11 is suitable for onion production. Farmers grow onion in large scale in Kushtia area. They mostly use Taherpuri and low yielding Indian varieties, which give poor yield and their storage quality is also poor. Recently BARI has developed a new variety of onion (BARI Piaj-1) which produce better yield and can be stored in ordinary condition for long duration. In this context, there is a need to study the performance of BARI Piaj-1 against available varieties in the area to find out the best one.

## Materials and Method

The experiment was conducted at Kushtia sadar MLT site during rabi 1999-2002. Four varieties viz., BARI Piaj-1, Taherpuri, Sukhsagar and Zitka were tested in this trial. The experiment was laid out in randomized complete block design with five dispersed replications. The unit plot size was 10m X 5m. Seedling was planted on 1st week of December, 2001. The spacing was line to line 20 cm and plant to plant 10 cm. The fertilizer dose was 120-120-100-29 kg N, $P_2O_5$, $K_2O$ and S per hectare from urea, TSP, MP and gypsum with10 ton cowdung per hectare. Full CD, TSP, MP, gypsum and half of urea were applied during the final land preparation and the rest of the urea was applied in two equal splits at 25 and 50 DAT. First mulching was done after first irrigation at 25 days after transplanting. The crop was harvested at first week of April, 2002. Data were collected on plant height, number of bulb per kg and bulb yield. Data were analyzed statistically by using IRRISTAT program.

## Results and Discussion

The yield and yield contributing characters of onion of different varieties are presented in Table-1. BARI Piaj-1 produced the highest plant height (39.4 cm) followed by Taherpuri (37.7 cm) but these were identical. Sukhsagar gave the lowest plant height (28.7 cm) which was significantly lower than BARI Piaj-1. Similar trend of results were also obtained for number of bulb per kilogram. Significantly highest bulb weight was obtained from BARI piaz-1 in 1999-2000 and 2001-2002 but statistically identical in 2000-01. Other treatments were statistically at par in 1999-2000 and 2001-02 but lower yield than BARI Piaz-1. On an average, highest bulb weight was recorded from BARI Piaz-1 & similar trend was followed in three years of experimentation. Among the varieties the minimum weight lost was observed in BARI Piaj-1. After 25 and 50 days of harvest BARI Piaj-1 lost 6.06 and 7.5 % weight where as Suksagar lost 10.23 and 12.25 % weight, respectively. The weight lost was also higher in variety Taherpuri than BARI Piaj-1.

### Output/Impact

Farmers of Kushtia opined that BARI Piaj-1 is preferable for its higher yield, less disease infestation and good storage quality. They desire to expand its cultivation if the seed would be available.

### Recommendation

From three years trail it is suggested that BARI Piaj-1 should be recommended for demonstration in the farmer's field through extension department.

Table 1. Yield and yield attributes of different onion varieties at Kushtia sadar MLTS during Rabi, 1999-2002

| Variety | Plant height (cm) | No. of bulb / kg | Bulb weight (t/ha) | | | Weight loss (%) | |
|---|---|---|---|---|---|---|---|
| | | | 1999-2000 | 2000-2001 | 2001-2002 | After 25 days | After 50 days |
| Taherpuri | 37.7a | 51.0a | 10.4b | 9.36 | 13.81b | 7.80 | 9.31 |
| BARI Piaj-1 | 39.4a | 46.0a | 12.04a | 10.05 | 16.78a | 6.06 | 7.54 |
| Zitka | 30.7b | 69.0b | 10.15b | 8 .87 | 11.75b | 9.33 | 11.62 |
| Sukhsagar | 28.7b | 67.7b | 10.10b | 8.97 | 12.45b | 10.23 | 12.25 |
| CV (%) | 3.2 | 12.2 | 4.5 | 5.5 | 8.3 | - | - |
| F-test | ** | * | ** | NS | * | - | - |

# PERFORMANCE OF SUMMER VEGETABLES ON THE TRELLIS FOLLOWED BY BOTTLE GOURD


## Abstract

Performance of four summer vegetable species on the same trellis used for bottle gourd variety BARI Lau-1, were studied. The program was initiated at FSRD site, Syedpur, Rangpur during 1998-99 and continued for next two succeeding years. In the second year, the program was extended at the three MLT sites viz., Polashbari, Nilphamari and Lalmonirhat. The studied summer vegetable species were bitter gourd, snake gourd, ribbed gourd and ash gourd. The said vegetable species could be successfully grown on the same trellis followed by BARI Lau-1 production at all the sites. BARI Lau-1 produced 81, 95, 94 and 90 numbers of fruits weighing 192.0, 181.5, 175.59 & 173.89 kg yield per decimal of land at the FSRD and MLT sites respectively. Among the summer vegetables tested ash gourd produced the highest vegetable yield of 124.83, 150.50, 159.40 and 156.13 kg/dec respectively at the FSRD and MLT sites (Polashbari, Nilphamari and Lalmonirhat). The highest benefit cost ratio was recorded from bottle gourd-ash gourd sequence to all the location with BCR 7.29, 4.97, 5.89 and 4.95 at Syedpur, Polashbari, Nilphamari and Lalmonirhat, respectively. The other vegetable sequences also produced good economic return and B: C ratio per unit area. The production system ensured continuous vegetable supply to the farm families for certain period of the year.


## Introduction

Bottle gourd is a popular vegetable. It is exclusively grown in winter as a cash crop. BARI developed variety BARI Lau-1 has gained popularity and at present it is being grown as a field crop in the north-western part of the country. After the harvest of the crop the bamboo support are partially damaged. The farmers remove the structure to pave the way for the establishment of the next crop. As a result the production cost of bottle gourd becomes higher. To minimize the said cost, summer vegetables can be grown on the said structure following the harvest of BARI Lau-1. This would increase the production of vegetables on the support over time as well as increase production per unit area. As a result, the present study was undertaken with the following objectives.

01. To economize the cost of trellis preparation for the production of BARI Lau-1.
02. To identify suitable summer vegetable species following the harvest of BARI Lau-1 using the same structure and there by production per unit area.

## Materials and Methods

The experiment was initiated during 1998-1999 at the FSRD site, Syedpur, Rangpur in the farmer's field and continued for two years. During the second year the program was extended to three MLT sites *viz.,* Polashbari, Nilphamari and Lalmonirhat. It was laid out in RCB design with eight dispersed replications (8 farmers). A total of four crop sequences *viz.,* Bottle gourd - Bitter gourd, Bottle gourd-Snake gourd, Bottle gourd-Ribbed gourd and Bottle gourd-Ash gourd were included in the study. Bottle gourd variety was BARI Lau-1 and the summer vegetables were local cultivars. The unit plot size was 20 ×2m. Bottle gourd was planted during 1-15 (first fortnight) August and summer vegetables were sown during 1st to 2nd week of February irrespective of years. The pit size for bottle gourd was 60 x 60 x 60 cm. It was within the prepared beds of 2.70 m wide keeping a drainage channel of 30 cm wide in between the two beds. Pit to pit distance was 2 m and 3-4 seeds were sowed per pit. The crop was fertilized by 70-15-60-15-4-1-2000 kg NPKSZnB and cowdung /ha. Half of cowdung and TSP were applied at the time of final land preparation and remaining half of cowdung and TSP and full amount of Gypsum, Zinc sulphate and Borax were used in pit before 7 days of sowing. Urea and MP were applied as side dress in three equal splits after 3 weeks of emergence of seed, at the time of first flowering and fruit formation period. After emergence of seeds only one healthy and vigorous seedling was kept in each pit. Structures were made of bamboo and other plant materials. Intercultural operations were done as and when necessary. Fruit flies were controlled by using low cost poison baits. The fruits were harvested by timely. Same management was followed for bottle gourd, ribbed gourd, snake gourd and ash gourd. But the bitter gourd, it was 2 x 2 m spacing and the trellis height was one meter high from the surface of land instead of 2 meters height followed in other vegetables. The height was made lower due to the dwarf creeping behavior of bitter gourd.

**Results and Discussion**

The yield of vegetables of four different vegetable sequences on the same trellis at Syedpur for three successive years has been presented in table-1. The yield of the vegetables for the same vegetable sequences at MLT sites viz. Polashbari, Nilphamari and Lalmonirhat for two successive years have been presented in Table 2, 3 & 4 respectively.

It is evident from the tables that on an average (average of 3 years) 81 number fruits of BARI Lau-1 could be harvested at the FSRD site weighing 192 kg yield in per decimal of land area. The number of fruits in two successive years at Polashbari, Nilphamari & Lalmonirhat MLT sites obtained was 95, 94 and 90 weighing 181.50, 175.59 and 173.84 kg yield in one decimal land area. Among the summer vegetables, ash gourd produced the highest yield of 124.83, 150.50, 159.40 and 156.13 kg/dec. at FSRD and MLT sites respectively. The immediate next higher yield was obtained with snake gourd followed by ribbed gourd in all the four sites. The only exception was at Lalmonirhat during 1999-2000, where, ribbed gourd occupied the second position. It might be due to difference in agro ecology prevailed in different sites for different years. The lowest yield (38-45 kg/dec.) was obtained from bitter gourd in all the four locations.

The highest gross return and gross margin was obtained from vegetable sequence, bottle gourd-ash gourd with lower total variable cost. The same sequence also showed highest benefit cost ratio with 7.29, 4.97, 5.89 and 4.95 at Syedpur, Polashbari, Nilphamari and Lalmonirhat, respectively.

**Farmer's reaction**

The cooperator farmer showed their keen interest to grow vegetables on trellis and follow the tested crop sequences. They reported that they would select the summer vegetables for the bottle gourd mutcha, depending on the demand of the particular vegetable species in the local market. They also expressed their willingness to utilize the lands that usually remain fallow. They expressed their opinion to cultivate partially shade loving crops like ginger, turmeric, etc under the support structure to optimize the land utilization.

**Recommendation**

From the above discussion it was found that ash gourd, bitter gourd, ribbed gourd and snake gourd could be successfully grown on the trellis followed by BARI Lau-1. The crop sequence of bottle gourd-ash gourd gives higher economic return. The production system ensured continuous supply of vegetables for certain period of the year to the families. It also helped to wipe out nutritional deficiencies partially for the farm family and for the nation. Investigation on the utilization of fallow land under the support structure of the tested vegetable sequences should be carried out with partially shade loving crops to optimize the land use.

Table 1. Yield of bottle gourd (BARI Lau-1) and summer vegetables grown on the same trellis (Average, 1998-2001)

Location: Syedpur, FSRD

| Vegetable sequence | | Yield (kg/ha) | | Gross return (Tk./dec.) | | TVC (Tk./dec.) | | GM (Tk./dec.) | | BCR (Average) |
|---|---|---|---|---|---|---|---|---|---|---|
| W | S | W | S | W | S | W | S | W | S | |
| BG | BIG | 192.0(81) | 40.63(304) | 899 | 312 | 128 | 95 | 766 | 253 | 6.45 |
| BG | SG | 192.0(81) | 59.9(315) | 894 | 230 | 128 | 55 | 766 | 175 | 6.14 |
| BG | RG | 192.08(81) | 47.92(340) | 894 | 262 | 128 | 59 | 766 | 208 | 6.35 |
| BG | AG | 192.08(81) | 127.83(57) | 894 | 425 | 128 | 53 | 766 | 372 | 7.29 |

BG= Bottle Gourd, BIG = Bitter Gourd, SG = Snake Gourd, RG = Ribbed Gourd, AG= Ash Gourd
Price (Tk.): BG = 2.30, BIG= 5.50, SG= 3.00, RG= 4.00 & AG= 2.75

Table 2. Yield of bottle gourd (BARI Lau-1) and summer vegetables grown on the same trellis (Average 1999-2001)

Location: Polashbari MLT site

| Vegetables sequence | | Yield (kg/dec.) | | Gross return (Tk./dec.) | | TVC (Tk./dec.) | | GM (Tk./dec.) | | BCR (Avg.) |
|---|---|---|---|---|---|---|---|---|---|---|
| W | S | W | S | W | S | W | S | W | S | |
| BG | BIG | 181.5 (95) | 44.18 (331) | 671 | 304 | 163 | 62 | 590 | 243 | 4.33 |
| BG | SG | 181.5 (95) | 58.63 (292) | 671 | 276 | 163 | 52 | 590 | 219 | 4.30 |
| BG | RG | 181.5 (95) | 53.91 (370) | 671 | 296 | 163 | 55 | 590 | 242 | 4.44 |
| BG | AG | 181.5 (95) | 150.5 (61) | 671 | 512 | 163 | 55 | 590 | 458 | 4.97 |

BG= Bottle Gourd, BIG = Bitter Gourd, SG = Snake Gourd, RG = Ribbed Gourd, AG= Ash Gourd

Price (Tk.): BG = 2.50, BIG= 6.00, SG= 3.50, RG= 4.00 & AG= 2.75

Table 3. Yield of bottle gourd (BARI Lau-1) and summer vegetables grown on the same trellis (Average 1999-2001)

Location: Nilphamari MLT site

| Vegetables sequence | | Yield (kg/dec.) | | Gross return (Tk./dec.) | | TVC (Tk./dec.) | | GM (Tk./dec.) | | BCR (Avg.) |
|---|---|---|---|---|---|---|---|---|---|---|
| W | S | W | S | W | S | W | S | W | S | |
| BG | BIG | 175.59(94) | 45.35 (393) | 602 | 311 | 152 | 59 | 452 | 253 | 4.33 |
| BG | SG | 175.59(94) | 67.38 (339) | 602 | 258 | 152 | 55 | 452 | 202 | 4.15 |
| BG | RG | 175.59(94) | 56.63 (393) | 602 | 254 | 152 | 53 | 452 | 202 | 4.18 |
| BG | AG | 175.59(94) | 159.4 (66) | 602 | 599 | 152 | 52 | 452 | 542 | 5.89 |

Price (Tk.): BG = 2.25, BIG= 6.00, SG= 3.25, RG= 4.00 & AG= 2.75

Table 4. Yield of bottle gourd (BARI Lau-1) and summer vegetables grown on the same trellis (Average 1999-2001)

Location: Lalmonirhat MLT site

| Vegetables sequence | | Yield (kg/dec.) | | Gross return (Tk./dec.) | | TVC (Tk./dec.) | | GM (Tk./dec.) | | BCR (Avg.) |
|---|---|---|---|---|---|---|---|---|---|---|
| W | S | W | S | W | S | W | S | W | S | |
| BG | BIG | 173.84 (90) | 38.40 (286) | 586 | 219 | 159 | 58 | 428 | 161 | 3.71 |
| BG | SG | 173.84 (90) | 56.40 (297) | 586 | 194 | 159 | 54 | 428 | 140 | 3.66 |
| BG | RG | 173.84 (90) | 58.24 (410) | 586 | 301 | 159 | 52 | 428 | 249 | 4.20 |
| BG | AG | 173.84 (90) | 156.13 (66) | 586 | 469 | 159 | 54 | 428 | 415 | 4.95 |

Price (Tk.): BG = 2.30, BIG= 5.50, SG= 3.00, RG= 4.25 & AG= 3.00

# STUDIES ON TURMERIC BASED INTERCROPPING SYSTEM


## Abstract

Experiments were conducted at FSRD site Golapgonj, Sylhet during 2000-2001 and 2001-2002 and MLT site Moulvibazar in 2001-02. In both experiments, intercropping of turmeric with country bean or turmeric intercropped with cucurbits relayed with country bean may be profitable instead of sole turmeric or country bean cultivation.


## Introduction

Turmeric is a popular spice crop in Bangladesh. It has multiple uses in dying industries, medicines, culinary preparations and in cosmetics. It is a long duration crop with slow growth in the early stages. Turmeric can be cultivated in shady places as they are shade tolerant crops. So, vegetables can be intercropped with turmeric supported on bamboo on the turmeric plot. Cucurbits and legumes like country bean and yard long bean can easily be grown with supports of bamboo sticks as they are creeping and climbing type of vegetables.

Farmers of Sylhet district usually grow country bean in vast areas mainly as high land field crops. The variety used for country bean is locally called 'Gohalghadda' and very popular to Sylhet's peoples. This variety is now exporting to U.K. On the other hand in Hobigonj district considerable areas of land under turmeric cultivation as a sole crop. In this context, the present investigation was undertaken to know the performance of turmeric based intercropping systems in the Sylhet region.

## Materials and Methods

The study was carried out at the FSRD site Golopgonj, Sylhet and at the MLT site Moulvibazar.

**Experiment I:** This experiment was carried out in two successive years 2000-2001 and 2001-2002. It was laid out in a RCB design with the four dispersed replications. The plot size was 3m $\times$3m and turmeric spacing (50cm$\times$ 25cm) was maintained to accommodate 96 plants per plot. Five different treatment combinations, such as Turmeric + country bean, Turmeric + Yard long bean, Turmeric sole, country bean sole and Yard long bean sole. Turmeric seeds were dibbled into the pits of every line with raising of soil on 20 March, 2000 and 12 April, 2001. Two pits of country bean were accommodated in the middle of the plot for both sole and intercrop situation. After every two rows of turmeric, yard long bean (YLB) was sown maintaining a spacing of 100 cm$\times$ 25 cm for both sole and intercropping. Seeds of country bean and yard long beans were sown on 20 July, 2000 and 28 July, 2001.

**Experiment II:** This experiment was conducted at MLT site, Moulvibazar during 2001-2002. RCB design was used with three replications. Plot size was 4m$\times$4m. Five different treatment combination such as Turmeric + wax gourd/country bean, Turmeric + bitter gourd/country bean, Turmeric + country bean, Turmeric sole and country bean sole. Turmeric seeds were sown on 25 April, 2001. Four holes/ pits were made to sow cucurbits seeds at every corner of the plot on the same date of turmeric sowing. Country bean seeds were sown into the same pit on 10 August just after harvest of cucurbits. For both the experiment turmeric crop was fertilizer @ 10 cowdung and 90-72-120 kg of N, $P_2O_5$ and $K_2O$/ha, respectively. Incase of cucurbits and country bean 3kg cowdung and 20-40-40 g of N, $P_2O_5$ and $K_2O$/ pit were applied. Cucurbits and country bean were allowed to climb on the bamboo support and YLB was allowed to creep with bamboo stick. Earthing up and weeded was done at twice. The average crop duration for turmeric was around 265 days. Cost and benefit analysis was done for each treatment on a hectare basis taking into account the market value of each crop.

## Results and Discussion

**Experiment I:** Maximum fresh rhizome yield of turmeric was obtained from turmeric + country bean combination which was followed by turmeric + YLB (Table 1). The lowest turmeric yield was obtained from sole situation. Intercropped yield of turmeric was higher than the monoculture turmeric might be due to partial shading. In case of country bean and YLB, the higher yield was recorded from their respective sole crops. Country bean showed higher yield than YLB.

All the intercropping situation showed higher turmeric equivalent yield than that of the sole crop. Among the intercropping combinations, the highest turmeric equivalent yield (38.08 t/ha) was obtained from the treatment turmeric + country bean combination. Economic performance of intercropping country bean and YLB with turmeric have been presented in Table 2. Average over the years showed that the highest gross return (Tk.228500 /ha) was obtained from turmeric + country bean combination which were 184,138 and 242 % higher than sole turmeric, country bean and YLB, respectively.

**Experiment II:** Yield of turmeric, cucurbits, country bean and turmeric equivalent yield were presented in Table 3. Yield of turmeric: Maximum turmeric yield (22.54 t/ha) was obtained from turmeric + wax gourd relayed with country bean, followed by turmeric + bitter gourd/ country bean at 21.10 t/ha. The lowest turmeric yield 18.74 t/ha in sole situation. This reduction is sole cropping situation might be the case of growing turmeric under open sunshine as it likes to grow under partial shade.

**Yield of cucurbits:** The highest yield (14.42 t/ha) was obtained from wax gourd and the bitter gourd yielded at 7.15 t/ha in intercrop situation. The yield variations between two cucurbits were due to the reason of bearing habit and genetic yield potentiality.

**Yield of country bean:** Sole country bean produced higher pod yield (9.05 t/ha) than in intercrop combinations (Table 2.).

**Turmeric equivalent yield:** All the intercropping situations showed higher equivalent yield than that of the sole crop. The highest turmeric equivalent yield (51.45 t/ha) was obtained from turmeric + wax gourd relayed with country bean.

**Economic analysis:** The economic performance of different intercropped and sole situations were presented in Table 4.The highest gross return (Tk.308680/ha) and gross margin (Tk.236810/ha) was recorded in turmeric + wax gourd/country bean combinations followed by turmeric + bitter gourd/ country bean combinations. Benefit cost ratio was also highest in turmeric + wax gourd / country bean (4.29) combinations.

The results showed that turmeric intercropping with cucurbits relayed with country bean or intercropped with country bean gave higher turmeric equivalent yield and monetary advantages than other sole crop combinations. So, farmers of the Sylhet region could be motivated to grow turmeric as intercrop with country bean or intercrop with wax gourd relayed with country bean instead of growing sole turmeric and country bean.

Table 1. Yields of turmeric, country bean, yard long bean, and turmeric equivalent yield of sole and intercropping combinations (FSRD Site, Golapgonj during 2000-2002)

| Treatments | Turmeric yield(t/ha) | | | Country bean yield(t/ha) | | | Yard long bean(t/ha) | | | TEY |
|---|---|---|---|---|---|---|---|---|---|---|
| | 00-01 | 01-02 | Mean | 00-01 | 01-02 | Mean | 00-01 | 01-02 | Mean | (t/ha) |
| Turmeric +CB | 24.20 | 20.40 | 22.30 | 9.09 | 9.85 | 9.47 | - | - | - | 38.08 |
| Turmeric + YLB | 23.04 | 19.15 | 21.10 | - | - | - | 5.95 | 5.40 | 5.68 | 29.61 |
| Turmeric sole | 22.82 | 18.65 | 20.74 | - | - | - | - | - | - | 20.74 |
| CB sole | - | - | - | 9.65 | 10.24 | 9.95 | - | - | - | 27.63 |
| YLB sole | - | - | - | - | - | - | 7.12 | 6.85 | 6.99 | 15.71 |

TEY = Turmeric equivalent yield

Table 2. Economic analysis of sole and intercropping combination of turmeric and beans (average of two years) at FSRD Site Golapgonj, Sylhet

| Treatment | Gross return (Tk/ha) | Total variable cost (Tk/ha) | Gross margin (Tk/ha) | Benefit cost ratio (BCR) |
|---|---|---|---|---|
| Turmeric +CB | 228500 | 61250 | 167250 | 3.73 |
| Turmeric + YLB | 177645 | 59480 | 118165 | 2.99 |
| Turmeric sole | 124410 | 36240 | 88170 | 3.43 |
| CB sole | 165750 | 29750 | 136000 | 5.57 |
| YLB sole | 94275 | 26130 | 68145 | 3.61 |

Table 3. Yields of turmeric, country bean, cucurbits, and turmeric equivalent yield of sole and intercropping combinations at MLT Site, Moulvibazar during 2001-2002

| Treatment | Turmeric yield (t/ha) | Country bean yield (t/ha) | Wax gourd (t/ha) | Bitter gourd (t/ha) | TEY (t/ha) |
|---|---|---|---|---|---|
| Turmeric+WG+CB | 22.54 | 7.25 | 14.42 | - | 51.45 |
| Turmeric+BG+CB | 21.10 | 7.64 | - | 7.15 | 45.75 |
| Turmeric+CB | 20.82 | 8.50 | - | - | 34.99 |
| Turmeric sole | 18.74 | - | - | - | 18.74 |
| CB sole | - | 9.05 | - | - | 15.08 |

Table 4. Economic analysis of sole and intercropping combination of turmeric, country beans, and cucurbits at MLT Site, Moulvibazar

| Treatment | Gross return (Tk/ha) | Total variable cost (Tk/ha) | Gross margin (Tk/ha) | Benefit cost ratio (BCR) |
|---|---|---|---|---|
| Turmeric+WG+CB | 308680 | 71870 | 236810 | 4.29 |
| Turmeric+BG+CB | 274500 | 72660 | 201840 | 3.78 |
| Turmeric+CB | 209920 | 61540 | 148380 | 3.41 |
| Turmeric sole | 112440 | 36730 | 75710 | 3.06 |
| CB sole | 90500 | 30070 | 604330 | 3.01 |

CB = Country bean
YLB = Yard long bean
WG = Wax Gourd
BG = Bitter Gourd
TEY = Turmeric equivalent yield

| **Crop** | **Price (Tk./kg)** |
|---|---|
| Turmeric | = 6.00 |
| Country bean | = 10.00 |
| Yard long bean | = 8.00 |
| Wax gourd | = 7.00 |
| Bitter gourd | = 10.00 |

# COMPARATIVE PERFORMANCE OF DIFFERENT PULSE, OIL SEED AND SPICES CROPS AS INTERCROPPED WITH SUGARCANE


## Abstract

An experiment was conducted at FSRD site, Ishan Gopalpur, Faridpur during 2000-2001 to study the comparative performance of different pulse and oilseed and spices crops as intercropped with sugarcane. Two pulses (chickpea and lentil) and two oilseed crops (mustard and groundnut) and onion as a spices crop were tested in the study. Yield of sugarcane in different treatments were sole Sugarcane, Sugarcane + Mustard, Sugarcane + Lentil, Sugarcane + Chickpea, Sugarcane + Groundnut and Sugarcane + Onion (97.4, 95.65, 91.95, 93.94, 93.7 and 92.15 t/ha, respectively). Chickpea, Lentil and Mustard produced yield of 1.19, 1.09 and 0.75 t/ha respectively. Onion is not feasible to grow successfully under rainfed condition. Groundnut is not also suitable to grow successfully under heavy clay to clay loam soil.


## Introduction

Mixed and intercropping is an old practice, which can minimize the risk of total crop failure by any unusual climatic devastation. Sugarcane is a major crop in Faridpur area. Farmers of Faridpur region usually grow sugarcane as a sole crop under rainfed condition. Sometimes it is mixed with lentil at early growth stage of sugarcane. The present study was undertaken in the farmers field to study the performance of different winter pulse and oilseed crops in intercropping with sugarcane,

## Materials and Methods

The trial was conducted at FSRD site, Ishan Gopalpur, Faridpur, during 2000-2001. The experiment was laid out in RCB design with six replications. The unit plot size was 6mx5m. Seeds of sugarcane (variety ISD-28) were planted on 14-11-2000 as double row planting system. Line to line spacing was 60 cm and spacing between two pairs of sugarcane was 120 cm. Seeds were treated with Bavistin before sowing. Fertilizers were applied at the rate of 290-200-120-190-3 kg/ha of Urea-TSP-MP-Gypsum and Zinc/ha for sugarcane. All TSP, Gypsum, 50% urea and 50% MP were applied as basal for sugarcane. The rest of urea and MP were applied as top-dressed at 145 DAP. There were six combinations in the study viz. (i) Sole sugarcane (ii) Sugarcane + chickpea (var. BARI Chola-5), (iii) Sugarcane + lentil (var. BARI Mashur-4), (iv) Sugarcane + mustard (var. Tori-7), (v) Sugarcane + groundnut (var. local) and (vi) Sugarcane + onion (var. Taherpuri). Fertilizers were applied at the rate of 100-75-45-80-0 kg in mustard, 18-50-20-33-0 kg in chickpea, 24-53-15 kg in lentil, 76-152-40 kg in groundnut and 165-150-150-150 kg Urea-TSP-MP and Gypsum/ha in onion. Seeds of pulses and oil seeds were sown at 14 Nov., 2000 as broadcast in between two paired rows. Irrigation was done as and when necessary. Mustard, lentil, chickpea and sugarcane were harvested at 15 January, 2001, 28 February, 2001, 05 March, 2001 and 05 December, 2001 respectively.

## Results and Discussion

The performance of Sugarcane yield and different intercrop are shown in table-1. Sole sugarcane produced higher yield could be due to the higher plant population/$m^2$. Lowest sugarcane yield was obtained from sugarcane + lentil combination and it was statistically similar with sugarcane + onion combination. The highest sugarcane equivalent yield, gross return and net return were obtained from sugarcane + chickpea combination. The highest intercrop yield (1.19 t/ha) was obtained from Sugarcane + Chickpea combination. But the highest benefit cost ratio was obtained from the sugarcane + lentil combination. From the above result it showed that Sugarcane+lentil combination gave highest benefit cost ratio. This experiment conducted only one year so this trial will be continued next year.

Table 1. Performance of different pulses and oilseeds as intercropped with sugarcane at FSRD site, Ishan Gopalpur during 2000-2001

| Treatment | Yield (t/ha) | | Sugarcane equivalent yield (t/ha) | Gross return (Tk./ha) | TVC (Tk./ha) | Net return (Tk./ha) | BCR |
|---|---|---|---|---|---|---|---|
| | Sugarcane | Intercrop | | | | | |
| Sugarcane sole | 97.4 | -- | 97.40 | 102270 | 40825 | 61445 | 2.50 |
| Sugarcane + Mustard | 95.66 | 0.75 | 107.09 | 113295 | 48220 | 65075 | 2.34 |
| Sugarcane + Lentil | 91.95 | 1.09 | 116.86 | 122703 | 47962 | 74741 | 2.55 |
| Sugarcane + Chickpea | 93.98 | 1.19 | 122.32 | 128425 | 51671 | 76754 | 2.48 |
| Sugarcane + Groundnut | 93.97 | - | 93.90 | 98595 | 49634 | 48961 | 1.98 |
| Sugarcane + Onion | 92.15 | - | 92.15 | 96757 | 58897 | 37860 | 1.64 |
| LSD (0.05) | ns | ns | | | | | |

Price (Tk./kg) :

| | | |
|---|---|---|
| Lentil | : | Tk. 24.00 |
| Mustard | : | Tk. 16.00 |
| Chickpea | : | Tk. 25.00 |
| Sugarcane | : | Tk. 1.05 |

# AGRO-ECONOMIC PERFORMANCE OF ALTERNATIVE CROPPING PATTERN AGAINST FARMERS' EXISTING CROPPING PATTERN


## Abstract

One alternative cropping pattern T.aus-T.aman- Mustard was tested against farmers' existing cropping pattern T.aus-T.aman-Fallow at FSRD site, Golapgonj, Sylhet under rainfed condition during three consecutive years of 1999-2000, 2000-01 and 2001-02. Alternative cropping pattern showed 246 % and 142 % higher yield over farmers' existing pattern in T.Aus and T.Aman, respectively. The turn around times in between T.aman and mustard were 3-7 days. The average seed yield of mustard was 0.95 t/ha. The highest gross return (Tk.95544/ha) and gross margin (Tk.58210/ha) of the whole pattern were obtained from alternative cropping pattern and that of existing pattern were Tk.47428/ha and the Tk.23415/ha, respectively. The MBCR was 3.61 which showed alternative pattern is more profitable than existing farmers' cropping pattern.


## Introduction

T.Aus- T.Aman- Fallow is the major the cropping pattern in Sylhet region. Farmers cultivate rice crops mainly in rainfed condition. Transplantation of T.Aus is being dependent on rainfall, mainly seed is sown during early monsoon. T.Aus is delayed that causes late cultivation and harvesting of T.aman accordingly. The soils under this cropping pattern areas are generally heavy, clay loams to clays and the topsoil quickly becomes dry and hard after the harvest of T.aman crop. In Sylhet, rainfall prevails from late October to early November each year that offers the opportunity for the production of short duration crop by utilizing the residual moisture. Short duration Mustard can be grown easily under this circumstances. Moreover improved rice varieties having high yield potentiality, early maturation and non-photosensitive criteria should be selected for T.aus and T.aman. Keeping these views in mind the present study was designed to introduce improved rice varieties instead of china and Pajam in T.aus and T.aman season, respectively. Therefore, the present experiment was undertaken to establish improved cropping pattern against farmers' existing cropping pattern in the Sylhet region.

## Materials and Methods

One alternative cropping pattern T.Aus-T.Aman- Mustard was tested against farmers' existing cropping pattern T.aus-T.aman-Fallow at FSRD site, Golapgonj, Sylhet during three consecutive years of 1999-2000,2000-2001 and 2001-2002. The detail agronomic parameters of these two patterns are stated in Table1. For cost and return analysis, the values of the product and by product obtained from different varieties under study were calculated on the basis of prevailing market prices. Owing to good quality, Pajam was sold at a higher price in the market.

## Results and Discussion

The pattern was initiated with T.aus and transplanting was done on the 18-25 May of different years (Table1). Transplanting time of Aus rice is fully depend on rainfall. Aus sowing is difficult to establish in proper time because of uneven distribution of pre-monsoon rainfall. Delayed transplanting also pushed T.aman in late condition. Results of three consecutive trials during 1999, 2000 and 2001 showed that T.aus of the alternative cropping pattern yielded 5.60,5.82 and 5.42 t/ha, respectively as against 2.14, 2.40 and 2.3 t/ha in existing cropping pattern. The yield of T.aman rice in alternative cropping pattern were 4.90, 3.52 and 5.06 t/ha and that of existing cropping pattern was 3.40, 2.35 and 3.70 t/ha during the year of 1999, 2000 and 2001, respectively.

The yields of T.aman in the year 2000 at both the patterns were much lower due to attack by rice hispa. The third crop of the alternative pattern was mustard. In the first two years, the variety use for mustard was improved Tori-7 and 3rd year, it was BARI sarisha-9. Field duration of mustard was 75, 73 and 80 days in 1999-2000, 2000-2001 and 2001-2002, respectively.

The turn around times in between T.aman and Mustard were 3-7days. The seed yields of mustard was 0.95, 0.85 and 1.05t/ha in 1999-2000, 2000-2001 and 2001-2002, respectively. whereas in the existing cropping pattern land was fallow during the rabi season. The rainfall occurred in the month of October to November were 342.8, 175.1 and 329.9 mm, and during crop growing period (December to March) it was 170.7, 184.1 and 83 mm in 1999-2000, 2000-2001, and 2001-2002, respectively. Though mustard sowing was late but its yield was comparatively better. The reason might be available soil moisture as well as lower temperature exists during January to March.

The total variable cost in alternative cropping pattern of T.aus-T.aman- Mustard were Tk. 14137,14115 and 9083/ha, respectively and that of existing pattern (T.aus-TAman- Fallow) were Tk. 11875 and 12138 /ha. The higher cost of production in HYV was due to high input costs in labour and fertilizer. The gross margin of whole pattern in alternative cropping pattern was Tk. 58210/ha and that of existing pattern was Tk.23415 /ha. BCR was recorded 2.56 in alternative pattern while 1.98 in existing indicating higher monitory advantages. The MBCR is 3.61, it implies that the replacement of existing cropping pattern by alternative cropping pattern is profitable.

The alternative cropping pattern gave the higher economic benefit than the farmers' existing cropping pattern. A short duration T.aus and T.aman rice variety like BR26 and BRRI Dhan32, respectively followed by mustard and established by normal tillage within 3 to 7 days after T.aman rice harvest, it is possible to enhance the total productivity of the rainfed areas of Sylhet region under AEZ 20.

Table 1. Crop management of alternate cropping pattern (T.aus-T.aman-Mustard) and farmers' existing cropping pattern (T.aus-T.aman-Fallow) at FSRD site, Golapgonj, Sylhet during 1999-2002

| Parameters | Alternative cropping pattern | | | Farmer's existing cropping pattern | | |
|---|---|---|---|---|---|---|
| | Crop-I | Crop-II | Crop-III | Crop-I | Crop-II | Crop-III |
| Cropping pattern | T.aus | T.aman | Mustard | T.aus | T.aman | Fallow |
| Variety | BR26 | BRRIDhan 32 | Improved Tori-7/ BARI Sarisha-9 | Local (china) | Pajam | - |
| Date of transplanting/ seeding | 18-25 May | 15-20 August | 28 Nov-2 Dec. | 20-28 May | 13-20 August | - |
| Seed rate (kg/ha) | 25 | 25 | 10 | 35 | 35 | - |
| Spacing (cm) | 25×15 | 25×15 | Broadcast | 25×10 | 25×10 | - |
| Fertilizer dose (N,P,K, & S) | | | | | | |
| 1ST year | 60-18-36-11 | 60-18-36-11 | 90-30-36-21 | 50-10-0-0 | 75-10-0-0 | - |
| 2nd and 3rd years | 60-18-36-0 | 60-9-20-0 | 90-30-36-21 | | | |
| Insect management | | 2 spray | 2 spray | 2 spray | 2 spray | - |
| Date of harvest | 9-14 August | 25-30 Nov | 8-18 Feb | 8-16 Aug | 3-12 Dec | - |
| Ave. crop duration (days) | 84 | 102 | 76 | 81 | 113 | - |
| Turn around time (days) | - | 6-11 | 3-7 | - | 5-12 | - |

Table 2. Yield (t/ha) of alternative cropping pattern (T.aus-T.aman-Mustard) against farmers' existing cropping pattern (T.aus-T.aman-Fallow) of FSRD site, Golapgonj, Sylhet

| Cropping pattern | Grain/seed yield(t/ha) | | | | Straw/stalk yield (t/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | 99-00 | 00-01 | 01-02 | Mean | 99-00 | 00-01 | 01-02 | Mean |
| Alternative cropping pattern | | | | | | | | |
| T.aus | 5.60 | 5.82 | 5.42 | 5.61 | 6.27 | 6.54 | 6.07 | 6.29 |
| T.aman | 4.90 | 3.52 | 5.06 | 4.49 | 5.50 | 3.97 | 5.68 | 5.05 |
| Mustard | 0.95 | 0.85 | 1.05 | 0.95 | 1.76 | 1.57 | 1.92 | 1.75 |
| Farmers' existing cropping pattern | | | | | | | | |
| T.aus | 2.14 | 2.40 | 2.30 | 2.28 | 3.10 | 3.60 | 3.47 | 3.39 |
| T.aman | 3.40 | 2.35 | 3.70 | 3.15 | 4.10 | 2.72 | 4.40 | 3.74 |
| Fallow | - | - | - | - | - | - | - | - |

Table 3. Cost and return analysis of alternative cropping pattern against farmers' existing cropping pattern at FSRD site, Golapgonj (ave. of 3 years)

| Parameter | Alternative cropping pattern | | | Farmers existing cropping pattern | | |
|---|---|---|---|---|---|---|
| | T.Aus | T.Aman | Mustard | T.Aus | T.Aman | Fallow |
| Total variable cost (Tk./ha) | 14137 | 14115 | 9082 | 11875 | 12138 | - |
| Gross return (Tk./ha) | 42047 | 36985 | 16512 | 19689 | 27739 | - |
| Gross Margin (Tk/ha) | 27910 | 22870 | 7430 | 7814 | 15601 | - |
| Gross Margin (Tk/ha) (whole pattern) | - | 58210 | - | 23415 | - | - |
| BCR (whole pattern) | | 2.56 | | | 1.98 | |
| MBCR | | | 3.61 | | | |

| Crop | Price (Tk./kg) |
|---|---|
| BR26 | = 6.25 |
| Rice straw | = 1.10 |
| BRRI Dhan32 & China | = 7.00 |
| Mustard straw | = 0.75 |
| Pajam | = 7.50 |
| Mustard | = 16.00 |

# PERFORMANCE OF ALTERNATIVE CROPPING PATTERN LENTIL-JUTE-T.AMAN UNDER RAINFED CONDITION


## Abstract

Performances of alternate cropping pattern (Lentil-Jute-T.Aman) were tested against the farmers existing cropping pattern (Lentil-Jute) at MLT site Madaripur, Faridpur under rainfed condition during rabi 2000-2001. Grain yield and jute fibre yield in alternative cropping pattern was much higher than existing cropping pattern. The total gross margin from alternate cropping pattern was Tk. 76232/ha against Tk. 32894/ha in existing cropping pattern. Similarly BCR was also higher in alternate cropping pattern.


## Introduction

With the fast expansion of shallow tube well, irrigation at farm level, the crop diversity has come down to only the cereal crops in most irrigated areas. Particularly, rapid expansion of HYV Boro rice cultivation has virtually eliminated the traditional winter pulses crop resulting in huge deficit of pulses. Consequently the deficits are met partially by importing them at a very high cost. The resource poor farmers cannot afford to buy this high price imported products and suffers from associated health problems due to reduced intake of pulses. Further continuous cropping of HYV cereals has already exerted nutrient mining effect resulting in gradual decline soil fertility and productivity. In this context, an experiment was conducted to develop an alternative cropping patterns to increase total productivity and cropping intensity.

## Materials and Methods

Improved cropping pattern (Lentil-Jute-T.Aman) was tested against farmers existing cropping pattern (Lentil-Jute) at MLT site Madaripur, Faridpur during 2000-2001. Randomized complete Block design was used with five dispersed replications. The unit plot size was 2500 $m^2$. Intercultural operation was done as and when necessary. The details agronomic parameters of these two patterns are presented in Table 1. For cost and return analysis the values of the product and by product obtained from different crops under study were calculated on the basis of prevailing market prices (Table 2). In case of lentil, all fertilizers were applied in the time of final land preparation. The weeding was done at 30 days after seed sowing. Fertilizers were applied in case of Jute i.e. one half of nitrogen and all phosphorus, potassium and sulphur fertilizers used at the time of final land preparation. Remaining nitrogen was top-dressed when the soil moist. The weeding was done as and when necessary. Forty days old seedlings of T.Aman rice were transplanted at the main plot. Fertilizers were applied in T.Aman i.e. all phosphorus, potassium and sulphur fertilizers were applied as broadcast and incorporated with soils prior to transplanting. N was applied as broadcast in three equal splits i.e. after seedling establishment, at rapid tillering stage and 5-7 days before panicle initiation. The crop was established by transplanting at 25x15 cm spacing with five seedlings in each hill. The crop was adequately protected from weeds, disease and insect-pests.

## Results and Discussion

The alternative-cropping pattern yielded 1352, 2964 and 4250 kg/ha of Lentil, Jute and T.Aman, respectively as against 800 and 2173 kg/ha of Lentil and Jute respectively in the existing pattern (Table 2). The total gross margin from alternate cropping pattern was Tk. 76232/ha against Tk. 32894/h only in existing cropping pattern. Similarly BCR was also higher in alternate cropping pattern.

### Farmers reaction

Farmer preferred BARI Mashur-4 for bigger seed size, disease resistance, high yielder and good market price. Farmer preferred Jute variety O-9897 for good quality of fibre. Farmer preferred BRRI Dhan-33 for its short duration and lodging resistance.

The experiment needs to be continuing at least two year and alter next conclusion can be made.

Table 1. Agronomic performance of alternative cropping pattern (Lentil-Jute-T.Aman) against farmers existing cropping pattern (Lentil-Jute-Fellow) at MLT site, Madaripur during 2000-2001

| Parameters | Alternate cropping pattern | | | Farmers existing CP | | |
|---|---|---|---|---|---|---|
| | Crop-1 | Crop-2 | Crop-3 | Crop-1 | Crop-2 | Crop-3 |
| Cropping pattern | Lentil | Jute | T.Aman | Lentil | Jute | Fallow |
| Variety | BARI-Mushur-4 | 0-9897 | BRRIDhan-33 | Local | Local | - |
| Date of seeding | 04-05 Nov. 2000 | 3 April 2001 | 30 July 2001 | 1 Nov. 2000 | 3 Mar. 2001 | - |
| Seed rate (kg/ha) | 40 | 8 | 25 | 45 | 8 | - |
| Spacing | Broad coast | Broad coast | 25cmx15cm | Broad coast | Broad coast | - |
| Fertilizer dose (NPK kg/ha) | 10-40-10 | 35-5-15-2 | 35-4-10-2 | - | 30-0-0-0 | - |
| Insect management | Seed treated with Bavistin | Malathion | Bistaron | - | - | - |
| Date of harvest | 20 Feb. 2001 | 20 July 2001 | 18 Oct. 2001 | 15 Feb. 2001 | 20 July 2001 | - |
| Duration (days) | 108 | 137 | 75 | 106 | 137 | - |

Table 2. Analysis of cost and return per hectare of alternative cropping pattern (Lentil-Jute-T.Aman) against farmers existing cropping pattern (MLT site, Madaripur during 2000-01)

| Parameters | Alternate cropping pattern | | | Farmers existing CP | | |
|---|---|---|---|---|---|---|
| | Crop-1 | Crop-2 | Crop-3 | Crop-1 | Crop-2 | Crop-3 |
| | Lentil | Jute | T.Aman | Lentil | Jute | Fallow |
| Grain Yield (kg/ha) | 1352 | 2964 | 4250 | 800 | 2173 | - |
| Straw yield (kg/ha) | 2000 | 9600 | 4000 | 1500 | 6400 | - |
| Total variable cost (Tk./ha) | 8300 | 10150 | 14145 | 4900 | 8195 | - |
| Gross return (Tk./ha) | 32696 | 48341 | 27790 | 19600 | 35163 | - |
| Gross margin (Tk./ha) | 24396 | 38191 | 13645 | 14700 | 18194 | - |
| Gross margin (whole pattern) | | 76232 | | | 32894 | |
| MBCR | 3.85 | 6.74 | 1.96 | - | - | - |
| BCR (whole pattern) | | 3.32 | | | 2.50 | |

# PERFORMANCE OF POTATO YAM GROWN ON SOME HOMESTEAD TREES AND VERTICAL BAMBOO SUPPORT


## Abstract

The performance of Potato yam grown on homestead trees and on vertical bamboo support was carried out at FSRD site Syedpur, Rangpur, Lalmonirhat, Polashbari & Nilphamari MLT sites during 1998-99 to 2001-2002. A total of six farmers were selected from each location during the four successive years. Highest yield was obtained from vertical bamboo support 5.93 kg yam/plant (average of 4 years) followed by Ziga, Drumstick, Mander & Pitraj. Bamboo, Ziga, Drumstick, mander & Pitraj trees may be considered as the best growing support for Potato yam in Rangpur region.


## Introduction

Potato yam (Dioscorea bulbiefera) is an uncommon vegetable grown on the homestead trees in Bangladesh. Recent studies revealed that it could give substantial yield. But the farmers do not grow it intensively. Therefore, it offers a scope for the improvement of the homestead production system. Farmers grow it on different tree species and fences. Previous survey also reveals that Ziga, Mandar and Drumstick are prevalent on the homestead. Farmers grow the trees for their different uses. These trees can be made more useful by using them as support of yam. But compatibility of yam with different tree species is not known. As such, the present study was initiated.

## Materials and Methods

The program was carried out for four consecutive years from 1998-1999 to 2001-2002 at FSRD site, Syedpur, Rangpur, and Lalmonirhat, Polashbari and Nilphamari MLT sites. A total of six farmers, in each of the years were involved in this program. Five different supports were used. They were Mandar, Ziga, Drumstick, Pitraj and Bamboo sole. Planting was done during the month of April of each individual year. Two germinating yam seedling (300-400 g.) were planted in two pits near each tree trunk. Pit size was 50x50x50 cubic cm. Soil of each pit was well mixed with 5 kg cowdung. In the initial stage care was taken so that the creepers were not damaged by the animals and can climb the tree. Granular insecticide was applied time to time at the base of the yam plants and it was well mixed with the soil to control the leaf feeder, which affects the growth of the yam plant. Data on number and weight of yam per plant were recorded after harvest and analyzed.

## Results and Discussion

The yields of potato yam at the FSRD and three MLT sites viz. Polashbari, Lalmonirhat and Nilphamari have been presented in Table 1. The mean potato yam yield on different support arrangements for four successive years have been presented in the table. It is evident from the table that the highest number (40) and weight (5.93 kg) of yam per plant was obtained when it was allowed to grow on the bamboo support. Presence of sufficient sunlight and absence of shading effect might have contributed to the better yield of yam on vertical bamboo support. Ziga, Mandar, Drumstick and Pitraj support produced 31, 32, 27 and 27 numbers of yam which yielded more than four 4 kg per plant.

### Farmers' reaction

Most of the farmers of all the sites were found to be less interested about the production of potato yam. They took very little care of the plants. Mixed reaction was observed about the taste of yam. MLT site farmers could sell some of their produced yam in the local market.

## Conclusion

It is revealed that the performances of four successive years, Bamboo, Zigha, drumstick, Mander and Pitraj can be considered as the best growing support for potato yam in Rangpur Region.

Table 1. Performance of potato yam grown on different support trees for 4(four) years at four locations of greater Rangpur area during 1998-99 to 2001-2002

| Trees Species | Yam per plant (no.) | | | | | Weight of yam per plant (kg) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2001-02 | 2000-01 | 1999-00 | 1998-99 | Mean | 2001-02 | 2000-01 | 1999-00 | 1998-99 | Mean |
| Mander | 35 | 29 | 42 | 20 | 32 | 5.0 | 4.53 | 5.1 | 3.6 | 4.55 |
| Ziga | 34 | 29 | 43 | 18 | 31 | 5.3 | 5.16 | 5.3 | 2.8 | 4.62 |
| Drumstick | 28 | 26 | 35 | 19 | 27 | 5.2 | 5.74 | 4.0 | 3.4 | 4.56 |
| Pitraj | 26 | 33 | 26 | 23 | 27 | 5.4 | 5.39 | 3.9 | 3.1 | 4.45 |
| Bamboo(sole) | 47 | 43 | 41 | 30 | 40 | 7.1 | 6.79 | 5.6 | 4.2 | 5.93 |

Table 2. Performance of Potato yam grown on different support trees for 4 (four) years four location of greater Rangpur during 1998-99, 1999-00, 2000-01 and 2001-2002

| Tree species | Yam/Support (no) | Weight of yam/support (kg) |
|---|---|---|
| Mander | 32 b | 4.55b |
| Ziga | 31 b | 4.62b |
| Drumstick | 27 b | 4.56b |
| Pitraj | 27 b | 4.45b |
| Bamboo (sole) | 40 a | 5.93a |
| CV (%) | 15.6 | 10.8 |

Means followed by a common letter are not significantly different at the 5% level by DMRT

# PERFORMANCE OF POTATO YAM GROWN ON DIFFERENT SUPPORT


## Abstract

The experiment was conducted at Regional Agricultural Research Station, Jamalpur from March 2001 to January 2002 to determine the suitable support of potato yam grown on different supporting materials viz. i) Cut tree branches, ii) Bamboo trellis and iii) Vertical bamboo support. The experiment was laid out in a randomized complete block design with three replications. The results indicated that the significantly highest total weight of yam/plant was found from bamboo trellis which was identical to cut tree branches. Vertical bamboo support produced the lowest yam/plant.


## Introduction

Potato yam (*Dioscoria bulbifera*), botanically a bulbil, locally known as *Gach Aloo*, is an uncommon vegetable. The plant is climbing creeper. It is usually grown without care in the homestead trees. The plant is propagated vegetatively and once sown, it does not require recurrent sowings. It grows from April to January. Its harvest can be extended up to October whereby supply of the vegetables can be prolonged. Recent studies revealed that it could give a substantial yield. But the farmers do not grow it extensively. Research studies indicated that there is a scope for its production through homestead plantation system. But studies on growing potato yam on other supporting material are very meagre. Therefore, to determine the suitable support of potato yam grown on other supporting materials, the experiment was conducted at the Regional Agricultural Research Station, Jamalpur from March 2001 to January 2002.

## Materials and Methods

The experiment was conducted at Regional Agricultural Research Station, Jamalpur during the period from March 2000 to January 2001.Three supports viz. i) Cut tree branches, ii) Bamboo trellis and iii) Vertical bamboo support were considered as the treatment. Single standard sized germinated yam seed (average weight of 120 g) was planted in the pit in the third week of April, 2001. Well decomposed 5 kg cowdung, 25 g urea, 20 g TSP and 30 g MP/pit was applied and mixed with the soil before planting. Each pit was weeded twice during the entire production period. The yam started flowering in the middle of September 2001 and harvesting began from November 2001. The periodical harvesting continued up to January 2002. The data on yield were statistically analyzed and the means were separated as per LSD test.

## Results and Discussion

Results indicated that total weight of yam/plant was obtained from bamboo trellis which was identical to cut tree branches. Vertical bamboo support produced the lowest yam/plant (Table 1).

Table 1. Performance of potato yam grown on different supporting materials

| Support | Total weight of yam/plant (kg) |
|---|---|
| Cut tree branches | 4.8a |
| Bamboo trellis | 5.9a |
| Vertical bamboo support | 2.8b |
| F | * |
| CV% | 10.19 |

Figure in a column having similar/no letter do not differ significantly

# STUDY ON THE FEASIBILITY OF GROWING VEGETABLES IN HOME GARDEN ROUND THE YEAR


## Abstract

An experiment was conducted in the homestead area at the farm house of Farming Systems Research and Development Site, Narikeli, Jamalpur during the period from Kharif 2001 to Rabi 2002 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. Tomato-Indian spinach-Data gave the highest gross margin and benefit cost ratio which was followed by Lalshak+Cabbage-Brinjal-Kangkong pattern. The lowest gross margin and benefit cost ratio was obtained from Spinach+Garlic-Chilli. Individually, tomato gave highest net return and benefit cost ratio.


## Introduction

Bangladesh has 23 million households with 5.6 family sizes per household (BBS, 1999). Approximately 5% area (0.45 million ha.) of the total 8.4 million hectares of cultivable land is occupied by homesteads. Increased production of vegetables could play an important role in nutritional improvement of the people in Bangladesh. With increasing population more land is being used to produce staple food thus reducing the area available for cultivation of vegetables. Vegetables are the major dietary nutritional source for the mass people in Bangladesh (Huq and Rahman, 1994). Consumption of vegetables in Bangladesh is very low (about 30 g/day/person) compared to that of the neighbouring 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. Vegetables are a good source of minerals and vitamins and also contain high quality protein. With the ever-increasing problems of malnutrition and not much land devoted to vegetable production, the only feasible option particularly for the small holder is to grow vegetables intensively in homestead. Hence, an experiment was conducted to find out the profitable vegetable production sequence in the homestead.

## Materials and Methods

Trials on different vegetables growing patterns at homestead round the year started at Farming Systems Research and Development (FSRD) Site, Narikeli, Jamalpur, from Kharif 2001 to rabi 2002 with a view to find out a profitable sequence of vegetables pattern 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 | Danta | Tomato |
| Plot 2 | Brinjal | 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 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, Indian spinach, Brinjal, Okra, in Kharif-II, Danta, Kangkong and Broad leaf coriander and in Rabi, Tomato, Lalsak, Cabbage, Coriander, Onion, Spinach, Garlic, Carrot and Bitter gourd while Chilli and Latiraj Kachu were tested both in Kharif-I and Kharif-II. The experiment was conducted in a randomized complete block design. The plot size was 5 x 1 m. Recommended seed rate, spacing and fertilizer were used for all the vegetables. 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

**Kharif-I:** The highest yield was obtained from Indian Spinach (65.4 t/ha) followed by Okra (46 t/ha) and Brinjal (43 t/ha). The highest gross return was recorded from Okra (Tk.230000/ha) followed by Indian Spinach (Tk.196200/ha) and Brinjal (Tk.172000/ha). The gross margin and BCR also followed the similar trend (Table 1).

**Kharif-II:** The highest yield was recorded from Kangkong and Latiraj kachu (42 t/ha each) followed by data (30 t/ha) and chilli (14 t/ha). The lowest yield was recorded from Broadleaf coriander (9 t/ha). The highest gross return was obtained from latiraj kachu (Tk.336,000/ha) followed by Broadleaf coriander (Tk. 180,000/ha). The lowest gross benefit was obtained from data (Tk. 60,000/ha). Litiraj kahchu also provide highest gross margin (Tk. 226000/ha) and BCR (3.05) followed by broad leaf coriander (Table 2).

**Rabi:** The highest yield was obtained from Tomato (90 t/ha) followed by Lalsak + Cabbage (11+38 t/ha) and Carrot+ Bitter gourd (17+18 t/ha). The lowest yield was obtained from coriander +onion (3.6+10 t/ha). The highest gross return (Tk.360000/ha), gross margin (Tk.240000/ha) and BCR (3.0) was obtained from Tomato. The lowest gross return (Tk.152000/ha) and BCR (1.36) were obtained from Coriander + Onion (Table 3).

**Performance of the vegetables patterns:** Tomato-Indian spinach-Data was better than other patterns. This pattern gave the highest gross return (Tk 616200 /ha) and gross margin (Tk.373200/ha). BCR (2.48) was the highest in Carrot-Bitter gourd-Latiraj kachu pattern. The lowest gross return, gross margin and BCR (Tk.383000/ha, Tk 168000/ha and 1.78, respectively) was found in Spinach + Garlic-Chilli vegetable sequence.

Among the five vegetable patterns, Tomato-Indian spinach-Data gave the highest gross margin (Tk. 616200/ha) followed by Lalsak + cabbage - Brinjal - kangkong (Tk.612000/ha) and coriander + Onion - Okra - Broad leaf coriander (Tk.562000/ha). All of the patterns might be benefited for the farmer both in nutritional and economic point of view.

Table 1. Yield, cost and return of different vegetables of Kharif-I at FSRD site, Narikeli, Jamalpur 2001

| Crop | Field duration (days) | Yield (t/ha) | Gross return (Tk/ha) | Total variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|---|
| Indian Spinach | 100 | 65.4 | 196200 | 82500 | 113700 | 2.38 |
| Brinjal | 125 | 43.0 | 172000 | 96000 | 76000 | 1.79 |
| Okra | 102 | 46.0 | 230000 | 90000 | 140000 | 2.55 |
| Chilli | - | - | - | - | - | - |
| Latiraj kachu | - | - | - | - | - | - |

**Price**: Indian Spinach - Tk.3.00/kg, Brinjal - Tk.4.00/kg, Okra - Tk.5.00/kg

Table 2. Yield, cost and return of different vegetables of Kharif-II at FSRD site, Narikeli, Jamalpur 2001

| Crop | Field duration (days) | Yield (t/ha) | Gross return (Tk/ha) | Total variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|---|
| Data | 68 | 30 | 60000 | 48000 | 12000 | 1.25 |
| Kangkong | 48 | 42 | 168000 | 80000 | 88000 | 2.10 |
| Broad leaf coriander | 65 | 9 | 180000 | 75000 | 105000 | 2.40 |
| Chilli | 141 | 14 | 168000 | 100000 | 68000 | 1.68 |
| Latiraj kachu | 146 | 42 | 336000 | 110000 | 226000 | 3.05 |

**Price**: Danta - Tk.2.00/kg, Kangkong - Tk.4.00/kg, Broad leaf coriander -Tk.25.00/kg, Chilli-Tk.12.00/kg, Latiraj kachu-Tk.8.00/kg

Table 3. Yield, cost and return of different vegetables of Rabi at FSRD site, Narikeli, Jamalpur 2000-2001

| Crop | Field duration (days) | Yield (t/ha) | Gross return (Tk/ha) | Total Variable Cost (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|---|
| Tomato | 120 | 90 | 360000 | 120000 | 240000 | 3.00 |
| Lalsak +Cabbage | 28+75 | 11+38 | 272000 | 150000 | 122000 | 1.81 |
| Coriander +Onion | 62+97 | 3.6+10 | 152000 | 112000 | 40000 | 1.36 |
| Spinach + Garlic | 60+110 | 18+5.0 | 215000 | 115000 | 100000 | 1.87 |
| Carrot+Bitter gourd | 75+110 | 17+18 | 210000 | 110000 | 100000 | 1.91 |

**Price (Tk./kg)**: Tomato=10.00, Coriander=20.00, Lalshak= 4.00, Onion= 8.00, Cabbage= 6.00, Spinach= 5.00, Garlic= 25.00, Carrot= 6.00, Bitter gourd= 6.00

Table 4. Cost and return analysis of different vegetables pattern round the year at FSRD site, Narikeli, Jamalpur 2001-2002

| Patterns | Gross return (Tk/ha.) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|
| Indian spinach -Data- Tomato | 616200 | 250500 | 365700 | 2.46 |
| Brinjal -Kangkong- Lalsak + Cabbage | 612000 | 326000 | 286000 | 1.88 |
| Okra-Broad leaf coriander-Coriander + Onion | 562000 | 277000 | 285000 | 2.03 |
| Chilli- Spinach+ Garlic | 383000 | 215000 | 168000 | 1.78 |
| Latiraj kachu - Carrot+ Bitter gourd | 546000 | 220000 | 326000 | 2.48 |

**(Coastal Farming)**

# EFFECT OF SOWING TIME ON THE YIELD OF MUNGBEAN IN SALINE AREA


## Abstract

An experiment was conducted at FSRD site, Atkapalia, Noakhali during the rabi 2001-02 to find out the optimum sowing time of mungbean in saline area. Four sowing dates viz., 31 December, 10 January, 20 January and 2 February were included. Among the sowing date maximum yield was obtained from February sowing 791 kg/ha followed by January sowing 687 kg/ha.


## Introduction

Mungbean (*Vigna radiata* L. Wilczek) is one of the most important pulse crops in Bangladesh. It is one of the important sources of protein for both man and domestic animals. It has good digestibility and flavour. This crop, like other pulses, has the potential to enrich soils through nitrogen fixation. In the FSRD site Atkapalia, Noakhali, mungbean is cultivated in the pre-kharif season when salinity is a major problem. Salinity increases in the root zone through upward movement of moisture and affects the crop. As a result yield decreases. If mungbean sown in time it could be harvested avoiding the effect of salinity before increasing of salinity to its peak period. So time of sowing is very important for mungbean cultivation successfully. With the view in mind, it is needed to know the optimum sowing time of mungbean after harvest of T.aman rice.

## Materials and Methods

The experiment was conducted at FSRD site, Atkapalia, Noakhali during rabi season 2001-02. The design of the experiment was RCB with four dispersed replications. The unit plot size was 8 m x 4 m. The variety of mungbean was BARI mung- 4. Field was fertilized with 45, 85 and 35 kg/ha of urea, TSP and MP, respectively. All fertilizers were applied as basal during each time of sowing. Four sowing times were i.e. 31 December, 10 January, 20 January and 2 February included as treatment. Salinity and moisture of the field were tested by collecting soil from the date of sowing and every 15 days interval up to harvesting. Data on plant height, plant/m$^2$, branch/plant, and pods/plant were recorded from 10 randomly selected plants. Seed yield was determined as whole plot basis. The collected data were analyzed statistically and means were separated with LSD test.

## Results and Discussion

Plants height, branch/plant, pods/plant, length of pod, 1000-seed weight and seed yields were significantly influenced by different sowing dates. Plant height showed higher in February sowing followed by January 20 sowing. Plants/m$^2$ was not influenced by sowing date. February and January sowing revealed similar branch/plant. Almost similar trend was followed in pods/plant. Seed/pod was statistically identical in respect of seed/pod. The seed weight statistically similar except February 2 sowing, which showed lowest weight. Seed yield increased with the advancement of date of sowing where February 2 sowing showed maximum yield followed by January 20 sowing. From the alone study it may revealed that end of January to February 2 may be feasible to mungbean at saline area, Noakhali but the experiment to be continued next year for confirmation.

Table 1. Yield and yield attributes of mungbean by different sowing dates at FSRD site, Atkapalia, Noakhali during 2001-2002

| Treatment | Plant ht. (cm) | Plant/ m$^2$ | Branch /plant | Pod /Plant | Pod length (cm) | Seed /pod | 1000-seed wt (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|
| 31 December | 21.25 b | 27.75 | 2.6 | 10.95b | 4.89ab | 5.92 | 27.64ab | 323c |
| 10 January | 26.88ab | 40.75 | 2.8bc | 12.8ab | 4.65b | 6.75 | 27.75a | 501bc |
| 20 January | 27.88ab | 45.00 | 3.12ab | 15.5a | 5.49a | 6.77 | 27.56ab | 687ab |
| 02 February | 31.25a | 39.50 | 3.25a | 15.63a | 5.37a | 6.70 | 27.35 b | 791a |
| LSD (0.05) | 7 | ns | 0.3 | 3.35 | 0.70 | ns | 0.36 | 252.2 |
| CV (%) | 16.54 | 33.4 | 7.11 | 15.28 | 8.60 | 12.8 | 0.81 | 27.40 |

# EFFECT OF SOWING TIME ON MUSTARD AS ZERO TILLAGE CONDITION IN THE SALINE SOIL OF NOAKHALI


## Abstract

The experiment was conducted in the farmers' field of FSRD site, Noakhali during the rabi season of 2001-02 to know the optimum sowing time of mustard as zero tillage condition. Four sowing times viz., 6 November, 20 November, 28 November and 5 December were tested. The former sowing was made as reley and other dates as normal. The result showed that highest siliqua/plant, seed and straw yield/ha were recorded from November 20 sowing. This treatment also showed higher benefit cost ratio (2.41: 1.0).


## Introduction

Mustard is one of the major oil crops in Bangladesh. Bangladesh imported mustard seeds (broken or not) 100890 metric tons with about Tk.127 core in the year 1997 (Anon., 1998). In the char area of Noakhali, mustard is not cultivated due to late harvest of T.aman rice and raising of soil salinity. If mustard sown possible in time, it could be harvested avoiding the effect of salinity before late February. So, moisture and time of sowing is very important for seed germination as well as crop establishment in the saline area of Noakhali. So, a field experiment was conducted to know the optimum sowing time of mustard as zero tillage condition, to grow mustard as rabi crop in the large fallow land of saline area in order to increase the cropping intensity and to avoid the effect of salinity on the yield.

## Materials and Methods

The experiment was conducted at FSRD site, Atkapalia, Noakhali during rabi season 2001-02. The experiment was laid out in RCB design with three dispersed replications having unit plot size 8m x 5m. The variety of mustard was Tori-7. The field was fertilized 250, 152, 70 kg/ha of Urea, TSP and MP respectively. All fertilizers were applied as basal during the time of sowing. Four sowing times were included as treatment i.e. 6 November, 20 November, 28 November and 5 December. Due to heavy rainfall during second week of November, the scheduled sowing of 14 November was replaced with 20 November as in treatment $T_2$. But in treatment $T_{1,}$ mustard was sown as relay in the existing T. aman rice field. Seed were sown harvesting of T. aman in other three treatments. Salinity and moisture of the field data were collected date wise every 15 days interval up to harvesting. Data on plant height, branches/plant and pods/plant were recorded from 10 randomly selected plants. Seed and straw yield were determined as whole plot basis. The collected data were analyzed statistically and means were separated with LSD test.

## Results and Discussion

Plant height, plants/m$^2$, yield & yield attributes were significantly influenced by different sowing dates. Plant height was statistically similar except November 6 sowing which showed lowest plant height (Table 1). Plants/m$^2$ was statistically at par between November 28 and December 5 sowing. Branches/plant was similar trend to plant height. Significantly highest siliqua/plant was obtained from November 28 sowing. Seed weight revealed similar to all dates except November 6 sowing which gave lowest seed weight. Significantly highest seed yield was obtained from November 28 sowing due to highest no. of plants/m$^2$, branches/plant and siliqua/plant. Almost similar trend was followed in straw yield as same in grain yield. Cost benefit analysis showed that highest gross return and benefit cost ratio was recorded from November 28 sowing. The present study result showed that last week of November would be viable for growing mustard in saline area of Noakhali but the experiment needs to be continued another year for confirmation.

## Reference


Anonymous. 1998. Statistical Year Book of Bangladesh. Ministry of Planning, Government of The People's Republic of Bangladesh. Dhaka, Bangladesh.

Table 1. Effect of sowing time on the yield and yield contributing characters of mustard as zero tillage condition

| Treatment | Plant height (cm) | Plant/ $m^2$ | Branch/ plant | Siliqua/ Plant | 1000 seed weight (g) | Seed yield (kg/ha) | Straw yield (t/ha) | TVC (Tk/ha) | Gross return (Tk/ha) | BCR |
|---|---|---|---|---|---|---|---|---|---|---|
| November 6 | 44.80b | 49.50c | 3.50b | 33.40c | 2.20b | 547.6c | 0.87c | 5836 | 9856 | 1.69 |
| November 20 | 54.40ab | 66.0b | 3.85ab | 42.80b | 2.52a | 652.0bc | 1.31b | 5836 | 11736 | 2.01 |
| November 28 | 65.37a | 83.4a | 5.48a | 52.25a | 2.35ab | 782.8a | 1.45a | 5836 | 14090 | 2.41 |
| December 5 | 52.20ab | 71.6ab | 4.33ab | 44.7b | 2.3ab | 670.0b | 1.26b | 5836 | 12060 | 2.06 |
| LSD (0.05) | 17.07 | 13.58 | 1.68 | 7.51 | 0.020 | 106.4 | 0.15 | - | - | - |
| CV% | 15.77 | 10.05 | 19.7 | 8.64 | 5.99 | 8.03 | 6.45 | - | - | - |

Figures followed by letters in common in column are not different significantly.

# ON FARM ADAPTIVE TRIAL OF DEVELOPED AND ADVANCED LINES OF GROUNDNUT IN SALINE AREA OF NOAKHALI


## Abstract

Two years field experiment were conducted in the farmers' field of FSRD site Atkapalia, Noakhali during the Rabi season of 2000-01 and 2001-02 with two developed varieties (BARI Badam-5 and BARI Badam-6) along with an advanced line ICGS89257 and local variety. Two years result showed that BARI Badam-6 performed better in respect of nut yield and recommended for cultivation in saline area of Noakhali.


## Introduction

Most of the farmers of the 'char' area cultivate local variety of groundnut with traditional management practices resulting very low yield. Oilseed Research Center of BARI already developed some variety and one promising line of groundnut on the basis of their yield performance. This variety/line needs to be tested to evaluate the performance of some varieties of groundnut under farmers' condition.

## Materials and Methods

The study was conducted at FSRD site Atkapalia, Noakhali during Rabi season of 2000-01 and 2001-2002. The experiment was laid out in RCB design with four replications. The soil was silty loam to clay under the Ramgoti soil series of AEZ 18. Unit plot size was 5 m X 4m. Fertilizer dose of 10-70-50 Kg/ha of NPK, respectively was applied in the form of Urea, T.S.P. and M.P. All fertilizers were applied as basal dose during final land preparation. Seeds were sown in lines maintaining 30 cmx15 cm spacing. A few root rot diseases were observed. Harvesting was done from mid to last of May.

## Results and Discussion

Yield and yield attributes were presented the Table 1 and 2. Yield and yield attributes differed significantly among the varieties/lines in both years except pods/plant. Significantly highest plant height (69.4cm) was found from ICGS89257 in 2001-02 but this line showed similar height with BARI Badam 5 & 6. Similar trend was followed in case of branches/plant. Lowest height and branch/plant was recorded from the local variety in both years. In respect of 100 kernel weight, BARI Badam-6 and respective line showed statistically similar and higher performance than local and BARI Badam-5. Higher nut yield was recorded from BARI Badam-6 (2.93 t/ha) which was statistically similar to BARI Badam-5 (2.87t/ha) and ICGS89257 (2.50 t/ha) in 2000-01. Significant difference in nut yield was not found in 2001-02. On an average, higher nut yield was obtained from BARI Badam-6 which was higher yield than local variety. It was concluded from the result that BARI Badam-6 could be grown for higher yield in saline area of Noakhali.

Table 1. Performance of different groundnut varieties/line in saline area of Noakhali (2000-01 & 2001-02)

| Variety/line | Plant height (cm) | | Branch/ plant (No) | | Pod/plant | | 100-kernal weight (g) | | Nut yield (t/ha) | | Stover yield (t/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 |
| BARIBadam-5 | 56.77b | 42.28a | 6.87b | 5.70ab | 34.60 | 23.80 | 42.67bc | 51.75b | 2.87ab | 2.81 | 43.96c | 17.38b |
| BARIBadam-6 | 49.67bc | 42.80a | 8.53a | 6.25ab | 38.67 | 20.77 | 56.67a | 56.75ab | 2.93a | 2.86 | 52.46a | 20.95ab |
| ICGS89257 | 69.47a | 43.38a | 5.53c | 6.87a | 42.20 | 22.77 | 48.67ab | 63.75a | 2.50ab | 2.94 | 48.63b | 22.00a |
| Local | 44.53c | 33.13b | 5.13c | 4.87b | 39.40 | 24.10 | 36.67c | 32.00c | 2.32b | 2.59 | 48.10b | 12.30c |
| LSD(0.05) | 10.68 | 6.83 | 1.194 | 1.77 | ns | ns | 10.32 | 9.576 | 0.5994 | ns | 3.561 | 4.109 |
| CV (%) | 9.70 | 10.57 | 9.16 | 18.68 | 17.60 | 11.50 | 11.19 | 11.72 | 11.30 | 14.59 | 3.69 | 14.15 |

# EFFECT OF MULCH ON DIFFERENT VARIETIES OF POTATO IN SALINE SOIL

## Abstract

Effect of mulch on different varieties of potatoes in saline area under rainfed condition was studied at FSRD site, Atkapalia, Noakhali during rabi season 2001-2002. Four varieties viz. Ailsa, Heera, Chamak and Multa were studied with rice straw mulch and no mulch. All the varieties with mulch showed better yield performance in comparison with no mulch. Significantly highest yield (11.73 t/ha) was found from Heera with straw mulch.

## Introduction

Normal cultivation of potato is usually difficult in the site area due to capillary movement of salinity and insufficient soil moisture in the topsoil during rabi season. In this situation application of mulch may reduces the evaporation of soil moisture and upward movement of salinity and control weed infestation. The use of water hyacinth mulch in potato has been in practice and it is well established that it conserve soil moisture, minimize evaporation loss and enhance root growth (Allamanas et al., 1977; Choudhury and Prihar, 1974). Tuber Crop Research Center of BARI has developed some promising varieties of potatoes with reasonable good yield. Water hyacinth is not available in the experimental site, but rice straw could be used as mulch in potato cultivation. So, it is important to know the effect of rice straw mulch on different varieties of potatoes.

## Materials and Methods

The experiment was conducted at farmers' field under Farming Systems Research and Development (FSRD) site, Atkapalia, Noakhali, during the rabi season of 2001-2002. The soil was silt loam to clay under the Ramgati soil series of AEZ 18 (Young Meghna Estuarine Flood plain). Rice straw amounting 4.0 t/ha and no mulch with four varieties of potatoes (Ailsa, Heera, Chamak and Multa) were tested. The experiment was conducted under randomized block design with five replications having unit plot size of 8mx5m. The crop was fertilized with 100-24-100 NPK kg/ha and was applied at the time of final land preparation as basal. The whole potato tubers were planted within 20-24 December 2001 with 60 cm x 25 cm spacing. Mulches were applied immediately after planting to check the loss of soil moisture. Harvesting was done from March, 7 to 21, 2002. All the data were recorded at the time of harvest and were statistically analyzed. The means were compared by Least Significant Differences (LSD) test.

## Results and Discussion

Mulches significantly affected plant height, number of tuber/hill, tuber weight/hill and tuber yield/ha on different varieties significantly (Table 1). The maximum plant height was recorded from variety Ailsa with rice straw mulch but at par to all cultivars under mulch treatment. The lowest plant height 29.56 was recorded from the Multa with no mulch. Significantly highest number of tubers per hill was obtained from variety Chamak with mulch treatment. The weight of tubers per plant was recorded highest from variety Multa with mulch which was identical to all most all treatments except MOC & $MOC_2$ treatment. Highest yield (11.73 t/ha) was found from the variety Heera with mulch which was statistically significant than the other varieties. The lowest yield (6.27 t/ha) was obtained from the variety Chamak with no mulch.

Potato can be cultivated with straw mulch in saline area where land remains fallow in rabi season after immediate harvest of T. aman rice.

## References

Allamanas, R.E.A. Halaure, W.W Nelson and S.d Evans.1977. Surface energy balance and soil thermal property modifications by tillage induced soil structure. Tech. Bull 306. University of Minnesota, USA.

Choudhury, M R and S.S. Prihar. 1974. Root development and growth response of corn following mulching cultivation and inter row compaction. Agron. J. 66: 350-355.

Table 1. Effect of mulch on the yield and yield parameters of different varieties of potato at FSRD site, Atkapalia, Noakhali (Rabi, 2001-2002)

| Treatment | Plant height (cm) | Tuber/hill | Tuber weight/hill ( g) | Yield (t/ha) |
|---|---|---|---|---|
| Mo $C_1$ | 30.28bcd | 4.81c | 163.2bc | 7.39cde |
| Mo $C_2$ | 30.08cd | 5.32bc | 153.5c | 7.99bcde |
| Mo $C_3$ | 30.80bcd | 6.68b | 190.4abc | 6.27e |
| Mo $C_4$ | 29.56d | 6.28bc | 192.6abc | 7.22de |
| $M_1$ $C_1$ | 36.52a | 5.48bc | 207.2abc | 9.42b |
| $M_1$ $C_2$ | 35.52ab | 5.08bc | 214.0ab | 11.73a |
| $M_1$ $C_3$ | 35.00abc | 9.00a | 239.2a | 9.22bc |
| $M_1$ $C_4$ | 30.74abcd | 6.60b | 201.0abc | 9.04bcd |
| CV (%) | 12.58 | 21.48 | 21.99 | 17.07 |
| LSD (0.05) | 5.35 | 1.71 | 55.60 | 1.89 |

Mo = No mulch, $M_1$ = Mulch, $C_1$ = Ailsa, $C_2$ = Heera, $C_3$ = Chamak, $C_4$ = Multa.
Figures in column having similar letter do not differ significantly.

# EFFECT OF MULCH AND TILLAGE ON POTATO IN SALINE AREA

## Abstract

Experiment on effect of mulch and number of tillage (2, 3 & 4) on potato (var. Dheera) in saline area under rainfed condition was studied at FSRD site, Atkapalia, Noakhali during rabi season 2001-2002.Tillages with mulch showed better performance in comparison with no mulch. Highest yield (116.65 t/ha) and BCR (2.18) were found from rice straw with twice number of tillage.

## Introduction

Potato (*Solanum tuberosum L.)*, a carbohydrate rich root crop, is one of the most important vegetables as well as cash crop in Bangladesh. It is grown very limited in the saline area due to upward movement of salinity and insufficient soil moisture in topsoil during rabi season. So, escaping or minimizing salinity is very important for the rabi crops of saline soil. Improved cultural practices have also been reported to control soil salinity to a considerable extent (Abrol and Gupta, 1991) Majority of the reports indicated that application of mulch soon after planting increases the growth and yield of some roots and tuber crops ( Jha et al. 1986, 1983; Mishra and Mishra, 1982). Tillage practices have significant effect on the yield and yield contributing characters of potato (Anon., 1999). The present study was, therefore, undertaken to evaluate the effect of different tillage practices with or without mulch on the yield of potato.

## Materials and Methods

The experiment was conducted at farmers' field under FSRD site, Atkapalia, Noakhali during rabi season, 2001-02. The treatment comprised of no mulch and rice straw mulch and number of tillage (2, 3 & 4). The variety was BARI potato-12 (Dhera). The experiment was conducted in RCB with 4 dispersed replications. The unit plot size was 5 m x 4 m with potato spacing 60 cm x 25 cm. The crop was sown on 20-24 December, 2001. The crop was fertilizer with 100-24-100 NPK kg/ha as basal. Mulches were applied immediately after planting. Harvesting was done from 7 March to 21 March, 2002. All data were analyzed & compared by LSD test.

## Results and Discussion

Mulch and no. of tillage affected significantly the plant height, tuber weight/hill and tuber yield of potato (Table 1). The higher plant height was obtained from the 2 tillage with mulch which was statistically similar to 4 tillage with mulch. Plant height from other treatments was statistically similar to each other. Although tillage and mulch did not affect no. of tuber/hill but higher in all no. of tillage with mulch in comparison with no mulch. Tuber weight per hill was higher in all no. of tillage with mulch. Although higher potato yield was obtained from M1T2 but statistically identical to all treatments except MoT1 but straw mulch showed higher yield than no mulch. There was no influence of number of tillage with mulch but gross return and benefit cost ratio was obtained from M1T2 i.e. rice straw mulch with twice number of tillage. The experiment was conducted first time in the site and another year trial is needed for confirmation.

## References

Abrol, I. P. and R. K. Gupta 1991. Managing Salt- Affected Soils and Poor Quality Irrigation Water for Sustained Crop Productivity. In Proc. Inter. Workshop On Evaluation for SUSTAINED Land Management in Development World. Chiang Rai, Thailand . September' 1991: 188-229.

Anonymous, 2000. BARI Annual Report for 1998-99. Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. 481 p.

Mishra, S. and S. S. Mishra, 1982. Effect of mulching and weeedicides on the growth and Fress Rhizome yield of ginger. In: Abstract of paper. Ann. Conf. Indian Soc. Weed Sci. Rajendra Agric Univ., Bihar, India.

Jha, R. C., K. R. Murya and R. D. Pandey. 1986. Influence of mulch on the yield of ginger in Bihar, Indian M. Cocoa Arecanut and Spices 9:87-90

Table 1. Effect of mulch and tillage on the yield and yield parameters of potato at FSRD site, Atkapalia, Noakhali during the winter of 2001-2002

| Treatment | Plant height (cm) | No. of Tuber /hill | Tuber weight/ hill (g) | Yield (t/ha) | TVC (Tk/ha) | Gross return (Tk/ha) | Benefit cost ratio |
|---|---|---|---|---|---|---|---|
| Mo $T_1$ | 29.6b | 7.30 | 294.2cd | 11.26b | 46321 | 67560 | 1.46 |
| $M_1$ $T_1$ | 48.1a | 8.15 | 360.0abc | 14.20ab | 48321 | 85200 | 1.76 |
| Mo $T_2$ | 32.9b | 7.85 | 320bcd | 12.35ab | 46621 | 74100 | 1.59 |
| $M_1$ $T_2$ | 38.8b | 8.90 | 395.6ab | 16.65a | 48621 | 99900 | 2.18 |
| Mo $T_3$ | 28.95b | 7.65 | 282.6d | 11.70ab | 46821 | 70200 | 1.50 |
| $M_1$ $T_3$ | 46.90a | 8.40 | 418.33a | 14.82ab | 48821 | 88920 | 1.82 |
| CV (%) | 19.27 | 15.21 | 14.77 | 24.00 | - | - | - |
| LSD ( 0.05) | 10.9 | ns | 76.84 | 4.867 | - | - | - |

Mo= No mulch, $M_1$= Rice straw mulch, $T_1$, $T_2$ & $T_3$ = 2, 3 & 4 no. of tillage

# SECONDARY YIELD TRIAL OF BARLEY FOR SALINE AREA


## Abstract

The trial was conducted with three selected lines viz. BSHL-2, BSHL-4 and BSH-32 along with a variety BARI barley-4 at the farmers' field of FSRD site Atkapalia, Noakhali, Paikgacha, Khulna and Kalapara, Patuakhali during the rabi season of 2001-02 to select and evaluate their yield potentiality and adaptability in saline area. Significantly highest grain yield (1333 kg/ha) and straw yield (1676 kg/ha) were recorded from BSH-32 at Noakhali and also Patuakhali whereas BSHL-4 at Khulna.


## Introduction

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

## Materials and Methods

The experiment was conducted under rainfed condition at the farmers' field of FSRD site, Atkapalia, Noakhali, MLT site Paikgacha, Khulna and Kalapara, Patuakhali during the rabi season of 2001-2002. Three lines of barley viz. BSHL-2, BSHL-4 and BSH-32 were compared with a variety BARI barley-4. The former three lines were hull less. The experiment was laid out in a RCB design with three replications. The plot size was 18 $m^2$. Fertilizer @ 100-60-40 kg of NPK/ha was applied as basal during the final land preparation. The seeds were sown in line with 30 cm spacing with seed rate 100 kg/ha on December 6, 2001 at Noakhali, 24 December at Khulna and December 10 at Patuakhali. Sevin dust was applied with molasses to control cut worm at the seedling stage. Hinosan (0.02%) was sprayed twice 10 days intervals at pre-flowering stage during the just appearance of blight. Weeding was done twice. The crops were harvested on March 9, 2002 at Noakhali, 1st week of April at Khulna and 4 April at Patuakhali. The experiment was conducted under rainfed condition. Initial salinity of field was 0.58 ds/m/. During the study period the salinity was up to 4.36 ds/m. The data on yield attributes were statistically analyzed by MSTAT and the means were separated by LSD. The soil salinity level at Khulna site during 24 Dec., 10 and 25 January, 10 & 20 Feb. 1, 10 & 25 March and 5 April were 2.03, 7.71, 6.45, 15.93, 15.80, 8.07, 11.21, 8.10 and 5.20 mm hos/cm, respectively, whereas soil salinity at Patuakhali site during Dec. 1, Dec. 15, Dec. 30, Jan. 15, Jan. 30, Feb. 15, March 3, March 16 and March 30 were 3.95, 4.21, 5.60, 7.50, 8.75, 11.05, 12.91, 13.88 and 15.27, respectively.

## Results and Discussion

### Site: Noakhali

Yield and yield attributes of Barley lines along with a variety are presented in Table 1. Plant height and number of effective tillers per plant did not differ significantly. Germination percentage was higher is BSHL-2 but statistically identical to BSH-32. The length of spike of different line was statistically at par except BARI Barley-4 which showed lowest panicle length. The line BSH-32 showed higher no. of grains/spike but statistically identical to BSHL-4. Significantly highest grain yield was obtained from line BSH-32 and others three line/variety were statistically identical. Straw yield showed similar beloved as in grain yield. Ayers and Westcost (1976) reported that most arable crop can withstand salinity not exceeding 4.5 ds/m without significant reduction in yield. Soil salinity is the most dominant factor, which limits crop productivity particularly in the rabi and kharif-I seasons (Karim *et. al*., 1990). However, Barley is one of the promising crops for Rabi season under saline condition having electrical conductance of 8-12 ds/m (Hussain *et al*., 1999).

**Site: Khulna**

Spike/m$^2$, length of spike, grains/spike, 1000-grain weight and grain yield was significantly influenced by different line/variety (Table 2). The line BB-4 showed highest spike/m$^2$ which was significantly higher than other variety/line. Length of spike gave higher from line BSH-32 but at par to BSHL-4. But significantly highest no. of grains/spike revealed from line BSH-32 whereas BSHL-4 showed significantly higher seed weight. Significantly highest grain yield was recorded from variety BSHL-4 due to seed wt.

**Site: Kalapara, Patuakhali**

Statistical analysis was not done at the site. But germination (%) was highest from BSH-32. The same variety also showed highest plant height and length of spike. But grains/spike revealed from BSHL-2 and effective tiller almost similar. The line BSH-32 gave higher yield among the variety.

From the study it was observed that BSH-32 line performed better in the saline area of Noakhali and Patuakhali but line BSHL-4 at Khulna. The experiment should be repeated another year for confirmation.

**References**


Ayers, R. S. and D. W. Westcot. 1976. Water quality for agriculture, Irrigation and Drainage Paper 29, F. A. O. Rome.

Karim, Z., Hussain, S. G., and M. Ahmed. 1990. Salinity problems and crop intensification in the coastal regions of Bangladesh. BARC Soil publication no. 33: page 63.

Qazi. A. K. P. Bisawas. M. H. K. Hawlader. M. L. Das. D. J. Costa and A. Rahman. 1996. Bangladesh J. Nuclear Agric. 12: 25-29

Hussain, M. M., Khandaker, M. H. K., Hoque, A. F. M. M., Saha, A. and M. A. Zaman. 1999. Soil salinity and prospect of crop production in the coastal region of Bangladesh. Bangladesh J. Agric. 24 (1): 27-40


Table 1. Yield and yield attributes of Barley at the FSRD site, Atkapalia, Noakhali during rabi 2001-2002

| Lines/ Variety | Germination (%) | Plant height (cm) | Effective tillers/plant (no.) | Spike length (cm) | Grains/ spike (no.) | Grain yield (kg/ha) | Straw yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| BSHL-2 | 81.67b | 63.93 | 3.25 | 7.53a | 35c | 1056b | 1444bc |
| BSHL-4 | 88.33a | 60.00 | 3.34 | 7.33ab | 38ab | 1028b | 1333c |
| BSH-32 | 86.67a | 60.40 | 3.42 | 7.40ab | 39a | 1333a | 1676a |
| BB-4 | 81.67b | 65.67 | 3.15 | 6.66b | 37bc | 1167b | 1611a |
| LSD(0.05) | 4.99 | ns | ns | 0.7941 | 2.26 | 148.1 | 16.0 |
| CV (%) | 2.96 | 5.73 | 6.73 | 5.49 | 3.01 | 6.47 | 5.52 |

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

Table 2. Yield and yield attributes of barley as affected by different lines/variety at Paikgacha MLT site during 2001-2002

| Line/ Variety | Days to maturity | Plant height (cm.) | Spike/m$^2$ (no.) | Grains/spike (no.) | 1000-grain weight (g.) | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|
| BSH-32 | 100 | 81 | 104c | 28a | 32.65c | 912d |
| BSHL-2 | 97 | 71 | 119b | 26b | 36.17bc | 954b |
| BSHL-4 | 97 | 65 | 121b | 23c | 43.80a | 1007a |
| BB-4 | 100 | 74 | 142a | 21d | 38.42b | 924c |
| CV (%) | - | 11.08 | 1.85 | 4.30 | 7.94 | 1 |

Table 3. Yield and yield attributes of Barley as influenced by different line/variety at Kalapara, Patuakhali (2001-02)

| Line/ Variety | Germination (%) | Plant height (cm.) | Length of spike (cm) | Grains/spike (no.) | Effective tiller/hill | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|
| BSH-32 | 81.66 | 62.0 | 6.00 | 33 | 3.90 | 1720 |
| BSHL-2 | 77.00 | 60.4 | 5.66 | 31 | 3.94 | 1497 |
| BSHL-4 | 74.30 | 52.3 | 5.00 | 34 | 3.43 | 677 |
| BB-4 | 70.33 | 55.4 | 6.00 | 32 | 3.83 | 837 |

# EVALUATION OF CEREALS, PULSES AND OILSEEDS IN COASTAL AREA OF NOAKHALI


## Abstract

A few varieties of different cereal, pulse and oilseed crops were tested against salinity at the FSRD, Atkapalia, and Noakhali during the Rabi season of 2001-2002. Among the cultivars, wheat variety 'Gourab' performed the best yield (1283 kg/ha) followed by 'Shotabdi' (1206 kg/ha) and 'Kanchan' (1177 kg/ha). Mustard variety 'Sonali' yielded (800 kg/ha) which was statistically similar to'Dhali' (783 kg/ha) and 'Tori-7' (744 kg/ha). Khesari variety 'BARI Khesari-2 yielded 905 kg/ha followed by BARI Khesari-1 (900 kg/ha).


## Introduction

Soil salinity is one of the major factors that restrict crop production. Salinity starts at the month of November and reaches peak in March and April. Preliminary studies have indicated that some crops and crop varieties can be grown in areas where salinity reaches within a reasonable limit. Salt tolerant varieties of different crops are needed to fit in the cropping system. It is necessary to identify the crop varieties tolerant to salinity and increase crop production in the coastal area. The present study was undertaken to find out suitable salt tolerant cultivars at the saline area of Noakhali.

## Materials and Methods

The experiment was conducted at the farmer's field of Farming Systems Research and Development (FSRD) site, Atkapalia, Noakhali .The experiment was laid out in RCB design with three dispersed replications. Wheat varieties (Kanchan, Shotabdi, Protiva, Gourab), maize varieties (Barnali, Mohar, BARI Bhutta-5, Khoibhutta), mustard varieties (Tori-7, Sonali Sarisha and Dhali), sunflower (variety Kironi), kheshari varieties (BARI Khesari –1 and BARI Khesari –2) and Chickpea varieties (BARI Chola-3, BARI Chola-4) were studied to evaluate against salinity. The unit plot size was $6m^2$. Before sowing, seeds germination was tested. The germination was carried out in petridish with fresh water according to ISTA, 1985 method. Seeds were sown in line method with recommended seed rate and spacing of different crops on December 10, 2001. Fertilizers were applied at the recommended dose. All the fertilizers were applied as basal during the final land preparation. The crops were weeded in two times. Sumuithion 50 E.C. (0.02%) was sprayed on mustard varieties to control aphids. Salinity of the plots was recorded at 15 days interval. All the flowers of sunflower were stolen at flowering stage. Chickpea varieties were totally damaged due to severe infection of blight at fruiting stage. Cob formation of maize was very poor and some initiated cobs were stolen. Harvesting of the others crops were done from February 25 to March 17, 2002. Data on yield and yield contributing characters were recorded and statistically analyzed by MSTAT.

## Results and Discussion

Germination percentage of wheat, maize, mustard, sunflower variety and khesari varieties were found 85-97, 45-65, 71-97, 90 and 80-90%, respectively. Salinity was up to 4.63 ds/m. The yield and yield contributing characters of the cultivars were presented in the table 1. Among the varieties of wheat Kanchan, Gourab and Protiva showed almost similar plant height but lower in Shotabdi. Number of grains per plant was highest in case of Gourab followed by Protiva and Shotabdi. The highest 1000 grain weight was recorded in case of Shotabdi which also statistically similar to Kanchan. Grain and straw yield were found highest in case of Gourab which were statistically similar to Shotabdi and lowest in Protiva. In case of mustard varieties, Dhali performed highest plant height, 1000 grain weight and number of branches per plant followed by Sonali. Number of seeds per spike, yield (t/ha) and straw yield were statistically similar in case of all varieties of mustard. Significant difference was not found of yield and yield attributes of khesari varieties.

## Conclusion

Among the wheat varieties, Gourab followed by Shotabdi, mustard variety Dhali and both khesari varieties showed better adaptability in the saline area of Noakhali.

It should be more emphasized to take security measures specially in case of sunflower and maize. Some further investigation in relation to management practices should be made to evaluate the performance of above crops.

Table 1. Performance of crops of different cultivars in coastal areas of Noakhali

| Crop | Cultivars | Plant height (cm) | No of branch/ spike/pod/ plant | No of seeds/ grains/ pod/plant | 1000 grain weight (g) | Yield seed/ (kg/ha) | Straw yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| **A. Cereals** | | | | | | | |
| Wheat | Kanchan | 83.87a | | 21.00b | 44.47ab | 1177 | 1367ab |
| | Shotabdi | 70.73b | | 23.40ab | 46.67a | 1206 | 1383ab |
| | Gourab | 81.33a | | 27.00a | 44.00b | 1283 | 1441a |
| | Protiva | 78.60a | | 23.73ab | 40.67c | 1164 | 1350b |
| LSD (0.05) | | 5.697 | | 5.183 | 2.58 | ns | 0.089 |
| **B. Oil seeds** | | | | | | | |
| Mustard | Tori-7 | 63.09c | 2.60b | 29.73 | 2.03b | 744 | 1367 |
| | Sonali | 74.47b | 2.80b | 26.80 | 2.87a | 800 | 1433 |
| | Dhali | 92.47a | 3.73a | 30.87 | 2.9a | 783 | 1502 |
| LSD(0.05) | | 7.23 | 0.258 | ns | 0.192 | ns | ns |
| **C. Pulses** | | | | | | | |
| Khesari | BARI Khesari-1 | 37.80 | 37.40 | 3.00 | 45.33 | 900 | 1117 |
| | BARI Khesari-2 | 37.53 | 36.20 | 2.87 | 48.00 | 905 | 1156 |
| LSD(0.05) | | ns | ns | ns | ns | ns | ns |

Means followed by common letter(s) are statistically similar.

# EVALUATION OF CEREALS, PULSES AND OIL SEEDS IN COASTAL AREAS


## Abstract

The experiment was conducted at two locations, at Banerpota farm, Satkhira and at Paikgacha MLT site to screen the different salt tolerant varieties of different crops. The result showed that wheat variety Protiva, Maize variety BARI Maize-5, Sunflower variety Kironi performed better at Banerpota farm. Mustard and Chickpea did not perform well. Wheat variety Sourav, Maize variety Barnali performed well at Paikgacha MLT site. Further investigation in relation to management practices need to be done.


## Introduction

In Bangladesh, more than 30% of the cultivable area is in the coast. Coastal areas are seriously affected by various degrees of salinity. After harvesting of T. Aman vast land remain fallow. During rabi season, the soil salinity levels increase through capillary movement. For higher salinity most of the rabi crops do not survive in the area. BARI recently developed many high yielding varieties of cereal, pulses and oilseed crops. The performance of the varieties of cereals, pulses and oilseeds need to be evaluated in saline area. The present study was therefore, undertaken to find out the suitable varieties of cereals, pulses and oilseeds in saline area.

## Materials and Methods

The trial was conducted at two locations, at Banerpota farm, Satkhira and Paikgacha MLT site during rabi season 2001-2002. Six different crops were sown on 12 December 2001at Banerpota farm. On the other hand, crops were sown on 24 December 2001 at Paikgacha, Five varieties of wheat ( Sourav, Gourab, Kanchan, Satabdi and Protiva ), three varieties of Mustard ( Tori-7, Dholi and Sonali ), four varieties of Maize ( Barnali, Mohor, BARI Maize-5 and Khoi Bhutta), two varieties of Khesari ( BARI Khasari-1 and 2 ), one variety of Chickpea (BARI Chola-5) and Sunflower (Kironi) were included in the study. The crop (mustard) was not sown at Paikgacha MLT site. The unit plot size was 3m x 2m. Seeds were sown following RCB design with four replications. The seeds were sown in line sowing. The detail particulars of materials and methods are presented below: Data on yield and yield attributes were collected and analyzed statistically.

| Name of crops | Method of sowing | Spacing | Fertilizer dose (kg/ha) | | | Irrigation (times) |
|---|---|---|---|---|---|---|
| | | | N | $P_2O_5$ | $K_2O$ | |
| Wheat | Line | 20cm | 80 | 60 | 30 | 2 |
| Maize | Line | 75525cm | 120 | 70 | 50 | 2 |
| Mustard | Line | 30cm | 80 | 60 | 40 | 2 |
| Sunflower | Line | 50525cm | 80 | 60 | 60 | 2 |
| Chickpea | Line | 40cm | 0 | 40 | 20 | - |
| Khesari | Line | 50cm | 0 | 40 | 20 | - |

The soil salinity level on 20 and 23 December 2001 7 and 20 January, 6 and 18 February, 2 and 16 March, 1 and 15 April, 2002 were 2.01, 2.0, 1.93, 1.88, 1.95, 2.3, 3.12, 3.04, 3.8 and 8.34 mm hos/cm, respectively

## Results and Discussion

### Wheat

Grain yield and 1000 grain weight were significantly influenced by different varieties. Grain weight was statistically identical except variety Sourav which showed lowest weight. Higher grain yield was obtained from Protiva but statistically at par to Gaurab and Sourab. The variety Satabdi followed by Kanchan did not perform better in respect of yield.

### Maize

Plant height, cob/plant and grain yield was significantly affected by different maize varieties. Significantly highest grain yield was obtained from BARI Maize-5 but all the varieties performed better in respect of saline area.

**Oil crop**

Plant/$m^2$ and grain yield was not significantly influenced by different varieties of mustard. Grain yield was very low in all the varieties. Sunflower variety kironi showed seed yield of 1200 kg/ha which may be reasonable yield in saline area.

**Pulse**

BARI Khesari-1 showed grain yield of 700 kg/ha whereas chickpea variety BARI Chola 5 revealed only seed yield of 473 kg/ha.

Further investigation is necessary in respect of management practices of wheat variety (Protiva, Sourab and Gaurob), maize variety (BARI maize 5, Barnali and Khoibhutta), sunflower (Var. Kironi) & Khesari (BARI kheshari 1) at saline area of Bonarpara of Satkhira district.

Table 2.Yield and yield attributes of different crops tested at Banerpota farm during Rabi, 2001-2002

**Wheat**

| Variety | Days to maturity | Plant height (cm) | Spike/$m^2$ (No.) | Grain/Spike (No.) | 1000 grain wt. (g) | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|
| Sourav | 99 | 88 | 202 | 39 | 38.25 b | 3042 ab |
| Gourab | 96 | 87 | 219 | 39 | 42.25 a | 3175 ab |
| Kanchan | 98 | 89 | 245 | 37 | 42.25 a | 2879 bc |
| Protiva | 96 | 82 | 223 | 44 | 42.25 a | 3325 a |
| Satabdi | 95 | 87 | 202 | 36 | 42.00 a | 2671 c |
| LSD | - | ns | ns | ns | * | * |
| CV ( %) | - | 3.44 | 14.32 | 8.22 | 5.61 | 7.61 |

**Maize**

| Variety | Days to Maturity | Plant population /m2 | Plant height (cm) | Cob/plant (No.) | Grain /cob (No.) | 1000 grain weight (g) | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| Barnali | 121 | 5.00 | 186 b | 1.6 a | 444 | 188 | 5021 b |
| Mohor | 121 | 4.00 | 168 c | 1.0 b | 439 | 192 | 3721 d |
| BARI Maize-5 | 123 | 5.00 | 188 ab | 1.8 a | 456 | 196 | 5600 a |
| Khoi Bhutta | 123 | 5.00 | 196 a | 1.0 b | 451 | 186 | 4002 c |
| LSD | -- | NS | * | * | NS | NS | * |
| CV (%) | -- | 7.71 | 3.60 | 23.42 | 4.88 | 5.83 | 3.40 |

**Mustard**

| Variety | Days to Maturity | Plant population/ m2 | Plant height (cm) | Seed/pod (No.) | Pod/plant (No.) | 1000 grain weight (g) | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| Tori-7 | 66 | 99 | 68 b | 6.7 c | 50 a | 1.77 a | 382 |
| Dholi | 69 | 98 | 81 a | 8.0 b | 36 b | 1.55 b | 404 |
| Sonali | 71 | 110 | 78 ab | 9.2 a | 36 b | 1.45 b | 362 |
| LSD | -- | NS | * | * | * | * | NS |
| CV( %) | -- | 8.70 | 7.70 | 11.21 | 7.11 | 6.19 | 5.29 |

**Sun flower**

| Variety | Days to maturity | Plant height (cm) | Head diameter (cm) | Seed/head (No.) | 1000 seed weight (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|
| Kironi | 97 | 148 | 15 | 307 | 47 | 1200 |

**Khesari**

| Variety | Days to maturity | Plant height (cm) | Pod/plant (No.) | Seed/pod (No.) | 1000 seed weight (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|
| BARI Khesari-1 | 110 | 44.3 | 14.2 | 3.8 | 52 | 750 |

**Chickpea**

| Variety | Days to maturity | Plant height (cm) | Pod/plant (No.) | Seed/pod (No.) | 1000 seed weight (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|
| BARI Chola-5 | 105 | 39 | 15 | 1.65 | 95 | 473 |

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

# SCREENING OF DIFFERENT RABI CROPS IN SALINE AREA


## Abstract

Different rabi crops specially vegetables were screened in saline area of Noakhali, under AEZ 18f during 2001-2002. Among the tomato varieties, BARI Tomato-8 gave the highest yield (42.48 t/ha) followed by BARI Tomato-7 (40.17 t/ha). Brinjal variety Islampuri and cabbage variety Greenrich hybrid produced yield of 11.51 t/ha and 44.67t/ha respectively.


## Introduction

Out of 2.83 million hectares in the 13 districts of Bangladesh, about 0.84 million hectares are affected by varying degrees of soil salinity (Karim and Iqbal, 2001). From the SRDI soil testing report, it was observed that salinity concentration vary from 0-16ds/m. Salinity level is low from May to November but Salinity level is highest during rabi season. As a result, it is very difficult to grow rabi crops in that area. From previous results of studies in saline area, it was observed that kone are crops grown recently. So, it is needed to screen the crops that can withstand certain levels of salinity.

## Materials and Methods

The experiment was conducted in farmers' field at FSRD Site, Atkapalia. Noakhali with 6 dispersed replications having different varieties of tomato, brinjal cabbage. The unit plot size was 6m x 5m. Screening program was continued to same crops due to late rainfall (251.1 mm) in October and 93.4 mm (in 8-12 November) and unavailability of planting materials. Seedlings of different crops were raised at the seedbed of the FSRD site office. The seedlings were severely damaged by the damping off disease. Ridomil -72 M.Z. @ 0.2% was sprayed two times at 10 days interval. Transplanting was done from December 1, 2001 to December 24, 2001. Recommended spacing and fertilizer doses were maintained depending upon the nature of crops. Weeding was done as when necessary. Harvesting was done depending upon the crops. Data on yield of different crops were collected and cost benefit was done.

## Results and Discussion

The yield performance of different crops and cost benefit are presented in Table 1. Among the tomato varieties BARI Tomato-8 gave the highest yield (42.48 t/ha) followed by BARI Tomato-7 (40.17 t/ha). Two summer tomato varieties viz. BINA Tomato-2 and BINA Tomato-3 performed also considerable yield 23.68 t/ha and 21.84 t/ha respectively in winter season. These yields would be higher in summer season providing with shade to protect from rainfall (Begum, 2002). Highest gross return and benefit cost ratio was obtained from BARI Tomato-8 followed BARI Tomato-7. Among the brinjal varieties, Islampuri gave 11.51 t/ha and local variety gave 9.23 t/ha. Cabbage variety Greenrich hybrid performed highest yield (44.67 t/ha) and highest BCR. (5.13) followed by Atlas-70.

## Farmers' reaction

Most of the tomato varieties were new at the FSRD site. Farmers expressed their satisfaction due to higher yield. BARI tomato-8 was preferred by the farmers for its long durability. Although the yield of local variety of brinjal was poor, its acceptability to farmers' was more than islampuri for its good taste.

More crops as well as more varieties should be included for further research program.

## References


Shamsad Begum. 2002. Personal communication. Plant Breeding Division, Bangladesh Institute of Nuclear Institute, Mymensingh, April 16, 2002.

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

Table 1. Yield performance and cost benefit of different rabi crops in saline area FSRD site, Atkapalia, Noakhali, during 2001-2002

| Crops/variety | Yield (t/ha) | Total Variable Cost (Tk./ha) | Gross margin* (Tk./ha) | Benefit Cost Ratio |
|---|---|---|---|---|
| Tomato | | | | |
| BARI Tomato-2 | 37.53 | 38400 | 168885 | 4.39 |
| BARI Tomato-6 | 29.83 | 38400 | 134235 | 3.49 |
| BARI Tomato-7 | 40.17 | 38400 | 180765 | 4.70 |
| BARI Tomato-8 | 42.48 | 38400 | 191160 | 4.97 |
| BARI Tomato-11 | 20.76 | 38400 | 51900 | 1.62 |
| BINA Tomato-2 | 23.68 | 38400 | 106560 | 2.77 |
| BINA Tomato-3 | 21.84 | 38400 | 98280 | 2.55 |
| Roma V.F | 35.67 | 38400 | 160515 | 4.18 |
| Brinjal | | | | |
| Islampuri | 11.51 | 27750 | 57550 | 2.07 |
| Local | 9.23 | 27750 | 36920 | 1.33 |
| Cabbage | | | | |
| Atlas-70 | 42.50 | 39150 | 191250 | 4.88 |
| Greenrich hybrid | 44.67 | 39150 | 201015 | 5.13 |

*Market price of tomato varieties (except BARI Tomato-11) was @ Tk.4.50/kg and BARI Tomato-11 was Tk.3.00/kg. Brinjal: Islampuri @ Tk. 5.00/kg and local @ Tk. 4.00/kg. Cabbage @ Tk. 4.50/kg

# SCREENING OF DIFFERENT RABI CROPS IN SALINE AREA


## Abstract

An attempt was made to identify suitable crops for saline area of MLT site Kalapara, Patuakhali during the season of 2001-02. Salinity level in the area ranges between 6-14 ds/m during the dry period. Chilli, mungbean, sesame, linseed, cowpea, sunflower and safflower were grown as test crop. Among those crops, chilli, sunflower, sesame and cowpea 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 due to salinity and farmers' are not known about crops/variety to be grown in the site. In this context an experiment was undertaken to find out the suitable crops in the saline area.

## Materials and Methods

The experiment was conducted at MLT site Kalapara, Patuakhali during rabi 2001-02. The experiment was laid out in randomized complete block design with 4 replications. The unit plot size was 6m x 5m. Seven crops were selected viz., mungbean, cowpea, sunflower, safflower, linseed, sesame and chilli. Crops were cultivated in rainfed and irrigated condition. The salinity level of water at the site in January, February and March were 0.53, 0.59 and 0.64 ds/m and soil moisture (0-15 cm depth) in January, February, March and April were 21.4, 16.4, 14.63 and 20.0, respectively. Salinity level was measured month wise where two times irrigation was given.

Spacing, fertilizer, sowing and harvesting time of different crops shown below:

| Crops | Variety | Spacing (cm) | NPK (kg/ha) | Sowing time | Harvesting time |
|---|---|---|---|---|---|
| Chilli | Local | 50 x 30 | 50-30-50 | Dec. 26-29 2001 | April 18 to May 4, 2002 |
| Mung | Kanti | 30 x 5 | 8-6-8 | Jan. 5, 2002 | Jan.12-18, 2002 |
| Sunflower | Kironi | 50 x 25 | 92-40-60 | Dec. 15, 2001 | April 5, 2002 |
| Sesame | T-6 | 30 x 5 | 45-20-24 | Feb. 10, 2002 | May 15, 2002 |
| Safflower | Kironi | 40 x 15 | 92-40-60 | Dec. 15, 2001 | April 5, 2002 |
| Linseed | Nile | 30 x 10 | 45-20-24 | Dec. 15, 2001 | April 13,2002 |
| Cowpea | BARI Felon | 40 x 15 | 8-14-18 | Dec. 15, 2001 | April 4-8, 2002 |

## Results and Discussion

Seven crops were evaluated in the saline area of Kalapara, Patuakhali of which chilli performed better with higher benefit cost ratio in both irrigated and rainfed condition. Although chilli involved higher cost of cultivation but due to its market price higher gross return was achieved. Among two pulses crops, cowpea was found better than mungbean in respect of yield and benefit. Four oilseed crops were put under trial of which sunflower showed higher yield and monetary benefit than other three crops in both situation.

From above result it showed that chilli, cowpea and sunflower could be grown in saline area of Patuakhali region but the experiment needs further investigation for confirmation.

Table 1. Salinity level (ds/m) at different depth of soil at Kalapara, Patuakhali during rabi 2001-2002

| Month | Top soil | 10 cm | 20 cm | 30 cm |
|---|---|---|---|---|
| December | 8.17 | 7.40 | 7.0 | 6.9 |
| 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 2. Cost and return analysis of Mungbean, Chilli, Cowpea and Sesame at Kalapara during Rabi 2001-2002 in irrigated condition

| Crops | Yield (kg/ha) | Gross return TK./ha | TVC (Tk/ha) | Gross margin Tk/ha | BCR |
|---|---|---|---|---|---|
| Chilli | 740 | 25900 | 12250 | 13650 | 2.12 |
| Cowpea | 1292 | 15504 | 10467 | 5037 | 1.48 |
| Mungbean | 490 | 11270 | 8029 | 1810 | 1.40 |
| Sesame | 1090 | 13080 | 9220 | 3860 | 1.42 |
| Sunflower | 1267 | 15204 | 9250 | 5954 | 1.64 |
| Safflower | 1167 | 14004 | 9220 | 4754 | 1.52 |
| Linseed | 800 | 10400 | 7250 | 3150 | 1.43 |

Table 3. Economic performance of Mungbean, Chilli, Cowpea and Sesame at Kalapara during Rabi 2001-2002 in rainfed condition

| Crops | Yield (kg/ha) | Gross return (Tk./ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|
| Cowpea | 1096 | 14248 | 10467 | 3781 | 1.36 |
| Chilli | 578 | 20230 | 12250 | 7980 | 1.65 |
| Mung | 420 | 9660 | 8029 | 1631 | 1.20 |
| Sesame | 986 | 11832 | 9220 | 2612 | 1.28 |
| Sunflower | 1007 | 12084 | 9250 | 2834 | 1.30 |
| Safflower | 900 | 10800 | 9220 | 2696 | 1.17 |
| Linseed | 700 | 8400 | 7250 | 1150 | 1.16 |

**Crops (Tk./kg):** Mungbean =23, Linseed= 12, Cowpea= 13, Chilli= 35, Sesame= 12, Sunflower= 12, Safflower= 12

# ADAPTABILITY TRIAL OF WHEAT IN SALINE AREA UNDER LATE SOWN CONDITION


## Abstract

On-farm performance of five wheat varieties namely Kanchan, Sourav, Gourab, Protiva and Shatabdi were evaluated at Paikgacha MLT site, Khulna. Shourav produced the significantly highest grain yield (1228 kg/ha). Protiva produced the lowest grain yield (894 kg/ha). Shourav can be grown in Fallow-Fallow- Fallow or Fallow-T.Aman- Fallow cropping pattern in saline area.


## Introduction

Wheat (*Triticum aestivum*) is the second important cereal crop in Bangladesh. Its cultivation has dramatically been increased during the last few years. Most of the lands in saline area remain fallow in winter season due to salinity. Recently study showed that wheat can survive and performed better up to medium level of salinity. Recently BARI has developed few high yielding varieties more tolerant to leaf rust disease. After late harvesting of T. Aman the land remain fallow due to salinity. So, an experiment was undertaken to test the performance of newly released wheat varieties in saline area under late sown condition.

## Materials and Methods

The trial was initiated at Paikgacha MLT site during Rabi season, 2001-2002 with five wheat varieties namely Shourav, Gourab, Kanchan, Protiva and Satabdi flowing RCB design with four replications in farmers field. The unit plot size was 3m x 2m. The crop was sown on 24 December, 2001 as line sowing. Line to line spacing was 20 cm. Fertilizer were applied at the rate of 80-60-30 kg/ha of N-$P_2O_5$-$k_2O$ respectively. All TSP, MP and urea were applied as basal. All the intercultural operations were done as and when necessary. The crop was harvested during the last week of March, 2002. Data on yield and yield attributes were collected and analyzed statistically. The soil salinity level during the crop growing periods measured. The salinity level at the site during 24 Dec., 10 & 25 May, 1 & 30 Feb., 1, 10, 25 March & 5 April were 2.03, 7.71, 6.45, 15.93, 15.80, 8.02, 11.21, 8.10 & 5.20 mm hos/cm, respectively.

## Results and Discussion

Plant height, spike/$m^2$, length of spike, no. of grains/spike, 1000-grain weight & grain yield were significantly affected by different varieties. Sourav showed significantly highest plant height. Spike/$m^2$ was statistically identical except variety Protiva. The variety Sourav and Kanchan revealed similar grain/spike & higher than other variety. Significantly highest 1000-grain weight was obtained from variety Sourav. The variety Sourav and Kanchan showed similar yield & higher than Gourav, Protiva & Shatabdi. Overall grain yield was not good but under late seeding (24 December) condition in saline area may be feasible. But it needs further trial for confirmation.

Table 1. Yield and Yield attributes of wheat as affected by different varieties at Paikgacha MLT site during 2001-2002

| Variety | Days to maturity | Plant height (cm) | Spike/$m^2$ (No.) | Grain/Spike (No.) | 1000 grain weight (g) | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|
| Sourav | 93 | 84.25a | 126c | 35 | 42.55a | 1228a |
| Gourab | 93 | 80.75b | 133bc | 31 | 40.65b | 950bc |
| Protiva | 95 | 78.50b | 112d | 30 | 39.72bc | 894c |
| Satabdi | 97 | 81.75b | 140ab | 33 | 37.67c | 950bc |
| Kanchan | 95 | 78.75b | 145a | 34 | 37.83c | 1100ab |
| CV (%) | - | 9.83 | 5.12 | 7.95 | 4.28 | 10.42 |

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

# STUDY ON THE PERFORMANCE OF SOME NEWLY RELEASED WHEAT VARIETIES


## Abstract

An experiment was conducted at the MLTsite Jhalokati and Bhola during Rabi 2001-2002 to study the performance of newly released wheat varieties. Four new varieties (Protiva, Gourab, Sourav and Satabdi with Kanchan) were studied. Among the varieties, Satabdi gave the highest yield (3.28 t/ha) at Jhalokati and 4.0 t/ha at Bhola.


## Introduction

Kanchan is the only adopted wheat variety cultivated in Barisal region. Its yield potential is 3.5-4.6 t/ha. Recently, Wheat Research Centre of BARI has released some new varieties with higher yield potential. These varieties need to be evaluated in the farmer's field to select suitable one for AEZ-13. Hence, the study was undertaken to assess the potentiality of the new varieties in the farmers' field of Jhalokati and Bhola.

## Materials and Methods

An on-farm trial was undertaken in the farmers' fields under irrigated conditions at the MLT site Bhola and Jhalokati during rabi season of 2001-2002. The experiment was laid out in a Randomized Complete Block Design. The five different varieties (Protiva, Gourab, Sourav, Satabdi and Kanchan) comprised the five treatments of the experiment. Each treatment was replicated three times. The unit plot size was 6x5m. Seeds were sown on December 5, 2001 at Bhola and December 20, 2001 at Jhalokati. Fertilizers were applied at recommended dose. One weeding was done at 30 DAS. The crop was harvested on March 20, 2002. All necessary data were collected and analyzed statistically.

## Results and Discussions

### Site: Jhalokati, MLT

Plant height, spikes/$m^2$, grains/spike, 1000-grain weight and grain yields were significantly influenced by different variety of wheat (Table 1). Significantly highest plant height was recorded from Satabdi but spikes/$m^2$ from the variety Kanchan. Grains/spike was statistically identical to variety Protiva, Satabdi and Sourav. Bolder seed size was produced by variety Satabdi followed by Protiva. Significantly highest grain yield was recorded from variety Satabdi and 31% higher yield than Kanchan.

### Site: Bhola, MLT

Plant height, spikes/$m^2$, grains/spike, 1000-grain wt. and grain yield was significantly affected by different variety (Table 2). The variety Satabdi, Gourav and Protiva were statistically identical in respect of plant height and higher than Sourav and Kanchan. The variety Kanchan gave higher no. of spikes/$m^2$ but statistically identical to Protiva. Satabdi showed higher grain/spike but statistically at par to Sourav and Protiva. Significantly heaviest grain weight was obtained from variety Satabdi. Similar trend was followed in case of grain yield. The Satabdi revealed 13% higher grain yield than Kancahn.

The results indicated that Satabdi could be grown for higher yield at Jalokati and Bhola. The experiment was conducted for only one year so it needs another year trial for confirmation.

Table 1. Yield and yield contributing character of wheat varieties at MLT site Jhalokathi

| Varieties | Plant height (cm) | Spikes/m$^2$ | Grains/spike | 1000-grain weight (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|
| Protiva | 74.67d | 237 | 35a | 36.33ab | 2.34b |
| Satabdi | 81.30a | 245c | 35a | 38.00a | 3.28a |
| Gourab | 75.29b | 254b | 301b | 34.00bc | 2.06c |
| Sourab | 68.03c | 251b | 33ab | 31.00c | 2.25bc |
| Kanchan | 70.57bc | 281a | 32b | 32.53c | 2.26bc |

Table 2. Yield and yield contributing character of wheat varieties at MLT site Bhola

| Varieties | Plant height (cm) | Spikes/m$^2$ | Grains/spike | 1000-grain weight (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|
| Protiva | 72.0a | 348a | 31ab | 32.12b | 3.76b |
| Satabdi | 81.1a | 301b | 35sa | 38.00a | 4.00a |
| Gourab | 78.9a | 312b | 28b | 33.02b | 3.12d |
| Sourab | 69.4b | 318b | 33ab | 30.45b | 3.26d |
| Kanchan | 72.6b | 361a | 29b | 30.1b | 3.49c |

# ON-FARM PERFORMANCE OF NEWLY RELEASED T.AMAN MV IN PATUAKHALI AREA


## Abstract

The experiment was conducted in farmers' field at FSRD site Lebukhali, MLT site Kalapara and MLT site Borguna for the year 1999-2000, 2000-2001 and 2001-2002 find out the adaptability of some newly released T.Aman modern varieties viz. BR23, BRRIDhan30, BRRIDhan31, BRRIDhan32 & BRRIDhan34. On an average, the highest grain yield was obtained with the variety BRRIdhan-32 at the three locations. The second highest grain yield at Lebukhali was obtained with the variety BRRIdhan-31 and at Kalapara, with the variety BRRIdhan-23 which were statistically identical to BRRIdhan-32, but in case of Borguna the second highest grain yield was obtained with variety BR-23 and BRRIdhan-31 (statistically identical). At Lebukhali the highest BCR was obtained with the variety BRRIdhan-32 (1.47). and the highest MBCR over the check variety BR-23 was obtained with the variety BRRIdhan-32 (11.04) followed by BRRIdhan-31 (10.71) and BRRIdhan-30 (10.40) (Table 1b). At Kalapara the highest BCR was obtained with the variety BRRIdhan-32 (1.47) and MBCR over the check variety BR-23 was obtained only with the variety BRRIdhan-32 (5.58) (Table 2b). At Borguna the highest BCR was obtained with the variety BRRIdhan-32 (1.49) and the highest MBCR over the check variety BR-23 was obtained with the variety BRRIdhan-32 (10.93) followed by BRRIdhan-31 (Table 3b).


## Introduction

Farmers of Patuakhali and Borguna used to grow T.aman modern variety BR-11 for several years and still large area under this variety. At present farmers particularly those of saline zone Kalapara adopted the variety BR23 like because of its suitability for delayed planting. During the period recent past BRRI has released several other T.aman MV like BRRIdhan-30, 31, 32, 33 34 and 39 some of which particularly BRRIdhan-32 and 33 are claimed to be superior than those released earlier which need to be tested. With this view, newly released BRRIdhan-30, 31, 32 and 34 with BR-23 (check) were taken under trial to check the better adaptability of those MV of T.aman.

## Materials and methods

The experiment was conducted in farmers' field at FSRD site Lebukhali, MLT site Kalapara and MLT site Borguna during 1999-2000, 2000-2001 and 2001-2002 with 5 modern T.aman varieties viz. BR23, BRRIDhan-30, BRRIDhan-31, BRRIDhan-32 & BRRIDhan-34. Unit plot size was 8mX5m and spacing was 25 x 15 cm. The experiment was laid out in RCB design with five dispersed replications. Transplantation was done on August 16-20 at Lebukhali, August 17-25 at Kalapara and August 23-27 at Borguna. Fertilizer doses were urea 150 kg/ha for BRRIdhan-32 and 180 kg/ha for BR23, BRRIDhan-30, BRRIDhan-31, BRRIDhan-32 & BRRIDhan-34; TSP 100 kg/ha and MP 70 kg/ha for all five varieties. Total amount of TSP and MP were applied during final land preparation. Urea was applied in 2 equal installments after 15-20 and 35-40 days of transplanting. Weeding and other intercultural operations were done as and when necessary. Harvesting was done on December 15-25 at Lebukhali, December 24-28 at Kalapara and December 25-30 at Borguna.

## Results and Discussion

### Lebukhali

The highest grain yield was obtained with the variety BRRIdhan-32 for all the three years followed by BRRIdhan-31. The lowest grain yield was obtained with the variety BRRIdhan-34 (Table 1a). Similar trend was followed in case of straw yield. The highest BCR was obtained with the variety BRRIdhan-32 (1.47) followed by BRRIdhan-31 (1.32) and BRRIdhan-30 (1.30). The lowest BCR was obtained with the variety BRRIdhan-34 (1.02). The highest MBCR over the check variety BR-23 was obtained with the variety BRRIdhan-32 (11.04) followed by BRRIdhan-31 (10.71) and BRRIdhan-30 (10.40) (Table 1).

**Kalapara**

On an average, highest grain yield was obtained with the variety BRRIdhan-32 followed by BR23. The lowest grain yield was obtained with the variety BRRIdhan-34 (Table 2a). The highest BCR was obtained with the variety BRRIdhan-32 (1.47) followed by BR-23 (1.32) and BRRIdhan-31 (1.36). The lowest BCR was obtained with the variety BRRIdhan-34 (0.93). MBCR over the check variety BR-23 was obtained only with the variety BRRIdhan-32 (5.58) (Table 2).

**Borguna**

The highest grain yield was obtained with the variety BRRIdhan-32 for all the three years was followed by BRRIdhan-31 and BR23. The lowest grain yield was obtained with the variety BRRIdhan-34 (Table 3a). The highest BCR was obtained with the variety BRRIdhan-32 (1.49) followed by BR-31 (1.30) and BRRIdhan-23 (1.25). The lowest BCR was obtained with the variety BRRIdhan-34 (1.19). The highest MBCR over the check variety BR-23 was obtained with the variety BRRIdhan-32 (10.93) followed by BRRIdhan-31(Table 3).

From the above result it showed that BARIDhan-32 could be grown in all sites.

Table 1. Yield of T.aman MV at FSRD site, Lebulhali, Patuakhali (1999-2001 & average)

| Variety | Grain yield (ton/ha) | | | | Straw yield (Ton/ha) |
|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | Mean | |
| BR23 | 3.55b | 3.39c | 3.60b | 3.51 | 3.70 |
| BRRIDhan-30 | 3.72ab | 3.70bc | 3.66b | 3.69 | 3.80 |
| BRRIDhan-31 | 3.80ab | 4.02ab | 3.98ab | 3.73 | 3.85 |
| BRRIDhan-32 | 4.05a | 4.35a | 4.22a | 4.20 | 4.50 |
| BRRIDhan-34 | 2.82c | 2.38d | 2.49c | 2.56 | 3.00 |
| CV (%) | 9.9 | 8.8 | 10.6 | | |
| LSD (.05) | 0.503 | 0.581 | 0.431 | | |

Table 1. Cost and return analysis of different T.aman MV at FSRD site, Lebulhali, Patuakhali (average)

| Variety | Gross Return (Tk/ha) | Variable Cost (Tk/ha) | Gross margin (Tk/ha) | BCR | MBCR over control |
|---|---|---|---|---|---|
| BR23 | 21155 | 16920 | - | 1.25 | - |
| BRRIDhan-30 | 22195 | 17020 | 1040 | 1.30 | 10.40 |
| BRRIDhan-31 | 22440 | 17040 | 1285 | 1.32 | 10.71 |
| BRRIDhan-32 | 25350 | 17300 | 4195 | 1.47 | 11.04 |
| BRRIDhan-34 | 16860 | 16616 | - | 1.02 | - |

Table 3. Yield of T.aman MV at MLT site, Kalapara, Patuakhali (1999-2001 and average)

| Variety | Grain yield (ton/ha) | | | | Straw yield (ton/ha) |
|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | Mean | |
| BR23 | 4.03ab | 4.25a | 3.95ab | 4.07 | 4.30 |
| BRRIDhan-30 | 3.67b | 3.60b | 3.30c | 3.52 | 3.70 |
| BRRIDhan-31 | 3.85b | 3.90ab | 3.85b | 3.86 | 4.00 |
| BRRIDhan-32 | 4.23a | 4.40a | 4.15a | 4.26 | 4.50 |
| BRRIDhan-34 | 2.56c | 2.25c | 2.20d | 2.33 | 2.60 |
| CV (%) | 11.8 | 8.9 | 8.3 | | |
| LSD (.05) | 0.405 | 0.579 | 0.613 | | |

Table 4. Cost and return analysis of different T.aman MV at MLT site, Kalapara, Patuakhali (average)

| Variety | Gross Return (Tk/ha) | Total Variable Cost (Tk/ha) | Gross margin (Tk/ha) | BCR | MBCR over control |
|---|---|---|---|---|---|
| BR23 | 24535 | 17150 | - | 1.43 | - |
| BRRIDhan-30 | 21210 | 16926 | - | 1.25 | - |
| BRRIDhan-31 | 23230 | 17113 | - | 1.36 | - |
| BRRIDhan-32 | 25555 | 17333 | 1022 | 1.47 | 5.88 |
| BRRIDhan-34 | 15280 | 16478 | | 0.93 | - |

Table 5. Yield of T.aman MV at MLT site, Borguna, Patuakhali (1999-2001 & January)

| Variety | Grain yield (ton/ha) | | | | Straw yield (ton/ha) |
|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | Mean | |
| BR23 | 3.57b | 3.45b | 3.50b | 3.50 | 3.80 |
| BRRIDhan-30 | 3.66b | 3.25b | 3.10c | 3.33 | 3.60 |
| BRRIDhan-31 | 3.70b | 3.50b | 3.80b | 3.66 | 4.00 |
| BRRIDhan-32 | 4.12a | 4.45a | 4.28a | 4.28 | 4.60 |
| BRRIDhan-34 | 2.70c | 2.25c | 2.18d | 3.37 | 3.70 |
| CV (%) | 12.2 | 7.8 | 8.6 | | |
| LSD (.05) | 0.551 | 0.479 | 0.482 | | |

Table 6. Cost and return analysis of different T.aman MV at MLT site, Borguna, Patuakhali (Average)

| Variety | Gross Return (Tk/ha) | Total Variable Cost (Tk/ha) | Gross margin (Tk/ha) | BCR | MBCR over control |
|---|---|---|---|---|---|
| BR23 | 21150 | 16915 | - | 1.25 | - |
| BRRIDhan-30 | 20115 | 16820 | - | 1.20 | - |
| BRRIDhan-31 | 22130 | 17003 | 980 | 1.30 | 10.68 |
| BRRIDhan-32 | 25840 | 17344 | 4690 | 1.49 | 10.93 |
| BRRIDhan-34 | 20385 | 17102 | - | 1.19 | |

# CROP SCREENING AFTER T.AMAN RICE HARVEST


## Abstract

An experiment was deigned to identify crops in the Patuakhali area after T.Aman harvest during rabi season of 2001-2002 at FSRD site Lebukhali, Patuakhali. The experiment was firstly initiated in all three phases of Medium highland. In lower phase only local varieties of t aman rice is grown which harvest late usually in last of December to mid January. Any rabi crops grown in the lower phase was not found more profitable in compare to mungbean. In the ridge almost all rabi crops of the experiment could be grown successfully and profitably. So in this current year the experiment was conducted only in the medium phase of medium high land. The experiment was conducted with 7 crops on medium high land (Ridge) modern and Local varieties of rice where harvested with in 30 November. All the crops grown were found promising of which onion showed highest benefit cost ratio (5.52).


## Introduction

The entire district of Patuakhali and Barguna is within the Ganges Tidal Floodplain (AEZ-13). Most of the lands of this zone gets tidally flooded from end of March to end of November. More than 60% of all the cultivable land of this area remains fallow during winter. 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 due to late harvest of T.Aman rice. Though major part of the area is of medium highland type there are variations in the flooding depth of the cropland varies from 15cm to 80cm. Depending upon flooding depth medium highland are divided into 3 phases namely ridge (6-30 cm) medium phase (30-60 cm) and lower phase(70 cm above). Modern and local varieties of rice are grown depending upon flooding depth. So, an experiment was designed to identify crops those could be grown profitability in medium high land ridge (flooding depth 15 to 30 cm).

## Materials and Methods

The experiment was conducted in medium highland at Farming Systems Research and Development (FSRD) site Lebukhali, Patuakhali during the year rabi 2000-01 and 2001-02 to find out the profitable crop production after t aman rice harvest in rainfed condition. The study was made as in RCB design with 5 replications. Each unit plot measured 6 x 5. T.Aman was rice was harvested on November 30, 2001. Seven crops viz. Chilli, Mungbean, Onion, Sesame, Chickpea, Saflower and Bushbean were grown in each unit plot as treatments.

Table 1. Manegement practice of different crops grown for the experiment

| Variety | Variety | Spacing (cm) | Fertilizer NPK (kg/ha) | Sowing time | Harvesting time |
|---|---|---|---|---|---|
| Chilli | Local | 50 x 30 | 50-30-50 | Jan. 17, 2002 | May. – 4 ,2002 |
| Mung | Kanti | 30 x 5 | 8-6-8 | January 8-13,2002 | Jan.12-18, 2002 |
| Onion | Local | 30 x 15 | 121-40-70 | January 15-18, 2002 | April 30 ,2002 |
| Sesame | T-6 | 30 x 5 | 45-20-24 | Jan. 18, 2002 | May-20, 2002 |
| Chickpea | | 30 x 10 | 15-14-15 | January 8-13,2002 | Jan.18-20, 2002 |

## Result and Discussion

Five crops were Satabdi of which onion was found better yield. Other crops were also showed better performance. Among the crops, highest gross return, gross margin and benefit cost ratio was obtained from onion though higher cost was involved. Mungbean was also showed reasonable yield are economic return. The experiment needs further trial for confirmation.

Table 1. Economics performance 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 |
|---|---|---|---|---|---|
| Sesame | 1200 | 14400 | 10250 | 4150 | 1.40 |
| Onion | 8546 | 102552 | 18500 | 84052 | 5.52 |
| Mung | 1000 | 25000 | 10550 | 14450 | 2.36 |
| Chickpea | 926 | 23150 | 14200 | 8950 | 1.63 |
| Chilli | 960 | 33600 | 16500 | 13140 | 2.03 |

| Crops | Price (Tk./kg) |
|---|---|
| Mungbean | = 25.00 |
| Onion | = 12.00 |
| Chickpea | = 25.00 |
| Chilli | = 35.00 |
| Sesame | = 12.00 |

# EFFECT OF TIME OF SOWING ON THE PERFORMANCE OF MUNGBEAN VARIETIES IN THE SOUTHERN REGION OF BANGLADESH


## Abstract

An experiment was conducted at Farming Systems Research and development (FSRD) site Lebukhali to determine optimum sowing time and variety of mungbean for the southern region of Bangladesh during rabi seasons of 2001- 2002. Four varieties, viz. BARI mung-2 (Kanti), BARI mung-3, BARI mung-4 and BARI mung-5 were sown at four different dates i.e. Jan-1, Jan-15, Feb.-1 and Feb -15 . Result revealed that Feb. 15 sowing was performed the best (1195 kg/ha) and variety BARI mung-5 yielded 1517.5 kg/ha on 15- February sowing.


## Introduction

Mungbean (*Vigna radiata* L. Wilczek) is one of the most important pulse crops in Bangladesh. Mungbean is cultivated with minimum land preparation without weed control, fertilizer application, and disease control. All these factors are responsible for poor yield of mungbean. Average mungbean yield is 514 kg/ha in Bangladesh (BBS, 1991). About 57.5% of total mung bean cultivated area is at southern region on coastal belt of Bangladesh (Salauddin, 1997). Farmers at this region did not pay due attention to the mung bean cultivation. They cultivated mung bean under rainfed condition under residual moisture with minimum management. In greater Patuakhali district about 70% of the arable land remains fallow during winter. Again among the crops grown in 30% of the land pulse crop mainly mungbean and khesari are the major rabi crops of this area.

## Materials and Methods

The experiment was conducted in the farmers' field at Farming systems research and development (FSRD) site, Lebukhali (AEZ 13) during rabi seasons of 2001- 2002 under rainfed condition. The experiment was carried out using the split plot design with 4 replications. Sowing date constituted the main plots and cultivars the sub plots. Four date of sowing (Jan. 1, Jan. 15, Feb. 1 and Feb. 15) and four varieties (BARI mung-2 (Kanti), BARI mung 3, BARI mung-4 and BARI mung-5) were used in the experiment. The unit plot size was 8m x 5m .The land was fertilized with NPK @ 10-8 -10 per hectare at final land preparation. Seeds were sown in line. The distance between the rows was 30 cm and between plant was continuous. The plants were sprayed with Malathion for the control of pod borer.

## Results and Discussion

### Effect of sowing date

Plants/m$^2$ and seed yield was significantly influenced by different sowing dates (Table 1). The higher seed yield (1195 kg/ha) was obtained from 15 February sowing followed by February sowing. Though significant difference in yield attributes were not found but higher yield contributing characters revealed higher yield in Feb. 15 sowing.

### Effect of varieties

Seed yield and 1000-seed weight were significantly affected by different varieties. Significantly highest seed weight was obtained from variety BARI Mung-5 which reflected highest seed yield (Table 2).

### Interaction between sowing dates and varieties

Plants/m$^2$, seed weight and seed yields were significantly affected by sowing date and variety. Sowing date from Jan. 15 to Feb. 15 in all the varieties were statistically identical in respect of plant/m$^2$ but January sowing showed lowest plant/m$^2$ in all the varieties (Table 3). Plant height, no. of branches/plant, pods/plant; seeds/pods were not significantly influenced by interaction effect. Seed weight revealed higher from variety BARI Mung-5 in all dates of sowing and was statistically identical. Significantly highest seed yield (1.52 t/ha) was obtained from variety BARI Mung-5 when sown on Feb. 15. But al least 1 t/ha could be achieved when sown from Jan. 15 to Feb. 15 in same variety (BARI Mung-5).

So, from one year result showed that BARI Mung-5 could be grown in middle of February for higher yield in Lebukhali, Patuakhali area. The experiment needs at least another year trial for confirmation.

**References**

Salahuddin, A. B. M. 1997. Problems and prospects of mungbean cultivation paper presented at the training on “Mungbean its sprouts production and uses ” at BARI Joydebpur, Gazipur during March 30- April 1,1997.

Table 1. Yield and yield components of mung as affected by sowing dates (rabi 2001-02)

| Date of sowing | Plants/m$^2$ | Plant height (cm) | Branches /plant | Pod/plant | Seeds/pod | 1000 -seed wt. (g) | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| Jan.-1 | 20.25 | 37.87 | 2.18 | 10.19 | 7.81 | 30.5 | 484.86 |
| Jan.-15 | 31.19 | 39.88 | 2.28 | 10.50 | 7.69 | 28.37 | 746.88 |
| Feb,-1 | 38.06 | 42.56 | 2.46 | 10.88 | 8.0 | 31.25 | 990.62 |
| Feb.-15 | 38.00 | 43.68 | 2.54 | 10.94 | 9.5 | 31.75 | 1192.0 |
| LSD (0.05) | 6.05 | ns | ns | ns | ns | ns | 200.6 |

Table 2. Yield and yield components of mung as affected by varieties in rabi 2001-02

| Variety | Plants/m$^2$ | Plant height (cm) | Branches /plant | Pod/plant | Seeds/pod | 1000 seed wt. (g) | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| V1 | 32.06 | 41.06 | 2.34 | 10.86 | 8.13 | 28.44 | 794 |
| V2 | 31.56 | 40.75 | 2.39 | 10.44 | 8.0 | 28.44 | 745 |
| V3 | 31.12 | 40.05 | 2.32 | 10.68 | 8.43 | 24.81 | 803 |
| V4 | 32.75 | 41.12 | 2.36 | 10.37 | 8.44 | 37.86 | 1072 |
| LSD (0.05) | ns | ns | ns | ns | ns | 3.03 | 95.6 |

V1= BARI mung–2 (kanti) , V2 = BARI mung-3 , V3 = BARI mung-4,V4 = BARI mung-5

Table 3. Yield and yield components of mung as affected by sowing time and varieties (Lebukhali, Patuakhali, 2001-02)

| Sowing time | Variety | Plants /m$^2$ | Plant height (cm) | Branch/plant | Pod/plant | Seeds/pod | 1000 seed wt. (g) | Yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|
| Jan.-1 | V1 | 20 | 38.75 | 2.2 | 11.25 | 8 | 28.25 | 499.5 |
| | V2 | 20 | 38.5 | 2.2 | 10. | 7.5 | 27.75 | 420.0 |
| | V3 | 19 | 35.25 | 2.15 | 10.0 | 7.5 | 28.25 | 392.5 |
| | V4 | 22 | 39.0 | 2.15 | 9.50 | 8.25 | 37.75 | 627.5 |
| Jan.-15 | V1 | 31.25 | 38.75 | 2.22 | 10.25 | 7.5 | 27.5 | 645.0 |
| | V2 | 30.0 | 39.25 | 2.27 | 10.0 | 7.5 | 28.5 | 627.5 |
| | V3 | 30.5 | 42.0 | 2.2 | 11.0 | 7.75 | 28.0 | 712.5 |
| | V4 | 33.0 | 39.50 | 2.3 | 10.5 | 8.0 | 36.25 | 1002.0 |
| Feb.-1 | V1 | 38.5 | 42.75 | 2.45 | 10.75 | 8.5 | 28.75 | 965.0 |
| | V2 | 39.0 | 43.0 | 2.55 | 10.75 | 8.0 | 29.0 | 935.0 |
| | V3 | 37.25 | 42.0 | 2.45 | 11.25 | 7.75 | 29.5 | 922.5 |
| | V4 | 37.5 | 42.5 | 2.40 | 10.75 | 7.75 | 37.75 | 1140.0 |
| Feb-15 | V1 | 38.5 | 44.0 | 2.5 | 11.5 | 8.5 | 29.25 | 1065.0 |
| | V2 | 37.25 | 46.25 | 2.35 | 11.0 | 9.0 | 28.5 | 1015.0 |
| | V3 | 37.75 | 41.0 | 2.5 | 10.25 | 10.75 | 29.5 | 1185.0 |
| | V4 | 38.5 | 43.5 | 2.6 | 10.75 | 9.75 | 39.75 | 1517.5 |
| LSD( 0.05) | | 8.5 | ns | ns | ns | ns | 7.6 | 290.5 |

# ON-FARM TRIAL OF TOMATO VARIETIES

## Abstract

Performance of four tomato varieties namely BARI tomato-6, BARI tomato-7, BARI tomato-8 and BARI tomato-11 were evaluated in saline belt of FSRD site, Atkapalia, Noakhali. BARI tomato-7 gave significantly highest yield (53.67 t/ha). The variety BARI tomato-11 produced the lowest yield (20.37 t/ha) due to less individual fruit weight. The highest gross margin (Tk. 214680/ha) and benefit cost ratio (5.59) was recorded in BARI tomato-7 due to its highest yield performance.

## Introduction

Tomato is not common and popular vegetables in Bangladesh. It is rich in Vitamin. The average yield of local variety is very low compared to release varieties of BARI. The low yield in Noakhali district is due to use of local variety and salinity effect. Therefore, the experiment was taken in order to determine the adaptability and yield performance of newly developed tomato varieties in the farmers' field.

## Materials and Methods

Four developed varieties of tomato by BARI viz., BARI tomato-6, BARI tomato-7, BARI tomato-8 and BARI tomato-11 were evaluated at FSRD site, Atkapali, Noakhali during the Rabi season of 2001-2002 in the farmers' field. The experiment was laid out in RCB design with six dispersed replications. The unit plot size was 40 $m^2$.Seedlings were transplanted from November, 25 to December 24, 2001 with 60 cm x 40 cm spacing Recommended dose of fertilizers were applied as basal during the final land preparation. The plots were weeded in two times. Harvesting was done from March, 4 to April 9, 2002 depending upon the maturity condition of fruits. Data on yield and yield contributing characters were recorded and analyzed. Moreover, input and output prices were recorded for cost and return analysis.

## Results and Discussion

Response of tomato varieties about yield and yield contributing character is presented in Table 1. The varieties differed signi1ficantly in all the characters. Among the varieties, BARI Tomato-11 produced significantly highest number of fruits/plant (216/plant). BARI Tomato-6 (31.67/plant), BARI Tomato-8 and BARI Tomato-7 were statistically at par but fruit longer than BARI Tomato-6. But reversibly, increasing the number of fruits/plant decreased the fruit weight. Significantly highest individual fruit weight was recorded in BARI tomato-7 and lowest from BARI Tomato-11. Similarly increase in individual fruit weight yield/plant also increased (Table 1). BARI Tomato-7 gave high yield which was statistically similar with BARI Tomato-8 and BARI Tomato-6. The highest yield was due to their individual highest fruit weight. The lowest yield was recorded in BARI Tomato-11 due to lower fruit weight. The variety BARI Tomato-7 gave the highest gross margin (Tk. 214680/ha) followed by BARI Tomato-8 (Tk.197320/ha) and BARI Tomato-6 (Tk. 184240/ha). But higher benefit cost ratio was recorded from BARI Tomato-7 followed by BARI Tomato-8.

## Conclusion

The production of tomato during rabi season, 2001-02 at Atkapalia, Noakhali was found satisfactory. The trial should be repeated next year for confirmation.

### Farmers' reaction

Farmers were very much pleased due to high yield performance. All the varieties were first time at the FSRD site. BARI tomato-8 was more popular for its long durability. Farmers already preserved the seeds of the BARI tomato -8 for next year cultivation.

Table 1. Yield, yield attributes and cost benefit analysis of Tomato at FSRD site, Atkapalia, Noakhali during 2001-2002

| Treatment | Fruits/ plant (no.) | Each fruit weight (g) | Yield/ plant (kg) | Yield (t/ha) | TVC (Tk./ha) | GR (Tk./ha) | BCR |
|---|---|---|---|---|---|---|---|
| BARI Tomato-6 | 32b | 72.67c | 2.30bc | 46.06a | 38400 | 184240 | 4.79 |
| BARI Tomato-7 | 29b | 102.20a | 3.15a | 53.67a | 38400 | 214680 | 5.59 |
| BARI Tomato-8 | 30b | 91.33b | 2.74ab | 49.33a | 38400 | 197320 | 5.13 |
| BARI Tomato-11 | 216a | 8.63a | 1.73c | 20.37b | 38400 | 61110 | 1.59 |
| CV (%) | 32.67 | 7.75 | 19.92 | 15.82 | | | |
| LSD (0.05) | 29.85 | 6.57 | 0.61 | 8.23 | | | |

Figures in column having similar letter do not differ significantly.

# ON FARM EVALUATION TRIAL OF SWEET POTATO VARIETIES


## Abstract

On farm evaluation trial of different Sweet potato varieties was carried out at FSRD site, Atkapalia, Noakhali during the Rabi season of 2001-2002.The result revealed that BARI SP-4 gave highest yield (20 t/ha) followed by Tripti (17.96 t/ha) and Kamalasundari (17.22 t/ha). Lowest yield was found from local variety (10.34 t/ha). Highest BCR (2.55) was found from BARI SP-4 and lowest in Daulatpuri (1.59).


## Introduction

Sweet potato grows well in char area of Noakhali district but yield is very low due to cultivation of local variety. Recently BARI has developed some new varieties of sweet potato. So, an experiment was undertaken to identify suitable variety for char area of Noakhali.

## Materials and Methods

The experiment was conducted at FSRD site, Atkapalia, Noakhali during 2001-02. There were six varieties Tripti, Daulatpuri, Kamalasunduri, BARI sweet potato-4, BARI sweet potato-5 and Local in the study. The experiment was laid out RCBD with 3 dispersed replication. The unit plot size was 8m x 5m. Row to row and plant to plant spacing was 60 cm x 30 cm. Fertilizer dose 114-92-58 NPK kg/ha were used as basal dose. The crop was sown on 14 December 2001 and harvested 11-12 May 2002. Data were statistically analyzed.

## Results and Discussion

Yield and yield performance as well as cost benefit analysis are presented in Table 1. Higher number of root/plant was found from BARI SP-5 which was statistically similar to BARI SP- 4, Daulatpuri (4.20) and Kamalasunduri. The root weight per plant was found high in BARI SP-4 but at par with other varieties except Kamalasunduri. Maximum yield was found from BARI SP-4 followed by Tripti and Kamalasunduri. Lowest yield was found from local variety but statistically identical to Daulatpuri and BARI SP-4.

Highest gross margin and benefit cost ratio was obtained from BARI SP-4. BARI SP -4 could be grown in saline area of Noakhali for its high yield but local variety tested better and people like it, so local variety can be improved with high yield.

### Farmers' reaction

BARI developed varieties of sweet potatoes are new in the FSRD site, Atkapalia, Noakhali and its market price lower than local variety. Farmers' attitude about Kamalasunduri is well for attractive colour, sweetness and softness.

Table 1. Yield, yield attributes and cost benefit analysis of different sweet potato varieties

| Variety | Root/plant | Root wt./ plant (g) | Yield (t/ha) | Gross return | TVC | BCR |
|---|---|---|---|---|---|---|
| Tripti | 2.87bc | 720.0ab | 17.96a | 53880 | 23500 | 2.29 |
| Daulatpuri | 4.20a | 588.3ab | 12.43b | 37290 | 23500 | 1.59 |
| Kamalasunduri | 3.73ab | 552.0b | 17.22a | 51660 | 23500 | 2.19 |
| BARI SP- 4 | 4.40a | 776.7a | 20.01a | 60030 | 23500 | 2.55 |
| BARI SP-5 | 4.60a | 752.0ab | 12.59b | 37770 | 23500 | 1.61 |
| Local | 2.40 | 661.3ab | 10.34b | 41360 | 23000 | 1.80 |
| LSD | 0.8987 | 211.9 | 4.509 | | | |
| CV (%) | 13.35 | 17.27 | 16.42 | | | |

**Market price:** Local variety@ Tk 4/kg and other varieties Tk 3/kg

**(Rainfed Farming)**

# ROOT TRAITS POTENTIALITY OF DIFFERENT CROPS UNDER RAINFED CONDITIONS IN THE HIGH BARIND TRACT


## Abstract

Root traits of six different crops were investigated in the High Barind Tract. Among the crops root system of barley, chickpea and *Brassica* were found down to 90-105 cm depth, while linseed 75-90 cm depth in 2001 and 120-135 cm depth in 2002, whereas roots of lentil and wheat to 45-60 cm depth in 2001 and 60-75 cm in 2002. Lentil plants died at flowering to pod-setting stages apparently due to soil moisture stress. Barley plants gave the highest root length density (RLD) followed by chickpea, linseed and *Brassica*. Barley possessed the smaller root diameter while *Brassica* had the thickest root. Chickpea, barley, linseed and *Brassica* gave higher yields and monetary return. Thus among the tested crops barley, linseed and possibly *Brassica* (*campestris* group, cv. Dhali) could be the possible alternatives of chickpea in terms of root system, yield and market price.


## Introduction

The High Barind Tract (HBT) is situated in north-west Bangladesh (latitude 24°25' to 25°10' N and longitude 88-89° E at about 30 m above sea level). HBT is an uplifted terraced landscape of calcareous, alluvial origin modified by weathering in a sub-tropical environment, characterized by low rainfall, it's soil possess high bulk density, low organic matter, low N and limited available P (Ali, 2000), and limited stored soil moisture in post-rainy season (Idris, 1990). Moreover continuous puddle rice cultivation without any recycling of organic matter make it difficult for rabi crop cultivation, particularly under rainfed conditions. Root trait is one of the important criterions for understanding adaptive capability of any crop under water stress condition. As a consequence chickpea area in HBT has increased from 1,000 ha in 1980s to near 10,000 ha by the late 1990s (Muse et al., 1998). However, root traits potentiality of other crops should be tested in the HBT for its adaptation and profitability. Musa *et al*., (2001) opined that increased monocropping of chickpea may lead to build-up of chickpea pests and diseases; this ultimately would lower chickpea yields and make the crop more risky. Therefore, the present study was undertaken to quantify the root traits of different crops and thereby to select suitable alternative crops of chickpea for the HBT.

## Materials and Methods

The experiment was conducted at Chabbisnagar FSRD site, Rajshahi during 2000-01 and 2001-02. Six crops were tested namely, chickpea (cv. BARI Chola-2), wheat (cv. Kanchan), *Brassica* (cv. Dhali), barley (cv. Local), linseed (cv. Nila), and lentil (cv. L-5). The experiment was laid out in randomized complete block design with three replications, having 4 x 5 $m^2$ unit plot size. Fertilizers were applied at the rate of $N_{20}$ $P_{20}$ $K_{20}$ $S_{15}$ for chickpea, $N_{80}$ $P_{30}$ $K_{60}$ $S_{20}$ for wheat, $N_{70}$ $P_{20}$ $K_{20}$ $S_{20}$ for *Brassica*, $N_{50}$ $P_{20}$ $K_{40}$ $S_{10}$ for barley, $N_{30}$ $P_{10}$ $K_{10}$ $S_8$ for linseed, and $N_{20}$ $P_{20}$ $K_{20}$ $S_{15}$ kg/ha for lentil, respectively. Seeds of the crops were sown on 15 November 2000 and 25 November, 2001.

Root monolith sampling was done during 20-25 January for 2001 and 5-7 February for 2002 as per Heeraman and Juma (1993). Roots of different crops were scanned at ICRISAT, India by a scanner (Commonwealth Aircraft Corporation), and root length was obtained. Root length density (RLD) was calculated as:

RLD (cm $cm^{-3}$) = Length of the root (cm)/Volume of the soil sample ($cm^3$)

TRL (km $m^{-2}$) = Length of the root (km)/Area of the soil sample ($m^2$)

After taking root length data roots were oven dried at 80° C for 72 hours and root dry weights (RDW) were measured. The harvest date of chickpea, wheat, *Brassica,* barley, and linseed were 15 March, 4 February, 28 March, 20 March for 2001 and March 27, March 19, March 7, March 22 and March 18 for 2002.

RLD and RDW were presented in graphical form, while grain, hay yield and TRL data were presented in tabular form.

## Results and Discussion

**Root length density (RLD):** Root length density is the volume of root per unit soil volume, which signifies the amount of soil exploited by plant roots (Ali, 2000).

Rooting patterns of the two years were different due to rainfall variation and a bit different soil type (Fig 1 and 2). The year 2000-01 was dry whereas in 2001-02 rainfall occurred three times. Moreover, soils of the later year trial plots were a bit loose compared to previous year. As 2001-02 was rainy year, therefore more roots grew at upper surface layers in comparison to previous dry year. For both the years roots were found down to 90-105 cm for chickpea, barley and *Brassica*. But for linseed roots were proliferated down to 75-90 cm in 2001, while in 2002 there was a big jump, those were found down to 120-135 cm depth, which indicated its potentiality for rainfed harsh situation of HBT. Again for wheat roots were found down to 45-60 cm depth in 2001, but in 2002 it penetrated down to deeper layer (60-75 cm). In general the RLD (Fig 1 and 2) of all the crops decreased with soil depth except in some soil layers of barley, chickpea, linseed and *Brassica*.

Lentil root proliferated only down to 45- 60 cm depth at flowering stage (January) in both the years. However, lentil plants quickly died at flowering to pod-setting stages, apparently due to lack of available soil moisture. As available soil moisture was below 60 cm depth. A recent soil moisture study at same location by Ali (2000) reported that in dry year soil moisture goes below wilting point down to 60 cm depth and the situation starts from late December. The above study supports our view that lentil plant died primarily because of soil moisture stress or drought. The findings suggest that lentil cultivation should be avoided in area like Chabbisnagar, as water source is often scarce in the HBT. The roots of wheat were also found down to 45-60 and 60-75 cm depths, but it survived and produced grain. The probable reason might be that wheat plant is more efficient user of soil moisture?. It needs to be investigated further. However, it could be hypothesized that any genotype of wheat which has a root system like barley could do well in the area like Barind under rainfed eco-system. Results suggests that environmental variations (year to year and soil type) of root growth was large in some crops like chickpea, barley, linseed and wheat.

**Total root length (TRL):** Total root length variations (Table 2) among the years were large particularly for chickpea, wheat, barley and linseed. The probable factors behind it might be yearly rainfall difference, soil type variation and sowing time difference of the crops. Apparently TRL had affected grain yield (Table 1) positively or negatively. When we compare TRL with yield it became clear that in general higher yields were related to prolific root growth and vice-versa. The above findings are in agreement with Barber and Silberbush (1984) who showed that in soybean higher grain yields in all three years were related to higher root length, i. e. relationship between root length and grain yield was linear. Therefore for rainfed situation of the HBT, the genotypes which has a vigorous root system would do better than that of poor root system one. Because for achieving yield potential plants need more water and mineral nutrition, which could be acquired only by larger root growth penetrated in deeper soil layers. As Ali (2000) demonstrated that in HBT available soil moisture goes below wilting point down to 60 cm soil depth from late December and onward. However till March stored soil moisture remains between >60 to 100 cm depth. Thus under drought situations the crop / genotype will performs better which has drought tolerant characteristics including deep and prolific root system.

**Root dry weight (RDW):** Root dry weights are presented in Fig 2 and 3. The results showed that *Brassica* had the thick root system, while barley had the thinnest root system. According to Fitter (1991) roots with smaller diameters are more effective for absorption of soil water and nutrients. Thus barley plant might be more efficient in utilizing soil water under drought conditions due to its fine root system. It may be mentioned here that in HBT area most of the soils have high bulk density (1.6 to 1.8 g $cm^{-3}$) and lower soil layers have very small pore space (personal experience of M. Yusuf Ali during root excavation for root monolith sampling), thus only roots of small diameter can penetrate. Therefore the crop whose RDW is comparatively lower, perhaps it will grow better in drought or rainfed conditions.

**Yield and Market Value:** Average yield levels of chickpea, barley, linseed and *Brassica* were above national average (Table 2). Thus those crops were worthwhile for consideration of cultivation under rainfed conditions in the HBT. Again from yield and market price aspects barley, linseed and *Brassica* might be considered as alternatives of chickpea because long term sustainability of this crop.

## Conclusions

Barley, chickpea and *Brassica* roots were found down to 90-105 cm depth, and had prolific root system over linseed, wheat and lentil in 2001. However, in 2002 linseed root penetrated into the deepest layer (120-135 cm depth). Lentil plants died apparently because of moisture stress, as available soil moisture was below rhizosphere. Chickpea, barley, linseed and *Brassica* (*campestris* group) gave higher yields and monetary return. Thus barley, linseed and possibly *Brassica* could be regarded as possible alternative to chickpea considering their root system, yield and market value.

Future research work would be to find out genotypic variation in root system, drought tolerance and yield levels for barley, linseed and *Brassica*.

## References

Ali, M. Y. 2000. Influence of phosphorus fertilizer and soil moisture regimes on root system development, growth dynamics and yield of chickpea. Ph. D. Thesis, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, Bangladesh, 221 pp.

Ali, M. Y., M. S. Ahmed and M. A. Salam. 2001. Performance of promising chickpea cultivar Annigeri at different locations of the High Barind tract during 2000-01.*In* Summary Proceedings of the Review and Planning Workshop for the DFID-funded Project on "Promotion of Chickpea in the Barind Tract of Bangladesh" (A. M. Musa, C. Johansen, D. Harris and J. V. D. K. Kumar Rao eds.), 30 p. PROVA (People's Resource Oriented Voluntary Association).

Idris, K. M. 1990. Barind Tract: problems and potentials. Publication No. 33, Soil Resources Development Institute (SRDI), Rajshahi, Bangladesh: SRDI, Ministry of Agriculture, Government of Bangladesh, 7 pp.

Heeraman, D. A. and N. G. Juma. 1993. A comparison of minirhizotron core and monolith methods for quantifying barley (*Hordeum vulgare* L.) and faba bean (*Vicia faba* L.) root distribution. Plant Soil 148: 29-41.

Krishnamurthy, L., C. Johansen and O. Ito. 1996. Genotypic variation in root development and its implications for drought resistance in chickpea, pp. 235-250. *In* Dydamics of Roots and Nitrogen in Cropping Systems of the Semi-Arid Tropics (O. Ito, C. Johansen, J. J. Adu- Gyamfi, K. Katayana, J. V. D. K. Kumar Rao and T. J. Rego, eds.). Japan International Center for Agricultural Sciences.

Musa, A. M., M. Shahjahan, J. Kumar and C. Johansen. 1998. Farming systems in the Barind Tract Bangladesh. Paper presented at the Farming Systems Symposium at the International Congress on Agronomy, Environment and Food Security for the 21st Century, Indian Society of Agronomy, New Delhi, 1998.

Musa, A. M., D. Harris, C. Johansen and J. Kumar. 2001. Short duration chickpea to replace fallow after aman rice: The role of on-farm seed priming in the High Barind Tract of Bangladesh. Expl. Agric. volume 37, pp. 509-521.

Table 1. Comparative yearly total root length (TRL) and grain yield of different crops, High Barind Tract, Bangladesh, 2001-2002

| Crops | 2001 | | 2002 | |
|---|---|---|---|---|
| | TRL ($km/m^2$) | Yield (t/ha) | TRL ($km/m^2$) | Yield (t/ha) |
| Chickpea | 0.13 | 1.37 | 0.29 | 1.42 |
| Wheat | 0.07 | 0.85 | 1.17 | 1.01 |
| Brassica | 0.12 | 0.93 | 0.10 | 0.61 |
| Barley | 0.60 | 2.00 | 0.30 | 1.43 |
| Linseed | 0.08 | 0.57 | 0.33 | 1.42 |

Table 2. Two years average grain and hay yields of different crops in the High Barind Tract (HBT), 2001-2002

| Crops | Grain yield (t/ha) | | | Hay yield (t/ha) | | | Value ** of products (Tk/ha) |
|---|---|---|---|---|---|---|---|
| | 2001 | 2002 | Mean | 2001 | 2002 | Mean | |
| Chickpea (BARI Chola-2 | 1.37 | 1.42 | 1.39 | 2.13 | 1.49 | 1.81 | 34750 |
| Wheat (Kanchan) | 0.85 | 1.01 | 0.93 | 1.90 | 2.18 | 2.04 | 8370 |
| Brassica (Dhali) | 0.93 | 0.61 | 0.77 | 3.43 | 2.19 | 2.81 | 11550 |
| Barley (Local) | 2.00 | 1.43 | 1.71 | 3.83 | 2.98 | 3.40 | 11970 |
| Linseed (Nila) | 0.57 | 1.42 | 0.99 | 1.8 | 2.19 | 1.99 | 1197 |
| Lentil* (L-5) | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

* Most of the lentil plants died at flowering to pod-setting stages
** Only seed/grain yields data of the crops were considered

Farm gate price of different crops

| Crops | Tk/ha |
|---|---|
| Chickpea | 25.00 |
| Wheat | 9.00 |
| Brassica | 10.00 |
| Barley | 7.00 |
| Linseed | 12.00 |

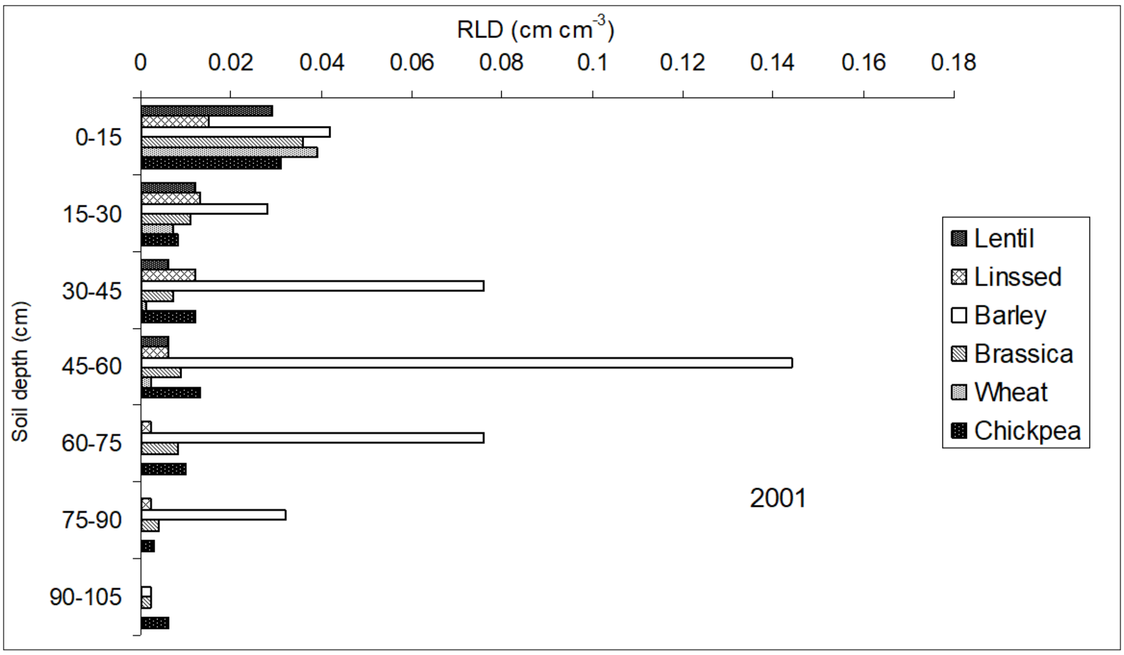



Fig. 1. Root length density of different crop under rainfed conditions, HBT, Bangladesh, 2000-01

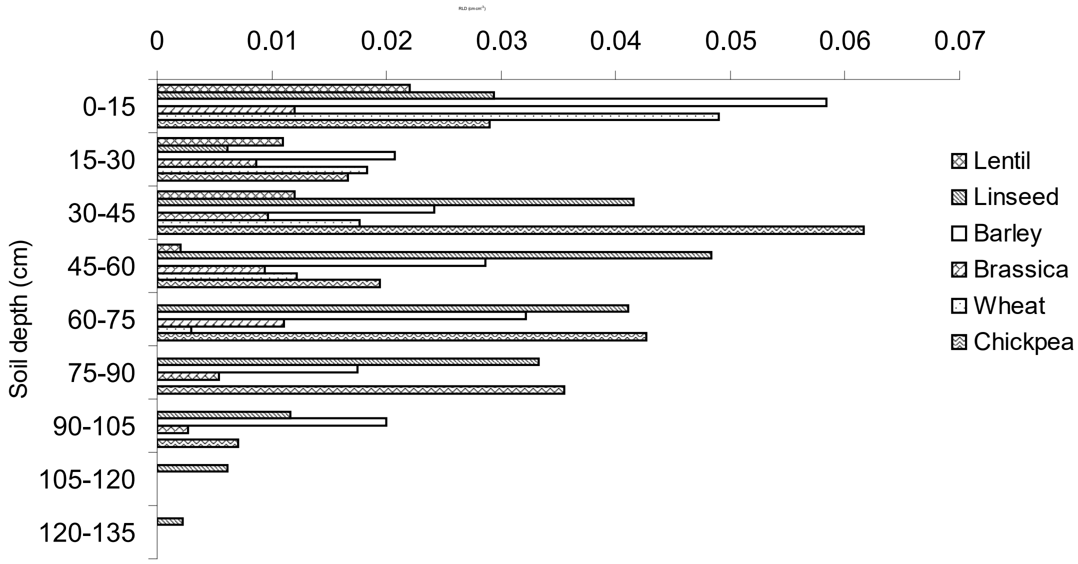



Fig 2. Root length density (RLD) of different rabi crops, High Barind Tract, Bangladesh, 2001-02.

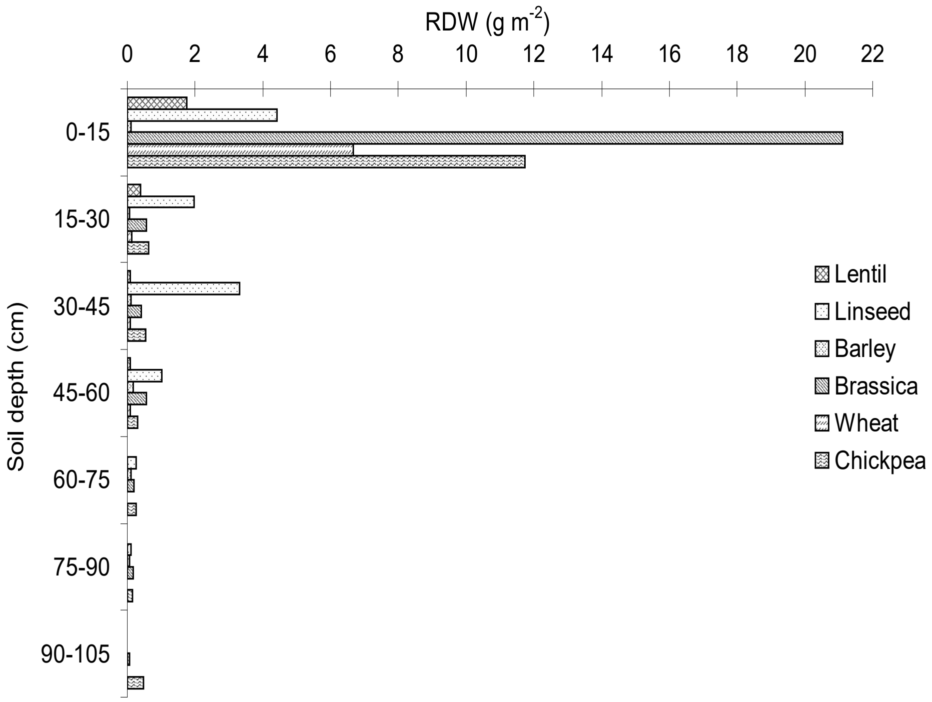



Fig 3. Root dry weight (RDW) of different crops in the High Barind Tract, 2001.

# INFLUENCE OF RHIZOBIUM INOCULATION, SOIL MOISTURE AND APPLIED PHOSPHORUS ON BIOLOGICAL NITROGEN FIXATION AND GRAIN YIELD OF CHICKPEA IN THE HIGH BARIND TRACT


## Abstract

Rhizobium inoculation along with phosphorus fertilizer at the rate of 20 kg P $ha^{-1}$ and one irrigation at vegetative stage of the crop gave markedly the highest nodule dry weight and apparently higher grain yield. Irrigation effect on yield was visible only in drought year. While only Rhizobium inoculation had no positive influence on yield. From the two years study P application along with Rhizobium inoculation could be suggested for chickpea cultivation in the High Barind Tract, Bangladesh.


## Introduction

Chickpea is a promising crop in the HBT, however its yield is still low and often unstable. Ali, 2000 observed that applied P-fertilizer and optimum soil moisture had positive influence on nodule dry weight and grain yield. From soil physical analysis it was observed that HBT soil possess high bulk density which may hamper the nodulation due to oxygen deficiency in root zone. Moreover, chemical analysis shows that HBT soil is extremely deficient in organic matter, nitrogen and available P. Possibly drought condition has negative effect on nodulation and availability of soil P and N. *Rhizobium* inoculation along with proper soil moisture and mineral nutrient (particularly P) should be tested for chickpea yield improvement and stability. Therefore the study was conducted to investigate the effect of inoculation, soil moisture and phosphorus fertilizer on the yield of chickpea.

## Materials and Methods

The experiment was carried out for consecutive two years (2000-01 to 2001-02) at Chabbisnagar FSRD site during November to March. There were five treatment combinations namely, 1.RI (*Rhizobium* inoculation) + $I_0$ (No irrigation) + $P_0$ ( phosphorus zero), 2. RI + $I_1$ (30-45 days after sowing) + $P_0$, 3. RI + $I_1$ (30-45 DAS) + $P_{20}$, 4. RI + $I_0$ + $P_{20}$ and 5. RI (No inoculation) + $I_1$ (30-45 DAS) + $P_{20.}$

Inoculant source was BINA (for chickpea). Experimental design was randomized complete block having three replications. Unit plot size was 4 x 5 $m^2$. All fertilizers were applied as basal at the rate of $N_{20}$ $K_{20}$ $S_{15}$ kg $ha^{-1}$. Phosphorus fertilizer was applied at the rate of $P_{20}$ kg/ha. Chickpea cultivar-BARI Chola 2 seeds were sown on 29 November, 2000 and 14 November, 2001at the rate of 50 kg $ha^{-1}$. Nodules were collected from 5 plants per plot and oven dried at 70° C for 24 hours for recording nodule dry weight (NDW), only in 2001-02.Yield attributes data were recorded from randomly selected 10 plants from each plot. Grain and hay yields were taken from a sample area of 3 x 2 $m^2$ for each plot. The crop was harvested on March 28, 2001 and March 26, 2002.The collected data were analyzed statistically and presented in tabular form.

## Results and Discussion

**Nodule dry weight (NDW):** Phosphorus fertilization along with one irrigation at vegetative stage and *Rhizobium* inoculation (RI+ $I_1$+$P_{20}$) gave markedly the highest NDW (Table 2), possibly due to stimulative effects of P and irrigation. The treatment where ($RI_0$+$I_1$+$P_{20}$) nodulation was not done gave the lowest NDW, thus influence of nodulation was clearly proved. However only nodulation without P application and irrigation produced inferior NDW in comparison to the treatments where P and irrigation or P was applied. Good nodulation effects on seed yields were very minimal, as yield was largely determined by some other physiological factors.

*Rhizobium* inoculation along with phosphorus fertilizer and one irrigation (RI + $I_1$ + $P_{20}$) at vegetative stage gave the highest yield in both the years (Table 1 and 2), however yield difference with other treatments was not significant due to high coefficient of variation (CV %), particularly in 2000-01. Despite that the above results indicate that inoculation (as new area for chickpea), P-fertilizer and one irrigation (in drought year) had a positive effect on yield and yield attributes. On the other hand, only

*Rhizobium* inoculation (RI + $I_0$ + $P_0$) had no positive influence on yield and its attributes without application of phosphorus fertilizer and irrigation, which resulted in the production of lowest grain yield. Ali (2000) reported that good nodulation occurred in chickpea plants in the HBT when P-fertilizer was applied at the rate of 20 kg P $ha^{-1}$ along with one irrigation in drought year, the present results partially agree with it. Irrigation effect was visible only in 2000-01 because of drought (RI+$I_1$+$P_0$), but not in the next year due to three times rainfall, thus irrigation effect is conditional depending on precipitation. Moreover, irrigation along with excess rabi season rainfall may reduce the seed yield by promoting excessive vegetative growth due to hormonal signal previously noticed in the same area (Ali, 2000). Again irrigation is a very scarce resource in the HBT, thus there is very limited scope of irrigation. However, applied P had a positive influence on yield in the present two years experiment as well in other studies (Ali, 2000).

Thus verifying the above studies P application (20kgP$ha^{-1}$) along with *Rhizobium* inoculation might be suggested, as HBT is comparatively a new area for chickpea.

## Conclusions

*Rhizobium* inoculation had a large influence on nodule dry weight but not so on yield. From two years study phosphorus application at the rate of 20 kg P $ha^{-1}$along with *Rhizobium* inoculation could be recommended for achieving higher yield.

### Reference

Ali, M. Y. 2000. Influence of phosphorus fertilizer and soil moisture regimes on root system development, growth dynamics and yield of chickpea. Ph. D. Thesis, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur.

Table 1. Yield and yield attributes of chickpea as affected by different combinations of inoculant, phosphorus fertilizer and irrigation, High Barind Tract, Rajshahi, 2000-01

| Treatment | Plant height (cm) | Pods/plant (No.) | Seeds/plant (No.) | 100-seed weight (g) | Grain yield (kg/ha) | Hay yield (kg/ha) |
|---|---|---|---|---|---|---|
| RI+$I_0$+$P_0$ | 6.93 | 19.46 | 1.40c | 10.93 | 583 | 916 |
| RI+$I_1$+$P_0$ | 27.00 | 24.06 | 1.60b | 11.43 | 889 | 1361 |
| RI+$I_1$+$P_{20}$ | 28.13 | 25.13 | 1.93a | 10.63 | 972 | 1278 |
| RI+$I_0$+$P_{20}$ | 24.00 | 19.8 | 1.73b | 10.26 | 694 | 944 |
| $RI_0$+$I_1$+$P_{20}$ | 26.46 | 20.53 | 1.70b | 10.86 | 680 | 958 |
| CV (%) | 13.8 | 26.6 | 5.7 | 6.0 | 38.1 | 33.5 |

Means followed by a common letter or no letter in a column are not significantly different at the 5 % level by DMRT

RI- Rhizobium inoculation, $RI_0$- No Rhizobium inoculation, $I_1$ - One irrigation at 35 days
$I_0$ - No irrigation, $P_{20}$ – 20 kg P $ha^{-1}$, $P_0$ - No P

Table 2. Nodule dry weight (NDW), yield and yield attributes of chickpea as affected by different combinations of *Rhizobium* inoculant, phosphorus fertilizer and irrigation, HBT, Bangladesh, 2001-02

| Treatment | NDW (mg/plant) | Plant height (cm) | Pods/plant (No.) | Seeds/plant (No.) | 100-seed weight (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|
| RI+$I_0$+$P_0$ | 133c | 49.73a | 45.70a | 1.30a | 13.90a | 2.21a |
| RI+$I_1$+$P_0$ | 194b | 46.28a | 47.03a | 1.16a | 14.43a | 2.38a |
| RI+$I_1$+$P_{20}$ | 331a | 46.60a | 49.07a | 1.30a | 15.10a | 2.93a |
| RI+$I_0$+$P_{20}$ | 135c | 47.07a | 48.33a | 1.33a | 15.00a | 2.82a |
| $RI_0$+$I_1$+$P_{20}$ | 80d | 45.07a | 47.40a | 1.36a | 15.13a | 2.70a |
| CV( %) 7.6 | | 14.8 | 12.5 | 6.8 | 10.0 | 16.1 |

Date of Sowing: November, 14

# PERFORMACE OF DIFFERENT CHICKPEA CULTIVARS UNDER OPTIMUM MANAGEMENT CONDITIONS IN THE HIGH BARIND TRACT


## Abstract

Performance of five chickpea genotypes viz. Annigeri, BARI Chola-2, BARI Chola-3, BARI Chola-5 and Local were evaluated under rainfed conditions in the High Barind Tract. For all the genotypes dry matter accumulation (DM) and crop growth rate (CGR) were maximum at pod-filling stage. Annigeri gave markedly higher DM from pod-filling stage to maturity over other cultivars. Further Annigeri had distinctly superior CGR at pod-filling stage but it dropped quickly at maturity (95-110 days after sowing). Because the cultivar was 5-7 days earlier in comparison to other varieties. Thus Annigeri is suitable for avoiding terminal stage drought. Annigeri gave the highest seed yield, 100-seed weight and apparently higher harvest index (HI).


## Introduction

BARI has released several cultivars of chickpea, some of which are promising. Two cultivars Annigeri and ICC 4958 seem to be better yielded in the High Barind Tract (Ali, 2000). The variety Annigeri has about one week shorter growth duration in comparison to other cultivars and drought resistant. Another important trait ICC4508 was deep and prolific rooting capability. Therefore, those cultivars along with Bangladesh released varieties are to be evaluated under rainfed optimum management conditions through different agronomic and physiological indicators.

## Materials and Methods

The experiment was conducted under rainfed condition at Chabbisnagar FSRD site, Rajshahi in 2001-02 during November to March. Five chickpea cultivars were tested (Annigeri, BARI-Chola 2, BARI-Chola 3, BARI-Chola 5 and Rajshahi local). The experiment was laid out in randomized complete block design with three replications, having 4 x 5 $m^2$ unit plot size. Fertilizers (kg $ha^{-1}$) were applied as basal at the rate of $N_{20}$ $P_{20}$ $K_{20}$ $S_{15}$. Seeds were sown on 20 November 2001 maintaining a spacing of 40 cm x 10 cm. Yield and yield attributes data were recorded from randomly selected 10 plants from each plot. Annigeri was harvested on March, 21 / 2002 and all other varieties were harvested on March 26 / 2002.The collected data were analyzed statistically and presented in graphical and tabular forms.

## Results and Discussion

**Dry matter (DM):** All the three BARI released chickpea varieties had good DM accumulation at vegetative stage, however, from pod-filling stage Annigeri had distinct superiority in DM production over four other cultivars (Fig 1). BARI-Chola 3 had also good DM accumulation at pod-filling stage but it sharply decreased at 110 days resulted in inferior DM. At the later stage of growth (110-120 DAS) Rajshahi local gave apparently superior DM production over the BARI released varieties.

Rapid DM production at flowering to pod-filling stages indicated that chickpea plants need sufficient water and nutrients to achieve the yield potential associated with other environmental factors such as clear sunshine and particularly air temperature below 30$^{o}$ C (Ali, 2000).

**Crop growth rate (CGR):** At vegetative stage BARI Chola-3 had the highest CGR (Fig 2), but it rapidly dropped at pod-filling stage. Annigeri had slow CGR at vegetative stage but it increased geometrically at pod-filling stage and attained its peak at 80-90 days and then it became negative at 95-110 days, as it was comparatively a short duration genotype (Ali, 2000, Rao and Rao, 2000). By contrast all other four varieties had positive CGR up to 95-110 days and they had negative CGR only at maturity (110-120 days). Thus Annigeri had the advantages to avoid terminal drought, which often occurred at pod-filling to ripening stages of the crops in the HBT region (AEZ 26).

**Yield and yield attributes:** The variety Annigeri gave significantly the highest seed yield due to combined effects of good number of pods /plant, seed/pod and the heaviest 100-seed weight. All other varieties were similar among themselves in seed yield. Other workers also reported that Annigeri produced higher yield over BARI Chola 2 and BARI Chola 5, particularly in drought year in the HBT. (Ali, 2000 & Ali *et al.,* 2001). Plant height, pods/plant and harvest index were statistically insignificant. Significantly heaviest 100-seed weight was obtained from Annigeri. Seed size might have a impact on farmers preference and market price. Annigeri also possessed the highest harvest index (HI) followed by local variety. One of the reason of higher seed yield by Annigeri was due to its rapid dry matter partitioning to seed at pod-filling stage.

## Conclusions

Genotype Annigeri produced higher seed yield due to genetic factor (bigger seed size and good number of pods per plant) as well as physiological factors, such as, rapid dry matter partitioning to grain at pod-filling stage and by escaping terminal high temperature through its shorter growth duration. The experiment will be continued for the second year for final conclusion.

## References

Ali, M. Y. 2000. Influence of phosphorus fertilizer and soil moisture regimes on root system development, growth dynamics and yield of chickpea. Ph. D. Thesis, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, Bangladesh.

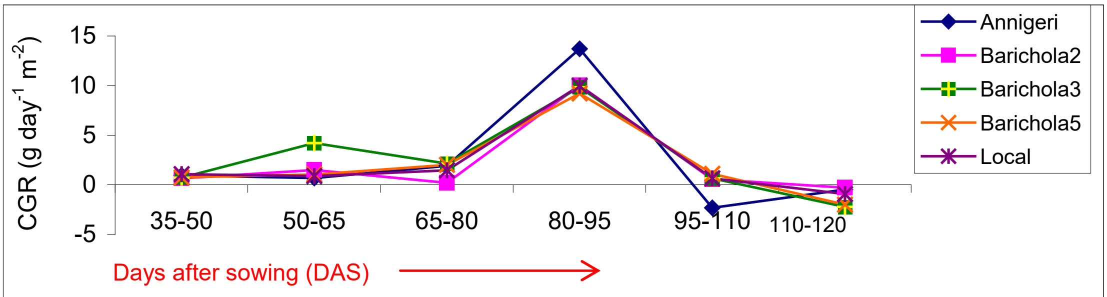



Fig 2. Crop growth rate (CGR) of different chickpea genotypes under rainfed conditions, High Barind Tract, Bangladesh, 2001-02.

Table 1. Yield and yield attributes of different chickpea genotypes under rainfed conditions, High Barind Tract, 2001-02

| Genotypes | Plant height (cm) | Pods/plant (no) | Seed/pod (no) | 100-seed wt. (g) | Seed yield (t/ha) | HI (%) |
|---|---|---|---|---|---|---|
| Annigeri | 41.15NS | 38.37NS | 1.30ab | 19.45a | 2.01a | 50.56 |
| BARI chola2 | 40.60 | 39.95 | 1.18b | 13.65c | 1.80b | 48.79 |
| BARI chola3 | 39.80 | 34.85 | 1.15b | 15.53b | 1.75b | 46.64 |
| BARI chola5 | 40.50 | 36.30 | 1.38ab | 13.70c | 1.85b | 48.00 |
| Local | 38.50 | 41.30 | 1.45a | 12.80c | 1.81b | 48.89 |
| CV (%) | 6.5 | 24.8 | 10.8 | 5.0 | 8.1 | 8.7 |

DS: November 20 NS= Not significant

# RESPONSE OF T.AMAN-CHICKPEA CROPPING PATTERN TO APPLIED PHOSPHORUS IN THE HIGH BARIND TRACT


## Abstract

Residual effect of P in chickpea was evaluated applied in previous wet land rice crop (T. aman rice) along with P and / or P + irrigation. No positive response of residual P was observed for chickpea yield and yield attributes. Rather, in general P application (20 kg P $ha^{-1}$) under both irrigated and non-irrigated conditions gave higher grain yield though always not markedly. P application response in T. aman rice was also not significant.


## Introduction

In the HBT, T.Aman - Chickpea is the major pattern. If proper amount of P is applied to T.Aman rice, probably it can compensate the demand of P for chickpea, which is important in the HBT context, because in most of the years chickpea planting in November become very difficult due to loss of soil moisture rapidly. Moisture holding capacity of HBT soil is poor due to critical organic matter contents and low infiltration of water (Ali, 2000). In such a situation if soil is opened by plowing or furrowing and exposed to sun drying for long time, soil moisture goes out quickly resulting in poor germination of seeds. Moreover, no fertilizer response was studied in the HBT for the T.aman-Chickpea cropping pattern. So, the present experiment was taken to find out the residual effect of P fertilizer on chickpea used in previous T.aman rice and interaction between P x soil moisture on chickpea.

## Materials and Methods

The experiment was conducted at FSRD site Chabbisnagar, High Barind Tract (HBT), Rajshahi, Bangladesh during July, 2001 to March, 2002. T.Aman rice variety BRRIDhan 39 was transplanted (35 days old seedlings) on July 28, 2001, maintaining a spacing of 25 x 15 cm following RCB design with three dispersed replications. The unit plot size was 6 x 10 m. Four Phosphorus (P) fertilizer doses were tested namely, 0,20, 40 and 60 kg P/ha as triple super phosphate. The common fertilizer doses for all the treatment were $N_{70}$ $K_{40}$ $S_{20}Zn_{1}$ kg/ha and applied as basal. T.Aman rice was harvested at maturity on October 29, 2001. Each rice plot was divided into four equal parts (15 $m^2$) and the four treatments were as: Irrigated (one irrigation at 40 DAS) x $P_0$, Non-irrigated x $P_0$, Irrigated (one irrigation at 40 DAS) x $P_{20}$ and Non-irrigated x $P_{20}$. Four P levels of T.aman rice x four treatments of chickpea i. e. 16 treatments combinations were tested for chickpea crop. Chickpea crop (BARI Chola 2) was sown on November 19, 2001 maintaining a spacing of 40 cm x 10 cm following RCB design with three dispersed replications. Only one light irrigation was applied at 40 days after sowing for irrigated treatments. Phosphorus fertilizer was applied as TSP in each furrow just before the sowing of seeds to maximize uptake. All other common fertilizer ($N_{20}$ $K_{20}$ $S_{15}$ $B_1$ kg $ha^{-1}$) was applied as basal. Chickpea was harvested at maturity on March 15, 2002. For T.aman rice and chickpea, yield attributed data were recorded at physiological maturity from 10 randomly selected plants from each plot. Soil samples were chemically analyzed before planting of T.aman rice and after harvest of T.aman.

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

| pH | Organic matter (%) | Ca | Mg | K | % Total N | P | S | B | Zn |
|---|---|---|---|---|---|---|---|---|---|
| | | meq/100 soil | | | | Micro /g soil | | | |
| 5.7 | 0.82 | 4.72 | 2.05 | 0.26 | 0.07 | 6.17 | 15 | 0.18 | 1.22 |

*Composite sample, mean of three replications.

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

| Treatment | pH | Organic matter (%) | Ca | Mg | K | % Total N | P | S | B | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | meq/100 soil | | | | Micro /g soil | | | |
| $P_0$ | 6.55 | 0.75 | 5.1 | 1.9 | 0.18 | 0.04 | 2.9 | 6.00 | 0.28 | 0.83 |
| $P_{20}$ | 6.55 | 0.81 | 5.4 | 2.0 | 0.22 | 0.04 | 3.9 | 8.80 | 0.27 | 1.00 |
| $P_{40}$ | 6.20 | 0.76 | 4.6 | 1.9 | 0.30 | 0.04 | 5.9 | 9.80 | 0.46 | 0.95 |
| $P_{60}$ | 6.05 | 0.82 | 4.9 | 2.0 | 0.28 | 0.05 | 7.35 | 8.00 | 0.38 | 0.90 |

*Mean of three replications

## Results and Discussion

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

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

The above results indicate that residual effect of P in T. aman-chickpea cropping pattern was not visible probably because of shifting of land from wet condition to complete dry condition. Therefore, it appears that P should be applied in chickpea irrespective of amount of P fertilizer applied in previous T. aman rice. The results are in agreement with Ali (2000) who suggested 20 kg P $ha^{-1}$ for chickpea production in HBT. The experiment needs to be continued in the $2^{nd}$ year.

### References

Ali, M. Y. 2000. Influence of phosphorus fertilizer and soil moisture regimes on root system development, growth dynamics and yield of chickpea. Ph. D. Thesis, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Salna, Gazipur, Bangladesh, pp, 221.

Tandon, H. L. S. 1987. Phosphorus Research and Agricultural Production in India, New Delhi, India: Fertilizer Development and Consultation Organization, pp. 7, 79.

Tisdale, S. L., W. L. Nelson, J. D. Beaton and J. L. Havlin. 1997. Soil Fertility and Fertilizers (5 th Edition). Published by Prentice-Hall of India, New Delhi, pp.203, 516.

Table 3. Effect of applied phosphorus on T. aman rice (BRRIDhan 39), High Barind Tract, Bangladesh, 2001

| P levels (kg P/ha) | Plant height (cm) | Panicle/m2 (no) | Filled grain/ panicle (no) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|
| $P_0$ | 104.27 | 217.66 | 88.06 | 2.92 | 7.22 |
| $P_{20}$ | 104.76 | 223.00 | 96.66 | 3.16 | 7.45 |
| $P_{40}$ | 110.70 | 222.00 | 97.03 | 3.38 | 7.99 |
| $P_{60}$ | 108.73 | 244.33 | 99.66 | 3.63 | 8.20 |
| F-test | NS | NS | NS | NS | NS |
| CV(%) | 4.7 | 5.2 | 5.1 | 7.8 | 6.2 |

Date of transplanting: July 28, 2001

Table 4. Effect of residual phosphorus (applied in T. aman rice), applied P and irrigation on the performance of chickpea (BARI Chola 2), High Barind Tract, Bangladesh, 2001-02

| Treatments | Plant height (cm) | Branchs/plant (no.) | Pods/plant (no.) | 100-seed weight (gm) | Seed yield (t/ha) |
|---|---|---|---|---|---|
| $RP_{60}I_0P_0$ | 34.47a | 5.86ab | 27.20ab | 10.20e | 0.90cd |
| $RP_{60}I_0P_{20}$ | 32.73a | 6.60a | 35.13ab | 11.10bcd | 1.12a-d |
| $RP_{60}$ $I_1P_0$ | 29.67a | 4.83abc | 22.73b | 11.20bc | 0.86cd |
| $RP_{60}I_1P_{20}$ | 31.87a | 5.13abc | 27.30ab | 12.20a | 1.42a |
| $RP_{40}I_0P_0$ | 31.73a | 6.30a | 29.00ab | 10.40de | 0.80bcd |
| $RP_{40}I_0P_{20}$ | 31.86a | 6.26a | 34.13ab | 10.60cde | 0.93bcd |
| $RP_{40}I_1P_0$ | 30.93a | 5.20abc | 27.20ab | 11.60ab | 1.09a-d |
| $RP_{40}I_1P_{20}$ | 33.46a | 6.53a | 30.20ab | 12.30a | 1.41a |
| $RP_{20}I_0P_0$ | 33.93a | 4.20bc | 29.18ab | 10.40de | 0.80d |
| $RP_{20}I_0P_{20}$ | 36.36a | 4.66abc | 31.74ab | 10.70cde | 1.02bcd |
| $RP_{20}I_1P_0$ | 31.93a | 3.66c | 32.73ab | 10.75cde | 1.21abc |
| $RP_{20}I_1P_{20}$ | 33.93a | 5.00abc | 34.06ab | 11.00bcd | 1.26ab |
| $RP_0I_0P_0$ | 32.77a | 5.00abc | 36.40ab | 10.40de | 0.82d |
| $RP_0I_0P_{20}$ | 36.07a | 5.86ab | 46.83a | 10.60cde | 1.07a-d |
| $RP_0I_1P_0$ | 33.80a | 4.66abc | 29.13ab | 11.30bc | 0.90cd |
| $RP_0I_1P_{20}$ | 33.40a | 5.90ab | 35.46ab | 11.23bc | 1.12a-d |
| CV(%) | 13.6 | 19.1 | 22.5 | 3.7 | 17.5 |

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

RP = Phosphorus applied in previous T. aman rice, $I_0$ = Non-irrigated, $I_1$ = One irrigation at 40 DAS. All P in kg P/ha, designated as P suffix.

# ADVANCED YIELD TRIAL OF CHICKPEA

## Introduction

Chickpea is widely grown in Barind tract of Rajshahi. At present farmers are using BARI Chola 2, BARI Chola 3, BARI Chola 4 and BARI Chola 5. Of which some late variety is giving higher yield but wilt disease is found widely in this area. So, an experiment was designed to evaluate the performance of promising wilt resistant lines over locations.

## Materials and Methods

The trial was conducted at FSRD site, Chabbishnagar Rajshahi during Rabi 2001-2002. The experiment was laid out in a randomized block design with three replications. The unit plot size was 6 rows x 4m. Nine advanced lines were included in the study (Table 1). The seeds were sown in 40cm row spacing with continuous sowing. Seeds were sown on November 16, 2001. The seed rate was maintained 50 kg/ha. The land was fertilized at the rate of 20-40-20 N, $P_2O_5$, $K_2O$ kg $ha^{-1}$ in the form of urea, TSP and MP respectively. The crops were harvested varieties on March 26, 2002. Data were collected on different yield components and yield, analyzed statistically and the differences between treatment means were evaluated by Duncans New Multiple Range Test.

## Results and Discussions

Data on yield and yield attributes of nine lines of chickpea were presented in Table 1. Plant height, pods /plant, 100 seed weight and growth duration significantly affected by chickpea genotypes. Significantly highest plant height was obtained from line E9 (ICCL87322). Shortest plant height recorded from line E5 but statistically at par to line E3, E2, E8 and E6 (Table-1). Plant population and branches/plant were not significant by influenced by different lines. Pod number per plant varied significantly among the genotypes but all genotypes were identical except E3 which showed least number of pods/plant. Higher 100-seed weight was obtained from line E6 genotypes but identical to E7, E3 & E4. Days to maturity differed significantly among the genotypes except line E1. No significant variation was observed in seed yield. But higher yield was obtained from line E4 which was 26% higher yield than BARI Chola-5 which is currently used in the site. Straw yield was not significantly influenced by different genotypes.

## Conclusion

From one year result showed that some promising lines (E4, E7 & E1) were found in respect of grain yield but it needs further trial for confirmation.

Table 1. Performance of some advance lines of chickpea at FSRD site, Chabbishnagar, Rajshahi during 2001-2002

| Treatment | Plant height (cm) | Plant population (No $m^{-2}$) | Branches $plant^{-1}$ (no.) | Pods $plant^{-1}$ (No.) | Seeds $plant^{-1}$ (No.) | 100-seed weight (g) | Duration (days to harvest) | Grain yield (t $ha^{-1}$) | Straw Yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| E1(ICCX-1002062) | 34.20c | 26.69 | 6.20 | 53.6ab | 1.73 | 12.73b | 124.b | 1.50 | 1.31 |
| E2(ICCV-96020) | 39.87bc | 20.22 | 5.40 | 59.4a | 1.67 | 15.53b | 125.a | 1.32 | 1.46 |
| E3(ICCV-95138) | 37.93bc | 21.27 | 5.20 | 31.6b | 1.40 | 23.47a | 127ab | 1.29 | 1.52 |
| E4(ICCV-97004) | 40.38bc | 23.33 | 5.87 | 35.5ab | 1.47 | 21.47a | 125ab | 1.56 | 1.43 |
| E5(ICCV-97020) | 44.32b | 24.46 | 5.13 | 52.3ab | 1.67 | 14.73b | 128a | 1.18 | 1.36 |
| E6(BCX-910109-3) | 41.20bc | 20.13 | 6.00 | 52.4ab | 1.47 | 25.47a | 127ab | 1.48 | 1.44 |
| E7(ICCV-96020) | 42.67b | 19.44 | 5.40 | 43.3ab | 1.53 | 23.20a | 127ab | 1.53 | 1.33 |
| E8(BARI Chola 5) | 37.53bc | 20.69 | 4.23 | 38.3ab | 1.40 | 13.13b | 128a | 1.16 | 1.35 |
| E9(ICCL87322) | 55.33a | 20.02 | 4.60 | 37.9ab | 1.60 | 16.00b | 127ab | 1.19 | 1.61 |
| CV (%0 | 9.10 | 19.09 | 21.70 | 28.0 | 21.41 | 15.16 | 1.35 | 24.87 | 22.95 |
| LSD (0.05) | 6.542 | NS | NS | 21.78 | NS | 4.831 | 2.961 | NS | NS |

# IDENTIFICATION OF FACTORS LIMITING THE YIELD OF CHICKPEA


## Abstract

A study was conducted at FSRD site, Chabbishnagar, Rajshahi during 2001-2002 to determine the factors limiting the high yield of chickpea in order to identify the causes of yield gap between farmers field and research. In this study 12 treatments combinations were used following principle of omission of a single factor from a set of optimum packages of practices. Results showed that seed sowing on 1-7 Nov, combined with seed rate 40 kg $ha^{-1}$ (broadcast), 20 kg $P_2O_5$ $ha^{-1}$ and disease & pest control as and when necessary gave the highest yield (1.25 kg ha-1).


## Introduction

Chickpea occupies a unique position by virtue of its high seed protein content and capacity to restore soil fertility through symbiotic nitrogen fixation. Chickpea ranks second in terms of acreage and production of pulses in Bangladesh. However, the potential yield of chickpea is 2 t/ha in Bangladesh if the full package of production in followed. Some of the causes of low yields were related with environmental conditions and better agronomic practices. Therefore, this study will be taken to identify the factors limiting the high yield of chickpea following the principle of omission of a single factor from a set of optimum package of practices.

## Materials and Methods

The experiment was conducted at FSRD site, Chabbishnagar, Rajshahi during 2001-2002. RCB design with 3 replications was followed in the study. Treatment combinations of the study were T1= Complete package (CP) : Sowing seed on November 1-7 for Barind + Recommended variety (var. BARI chola-5 + recommended seed rate 40 kg/ha (line sowing 30 cm x 5cm) + seed treatment with 3 g. Vitavax kg/ha seed + fertilizers @ 20 kg N, 40 kg p205, 30 kg k20, 20 kg S and I kg B/ha + disease and insect control (pre-sowing irrigation for germination if needed), T2 = CP but sowing seeds on November 25-30 for Barind, T3 = CP omission of chemical fertilizers, T4 = CP with cowdung @ 5 t/ha but omission of chemical fertilizer, T5 = CP with inoculum instead of N fertilizer (only N fertilizer omission), T6 = CP with seed rate @ 30 kg/ha (instead of 40-45 kg/ha), T7 = CP omission of seed treatment by vitavax, T8 = CP omission of disease and insect control, T9 = Farmers practices (FP): Sowing seeds on November 1-7 + seed rate 40 kg/ha (Broadcast) + fertilizer 20 kg P205 + disease and insect control, T10= FP omission of disease and insect control, T11= CP with seed soaking for 8 hrs in waterlogged conditions before sowing (sowing time like T1) and T12= CP with seed soaking for late sowing (sowing time like T2).

Seed treatment, sowing method, seed rate, sowing time, fertilizer dose, disease and pest control in the study were followed as per treatment. All fertilizers were used as basal before final land preparation. The unit plot size was 3m x 4m. The crops were harvested on March 21, 2002. Data on yield and yield attributes were collected and analyzed statistically.

## Results and Discussion

Different cultural practices i.e. different factors involved in chickpea cultivation produced significant effect on the yield and yield attributes of chickpea except plant population $m^{-2}$, branches $plant^{-1}$ and 1000 seed weight (Table-1). Higher pods/plant was obtained from treatment T5 which was statistically identical to treatment T9, T1 and T6. The lowest pods/plant was recorded from T8 where CP + omission of disease and insect control. Almost similar trend was followed in case seed/pod. Higher seed yield was obtained from treatment T9 but statistically at par to treatment T1, T2, T3, T4, T5, T6, T7 and T11 but higher pods/plant and seeds/pod contributed higher yield from farmer practice + sowing seeds as November 1-7 + seed rate 40 kg/ha (broadcast) + fertilizer 20 kg $P_2O_5$ + disease and insect control. It is noted there that complete package failed to show higher yield than farmer practice. The trial needs to be continued in the next year.

Table 1. Yield and yield attributes of chickpea as affected by different factors in 2001-02

| Treatment | Plant height (cm) | Plant pop./ $m^2$) | Branches/plant (no.) | Pods/ plant (no.) | Seeds/ pod (no.) | 100 seed weight (g) | Seed yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| T1 | 27.53ab | 33.33 | 3.80 | 33.93abc | 1.67bc | 10.40 | 1.16ab | 1.13ab |
| T2 | 24.67b | 34.67 | 4.33 | 27.25bcde | 1.33cd | 10.20 | 0.63c | 0.82b |
| T3 | 27.33ab | 35.67 | 4.27 | 26.80bcde | 1.60ab | 9.87 | 1.00ac | 1.46a |
| T4 | 28.93ab | 32.33 | 4.00 | 30.13bcd | 1.47bc | 10.20 | 0.86ac | 1.39ab |
| T5 | 28.13ab | 31.67 | 4.60 | 40.07a | 1.73a | 10.28 | 1.16ab | 1.25ab |
| T6 | 29.57a | 35.67 | 4.17 | 35.47ab | 1.60ab | 10.00 | 0.98ac | 1.27ab |
| T7 | 26.57ab | 31.33 | 3.33 | 29.80bcd | 1.47bc | 9.98 | 0.97ac | 1.00ab |
| T8 | 26.63ab | 27.33 | 3.00 | 19.80e | 1.27cd | 9.67 | 0.68c | 1.27ab |
| T9 | 25.65ab | 32.33 | 4.60 | 39.40a | 1.74a | 10.40 | 1.25a | 1.31ab |
| T10 | 26.67ab | 26.00 | 3.27 | 25.17cde | 1.20d | 9.87 | 0.72bc | 0.87b |
| T11 | 26.10ab | 30.00 | 3.40 | 23.73de | 1.47bc | 10.60 | 1.00ac | 0.94ab |
| T12 | 25.70ab | 31.00 | 3.80 | 29.47bcd | 1.33cd | 9.87 | 0.65c | 1.00ab |
| CV (%) | 8.15 | 15.24 | 32.33 | 16.45 | 9.22 | 5.71 | 26.43 | 26.33 |
| LSD (0.05) | 3.179 | ns | ns | 8.379 | 0.2272 | ns | 0.4043 | 0.5052 |

T1= Complete package (CP): Sowing seed on November 1-7 for Barind + Recommended variety (var. BARI chola-5 + recommended seed rate 40 kg/ha (line sowing 30 cm x 5cm) + seed treatment with 3 g. Vitavax kg/ha seed + fertilizers @ 20 kg N, 40 kg p205, 30 kg k20, 20 kg S and I kg B/ha + disease and insect control (pre-sowing irrigation for germination if needed),
T2 = CP but sowing seeds on November 25-30 for Barind,
T3 = CP omission of chemical fertilizers,
T4 = CP with cowdung @ 5 t/ha but omission of chemical fertilizer,
T5 = CP with inoculum instead of N fertilizer (only N fertilizer omission),
T6 = CP with seed rate @ 30 kg/ha (instead of 40-45 kg/ha),
T7 = CP omission of seed treatment by vitavax,
T8 = CP omission of disease and insect control,
T9 = Farmers practices (FP): Sowing seeds on November 1-7 + seed rate 40 kg/ha (Broadcast) + fertilizer 20 kg P205 + disease and insect control,
T10= FP omission of disease and insect control,
T11= CP with seed soaking for 8 hrs in waterlogged conditions before sowing (sowing time like T1) and
T12= CP with seed soaking for late sowing (sowing time like T2).

# EVALUATION OF CHICKPEA VARIETY FOR INTERCROPPING WITH MUSTARD


## Abstract

The study was carried out during Rabi season of 2000-01 & 2000-02 at FSRD site, Chabbishnagar, Rajshahi to verify the technology under chickpea mustard intercropping at farmer's level of High Barind Tract. Seven treatment combinations were taken i.e.$T_1$= 2 rows of chickpea (var. BARI Chola-2) alternate with 2 rows of mustard (50C: 50M), $T_2$= 4 rows of chickpea (BARI Chola-2) alternate with 2 rows of mustard (67C: 33M), $T_3$= 2 rows of chickpea(var. BARI Chola-5) alternate with 2 rows of mustard (50C: 50M), $T_4$= 4 rows of chickpea(var. BARI Chola-5) alternate with 2 rows of mustard (67 C: 33M), $T_5$= Sole mustard (var. Tori-7), $T_6$= Sole Chickpea (var. BARI chola-2) and $T_7$= Sole chickpea (var. BARI chola-5). Treatment $T_3$ i.e 2 rows of chickpea (var. BARI chola-5) alternate with 2 rows of mustard gave the significantly highest yield (1.31 t ha-1) and the highest LER value (1.27). When cost & return analysis was done it was found that the highest gross return (47,800 Tk. ha-1), highest gross margin (41530 Tk ha-1) and the highest benefit cost ratio (7.62) were found in $T_2$ i.e. 4 rows of chickpea (BARI cholo-2) alternate with 2 rows of chickpea (BARI Chola -2) alternate with 2 rows of mustard (67 c : 33 m).


## Introduction

Chickpea and mustard are the most important Rabi crops and it is grown in the High Barind Tract with traditional varieties. The vast area remains fallow after harvesting of T.Aman due to lack of water. But it has a great opportunity of chickpea and mustard under rainfed condition. Intercropping chickpea with mustard was found remunerative in different locations of Bangladesh. Agronomy division of BARI was examined that mustard variety and Chickpea variety BARI chola-5 was given higher yield and benefit. So, an attempt is therefore made to verify the technology at farmer's level of High Barind Tract.

## Materials and Methods

The study was carried out in rainfed condition during Rabi season of 2000-2001 and 2001-2002 at FSRD site Chabbishnagar under Godagari thana of Rajshahi district. The soil of the experiment plot was silty clay loam ($p^H$ 5.8). The experiment consisted of the treatments were $T_1$= 2 rows of chickpea (var.BARI Chola-2) alternate with 2 rows of mustard (50C: 50M), $T_2$ = 4 rows of chickpea (BARI Chola-2) alternate with2 rows of mustard (67C: 33M), $T_3$ = 2 rows of chickpea(var.BARI Chola-5) alternate with 2 rows of mustard (50C: 50M), $T_4$ = 4 rows of chickpea(var. BARI Chola-5) alternate with 2 rows of mustard (67 C: 33M), $T_5$ = Sole mustard (var. Tori-7), $T_6$ = Sole Chickpea (var. BARI chola-2) and$T_7$ = Sole chickpea (var. BARI chola-5).

The experiment was laid out in RCB design with three replications. The unit plot size was 3m x 3.6m. The spacing for the sole crops of mustard and Chickpea was 30 cm x 10 cm. The mustard variety Tori-7 and chickpea variety BARI Chola 2 and BARI chola-5 were used but in 2001-2002 the mustard variety Daulat was used instead of Tori 7. Seeds of mustard and chickpea were sown on 20 November 2000 and on 11 November 2001 at the rate of 8 kg and 40 kg seeds/ ha respectively. The fertilizer doses of 20-40-20 kg N- $P_2O_5$- $K_2O$ $ha^{-1}$ was used for sole chickpea while 80-60-40-20-5 kg N- $P_2O_5$,- $K_2O$- S- Zn $ha^{-1}$ for sole mustard. All fertilizers were applied as basal at the time of final land preparation. Appropriate cultural practice was taken as and when necessary. Chickpea and mustard were harvested at 122 and 73 days after sowing (DAS) in 2000-2001 but same crops were harvested at 112 and 106 DAS in 2001-2002. Data on yield & yield attributes were analyzed statistically. Land equivalent ratio (LER) was computed according to Shang *et. al*. (1982). Cost and return analysis was done for each treatment on a hectare basis taking the market prices of mustard and chickpea.

## Results and Discussion

Seed yield, mean seed yield and chickpea equivalent yields were mustard intercropping (Table 1). The highest seed yield of chickpea 1.43 t $ha^{-1}$ and 1.12 t $ha^{-1}$ were produced in T7 i.e. sole chickpea (BARI Chola 5) during 20001-02 and 2000-01 respectively. The second highest seed yield 1.38 t $ha^{-1}$ and

1.03 t $ha^{-1}$ were produced in T6 i.e. sole chickpea (BARI Chola 2) during 2001-02 and 2000-01 respectively. The lowest seed yield of chickpea was recorded in T1 (0.94 t/ha) and T2 (0.74 t/ha) in 2000-01 and 2001-02 respectively probably due to interspecies competition of plant nutrients, soil moisture and sunlight. Similar results were obtained in cases of mustard (Table 1). The highest seed yield 0.47 t $ha^{-1}$and 0.63 t $ha^{-1}$ of mustard were produced in T5 (i. e. sole mustard) and the lowest yield (0.14 $tha^{-1}$) was in T2 during 2000-01 and T2 and T4 during 2001-02. Chickpea equivalent yield was calculated in both the year (Table 1). It was found that the highest chickpea equivalent yield was recorded from T3.

Monetary advantage of sole and intercropping crops is presented in Table-2. The results revealed that the highest gross return (Tk 47,800 $ha^{-1}$) was obtained from T2 treatment, which was followed by T3 treatment (Tk. 32700 $ha^{-1}$). The former treatment provided the highest gross margin (Tk. 41530 $ha^{-1}$) which was followed by the latter treatment (Tk. 26590 t $ha^{-1}$) with some trend of benefit cost ratio (BCR) 7.62 and 5.35 respectively. Considering cost and return analysis of different treatment combinations, the average highest gross returns, highest gross margin and highest benefit cost ratio (BCR) were recorded in T2 which was also produced significantly the highest seed yield. This result indicated that among the treatment combinations T2 was found economically profitable.

## Conclusion

Treatment $T_3$ i.e 2 rows of chickpea (var. BARI chola-5) alternate with 2 rows of mustard gave the significantly highest yield (1.31 t ha-1) and the highest LER value (1.27). When cost & return analysis was done it was found that the highest gross return (47,800 Tk. ha-1), highest gross margin (41530 Tk ha-1) and the highest benefit cost ratio (7.62) were found in $T_2$ i.e. 4 rows of chickpea (BARI chola-2) alternate with 2 rows of chickpea (BARI Chola -2) alternate with 2 rows of mustard (67 c : 33 m). . This is the second year study and it should be continued for the nest year for final recommendation.

Table 1. Seed yield, chickpea equivalent yield and LER of chickpea and mustard intercropping during 2000-01 and 2001-02

| Treatment | Seed Yield (t $ha^{-1}$) | | | | Mean Chickpea equivalent yield (t/ha) | Mean LER | Total gross return (Tk/ ha) | variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Chickpea | | Mustard | | | | | | | |
| | 2000-01 | 2001-02 | 2000-01 | 2001-02 | | | | | | |
| T1 | 0.94 | 0.84b | 0.15 | 0.21 | 1.04a | 1.08 | 25850 | 6110 | 19740 | 3.23 |
| T2 | 1.06 | 0.74 | 0.14 | 0.14 | 1.02a | 1.01 | 25300 | 6270 | 19030 | 1.33 |
| T3 | 1.30 | 0.98 | 0.19 | 0.22 | 1.31a | 1.27 | 32700 | 6110 | 26590 | 4.35 |
| T4 | 1.27 | 0.90 | 0.16 | 0.14 | 1.24a | 1.11 | 30250 | 6270 | 23980 | 3.82 |
| T5 | - | - | 0.47 | 0.63 | 0.45b | | 11000 | 5680 | 5320 | 0.92 |
| T6 | 1.38 | 1.03 | - | - | 1.21a | | 30250 | 6550 | 23700 | 3.62 |
| T7 | 1.43 | 1.12 | - | - | 1.28a | | 32000 | 6550 | 25450 | 3.89 |
| CV (%) | | | | | | | | | | |
| $LSD_{(0.05)}$ | 0.15 | ns | 0.20 | 0.25 | 0.32 | | | | | |

**Price:**
Mustard Tk 20 $kg^{-1}$
Chickpea Tk 25 $kg^{-1}$

# EFFECT OF MINOR ELEMENTS ON CHICKPEA GROWTH AND YIELD IN THE HIGH BARIND TRACT


## Abstract

This study was carried out at FSRD site, Chabbishnagar, Rajshahi during Rabi season, 2001-2002 to determine the effect of minor elements (B, Mo, Zn & S) on chickpea yield. In this experiment seven treatment combinations were taken i.e. T1= Control i.e. no seed treatment & no addition of minor elements, T2= Seed treated i.e. treatment with priming, and lime pelleting with Rhizobium, T3= Treatment 2 with B + Mo + Zn + S, T4= Treatment 2 with Mo +Zn+ S, T5= Treatment 2 with B+Zn+ S, T6= Treatment 2 with B+Mo+S, T7= Treatment 2 with B+Mo+Zn. From this study it was observed that minor element had no significant effect on chickpea yield but produced numerically higher seed yield in chickpea. The results showed that seed treatment plus B, Mo and Zn addition gave numerically highest yield (1.52 t/ha).


## Introduction

The effect of seed priming on boosting chickpea yield in the High Barind Tract (HBT) has been confirmed, over three seasons in multi location trails at farmer's fields. Fungicidal seed treatments could reduce problems of seedling disease. These seed treatments combined with priming were indeed tried in small plot studies in the 1999-2000 and 2000-01 seasons but poor crop establishment due to inadequate soil moisture at sowing caused abandonment of the experiments. As previous attempts, to conduct this study were unsuccessful due to inadequate soil moisture for even crop establishment. It is therefore intended to repeat the study ensuring sufficient water, through irrigation, for even crop establishment and to determine the effect of minor elements (B, Mo, Zn & S) on chickpea yield in the High Barind Tract.

## Materials and Methods

The study was conducted at FSRD site, Chabbishnagar, Rajshahi during Rabi season, 2001 - 2002. The treatment combinations of the experiments are T1 = Control i.e. no seed treatment & no addition of minor elements, T2 = Seed treated i.e. treatment with priming, and lime pelleting with *Rhizobium,* T3 = Treatment 2 with B + Mo + Zn + S, T4 = Treatment 2 with Mo +Zn + S, T5 = Treatment 2 with B + Zn + S, T6 = Treatment 2 with B + Mo + S, T7 = Treatment 2 with B + Mo + Zn.

The experiment was laid out in RCB design with four replications. The unit plot size was 1.8 m x 2m. The spacing was 30 cm x 10 cm. All of the plots were fertilized with phosphorus @ 20 kg/ha in the form of Triple Super Phosphate. The dose of minor element was 1-0.5-5-20 kg B-Mo-Zn-S /ha. Boron, Mo, Zn and S were applied as boric acid, molybdate, carbonate and gypsum, respectively. All fertilizers were applied as basal at the time of final land preparation. Appropriate cultural practices were taken as and when necessary. Seeds were sown on November 17, 2001. The crops were harvested on March 22, 2002 i.e. 128 days after sowing (DAS). Data on yield and yield attributes were taken and analyzed statistically by DMRT.

## Results and Discussion

Yield and yield attributes of chickpea were not affected by minor element treatment except pods/plant and 100 seed weight. Higher number of pod/plant was obtained from treatment T7 which was statistically identical to all treatment except treatment T5 which showed lowest pods/plant. Almost similar trend was followed in case 100-seed weight. Seed yield was not influenced by different minor fertilizer element but higher seed yield was recorded from treatment T7 i.e. seed treatment (priming and line pelleting with Rhizobium + 1-0.5-5 kg/ BMO Zn kg/ha). It is noted that Boron is required for higher seed yield of chickpea accompanied with Molybdenum T7 and Zinc. This experiment needs further trial for confirmation.

Table 1. Yield and yield contributing characters as affected by minor elements in 2001-2002

| Treatment | Plant height (cm) | Plant pop./m $^2$ | Branches/plant (no.) | Pods/ plant (no.) | Seeds/ pod (no.) | 100-seed weight (g) | Seed yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| T1 | 35.67 | 43.21 | 3.35 | 32.75ab | 1.45 | 11.58c | 1.17 | 1.71 |
| T2 | 32.80 | 44.55 | 3.70 | 28.20ab | 1.10 | 14.20ab | 1.05 | 1.44 |
| T3 | 31.63 | 41.20 | 4.00 | 30.41ab | 1.25 | 14.60a | 1.21 | 1.45 |
| T4 | 33.95 | 55.10 | 4.05 | 37.75ab | 1.25 | 14.13ab | 1.41 | 1.53 |
| T5 | 30.90 | 44.29 | 3.90 | 24.00b | 1.30 | 12.70bc | 0.94 | 1.17 |
| T6 | 34.25 | 45.63 | 3.95 | 36.75ab | 1.50 | 14.43a | 1.31 | 1.76 |
| T7 | 34.10 | 42.70 | 3.95 | 40.50 a | 1.45 | 14.45a | 1.52 | 1.75 |
| CV (%) | 11.19 | 25.47 | 21.41 | 27.16 | 24.62 | 7.57 | 29.28 | 21.20 |
| LSD (0.05) | ns | ns | ns | 13.25 | ns | 1.542 | ns | ns |

# EFFECT OF SOWING TIME ON THE YIELD AND YEIELD ATTRIBUTES OF BARLEY IN HIGH BARIND TRACT


## Abstract

The experiment was conducted in farmer's field at Chabbishnagar, a farming system research site of on-farm research division, Rajshahi, BARI during rabi season 2001-2002 to find out the suitable time of sowing with variety of barley, Three sowing time (30 November, 15 December and 30 December) and three barley varieties (BARI barley 1, BARI barley 2 and Local) were used in the study. Grain and straw yields increased significantly with early sowing (15 Nov.) in all the varieties. The results show that the early sowing (15 Nov.) combined with BARI barley-1 gave the highest grain and straw yield (2.68 t $ha^{-1}$ and 4.37 t $ha^{-1}$) but statistically identical to December 15 sowing of same variety.


## Introduction

A vast area of High Barind Tract remains fallow after harvesting of T.Aman due to lack of soil moisture. The farmers of Barind area already started chickpea cultivation but continuous cultivation in same land will break disease. On the other hand, barley may be alternative crop which is resistant to disease and will adaptive to rainfed cultivation. Barley is also a deep rooted crop (90 cm penetrated) like chickpea. Therefore, it is important to find out the optimum sowing time of barley in Barind area.

## Materials and Methods

The experiment was carried out at FSRD site Chabbishnagar, Rajshahi during Rabi season of 2001-2002 under rainfed condition. The soil belongs to Amnura series loamy silty clay loam texture. The land was prepared by ploughing and cross ploughing followed by laddering. At the time of final land preparation, fertilizers were applied at the rate of 85-25-45 kg N-P-K $ha^{-1}$ in the form of urea, TSP, MP respectively as basal dose. The treatments of the experiment comprised of different sowing time (30 November, 15 December and 30 December) and three varieties (BARI barley 1, BARI barley 2 and local). Seeds were sown in lines at 20-cm apart with continuous sowing with seed rate 120 kg $ha^{-1}$ .The experiment was laid out in randomized completed block design (factorial) with three replications. The unit plot size was 4m x 5m. Intercultural operations were done as and when necessary. The crops were harvested at matured stage and necessary data were collected. The data were collected on different yield components and yield. Analyzed statically and the differences between treatment means were evaluated by Duncan's New Multiple Range Test.

## Results and Discussion

### Effect of sowing time

Plant height, tiller/$m^2$, grains/spike, 1000-grain weight, grain and straw yield showed significantly influenced by sowing data (Table 1). There was trend to decrease plant height with the advancement of sowing data. Similar trial was followed in case of tillers/$m^2$, grains/spike and 1000-grain weight. Grain yield was significantly highest from 30 November sowing due to higher yield attributes. November 30 and December 15 sowing showed similar yield and higher than 30 December sowing.

### Effect of variety

Plant height, grains/spike, seed weight, grain and straw yields were significantly affected by different varieties (Table 2). Plant height between variety V1 and V2 were statistically identical but higher than V3. Similar trend was shown in case of grains/spike. But 1000-grain weight was recorded from variety V1 which was significantly different from V2 and V3. Grain yield was statistically at par in between variety V1 and V2 but higher than V3. Similar trend was followed in straw yield.

### Interaction effect between sowing time and variety

Interaction effect of variety and sowing time were significant in yield and yield attributes of barley (Table-3). Significantly highest plant height was obtained from variety BARI Barley 2 when sown in

30 November. Plant population was not significantly influenced with different date and variety. There was no definite trend was followed in case of no. grains/spike but 1000-grain weight showed higher in early sowing with variety BARI Barley 1 and BARI Barley 2. BARI Barley 1 sown in November 30 and December 15 were statistically identical and higher than other dates of sowing. Local variety showed lower yield than high yielding variety. Similar trend was followed in case of straw yield.

From one year result revealed that variety BARI Barley 1 could be grown up to December 15 if moisture is available. If T.Aman rice is delayed in harvesting, BARI Barley 1 may be alternative crop in this situation. But this experiment needs another year trial for confirmation.

Table 1. Effect of sowing time on yield and yield components of barley as affected by sowing data in Barind Soil

| Treatment | Plant height (cm) | Effective tiller/m$^2$ (no.) | Grains/spike (no.) | 1000-grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| D1 | 73.30a | 184.11a | 35.22a | 38.14a | 2.50a | 3.99a |
| D2 | 62.11b | 175.67b | 34.57ab | 37.30b | 2.25b | 4.00a |
| D3 | 50.48c | 134.33c | 33.76b | 36.51c | 1.62c | 3.63b |
| CV (%) | 2.39 | 4.04 | 2.84 | 0.49 | 5.75 | 4.66 |
| LSD (0.05) | 1.482 | 6.65 | 0.979 | 1.33 | 0.12 | 0.18 |

D1= 30 November, D2= 15 December, D3= December

Table 2. Effect of varieties on yield and yield components of barley as affected by variety in Barind Soil

| Treatment | Plant height (cm) | Effective tiller/m$^2$ | Grains/spike (no.) | 1000-grain weight (g) | Grain yield (t/ha) | Straw Yield (t/ha) |
|---|---|---|---|---|---|---|
| V1 | 63.67a | 162.44 | 37.64a | 38.19a | 2.31a | 4.06a |
| V2 | 63.98a | 164.78 | 36.69a | 38.34b | 2.30a | 4.06a |
| V3 | 58.24b | 166.89 | 29.21b | 35.42c | 1.76b | 3.51b |
| CV (%) | 2.39 | 4.04 | 2.84 | 0.49 | 5.75 | 4.66 |
| LSD (0.05) | 1.48 | ns | 0.97 | 1.33 | 0.12 | 0.18 |

V1= BARI Barley 1, V2= BARI Barley 2 and V3= Local

Table 3. Interaction effect of different sowing time and varieties on yield and yield components of Barley

| Treatment combination | | Plant height (cm) | Plant pop./m$^2$ | Grains/ spike (no.) | 1000-grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Sowing time | Variety | | | | | | |
| D1(30 Nov) | V1 | 76.00a | 180.0 | 38.83a | 38.83ab | 2.68a | 4.37a |
| | V2 | 75.17a | 185.0 | 35.87c | 39.33a | 2.61ab | 4.08ab |
| | V3 | 68.73b | 187.0 | 30.97d | 36.27d | 2.20c | 3.52c |
| D2 (15 Dec) | V1 | 63.83c | 175.0 | 37.83ab | 38.17bc | 2.50ab | 4.05ab |
| | V2 | 64.83c | 175.0 | 36.53bc | 38.23bc | 2.45b | 4.10ab |
| | V3 | 57.67d | 176.67 | 29.33d | 35.50d | 1.87d | 3.85bc |
| D3 (30 Dec) | V1 | 51.17c | 132.0 | 36.27bc | 37.57c | 1.75d | 3.75bc |
| | V2 | 51.93c | 134.0 | 37.67abc | 37.47d | 1.83d | 3.98b |
| | V3 | 48.33 | 136.67 | 27.33 c | 34.50c | 1.29c | 3.17d |
| CV (%) | | 2.39 | 4.04 | 2.84 | 1.33 | 5.75 | 4.87 |
| LSD (0.05) | | 2.56 | ns | 1.16 | 0.85 | 0.21 | 0.32 |

**(Hill Agriculture)**

# ESTABLISHMENT OF MULTI-STRATA FRUIT BASE MODEL IN HILLSLOPE

## Introduction

Continuous depletion of soil fertility in the hilly region is the major problem of crop production. Due to jhum cultivation, heavy rainfall and improper management practices enhanced the4 nutrient depletion through soil erosion. To check the continuous soil erosion and improve the soil fertility, multi-strata fruit based model for hill slope are found to be effective technology for sustainable management of resources and maintenance of environment. The wide range environment variation indicates, fruits and vegetable can be grown round the year and great scope to cultivate the hilly land intensively. For this reason restoration of soil fertility is very important. Besides, demands of intensive soil analysis and to recommended the fertilizer dose and suitability of crop production.

## Materials and Methods

The experiment was conducted at the site of OFRD, Khagrachari, under the agro-ecological zone-29. The designed was RCB with the dispersed replications but factor RCB in litchi and guava. Each farmers used as one replication having half hectare of land. The initial soil samples were collected from ten different farmer's land and analyzed. The result of analyzed soil has been shown in table 1. Initially two farmers and rest eight farmers were selected later on (2001). The experiment was started with Pineapple and other fruit crops. The growth data of Pineapple, Litchi and Guava were recorded.

Table 1. Initial soil status of experimental site at Khagrachari

| Parameters | Top hill | Mid hill | Foot hill | CV (%) | LSD (0.05) |
|---|---|---|---|---|---|
| Soil pH | 4.48 | 4.40 | 4.52 | 4.23 | 0.13 |
| OM (%) | 1.54 | 1.55 | 1.55 | 21.32 | 0.22 |
| Exchangeable-K (meq/100g soil) | 0.26 | 0.18 | 0.20 | 44.00 | 0.06 |
| Total Nitrogen (%) | 0.10 | 0.10 | 0.08 | 26.38 | 0.02 |
| Available-P (µg/g) | 4.50 | 4.90 | 6.00 | 37.66 | 1.28 |
| Available-S (µg/g) | 14.60 | 15.50 | 13.20 | 38.44 | 3.73 |
| Exchangeable-Bo (µg/g) | 0.95 | 0.98 | 0.99 | 9.42 | 0.06 |
| Exchangeable-Zn (µg/g) | 2.99 | 4.33 | 5.11 | 50.90 | 1.42 |

## Result and Discussion

### Pineapple

Plant height, leaf characters, no. of sucker, fruit character and yields were not significantly influenced by different position of hill except length of fruit. Fruit length was statistically at par to foot and mid hill position and higher than top hill. Though yield was found insignificant but there was trend to decrease yield from top to foot hill position (Table 2).

### Guava

Plant height, spread nature (N-S & E-W), no. of primary and secondary branches was significantly influenced by direction and hill position (Table 3). Significantly highest plant height was obtained from top hill in north mid direction. Top hill in south side in different spread direction showed significantly highest. Number of primary branches showed lower in foot hill in both side but secondary branches revealed higher from all hill position in south side and only top hill in north side.

### Litchi

Plant height, spread nature (W-S & E-W), base and primary branches were significantly affected by direction and hill position (Table 4). North side in all hill position showed higher plant height than south side in hill position. Similar trend was followed in spreading in N-S direction but significantly highest in top hill in E-W direction. Significantly highest base girth was recorded from foot hill in north side. Secondary branches were not significantly influenced by hill position in different director.

Table 2. Effect of hill position on the growth and yield of pineapple

| Treatments | Plant height (cm) | No. of leaves/ plant | Leaf | | No. of suckers | Fruit | | | | | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Position | | | Length (cm) | Breath (cm) | | Fruit (wt. (g) | Length (cm) | Diameter (cm) | Crown wt. (g) | Tss (%) | |
| Top hill | 63.53 | 24.95 | 48.10 | 3.97 | 5.10 | 537.50 | 9.69b | 26.48 | 40.37 | 14.52 | 18.58 |
| Mid hill | 61.39 | 28.30 | 46.92 | 4.09 | 4.93 | 534.10 | 10.61a | 25.17 | 40.13 | 14.47 | 17.30 |
| Foot hill | 64.45 | 30.34 | 52.24 | 3.86 | 4.62 | 511.56 | 10.83a | 26.02 | 42.76 | 15.32 | 16.57 |
| CV(%) | 6.79 | 17.98 | 9.62 | 6.61 | 13.42 | 13.46 | 4.02 | 12.22 | 11.87 | 5.29 | 12.65 |
| LSD(0.05) | NS | NS | NS | NS | NS | NS | 0.66 | NS | NS | NS | NS |

Table 3. Combined effect of Hill side and position on the growth of Guava

| Treatment | Plant height (cm) | Spread (cm) | | Base girth (cm) | No. of branches | |
|---|---|---|---|---|---|---|
| | | N-S | E-W | | Primary | Secondary |
| **North side** | | | | | | |
| Top Hill | 223.25a | 144.65c | 140.70b | 14.00 | 2.15a | 4.00a |
| Mid Hill | 163.50d | 123.25e | 103.20d | 11.50 | 2.25a | 2.00c |
| Foot Hill | 160.85d | 154.75b | 142.50b | 14.50 | 1.65b | 3.15b |
| **South side** | | | | | | |
| Top Hill | 208.50b | 173.90a | 155.00a | 13.50 | 2.45a | 4.25a |
| Mid Hill | 159.50d | 133.50d | 106.50d | 13.50 | 2.10a | 4.35a |
| Foot Hill | 182.50c | 119.00e | 125.00c | 16.00 | 1.45b | 4.25a |
| LSD(0.05) | 10.68 | 6.50 | 5.41 | NS | 0.430 | 0.43 |

Table 4. Combined effect of Hill side and position on the growth of litchi

| Treatment | Plant height (cm) | Spreading (cm) | | Base girth (cm) | No. of branches | |
|---|---|---|---|---|---|---|
| | | N-S | E-W | | Primary | Secondary |
| **North side** | | | | | | |
| Top Hill | 111.10ab | 92.50a | 122.40a | 7.65b | 2.60a | 2.15 |
| Mid Hill | 108.00a | 111.35ab | 70.13b | 6.90cd | 2.20b | 2.30 |
| Foot Hill | 121.35a | 82.40a | 87.25b | 7.40bc | 2.00b | 2.10 |
| **South side** | | | | | | |
| Top Hill | 63.30b | 51.10c | 40.90c | 4.10e | 1.25c | 2.25 |
| Mid Hill | 66.75b | 45.00d | 44.90c | 6.50d | 1.52c | 2.10 |
| Foot Hill | 68.70b | 61.00c | 49.00c | 8.60a | 1.50c | 2.30 |
| LSD(0.05) | 6.57 | 9.43 | 12.49 | 0.52 | 0.28 | ns |

## Subproject: Cropping Pattern Based Fertilizer Management

# DEVELOPMENT OF FERTILIZER RECOMMENDATION FOR DIFFERENT CROPPING PATTERNS AND ENVIRONMENTS


### Abstract

The experiment was conducted at different location on different cropping pattern based on fertilizer recommendation during 1999-2002 with the objective to develop a cropping pattern based fertilizer recommendation under different AEZ. A total of 12 (twelve) cropping pattern with six fertilizer management package (estimated mineral fertilizer dose for MYG, estimated mineral fertilizer dose for HYG, IPNS for HYG, FRG '97, farmers practice and absolute control) were studied. On an average three years results showed that fertilizer on the basis of Recommendation Guide '97 gave higher yield and monetary benefit in Boro-T.Aman cropping pattern at Rangpur, Jamalpur and Tangail, cropping pattern Wheat-T.Aman at Barind, on the basis of estimated fertilizer dose ($ED_1$) for MYG, only T.Aman at Atkapalia on ED1 basis, Wheat-Jute-T.Aman at Narikeli, Jamalpur on ED1, other areas, only one cycle was completed and other places cropping pattern from started from rabi season, 2001-02. Recommendation will be made after three years of completion of the cycle. However, some cropping patterns already completed three year at different locations which already mentioned above.


### Introduction

There has been a gradual declining or stagnating trend in the yield of major crops almost all over Bangladesh. This is mainly due to the degradation of soil fertility status of the soil. The low organic matter content, higher cropping intensity, improper cropping sequence and faulty management practices are the major causes of depletion of soil fertility. Intensive use of high yielding varieties of crop has led to a sharp increase in removal of plant nutrients. In 1996, 421-71-451-44 million tons of NPKS respectively were removed in grain and straw. While in the same year 507-119-114-13 million tons of the same elements were added in the form of inorganic fertilizers. Considering the recovery percentage of the added nutrients tile gap was about 244-47-400-41 million tons of NPKS respectively. Imbalance use of fertilizers is another serious problem for the country. Previous survey revealed that farmers in many areas in Bangladesh applied nitrogenous fertilizer higher than the recommended dose for some crops. They usually did not use any organic fertilizers. Scarcity of fuel led them to use cowdung and crop residues as domestic fuel. Farmers usually use of fertilizers on single crop basis without considering the whole cropping pattern. But some of the nutrients by now knew to have considerable residual effect on the succeeding crops. Recently BARC developed a national fertilizer recommendation guide '97 that needs to be further updated and verified for different dominant cropping patterns at different environments. Therefore, it is very important to develop a cropping pattern based fertilizer recommendation under different agro-ecological conditions.

**Objectives**

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

### Materials and Methods

The experiment was conducted at 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. A total of six dominant cropping patterns were tested at 12 different locations. 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
$T_3$ (INM) = 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 | Narikeli, Melandah, Muktagacha, Gabtali, Bagherpara |
| 2. | Wheat-Jute-T.Aman | Narikeli, Sherpur, Kishoregonj, Goyeshpur |
| 3. | Boro-T.Aman | Kendua, Phulpur, Netrokona, Laksam, Shibpur, Ishan Gopalpur, Syedpur, Polashbari, Nilphamari, Palima, Sujanagar, Kolaroa, Bagerhat |
| 4. | Potato-Jute-T.Aman | Narikeli |
| 5. | Groundnut-T.Aman | Laxmipur |
| 6. | Wheat-T.Aman | Barind |
| 7. | Potato-T.Aman | Barind |
| 8. | Potato-Boro-T.Aman | Syedpur |
| 9. | Potato-T.Aus-T.Aman | Chandina |
| 10. | Onion-T.Aus-T.Aman | Kushtia |
| 11. | T.Aus-T.Aman | Golapganj, Moulvibazar, Jhalokati |
| 12. | Mungbean-T.Aus-T.Aman | Bhola, Lebukhali |
| 13. | Onion-B.Aman | Baliakandi |
| 14. | T.Aman-Fallow-Fallow | Atkapalia |
| 15. | Potato-Jute | Munshiganj |
| 16. | Mustard-Boro | Manikganj |

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

Site: Narikeli, Jamalpur

| Treatment | Mustard (N-P-K-S-Zn-B-MOC) | Boro (N-P-K-S-Zn-MOC) | T.Aman (N-P-K-S-MOC) |
|---|---|---|---|
| $T_1$ | 77-14-28-14-1.4-1.4-0 | 140-16.8-56-9.8-1.4-0 | 98-11.2-35-5.6-0 |
| $T_2$ | 51.5-5-2.5-14-1.4-1.4-500 | 114.5-7.8-50.5-9.8-1.4-500 | 72.5-2.2-5.6-5.6-500 |
| $T_3$ | 55-10-20-10-1.0-10 | 100-12-40-7-1-0 | 25-8-4-4-0 |
| $T_4$ | 30-25-20-0-0-1.1-0 | 58-25-31-0-0-0 | 16-15-0-0-0 |
| $T_5$ | 0-0-0-0-0-0-0 | 0-0-0-0-0-0 | 0-0-0-0-0 |

Site: Melandah, Jamalpur

| Treatment | Mustard (N-P-K-S-Zn-B-MOC) | Boro (N-P-K-S-Zn-MOC) | T. Aman (N-P-K-S-MOC) |
|---|---|---|---|
| $T_1$ | 81-6-23-14-3.8-8.2-0 | 143-7-46-10-4-0 | 100-4-46-14-0 |
| $T_2$ | 53-5-19-14-3.8-8.2-500 | 117-3-42- 10-4-500 | 49-20-42-10-0 |
| $T_3$ | 58-4-16-10-2.7-7-0 | 102-5-33-7-3-0 | 61-4-25-4-0 |
| $T_4$ | 87-13-15-14-7.5-10-0 | 144-38-49-11-8-0 | 115-14-22-11-0 |
| $T_5$ | 0-0-0-0-0-0-0 | 0-0-0-0-0-0 | 0-0-0-0-0 |

Site: Muktagacha, Mymensingh

| Treatment | Mustard (N-P-K-S) | Boro rice (N-P-K-S) | T.Aman rice (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 47-21-34-2 | 70-12-14-4 | 47-8-7-3 |
| $T_2$ | 65-27-49-2.3 | 96-18-19-5 | 64-10-52-3.8 |
| $T_3$ | 59-25-44-20 | 86-14-10-5 | 64-10-52-3.8 |
| $T_4$ | 55-10-20-10 | 100-9-30-5 | 60-8-30-4 |
| $T_5$ | 50-35-40-3 | 120-14-23-11 | 84-15-20-7 |
| $T_6$ | 0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Gabtali, Bogra

| Treatment | Mustard (N-P-K-S-Zn-B-Oilcake) | Boro rice | T.Aman rice |
|---|---|---|---|
| $T_1$ | 65-70-34-14-4-1.4-0 | | |
| $T_2$ | 88-93-50-17-5.5-1.4-0 | | |
| $T_3$ | 70-75-44-17-5.5-1.4-400 | | |
| $T_4$ | 65-38-36-14-3-1.75-0 | | |
| $T_5$ | 52-37.5-31-13.5-0-0 | | |
| $T_6$ | 0-0-0-0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Bagherpara, Jessore

| Treatment | Mustard (N-P-K-S-Zn) | Boro (N-P-K-S-Zn) | T.Aman (N-P-K-S-Zn) |
|---|---|---|---|
| $T_1$ | 61-11-6-24-0 | 90-5-0-9-0 | 61-4-0-7-0 |
| $T_2$ | 86-15-11-30-0 | 125-7-0-12-0 | 83-5-0-9-0 |
| $T_3$ | 81-12-6-30-0 + 5 t/ha CD | 125-7-0-12-0 | 83-5-0-9-0 |
| $T_4$ | 61-11-6-24-0 | 100-20-35-10-2 | 70-6-20-40-0 |
| $T_5$ | 86-30-16-6-0 | 135-57-45-17-4 | 135-57-45-17-4 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Narikeli, Jamalpur

| Treatment | Wheat (N-P-K-S-Zn-MOC) | Jute (N-P-K-S) | T. Aman (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 84-21-35-11.2-1.4-0 | 77-9.8-35-7 | 98-11.2-35-5.6 |
| $T_2$ | 58.5-12-29.5-11.2-1.4-500 | 51.5-0.8-29.5-7 | 72.5-2.2-29.5-5.6 |
| $T_3$ | 60-15-25-8-1.0-0 | 55-7.0-25-5 | 70-8-25-4 |
| $T_4$ | 30-22-28-0-0-0 | 28.8-25-31-11.5 | 58-2.5-31-0 |
| $T_5$ | 0-0-0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Sherpur, Jamalpur

| Treatment | Wheat (N-P-K-S-Zn-MOC) | Jute (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 100-20-50-17-1-0 | 80-15-50-10 | 70-10-40-7 |
| $T_2$ | 125-30-75-27-1.5-0 | 120-20-80-20 | 100-15-50-10 |
| $T_3$ | 75-10-50-27-1.5-500 | 90-10-70-20 | 75-7-44-10 |
| $T_4$ | 50-10-25-7-0.5-0 | 30-4-15-20 | 70-8-25-4 |
| $T_5$ | 30-22-28-0-0-0 | 30-25-31-12 | 58-2.8-31-0 |
| $T_6$ | 0-0-0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Kishoregonj

| Treatments | Wheat (N-P-K-S) | Jute (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 71-28-10-8 | 73-18-10-10 | 64-17-17-4 |
| $T_2$ | 101-38-15-12 | 103-25-14-14 | 87-20-22-5 |
| $T_3$ | 91-32-7-12+CD.5 t/ha | 103-25-14-14 | 87-20-22-5 |
| $T_4$ | 50-10-25-7 | 30-4-15-0 | 35-4-15-3 |
| $T_5$ | 42-8-5-0 | 23-0-0-0 | 64-10-13-0 |
| $T_6$ | 0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Goyeshpur, Pabna

| Treatment | Wheat (N-P-K-S-Zn-B-CD) | Jute (N-P-K-S) | T.Aman (N-P-K-S-Zn) |
|---|---|---|---|
| $T_1$ | 75-26-17-20-2.5-0.3 | 71-8-8-8 | 60-8-2-5 |
| $T_2$ | 107-35-24-29-3.5-0.5 | 94-11-11-11 | 80-9-3-7 |
| $T_3$ | 82-26-19-29-3.5-0.5+5000 | 94-11-11-11 | 80-9-3-7 |
| $T_4$ | 90-20-35-10-2-0.5 | 65-7-20-4 | 70-8-20-4 |
| $T_5$ | 64-26-17-0-0-0 | 35-11-25-1.36 | 75-16-29-4-6 |
| $T_6$ | 0-0-0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Kendua, Kishoreganj

| Treatments | Boro (N-P-K-S-Zn) | T.Aman (N-P-K-S-Zn) |
|---|---|---|
| $T_1$ | 75-26-48-10-0.6 | 46-18-34-7-0.5 |
| $T_2$ | 105-37-69-15-1.08 | 70-22-43-9-0.83 |
| $T_3$ | 97-35-35-15-1.08 + 4 t/ha straw residue | 62-20-11-9-0.83 |
| $T_4$ | 100-15-40-10-1 | 60-8-30-4-0 |
| $T_5$ | 105-24-37-13-0 | 58-14-25-0-0 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Phulpur, Mymensingh

| Treatment | Boro rice (N-P-K-S-Zn) | T.Aman rice (N-P-K-S-Zn) |
|---|---|---|
| $T_1$ | 100-10.5-40-13.5-1.0 | 67-4.5-28-4-0 |
| $T_2$ | 140-14.7-55-19-1.3 | 94-5.5-36-5.5-0 |
| $T_3$ | 130-9.7-46-19-1.3 | 94-5.5-36-5.5-0 |
| $T_4$ | 100-15-40-10-1.0 | 60-8-30-4-0 |
| $T_5$ | 108-20.4-26-4.9-0 | 84-15-20-7-0 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Netrakona, Mymensingh

| Treatment | Boro rice (N-P-K-S-Zn) | T.Aman rice (N-P-K-S-Zn) |
|---|---|---|
| $T_1$ | 95-29.5-37.6-12.2-0 | 65.5-9.7-27-3.7-0 |
| $T_2$ | 134-42.2-52.6-17.1-0 | 89.3-11.6-35-4.9-0 |
| $T_3$ | 124-36.2-42.6-17.1-0 | 89.3-11.6-35-4.9-0 |
| $T_4$ | 100-15.0-40.0-10.0-1.0 | 60-8-30-4-0 |
| $T_5$ | 120-18-20-5-0 | 92-16-23-8-0 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Laksam, Comilla

| Treatment | Boro (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|
| $T_1$ | 83-21-40-3 | 57-9-25-2 |
| $T_2$ | 116-30-55-5 | 78-12-32-3 |
| $T_3$ | 106-25-45-5+CD 10t/ha | 78-12-32-3 |
| $T_4$ | 100-15-40-10 | 60-8-30-4 |
| $T_5$ | 100-30-60-4 | 80-16-20-2 |
| $T_6$ | 0-0-0-0 | 0-0-0-0 |

Site: Shibpur, Narsinghdi

| Treatment | Boro (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|
| $T_1$ | 83-21-40-3 | 57-9-25-2 |
| $T_2$ | 116-30-55-5 | 78-12-32-3 |
| $T_3$ | 106-25-45-5+CD 10t/ha | 78-12-32-3 |
| $T_4$ | 100-15-40-10 | 60-8-30-4 |
| $T_5$ | 100-30-60-4 | 80-16-20-2 |
| $T_6$ | 0-0-0-0 | 0-0-0-0 |

Site: Ishan Gopalpur, Faridpur

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

Site: Syedpur, Rangpur

| Treatment | Boro (N-P-K-S-Zn-CD) | T.Aman (N-P-K-S) |
|---|---|---|
| $T_1$ | 80-18-35-2-1-0 | 55-10-20-2 |
| $T_2$ | 111-26-48-3-1-0 | 75-12-25-3 |
| $T_3$ | 101-20-38-3-1-10000 | 75-12-25-3 |
| $T_4$ | 100-20-30-10-1-0 | 65-7-20-3 |
| $T_5$ | 155-18-33-08-0-4000 | 97-18-28-0 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Polashbari

| Treatment | Boro (N-P-K-S-Zn-CD) | T.Aman (N-P-K-S) |
|---|---|---|
| $T_1$ | 100-17-57-14-1 | 86-10-30-4 |
| $T_2$ | 141-24-79-19-1 | 117-12-40-5 |
| $T_3$ | 131-18-69-19-1-10000 | 117-12-40-5 |
| $T_4$ | 100-20-30-10-1 | 65-7-20-3 |
| $T_5$ | 155-16-28-06-0-8000 | 86-16-25-2 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Nilphamari, Rangpur

| Treatment | Boro (N-P-K-S-Zn-CD) | T.Aman (N-P-K-S) |
|---|---|---|
| $T_1$ | 100-10-49-10-1-0 | 86-6-29-2 |
| $T_2$ | 140-14-68-14-1-0 | 117-7-38-3 |
| $T_3$ | 130-8-58-14-1-10000 | 117-7-38-3 |
| $T_4$ | 100-20-30-10-1-0 | 65-7-20-3 |
| $T_5$ | 103-18-23-7-1-7500 | 86-17-24-0 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0-0 |

Site: Palima, Tangail

| Treatment | Boro N-P-K-S-Zn-CD | T.Aman N-P-K-S-Zn-CD |
|---|---|---|
| $T_1$ | 90-20-50-0-0 | 62-15-32-0 |
| $T_2$ | 130-30-70-0-0 | 87-20-45-0 |
| $T_3$ | 123-25-57-0-0 5t/ha | 83-17-36-0-5t/ha |
| $T_4$ | 100-20-35-12-1.0 | 70-8-25-4 |
| $T_5$ | 110-10-20-0-0 | 45-12-20-0 |
| $T_6$ | 0-0-0-0-0 | 0-0-0-0 |

Site: Sujanagar, Pabna

| Treatment | Boro (N-P-K-S-Zn-B-CD) | T.Aman |
|---|---|---|
| $T_1$ | 94-27-20-16-0.29-1.0-0 | |
| $T_2$ | 133-38-20-22-0.38-1.0-0 | |
| $T_3$ | 108-18-3-22-0.38-+5000 | |
| $T_4$ | 100-20-35-10-1.5-0 | |
| $T_5$ | 93-29-35-0-0-0 | |
| $T_6$ | 0-0-0-0-0-0 | |

Site: Kalaroa, Khulna

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

Site: Bagerhat, Khulna

| Treatment | Boro (N-P-K-S-Zn) | T.Aman (N-P-K-S-Zn) |
|---|---|---|
| $T_1$ | 94-23-20-10-2 | 64-10-20-0 |
| $T_2$ | 132-33-20-0-2.5 | 88-13-20-0 |
| $T_3$ | 120-27-20-0-2.5+10 t/ha CD | 88-13-20-0 |
| $T_4$ | 65-20-20-0-0 | 35-04-15-2 |
| $T_5$ | 138-30-37-0-0 | 78-30-25-8 |
| $T_6$ | 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: Laksmipur, Noakhali

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

Site: Barind, Rajshahi

| Treatments | Wheat (N-P-K-S-Zn-B) | T.Aman (N-P-K-S) |
|---|---|---|
| $T_1$ | 105-30-21-13-1.5-0.5 | 80-10-20-4 |
| $T_2$ | 150-42-31-20-2.0-1.0 | 105-12-25-5 |
| $T_3$ | 140-36-21-20-2.0-1.0+ 10 t/ha CD | 105-12-25-5 |
| $T_4$ | 90-25-60-20-1.5-0.5 | 75-12-40-5 |
| $T_5$ | 62-25-15-8-0-0 | 62-13-16- 8 |
| $T_6$ | 0-0-0-0-0-0 | 0-0-0-0 |

Site: Barind, Rajshahi

| Treatments | Potato (N-P-K-S-Zn-B) | T.Aman |
|---|---|---|
| $T_1$ | 106-22-37-8- 2.5-5 | |
| $T_2$ | 147-32-54-18-4- 6 | |
| $T_3$ | 138-27-48-18-2.5-7+10t/ha CD | |
| $T_4$ | 161-30-132-18- 2.5-6 | |
| $T_5$ | 207-70-210-18-2-6 | |
| $T_6$ | 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: Chandina, Comilla

| Treatment | Potato (N-P-K-S-Zn) | T.Aus (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 80-11-50-113-4 | 51-10-55-8 | 51-10-55-8 |
| $T_2$ | 113-20-101-15-5 | 72-12-60-12 | 72-12-60-12 |
| $T_3$ | 88-12-75-15-5 (5t/ha CD) | 44-10-40-12 (5t/ha) | 44-10-40-12 (5t/ha) |
| $T_4$ | 95-20-56-8-3 | 64-14-40-8 | 64-14-40-8 |
| $T_5$ | 225-117-225 | 90-59-100 | 90-59-100 |
| $T_6$ | 0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Kushtia

| Treatment | Onion (N-P-K-S-Zn-CD) | T.Aus (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 80-60-0-0-2-0 | 55-15-7-3 | 55-15-7-3 |
| $T_2$ | 80-60-0-0-2-0 | 75-18-10-5 | 75-18-10-5 |
| $T_3$ | 70-55-0-0 -2-10t/ha | 75-18-10-5 | 75-18-10-5 |
| $T_4$ | 100-40-60-25-2-0 | 70-6-15-4 | 70-6-15-4 |
| $T_5$ | 109-22-74-17-0-0 | 52-25-31-4 | 52-25-31-4 |
| $T_6$ | 0-0-0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

Site: Jhalokati, Barisal

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

*2 t/ha CD were applied in $T_3$ treatment

Site: Bhola, Barisal

| Treatment | Mungbean (N-P-K-S) | T.Aus (N-P-K-S) | T.Aman (N-P-K-S) |
|---|---|---|---|
| $T_1$ | 20-10-01 | 64-5-0-1.5 | 66-5-0-1.5 |
| $T_2$ | 25-15-0-2 | 64-7.5-0-2 | 96-7.5-0-2 |
| $T_3$* | 5-5-0-2 | 94-7.5-0-2 | 96-7.5-0-2 |
| $T_4$ | 12-8-8-6 | 44-7.5-0-5 | 46-7.5-0-5 |
| $T_5$ | 0-0-0-0 | 40-8-35-0 | 36-8-35-0 |
| $T_6$ | 0-0-0-0 | 0-0-0-0 | 0-0-0-0 |

*2 t/ha CD were applied in $T_3$ treatment

Site: Lebukhali, Patuakhali

| Treatment | Mungbean (N-P-K) | T.Aus (N-P-K) | T.Aman (N-P-K) |
|---|---|---|---|
| $T_1$ | 10-16-0 | 36-7-0 | 26-10-0 |
| $T_2$ | 10-16-0 | 50-11-0 | 38-12-0 |
| $T_3$ | 5-14-0 CD 5t/ha | 45-7-0 | 33-9-0 |
| $T_4$ | 12-8-8 | 35-4-20 | 30-3-20 |
| $T_5$ | - | 60-0-0 | 50-0-0 |
| $T_6$ | - | - | - |

Site: Baliakandi, Faridpur

| Treatment | Onion (N-P-K-S) | B.Aman |
|---|---|---|
| $T_1$ | 75-62-40-25 | |
| $T_2$ | 95-82-50-33 | |
| $T_3$ | 80-77-35-33 + 5 t/ha CD | |
| $T_4$ | 80-40-40-25 | |
| $T_5$ | 80-80-100-25 | |
| $T_6$ | 0-0-0-0 | |

Site: Atkapatia, Noakhali

| Treatment | T.Aman (N-P-K-S-Zn-CD) |
|---|---|
| $T_1$ | 103-21-13-1-0 |
| $T_2$ | 140-25-17-2-0 |
| $T_3$ | 130-19-12-0-0-10 |
| $T_4$ | 65-20-40-1-4 |
| $T_5$ | 38-16-0-0-0-1.25 |
| $T_6$ | 0-0-0-0-0 |

Site: Munshiganj

| Treatment | Potato (N-P-K-S) | Jute (N-P-K-S) |
|---|---|---|
| $T_1$ | 90-8-35-10 | 35-0-10-0 |
| $T_2$ | 128-11-50-15 | 50-0-15-0 |
| $T_3$ | 118-6-40-15+ CD 10 t/ha | 50-0-15-0 |
| $T_4$ | 95-20-56-8 | 35-4-20-3 |
| $T_5$ | 400-150-400-0 | 60-0-0-0 |
| $T_6$ | 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 |

## Results and Discussion

**CP : Mustard-Boro-T.Aman**
**Location : Narikeli, Jamalpur (AEZ 9)**
**Year : 1998-99 to 2000-01**

Average of three years data revealed that higher grain yield of Mustard was obtained from $T_2$ followed by $T_1$ and $T_3$. No significant difference in yield was observed between soil test based fertilizer dose for HYG and MYG. Even response of organic manure applied in $T_2$ was not evident in Mustard. In boro and T.Aman rice almost similar trend was found over the years. Treatments varied only with farmers' practice and no fertilizer plots.

Cost and return analysis showed that the highest gross margin was obtained from STB fertilizer dose for HYG and MYG. But the highest MBCR was calculated from $T_4$ followed by. In INM treatments, due to additional cost of cowdung reduced the MBCR whereas lowest among the treatments from STB fertilizer dose for MYG.

Table 1. Yield of Mustard, Boro and T.Aman as affected by fertilizer levels in the cropping pattern Mustard-Boro-T.Aman at FSRD site, Narikeli during 1998-99 to 2000-01

| Treat | Seed/grain yield (t/ha) | | | Seed/grain yield (t/ha) | | | Seed/grain yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000-2001 | | | 1999-2000 | | | 1998-1999 | | |
| | Mustard | Boro | T. Aman | Mustard | Boro | T. Aman | Mustard | Boro | T.Aman |
| $T_1$ | 0.95a | 6.02a | 4.84a | 1.00ab | 5.80a | 4.05a | 1.05b | 6.8b | 4.2a |
| $T_2$ | 0.93a | 6.12a | 4.78a | 1.10a | 5.41a | 3.90a | 1.20a | 6.9a | 3.9ab |
| $T_3$ | 0.86a | 5.84a | 4.13a | 1.00ab | 5.46a | 3.78a | 0.97bc | 6.6b | 3.8b |
| $T_4$ | 0.66b | 4.89b | 3.17c | 0.80b | 3.81b | 2.32b | 0.88c | 6.0c | 3.6b |
| $T_5$ | 0.38c | 2.21c | 2.07d | 0.50c | 2.32c | 1.76c | 0.51d | 3.0d | 3.0c |

Table 1. Contd.

| Treat | Stover/ Straw yield (t/ha) | | | Stover/ Straw yield (t/ha) | | | Stover/ Straw yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000-2001 | | | 1999-2000 | | | 1998-1999 | | |
| | Mustard | Boro | T. Aman | Mustard | Boro | T. Aman | Mustard | Boro | T.Aman |
| $T_1$ | 2.41a | 6.92a | 6.16a | 2.2a | 6.7a | 6.78a | 3.3ab | 12.6a | 8.3a |
| $T_2$ | 2.89a | 6.08a | 5.77a | 2.4a | 6.9a | 6.36a | 3.5a | 13.0a | 7.9a |
| $T_3$ | 2.47ab | 6.86a | 6.00a | 2.2a | 6.3a | 6.07a | 3.1b | 12.8a | 7.8ab |
| $T_4$ | 1.82bc | 5.62b | 4.18b | 2.1a | 5.2b | 4.52b | 2.7bc | 12.1a | 7.2b |
| $T_5$ | 1.08c | 3.12c | 2.93c | 1.4b | 3.9c | 2.70c | 1.9c | 9.4b | 6.2c |

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 FSRD site Narikeli during 1998-99 to 2000-01

| Treat | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR | TVC | GM | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mustard | Boro | T.Aman | Mustard | Boro | T.Aman | | | | |
| $T_1$ | 1.00 | 6.21 | 4.36 | 2.64 | 8.74 | 7.08 | 95220 | 12305 | 82915 | 6.74 |
| $T_2$ | 1.08 | 6.14 | 4.19 | 2.93 | 8.66 | 6.59 | 94360 | 18160 | 76200 | 4.20 |
| $T_3$ | 0.94 | 5.97 | 3.90 | 2.59 | 8.65 | 6.62 | 89300 | 9592 | 79708 | 8.31 |
| $T_4$ | 0.78 | 4.90 | 3.03 | 2.20 | 7.64 | 5.30 | 72440 | 7697 | 64743 | 8.41 |
| $T_5$ | 0.46 | 2.51 | 2.28 | 1.46 | 5.47 | 3.94 | 44485 | - | 44485 | - |

**Output:** Mustard Tk. 12.00, T. Aman rice = Tk. 7.00, Boro =Tk. 7.00, Mustard straw = Tk. 0.50, Rice straw = Tk. 0.50

**Inputs:** Urea = Tk. 5.60, TSP = Tk. 12.40, MP =Tk. 9.40, Gypsum =Tk. 4.00, Zinc sulphate =Tk. 25.00, Mustard oil cake =Tk. 6.00, Boric acid = Tk. 90.00

**Location : Melandah, Jamalpur (AEZ 9)**
**Year : 2000-01**

### Crop yield

Grain yield of Mustard did not vary among the treatments except no fertilizer treatment. Effect of higher levels of fertilizers as well as organic manure on the yield of mustard was not observed. Similar result was observed in grain yield of Boro rice. In T.Aman rice the highest grain yield was recorded from STB fertilizer dose for HYG ($T_1$) which was identical to BARC fertilizer recommendation ($T_3$). In all cases the lowest yield was obtained from no fertilizer ($T_5$). Different fertilizer packages identical stover yield in Mustard except with farmers practice and no fertilizer. The highest straw yield of Boro rice was obtained from STB fertilizer dose for HYG followed by MYG. But significantly highest straw from yield of T.Aman rice was recorded from treatment $T_1$.

From economic point of view, the higher gross margin was obtained from $T_1$ followed by $T_2$ but higher MBCR was recorded from treatment $T_3$ followed by $T_1$. It is noted that present fertilizer dose FRG '97 was lowest among the treatments.

Table 3. Yield and economics of Mustard-Boro-T.Aman cropping pattern as affected by fertilizer levels at Melandaha, Jamalpur during 2000-2001

| Treat. | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR (Tk/ha) | VC (Tk/ha) | GM (Tk/ha) | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mustard | Boro | T.Aman | Mustard | Boro | T.Aman | | | | |
| $T_1$ | 1.05a | 6.48a | 4.93a | 4.55a | 6.80a | 6.73a | 102867 | 9743 | 93124 | 5.55 |
| $T_2$ | 1.11a | 6.04a | 4.08b | 4.68a | 6.61ab | 6.06b | 94910 | 13959 | 80951 | 3.87 |
| $T_3$ | 0.99a | 5.88a | 4.40ab | 4.43a | 5.29b | 5.75b | 87070 | 6726 | 80344 | 5.69 |
| $T_4$ | 0.82a | 5.80a | 4.27b | 3.41b | 4.96b | 5.90b | 61115 | 13256 | 47859 | 0.93 |
| $T_5$ | 0.43b | 2.08b | 3.45c | 1.29c | 2.30c | 4.84c | 48797 | 0 | 48797 | - |

**Output:** Mustard Tk. 12.00, T. Aman rice = Tk. 7.00, Boro =Tk. 7.00, Mustard straw = Tk. 0.50, Rice straw = Tk. 0.50

**Inputs:** Urea= Tk. 5.60, TSP = Tk. 12.40, MP =Tk. 9.40, Gypsum =Tk. 4.00, Zinc sulphate =Tk. 25.00, Mustard oil cake =Tk. 6.00, Boric acid = Tk. 90.00

**Location: Muktagacha, Mymensingh (AEZ 9)**
**Year : 2000-01**

Seed yield of Mustard did not differ significantly among the fertilizer packages except with $T_1$ and no fertilizer ($T_6$). However the higher yield was recorded from $T_3$ where IPNS based fertilizer was applied. The yield of Mustard is generally very low due to late sowing of Mustard after harvesting of T.Aman rice. In Boro rice, significantly higher grain yield was recorded from $T_3$, followed by $T_2$ and $T_4$. STB fertilizer dose for MYG showed similar yield to farmer practice. In T.Aman rice, the higher yield was obtained from $T_3$ but identical to $T_2$ and farmers' practice. Regarding straw yield almost similar trend was found.

Cost and return analysis showed that the highest gross margin as well as MBCR was obtained from IPNS treatment $T_3$ but FRG '97 also showed reasonable MBCR and recorded highest among the treatments.

Table 4. Yield and economics of Mustard -Boro-T.Aman cropping pattern as affected by fertilizer levels at Muktagacha, Mymensingh during 2000-01

| Treat. | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR (Tk/ha) | VC (Tk/ha) | GM (Tk/ha) | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mustard | Boro | T.Aman | Mustard | Boro | T.Aman | | | | |
| $T_1$ | 468.3b | 4.51b | 3.46c | 726.7ab | 5.61c | 4.12c | 67921 | 7677 | 60244 | 2.20 |
| $T_2$ | 543.3ab | 5.36a | 4.41a | 716.7b | 6.18ab | 5.01ab | 82372 | 11172 | 71200 | 2.81 |
| $T_3$ | 601.7a | 5.44a | 4.52a | 796.7a | 6.34a | 5.10a | 84750 | 10078 | 74672 | 3.35 |
| $T_4$ | 530.0ab | 5.23a | 3.90b | 735.0ab | 5.93bc | 4.76b | 77556 | 8367 | 69189 | 3.17 |
| $T_5$ | 501.7ab | 4.49b | 4.40a | 771.7ab | 5.69c | 5.06a | 75343 | 11271 | 64072 | 2.16 |
| $T_6$ | 246.2c | 3.44c | 2.73d | 463.3c | 4.75d | 3.24d | 51008 | 0 | 51008 | - |

**Price:** Rice grain = Tk. 7.00 kg$^{-1}$, Rice straw = Tk. 0.50 kg$^{-1}$, Mustard = Tk. 13 kg$^{-1}$, Stover Tk. 0.25 kg$^{-1}$

**Location: Gabtali, Bogra (AEZ 25)**
**Year : 2001-02**

Significantly higher grain yield was recorded from $T_2$ followed by $T_3$. No considerable response of cowdung was evident in the yield of mustard. Fertilizer dose for moderate yield in STB and FRG'97 produced identical yield. A significantly lower yield was obtained from farmers' practice and control treatment. Almost similar trend was observed in stover yield. From cost and return analysis it was found that higher gross margin was obtained from $T_2$ followed by $T_1$ but BCR was highest in $T_4$. Due to additional cost of cowdung applied in $T_3$ reduce the gross margin and BCR. It is noted that only mustard crop yield was shown and conclusion will be made after harvest of T.Aman rice.

Table 5. Agro-economic performance of Mustard in cropping pattern Mustard-Boro-T.Aman at Gabtali, Bogra, 2001-02

| Treatments | Grain yield (t/ha) | Straw yield (t/ha) | Total variable cost (Tk/ha) | Gross return (Tk/ha) | Gross margin (Tk/ha) | Benefit-cost ratio |
|---|---|---|---|---|---|---|
| $T_1$ | 9567c | 2.66b | 9682 | 15871 | 6189 | 1.64 |
| $T_2$ | 1092a | 3.04a | 10928 | 17709 | 6780 | 1.62 |
| $T_3$ | 1023ab | 3.07a | 13382 | 16878 | 3495 | 1.13 |
| $T_4$ | 900cd | 2.74b | 8923 | 14869 | 5945 | 1.67 |
| $T_5$ | 8117e | 2.52b | 8247 | 13434 | 5186 | 1.63 |
| $T_6$ | 3667f | 0.62c | 6040 | 5813 | -227 | 0.96 |

**Location : Bagherpara, Jessore (AEZ 11)**
**Year : 2000-01**

Grain yield of Mustard did not varied significantly among the fertilizer packages except with no fertilizer treatment. The yield level of mustard was low due to late sowing of Mustard and delayed harvest of T.Aman rice. Higher level of fertilizers as well as organic manure failed to produce any significant response towards mustard yield. Stover yield almost follow the same trend. In Boro rice, higher yield was obtained from BARC recommended dose ($T_4$) followed by farmers' practice ($T_5$). Soil test based fertilizer recommendation failed to show any positive response over present fertilizer recommendation. In T.Aman rice almost similar result was observed except $T_6$. In farmers' practice the fertilizer dose was much higher and that contributed to the higher yield.

From cost and return analysis it was found that highest gross return and margin was recorded from $T_4$ (FRG'97) but the highest MBCR was calculated from $T_2$ where soil test based fertilizer for high yield goal was applied. The MBCR was lowest in farmer practice due to application of higher fertilizer dose with high cost involvement.

Table 6. Yield and economics of Mustard-Boro-T.Aman cropping pattern as affected by fertilizer levels at Bagherpara, Jessore during 2000-01

| Treat | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR (Tk/ha) | VC (Tk/ha) | GM (Tk/ha) | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mustard | Boro | T.Aman | Mustard | Boro | T.Aman | | | | |
| $T_1$ | 0.715a | 4.97c | 4.34b | 2.18b | 5.11c | 4.25a | 69355 | 4078 | 65277 | 5.69 |
| $T_2$ | 0.887a | 5.4b | 4.58ab | 2.60ab | 5.52abc | 4.58a | 87685 | 5148 | 82537 | 8.07 |
| $T_3$ | 0.872a | 5.48b | 5.15ab | 2.63ab | 5.69ab | 4.52a | 91585 | 6015 | 85570 | 7.55 |
| $T_4$ | 0.897a | 5.97a | 5.23a | 2.64ab | 5.94a | 4.75a | 96070 | 6435 | 89635 | 7.76 |
| $T_5$ | 0.987a | 5.60ab | 5.10ab | 2.92a | 5.44bc | 5.14a | 94185 | 10035 | 84150 | 4.79 |
| $T_6$ | 0.420b | 2.91d | 2.39c | 1.49c | 3.63d | 2.24b | 46150 | 0 | 46150 | - |

| | | | | | |
|---|---|---|---|---|---|
| Input price: | Urea – | Tk. 6.00 /kg | Product price: | Mustard grain - | Tk. 15.50/kg |
| | TSP- | Tk. 12.00/kg | | Mustard straw- | Tk. 0.50/kg |
| | MP- | Tk. 8.50/kg | | Rice grain | Tk. 6.50/kg |
| | Gypsum- | Tk. 3.00/kg | | Rice straw | Tk. 0.75/kg |
| | $ZnSO_4$ - | Tk. 60.00/kg | | | |

**CP : Wheat-Jute-T.Aman**
**Location : Narikeli, Jamalpur (AEZ 9)**
**Year : 1998-99 to 2000-01**

Grain and fibre yield of the crops are presented in Table 7. From the average of three years data showed that the highest grain yield of wheat (3.0 t/ha) was obtained from $T_1$ though there was no considerable differences among $T_2$, $T_3$ and $T_4$. The lowest yield was obtained from control plot (1.62 t/ha). Response of organic manure was not apparent. The highest fibre yield (2.70 t/ha) was also followed by obtained from $T_1$ which was closely followed by $T_2$. However, a marked yield increase was noticed in recommended fertilizer doses over farmers' practice and control. In T.Aman rice almost similar result was observed. Application of mustard oil cake has no direct effect on the yield of the succeeding crops. Similar trend was also found in case of straw and stick yield of Wheat, Jute and T.Aman rice.

The highest gross margin as well as MBCR was obtained from soil test based mineral fertilizers for HYG (T1) followed by BARC fertilizer recommendation (FRG'97). Due to the additional cost of MOC the profit was least in T2.

From the three years study it may be concluded that application of organic manure (MOC) did not have any positive effect on the yield of crops. Soil test based inorganic fertilizer for HYG was found optimum for the cropping pattern in respect of yield and economics.

Table 7. Yield of Wheat, Jute and T.Aman as affected by fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at FSRD site, Narikeli during 2000-01

| Treat | Grain/fibre yield (t/ha) | | | Grain/fibre yield (t/ha) | | | Grain/fibre yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000-2001 | | | 1999-2000 | | | 1998-1999 | | |
| | Wheat | Jute | T.Aman | Wheat | Jute | T.Aman | Wheat | Jute | T.Aman |
| $T_1$ | 3.33a | 2.89a | 4.41a | 2.81a | 2.4a | 4.74a | 2.85a | 2.8a | 4.01a |
| $T_2$ | 2.96a | 2.30b | 4.40a | 2.73a | 2.3a | 4.37a | 2.70a | 2.7a | 4.12a |
| $T_3$ | 3.02a | 2.20bc | 4.33a | 2.73a | 2.0a | 3.85a | 2.26a | 2.6a | 4.16a |
| $T_4$ | 2.85a | 1.86c | 4.25a | 2.62a | 1.4bc | 3.59b | 2.51a | 2.3a | 3.90a |
| $T_5$ | 1.54b | 0.93d | 1.97b | 1.51b | 1.0c | 1.82c | 1.80b | 2.0b | 3.32b |
| F | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| CV (%) | 19.53 | 9.32 | 10.49 | 4.12 | 16.86 | 12.32 | 8.88 | 14.91 | 3.59 |

Table 7. Contd.

| Treat | Straw/ stick yield (t/ha) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000-2001 | | | 1999-2000 | | | 1998-1999 | | |
| | Wheat | Jute | T.Aman | Wheat | Jute | T.Aman | Wheat | Jute | T.Aman |
| $T_1$ | 4.13a | 3.78a | 5.47a | 3.9a | 4.0a | 6.34a | 3.80a | 7.5a | 7.7a |
| $T_2$ | 3.78a | 3.81a | 5.15a | 3.9a | 4.3a | 5.89a | 3.75a | 7.4a | 7.7a |
| $T_3$ | 4.02a | 3.79a | 5.05a | 3.9a | 4.3a | 5.61ab | 3.60a | 7.4a | 7.6a |
| $T_4$ | 3.66a | 3.16a | 4.64a | 3.8a | 3.1a | 4.60b | 2.52b | 6.9b | 7.4b |
| $T_5$ | 2.49b | 2.12b | 3.03b | 2.9b | 1.9b | 2.95c | 2.20c | 5.6c | 7.1a |

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

Table 8. Cost and return analysis of Wheat -Jute-T. Aman cropping pattern as affected by fertilizer levels at FSRD site Narikeli during 1998-99 to 2000-01

| Treat | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR | TVC | GM | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat | Jute | T.Aman | Wheat | Jute | T.Aman | | | | |
| $T_1$ | 3.00 | 2.70 | 4.39 | 3.94 | 5.09 | 6.50 | 77667 | 8526 | 68141 | 2.95 |
| $T_2$ | 2.80 | 2.43 | 4.30 | 3.81 | 5.17 | 6.25 | 75617 | 14025 | 61592 | 1.33 |
| $T_3$ | 2.67 | 2.27 | 4.11 | 3.84 | 5.16 | 6.09 | 72785 | 7879 | 64906 | 2.79 |
| $T_4$ | 2.66 | 1.85 | 3.91 | 3.33 | 4.39 | 5.55 | 66672 | 6972 | 59700 | 2.40 |
| $T_5$ | 1.62 | 1.31 | 2.37 | 2.53 | 3.20 | 4.36 | 42945 | - | 42945 | - |

**Products:** Wheat = Tk. 7.00, T.Aman rice = Tk. 7.00, Jute (fibre) =Tk. 6.25, Wheat straw = Tk. 0.50, Rice straw = Tk. 0.75, Jute stick= Tk. 0.75,

**Inputs:** Urea = Tk. 5.60, T.S.P. = Tk. 12.40, M.P. =Tk. 9.40, Gypsum =Tk. 4.00, Zinc sulphate =Tk. 25.00, Mustard oil cake =Tk. 6.00

**Location : Sherpur, Jamalpur (AEZ 9)**
**Year : 2001-02**

The higher no. of spikes/m$^2$ was noted from $T_2$ which was statistically similar to $T_1$. The control plot produced the lowest spikes/m$^2$ but at par to $T_3$. The highest spikelets/spikes were obtained from $T_2$ which was statistically similar to $T_1$ and $T_5$. The number of grains/spike was found highest in $T_2$ which was statistically similar to $T_1$, $T_3$ and $T_4$. The highest grain yield was obtained from $T_3$ and it was statistically identical with $T_5$, $T_2$ and $T_1$. The control plot produced the lowest grain yield. Similar trend was also observed in case of straw yield. Wheat is the first crop in the pattern so conclusion can be made after completion of the cycle.

Table 9. Yield contributing characters of Wheat as affected by fertilizer levels in the cropping pattern under Wheat-Jute-T. Aman at MLT site, Sherpur during 2001-02

| Treat | Plant height (cm) | Spikes/ m$^2$ (no.) | Spikelets/ spike (no.) | Spike length (cm) | Grains/ spike (no.) | 1000 grain wt (g) | Straw yield (t/ha) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 89.73a | 310a | 14.88abc | 8.57a | 26.08a | 32.00a | 3.87ab | 2.37ab |
| $T_2$ | 90.78a | 314a | 15.20a | 8.58a | 26.41a | 32.67a | 3.89ab | 2.39ab |
| $T_3$ | 92.43a | 386b | 15.17ab | 8.85a | 26.22a | 32.67a | 4.21a | 2.53a |
| $T_4$ | 84.98a | 259b | 14.48c | 8.32a. | 25.82a | 31.50a | 3.61b | 2.05b |
| $T_5$ | 88.88a | 295c | 14.60bc | 8.50a | 12.08b | 32.33a | 3.88ab | 2.43a |
| $T_6$ | 57.58b | 267c | 7.12d | 5.28b | 9.70 | 27.67b | 1.63c | 0.83c |
| F | * | * | ** | ** | ** | ** | ** | ** |
| CV (%) | 4.37 | 11.57 | 2.11 | 7.88 | 3.25 | 2.46 | 9.25 | 10.18 |

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

**Location : Kishoreganj (AEZ 9)**
**Year : 2000-01**

Grain yield of wheat increased with the increase of fertilizer doses and the significantly higher grain yield was recorded from $T_3$ followed by $T_2$. Two fertilizer doses for MYG (STB & FRG '97) produced similar yield and it was also identical to farmers' practice.

The highest fibre yield (2.93 t/ha) of Jute was obtained from $T_3$ (INM) which was identical to $T_1$ and $T_2$. A considerable response of organic manure was apparent in the yield of Jute. In T.Aman rice all the fertilizer packages produced identical yield and only differ with no fertilizer treatment. Response of crop towards higher fertilizer doses was not 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 $T_3$ (INM) followed by T4 (FRG'97). But the highest MBCR (5.66) was obtained from treatment $T_4$ (FRG'97) due to use of less amount of fertilizers. Additional cost for organic manure in T3 reduces the MBCR. Farmer practice was also showed reasonable MBCR and higher than other treatments except $T_4$.

Table 10. Yield and economics of Wheat-Jute-T.Aman cropping pattern as affected by fertilizer levels at Kishoreganj during 2000-01

| 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 | | | | |
| $T_1$ | 1.32b | 2.55ab | 3.90a | 1.53ab | 3.25ab | 4.82abc | 81577 | 8089 | 73488 | 2.36 |
| $T_2$ | 1.53a | 2.71ab | 4.05a | 1.76a | 3.22ab | 5.34a | 87674 | 10963 | 76711 | 2.30 |
| $T_3$ | 1.59a | 2.93a | 4.43a | 1.72ab | 3.64a | 4.90ab | 93914 | 10277 | 83637 | 3.06 |
| $T_4$ | 1.28b | 2.29bc | 3.88a | 1.62ab | 2.85bc | 4.56bc | 85570 | 4078 | 81492 | 5.66 |
| $T_5$ | 1.29b | 2.44b | 3.9a | 1.48bc | 3.15ab | 4.69bc | 80215 | 3492 | 76723 | 5.17 |
| $T_6$ | 1.00c | 1.85c | 3.04b | 1.25c | 2.41c | 4.27c | 62478 | 0 | 62478 | - |

**Location : Goyeshpur, Pabna (AEZ 11)**
**Year : 2000-01**

The result showed that significantly higher grain yield wheat was obtained from INM treatment ($T_3$) which was at par with the soil test based fertilizer recommendation for HYG (T2). Fertilizer doses for moderate yield (STB & FRG'97) produced similar yield and it was also identical to farmers' practice. The fibre yield of Jute did not varied significantly among the treatments except with STB fertilization for MYG ($T_1$). Similarly, in T.Aman rice the grain yield did not varied significantly among the different fertilizer packages. Higher levels of fertilizers failed to produce marked response towards the yield of rice. The control plot where no fertilizer was applied produced significantly lower yield in all the crops. Almost similar trend was found in case of straw and stick yield of crops.

From cost and return analysis, it was found that the highest gross margin was obtained from INM treatment ($T_3$) followed by $T_2$ and $T_4$. Similarly, the highest MBCR was calculated from $T_3$. However, the MBCR was lower than 2 in all cases.

Table 11. Yield and economics of Wheat-Jute-T.Aman cropping pattern as affected by fertilizer levels at Goyeshpur, Pabna during 2000-01

| 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 | | | | |
| $T_1$ | 2.60b | 1.50b | 4.40a | 3.63b | 2.67a | 5.78a | 100014 | 19488 | 80526 | 1.15 |
| $T_2$ | 3.19a | 1.65ab | 4.46a | 4.26a | 2.99a | 5.71a | 105531 | 21902 | 83629 | 1.17 |
| $T_3$ | 3.20a | 1.77a | 4.59a | 4.43a | 3.10a | 5.99a | 111591 | 23033 | 88558 | 1.32 |
| $T_4$ | 2.60b | 1.77a | 4.23a | 3.48b | 2.98a | 6.12a | 101094 | 19377 | 81717 | 1.22 |
| $T_5$ | 2.42b | 1.57ab | 4.14a | 3.14c | 2.96a | 5.85a | 96237 | 19790 | 76447 | 0.93 |
| $T_6$ | 1.09c | 0.98c | 2.39b | 1.60d | 1.82b | 4.24b | 58083 | 0 | 58083 | - |

**CP : Boro-T.Aman**
**Location : Kendua, Kishoreganj (AEZ 9)**
**Year : 2000-01**

The highest grain yield of Boro rice was obtained from $T_3$ which was identical to other treatments except $T_1$ (STB fertilizer dose for MYG) and $T_6$. Effect of organic manure applied in T3 was not evident. In T.Aman rice almost similar result was observed and the grain yield is differ with farmers practice. The lowest yield in both the crops was obtained in control plots where no fertilizer was applied. In case of straw yield the same result was noticed.

Cost and return analysis of different nutrient management packages in Boro- T.Aman rice cropping pattern showed that the highest gross return as well as MBCR was obtained from the Treatment $T_2$ but MBCR was highest from treatment T4 in FRG '97. Except $T_1$, the MBCR is more than 2 indicted economics suitability of the different fertilizer packages in Boro-T.Aman cropping pattern.

Table 12. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Kendua, Netrokona during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 4.33b | 4.31ab | 4.55b | 4.64a | 62712 | 6652 | 56060 | 1.51 |
| $T_2$ | 5.16a | 4.38a | 5.33a | 4.64a | 72880 | 9177 | 63703 | 2.20 |
| $T_3$ | 5.21a | 4.04ab | 5.70a | 4.66a | 71202 | 8131 | 63071 | 2.28 |
| $T_4$ | 4.94ab | 4.20ab | 5.77a | 4.58a | 70225 | 5361 | 64864 | 3.27 |
| $T_5$ | 5.13a | 4.01b | 5.48a | 4.57a | 70182 | 6152 | 64029 | 2.84 |
| $T_6$ | 3.58c | 3.15c | 4.52b | 3.73b | 52675 | 0 | 52675 | - |

**Location : Phulpur and Netrakona, Mymensingh (AEZ 9)**
**Year : 2000-01**

**Phulpur**

Significantly higher grain yield of Boro rice was recorded from $T_3$ and T2 indicated positive response of higher fertilizer levels towards yield. Fertilizer doses for MYG (STB & FRG '97) also produced identical yield. In T.Aman rice, significantly highest grain yield was obtained from $T_2$. Response of organic manure was not apparent in T.Aman rice. The lowest grain yield was obtained from $T_6$ where no fertilizer was applied.

From cost and return analysis it was found that, the highest gross return and margin was obtained from T2 followed by T3. The MBCR was almost same at it was more than 3 in all the fertilizer packages except farmers practice.

Table 12. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Phulpur, Mymensingh during 2000-2001

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross retutn (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.19b | 4.14d | 5.97bc | 5.13d | 70873 | 5729 | 65144 | 3.69 |
| $T_2$ | 5.43a | 4.72a | 6.17ab | 5.79a | 76994 | 7614 | 69380 | 3.58 |
| $T_3$ | 5.44a | 4.52b | 6.25a | 5.66ab | 75689 | 7965 | 67724 | 3.26 |
| $T_4$ | 5.16b | 4.29c | 5.87c | 5.51bc | 71824 | 6136 | 65688 | 3.60 |
| $T_5$ | 4.60c | 4.16d | 5.36d | 5.36c | 66679 | 6675 | 60004 | 2.54 |
| $T_6$ | 3.24d | 3.24e | 4.20e | 4.50e | 49724 | 0 | 49724 | - |

**Netrokona**

Higher grain yield was recorded from $T_2$ and $T_3$ which were also identical to $T_1$ and farmers' practice. No appreciable difference in yield was observed between two yield goal level fertilizer doses (HYG & MYG). Response of cowdung was not apparent. In T.Aman rice, significantly higher yield was obtained from $T_2$ and $T_3$. Soil test based fertilizer doses for MYG and BARC recommended fertilizer dose also produced identical but superior yield over farmers' practice. Similar trend was found in straw yield of rice.

From cost and return analysis, it was found that the highest gross return and margin was obtained from $T_2$ closely followed by $T_3$ and $T_1$. But the highest MBCR was calculated from $T_1$ followed by $T_4$. However, in all cases the MBCR is more than 2 except in farmers' practice.

Table 13. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Netrokona, Mymensingh during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 4.86ab | 3.47b | 5.57ab | 3.55b | 65854 | 7005 | 58849 | 3.21 |
| $T_2$ | 5.15a | 3.96a | 6.03a | 4.04a | 68802 | 9521 | 59281 | 2.67 |
| $T_3$ | 5.12a | 3.97a | 6.04a | 4.07a | 68665 | 9701 | 58964 | 2.61 |
| $T_4$ | 4.53b | 3.45b | 5.20b | 3.53b | 60190 | 5725 | 54465 | 2.94 |
| $T_5$ | 4.67ab | 2.98c | 5.39b | 3.03c | 57740 | 10862 | 46878 | 1.32 |
| $T_6$ | 3.23c | 2.52d | 3.64c | 2.58d | 43382 | - | - | - |

**Location : Laksam, Comilla (AEZ 8)**
**Year : 2000-01**

No significant difference in grain yield of Boro rice was observed among the different fertilizer packages except with $T_1$ and no fertilizer treatment. Except control plot in all cases the yield was more than 6 t/ha. Higher level of fertilizers even along with organic manure did not show considerable response towards the yield. In T.Aman rice, the highest grain yield was recorded from T3 which is identical to $T_2$ and $T_4$. Present BARC fertilizer recommendation for MYG (FRG'97) produced similar yield with STB fertilizer dose for HYG. Almost similar trend was found in case of straw yield.

From cost and return analysis it was found that, the highest gross margin was obtained from INM ($T_3$) followed by $T_2$. Regarding MBCR, the highest figure was calculated from BARC fertilizer recommendation (FRG'97). Due to additional cost of organic manure in $T_3$ the MBCR was less. However, in all cases the MBCR is more than 4 indicating the economic suitability of fertilization in Boro-T.Aman cropping pattern

Table 14. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Laksam, Comilla during 2000-2001

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 6.25b | 4.58bc | 7.50 | 5.14 | 82,200 | 6,312 | 75,888 | 6.68 |
| $T_2$ | 6.45ab | 5.42ab | 8.06 | 6.48 | 91,180 | 7,884 | 83,296 | 6.29 |
| $T_3$ | 6.50a | 5.87a | 8.13 | 6.81 | 55,030 | 8,795 | 86,235 | 5.97 |
| $T_4$ | 6.28ab | 5.17ab | 7.80 | 6.97 | 88,640 | 5,747 | 82,893 | 8.56 |
| $T_5$ | 6.48ab | 4.93b | 8.10 | 5.90 | 87,390 | 10,554 | 76,836 | 4.09 |
| $T_6$ | 2.50c | 1.85c | 3.01 | 2.73 | 33,690 | 0 | 33,690 | - |

* Variable Cost = Fertilizer Cost only

**Price:** Boro = Tk. 6.00/kg , T.Aman= Tk 7.00/kg , Rice straw= Tk 1.00/kg
Urea Tk 6.00/kg, T.S.P Tk 15.00/kg, MP Tk 9.00/kg and Gypsum Tk 4.5/kg

**Location : Shibpur, Narsinghdi (AEZ 19)**
**Year : 2000-01**

Significantly highest grain yield was recorded from $T_3$ where STB fertilizer dose for HYG along with organic fertilizer was applied. A considerable response of cowdung was observed on the grain yield of Boro rice. In T.Aman rice similar trend was found. Cowdung applied in Boro rice has considerable residual effect on T.Aman rice reflected in yield. More or less same trend was also found in case of straw yield of rice.

Similarly, highest gross return and margin was obtained from $T_3$. But the highest MBCR was calculated from fertilizer doses for MYG (FRG'97) followed by MYG (STB). Due to the cost of cowdung the MBCR was less in T3. In farmers' practice, gross margin as well as MBCR was less.

Table 15. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Shibpur, Narsinghdi during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.12b | 4.11b | 7.19b | 4.78ab | 80690 | 5626 | 75064 | 6.11 |
| $T_2$ | 5.45b | 4.09b | 7.41b | 4.81ab | 83090 | 7707 | 75383 | 4.51 |
| $T_3$ | 6.38a | 4.55a | 7.96a | 5.32a | 94380 | 9592 | 84788 | 4.60 |
| $T_4$ | 5.23b | 4.23b | 7.44b | 4.76ab | 82650 | 5702 | 76948 | 6.36 |
| $T_5$ | 4.53c | 3.61c | 6.98d | 4.64b | 72210 | 7173 | 65037 | 3.39 |
| $T_6$ | 2.70d | 1.93d | 3.51c | 2.81c | 40660 | 0 | 40660 | - |

* Variable Cost = Fertilizer Cost only

**Location : Ishan Gopalpur, Faridpur (AEZ 16)**
**Year : 2000-01**

The grain yield of Boro and T.Aman rice varied significantly due to treatments and season differences. Significantly highest grain yield was obtained in INM ($T_3$) both from Boro (6.18 t/ha) and T.Aman (4.20 t/ha). No significant difference was found among the yield of T1, $T_2$, $T_4$ and farmers' practice ($T_5$) in Boro rice. In T.Aman rice, almost similar result was found. Highest straw yield was also obtained from INM for both the crops. In INM treatment where cowdung was applied along with inorganic fertilizers might have played a vital role for uptake of different nutrients which contributed to achieve a comparatively high yield.

From cost and return analysis, it was found that the highest gross return and margin as well as MBCR was also obtained from treatment $T_3$. But the MBCR was very low and less than 1 in all cases.

Table 16. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Ishangopalpur, Faridpur during 2000-001

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.13b | 3.91bc | 6.60c | 5.01b | 66576 | 14008 | 52568 | 0.64 |
| $T_2$ | 5.42b | 4.07b | 6.85b | 5.21a | 69799 | 15309 | 54490 | 0.71 |
| $T_3$ | 6.18a | 4.20a | 7.68a | 5.16ab | 75990 | 17985 | 58005 | 0.80 |
| $T_4$ | 5.33b | 3.93bc | 6.90b | 5.00b | 68126 | 14563 | 53563 | 0.69 |
| $T_5$ | 5.20b | 3.81c | 6.75b | 4.57c | 66130 | 18110 | 48020 | 0.24 |
| $T_6$ | 2.87c | 2.57d | 4.05d | 3.80d | 43570 | 0 | 43570 | -- |

Variable Cost = Fertilizer Cost only

Price of fertilizer: Urea = 6.50 Tk./kg, TSP = 11.00 Tk./kg, MP = 9.00 Tk./kg, Gypsum = 3.00 Tk./kg, Cowdung = 0.40 Tk./kg
Price of product: Boro rice = 7.00 Tk./kg, T.Aman rice = 6.50 Tk./kg, Rice straw = 0.50 Tk./kg

**Location : Syedpur, Polashbari and Nilphamari, Rangpur (AEZ 12)**
**Year : 1998-99 to 2000-01**

The results presented in table 17-19 revealed that the grain yield of Boro rice and T.Aman rice in each location varied significantly due to different treatments. The mean of three years results revealed that with the application cowdung along with STB inorganic fertilizers for HYG ($T_3$) produced the highest grain yield both in Boro and T.Aman rice followed by only STB inorganic fertilizer for HYG ($T_2$). The trend was similar over the locations -Syedpur FSRD, Polashbari and Nilphamari MLT sites. Fertilizer doses for MYG (STB & FRG'97) and farmers' practice produced identical yield. Almost similar results were also obtained with straw yield of Boro and T. aman rice. Effect of cowdung on the yield of rice was not evident over the years and locations.

The highest gross margin was obtained from $T_3$ but highest MBCR from $T_1$ followed by $T_4$ at Syedpur. But at Nilphamari, higher MBCR from $T_4$ followed by $T_1$ whereas at Polashbari, higher MBCR from $T_4$ treatment.

After three years of experimentation it may be concluded that present recommendation (FRG '97) soil test based fertilizer recommendation was found superior in respect of yield and profit. However, the effect of organic manure is not very evident but considering the long term effect of nutrient mining and soil fertility cowdung should be applied at least once in a year.

Table 17. Effect of different nutrient management packages on the yield of crops in Boro-T.Aman cropping patterns at Syedpur FSRD site, OFRD, BARI, Rangpur during 1998-99, 1999-2000 and 2000-01

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Mean of 3 years | |
|---|---|---|---|---|---|---|---|---|
| | Boro | T. aman | Boro | T.aman | Boro | T.aman | Boro | T.aman |
| | Grain yield (t/ha) | | | | | | | |
| $T_1$ | 4.93b | 4.75 b | 5.19b | 4.44c | 5.09c | 4.26c | 5.07 | 4.48 |
| $T_2$ | 5.36a | 5.05 ab | 6.23a | 4.96ab | 6.08a | 5.10ab | 5.89 | 5.04 |
| $T_3$ | 5.42a | 5.26a | 6.31a | 5.24a | 6.42a | 5.37a | 6.05 | 5.29 |
| $T_4$ | 4.95b | 4.82b | 5.36b | 4.62bc | 5.29bc | 4.32c | 5.20 | 4.59 |
| $T_5$ | 4.65b | 4.81b | 5.65ab | 4.70bc | 5.58b | 4.82b | 5.29 | 4.78 |
| $T_6$ | 2.61c | 2.13c | 2.04c | 1.72d | 1.95d | 1.52d | 2.2 | 1.79 |
| CV (%) | 6.2 | 7.2 | 10.8 | 8.3 | 6.8 | 6.9 | - | - |
| | Straw Yield (t/ha) | | | | | | | |
| $T_1$ | 6.15b | 6.05a | 6.82b | 5.59c | 6.65c | 5.42b | 6.54 | 5.69 |
| $T_2$ | 6.90ab | 6.33a | 7.93a | 6.21ab | 7.36ab | 6.55a | 7.39 | 6.37 |
| $T_3$ | 6.99a | 6.56a | 7.92a | 6.69a | 7.85a | 6.88a | 7.59 | 6.71 |
| $T_4$ | 6.11b | 6.07a | 6.75b | 5.74bc | 6.60c | 5.66b | 6.49 | 5.82 |
| $T_5$ | 7.08a | 6.39a | 8.09a | 6.02bc | 7.22 | 5.84b | 7.46 | 6.08 |
| $T_6$ | 2.93c | 2.62b | 3.11c | 2.72d | 2.70d | 2.29c | 2.90 | 2.54 |
| CV (%) | 7.6 | 7.9 | 8.4 | 8.0 | 6.9 | 7.6 | - | - |

Table 18. Effect of different nutrient management packages on the yield of crops in Boro-T.Aman cropping patterns at Nilphamari MLT site, OFRD, BARI, Rangpur during 1998-99 to 2000-01

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Mean of 3 Years | |
|---|---|---|---|---|---|---|---|---|
| | Boro | T. aman | Boro | T.Aman | Boro | T. aman | Boro | T. aman |
| | Grain yield (t/ha) | | | | | | | |
| $T_1$ | 6.07bc | 4.98bc | 5.38cd | 4.50b | 5.49c | 4.57b | 5.65 | 4.68 |
| $T_2$ | 6.36ab | 5.45ab | 6.35ab | 5.08a | 6.54ab | 5.28a | 6.42 | 5.27 |
| $T_3$ | 6.76a | 5.57a | 6.74a | 5.28a | 6.84a | 5.40a | 6.78 | 5.42 |
| $T_4$ | 6.31b | 4.76c | 5.19d | 4.48b | 5.26c | 4.33b | 5.59 | 4.52 |
| $T_5$ | 5.78c | 4.96bc | 5.89bc | 4.56b | 6.04b | 4.63b | 5.89 | 4.72 |
| $T_6$ | 3.19d | 2.21d | 1.94e | 1.79c | 2.04d | 1.89c | 2.39 | 1.96 |
| CV (%) | 4.6 | 8.9 | 8.7 | 6.7 | 7.8 | 7.3 | - | - |

Table 18. Contd.

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Mean of 3 Years | |
|---|---|---|---|---|---|---|---|---|
| | Boro | T. aman | Boro | T.Aman | Boro | T. aman | Boro | T. aman |
| Straw Yield (t/ha) | | | | | | | | |
| $T_1$ | 6.58bc | 6.30bc | 6.58b | 5.71bc | 6.69bc | 5.82bc | 6.62 | 5.94 |
| $T_2$ | 7.14ab | 6.41ab | 7.36a | 6.63a | 7.64a | 6.78a | 7.38 | 6.61 |
| $T_3$ | 7.56a | 7.05a | 7.61a | 6.73a | 7.79a | 6.96a | 7.65 | 6.90 |
| $T_4$ | 7.01abc | 6.12c | 6.57b | 5.62c | 6.63b | 5.46c | 6.74 | 5.73 |
| $T_5$ | 6.44c | 6.27bc | 7.61a | 6.28ab | 7.44a | 6.16b | 7.16 | 6.24 |
| $T_6$ | 3.52d | 2.96d | 3.15c | 2.79d | 3.28c | 3.04d | 3.32 | 2.93 |
| CV (%) | 8.2 | 7.8 | 7.3 | 8.7 | 6.5 | 6.3 | - | - |

Table 19. Effect of different nutrient management packages on the yield of crops in Boro-T.Aman cropping patterns at Polashbari MLT site, OFRD, BARI, Rangpur during 1998-99, 1999-2000 and 2000-01

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Mean of 3 years | |
|---|---|---|---|---|---|---|---|---|
| | Boro | T. aman | Boro | T. aman | Boro | T. aman | Boro | T. aman |
| | Grain yield (t/ha) | | | | | | | |
| $T_1$ | 5.92b | 5.09b | 6.05bc | 4.66b | 6.10b | 4.34b | 6.02 | 4.69 |
| $T_2$ | 6.47a | 5.78a | 6.89a | 5.44a | 6.94a | 5.10a | 6.77 | 5.44 |
| $T_3$ | 6.81a | 5.84a | 6.92a | 5.50a | 7.05a | 5.17a | 6.93 | 5.50 |
| $T_4$ | 5.94b | 4.87b | 5.81c | 4.59b | 5.95b | 4.34b | 5.90 | 4.60 |
| $T_5$ | 4.38c | 5.04b | 6.47ab | 4.94b | 6.35b | 4.48b | 5.73 | 4.82 |
| $T_6$ | 3.40d | 2.02c | 2.35d | 1.47c | 1.99c | 1.39c | 2.58 | 1.63 |
| CV (%) | 5.9 | 9.4 | 6.6 | 9.5 | 7.2 | 6.9 | - | - |
| Straw Yield (t/ha) | | | | | | | | |
| $T_1$ | 6.55b | 6.25b | 6.68b | 5.57bc | 6.74b | 5.80b | 6.66 | 5.87 |
| $T_2$ | 7.03ab | 7.11a | 7.69a | 7.02a | 7.78a | 6.81a | 7.50 | 6.98 |
| $T_3$ | 7.40a | 7.27a | 7.89a | 7.02a | 8.00a | 6.89a | 7.76 | 7.06 |
| $T_4$ | 6.61b | 6.15b | 6.54b | 5.49c | 6.69b | 5.89b | 6.61 | 5.84 |
| $T_5$ | 7.10ab | 6.49b | 7.98a | 6.13b | 8.21a | 6.00b | 7.76 | 6.21 |
| $T_6$ | 3.74c | 2.50c | 3.13c | 2.26d | 2.96c | 2.20c | 3.28 | 2.32 |
| CV (%) | 7.4 | 8.4 | 8.0 | 8.5 | 8.2 | 7.6 | - | - |

Table 20. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Syedpur FSRD site, Rangpur during 1998-99 to 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.07 | 4.48 | 6.54 | 5.69 | 82540 | 25230 | 57310 | 8.79 |
| $T_2$ | 5.89 | 5.04 | 7.39 | 6.37 | 94295 | 26927 | 67368 | 8.34 |
| $T_3$ | 6.05 | 5.29 | 7.59 | 6.71 | 97868 | 28830 | 69038 | 6.98 |
| $T_4$ | 5.20 | 4.59 | 6.49 | 5.82 | 84448 | 25462 | 58986 | 8.76 |
| $T_5$ | 5.29 | 4.78 | 7.46 | 6.08 | 87307 | 28076 | 59230 | 6.35 |
| $T_6$ | 2.2 | 1.79 | 2.90 | 2.54 | 34648 | 19779 | 14869 | - |

* Variable Cost = Fertilizer Cost only

Table 21. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Nilphamari MLT site Rangpur during 1998-99 to 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.65 | 4.68 | 6.62 | 5.94 | 88920 | 25290 | 63630 | 8.75 |
| $T_2$ | 6.42 | 5.27 | 7.38 | 6.61 | 100420 | 27126 | 73294 | 8.16 |
| $T_3$ | 6.78 | 5.42 | 7.65 | 6.90 | 104857 | 28806 | 76051 | 7.16 |
| $T_4$ | 5.59 | 4.52 | 6.74 | 5.73 | 87115 | 25029 | 62086 | 8.84 |
| $T_5$ | 5.89 | 4.72 | 7.16 | 6.24 | 91553 | 27530 | 64043 | 6.65 |
| $T_6$ | 2.39 | 1.96 | 3.32 | 2.93 | 37950 | 19467 | 18483 | - |

* Variable Cost = Fertilizer Cost only

Table 22. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Polashbari MLT site, Rangpur during 1998-99 to 2000-2001

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 6.02 | 4.69 | 6.66 | 5.87 | 29145 | 26158 | 65987 | 8.34 |
| $T_2$ | 6.77 | 5.44 | 7.50 | 6.98 | 104881 | 28251 | 76630 | 7.79 |
| $T_3$ | 6.93 | 5.50 | 7.76 | 7.06 | 106852 | 29931 | 76921 | 6.72 |
| $T_4$ | 5.90 | 4.60 | 6.61 | 5.84 | 90228 | 25293 | 64935 | 9.27 |
| $T_5$ | 5.73 | 4.82 | 7.76 | 6.21 | 91412 | 28393 | 63019 | 6.14 |
| $T_6$ | 2.58 | 1.63 | 3.28 | 2.32 | 37303 | 19581 | 1722 | - |

* Variable Cost = Fertilizer Cost only
Price: (Tk./ha)

| Year | Urea | TSP | MP | Gypsum | Zinc Sulphate | Cowdung | Rice seed | Rice grain | Rice straw |
|---|---|---|---|---|---|---|---|---|---|
| 1998-99 | 5.50 | 13.00 | 9.50 | 3.00 | 60.00 | 0.25 | 12.00 | 8.00 | 0.50 |
| 1999-00 | 5.60 | 12.40 | 8.40 | 3.00 | 35.00 | 0.25 | 12.00 | 8.00 | 0.50 |
| 2000-01 | 5.70 | 13.14 | 8.70 | 2.75 | 35.00 | 0.25 | 14.50 | 8.00 | 0.50 |

**Location : Palima, Tangail (AEZ 3)**
**Year : 1998-99 to 2000-01**

Grain yield of Boro rice did not varied significantly among the fertilizer treatments. Even high yield goal fertilizer dose along with organic manure ($T_3$) failed to produce any significant increase of grain yield over MYG fertilizer doses ($T_1$ and $T_4$) and farmers' practice ($T_5$). Almost similar results were found over the years. However, the initial nutrient status of the soil indicated the nutrient deficiency of the soil but it was not reflected on the yield of Boro rice. In T.Aman rice, a considerable higher grain yield was recorded from STB fertilizer doses for HYG ($T_3$ & $T_2$). A positive response of INM with higher fertilizer doses was apparent on grain yield of T.Aman rice. In case of straw yield more or less similar trend was observed for both the rices.

From cost and return analysis it was found that the higher but similar gross margin was obtained from $T_2$ and $T_4$. But the highest MBCR was calculated from $T_4$. Due to additional cost for organic manure in $T_3$ the MBCR was lowest and less than 2. Therefore, three years of experimentation it revealed that response of organic manure was not evident on the yield of crops. The present BARC fertilizer recommendation dose ($T_4$) was found optimum for Boro-T.Aman cropping pattern at Palima, Tangail in respect of yield and economics.

Table 23. Effect of different nutrient management packages on the yield of crops in Boro-T.Aman cropping patterns at Palima, Tangail during 1998-99 to 2000-2001

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Mean of 3 years | |
|---|---|---|---|---|---|---|---|---|
| | Boro | T. aman | Boro | T. aman | Boro | T. aman | Boro | T. aman |
| | Grain yield (t/ha) | | | | | | | |
| $T_1$ | 7.62a | 3.83b | 5.00a | 3.08b | 6.68ab | 3.13ab | 6.43 | 3.35 |
| $T_2$ | 7.18a | 3.99ab | 5.45a | 3.80a | 6.68ab | 3.62ab | 6.44 | 3.80 |
| $T_3$ | 6.75a | 4.19a | 5.29a | 3.72a | 6.91a | 3.78a | 6.32 | 3.90 |
| $T_4$ | 7.56a | 3.85b | 5.35a | 3.30a | 6.86a | 3.53ab | 6.59 | 3.56 |
| $T_5$ | 7.37a | 3.16c | 5.10a | 2.95b | 6.06b | 2.93b | 6.18 | 3.01 |
| $T_6$ | 5.19b | 2.12d | 2.71b | 2.50c | 3.06c | 2.45c | 3.65 | 2.36 |
| | Straw Yield (t/ha) | | | | | | | |
| $T_1$ | 9.45a | 5.97a | 6.99a | 4.32b | 7.75ab | 4.45ab | 8.06 | 4.91 |
| $T_2$ | 9.20a | 5.93a | 7.66a | 5.02a | 7.68ab | 4.63ab | 8.18 | 5.19 |
| $T_3$ | 8.94a | 6.45a | 7.40a | 4.50ab | 7.87a | 4.70a | 8.07 | 5.22 |
| $T_4$ | 9.67a | 5.95a | 7.49a | 4.38b | 7.56ab | 4.30bc | 8.24 | 4.88 |
| $T_5$ | 9.25a | 5.03a | 7.14a | 4.08b | 7.15b | 4.03c | 7.85 | 4.38 |
| $T_6$ | 7.42b | 3.47b | 3.80b | 3.42c | 4.21c | 3.52d | 5.14 | 3.47 |

Table 24. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Palima, Tangail during 1998-99 to 2000-2001

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 6.43 | 3.35 | 8.06 | 4.91 | 76385 | 8279 | 68106 | 2.44 |
| $T_2$ | 6.44 | 3.80 | 8.18 | 5.19 | 80770 | 10411 | 70359 | 2.16 |
| $T_3$ | 6.32 | 3.90 | 8.07 | 5.22 | 78808 | 12596 | 66212 | 1.46 |
| $T_4$ | 6.59 | 3.56 | 8.24 | 4.88 | 79359 | 8789 | 70570 | 2.58 |
| $T_5$ | 6.18 | 3.01 | 7.85 | 4.38 | 66962 | 6252 | 60710 | 2.05 |
| $T_6$ | 3.65 | 2.36 | 5.14 | 3.47 | 47862 | 0 | 47862 | - |

* Variable Cost = Fertilizer Cost only

Market price of different inputs and outputs:
Grain boro@Tk.6.25/kg.T.aman@Tk.7/kg, boro Straw2Tk.1/kg,T.aman straw@Tk.1.5/kg
Urea@Tk.6/kg,TSP@Tk.14/kg, MP@Tk.10/kg,Gypsump@TK.5/kg,Zinc Sulphate@Tk.55/Kg

**Location : Sujanagar, Pabna (AEZ 11)**
**Year : 2001-02**

Yield and yield contributing parameters of boro rice is presented in Table 25. Yield attributes affected significantly by different nutrient packages. The highest grain yield was obtained from high yield goal treatment ($ED_2$) which was at par with IPNS treatment. Other fertilizer packages produced identical yield except with no fertilizer. Boro rice in the first crop of the cycle and conclusion could be made after harvest of T.Aman rice.

Table 25. Effect of different nutrient packages on yield and yield contributing characters of boro rice under Boro-fallow -T.Aman cropping pattern at MLT site Sujanagar, Pabna during 2002

| Treatment | Plant height (cm) | Grain/panicle (no.) | 1000 grain weight (g) | Grain yield (t/ha) |
|---|---|---|---|---|
| $T_1$ | 83.72b | 75.62b | 24.90a | 4.23b |
| $T_2$ | 87.11ab | 86.27a | 20.40e | 5.51a |
| $T_3$ | 89.41a | 86.92a | 20.70cd | 5.46a |
| $T_4$ | 83.60b | 69.38b | 20.50de | 4.45b |
| $T_5$ | 83.54b | 67.57bc | 21.00b | 4.22b |
| $T_6$ | 70.24c | 59.87c | 20.90bc | 2.22c |
| CV(%) | 12.32 | 10.20 | 5.14 | 11.30 |

**Location : Kolaroa and Bagerhat, Khulna (AEZ 13)**
**Year : 2000-01**

**Kolaroa**

Grain yield of Boro and T.Aman rice did not varied significantly among the different fertilizer packages. No response of higher doses of fertilizers as well as organic manure was observed at all. Even farmers' dose also produced identical yield and only differ with no fertilizer treatment. Similar trend was found in case of straw yield of rice.

The highest gross margin was obtained from STB fertilizer dose for HYG ($T_2$) followed by two MYG fertilizer doses $T_1$ and $T_4$ (STB & FRG '97). Similar trend was found in MBCR also.

**Bagerhat**

Significantly higher grain yield of Boro rice was recorded from $T_3$ where STB fertilizer dose along with organic manure was applied. It was also identical to farmers' practice also. Traditionally the farmers' of that are applied a high dose of inorganic fertilizers. In T.Aman rice almost similar trend was found. Regarding, straw yield similar result was noticed in Boro rice like grain yield. But in T.Aman rice it did not varied among the treatments except with control.

Cost and return analysis showed that the highest gross margin was obtained from $T_3$ followed by $T_2$. But the MBCR was highest in $T_1$. In other cases the MBCR is less than 2. Due to additional cost for organic manure increased the fertilization cost and reduced MBCR in $T_3$.

Table 26. Yield and economics of Boro -T.Aman rice cropping pattern as affected by fertilizer levels at Kolaroa MLT site, Khulna during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.16a | 4.40a | 4.75b | 4.95a | 66990 | 6609 | 60381 | 2.92 |
| $T_2$ | 5.95a | 4.77a | 5.81a | 5.15a | 75160 | 9207 | 65153 | 2.98 |
| $T_3$ | 5.72a | 4.45a | 5.69a | 4.82a | 71360 | 14996 | 56364 | 1.58 |
| $T_4$ | 5.15a | 4.40a | 4.81b | 4.90a | 66930 | 6622 | 60308 | 2.90 |
| $T_5$ | 5.70a | 4.37a | 5.10b | 4.70a | 70355 | 11921 | 58434 | 1.90 |
| $T_6$ | 3.85b | 2.95b | 3.37c | 3.65b | 47710 | 0 | 47710 | -- |

* Variable Cost = Fertilizer Cost only

Table 27. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Bagerhat MLT site, Khulna during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 5.20bc | 3.12bc | 6.05bc | 4.37ab | 59290 | 6505 | 52785 | 2.00 |
| $T_2$ | 5.42b | 3.25bc | 6.22ab | 4.78ab | 61855 | 8220 | 53635 | 1.90 |
| $T_3$ | 5.75a | 4.06a | 6.52a | 5.25a | 69650 | 12900 | 56750 | 1.81 |
| $T_4$ | 4.75d | 2.95bc | 5.77c | 4.18ab | 55025 | 4500 | 50525 | 1.94 |
| $T_5$ | 5.07a | 3.47ab | 5.90bc | 4.76ab | 60850 | 9000 | 51850 | 1.82 |
| $T_6$ | 3.72c | 2.71c | 5.15d | 3.77b | 46255 | 0 | 46255 | -- |

* Variable Cost = Fertilizer Cost only

**Price (Tk/kg):** Urea = 6.75, TSP= 14.00, MP= 10.00, Gypsum = 4.00, Cow dung = 0.50, Rice grain= 6.50, Rice straw= 0.50

**CP : Potato-Jute-T-Aman**
**Location : Narikeli, Jamalpur (AEZ 9)**
**Year : 2001-02**

No significant difference in tuber yield of Potato among the different fertilizer packages was observed. Response of higher doses of fertilizers and organic manure towards yield was not evident. Even 20 t/ha of tuber yield was produced from no fertilizer treatment. The highest gross margin as well as MBCR was obtained from $T_1$ followed by $T_4$. Potato in the first crop of the cycle and will be completed after T.Aman harvest.

Table 28. Yield and economics of Potato in Potato-Jute-T.Aman cropping pattern affected by different fertilizer doses at Narikeli, Jamalpur during 2001-02

| Treat | Tuber yield (T/ha) | Gross return (Tk/ha) | Fertilizer cost (Tk/ha) | Gross margin (Tk/ha) | MBCR |
|---|---|---|---|---|---|
| $T_1$ | 31a | 124000 | 4828 | 119172 | 9.11 |
| $T_2$ | 29a | 116000 | 7299 | 108701 | 4.93 |
| $T_3$ | 32a | 128000 | 10877 | 117123 | 4.41 |
| $T_4$ | 28a | 112000 | 3562 | 108438 | 8.98 |
| $T_5$ | 30a | 120000 | 3825 | 96175 | 5.23 |
| $T_6$ | 20b | 80000 | - | 80000 | - |

**CP : Groundnut-T.Aman (AEZ 18)**
**Location : Laxmipur, Noakhali**
**Year : 2000-01**

Significantly highest nut yield was obtained from $T_3$ where STB fertilizer dose for HYG along with organic manure was applied. A positive response of organic manure was evident and about 10% yield increased due to organic fertilization. Regarding stover yield, higher and identical yield was recorded from $T_3$, $T_2$ and $T_4$. In T.Aman rice, the same treatment ($T_3$) produced significantly higher yield but identical to $T_2$. Almost similar trend was found in straw yield of rice.

Similarly the highest gross margin was recorded from $T_3$ followed by $T_2$. But the highest MBCR was calculated from $T_1$. Due to inclusion of additional cost for organic manure in $T_3$ the MBCR was the lowest, however, it produced highest yield and gross margin. In all cases MBCR is higher than 4 indicating the economic suitability of fertilization in crops.

Table 29. Effect of different nutrient packages on agro-economics performance of Groundnut-T.Aman cropping pattern at Laksmipur during 2000-2001

| Treatment | Nut/Grain yield (t/ha) | | Stover/Straw yield(t/ha) | | VC (fertilizer cost) Tk/ha | Gross margin (Tk/ha) | MBCR (Over control) |
|---|---|---|---|---|---|---|---|
| | G.nut | T.Aman | G.nut | T.Aman | | | |
| $T_1$ | 2.45c | 4.25b | 2.70bc | 5.62a | 4500 | 70123 | 5.57 |
| $T_2$ | 2.58b | 4.50ab | 3.16ab | 6.05a | 6100 | 72859 | 4.56 |
| $T_3$ | 2.84a | 4.85a | 3.25a | 5.83a | 7854 | 77377 | 4.12 |
| $T_4$ | 2.19d | 4.30b | 2.91abc | 5.05b | 4545 | 66293 | 4.68 |
| $T_5$ | 1.72e | 3.75c | 2.587c | 4.72b | 2778 | 56689 | 4.19 |
| $T_6$ | 1.14f | 3.10d | 1.488d | 3.85c | 0 | 45024 | - |

Price of inputs: Urea @ Tk.6.00/Kg, TSP @ Tk.13.00/Kg, MP @ Tk.10.00/Kg, Gypsum @ Tk.4.00/Kg, Zinc sulphate @ Tk.55.00/Kg

Outputs: Groundnut @ Tk. 14.00/Kg, Stover@ Tk.0.25/Kg, Grain @ Tk. 8.00/Kg, Straw @ Tk.1.00/Kg

**CP : Wheat-T.Aman**
**Location : Barind, Rajshahi (AEZ 26)**
**Year : 1998-99 to 2000-01**

The average of three years result revealed that the higher grain yield of wheat was recorded from $T_3$ and $T_2$ followed by $T_1$ and $T_4$. Response of organic manure was not evident. STB fertilizer dose for MYG produced about 11% higher yield over BARC fertilizer recommendation. In T.Aman rice the highest yield was recorded from $T_3$ followed by $T_4$. A considerable residual effect of cowdung applied in wheat was appeared in grain yield of T.Aman rice. 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 margin was recorded from $T_3$ followed by $T_2$. But the MBCR was higher in $T_1$ and $T_2$. Additional cost for cowdung increased the fertilization cost in $T_3$. Therefore, in spite of high yield and gross margin the MBCR was less in $T_3$.

The partial net balance of N was negative in all the cases and ranged from -50 to -79 kg $ha^{-1}$. The lowest negative balance was obtained in INM practice. Similarly K balance was negative in all treatments and it was ranged from -34 to -98 kg $ha^{-1}$.The balance were more negative in soil test based fertilizer application. On the other hand, P and S balance was positive in all treatments except control practice as no fertilization was done in control treatment (Appendix table 4).

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 nutrient balance. Initially soils of High Barind are very low in organic matter and other nutrients content. In this regard farmers' should be motivated to use cowdung at least once in a year for sustainable yield and soil fertility.

Table 30. Effect of different nutrient management packages on the yield and mean yield of crops in Wheat-T.aman cropping pattern at FSRD site Chabbishnagar, Barind, Rajshahi during 1998-99 to 2000-01

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | |
|---|---|---|---|---|---|---|
| | Wheat | T.Aman | Wheat | T.Aman | Wheat | T.Aman |
| | | | Grain yield (t $ha^{-1}$) | | | |
| $T_1$ | 1.91ab | 3.83a | 2.93a | 3.84cd | 2.39b | 3.49a |
| $T_2$ | 2.33a | 4.41a | 3.10a | 4.38ab | 2.79a | 4.22a |
| $T_3$ | 2.33a | 4.39a | 3.22a | 4.73a | 2.80a | 4.44a |
| $T_4$ | 1.45bc | 4.30a | 2.79b | 4.15bc | 2.27b | 3.66a |
| $T_5$ | 1.09c | 2.81b | 2.09c | 3.67d | 2.34b | 3.83a |
| $T_6$ | 0.49d | 2.08c | 0.79d | 1.88e | 1.38c | 2.77b |
| | | | Straw yield (t $ha^{-1}$) | | | |
| $T_1$ | 2.20a | 5.50a | 3.23b | 5.54abc | 3.98a | 5.63a |
| $T_2$ | 2.33a | 5.74a | 2.95a | 5.94ab | 3.17a | 5.85a |
| $T_3$ | 2.21a | 5.72a | 3.91a | 6.17a | 3.05a | 5.82a |
| $T_4$ | 1.62b | 5.60a | 3.19b | 4.50c | 3.39a | 5.05a |
| $T_5$ | 1.23b | 4.74b | 2.83b | 4.27bc | 3.54a | 5.35a |
| $T_6$ | 0.53c | 3.76c | 1.13c | 3.68b | 1.52b | 4.05b |

Table 31. Yield and economics of Boro -T. Aman rice cropping pattern as affected by fertilizer levels at Chabbishnagar, Barind, Rajshahi during 1998-99 to 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | | | | |
| $T_1$ | 2.41 | 3.66 | 3.13 | 5.55 | 58251 | 6412 | 51839 | 3.46 |
| $T_2$ | 2.74 | 3.33 | 2.81 | 5.84 | 66425 | 8769 | 57656 | 3.19 |
| $T_3$ | 2.78 | 4.52 | 3.05 | 5.90 | 70206 | 10555 | 59651 | 2.84 |
| $T_4$ | 2.17 | 4.03 | 2.73 | 4.85 | 57279 | 7173 | 50106 | 2.85 |
| $T_5$ | 1.84 | 3.43 | 2.53 | 5.12 | 48361 | 5470 | 42911 | 2.42 |
| $T_6$ | 0.88 | 2.24 | 1.06 | 3.83 | 29661 | 0 | 29661 | - |

* Variable Cost = Fertilizer Cost only

**CP : Potato-T.Aman**
**Location : Barind, Rajshahi (AEZ 26)**
**Year : 2001-02**

**Potato**

Different nutrient management packages differed significant effect on tuber yield and yield contributing characters of potato. Tuber number per plant varied significantly among differed doses of fertilizer and highest number was accorded in $T_5$ (4.10) and lowest number (2.70) was obtained from control plot ($T_6$). Other treatments were statistically identical. Tuber weight per plant varied significantly among different fertilizer doses and the highest figure was obtained from $T_5$ (152.50 g) which was identical to $T_3$ (143.00 g) and T4 (140 g). Tuber yield varied significantly among different treatments. Significantly highest tuber yield (23.09 t ha-1) was produced by farmers' practice ($T_5$). The lowest tuber yield (9.71 t ha-1) was obtained from absolute control plot (T6).

Table 32. Effect of different nutrient management packages on the yield and yield attributes of potato in Potato-T.Aman rice cropping pattern at FSRD site Chabbishnagar, Rajshahi during 2001-02

| Treatment | Plant height (cm) | Plant population (No.m$^{-2}$) | Tuber plant$^{-1}$ (No.) | Tuber weight plant$^{-1}$ (g) | Tuber yield (t ha$^{-1}$) | Haulm yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|
| $T_1$ | 30.23bcd | 14.50 | 3.53a | 98.75c | 13.75d | 2.96d |
| $T_2$ | 33.78abc | 14.00 | 3.88a | 126.25b | 18.31c | 3.50c |
| $T_3$ | 27.23cd | 14.25 | 3.85a | 143.00ab | 19.12c | 3.83b |
| $T_4$ | 36.33ab | 14.75 | 3.53a | 140.00ab | 20.69b | 4.03ab |
| $T_5$ | 40.23a | 15.50 | 4.10a | 152.50a | 23.09a | 4.25a |
| $T_6$ | 23.28d | 14.25 | 2.70b | 67.75d | 9.71e | 1.69e |
| CV (%) | 17.40 | 10.22 | 12.79 | 12.04 | 5.20 | 6.48 |
| LSD (0.05) | 8.352 | NS | 0.7085 | 22.05 | 1.368 | 0.3302 |

**CP : Potato-Boro-T.Aman rice**
**Location : Syedpur, Rangpur (AEZ 3)**
**Year : 2001-02**

**Potato**

Significantly highest tuber yield was recorded from farmers' practice ($T_5$). In farmers practice, they used a higher dose of fertilizers along with micronutrients (Zn and B) and organic manure which might be contributed to higher yield. Two MYG fertilizer doses (STB & FRG'97) also produced identical yield. Different yield contributing characters almost follow the same trend like yield.

Table 33. Effect of different nutrient management packages on the yield and yield attributes of potato in Potato-Boro-T.Aman cropping pattern at Syedpur FSRD site, OFRD, BARI, Rangpur during 2001-02

| Treatment | Tuber yield (t/ha) | Wt of tuber /hill (gm) | Tuber/hill (no) | Plant/hill (no) | Plant height (cm) |
|---|---|---|---|---|---|
| $T_1$: MYG(FRG'97) | 22.33c | 371.3b | 7.32b | 5.43a | 65.65b |
| $T_2$ :HYG(FRG'97) | 25.63b | 454.7a | 7.68ab | 5.08a | 79.05a |
| $T_3$:HYG(INPS) | 26.08b | 460.5a | 7.88ab | 5.22a | 68.78a |
| $T_4$:MYG(FRG;97) | 22.84c | 384.5b | 7.70ab | 5.03a | 64.15b |
| $T_5$ (FP) | 28.67a | 480.5a | 8.20a | 5.23a | 70.40a |
| $T_6$ (Control) | 10.72d | 220.0c | 6.30c | 5.03a | 44.87c |
| CV (%) | 8.9 | 10.7 | 8.2 | 10.8 | 4.1 |

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

**CP : Potato-T.Aus-T.Aman**
**Location : Chandina, Comilla (AEZ 19)**
**Year : 2000-01**

Regarding the performance of potato, it was found that there was significant yield difference among the treatments. Treatment $T_5$ (Farmers Practice) gave significantly the highest tuber yield of 20.88 t/ha which was statistically identical to treatment $T_2$ where HYG. STB fertilizer dose was applied. Treatment $T_3$ (INM) could not perform well in potato yield, which might be due to the lower amount of added mineral fertilizer.

The yield of T.Aus was significant and gave highest in $T_3$ (INM) suggesting that addition of organic matter along with chemical fertilizers could increase the grain yield. In T.Aman rice, the higher grain yield was obtained from $T_3$ but it was identical to $T_5$ (FP) and $T_4$.

Highest gross margin as well as MBCR was obtained from $T_2$ followed by $T_3$ and $T_5$. Although, farmers practices showed highest gross return but due to higher cost of cultivation it failed to showed higher MBCR than other treatments.

Table 34. Yield and economics of Potato-T.Aus-T.Aman cropping pattern as affected by fertilizer levels at Chandina, Comilla during 2000-01

| Treat | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR | VC | GM | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Potato | T.Aus | T.Aman | Potato | T.Aus | T.Aman | | | | |
| $T_1$ | 15.46c | 4.80bc | 3.43bc | 3.65 | 6.1 | 4.30 | 114390 | 11229 | 103161 | 2.64 |
| $T_2$ | 18.23ab | 5.00ab | 3.83b | 4.54 | 6.25 | 4.80 | 127550 | 13813 | 113737 | 2.91 |
| $T_3$ | 15.92bc | 5.10a | 4.32a | 3.456 | 6.60 | 5.40 | 125700 | 14232 | 111468 | 2.67 |
| $T_4$ | 15.92bc | 4.93b | 4.05a | 3.456 | 6.21 | 5.06 | 121890 | 12216 | 109674 | 2.96 |
| $T_5$ | 20.88a | 5.09ab | 4.12a | 9.71 | 6.36 | 5.15 | 138620 | 27699 | 110921 | 1.35 |
| $T_6$ | 6.23d | 3.52d | 3.18c | 0.6 | 3.94 | 3.97 | 73500 | 0 | 73500 | - |

* Variable Cost = Fertilizer cost only.

Price: Potato @ 3.00 Tk/Kg , T. aus rice @ 7.00 Tk/ Kg , T.aman @ 7.00 Tk/Kg, Rice straw @ 1.00 Tk/Kg , Urea @ 6.00 Tk/Kg, T.S.P @ 15.00Tk/Kg, M P @ 9.00 Tk/Kg, Gypsum @ 4.5 Tk/Kg

**CP : Onion-T.Aus-T.Aman**
**Location : Kushtia (AEZ 11)**
**Year : 2000-01**

Application of fertilizers significantly increased the bulb yield of onion and grain yield of T.Aus and T.Aman rice. The highest bulb yield of onion was recorded from $T_3$ which is also identical to $T_2$ and $T_4$. Addition of cowdung might have influenced to produce highest yield of onion in this treatment. In T.Aus rice, the INM treatment produced higher yield but identical with other treatment except control. In T.Aman rice, almost similar trend of result was found and the treatments varied only with $T_1$ and no fertilizer plots ($T_6$).

The highest gross margin as well as MBCR was found in INM ($T_3$) followed by FRG '97 ($T_4$). Among the fertilizer packages treatment $T_1$ where STB fertilizer dose for MYG was applied produced lowest gross margin and MBCR.

Table 35. Yield and economics of Onion-T.Aus-T.Aman cropping pattern as affected by fertilizer levels at Kushtia during 2000-01

| Treat. | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR | VC | GM | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Onion | T.Aus | T.Aman | Onion | T.Aus | T.Aman | | | | |
| $T_1$ | 9.26bc | 3.75a | 3.69bc | - | 3.96 | 4.50 | 99070 | 14458 | 184612 | 0.44 |
| $T_2$ | 10.97ab | 3.90a | 4.28a | - | 4.12 | 4.58 | 233582 | 15494 | 218088 | 2.57 |
| $T_3$ | 12.99a | 4.00a | 4.58a | - | 4.42 | 4.88 | 264175 | 17813 | 243662 | 3.67 |
| $T_4$ | 11.48ab | 3.98a | 4.24ab | - | 4.42 | 4.49 | 244392 | 14870 | 229522 | 3.45 |
| $T_5$ | 10.87b | 3.91a | 4.17ab | - | 4.10 | 4.91 | 228452 | 12192 | 216260 | 3.11 |
| $T_6$ | 8.42c | 3.22b | 3.06c | - | 3.75 | 3.86 | 178247 | 0 | 178247 | - |

* Variable Cost = Fertilizer cost only.
Price: Onion - Tk. 15.00/kg, T.Aus - Tk. 7.00/kg, T.Aman - Tk. 7.50/kg.

**CP : T.Aus-T.Aman**
**Location : Golapganj and Moulvibazar, Sylhet (AEZ 20)**
**Year : 2000-01**

Higher grain yield was recorded from $T_3$ followed by $T_2$ and $T_1$. There was no significant yield difference was observed between Soil test based fertilizer dose for MYG ($T_1$) and HYG ($T_2$). Similarly, effect of cowdung was not evident in T.Aus rice. Present BARC fertilizer recommendation (FRG ’97) and farmers’ practice gave identical yield and the lowest was recorded from no fertilizer treatment. Similar trend was followed in case straw yield. In T.Aman rice, similar result was found. Results did not vary over the locations-Golapganj and Moulvibazar.

Cost and return analysis at Golapganj site showed that the highest gross margin was obtained from $T_2$ followed by $T_1$ and $T_3$. But the highest MBCR was calculated from $T_1$ followed by $T_2$. Due to additional cost for organic manure in $T_3$, the MBCR was the lowest but gave higher yield and gross margin. Same trend was found at Moulvibazar.

Table 36. Yield and economics of T.Aus -T.Aman rice cropping pattern as affected by fertilizer levels at Golapganj FSRD site, Sylhet during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | T.Aus | T.Aman | T.Aus | T.Aman | | | | |
| $T_1$ | 5.08a | 4.35a | 6.15a | 5.48a | 74993 | 5244 | 69748 | 6.85 |
| $T_2$ | 5.40a | 4.60a | 6.64a | 5.89a | 79733 | 6807 | 72925 | 5.97 |
| $T_3$ | 5.30a | 4.85a | 6.41a | 6.16a | 80902 | 11162 | 69739 | 3.75 |
| $T_4$ | 3.45b | 3.15b | 4.96b | 4.74b | 54282 | 2824 | 51457 | 5.38 |
| $T_5$ | 3.76b | 3.34b | 5.49b | 4.79b | 58188 | 3839 | 54348 | 4.98 |
| $T_6$ | 2.80c | 1.95c | 3.36c | 2.47c | 37563 | 0 | 37563 | - |

* Variable Cost = Fertilizer Cost only

Table 37. Yield and economics of T.Aus -T.Aman rice cropping pattern as affected by fertilizer levels at Moulvibazar MLT site, Sylhet during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | T.Aus | T.Aman | T.Aus | T.Aman | | | | |
| $T_1$ | 4.93a | 4.52a | 5.96a | 5.70a | 75279 | 3826 | 71452 | 9.45 |
| $T_2$ | 5.24a | 4.83a | 6.44a | 6.16a | 80420 | 4878 | 75541 | 8.46 |
| $T_3$ | 5.09a | 5.04a | 6.21a | 6.38a | 80942 | 9227 | 71713 | 4.53 |
| $T_4$ | 3.34b | 3.42b | 4.81b | 4.98b | 55584 | 2824 | 52759 | 5.82 |
| $T_5$ | 3.75b | 3.55b | 5.33b | 5.01b | 59662 | 3460 | 56200 | 5.93 |
| $T_6$ | 2.72c | 2.04c | 3.26c | 2.56c | 37682 | 0 | 37682 | - |

* Variable Cost = Fertilizer Cost only

**Location : Jhalokati, Barisal (AEZ 13)**
**Year : 2000-01**

Significantly higher grain yield of T.Aus rice was recorded from $T_3$ and $T_2$. About 10% yield increased in HYG fertilizer over MYG. Similarly, in T.Aman rice, significantly higher grain yield was obtained from $T_3$ followed by $T_4$. A considerable residual effect of cowdung was observed in T.Aman rice. STB fertilizer doses for HYG and MYG produced significantly lower yield than BARC recommended fertilizer dose ($T_4$) and farmers' practice.

Cost and return analysis showed that the highest gross margin and MBCR was obtained from the treatment $T_3$. Treatment $T_2$ and $T_4$ also performed better in this regard.

Table 38. Yield and economics of T.Aus -T.Aman rice cropping pattern as affected by fertilizer levels at Jhalokati MLT site, Barisal during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | T.Aus | T.Aman | T.Aus | T.Aman | | | | |
| $T_1$ | 2.93c | 4.02d | - | 5.86b | 50610 | 3310 | 47300 | 2.65 |
| $T_2$ | 3.14a | 4.10d | - | 6.10ab | 56785 | 3976 | 52809 | 3.76 |
| $T_3$ | 3.25a | 5.00a | - | 6.60a | 59730 | 4013 | 55717 | 4.46 |
| $T_4$ | 2.88c | 4.71b | - | 6.25ab | 54310 | 3774 | 50536 | 3.31 |
| $T_5$ | 2.78c | 4.58c | - | 6.10ab | 48790 | 2260 | 46535 | 3.08 |
| $T_6$ | 2.14d | 3.53e | - | 4.75c | 41825 | 0 | 41825 | - |

* Variable Cost = Fertilizer Cost only

**Price (Tk./kg):**
Input: Urea= 7.00, TSP= 15.00, MP= 9.00, Gypsum= 4.50, CD= 0.50
Output: T.Aus= 6.00, T.Aman= 7.00

**CP : Mungbean-T.Aus-T.Aman**
**Location : Bhola, Barisal (AEZ 13)**
**Year : 2000-01**

The highest seed yield of Mungbean was recorded from $T_3$ which was also identical to other treatments except farmers' practice and no fertilizer. A positive response of higher fertilizer doses was observed to some extant and about 10% yield increased in HYG fertilizer dose over MYG fertilizer. However, effect of organic manure was not evident in Mungbean. In T.Aus rice, significantly higher grain yield was recorded from higher level of fertilizers (HYG) $T_3$ and $T_2$. Fertilizer doses for MYG (STB & FRG '97) produced identical yield. More or less similar trend was found in T.Aman rice also.

The highest gross margin as well as MBCR was obtained from $T_5$ i.e. farmers practice followed by STB fertilizer dose for HYG along with organic fertilizer in 1[st] crop was applied. However, in all the cases MBCR is more than 5.

Table 39. Yield and economics of Mungbean-T.Aus-T.Aman cropping pattern as affected by fertilizer levels at Bhola MLT site, Barisal during 2000-01

| Treat. | Grain yield (t/ha) | | | GR | VC | GM | MBCR |
|---|---|---|---|---|---|---|---|
| | Mungbean | T.Aus | T.Aman | | | | |
| $T_1$ | 942ab | 3.12b | 4.33ab | 70250 | 3804 | 66446 | 5.47 |
| $T_2$ | 1023a | 3.34a | 4.36ab | 73690 | 4796 | 68894 | 5.05 |
| $T_3$ | 1048a | 3.46a | 4.75a | 77610 | 4874 | 73736 | 5.78 |
| $T_4$ | 973a | 3.98ab | 3.83bc | 72760 | 4216 | 68544 | 5.52 |
| $T_5$ | 736b | 2.52c | 3.31c | 55490 | 1040 | 54450 | 5.80 |
| $T_6$ | 762b | 2.15d | 2.79d | 49450 | 0 | 49450 | - |

* Variable Cost = Fertilizer cost only.

**Price (Tk./kg):**

Input: Urea= 7.00, TSP= 15.00, MP= 9.00, Gypsum= 4.50, CD= 0.50
Output: Mungbean= 20.00, T.Aus= 6.00, T.Aman= 7.00

**Location : Lebukhali, Patuakhali (AEZ 13)**
**Year : 1998-99 to 2000-01**

Average of three years data revealed that significantly higher grain yield of Mungbean was obtained from IPNS treatment ($T_3$) followed by fertilizer dose based on FRG'97 ($T_4$). A slight yield increased due to application of organic manure. In T.Aus and T.Aman rice all the treatment produced identical yield only differ with farmers practice and no fertilizer treatment. More or less similar trend was found in case of stover/straw yield of crops.

Cost and return analysis showed that the highest gross margin and MBCR was obtained from $T_3$ followed by $T_4$. However, in all cases the MBCR is more than 4.

After three years of experimentation it may be concluded that effect of organic manure on the yield of crops was observed. Fertilizer recommendation by BARC (FRG'97) for the cropping pattern was found still better in respect of yield and economics but IPNS could be used for higher benefit.

Table 40. Yield of crops grown under Mungbean-T.Aus-T.Aman cropping pattern at Lebukhali, Patuakhali during 1998-99 to 2000-01 affected by different fertilizer packages

| Treatment | 1998-99 | | | 1999-2000 | | | Grain yield 2000-01 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mungbean (kg/ha) | T.Aus (t/ha) | T.Aman (t/ha) | Mungbean (kg/ha) | T.Aus (t/ha) | T.Aman (t/ha) | Mungbean (kg/ha) | T.Aus (t/ha) | T.Aman (t/ha) |
| | Grain yield | | | | | | | | |
| $T_1$ | 690cd | 4.14a | 3.16ab | 800c | 4.12a | 3.74a | 920b | 3.95a | 3.76a |
| $T_2$ | 750bc | 4.28a | 3.26a | 820bc | 4.22a | 3.94a | 930b | 4.10a | 3.96a |
| $T_3$ | 890a | 4.32a | 3.56a | 900a | 4.28a | 3.98a | 1230a | 4.20a | 3.96a |
| $T_4$ | 810ab | 4.16a | 3.17ab | 850b | 4.20a | 3.93a | 1210a | 4.16a | 3.87a |
| $T_5$ | 610b | 3.37b | 2.84b | 780cd | 3.23b | 3.30b | 840bc | 3.05b | 2.94b |
| $T_6$ | 550e | 2.70c | 2.34c | 750c | 2.58c | 3.28b | 810c | 2.73c | 2.74b |

Table 40. Contd.

| Treatment | 1998-99 | | | 1999-2000 | | | Grain yield 2000-01 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mungbean (kg/ha) | T.Aus (t/ha) | T.Aman (t/ha) | Mungbean (kg/ha) | T.Aus (t/ha) | T.Aman (t/ha) | Mungbean (kg/ha) | T.Aus (t/ha) | T.Aman (t/ha) |
| | | | | Stover/ straw yield | | | | | |
| $T_1$ | 1.94ab | 1.85c | 1.75bcd | 4.25a | 4.54a | 4.00b | 4.84ab | 5.46ab | 5.65a |
| $T_2$ | 2.26a | 1.80d | 1.80bc | 4.45a | 4.30a | 4.25ab | 4.82a | 5.92a | 5.95a |
| $T_3$ | 2.36a | 2.0a | 2.00a | 4.52a | 4.38a | 4.40a | 5.35a | 5.90a | 5.98a |
| $T_4$ | 2.30a | 1.9b | 1.85b | 4.29a | 4.32a | 4.37a | 4.72ab | 5.80a | 5.82a |
| $T_5$ | 2.12ab | 1.84c | 1.65d | 3.39b | 3.79b | 3.38c | 4.25b | 4.97b | 4.45b |
| $T_6$ | 1.81b | 1.87bc | 1.70cd | 2.90c | 3.32b | 2.85d | 3.88c | 4.97b | 4.20b |

Table 41. Yield and economics of Mungbean-T.Aus-T.Aman cropping pattern as affected by fertilizer levels at Lebukhali, Patuakhali during 1998-99 to 2000-01

| Treat. | Grain yield (t/ha) | | | Stover/ straw yield (t/ha) | | | GR (Tk/ha) | VC (Tk/ha) | GM (Tk/ha) | MBCR |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mungbean | T.Aus | T.Aman | Mungbean | T.Aus | T.Aman | | | | |
| $T_1$ | 793 | 4.07 | 3.55 | 1.85 | 4.26 | 5.32 | 62220 | 43430 | 18790 | 4.46 |
| $T_2$ | 833 | 4.23 | 3.72 | 1.95 | 4.33 | 5.56 | 64862 | 44032 | 20830 | 4.45 |
| $T_3$ | 1007 | 4.27 | 3.83 | 2.12 | 4.43 | 5.74 | 69743 | 43082 | 26391 | 7.36 |
| $T_4$ | 957 | 4.17 | 3.66 | 2.02 | 4.33 | 5.45 | 67089 | 43294 | 23435 | 6.14 |
| $T_5$ | 747 | 3.22 | 3.03 | 1.87 | 3.62 | 4.56 | 53101 | 41415 | 11661 | 4.35 |
| $T_6$ | 704 | 2.65 | 2.79 | 1.79 | 3.02 | 4.02 | 47157 | 40050 | 7492 | - |

**CP : Onion-B.Aman**
**Location : Baliakandi, Faridpur (AEZ 12)**
**Year : 2000-01**

The dominant cropping pattern was Onion-B.Aman at Baliakandi MLT site, Faridpur. But fertilization in B.Aman as per treatment was not possible as the crop submerged in water. Therefore the experiment was conducted as single crop basis and the test crop was Onion.

The yield of Onion as affected by different doses of fertilizer and significantly highest yield was recorded from STB fertilizer dose for HYG ($T_2$). The effect of organic manure applied in $T_3$ was not evident in Onion. STB fertilizer for MYG ($T_1$) also gave higher yield over BARC fertilizer recommendation ($T_4$).

From cost and return analysis, it was found that the highest gross margin was obtained from $T_2$. Regarding MBCR, the highest figure was calculated from $T_4$ (FRG'97) as the cost of fertilization was less as compared to $T_2$. However, in all cases the MBCR is more than 4 indicating the economic suitability of fertilization in Onion.

Table 42. Yield and economics of onion affected by different fertilizer doses at Baliakandi MLT site, Faridpur, during 2000-01

| Treatment | Bulb yield (t/ha) | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|
| $T_1$ | 14.68c | 95420 | 27829 | 67590 | 5.61 |
| $T_2$ | 15.55a | 101075 | 29840 | 71234 | 5.11 |
| $T_3$ | 14.87b | 96655 | 30832 | 65822 | 4.32 |
| $T_4$ | 14.28d | 92820 | 26789 | 66030 | 6.02 |
| $T_5$ | 13.98e | 91195 | 29820 | 61374 | 4.23 |
| $T_6$ | 6.83f | 44395 | 18760 | 25635 | -- |

Price of fertilizer: Urea= 6.00 Tk./kg, TSP = 10.60 Tk./kg, MP = 9.00 Tk./kg, Gypsum = 2.50 Tk./kg, Cowdung = 0.40 Tk./kg
Price of product: Onion = 6.50 Tk./kg

**Crop : Fallow-Fallow-T.Aman**
**Location : Atkapalia, Noakhali (AEZ 18)**
**Year : 1999-2001**

At Atkapalia, Noakhali the cropping intensity is very low and T.Aman is the single crop grown in that area so, fertilization was considered only for T.Aman rice.

The results of yield and yield parameters of T.Aman during1999-2001 presented in the Table 41 revealed that the grain and straw yield of T.Aman varied significantly due to different treatments. The nutrient package $ED_2$ performed highest grain yield in 1999 (4.72 t/ha) and in 2001(4.56t/ha) followed by $ED_1$. But this result was inconsistent that observed in the year 2000. In the year 2000, highest grain yield (4.46 t/ha) was observed from INM doses followed by $ED_2$ (4.40 t/ha). Farmers practice and control showed the lower performance in the three consecutive years.

From the economic point of view, the highest gross return and gross margin were calculated from $ED_2$ followed by $ED_1$ (Table 42). But the highest marginal benefit cost ratio (MBCR) was found in $ED_1$ (3.08). This might be due to lower fertilization cost. Additional cost for cow dung (10t/ha) in integrated nutrient management (INM) practice, reduced the MBCR value.

Average results of three years experimentation revealed that the highest yield and gross margin was obtained $T_2$ But the highest MBCR was from $T_1$. Therefore soil test based fertilizer doses were found optimum in respect of yield and economics and may be recommended for Fallow-Fallow-T.Aman cropping pattern under AEZ 18.

Table 43. Effect of different nutrient management practices on the yield and yield attributes of T.Aman at the FSRD site, Atkapalia, Noakhali during 1999 to 2001

| Treatment | Plant height (cm) | No. of effective tiller/hill | Grain/ Panicle (no.) | 1000 grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| 1999 | | | | | | |
| $T_1$ | 118.9a | 9.20a | 103.5b | 20.23 | 4.31ab | 5.04ab |
| $T_2$ | 118.8a | 8.30ab | 103.3b | 20.18 | 4.72a | 5.61a |
| $T_3$ | 118.8a | 8.65ab | 106.3b | 20.03 | 4.02ab | 4.53bc |
| $T_4$ | 121.0a | 8.62ab | 108.5a | 20.35 | 4.03ab | 4.35bc |
| $T_5$ | 118.75a | 8.07b | 107.5b | 20.42 | 3.70b | 4.33bc |
| $T_6$ | 114.5b | 7.62b | 101.2b | 19.86 | 2.79c | 3.73c |
| CV (%) | 2.71 | 10.84 | 6.9 | 4.7 | 14.3 | 8.4 |

Table 43. Contd.

| Treatment | Plant height (cm) | No. of effective tiller/hill | Grain/ Panicle (No) | 1000 grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| 2000 | | | | | | |
| $T_1$ | 104.9a | 8.03ab | 108.9ab | 21.33 | 4.05a | 4.88c |
| $T_2$ | 106.8a | 9.06a | 118.8a | 20.98 | 4.40a | 5.42b |
| $T_3$ | 107.5a | 7.96ab | 111.3ab | 21.90 | 4.46a | 5.97a |
| $T_4$ | 105.3a | 9.08a | 112.1ab | 21.59 | 4.30a | 4.82c |
| $T_5$ | 106.8a | 8.56a | 100.6bc | 21.33 | 3.51b | 4.14c |
| $T_6$ | 99.37b | 7.03ab | 89.45c | 20.92 | 2.71c | 3.62b |
| CV (%) | 3.47 | 11.43 | 10.64 | (ns) | 10.77 | 7.37 |
| 2001 | | | | | | |
| $T_1$ | 111.1ab | 9.78a | 108.4 | 23.70a | 4.50b | 5.41a |
| $T_2$ | 113.8a | 9.08a | 111.4 | 23.53a | 4.56a | 6.00a |
| $T_3$ | 113.8a | 9.18a | 106.3 | 23.70a | 4.01b | 5.93a |
| $T_4$ | 108.5bc | 8.61ab | 112.3 | 23.25a | 4.10ab | 4.83ab |
| $T_5$ | 111.9ab | 8.76a | 110.1 | 22.92b | 3.31c | 4.93ab |
| $T_6$ | 105.1c | 7.36b | 106.7 | 22.87b | 3.10c | 3.91b |
| CV (%) | 3.80 | 12.48 | 8.34 | 2.14 | 5.61 | 20.22 |
| LSD(0.05) | 5.002 | 1.306 | ns | 0.594 | 0.284 | 1.249 |

Table 44. Yield and economics of T.aman in the Fallow-Fallow-T.aman cropping pattern at the FSRD site Atkapalia during 1999 to 2001 (pooled average 3 years)

| Treatment | Yield(t/ha) | | Variable cost* (Tk/ha) | Gross return ( Tk/ha) | Gross margin (Tk/ha) | MBCR over control |
|---|---|---|---|---|---|---|
| | Grain | Straw | | | | |
| $T_1$ | 4.29 | 5.11 | 3146 | 39430 | 36284 | 3.04 |
| $T_2$ | 4.56 | 5.68 | 4117 | 42160 | 38043 | 2.75 |
| $T_3$ | 4.16 | 5.48 | 8053 | 38760 | 30404 | 0.46 |
| $T_4$ | 4.14 | 4.67 | 2911 | 37790 | 34879 | 2.81 |
| $T_5$ | 3.53 | 4.47 | 2170 | 32710 | 30540 | 1.76 |
| $T_6$ | 2.87 | 3.75 | 0 | 26710 | 26710 | 0 |

*Variable cost is fertilizer cost only.

Price of inputs: Urea @ Tk.6.00/Kg, TSP @ Tk.13.00/Kg, MP @ Tk.10.00/Kg, Gypsum @ Tk.4.00/Kg, Zinc sulphate @ Tk.55.00/Kg
Price of outputs: Grain @ Tk. 8.00/Kg, Straw @ Tk.1.00/Kg

**CP : Potato-Jute**
**Location : Munshiganj (AEZ 19)**
**Year : 2000-01**

Yield of potato significantly influenced by different doses of fertilizers. The initial soil status of the experimental site (Appendix table 2) showed that except nitrogen all other nutrient elements are at optimum level to very high. Therefore, P and K were applied as maintenance dose and no sulphur was applied at all. The yield difference was mainly due to nitrogen and cowdung. The significantly highest tuber yield was recorded from INM ($T_3$) treatment followed by farmers' practice ($T_5$).

In Jute, identical fibre yield was obtained from the different fertilizer packages. The yield only differs with $T_1$ and control treatment. Similar trend was found in case of stick yield.

The highest gross margin was calculated from $T_3$ followed by $T_2$. The variable cost was highest in Farmers' practice as they apply a very high dose of fertilizer in potato. The second highest figure was found in INM due to the cost of cowdung applied in potato. Due to higher fertilizer cost, the margin was less in farmers' practice. The highest MBCR was found in $T_1$ followed by $T_2$. However, the gross return was higher in $T_5$ but due to higher fertilization cost the MBCR was less and the lowest figure was calculated. Considering the yield and cost and return the fertilizer dose based on soil analysis for high yield goal was found superior among the different nutrient management packages.

Table 45. Yield and economics of Potato-Jute cropping pattern as affected by fertilizer levels at Munshiganj MLT site during 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Potato | Jute | Potato | Jute | | | | |
| $T_1$ | 27.3c | 1.72b | - | 3.77b | 120284 | 4086 | 116204 | 10.36 |
| $T_2$ | 31.6b | 1.90ab | - | 3.89ab | 137380 | 5806 | 131574 | 9.94 |
| $T_3$ | 33.5a | 2.0a | - | 4.06a | 145370 | 8362 | 137008 | 7.55 |
| $T_4$ | 28.7c | 1.92a | - | 3.90ab | 127450 | 5832 | 121618 | 8.19 |
| $T_5$ | 32.8a | 2.03a | - | 4.28a | 143660 | 18360 | 125300 | 2.80 |
| $T_6$ | 17.0d | 1.07c | - | 1.82c | 73840 | 0 | 73840 | - |

* Variable Cost = Fertilizer Cost only

**CP : Mustard-Boro**
**Location : Manikganj (AEZ 8)**
**Year : 2001-02**

Significantly highest grain yield of Mustard was obtained from farmers' practice ($T_5$) due to higher fertilizer dose was used. Yield obtained from soil test based fertilizer doses for HYG and MYG did not overcome the yield obtained from present BARC fertilizer recommendation (FRG'97). In Boro rice, significantly higher grain yield was recorded from $T_4$ which was identical to $T_3$ and $T_2$. Farmers' fertilization practice gave moderate yield. Almost similar trend was observed in stover/ straw yield of crops.

From cost and return analysis it was found that the highest gross margin as well as MBCR was calculated from $T_4$ based on FRG '97 rec. Due to higher fertilization cost in IPNS treatment and farmers' practice, the gross margin and MBCR was less.

Table 46. Yield and economics of Mustard-Boro cropping pattern as affected by fertilizer levels at Manikganj during 2001-02

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|
| | Mustard | Boro | Mustard | Boro | | | | |
| $T_1$ | 609c | 4.74c | 1192c | 6.0c | 40529 | 4944 | 35585 | 2.43 |
| $T_2$ | 649c | 5.40ab | 1337b | 6.69ab | 45552 | 7170 | 38382 | 2.37 |
| $T_3$ | 579d | 5.72a | 1190c | 7.07a | 46828 | 14106 | 32722 | 1.30 |
| $T_4$ | 729b | 5.75a | 1451b | 6.77ab | 48797 | 4758 | 44039 | 4.26 |
| $T_5$ | 844a | 5.10bc | 1720a | 6.20bc | 45975 | 8831 | 37144 | 1.98 |
| $T_6$ | 295d | 3.56d | 565d | 4.92d | 28533 | 0 | 28533 | - |

* Variable Cost = Fertilizer Cost only

**Recommendation (based on 3 year result)**

| Location | Cropping pattern | Fertilizer dose (N-P-K-S-Zn-B-MOC) |
|---|---|---|
| Narikeli, Jamalpur | Mustard | 30-25-20-0-0-1.1-0 |
| | Boro | 58-25-31-0-0-0-0 |
| | T.Aman | 16-15-0-0-0-0-0 |
| Narikeli, Jamalpur | Wheat | 84-21-35-11-1.4-0-0 |
| | Jute | 77-10-35-7-0-0-0 |
| | T.Aman | 90-11-35-6-0-0-0 |
| Syedpur, Rangpur | Boro | 80-18-35-2-1-0-0 |
| | T.Aman | 55-10-20-2-0-0-0 |
| Nilphamari | Boro | 100-20-30-10-1-0-0 |
| | T.Aman | 65-7-20-3-0-0-0 |
| Polashbari | Boro | 100-20-30-10-1-0-0 |
| | T.Aman | 65-7-20-3-0-0-0 |
| Palima, Tangail | Wheat | 100-20-35-12-1-0-0 |
| | T.Aman | 70-8-25-4-0-0-0 |
| Barind, Rajshahi | Wheat | 105-30-21-13-1.5-0.5-0 |
| | T.Aman | 80-10-20-4-0-0-0 |
| Atkapalia, Noakhali | T.Aman | 103-21-13-1-0-0-0 |

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 | | | |
| Muktagacha (9) | MHL | I | 5.56 | 1.98 | 0.171(L) | 0.085 (VL) | 7.33 (VL) | 28.3 (Opt.) | - | - |
| 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) |
| Satkaniya (23) | MHL | I | 5.6 | 1.95 | 0.08 (VL) | 0.08 (L) | 2.67 (VL) | 16.3 (L) | - | - |
| 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) |
| Palima (9) | MHL | I | 5.3 | 2.08 | 0.10 (L) | 0.12 (L) | 5.0 (VL) | 51.0 (H) | 2.42(H) | - |
| Kendua (9) | MHL | I | - | - | 0.15 (L) | 0.12 (L) | 1.59 (VL) | 16.6 (L) | 1.08 (M) | - |
| Kishoreganj | MHL | I | - | - | 0.09 (L) | 0.31 (M) | 4.11 (VL) | 21.9 (M) | 1.27 (M) | - |
| Laksam (19) | MHL | I | 5.5 | 1.80 | 0.09 (L) | 0.26 (M) | 32.0 (VH) | 15.0 (L) | 0.45 (L) | 0.52 (O) |
| Lebukhali | MHL | R | 5.3 | 1.44 | 0.08 (VL) | 0.28 (Opt) | 4.4 (VL) | 33.46(Opt) | 0.34(VL) | - |
| Paba | MHL | I | 8.5 | 1.52 | 0.07 (VL) | 0.16 (L) | 5.16 (L) | 19.5 (M) | 0.65 (L) | 0.29 (L) |
| Barind (25) | MHL | I | 8.48 | 1.53 | 0.08 (VL) | 0.16 (L) | 5.16 (L) | 19.5 (M) | 0.65 (L) | 0.29 (L) |
| Munshiganj(19) | MLL | I | 4.9 | 1.97 | 0.11 (L) | 0.30 (Opt) | 29.0 (Opt) | 127.8 (VH) | 4.36 (VH) | 0.58(Opt) |
| Atkapalia (18) | MHL | R | 7.06 | 1.41 | 0.03 | 0.23 | 5.7 | 65.2 | 0.66 | - |
| Laxmipur (18) | MHL | R | 6.6 | 2.12 | 0.12 (L) | 0.19 (M) | 1.5 (VL) | 31.3 (VH) | 0.85 (L) | 0.47 (O) |
| Syedpur (3) | MHL | I | 5.4 | 2.41 | 0.14 (L) | 0.17 (M) | 9.1 (L) | 33.9 (Opt) | 1.3 (Opt) | 0.24 (L) |
| Polashbari | MHL | I | 5.9 | 1.27 | 0.08 (VL) | 0.09 (L) | 10.1 (L) | 12.5 (L) | 1.1 (M) | 0.19 (L) |
| Nilphamari | MHL | I | 5.1 | 1.55 | 0.09 (VL) | 0.12 (L) | 16.5 (M) | 18.5 (M) | 1.24 (M) | 0.27 (L) |
| Kushtia | MHL | I | 8.1 | 2.54 | 0.15 (L) | 0.69 (VH) | 3.98 (VL) | 30.0 (O) | 0.82 (L) | 0.36 (M) |
| Shibpur | MHL | I | 5.62 | 1.70 | 0.13 (L) | 0.17 (M) | 6.1 (L) | 30.8 (O) | 1.17 (M) | 0.22 (L) |
| Bagherpara | MHL | I | - | - | 0.11 (L) | 0.39 (H) | 17.9 (M) | 7.34 (VL) | 3.29 (VH) | 0.4 (M) |
| Norail | MHL | I | - | - | 0.11 (L) | 0.27 (M) | 1.88 (VL) | 36.0 (H) | 2.57 VH) | 0.82 (O) |
| Goyeshpur | MHL | I | 7.7 | 2.06 | 0.12 (L) | 0.23 (M) | 6.5 (VL) | 5.36 (M) | 0.45 (M) | 0.33 (O) |
| Chatmohor | MHL | I | 7.4 | 1.61 | 0.08 (VL) | 0.13 (O) | 2.5 (VL) | 17.67 (M) | 0.81 (M) | 0.20 (O) |
| Baliakandi | MHL | I | 6.3 | - | 0.16 (L) | 0.44 (VH) | 1.84 (VL) | 18.5 (M) | - | - |
| Ishan Gopalpur | MHL | I | 7.5 | - | 0.18 (M) | 0.42 (VH) | 9.03 (L) | 18.0 (M) | - | - |
| Golapganj (20) | MHL | R | 5.20 | 1.70 | 0.08 (VL) | 0.05 (VL) | 3.25 (VL) | 22.5 (M) | 0.73 (L) | 0.36 (M) |
| Moulvibazar (20) | MHL | R | 4.74 | 1.95 | 0.09 (VL) | 0.17 (M) | 9.56 (L) | 22.3 (M) | 3.30 (VH) | 0.58 (O) |
| Bhola (13) | MHL | R | 7.1 | - | 0.57 (VL) | 0.50 (VH) | 8.8 (L) | 27.2 (O) | 1.59 (O) | 0.48 (O) |
| Jhalokati (13) | MHL | R | 6.5 | - | 0.12 (L) | 0.39 (VH) | 7.6 (L) | 50.3 (VH) | 0.93 (M) | - |
| Bagerhat (13) | MHL | I | 8.0 | 2.14 | 0.10 (L) | 0.42 (VH) | 4.94 (VL) | 178.0 (VH) | 0.50 (L) | - |
| Kolaroa (11) | MHL | I | 8.1 | 1.88 | 0.09 (L) | 0.22 (M) | 4.80 (VL) | 13.2 (L) | 0.51 (L) | - |

Appendix table 2. Crop management practices

| Site | Cropping pattern | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Muktagacha | Mustard | Tori-7 | 10 | 4th week of Nov | 1st week of Feb |
| | Boro | BR 28 | 40 | 2nd week of Feb | 3rd week of May |
| | T.Aman | BRRI Dhan 33 | 40 | 4th week of July | 1st week of Nov |
| Bagherpara | Mustard | Tori-7 | 08 | 3rd week of Nov | 2nd week of Feb |
| | Boro | BR 28 | 40 | 3rd week of Feb | Last week of May |
| | T.Aman | BR 11 | 40 | Last week of July | 4th 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 |
| Palima | Mustard | Tori-7 | 10 | 3rd week of Nov | 3rd week of Jan |
| | Jute | O-9897 | 12 | 3rd week of April | 2nd week of Aug |
| | T.Aman | BRRI Dhan 33 | 40 | 2nd week of Aug | 2nd week of Nov |
| Narikeli | Wheat | Kanchan | 100 | 4th week of Nov | 4th week of March |
| | Jute | O-9897 | 10 | 1st week of April | 1st week of Aug |
| | T.Aman | BRRI Dhan 32 | 50 | 1st week of Aug | 2nd week of Nov |
| Kishoregonj | Wheat | Kanchan | 120 | 1st week of Dec. | 3rd week of March |
| | Jute | Falgunitosa | 08 | 1st week of April | 1st week of Aug |
| | T.Aman | BR 11 | 50 | 2nd week of Aug | 4th week of Nov |
| Lebukhali | Mungbean | Kanti | 40 | 2nd week of Feb | 4th week of April |
| | T.Aus | BR 2 | 40 | 1st week of May | 3rd week of Aug. |
| | T.Aman | BR 23 | 40 | Last week of Aug | Last week of Dec |
| Palima | Boro | BR 29 | 40 | 1st week of Feb | 4th week of May |
| | T.Aman | BRRI Dhan 33 | 40 | 3rd week of July | 1st week of Nov |
| Kendua | Boro | BR 3 | 40 | 1st week of Feb. | 3rd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | Last week of July | 3rd week of Nov |

| Site | Cropping pattern | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Phulpur | Boro | BRRI Dhan 28 | 40 | Last week of Jan. | 1st week of May |
| | T.Aman | BRRI Dhan 33 | 40 | Last week of July | Last week of Oct. |
| Netrokona | Boro | Pajam | 40 | 1st week of Feb. | 2nd week of May |
| | T.Aman | BRRI Dhan 33 | 40 | Last week of July | Last week of Oct. |
| Hathazari | Boro | BR 29 | 35 | 3rd week of Jan | 2nd week of May |
| | T.Aman | BRRI Dhan 30 | 35 | Last week of July | Last week of Nov |
| Satkaniya | Boro | BR 29 | 35 | 3rd week of Jan | 2nd week of May |
| | T.Aman | BRRI Dhan 30 | 35 | Last week of July | Last week of Nov |
| Syedpur | Boro | BR 14 | 40 | 1st week of Feb | 2nd week of May |
| | T.Aman | BR 11 | 40 | 3rd week of July | Last week of Nov |
| Polashbari | Boro | BR 2 | 40 | 1st week of Feb | 2nd week of May |
| | T.Aman | BR 11 | 40 | 3rd week of July | Last week of Nov |
| Nilphamari | Boro | BR 14 | 40 | 4th week of Jan | 1st week of May |
| | T.Aman | BR 11 | 40 | 3rd week of July | Last week of Nov |
| Norail | Boro | BRRI Dhan 28 | 40 | 1st week of Feb. | 3rd week of May |
| | T.Aman | BR 11 | 40 | 3rd week of July | Last week of Nov |
| Paba | Wheat | Kanchan | 120 | 1st week of Dec | 4th week of March |
| | T.Aman | BRRI Dhan 30 | 40 | 2nd week of July | 1st week of Nov. |
| Barind | Wheat | Kanchan | 120 | Last week of Nov | 4th week of March |
| | T.Aman | BRRI Dhan 29 | 40 | 2nd week of July | 1st week of Nov |
| Munshiganj | Potato | Diamont | 1500 | Last week of Nov. | 1st week of March |
| | Jute | O-9897 | 10 | 2nd week of April | 2nd week of July |
| Atkapalia | T.Aman | BRRI Dhan 32 | 40 | Last week of July | Last week of Nov |
| Laxmipur | G.nut | Dhaka-1 | - | 3rd week of Dec. | 3rd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | Last week of July | Last week of Nov. |
| Goyeshpur | Wheat | Kanchan | 120 | 1st week of Dec. | 3rd week of March |
| | Jute | O-9897 | 08 | 3rd week of April | 3rd week of July |
| | T.Aman | BR 11 | 50 | Last week of July | 3rd week of Nov |
| Chatmohor | Wheat | Kanchan | 120 | 1st week of Dec. | 3rd week of March |
| | T.Aman | BR 11 | 40 | Last week of July | 3rd week of Nov |
| Chandina | Potato | Diamont | 1500 | 1st week of Dec.. | 2nd week of Feb. |
| | T.Aus | BRRI Dhan 32 | 40 | Last week of April | 3rd week of July |
| | T.Aman | BR 11 | 40 | 1st week of Aug. | 3rd week of Nov. |
| Laksam | Boro | BRRI Dhan 29 | 40 | Last week of Jan. | 2nd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | 1st week of Aug. | 1st week of Dec. |
| Shibpur | Boro | BRRI Dhan 29 | 40 | Last week of Jan. | 3rd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | 1st week of Aug. | 1st week of Dec. |
| Kushtia | Onion | Taherpuri | - | 1st week of Jan. | 1st week of April. |
| | T.Aus | IR 50 | 40 | 4th week of May | 1st week of Aug. |
| | T.Aman | BR 22 | 40 | 3rd week of Aug. | 2nd week of Dec. |
| Bhola | M.bean | BARI M.bean-2 | 60 | 2nd week of Feb | Mid April |
| | T.Aus | BR-14 | 40 | 2nd week of May | 3rd week of July |
| | T.Aman | BR-23 | 40 | Last week of July | Last week of Nov. |
| Jhalokati | T.Aus | Kazla | 40 | 3rd week of May | 3rd week of July |
| | T.Aman | BR-23 | 40 | Last week of July | Last week of Nov. |
| Bagerhat | Boro | BRRI Dhan 28 | 40 | Last week of Jan. | 2nd week of May |
| | T.Aman | BRRI Dhan 23 | 40 | 3rd week of July | 3rd week of Nov. |
| Kolaroa | Boro | BRRI Dhan 28 | 40 | Last week of Jan. | 1st week of May |
| | T.Aman | BR-11 | 40 | Mid. Aug. | 3rd week of Dec. |
| Golapganj | T.Aus | BR 26 | 40 | 1st week of June | Mid. Aug. |
| | T.Aman | BRRI Dhan 32 | 40 | 1st week of Sept. | Last week of Nov. |
| Moulvibazar | T.Aus | BR 26 | 40 | 1st week of June | Mid. Aug. |
| | T.Aman | BRRI Dhan 32 | 40 | 1st week of Sept. | Last week of Nov. |
| Manikganj | Mustard | Tori-7 | 8 | 3rd week of Nov | Last week of Jan. |
| | Boro | BRRI Dhan 29 | 40 | 2nd week of Feb. | Last week of May |

# INTEGRATED NUTRIENT MANAGEMENT FOR POTATO-T.AUS-T.AMAN RICE CROPPING PATTERN, OFRD, COMILLA


## Abstract

The experiment was conducted at farmers' field of Chandina, Comilla during 1996-97 to 1999-2000 to develop a suitable combination of inorganic and organic fertilizers for Potato-T.Aus-T.Aman cropping pattern. Different combinations of NPKS and organic manure were tested. The local farmers' fertilization practices and a no fertilizer treatment were also included for comparison. The highest tuber yield of potato was recorded from soil test based (STB) fertilizer doses for high yield goal along with cowdung. A considerable response of cowdung was observed as cowdung increased about 30% yield over inorganic fertilizer ($T_3$). No appreciable yield loss occurred due to reduction of 33% of PKS in succeeding T.Aus and T.Aman rice indicating the beneficial residual effect of fertilizer applied to the preceding crop. The highest gross margin was calculated from $T_{4.1}$ where soil test based fertilizer dose along with cow dung was applied in Potato and 66% PKS + full dose of N was applied in subsequent rice crops. However, the MBCR was little less due to the cost of cowdung. After three years of experimentation it was found that application of organic manure along with soil test based inorganic fertilizers in Potato and 66% PKS with full dose of N in succeeding T.Aus and T.Aman rice are suitable for the cropping pattern at Chandina, Comilla.


## Introduction

Potato-T.Aus-T.Aman is one of the pre-dominant cropping patterns in the medium highland area of Chandina, Comilla under irrigated condition. Traditionally farmers' of the area followed single crop based fertilizer and in potato they used a huge quantity of fertilizer, which is much more than the BARC recommendation without considering the residual effect of the fertilizer nutrients. But it is reported that P, K, S and Zn applied in rabi crop have a considerable residual effect on succeeding crops. It is needed to determine how much of the nutrients are needed for succeeding crops after full amount of theses elements applied in rabi crops. Excessive and continuous use of chemical fertilizer is detrimental for soil health and environment. At the same time, it incurs a great loss of money. Therefore, it is very important to develop a cropping pattern based fertilizer recommendation considering carryover effect of nutrient elements and to rationale use of fertilizer for Potato-T.Aus - T.Aman cropping pattern the present study was undertaken.

## Materials and Methods

The experiment was initiated from rabi 1996-97 at Chandina, Comilla with Potato-T.Aus- T.Aman cropping pattern in medium highland area under irrigated condition. The experiment could not be completed as the crops were damaged due to flood during 1997-98 and 1998-99. The experiment started again in 1999-2000 and continued to 2000-01. The experiment was laid out in RCB design with five dispersed replications. Different fertilizer combinations were tested in 8 x 5 m unit plot area. Treatments are shown below-

| Potato | T.Aus | T.Aman |
|---|---|---|
| $T_1$= Absolute control | T1= Absolute control | $T_1$= Absolute control |
| $T_2$= RF for MYG (120-70-120-20-4 kg/ha of N, P, K, S and Zn) | $T_2$= RF for MYG | $T_2$= RF for MYG |
| $T_3$= Soil test based fertilizer rate for MYG (150-40-150-10 kg/ha of N, P, K and S) | $T_{3.1}$= 100% nutrient rate<br>$T_{3.2}$= 100% N+66% others<br>$T_{3.3}$= 100% N+33% others<br>$T_{3.4}$= 100% N+0 | $T_{3.1}$= 100% nutrient rate<br>$T_{3.2}$= 100% N+66% others<br>$T_{3.3}$= 100% N+33% others<br>$T_{3.4}$= 100% N+0 |
| $T_4$= $T_3$+CD 10t/ha | $T_{4.1}$= 100%+66% others<br>$T_{4.2}$= 100%+33% others | $T_{4.1}$= 100%+66% others<br>$T_{4.2}$= 100%+33% others |
| $T_5$= Farmers' dose (225-270-225 kg/ha of NPK) | $T_5$= Farmers' dose | $T_5$= Farmers' dose |

Potato (Diamont) was planted in December with 60cm x 25 cm spacing. Each plot was fertilized with as per treatment. Entire amount of PKSZn and half of N was applied as basal and the rest of N was top dressed at 30 DAP. The crop was irrigated as and when needed. Dithane M-45 was sprayed three times to control late blight disease. The crop was harvested during the 2nd week of March.

T.Aus (BR 14) seedlings of thirty days old were transplanted in the 1st week of April and 35 days old seedlings of T.Aman (BR 11) were planted in 1st week of August. The plots were fertilized as per treatment. Entire amount of PKS and Zn were applied as basal and the N was applied in three equal splits at 15, 30 and 45 DAT. All the intercultural operations were done as and when needed. The crops were harvested on 2nd week of July and 2nd week of November, respectively. Potato was planted in last week of November and harvested on 3rd week of February. Due to heavy shower the crop was harvested little bit earlier. All the data were collected carefully and subjected to statistical analyzed.

## Results and Discussion

Tuber/grain yield and haulm/straw yield of crops affected by different fertilizer packages are shown in Table 1.

### Yield

**Potato:** Tuber yield of potato increased with the increase of nutrient levels. Significantly higher yield was recorded from treatment $T_4$ where soil test based fertilizer dose for HYG was applied along with cowdung @ 10 t/ha followed by $T_5$. A considerable response of cowdung was observed as cowdung increased yield over only inorganic fertilizer ($T_3$) about 30%. The farmers' traditionally used higher dose of fertilizer in potato that is almost two times higher than present BARC recommendation. The Initial soil test data showed that soil organic matter, N and P was low in the experimental plots. Therefore, response of cowdung as well as N and P was distinct in the yield of potato. Similar results were noticed over the years of experimentation. Haulm yield of potato also followed the same trend.

**T.Aus and T.Aman rice**: Grain yield of crops increased significantly in fertilized plot over control. The higher T.Aus yield was recorded from soil test based fertilizer dose for HYG ($T_3$ and $T_4$). Reduction of PKS doses by 33% did not decrease the grain yield markedly. A further reduction of PKS doses resulted considerable yield losses. The effect of fertilizer regimes on the grain yield of T.Aman rice was almost similar as observed in preceding crop T.Aus rice. A small but positive response of cowdung applied to the first crop (Potato) was evident on the subsequent crops. Similar trend was also observed in straw yield of rice.

### Cost and return analysis

Cost and return analysis of different fertilizer packages was done assuming that the variable cost except fertilizer and manure prices involved in hauling and application were the same for all the treatments. The highest gross return was obtained from the treatment $T_{4.1}$. Total variable cost was highest in farmers; practice as the farmers' generally used a very high amount of chemical fertilizers. Similarly the next higher value was found in $T_{4.1}$ due to the price of cowdung applied in 1st crop. The gross margin was also highest in $T_{4.1}$ followed by $T_{3.1}$. MBCR was calculated on the basis of the additional benefits due to fertilizer application and additional variable costs incurred due to fertilizer/manure application. The MBCR of all the treatments was more than 2, indicating all the fertilizer treatments were economically viable. The highest MBCR was calculated from $T_{3.4}$ followed by $T_{3.2}$ and $T_{3.1}$. Due to higher fertilization cost the MBCR was less in $T_{4.1}$ and the least was calculated from farmers' practice.

### Nutrient uptake and balance

The amount of NPKS uptake by potato and two rice crops are presented in Table 3. The amounts varied widely with the treatments and yield levels. Mineral uptake by crop is associated with biomass production. Therefore, the uptake was higher in $T_{4.1}$ plots where soil test based chemical fertilizers + cowdung was applied.

Nitrogen replenishment through inorganic fertilizer and cowdung was not enough to balance N removal by crops since most of the applied N was lost from the soil. The partial net balance of N thus was negative in all cases and varied from -44 to -102 kg/ha. P balance was also negative in some fertilized plots particularly where reduced amount of P was applied in 2nd and 3rd crops. A very high amount (122 kg/ha/year) of P accumulated in farmers fertilized plots due to excessive amount of P applied in potato that might be a great concern in future in the context of soil health. The K balance was negative except in farmers' practice and a considerable amount of K (29 kg/ha/year) was accumulated in the soil. Similarly, the S balance was negative in all cases except in soil test based fertilized plots. Application of cowdung along with inorganic fertilizers is found favorable in nutrient balance.

## Conclusion

After three years of experimentation it was found that application of organic manure along with soil test based inorganic fertilizers in potato and 66% PKS with full dose of N in succeeding T.Aus and T.Aman rice are suitable for the cropping pattern. Traditionally the farmers use a very high amount of inorganic fertilizer in potato and a considerable amount of PK accumulated every year. That will be a great concern for sustainable crop production in future. The soil already becomes acidic and other related problems will come out that destroy soil fertility. Organic manure should at least be applied in one crop of the pattern and a reduced amount of inorganic fertilizer should be applied in subsequent crops.

Table 1. Yield of crops affected by different fertilizer doses in Potato-T.Aus-T.Aman cropping pattern at Chandina, Comilla during 1996-97 to 2000-01

| Treatment | | | Tuber/Grain yield (t/ha) | | | Haulm/straw yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|
| Potato | T.Aus | T.Aman | Potato | T.Aus | T.Aman | Potato | T.Aus | T.Aman |
| **Year 1 (1996-97)** | | | | | | | | |
| $T_1$ | $T_1$ | $T_1$ | 7.71d | 2.17c | 1.92d | 1.42b | 2.17 | 2.73 |
| $T_2$ | $T_2$ | $T_2$ | 11.41c | 3.22ab | 4.15b | 3.68ab | 4.20 | 4.80 |
| $T_3$ | $T_{3.1}$ | $T_{3.1}$ | | 4.38a | 4.75a | | 5.10 | 5.30 |
| | $T_{3.2}$ | $T_{3.2}$ | | 4.01ab | 4.48ab | 3.96a | 4.61 | 4.92 |
| | $T_{3.3}$ | $T_{3.3}$ | 13.92b | 3.71b | 3.94bc | | 3.95 | 4.09 |
| | $T_{3.4}$ | $T_{3.4}$ | | 3.62b | 3.43c | | 3.40 | 4.06 |
| $T_4$ | $T_{4.1}$ | $T_{4.1}$ | 17.99a | 4.32a | 4.68a | 5.05a | 6.34 | 7.00 |
| | $T_{4.2}$ | $T_{4.2}$ | | 3.80b | 4.07ab | | 5.20 | 6.90 |
| $T_5$ | $T_5$ | $T_5$ | 17.24a | 4.15a | 4.63ab | 4.67a | 5.89 | 6.94 |
| **Year 2 (1999-2000)** | | | | | | | | |
| $T_1$ | $T_1$ | $T_1$ | 6.89c | 1.98c | 2.23d | - | 2.32 | 2.26 |
| $T_2$ | $T_2$ | $T_2$ | 15.23b | 3.44ab | 4.78b | - | 3.90 | 5.14 |
| | $T_{3.1}$ | $T_{3.1}$ | | 3.71a | 5.09ab | | 4.30 | 5.96 |
| $T_3$ | $T_{3.2}$ | $T_{3.2}$ | | 3.62ab | 4.98b | - | 3.95 | 6.22 |
| | $T_{3.3}$ | $T_{3.3}$ | 17.80ab | 3.00b | 3.89bc | | 3.78 | 5.05 |
| | $T_{3.4}$ | $T_{3.4}$ | | 2.72bc | 3.35c | | 3.72 | 4.80 |
| $T_4$ | $T_{4.1}$ | $T_{4.1}$ | 19.21a | 3.79a | 5.69a | - | 4.67 | 6.88 |
| | $T_{4.2}$ | $T_{4.2}$ | | 3.23ab | 5.14ab | | 4.01 | 6.37 |
| $T_5$ | $T_5$ | $T_5$ | 17.52ab | 3.61a | 5.65a | - | 4.82 | 7.00 |
| **Year 3 (2000-01)** | | | | | | | | |
| $T_1$ | $T_1$ | $T_1$ | 7.31c | 2.05c | 2.44d | 1.37 | 3.01 | 3.85 |
| $T_2$ | $T_2$ | $T_2$ | 19.02b | 3.07ab | 3.92b | 5.97 | 3.86 | 5.87 |
| | $T_{3.1}$ | $T_{3.1}$ | | 3.76a | 4.72a | | 3.85 | 6.85 |
| $T_3$ | $T_{3.2}$ | $T_{3.2}$ | | 3.05ab | 4.05b | 7.05 | 3.89 | 5.98 |
| | $T_{3.3}$ | $T_{3.3}$ | 21.89ab | 2.61b | 3.90bc | | 3.16 | 5.50 |
| | $T_{3.4}$ | $T_{3.4}$ | | 2.45bc | 3.25c | | 3.00 | 5.40 |
| $T_4$ | $T_{4.1}$ | $T_{4.1}$ | 22.4a | 3.39a | 4.60a | 7.39 | 4.29 | 6.89 |
| | $T_{4.2}$ | $T_{4.2}$ | | 3.18ab | 4.11b | | 4.16 | 6.24 |
| $T_5$ | $T_5$ | $T_5$ | 23.09a | 3.17ab | 4.74a | 7.10 | 4.45 | 6.33 |

Table 1. Contd.

| Treatment | | | Tuber/Grain yield (t/ha) | | | Haulm/straw yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|
| Potato | T.Aus | T.Aman | Potato | T.Aus | T.Aman | Potato | T.Aus | T.Aman |
| **Mean (avg. of three years)** | | | | | | | | |
| $T_1$ | $T_1$ | $T_1$ | 7.30 | 2.07 | 2.19 | 1.39 | 2.50 | 2.94 |
| $T_2$ | $T_2$ | $T_2$ | 15.22 | 3.24 | 4.28 | 4.82 | 3.98 | 5.27 |
| $T_3$ | $T_{3.1}$ | $T_{3.1}$ | 17.87 | 3.95 | 4.79 | 5.50 | 4.42 | 6.12 |
| | $T_{3.2}$ | $T_{3.2}$ | | 3.56 | 4.59 | | 4.15 | 5.62 |
| | $T_{3.3}$ | $T_{3.3}$ | | 3.11 | 3.91 | | 3.63 | 4.88 |
| | $T_{3.4}$ | $T_{3.4}$ | | 2.93 | 3.34 | | 3.37 | 4.73 |
| $T_4$ | $T_{4.1}$ | $T_{4.1}$ | 19.88 | 3.96 | 4.72 | 6.22 | 4.40 | 6.32 |
| | $T_{4.2}$ | $T_{4.2}$ | | 3.60 | 4.11 | | 4.07 | 5.80 |
| $T_5$ | $T_5$ | $T_5$ | 19.28 | 3.91 | 4.77 | 5.88 | 4.95 | 6.32 |

Table 2. Cost and return analysis of Potato-T.Aus-T.Aman cropping pattern under different fertilizer packages at Chandina, Comilla during 1996-97 1999-2000

| Treatment | | | Tuber yield of potato (t/ha) | Total rice yield (t/ha) | Straw yield of rice (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|---|---|---|---|---|
| Potato | T.Aus | T.Aman | | | | | | | |
| $T_1$ | $T_1$ | $T_1$ | 7.30 | 4.26 | 5.44 | 54440 | 50060 | 4380 | - |
| $T_2$ | $T_2$ | $T_2$ | 15.22 | 7.52 | 9.25 | 102925 | 60554 | 42371 | 3.62 |
| $T_3$ | $T_{3.1}$ | $T_{3.1}$ | 17.87 | 8.74 | 10.5 | 120480 | 61718 | 58762 | 4.66 |
| | $T_{3.2}$ | $T_{3.2}$ | | 8.15 | 9.77 | 114915 | 60590 | 54325 | 4.74 |
| | $T_{3.3}$ | $T_{3.3}$ | | 7.02 | 8.51 | 107005 | 59558 | 47448 | 4.53 |
| | $T_{3.4}$ | $T_{3.4}$ | | 6.17 | 8.10 | 101550 | 58170 | 43380 | 4.80 |
| $T_4$ | $T_{4.1}$ | $T_{4.1}$ | 19.88 | 8.68 | 10.7 | 124840 | 64590 | 60250 | 3.84 |
| | $T_{4.2}$ | $T_{4.2}$ | | 7.71 | 9.87 | 117145 | 63334 | 53811 | 3.72 |
| $T_5$ | $T_5$ | $T_5$ | 19.28 | 8.68 | 11.3 | 122345 | 72531 | 49814 | 2.02 |

Table 3. Effect of different fertilizer management packages on the nutrient balance in Potato-T.Aus-T.Aman cropping pattern at Chandina, Comilla during 1996-97 to 1999-2000

| Treatment | Nutrient uptake (kg/ha) | | | | Nutrient added (inorg. + org.) (kg/ha) | | | | Apparent nutrient balance (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 102 | 18 | 116 | 11 | 0 | 0 | 0 | 0 | -102 | -18 | -116 | -11 |
| $T_2$ | 189 | 33 | 215 | 20 | 260 | 54 | 150 | 8 | -85 | 21 | -65 | -12 |
| $T_{3.1}$ | 221 | 38 | 252 | 24 | 330 | 42 | 191 | 30 | -89 | 4 | -61 | 6 |
| $T_{3.2}$ | 208 | 36 | 238 | 23 | 330 | 34 | 171 | 24 | -76 | -2 | -67 | 1 |
| $T_{3.3}$ | 189 | 33 | 217 | 21 | 330 | 26 | 147 | 16 | -57 | -7 | -70 | -5 |
| $T_{3.4}$ | 176 | 31 | 202 | 19 | 330 | 18 | 125 | 10 | -44 | -13 | -77 | -9 |
| $T_{4.1}$ | 224 | 39 | 256 | 24 | 360 | 44 | 201 | 24 | -80 | 5 | -55 | -0.4 |
| $T_{4.2}$ | 205 | 36 | 235 | 22 | 360 | 36 | 177 | 16 | -61 | .04 | -58 | -6 |
| $T_5$ | 219 | 38 | 251 | 24 | 405 | 160 | 280 | 0 | -57 | 122 | 29 | -24 |

Appendix Table 1. Fertilizers used for Potato-T.Aus-T.Aman cropping pattern at Chandina, Comilla

| Treatment | Nutrient (kg/ha) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Potato | | | | | T.Aus | | | | | T.Aman | | | | |
| | N | P | K | S | Zn | N | P | K | S | Zn | N | P | K | S | Zn |
| $T_1$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $T_2$ | 120 | 30 | 100 | 8 | 2 | 70 | 12 | 25 | 0 | 0 | 70 | 12 | 25 | 0 | 0 |
| $T_{3.1}$ | | | | | | 90 | 12 | 33 | 10 | 0 | 90 | 12 | 33 | 10 | 0 |
| $T_{3.2}$ | 150 | 18 | 125 | 10 | 0 | 90 | 8 | 23 | 7 | 0 | 90 | 8 | 23 | 7 | 0 |
| $T_{3.3}$ | | | | | | 90 | 4 | 11 | 3 | 0 | 90 | 4 | 11 | 3 | 0 |
| $T_{3.4}$ | | | | | | 90 | 0 | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 0 |
| $T_{4.1}$ | 150 | 18 | 125 | 10 | 0 | 90 | 8 | 23 | 7 | 0 | 90 | 8 | 23 | 7 | 0 |
| $T_{4.2}$ | | | | | | 90 | 4 | 11 | 3 | 0 | 90 | 4 | 11 | 3 | 0 |
| $T_5$ | 225 | 100 | 180 | 0 | 0 | 90 | 30 | 50 | 0 | 0 | 90 | 30 | 50 | 0 | 0 |

$T_1$ = Absolute control, $T_2$ = Fertilization based on BARC Fertilizer Recommendation Guide
$T_{3.1}$ = Soil test based (STB) fertilizer recommendation for HYG, $T_{3.2}$ = 66% of PKS used in $T_{3.1}$
$T_{3.3}$ = 33% of PKS used in $T_{3.1}$, $T_{3.4}$ = Only N and no PKS in $T_{3.1}$, $T_{4.1}$ = $T_{3.1}$ = CD @ 10 t/ha
$T_{4.2}$ = = 66% of PKS used in $T_{4.1}$, $T_5$ = Farmers' fertilization practice

Appendix Table 2. Initial soil nutrient status of the experimental plots at Chandina, Comilla

| Sl. No. | $P^H$ | OM | N | K | P | S |
|---|---|---|---|---|---|---|
| | | (%) | | ml eq. / 100g soil | mg / g soil | |
| 1 | 5.9 | 1.5 | 0.15 | 0.15 | 18 | 27 |
| 2 | 5.7 | 1.3 | 0.18 | 0.11 | 16 | 16 |
| 3 | 5.1 | 1.8 | 0.13 | 0.16 | 15 | 18 |
| 4 | 5.4 | 1.7 | 01.7 | 0.15 | 9 | 21 |
| 5 | 5.65 | 1.3 | 0.15 | 0.17 | 16 | 19 |
| Mean | 5.54 | 1.52 | 0.15 | 0.15 | 14.8 | 20.2 |
| Status | Acidic | Low | Low | Low | Low | Medium |

# EFFECTS OF RICE STRAW ON THE PERFORMANCE OF BORO-FALLOW-T.AMAN RICE SYSTEM


## Abstract

An on-farm experiment was conducted at four different locations viz. Netrakona, Rangpur, Pabna and Comilla during 1998-99 to 2000-01 to see the effect of Boro rice straw in corporation on the yield of T.Aman rice in Boro-T.Aman rice system. Boro rice was grown with recommended fertilizer and it was harvested at different height to remain straw in the soil. In T.Aman rice, ⅓rd and ⅔rd Boro rice straw was incorporated to the soil along with full doses as well as reduced doses of inorganic fertilizers for MYG and HYG. Only inorganic fertilizers of recommended dose for MYG and HYG and farmers' practice were also included to compare. Results showed that no significant difference was observed on the yield of T.Aman rice over the locations except in Rangpur. In Rangpur, grain yield of T.Aman rice significantly increase due to incorporation of rice straw in the soil. Regarding economic performance, higher benefit was obtained from rice straw incorporating treatment irrespective of locations.


## Introduction

Boro-T.Aman rice system is a predominant cropping pattern in Bangladesh under irrigated medium high to medium low land condition. Due to continuous practice of rice based cropping system the production seems to have reached in a stagnant position in spite of using more and more fertilizers. Use of organic matters like cowdung and farmyard manure is decreasing because of utilization as fuel materials. Further, continuous cultivation of HYV rice over the years is exhausting the soil nutrients. Thus, organic matter content and soil fertility is decreasing day by day. Recycling of organic matter is essential for maintaining soil fertility. Establishment of dhaincha or any other green manuring crop is very difficult because of heavy rainfall in the month of May (more than 300 mm.). As such, alternative strategy might be incorporation of rice straw. Boro rice straw may be used as an alternate source of organic matter and may stabilize the yield of the crops under Boro-Fallow-T.Aman rice system.

Generally, Boro rice is harvested in the month of May and particularly in medium low land due to high rainfall and flash flood water farmers are forced to harvest the crop at the top remaining the straw. Thus the Boro rice straw can be utilized as organic residue to the succeeding T.Aman rice. Therefore, the complementary use of rice straw with mineral fertilizer will help to increase use efficiency of applied fertilizers and maintaining soil fertility. With this view in mind the experiment was under taken to compare rice straw and inorganic fertilizer effects with conventional practice of chemical fertilizers application on Boro-T.Aman rice system.

## Materials and Methods

The experiment was initiated from Boro season of 1998-99 and continued to 2000-01. It was conducted at 4 different locations with 8 treatments and 6 (six) dispersed replications. The plot was divided into 8 (eight) sub-plot. The size of each unit plot was 10m x 10m.

In Boro rice recommended dose of fertilizers were applied in all the 8 plots. Irrigation and other intercultural operations were done as and when necessary. Boro rice straw was harvested leaving 10, 20 and 30 cm straw from ground level. Yield and yield contributing characters of Boro rice were recorded as per requirement. Rice straw of Boro was incorporated (Table 2) in to the soil by ploughing. In T.Aman rice fertilizers were applied as per following treatments combinations. Eight treatments were as follows:

$T_1$= T.Aman grown with $RF_2$
$T_2$= $\frac{1}{3}$ Boro rice straw ($\frac{2}{3}$ should be harvested from top) incorporation then T.Aman with $RF_2$
$T_3$= $\frac{2}{3}$ Boro rice straw ($\frac{1}{3}$ should be harvested from top) incorporation then T.Aman with $RF_2$
$T_4$= $T_2$ + T.Aman with 65-22-25-20-5 kg NPKSZn/ha.
$T_5$= $T_3$ + T.Aman with 50-18-16-20-5 kg NPKSZn/ha.
$T_6$= Recommended fertilizer for high yield goal ($RF_1$)
$T_7$= Recommended fertilizer for moderate yield goal ($RF_2$)
$T_8$= Farmers practices (Harvesting).

Note: $RF_1$ = 76-16-46-11-1.5 kg/ha of NPKSZn
$RF_2$ = 60-8-30-4 kg/ha of NPKS

Irrigation and other intercultural operations were done as and when necessary. Yield and yield contributing characters were recorded as per requirement and were statistically analyzed. Soil characteristics and different crop management practices followed in different sites are given in appendix I.

**Location : Mymensingh**
**Year of conduction : 1998-99 to 2000-01**

**Performance of Boro rice and straw incorporation:**

During 1998-99 Boro rice was grown with recommended fertilizer and 4.06 t/ha and 4.49 t/ha of grain and straw yield was obtained, respectively. In 1999-2000 and 2000-01, no significant differences in the yield were observed due to the addition of different amount of rice straw in 1998-99 (Table 1). Almost similar trend was found in straw yield also.

Boro rice was harvested at different height as per treatment and the amount of Boro rice straw incorporated into in the soil before T.Aman transplanting has been presented in Table 2. The highest amount of Boro rice straw (3.85 t/ha) was added when $\frac{2}{3}$rd of straw was incorporated into the soil. About 2.73 t/ha and 1.65 t/ha of rice straw were added in the soil from $\frac{1}{3}$rd and farmers' practice, respectively.

**Performance T.Aman rice**

Average of three years data showed that grain yield did not vary significantly with different treatments. The effect of Boro rice straw on the yield of succeeding T.Aman rice was not evident during 1999 and 2000 but significantly highest grain and straw yield was recorded from treatment $T_6$. Even no significant difference was observed between two levels of fertilizers-MYG and HYG. However, the highest grain yield was recorded from recommended fertilizer dose for HYG ($T_6$) followed by $T_3$ where $\frac{2}{3}$rd Boro rice straw was incorporated along with recommended fertilizer for MYG. Similar result was found in straw yield also.

Cost and return analysis showed that the highest gross return was obtained from $T_6$ followed by $T_3$ but highest gross margin from treatment $T_3$ followed by $T_6$. Similarly, the highest benefit cost ratio was recorded from $T_3$ followed by $T_7$.

After getting the soil test data it will be noticed that whether any change occur in soil nutrient status due to incorporation of rice straw in the soil.

Table 1. Performance of Boro rice under Boro-Fallow-T.Aman cropping pattern at Netrokona MLT site during rabi- 99-2000 to 2000-01

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | |
|---|---|---|---|---|
| | 1999-2000 | 2000-01 | 1999-2000 | 2000-01 |
| $T_1$ | 4.38 | 4.85 | 5.33 | 5.62 |
| $T_2$ | 4.16 | 5.04 | 4.87 | 5.68 |
| $T_3$ | 4.24 | 5.25 | 5.00 | 6.09 |
| $T_4$ | 3.95 | 5.05 | 4.64 | 5.83 |
| $T_5$ | 4.23 | 5.08 | 5.02 | 5.88 |
| $T_6$ | 4.28 | 4.96 | 4.96 | 5.81 |
| $T_7$ | 4.31 | 4.87 | 5.03 | 5.79 |
| $T_8$ | 4.03 | 4.89 | 4.72 | 5.64 |

Table 2. Rice straw dry matter incorporated into the soil before T. Aman transplanting, in 1999, 2000 and 2001

| Treatments | Incorporated dry matter from Boro Rice straw (t $ha^{-1}$) | | | |
|---|---|---|---|---|
| | 1999 | 2000 | 2001 | Mean |
| $T_1$ | 1.54 | 1.62 | 1.71 | 1.62 |
| $T_2$ | 2.65 | 2.76 | 2.85 | 2.75 |
| $T_3$ | 3.74 | 3.95 | 3.90 | 3.86 |
| $T_4$ | 2.62 | 2.70 | 2.82 | 2.71 |
| $T_5$ | 3.68 | 3.92 | 3.88 | 3.83 |
| $T_6$ | 1.51 | 1.65 | 1.67 | 1.61 |
| $T_7$ | 1.55 | 1.62 | 1.69 | 1.62 |
| $T_8$ | 1.57 | 1.69 | 1.70 | 1.65 |

Table 3. Effect of Boro rice straw and fertilizers on yield of T.Aman rice under Boro-T.Aman rice cropping pattern at Netrakona MLT site (1999- 2001)

| Treatment | Grain yield (t $ha^{-1}$) | | | Straw yield (t $ha^{-1}$) | | |
|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| $T_1$ | 3.80 | 4.30 | 3.78 c | 4.00 | 4.89 | 3.89 c |
| $T_2$ | 3.93 | 4.68 | 3.73 c | 4.34 | 4.95 | 3.85 cd |
| $T_3$ | 4.19 | 4.85 | 4.01 b | 4.90 | 5.46 | 4.12 b |
| $T_4$ | 4.06 | 4.73 | 3.92 b | 4.66 | 5.28 | 4.02 b |
| $T_5$ | 3.96 | 4.76 | 4.00 b | 4.68 | 5.16 | 4.11 b |
| $T_6$ | 4.26 | 4.96 | 4.22 a | 4.74 | 5.32 | 4.34 a |
| $T_7$ | 4.00 | 4.65 | 3.67 c | 4.56 | 5.27 | 3.76 d |
| $T_8$ | 3.89 | 4.56 | 3.30 d | 4.28 | 5.03 | 3.38 e |
| CV(%) | 9.3 | 11.7 | 2.8 | 12. 8 | 13.8 | 12.7 |

Table 4. Effect of rice straw on agro-economic performance of T.Aman rice at Netrakona (Avg. of 1999-2001)

| Treatment | Grain yield (t/ha) | Straw yield (t/ha) | GR (Tk/ha) | TVC (Tk/ha) | GM (Tk/ha) | BCR |
|---|---|---|---|---|---|---|
| $T_1$ | 3.96 | 4.26 | 29200 | 11599 | 17601 | 2.52 |
| $T_2$ | 4.11 | 4.38 | 30247 | 11990 | 18257 | 2.52 |
| $T_3$ | 4.35 | 4.83 | 32972 | 11990 | 20982 | 2.75 |
| $T_4$ | 4.24 | 4.65 | 31832 | 13852 | 18980 | 2.30 |
| $T_5$ | 4.24 | 4.65 | 31832 | 13596 | 18236 | 2.34 |
| $T_6$ | 4.48 | 4.80 | 33283 | 13661 | 19622 | 2.44 |
| $T_7$ | 4.11 | 4.53 | 30817 | 11990 | 18827 | 2.57 |
| $T_8$ | 4.04 | 4.23 | 28925 | 14174 | 14751 | 2.04 |

**Location : Rangpur**
**Year of conduction: 1999-2000 to 2000-01**

The performance of Boro rice showed that 5.72 t/ha and 6.68 t/ha of grain and straw yield of Boro rice was obtained. The effects of treatments on the yield of T.Aman rice have been shown in Table 1. The two years results revealed that there were significant differences among the different treatments both the years. The highest grain yield was recorded from the treatment $T_5$ which was also identical to $T_4$ and $T_2$. These results indicated that the incorporation of $\frac{2}{3}$ rice straw along with 65-7-20-3-0 and 50-18-16-20-5 kg NPKSZn/ha had significant effect on the yield of T.Aman rice in comparison to only inorganic fertilizers.

The effect of rice straw on the economic performance of T.Aman rice has been shown in Table 2. The average of two years results revealed that the highest gross margin was obtained from $T_5$ followed by $T_4$. The benefit cost ratio was also highest in this treatment.

From the two years results it is clear that incorporation of $\frac{2}{3}$rd boro rice straw with 50-18-16-20-5 or 65-7-20-3-0 kg NPKSZn/ha had positive effect on the production of T.Aman rice in Boro-T.Aman rice system.

Table 1. Effect of Boro rice straw on the yield of T.Aman rice in the Boro-T.Aman rice systems during 1999-2000 and 2000-2001 at Nilphamari MLT site, OFRD, Rangpur

| Treatment | Grain yield (t/ha) | | | Straw Yield (t/ha) | | |
|---|---|---|---|---|---|---|
| | 1999-00 | 2000-01 | Mean | 1999-00 | 2000-01 | Mean |
| $T_1$ | 4.55cd | 4.69c | 4.62 | 5.46cd | 5.65bc | 5.56 |
| $T_2$ | 5.00abc | 5.14abc | 5.07 | 6.08b | 6.28ab | 6.18 |
| $T_3$ | 4.86bc | 5.00abc | 4.93 | 5.83bc | 6.09bc | 5.96 |
| $T_4$ | 5.21ab | 5.37ab | 5.29 | 6.19ab | 6.40ab | 6.30 |
| T5 | 5.46a | 5.58a | 5.52 | 6.66a | 6.92a | 6.79 |
| $T_6$ | 4.24d | 4.56c | 4.40 | 5.23d | 5.49c | 5.36 |
| $T_7$ | 4.78bc | 4.90bc | 4.84 | 6.03b | 6.35ab | 6.19 |
| CV (%) | 7.70 | 9.7 | - | 7.4 | 9.2 | - |

Mean followed by the common letter(s) are not significantly different at the 5% level by DMRT.

Table 2. Effect of Boro rice straw on the economy of T.Aman rice in Boro-T.Aman rice system at Nilphamari MLT site, OFRD, Rangpur during 1999-2000 and 2000-01

| Treatment | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|
| Year 1999-2000 | | | | |
| $T_1$ | 38730 | 10486 | 28244 | 3.69 |
| $T_2$ | 43040 | 11461 | 31579 | 3.76 |
| $T_3$ | 41795 | 12270 | 29525 | 3.41 |
| $T_4$ | 44775 | 12663 | 32112 | 3.54 |
| T5 | 47010 | 9877 | 37133 | 4.76 |
| $T_6$ | 36535 | 9236 | 27299 | 3.96 |
| $T_7$ | 41255 | 10129 | 31126 | 4.07 |
| Year 2000-01 | | | | |
| $T_1$ | 40345 | 11316 | 29029 | 3.57 |
| $T_2$ | 44260 | 12263 | 31997 | 3.61 |
| $T_3$ | 43045 | 12742 | 30303 | 3.38 |
| $T_4$ | 46160 | 13078 | 33082 | 3.53 |
| T5 | 48100 | 10233 | 37867 | 4.70 |
| $T_6$ | 38725 | 9604 | 29121 | 4.03 |
| $T_7$ | 42375 | 10522 | 31853 | 4.02 |

Table 2. Contd.

| Treatment | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|
| | | Mean | | |
| $T_1$ | 39538 | 10901 | 28637 | 3.62 |
| $T_2$ | 43650 | 11862 | 31788 | 3.67 |
| $T_3$ | 42420 | 12506 | 29914 | 3.39 |
| $T_4$ | 45468 | 12871 | 32597 | 3.53 |
| T5 | 47555 | 10055 | 37500 | 4.72 |
| $T_6$ | 37630 | 9420 | 28210 | 3.99 |
| $T_7$ | 41815 | 10326 | 31489 | 4.04 |

Price (Tk/kg)

| Year | Urea | TSP | MP | Gypsum | Zinc Sulphate | Rice seed | Rice grain | Rice straw |
|---|---|---|---|---|---|---|---|---|
| 1999-00 | 5.60 | 12.40 | 8.40 | 3.00 | 35.00 | 12.00 | 8.00 | 0.50 |
| 2000-01 | 5.70 | 13.14 | 8.70 | 2.75 | 35.00 | 14.50 | 8.00 | 0.50 |

**Location : Goyeshpur FSRD site, Pabna**
**Year of conduction: 1999-2000 to 2000-01**

Average of two years data revealed that 5.45 t/ha of grain yield was obtained from Boro rice. Incorporation of Boro rice straw did not show any significant effect on the yield of T.Aman rice. Two levels of fertilizer dose (HYG & MYG) also produced identical yield and even don't have any difference with farmers practice. Straw yield also showed same result.

Regarding cost and return analysis, no marked variation was found among the treatments. Gross margin as well as BCR was close each other but treatment $T_2$ showed slightly higher BCR than other treatments.

Table 1. Effect of different nutrient management packages on the yield of T.Aman rice in Boro-T.Aman rice cropping pattern at FSRD site Goyeshpur, Pabna during 2000-01

| Treatment | Year | | |
|---|---|---|---|
| | 2000 | 2001 | Mean |
| | | Grain yield (t/ha) | |
| $T_1$= $RF_2$= 52-16-20-9-0 Kg NPKS Zn/ha-30kg N/ha | 2.73b | 3.65a | 3.19 |
| $T_2$=$^1/_3$ boro rice straw+52-16-20-9-0 kg NPKS Zn/ha | 3.13a | 3.62a | 3.38 |
| $T_3$=$^2/_3$ boro rice straw+52-16-20-9-0 kg NPKS Zn/ha | 2.98a | 3.47a | 3.23 |
| $T_4$=$^1/_3$ boro rice straw+65-22-25-20-5kgNPKS Zn/ha | 3.28a | 3.62a | 3.45 |
| $T_5$=$^2/_3$ boro rice straw+50-18-16-20-5kgNPKS Zn/ha | 3.23a | 3.30a | 3.27 |
| $T_6$=HYG($RF_1$)=70-20-20-12-0kgNPKS Zn/ha | 3.10a | 3.39a | 3.25 |
| $T_7$=MYG($RF_2$)=52-16-20-9-0kgNPKS Zn/ha | 3.23a | 3.47a | 3.35 |
| $T_8$= Farmers practice=75-16-29-4-6kgNPKS Zn/ha | 3.08a | 3.69a | 3.39 |
| CV (%) | 7.02 | 9.1 | - |
| | | Straw yield (t/ha) | |
| $T_1$= $RF_2$= 52-16-20-9-0 Kg NPKS Zn/ha -30kg N/ha | 3.54a | 5.73a | 4.64 |
| $T_2$=$^1/_3$ boro rice straw+52-16-20-9-0kg NPKS Zn/ha | 4.07a | 5.63a | 4.85 |
| $T_3$=$^2/_3$ boro rice straw+52-16-20-9-0kg NPKS Zn/ha | 3.87a | 5.70a | 4.79 |
| $T_4$=$^1/_3$ boro rice straw+65-22-25-20-5kg NPKS Zn/ha | 4.26a | 5.71a | 4.99 |
| $T_5$=$^2/_3$boro rice straw+50-18-16-20-5kg NPKS Zn/ha | 4.20a | 5.12a | 4.66 |
| $T_6$=HYG($RF_1$)=70-20-20-12-0 kg NPKS Zn/ha | 4.03a | 5.71a | 4.87 |
| $T_7$=MYG($RF_2$)=52-16-20-9-0 kg NPKS Zn/ha | 4.20a | 6.12a | 5.16 |
| $T_8$= Farmers practice=75-16-29-4-6 kg NPKS Zn/ha | 4.00a | 6.01a | 5.01 |
| CV (%) | 11.3 | 10.6 | |

Table 2. Agroeconomic performance of T.Aman rice under cropping pattern Boro rice-Fallow- T.Aman with different fertilizer and management at FSRD site, Goyeshpur, Pabna during 2000-01

| Treatment | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|
| $T_1$= $RF_2$= 52-16-20-9-0 $K_0$ NPKS Zn/ha -30kg N/ha | 23055 | 8631 | 14424 | 2.67 |
| $T_2$=$^1/_3$ boro rice straw+52-16-20-9-0kg NPKS Zn/ha | 24395 | 8781 | 15614 | 2.78 |
| $T_3$=$^2/_3$ boro rice straw+52-16-20-9-0kg NPKS Zn/ha | 23390 | 8831 | 14559 | 2.65 |
| $T_4$=$^1/_3$ boro rice straw+65-22-25-20-5kg NPKS Zn/ha | 24920 | 9733 | 15187 | 2.56 |
| $T_5$=$^2/_3$boro rice straw+50-18-16-20-5kg NPKS Zn/ha | 23585 | 9121 | 14464 | 2.58 |
| $T_6$=HYG($RF_1$)=70-20-20-12-0 kg NPKS Zn/ha | 23560 | 9194 | 14366 | 2.56 |
| $T_7$=MYG($RF_2$)=52-16-20-9-0 kg NPKS Zn/ha | 24355 | 8771 | 15584 | 2.78 |
| $T_8$= Farmers practice=75-16-29-4-6 kg NPKS Zn/ha | 24550 | 9645 | 14895 | 2.54 |

**Price of input:** Seed (Boro) = 75Kg/ha @ Tk 14.00/kg, Seed (T.Aman)= 38 kg/ha @ Tk.16.00/kg , Land preparation= @ Tk 2625 /ha, Intercultural operation 15labour/8hrs. @ Tk 60/labour, Furadan = 15 kg/ha @ Tk.90.00/kg, Irrigation = Tk 4875/ha, Harvest = 15 Labour/8hrs @ Tk 60/ labour.

**Price of output:** T.Aman: Grain =Tk.6.50/kg, Straw = Tk. 0.50 /kg

**Location : Comilla**
**Year of conduction: 1999-2000 to 2000-01**

Performance of Boro rice showed that in 1999-2000 the grain and straw yield of boro rice was 5.15 t/ha and 6.69 t/ha, respectively in 1999-2000 and 2000-01. But in 2000-01, a little variation in yield was observed and it varied from 6.3-6.87 and 8.1-8.8 t/ha for grain and straw, respectively. In T.Aman rice no significant difference in grain and straw yield was observed among the treatments except $T_1$ ($RF_2$-30 kg N/ha) in 2000 and $T_1$ and $T_7$ in 2001. The treatments where rice straw was incorporated at different levels did not varied significantly. Even reduced amount of inorganic fertilizer along with RS produced identical yield. More or less similar trend was found in previous year also.

Cost and return analysis showed that the higher gross margin was obtained from treatment $T_4$ where $\frac{1}{3}$ rice straw was incorporated with fertilizer dose 65-22-25-20-5 NPKSZn kg/ha.

Table 1. Effect of different nutrient management packages on the yield of T.Aman rice in Boro-T.Aman rice cropping pattern at Comilla during 2000 - 2001

| Treatment | Year | |
|---|---|---|
| | 2000 | 2001 |
| | Grain yield (t/ha) | |
| $T_1$= $RF_2$= 52-16-20-9-0 Kg NPKS Zn/ha-30kg N/ha | 3.72b | 3.75c |
| $T_2$=$^1/_3$ RS+52-16-20-9-0 kg NPKS Zn/ha | 4.52a | 5.38a |
| $T_3$=$^2/_3$ RS+52-16-20-9-0 kg NPKS Zn/ha | 4.65a | 5.48a |
| $T_4$=$^1/_3$ RS+65-22-25-20-5kgNPKS Zn/ha | 4.45a | 5.38a |
| $T_5$=$^2/_3$ RS+50-18-16-20-5kg NPKS Zn/ha | 4.42a | 5.18ab |
| $T_6$=HYG($RF_1$)=70-20-20-12-0kg NPKS Zn/ha | 4.29ab | 5.30a |
| $T_7$=MYG($RF_2$)=52-16-20-9-0kg NPKS Zn/ha | 4.06ab | 4.63b |
| $T_8$= Farmers practice=75-16-29-4-6kg NPKS Zn/ha | 4.30ab | 5.00ab |
| | Straw yield (t/ha) | |
| $T_1$= $RF_2$= 52-16-20-9-0 Kg NPKS Zn/ha -30kg N/ha | 4.49 | 4.62 |
| $T_2$=$^1/_3$ RS+52-16-20-9-0kg NPKS Zn/ha | 4.49 | 6.71 |
| $T_3$=$^2/_3$ RS+52-16-20-9-0kg NPKS Zn/ha | 5.35 | 5.13 |
| $T_4$=$^1/_3$ RS+65-22-25-20-5kg NPKS Zn/ha | 5.27 | 6.76 |
| $T_5$=$^2/_3$ RS+50-18-16-20-5kg NPKS Zn/ha | 5.58 | 5.49 |
| $T_6$=HYG($RF_1$)=70-20-20-12-0 kg NPKS Zn/ha | 4.96 | 6.62 |
| $T_7$=MYG($RF_2$)=52-16-20-9-0 kg NPKS Zn/ha | 5.75 | 5.78 |
| $T_8$= Farmers practice=75-16-29-4-6 kg NPKS Zn/ha | 5.40 | 6.25 |

RS= Rice straw

Table 2. Cost and return analysis of the cropping pattern Boro- T.Aman rice system at, Comilla during 2000-01

| Treat. | Yield (t/ha) | | Variable cost (Tk/ha) | Gross return (t/ha) | Gross margin (tk/ha) |
|---|---|---|---|---|---|
| | Boro | T.Aman | | | |
| T1 | 6.43 | 3.75 | 6032 | 77550 | 71518 |
| T2 | 6.47 | 5.38 | 6503 | 91590 | 85087 |
| T3 | 6.37 | 5.48 | 6572 | 92010 | 85438 |
| T4 | 6.87 | 5.38 | 7331 | 94440 | 87109 |
| T5 | 6.67 | 5.18 | 6740 | 91270 | 84530 |
| T6 | 6.23 | 5.30 | 7946 | 89200 | 81254 |
| T7 | 6.3 | 4.63 | 6434 | 84190 | 77756 |
| T8 | 6.3 | 5.00 | 12541 | 87250 | 74709 |

Variable cost = Fertilizer cost only

Input: Urea @ 6.00 Tk/Kg, TSP @ 15.00 Tk./kg, MP 9.00 Tk./kg, MP @ 4.50 Tk./kg,
Output: Price of rice Boro @ 6.00 Tk./kg T. aman @ 7.00 Tk./kg Rice straw @ 1.00 Tk./kg.

Appendix table 1. Crop management practices

| Site | Crop | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Netrokona | Boro | BR 3 | 40 | 2nd week of Feb | Last week of May |
| | T.Aman | BRRI Dhan 29 | 40 | 4th week of July | Last week of Nov |
| Nilphamari | Boro | BRRI Dhan 29 | 40 | 1st week of Feb | Last week of May |
| | T.Aman | BR 11 | 40 | 3rd week of July | 4th week of Nov |
| Goyeshpur | Boro | BRRI Dhan 29 | 50 | 1st week of Feb | Last week of May |
| | T.Aman | BR 11 | 50 | 3rd week of July | 3rd week of Nov |
| Comilla | Boro | BRRI Dhan 29 | 4040 | 1st week of Feb | 2nd week of June |
| | T.Aman | BRRI Dhan 33 | | 2nd week of Aug | 2nd week of Nov |

Appendix table 2. Effect of boro rice straw and fertilizers on yield contributing characters of T.Aman rice under Boro-T.Aman rice cropping pattern at Netrakona MLT site, 1999- 2001

| Trt. | Plant height (cm) | | | No. of panicle hill$^{-1}$ | | | No. of filled grain panicle$^{-1}$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| $T_1$ | 107b | 91 | 87c | 7.3c | 8.05 | 6.1c | 107cd | 112e | 77ab |
| $T_2$ | 111a | 92 | 86cd | 7.4a | 8.35 | 6.2bc | 127a | 118d | 76b |
| $T_3$ | 109a | 94 | 88b | 7.4ab | 8.65 | 6.3ab | 122a-c | 131a | 78a |
| $T_4$ | 111a | 94 | 88bc | 7.3a-c | 8.38 | 6.2bc | 115a-d | 126bc | 76b |
| $T_5$ | 110a | 93 | 89b | 7.4ab | 8.30 | 6.3ab | 103d | 123bc | 77ab |
| $T_6$ | 110a | 93 | 91a | 7.4ab | 8.43 | 6.4a | 125ab | 126ab | 78a |
| $T_7$ | 109a | 93 | 85d | 7.3a-c | 8.39 | 6.1c | 115a-d | 121cd | 75b |
| $T_8$ | 110a | 94 | 88b | 7.3bc | 8.55 | 5.9d | 109b-d | 113e | 72c |
| CV (%) | 1.1 | 3.3 | 1.3 | 1.0 | 6.1 | 3.4 | 10.8 | 2.4 | 2.8 |

Appendix table 3. Cost and return analysis of T. Aman rice as affected by boro rice straw and fertilizer under Boro- T.Aman rice cropping system at Netrakona MLT site during 1999 and 2001

| Trt. | Gross return (Tk ha$^{-1}$) | | | Variable cost (Tk ha$^{-1}$) | | | MBCR (over FP) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| $T_1$ | 28750 | 30445 | 28405 | 1651 | 1651 | 1660 | - 6.95 | - 8.57 | - |
| $T_2$ | 29850 | 32855 | 28035 | 2087 | 2112 | 2050 | 1.04 | 1.08 | 10.06 |
| $T_3$ | 31755 | 37030 | 30130 | 2392 | 2762 | 2050 | 3.55 | 4.55 | 17.51 |
| $T_4$ | 30785 | 35260 | 29450 | 4105 | 4355 | 4310 | 0.54 | 1.07 | 1.81 |
| $T_5$ | 30100 | 35340 | 30055 | 3334 | 3714 | 3655 | 0.37 | 1.47 | 2.76 |
| $T_6$ | 32300 | 35840 | 31710 | 3893 | 3993 | 3586 | 1.31 | 0.15 | 3.76 |
| $T_7$ | 30325 | 34555 | 27570 | 2167 | 2367 | 2050 | 2.00 | 3.43 | 9.11 |
| $T_8$ | 29510 | 32475 | 24790 | 1760 | 1760 | 1745 | - | - | - |

Appendix table 4. Initial soil nutrient status of Rangpur

| CEC | $P^H$ | OM | N | Ca | Mg | K | P | S | Zn | B |
|---|---|---|---|---|---|---|---|---|---|---|
| | | (%) | (%) | me g/100g soil | | | Microgram/g soil | | | |
| 0.19 | 5.3 | 1.58 | 0.08<br>V. Low | 2.5<br>Low | 0.6<br>Low | 0.10<br>Low | 15.2<br>Med | 16.5<br>Med | 1.20<br>Med | 0.21<br>Low |

Appendix table 5. Effect of Boro rice straw on the yield attributes of T.Aman rice in the Boro-T.Aman rice systems during 1999-2000 and 2000-2001 at Nilphamari MLT site, OFRD, Rangpur

| Treatment | Filled grain/panicle (no.) | Effective panicle/ hill no.) | 1000 seed wt. (g) | Plant height (cm) |
|---|---|---|---|---|
| | 1999-2000 | | | |
| $T_1$ | 109a | 11.5bc | 24.4bc | 106a |
| $T_2$ | 111a | 12.2ab | 24.9ab | 107a |
| $T_3$ | 110a | 12.1ab | 24.9ab | 106a |
| $T_4$ | 114a | 12.0ab | 25.2a | 106a |
| T5 | 113a | 13.1a | 25.0ab | 109a |
| $T_6$ | 108a | 10.4c | 24.2c | 106a |
| $T_7$ | 110a | 11.9ab | 24.4bc | 109a |
| CV (%) | 7.00 | 9.70 | 2.00 | 2.10 |
| $T_1$ | 109.5a | 10.3c | 24.8d | 107a |
| $T_2$ | 111.3a | 11.2bc | 25.6abc | 108a |
| $T_3$ | 111.6a | 12.4ab | 25.2bcd | 106a |
| $T_4$ | 115.2a | 12.0ab | 26.0a | 107a |
| T5 | 115.3a | 12.9a | 25.8ab | 110a |
| $T_6$ | 109.4a | 10.3c | 24.8cd | 107a |
| $T_7$ | 111.6a | 11.6abc | 25.0cd | 110a |
| CV (%) | 7.4 | 10.2 | 2.3 | 3.8 |

Mean followed by the common letter(s) are not significantly different at the 5% level by DMRT.

Appendix table 6. Performance of Boro rice under cropping pattern Boro-T.Aman rice at FSRD site, Goyeshpur, Pabna during 2000 to 2001

| Treatment | Plant height (cm) | | No. of grains/panicle (no.) | | 1000-grain wt | | Grain yield (t/ha) | | Mean (t/ha) | Straw yield (t/ha) | | Mean (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 | | 2000 | 2001 | |
| Recommended dose N- P- K- S- Zn (kg/ha) 10-20-25-10-0.5 | 86.11 | 87.38 | 88.86 | 121.25 | 21.04 | 19.68 | 4.89 | 6.00 | 5.45 | 7.88 | 9.03 | 8.46 |
| Farmer dose N- P- K (kg/ha) 110- 23- 20 | 90.58 | 90.06 | 84.00 | 118.00 | 19.02 | 19.65 | 3.93 | 5.97 | 4.95 | 7.32 | 8.96 | 8.14 |

Appendix table 7. Performance of T.Aman rice under cropping pattern Boro-T.Aman rice at FSRD site, Goyeshpur, Pabna during 2000-01

| Treatment | Plant height (cm) | | No. of filled grain/panicle (no.) | | 1000-Grain wt (g) | |
|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| $T_{1=}$ $RF_2$= 52-16-20-9-0 $K_g$ NPKS Zn/ha | 94.28a | 92.75a | 56.00ab | 108.25abc | 21.12a | 22.51a |
| $T_{2=}$ $^1/_3$ boro rice straw+52-16-20-9-0kg NPKS Zn/ha | 94.08a | 92.25a | 66.00ab | 101.75abc | 22.30a | 22.75a |
| $T_{3=}$ $^2/_3$ boro rice straw+52-16-20-9-0kg NPKS Zn/ha | 90.18 | 92.25a | 44.00ab | 114.25a | 21.16a | 22.44a |
| $T_{4=}$ $^1/_3$ boro rice straw+65-22-25-20-5kgNPKS Zn/ha | 97.40a | 93.25a | 81.00a | 93.75bc | 21.99a | 23.13a |
| $T_{5=}$ $^2/_3$boro rice straw+50-18-16-20-5kg NPKS Zn/ha | 91.80a | 94.50a | 70.00ab | 110.00ab | 21.20a | 22.15a |
| $T_{6=}$HYG($RF_1$)=70-20-20-12-0 kg NPKS Zn/ha | 96.95a | 94.25a | 73.00ab | 90.75c | 21.79a | 23.08a |
| $T_{7=}$MYG($RF_2$)=52-16-20-9-0 kg NPKS Zn/ha | 94.00a | 93.50a | 59.00ab | 99.50abc | 21.35a | 23.14a |
| $T_{8=}$ Farmers practice=75-16-29-4-6 kg NPKS Zn/ha | 95.13a | 91.75a | 72.00ab | 105.25abc | 22.18a | 22.74a |
| CV (%) | 4.7 | 4.1 | 27.9 | 10.5 | 5.1 | 3.7 |

Appendix table 8. Nutrient Status of the initial soils sample (0-15) depth at FSRD Site, Goyeshpur

| Replication | pH | Organic matter (%) | K | Total N (%) | P | S | B | Zn |
|---|---|---|---|---|---|---|---|---|
| | | | meq/100g soil | | Micro gram/g soil | | | |
| Rep-1 | 7.8 | 2.60 | 0.47 | 0.15 | 4.7 | 5.7 | 0.40 | 0.53 |
| Rep-2 | 7.8 | 3.19 | 0.50 | 0.16 | 3.8 | 5.9 | 0.34 | 0.73 |
| Rep-3 | 7.7 | 3.61 | 0.46 | 0.17 | 4.2 | 15.0 | 0.35 | 0.46 |
| Rep-4 | 7.9 | 3.25 | 0.23 | 0.11 | 5.0 | 5.8 | 0.32 | 0.51 |
| Rep-5 | 7.7 | 3.23 | 0.43 | 0.18 | 2.4 | 8.0 | 0.29 | 0.55 |
| Mean Nutrient status | 7.78 | 2.98 | 0.42 | 0.15 | 4.22 | 8.08 | 0.34 | 0.56 |
| Interpretation | Slightly alkaline | Low | High | Low | Very low | Low | Medium | Low |

Appendix table 9. Nutrient (N, P, K) balance in T.Aman under Boro-T.Aman cropping pattern (Goyeshpur)

| Treat ment | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | In Org. | Org. | BNF | Total | In Org. | Org. | BNF | Total | |
| | | N | 61 | 52 | 8 | - | 60 | 18 | 1 | - | 19 | -42 |
| $T_2$* | 3.38 | P | 10 | 16 | 8 | - | 24 | 3 | 1 | - | 4 | -6 |
| | | K | 68 | 20 | 26 | - | 46 | 10 | 3 | - | 13 | -55 |
| | | N | 62 | 65 | 8 | - | 73 | 23 | 1 | - | 24 | -38 |
| $T_4$* | 3.45 | P | 10 | 22 | 8 | - | 30 | 4 | 1 | - | 5 | -5 |
| | | K | 69 | 25 | 26 | - | 51 | 13 | 3 | - | 16 | -53 |
| | | N | 60 | 52 | 0 | - | 52 | 18 | 0 | - | 18 | -42 |
| $T_7$ | 3.35 | P | 10 | 16 | 0 | - | 16 | 3 | 0 | - | 3 | -7 |
| | | K | 67 | 20 | 0 | - | 20 | 10 | 0 | - | 10 | -57 |

Appendix table 10. Yield and yield contributing characters of Boro under Boro-T.aman cropping pattern at Comilla sadar during 1999-2000

| Treatment | Plant height (cm) | Tiller\ Hill | Panicle/ hill | Grain/ Panicle | Length of panicle (cm) | panicle/$m^2$ | 1000 Grain wt.(g) | Straw wt. (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| T1=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T2=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T3=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T4=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T5=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T6=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T7=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |
| T8=95-20-40-10 | 90.83 | 16.7 | 13.43 | 159.55 | 21 | 311.25 | 23.65 | 6.9 | 5.15 |

Appendix table 11. Yield and yield contributing characters of T.Aman under Boro - T.Aman cropping pattern at Comilla sadar during 1999-2000

| Treatment | Plant height (cm) | Tiller/ hill | Panicle/ hill | Grain/ Panicle | Length of panicle (cm) | panicle/ $m^2$ | 1000 Grain wt.(g) | Straw wt. (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| T1= 24-19-21-4.5 | 100.6 | 13.38 | 12.13 | 118 | 21.25 | 288.63 | 22.15 | 4.49 | 3.72b |
| T2=54-19-21-4.5+1/3rd RS | 100.2 | 12.65 | 10.80 | 121 | 21.43 | 308.03 | 22.15 | 4.49 | 4.52a |
| T3=54-19-21-4.5+/3rd SR | 71.6 | 13.80 | 12.48 | 108 | 20.40 | 312.55 | 21.98 | 5.35 | 4.65a |
| T4=65-22-25-20-+1/3rd RS | 96.5 | 13.50 | 12.58 | 125 | 21.95 | 325.68 | 22.5 | 5.27 | 4.45a |
| T5=50-18-16-20+2/3rd RS | 99.5 | 13.05 | 12.53 | 126 | 21.83 | 308.68 | 22.45 | 5.58 | 4.42a |
| T6=74-23-27-6.3 | 98.4 | 13.30 | 12.08 | 126 | 21.10 | 321.03 | 23.54 | 4.96 | 4.29ab |
| T7=54-19-21-4.5 | 98.2 | 12.38 | 10.98 | 121 | 21.38 | 278.00 | 23.77 | 5.75 | 4.06ab |
| T8=90-37-32 | 98.0 | 12.35 | 11.88 | 110 | 21.43 | 319.95 | 23.65 | 5.40 | 4.30ab |
| Sx | * | ns | ns | ** | * | * | ns | * | * |
| CV(%) | 5.2 | 4.2 | 0.5 | 2.1 | 4.5 | 12.9 | 2.5 | 7.2 | 6.5 |

Appendix table 12. Cost and return analysis of the cropping pattern Boro- T.Aman rice system at Comilla sadar during, 1999- 2000

| Treat. | Yield (t/ha) | | Variable cost(tk/ha) | Gross return (t/ha) | Gross margin (Tk/ha) | MBCR | MRR (%) |
|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | | | | | |
| T1 | 5.15 | 3.72 | 6032 | 68330 | 62298 | 0.76 | 23.6 |
| T2 | 5.15 | 4.52 | 6503 | 73930 | 67427 | 0.15 | 110.4 |
| T3 | 5.15 | 4.65 | 6572 | 75700 | 69128 | 0.40 | 140.2 |
| T4 | 5.15 | 4.45 | 7331 | 74220 | 66889 | 0.17 | 117.7 |
| T5 | 5.15 | 4.42 | 6740 | 74320 | 67580 | 0.18 | 117.6 |
| T6 | 5.15 | 4.00 | 7946 | 72790 | 64844 | 0.11 | 88.9 |
| T7 | 5.15 | 4.06 | 6434 | 71970 | 65536 | 0.22 | 78.2 |
| T8 | 5.15 | 4.30 | 12541 | 73300 | 60759 | - | - |

Variable cost = Fertilizer cost only

Input: Urea @ 6.00 Tk/Kg, TSP @ 15.00 Tk./kg, MP 9.00 Tk./kg, MP @ 4.50 Tk./kg
Output : Price of rice Boro @ 6.00 Tk./kg T. aman @ 7.00 Tk./kg Rice straw @ 1.00 Tk./kg.

Appendix table 13. Yield and yield contributing characters of Boro under Boro-T.Aman cropping pattern at Comilla sadar during 2000-01

| Treatment | Plant height (cm) | Tiller\ hill | Panicle/ hill | Grain/ Panicle | Length of panicle (cm) | panicle/ $m^2$ | 1000 Grain wt.(g) | Straw wt. (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| T1=95-20-40-10 | 103.05 | 10.10 | 9.9 | 159.90 | 28.10 | 301.40 | 23.8 | 8.1 | 6.43 |
| T2=95-20-40-10 | 103.62 | 9.90 | 9.3 | 154.15 | 28.30 | 312.50 | 23.9 | 8.4 | 6.47 |
| T3=95-20-40-10 | 104.53 | 10.10 | 9.6 | 161.85 | 29.35 | 306.40 | 24.1 | 8.3 | 6.37 |
| T4=95-20-40-10 | 103.26 | 9.50 | 9.1 | 157.10 | 29.20 | 298.98 | 23.9 | 8.8 | 6.87 |
| T5=95-20-40-10 | 104.88 | 10.30 | 9.8 | 153.40 | 28.30 | 305.20 | 23.4 | 8.5 | 6.67 |
| T6=95-20-40-10 | 101.10 | 10.15 | 9.6 | 161.30 | 28.85 | 299.30 | 23.6 | 8.1 | 6.23 |
| T7=95-20-40-10 | 103.63 | 10.50 | 9.8 | 153.85 | 29.70 | 301.40 | 23.7 | 8.2 | 6.30 |
| T8=95-20-40-10 | 102.15 | 10.10 | 9.7 | 153.40 | 27.30 | 305.20 | 23.9 | 8.2 | 6.30 |
| CV (%) | 3.5 | 2.4 | 1.4 | 9.4 | 3.1 | 6.9 | 1.5 | 2.5 | 3.7 |

Appendix table 14. Yield and yield contributing characters of T.Aman under Boro-T.Aman cropping pattern at Comilla sadar during 2000-01

| Treatment | Plant height (cm) | Tiller/ hill | Panicle/ hill | Grain/ Panicle | Length of panicle (cm) | 1000 Grain wt.(g) | Straw wt. (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| T1= 24-19-21-4.5 | 86.63 | 11.90 | 10.28 | 101.53 | 20.63 | 23.45 | 4.62 | 3.75c |
| T2=54-19-21-4.5+1/3rd RS | 86.06 | 12.93 | 11.75 | 87.70 | 22.85 | 23.1 | 6.71 | 5.38a |
| T3=54-19-21-4.5+2/3rd RS | 85.48 | 10.98 | 11.15 | 101.08 | 21.80 | 23.6 | 5.13 | 5.48a |
| T4=65-22-25-20-+1/3rd RS | 91.53 | 10.98 | 10.13 | 100.18 | 21.95 | 22.45 | 6.76 | 5.38a |
| T5=50-18-16-20+2/3rd RS | 80.10 | 12.03 | 10.68 | 89.68 | 19.60 | 22.98 | 5.49 | 5.18ab |
| T6=74-23-27-6.3 | 88.78 | 13.35 | 12.53 | 107.30 | 22.38 | 23.65 | 6.62 | 5.30a |
| T7=54-19-21-4.5 | 81.80 | 12.63 | 12.90 | 81.13 | 19.75 | 23.4 | 5.78 | 4.63b |
| T8=90-37-32 | 89.40 | 11.70 | 10.95 | 94.20 | 22.75 | 23.65 | 6.25 | 5.00ab |
| CV (%) | 4.6 | 5.1 | 2.1 | 11.3 | 2.5 | 2.6 | 3.1 | 4.8 |

# DEVELOPMENT OF FERTILIZER RECOMMENDATION FOR THE CROPPING PATTERN MAIZE (HYBRID)–T.AMAN RICE (MV) UNDER IRRIGATED CONDITION


## Abstract

Experiments were conducted at ARS, OFRD, BARI, Rangpur from 1998-99 to 2000-01 to observe the effect of seeding time and fertilizer dose on hybrid maize and residual effects of P and K on T.Aman rice for developing a profitable fertilizer recommendation for the cropping pattern 'Maize (hybrid)-T.Aman rice (MV)'. There was no effect of seeding time on the yield of hybrid maize. There was also no significant difference between the fertilizer dose for HYG and MYG in maize. There were enough residual effects of P and K used in maize for T.Aman. Since some P and K to be applied every crops for maintaining soil fertility, using recommended fertilizer dose for MYG for maize and 90-11-17 kg N-P-K $ha^{-1}$ fertilizer for T.Aman rice may be recommended for the cropping pattern 'Maize (hybrid) - T.aman rice (MV)' for the AEZ # 3.


## Introduction

Farmers in greater Rangpur and Dinajpur districts are practicing the cropping pattern 'Maize (hybrid) – T.Aman rice (MV)' under irrigated condition in the medium highlands. The said pattern provides higher economic return than 'Boro rice-T.Aman rice' cropping pattern. Chemical fertilizers have become costly resulting in high cultivation cost of each individual crop. It is already reported that the soils of agro-ecological zone 3 (AEZ # 3) are low in organic matter, nitrogen, phosphorus and sulphur content. Besides, farmers usually apply chemical fertilizers on individual crop basis. It was, therefore, felt essential to develop a profitable and economically viable fertilizer dose for the said cropping pattern. The objective of the study were to observe the effect of seeding time and fertilizer dose on hybrid maize and residual effects of P and K on T.Aman rice for developing a profitable fertilizer recommendation for the cropping pattern 'Maize (hybrid) – T.Aman rice (MV)', and to maximize the productivity of the crops of the pattern and minimize the use of chemical fertilizers.

## Materials and Methods

During the rabi season of 1998-99, hybrid maize (var. Pacific-60) was grown as the first crop of the pattern 'Maize(hybrid)-T.Aman(MV)'. The experiment was laid out in a split-plot design accommodating the date of seeding in the main plots. The dates of seeding were 30 Nov. ($D_1$) and 15 Dec. ($D_2$), 1998. Sub-plots were assigned by 2 fertilizer doses. Fertilizer doses were; i) for high yield goal (HYG) i.e., 250-53-140-40-5-2 kg P-K-S-Zn-B $ha^{-1}$ and ii) for moderate yield goal (MYG), i.e., 175-37-100-30-3.5-1 kg N-P-K-S-Zn-B $ha^{-1}$ based on soil analysis interpretation.

In the following crop i.e., T.Aman, the experiment was laid out in a split-split-plot design. Plots for maize were sub-divided into six sub-sub-plots. The plots were fertilized by six different NPK combinations. They were 90-22-33 ($T_1$), 90-17-25 ($T_2$), 90-11-17 ($T_3$), 90-6-8 ($T_4$), 90-0-0 ($T_5$) and 45-0-0 ($T_6$) kg N-P-K $ha^{-1}$. Thirty-d-old seedlings of BR-11 were transplanted at a spacing of 25 × 15 cm on 15 July, 1999.

In the 2nd and 3rd cycles of the cropping pattern all the crops were grown without breaking boundaries of the plots. Maize was grown with two recommended fertilizer doses maintaining similar spacing of 1998 and seeds were sown on two dates; 26 Nov. ($D_1$) and 20 Dec. ($D_2$) in 1999 and 23 Nov. ($D_1$) and 20 Dec. ($D_2$) in 2000. T.Aman was grown with 6 different fertilizers described earlier in the same plots of previous fertilizers dose. Thirty-three and 32-d-old seedlings of T.Aman rice (var. BR-11) were transplanted at a spacing of 25 × 15 cm on 18 July, 2000 and 17 July, 2001, respectively. Standard procedure of fertilizer application was followed for all the crops. Weeding, mulching and plant protection measures were taken as and when necessary. The crops were harvested after maturity and yield data were taken. Data were analyzed statistically.

## Results and Discussion

The result showed that there was no significant difference between the fertilizer dose for high yield and medium yield goal in maize (Table 15). On the basis of three year findings it may be concluded that 175-37-100-30 - 3.5-1 kg N-P-K-S-Zn-B for hybrid maize and 90-0-0 kg NPK kg/ha for T. Aman rice is found profitable (Table 15) and recommended for AEZ 3 of Rangpur region.

Table 1. Effect of date of seeding and fertilizer dose on yield of hybrid maize (var. Pacific-60) at ARS, OFRD, BARI, Rangpur during rabi, 1998-99

| Treatment | Grain yield(t $ha^{-1}$) | Stover yield(t $ha^{-1}$) |
|---|---|---|
| Date of seeding | | |
| 30 Nov., 1998 ($D_1$) | 9.49 | 12.73 |
| 15 Dec., 1998 ($D_2$) | 9.12 | 11.11 |
| $LSD_{0.05}$ | ns | ns |
| CV (%) | 22.52 | 9.06 |

Table 2. Effect of fertilizer does on the yield of hybrid maize during winter season 1998-2001 (Pacific -60)

| Fertilizer dose | Grain yield (t/ha) | | | | Stover yield (t/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | 98-99 | 99-00 | 2000-01 | Average | 98-99 | 99-00 | 2000-01 | Average |
| HYG | 9.82 | 9.25 | 9.18 | 9.42 | 12.14 | 11.92 | 12.02 | 12.04 |
| MYG | 8.78 | 8.61 | 8.69 | 8.69 | 11.11 | 11.33 | 11.39 | 11.48 |
| LSD(.05) | ns | ns | ns | ns | ns | ns | ns | ns |
| CV (%) | 10.04 | 13.33 | 9.88 | 10.68 | 4.26 | 8.68 | 16.88 | 9.44 |

HYG : 250-53-140-40-5- 2 kg NPKSZNB/ha
MYG : 175-37-100-30-3.5-1 kg.

Table 3. Cost and return analysis of maize (hybrid)-T.Aman rice (BR11) cropping pattern as influenced by different dose of fertilizer (average 1999-2001)

| Fertilizer for Maize | Treatment T.Aman | Grain yield of T.Aman (t/ha) | Gross margin ($/ha) | Total Variable cost ($/ha) | Gross return ($/ha) | Benefit cost ratio |
|---|---|---|---|---|---|---|
| High yield goal | $T_1$ | 3.47 | 1605 | 542 | 1063 | 2.96 |
| (250-53-14-40-5-2 | $T_2$ | 3.27 | 1588 | 535 | 1053 | 2.97 |
| NPKSZnB kg/ha) | $T_3$ | 3.32 | 1596 | 528 | 1062 | 3.02 |
| | $T_4$ | 3.30 | 15925 | 520 | 1072 | 3.02 |
| | $T_5$ | 3.26 | 1586 | 509 | 1077 | 3.12 |
| | $T_6$ | 2.66 | 1504 | 503 | 1001 | 2.99 |
| Medium high yield goal | $T_1$ | 3.45 | 1525 | 483 | 1042 | 3.16 |
| (175-3-7-100-30-3.5-1 | $T_2$ | 3.38 | 1509 | 476 | 1033 | 3.17 |
| NPKSZnB kg/ha) | $T_3$ | 3.36 | 1515 | 470 | 1045 | 3.23 |
| | $T_4$ | 3.35 | 1512 | 461 | 1051 | 3.28 |
| | $T_5$ | 3.31 | 1506 | 454 | 1052 | 3.32 |
| | $T_6$ | 2.72 | 1424 | 444 | 980 | 320 |

ns= Not significant
$T_1$= 90-22-33, $T_2$=90-17-25 1 $ = Tk. 58/-
$T_3$ =90-11-17, $T_4$=90-6-8
$T_5$= 90-0-0, $T_6$ =45-0-0 NPK kg/ha

## 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 21 different locations across the country with 7 dominant cropping patterns during 1998-99 to 2000-01 to see the response of crops to NPKS and to find out an optimum fertilizer dose for the crops. Four different levels of NPKS, viz. 0, MYG, HYG and HYG x 1.3 were tested. Results showed that a marked response on the yield of crops to N was evident irrespective of locations. Even in some locations the response was linear. A considerable response to P was also observed in most of the locations, particularly in p deficient soils. But response to K and S was not clear in some of the locations. From the yield data a response curve was drawn and optimum fertilizer dose for the crops were find out.


### Introduction

Crops grown in different cropping patterns and environment responded differently to mineral fertilizer nutrients. The nature of response may vary over time. In the past, most of the fertilizer recommendations were individual crop basis. But there some residual effects of some nutrient elements particularly PKS and Zn are found in the succeeding crops. In Bangladesh different crops are grown in different cropping patterns under different agro-climatic condition. Recently BARC developed a national fertilizer recommendation guide '97 with fertilizer recommendation for different crops based on AEZ that needs to further update and verified for different dominant cropping patterns at different environments. Therefore, it is very important to verify and update the present recommendation of BARC FRG'97 for major crops under different agro-ecological condition.

### Objective

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

### Materials and Methods

The experiment on seven dominant cropping patterns was conducted during 1998-99 to 2000-01 at different AEZs to determine optimum and economic dose of fertilizer nutrients for major crops grown in different environments. 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 | Palima, Melandah, Narikeli, Muktagacha , Bagherpara |
| Boro-T.Aman | Phulpur, Netrokona, Kishoreganj, Kendua, Ishan Gopalpur, Bagerhat, Kalaroa |
| Wheat-Jute-T.Aman | Sherpur |
| Wheat-T.Aman | Goyeshpur, Barind |
| Mungbean-T.Aus-T.Aman | Bhola, Lebukhali |
| Mustard-Boro | Manikganj |
| Groundnut-T.Aman | Laxmipur |
| Onion-T.Aman | Baliakandi |
| T.Aus-T.Aman | Golapganj, Moulvibazar |
| Fallow-Fallow-T.Aman | Atkapalia |

**Cropping pattern : Mustard - Boro - T.Aman**
**Location : Palima, Tangail**
**Year of establishment : 1998-99 to 2000-01**

### Mustard

In Mustard, response of nitrogen to some extent was observed. Seed yield increased significantly up to 60 kg N/ha and then tended to decrease. Similarly, phosphorus also showed some response towards the yield and yield increased up to 20 kg P/ha. A little response of K was also found. Seed yield increased up to 45 kg K/ha.

### Boro rice

Grain yield of rice increased up to the application of N @ 130 kg/ha and thereafter the yield decreased slowly. Similar trend was observed in case of phosphorus and the highest yield was recorded from 30 kg P/ha. Response of K was not very clear but yield slightly increased up to 50 kg/ha.

### T.Aman rice

Response of nitrogen was found on the yield of T.Aman rice. Yield increased markedly with the increase of nitrogen up to 60 kg/ha and thereafter slowly increased up to 80 kg /ha. After that level grain yield started to decrease. In case of phosphorus and potassium a little response was observed and the grain yield increased slowly up to 20 and 50 kg/ha of P and K, respectively. From the data a response curve was drawn and the optimum dose for Mustard, Boro and T. aman rice were calculated.

| Crop | Optimum doses (kg/ha) | | | Economic doses (kg/ha) | | |
|---|---|---|---|---|---|---|
| | N | P | K | N | P | K |
| Mustard | 77 | 26 | 47 | 74 | 25 | 40 |
| Boro rice | 157 | 30 | 60 | 110 | 27 | 61 |
| T.Aman rice | 91 | 21 | 30 | 88 | 18 | 29 |

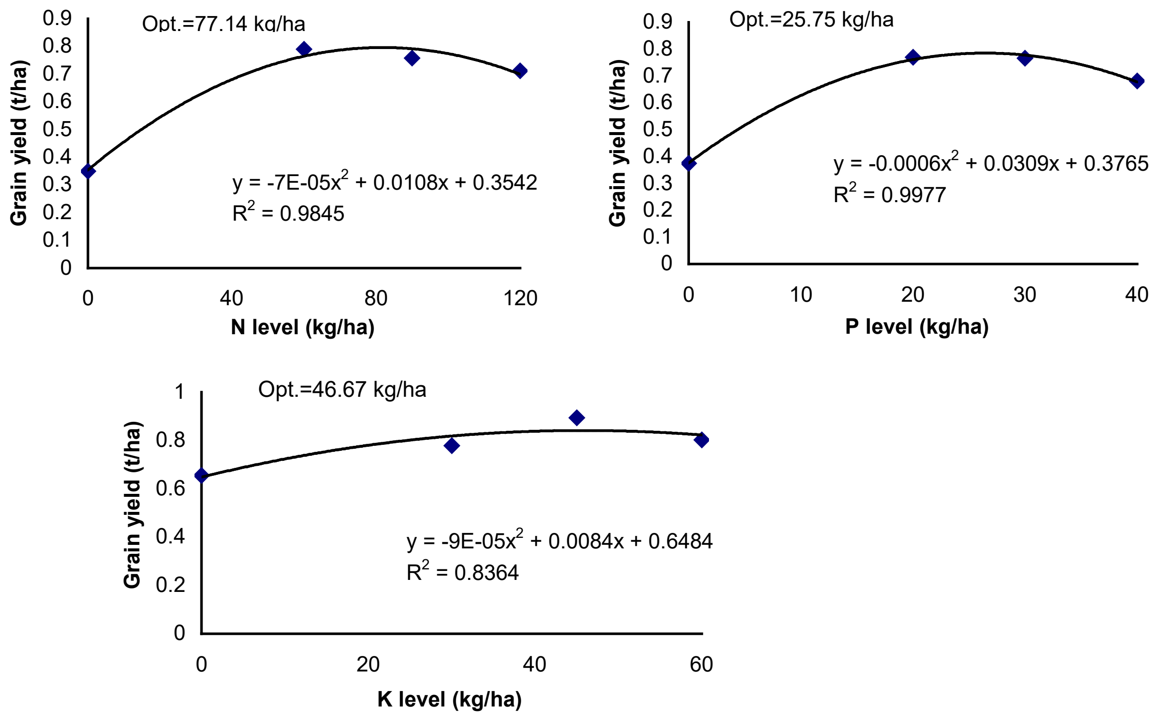



Figure 1. Response of Mustard to added N, P and K grown in Mustard-Boro-T.Aman cropping pattern at Palima, Tangail (Avg. of 1998-99 to 2000-01)

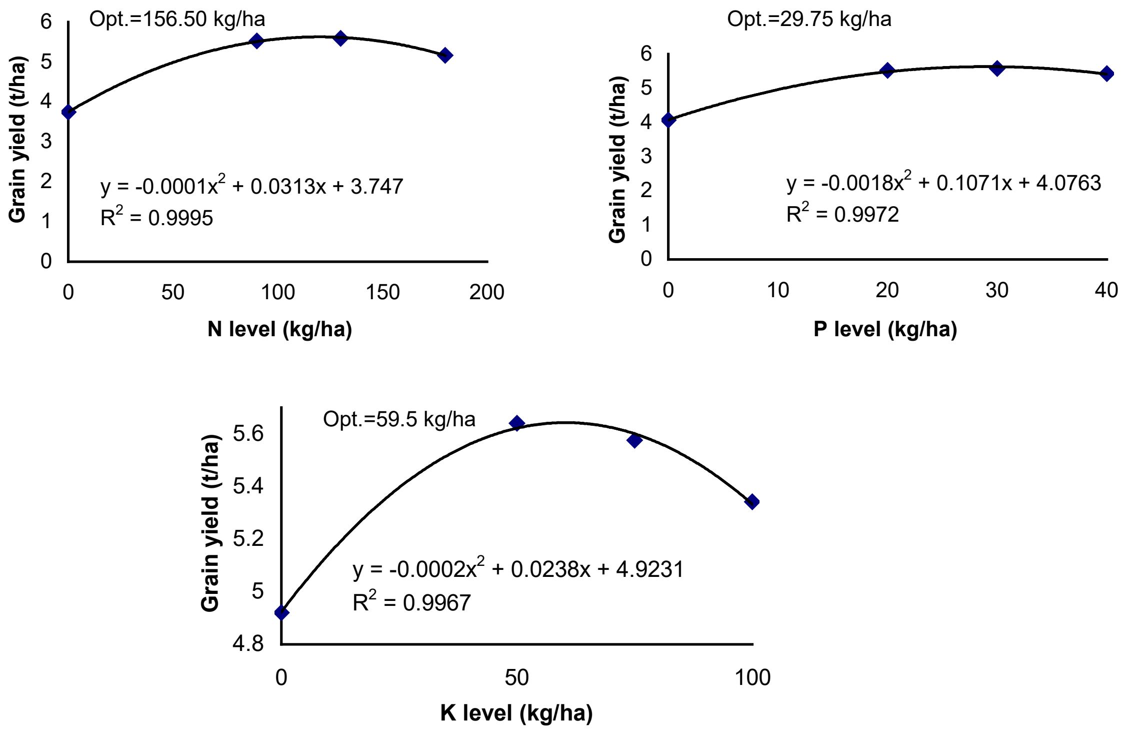



Figure 2. Response of Boro to added N, P and K grown in Mustard-Boro-T.Aman cropping pattern at Palima, Tangail (Avg. of 1998-99 to 2000-01)

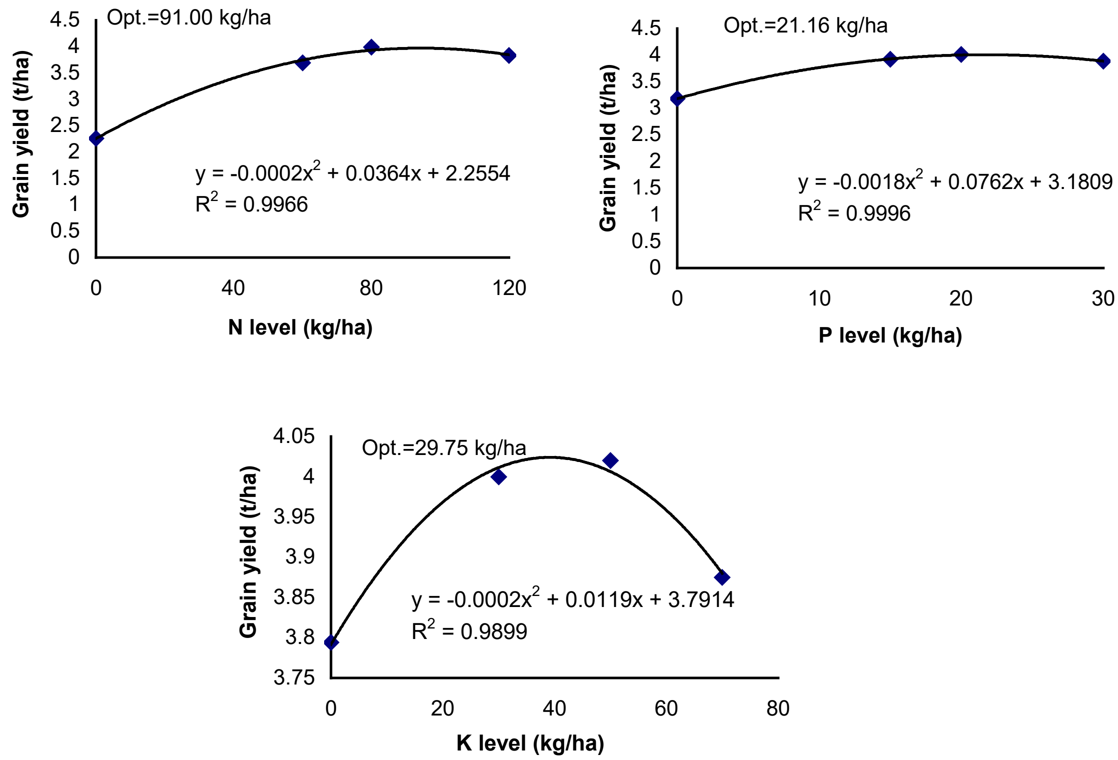



Figure 3. Response of T.Aman to added N, P and K grown in Mustard-Boro-T.Aman cropping pattern at Palima, Tangail (Avg. of 1998-99 to 2000-01)

Table 1. Effect of different level of fertilizer nutrients on the yield and economics of Mustard in Mustard-Boro-T.Aman cropping pattern at Palima, 1998-99 to 2000-01

| Fertilizer level | Grain yield (t/ha) | | | |
|---|---|---|---|---|
| | 1998-99 | 1999-2000 | 2000-2001 | Average |
| N level (kg/ha) | | | | |
| 0 | 0.321 | 0.343 | 0.385 | 0.350 |
| 60 | 0.702 | 0.700 | 0.968 | 0.790 |
| 90 | 0.719 | 0.692 | 0.864 | 0.758 |
| 120 | 0.673 | 0.641 | 0.822 | 0.712 |
| P level (kg/ha) | | | | |
| 0 | 0.364 | 0.377 | 0.385 | 0.375 |
| 20 | 0.716 | 0.717 | 0.877 | 0.770 |
| 30 | 0.739 | 0.692 | 0.868 | 0.766 |
| 40 | 0.691 | 0.602 | 0.752 | 0.682 |
| K level (kg/ha) | | | | |
| 0 | 0.660 | 0.639 | 0.66 | 0.655 |
| 30 | 0.783 | 0.751 | 0.802 | 0.779 |
| 45 | 0.859 | 0.854 | 0.968 | 0.894 |
| 60 | 0.801 | 0.777 | 0.832 | 0.803 |

Table 2. Effect of different level of fertilizer nutrients on the yield and economics of Boro in Mustard- Boro-T.Aman cropping pattern at Palima, 1998-99 to 2000-01

| Fertilizer level | Grain yield (t/ha) | | | |
|---|---|---|---|---|
| | 1998-'99 | 1999-2000 | 2000-2001 | Average |
| N level (kg/ha) | | | | |
| 0 | 3.28 | 3.676 | 4.275 | 3.744 |
| 90 | 5.01 | 5.078 | 6.500 | 5.529 |
| 130 | 5.56 | 4.938 | 6.275 | 5.591 |
| 180 | 5.46 | 4.522 | 5.525 | 5.169 |
| P level (kg/ha) | | | | |
| 0 | 3.73 | 3.980 | 4.500 | 4.070 |
| 20 | 5.56 | 4.872 | 6.125 | 5.519 |
| 30 | 5.53 | 4.938 | 6.275 | 5.581 |
| 40 | 5.50 | 4.920 | 5.875 | 5.432 |
| K level (kg/ha) | | | | |
| 0 | 5.01 | 4.501 | 5.250 | 4.920 |
| 50 | 5.56 | 4.836 | 6.525 | 5.640 |
| 75 | 5.46 | 4.794 | 6.475 | 5.576 |
| 100 | 5.40 | 4.652 | 5.975 | 5.342 |

Table 3. Effect of different level of fertilizer nutrients on the yield of T.Aman in Mustard-Boro- T.Aman cropping pattern at Palima, 1998-99 to 2000-01

| Fertilizer level | Grain yield (t/ha) | | | |
|---|---|---|---|---|
| | 1998-'99 | 1999-2000 | 2000-2001 | Average |
| N level (kg/ha) | | | | |
| 0 | 2.28 | 2.125 | 2.383 | 2.262 |
| 60 | 3.64 | 3.537 | 3.900 | 3.692 |
| 80 | 4.23 | 3.675 | 4.067 | 3.991 |
| 120 | 4.06 | 3.600 | 3.833 | 3.831 |
| P level (kg/ha) | | | | |
| 0 | 3.18 | 3.065 | 3.300 | 3.182 |
| 15 | 4.03 | 3.313 | 4.417 | 3.920 |
| 20 | 4.23 | 3.342 | 4.467 | 4.013 |
| 30 | 4.10 | 3.339 | 4.217 | 3.885 |
| K level (kg/ha) | | | | |
| 0 | 4.11 | 3.254 | 4.017 | 3.794 |
| 30 | 4.24 | 3.412 | 4.350 | 4.000 |
| 50 | 4.23 | 3.463 | 4.367 | 4.020 |
| 70 | 4.16 | 3.365 | 4.100 | 3.875 |

**Location : Melandah, Jamalpur**
**Year of establishment: 2000-01**

### Mustard

In Mustard, a positive response of N was observed. Seed yield increased with the increase of N level and the highest yield was recorded from 100 kg N/ha. Similarly P, K and S also have some response and yield increased up to 24, 26 and 30 kg/ha of P, K and S, respectively.

### Boro

In Boro rice, grain yield increased up to 145 kg N/ha and then showed to decrease. As regards P, K and S, grain yield increased up to 26, 45 and 22 kg/ha P, K and S, respectively.

### T.Aman

In T.Aman rice, the grain yield increased markedly up to 100 kg N/ha and then decreased slowly. Similarly P, K and S also showed some response and yield increased up to 16, 29 and 13 kg/ha of P, K and S, respectively.

From the data a response curve was drown and the optimum dose of N P and K both for agronomic and economic as well was find out.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Mustard | 103 | 23 | 25 | 29 | 102 | 20 | 24 | 27 |
| Boro | 135 | 26 | 45 | 23 | 135 | 26 | 45 | 22 |
| T.Aman | 98 | 17 | 30 | 14 | 95 | 16 | 29 | 13 |

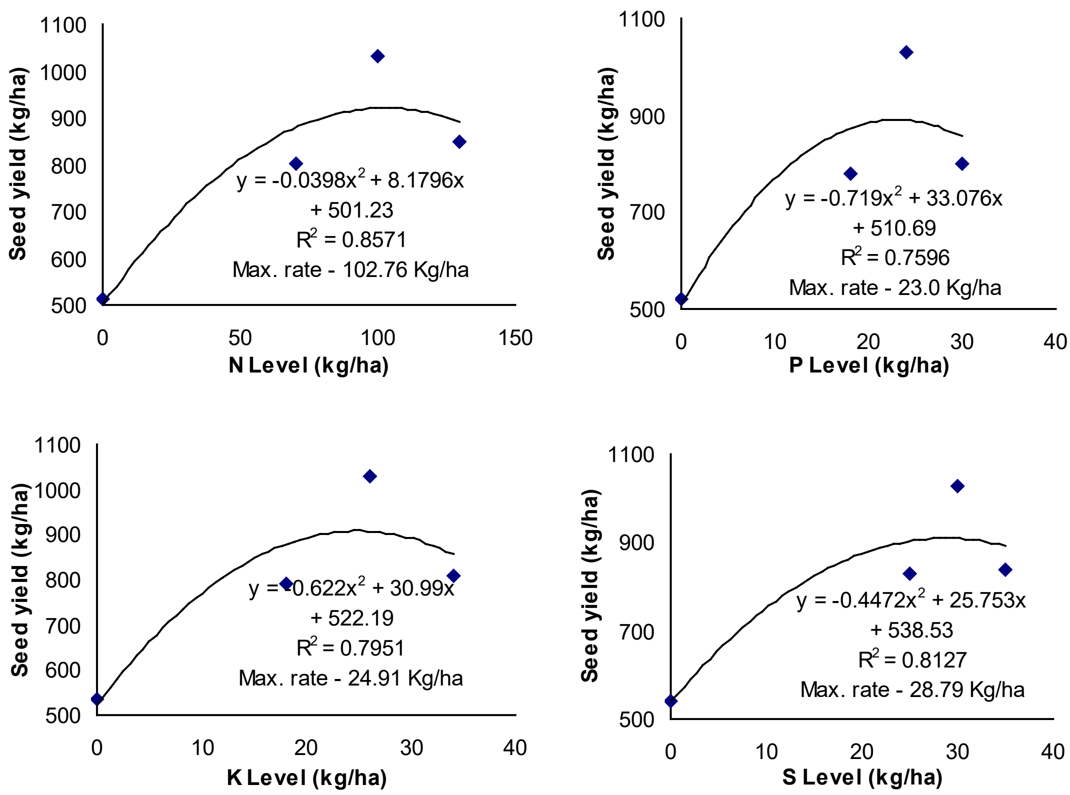



Figure 4. Response of Mustard to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern at Melandah during 1999-2000

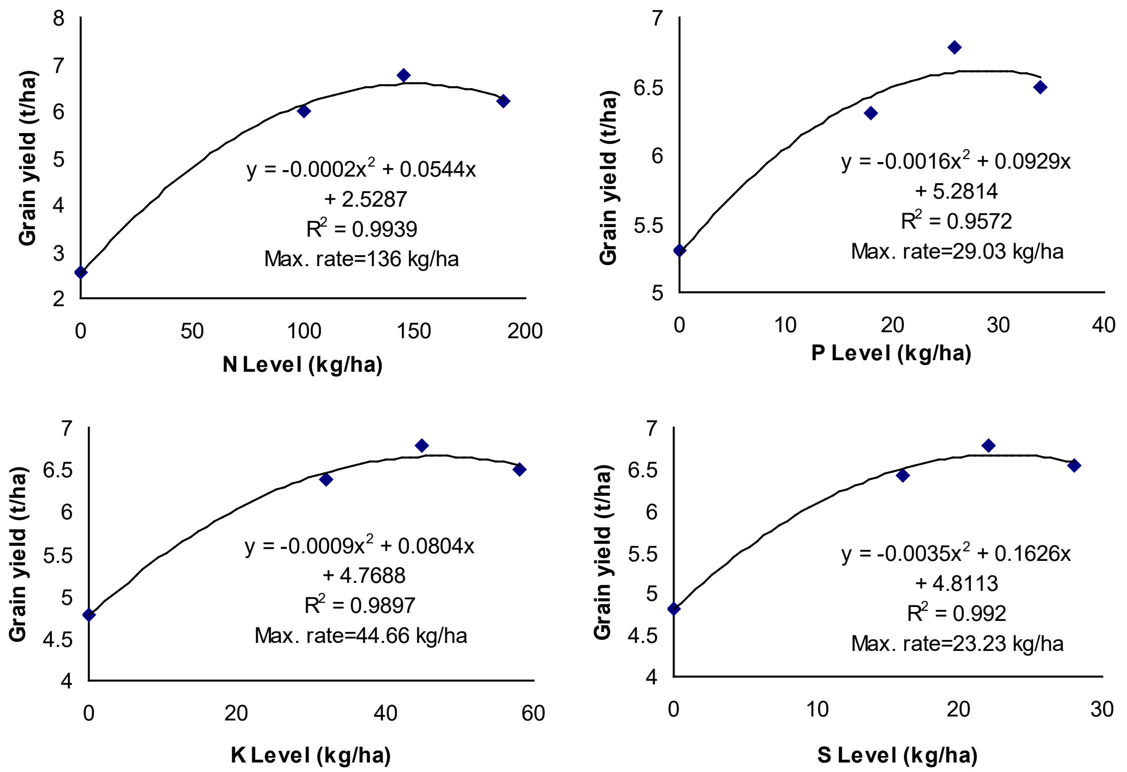



Figure 5. Response of Boro to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern at Melandah during 1999-2000

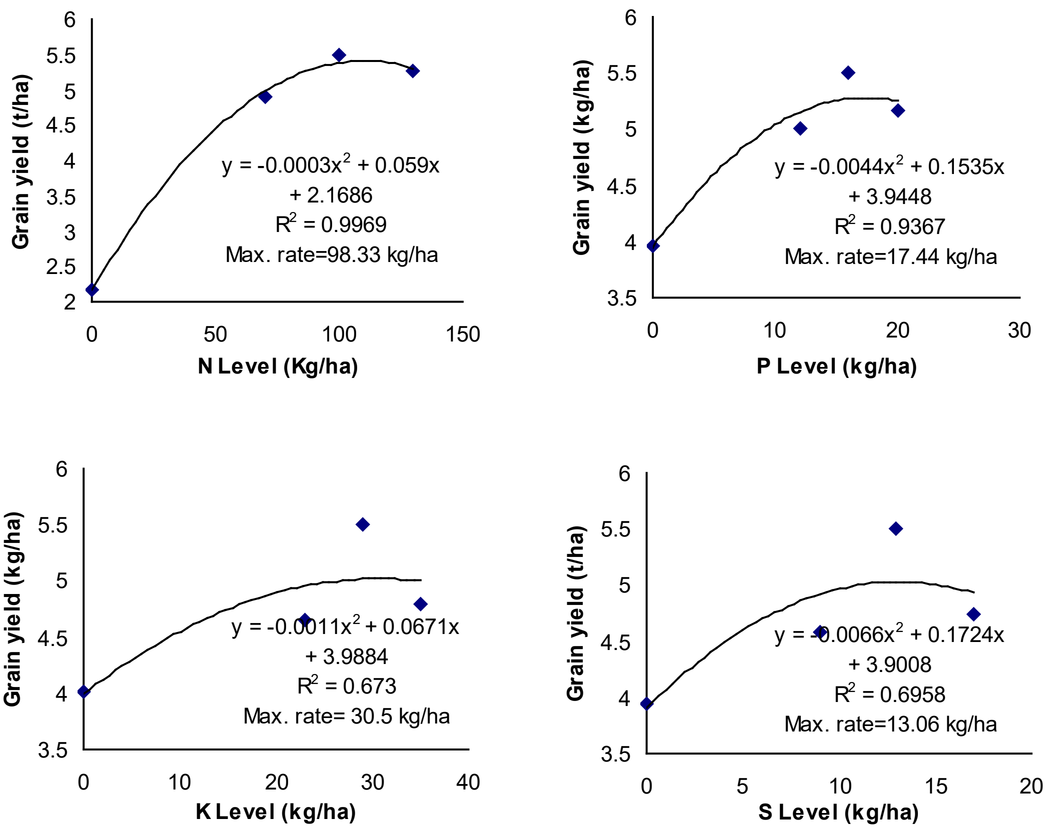



Figure 6. Response of T.Aman to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern at Melandah during 1999-2000

Table 4. Effects of different levels of fertilizer nutrients on the yield of crops in Mustard- Boro - T.Aman cropping pattern at Melandah, Jamalpur, 2000-01

| Nutrient levels (kg/ha) | | | Grain yield | | |
|---|---|---|---|---|---|
| Mustard | Boro | T.Aman | Mustard (kg/ha) | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | | | |
| 0 | 0 | 0 | 512 | 2.55 | 2.18 |
| 70 | 100 | 70 | 801 | 6.00 | 4.90 |
| 100 | 145 | 100 | 1030 | 6.78 | 5.50 |
| 130 | 190 | 130 | 850 | 6.20 | 5.26 |
| P levels | | | | | |
| 0 | 0 | 0 | 520 | 5.30 | 3.96 |
| 18 | 18 | 13 | 780 | 6.30 | 5.00 |
| 24 | 26 | 16 | 1030 | 6.78 | 5.50 |
| 30 | 34 | 20 | 800 | 6.50 | 5.16 |
| K levels | | | | | |
| 0 | 0 | 0 | 535 | 4.78 | 4.01 |
| 18 | 32 | 23 | 790 | 6.38 | 4.65 |
| 26 | 45 | 29 | 1030 | 6.78 | 5.50 |
| 34 | 58 | 35 | 810 | 6.51 | 4.80 |
| S levels | | | | | |
| 0 | 0 | 0 | 542 | 4.82 | 3.95 |
| 25 | 16 | 9 | 830 | 6.43 | 4.58 |
| 30 | 22 | 13 | 1030 | 6.78 | 5.50 |
| 35 | 28 | 17 | 840 | 6.54 | 4.75 |

**Location : Narikeli, Jamalpur**
**Year of establishment : 2000-01**

**Mustard**

In Mustard, a positive response of N was observed. Seed yield increased with the increase of N level and the highest yield was recorded from 80 kg N/ha. Similarly P, K and S also have some response and yield increased up to 20, 36 and 20 kg/ha of P, K and S, respectively.

**Boro**

In Boro rice, grain yield increased up to 130 kg N/ha and then started to decrease. As regards P, K and S, grain yield increased up to 20, 60 and 20 kg P, K and S, respectively.

**T.Aman**

In T.Aman rice, the grain yield increased markedly up to 60 kg N/ha. Thereafter yield also increased slowly up to 80 kg N/ha and then started to decrease. Similarly P, K and S also showed some response and yield increased up to 16, 45 and 9 kg/ha of P, K and S, respectively.

From the data a response curve was drown and the optimum dose of N P and K both for agronomic and economic as well was find out.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Mustard | 79 | 18 | 25 | 16 | 76 | 14 | 23 | 14 |
| Boro | 135 | 20 | 43 | 22 | 130 | 18 | 42 | 21 |
| T.Aman | 83 | 14 | 34 | 7 | 70 | 13 | 32 | 7 |

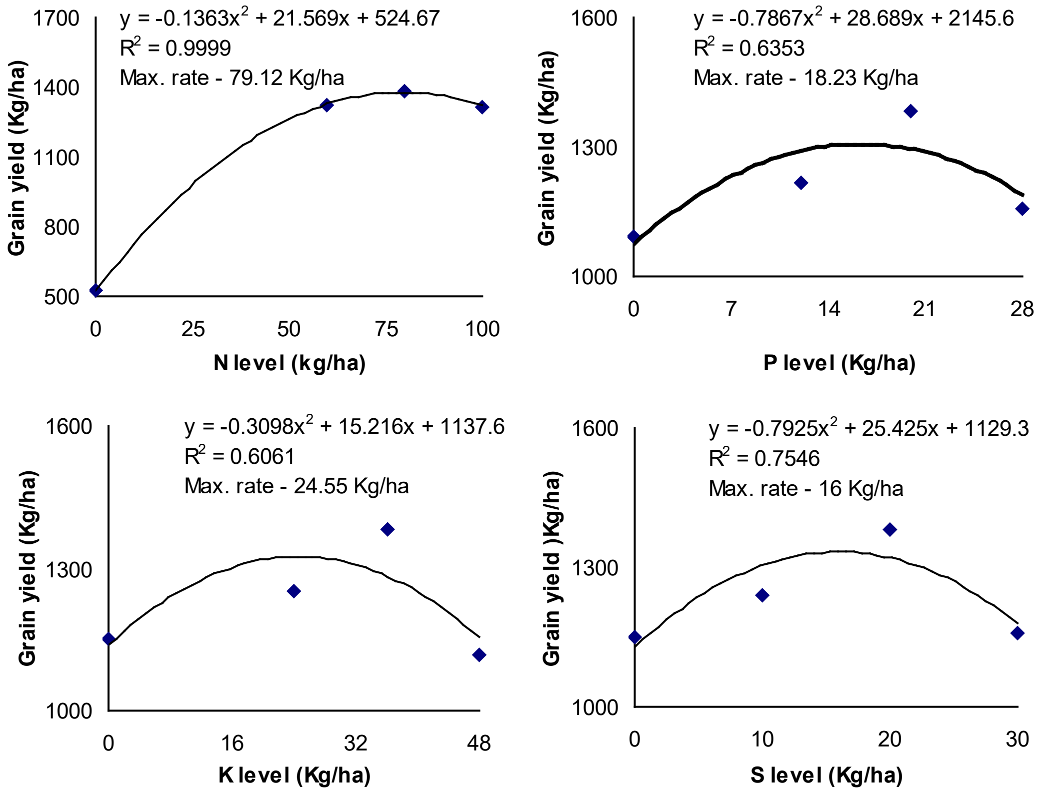



Figure 7. Response of Mustard to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern at FSRD site, Narikeli, Jamalpur during 2000-2001

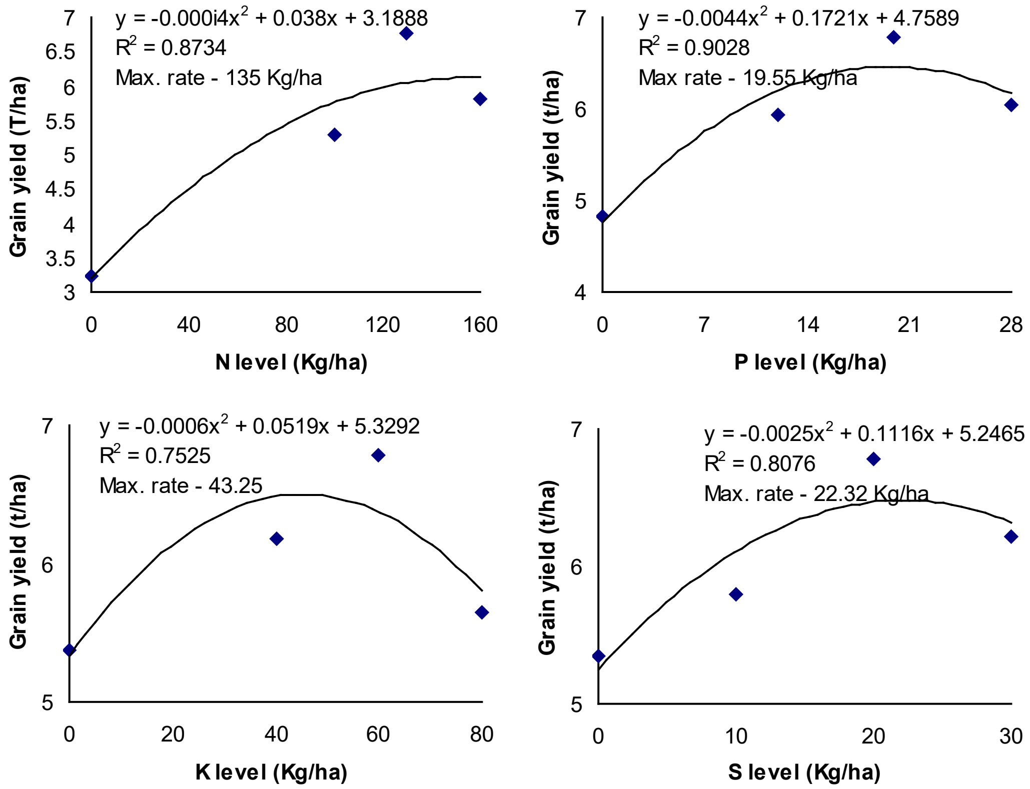



Figure 8. Response Boro rice to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern at FSRD site, Narikeli, Jamalpur during 2001

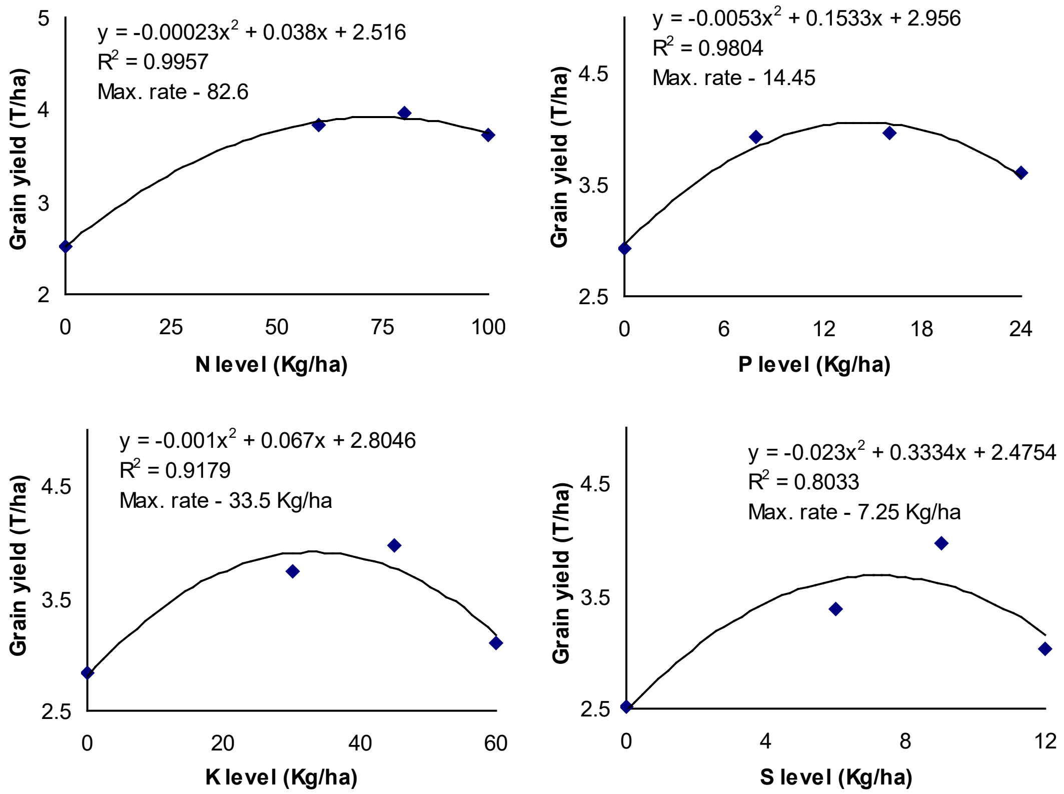



Figure 9. Response of T.Aman to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern at FSRD site, Narikeli, Jamalpur during 2001

Table 5. Effects of different levels of fertilizer nutrients on the yield of crops in Mustard- Boro - T.Aman cropping pattern at Narikeli, Jamalpur, 2000-01

| Nutrient levels (kg/ha) | | | Grain yield | | |
|---|---|---|---|---|---|
| Mustard | Boro | T.Aman | Mustard (kg/ha) | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | | | |
| 0 | 0 | 0 | 525 | 3.23 | 2.52 |
| 60 | 100 | 60 | 1325 | 5.28 | 3.83 |
| 80 | 130 | 80 | 1383 | 6.78 | 3.97 |
| 100 | 160 | 100 | 1317 | 5.82 | 3.72 |
| P levels | | | | | |
| 0 | 0 | 0 | 1092 | 4.82 | 2.93 |
| 12 | 12 | 8 | 1217 | 5.93 | 3.92 |
| 20 | 20 | 16 | 1383 | 6.78 | 3.97 |
| 28 | 28 | 24 | 1158 | 6.05 | 3.60 |
| K levels | | | | | |
| 0 | 0 | 0 | 1150 | 5.38 | 2.83 |
| 24 | 40 | 30 | 1250 | 6.18 | 3.75 |
| 36 | 60 | 45 | 1383 | 6.78 | 3.97 |
| 48 | 80 | 60 | 1117 | 5.65 | 3.10 |
| S levels | | | | | |
| 0 | 0 | 0 | 1150 | 5.35 | 2.52 |
| 10 | 10 | 6 | 1242 | 5.80 | 3.38 |
| 20 | 20 | 9 | 1383 | 6.78 | 3.97 |
| 30 | 30 | 12 | 1158 | 6.22 | 3.03 |

**Location : Muktagacha, Mymensingh**
**Year of establishment: 2000-01**

**Mustard**

Grain yield was increased with the addition of N fertilizer. Highest yield (600 kg/ha) was obtained when highest dose of N 85 kg/ha was applied. Here yield increased linearly so we don't know where the maximum doses or optimum dose up to the stated limit. But response to P, K and S was observed to some extent. Seed yield increased up to 25, 50 and 7 kg/ha of P, K and S, respectively.

**Boro rice**

Grain yield increased with the increase of nitrogen and the trend was linear. Highest grain yield (5.68 t/ha) was obtained from the highest level of N (160 kg/ha). The maximum or optimum dose may be the next addition of nutrients. Similar trend was also observed in case of phosphorus. However, the rate of increment was not so high but tended to increase up to the highest level of P. So we don't know where the maximum or optimum dose up to the stated limit. In case of K and S a quadratic relationship was observed and yield increased up to the application of 45 and 12 kg/ha of K and S, respectively.

**T.Aman**

Response of T.Aman to nitrogen was similar to Mustard and Boro rice. Grain yield increased linearly over nitrogen application. The result indicates that the nitrogen requirement of the crops is more than the applied rate. A further addition of higher level of N is needed to find out an optimum rate for the crops. Similar trend was observed in phosphorus and a slower but linear increase of yield was noticed. A positive response of K and S towards the yield was evident and yield increased up to 60 and 4 kg/ha, respectively.

From the data a response curve was drown and the optimum dose of nutrients both for agronomic and economic as well was find out.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Mustard | - | 25 | 50 | 8 | - | 5 | 28 | 7 |
| Boro | - | - | - | 23 | - | - | - | 21 |
| T.Aman | - | - | 52 | 4 | - | - | 51 | 4 |

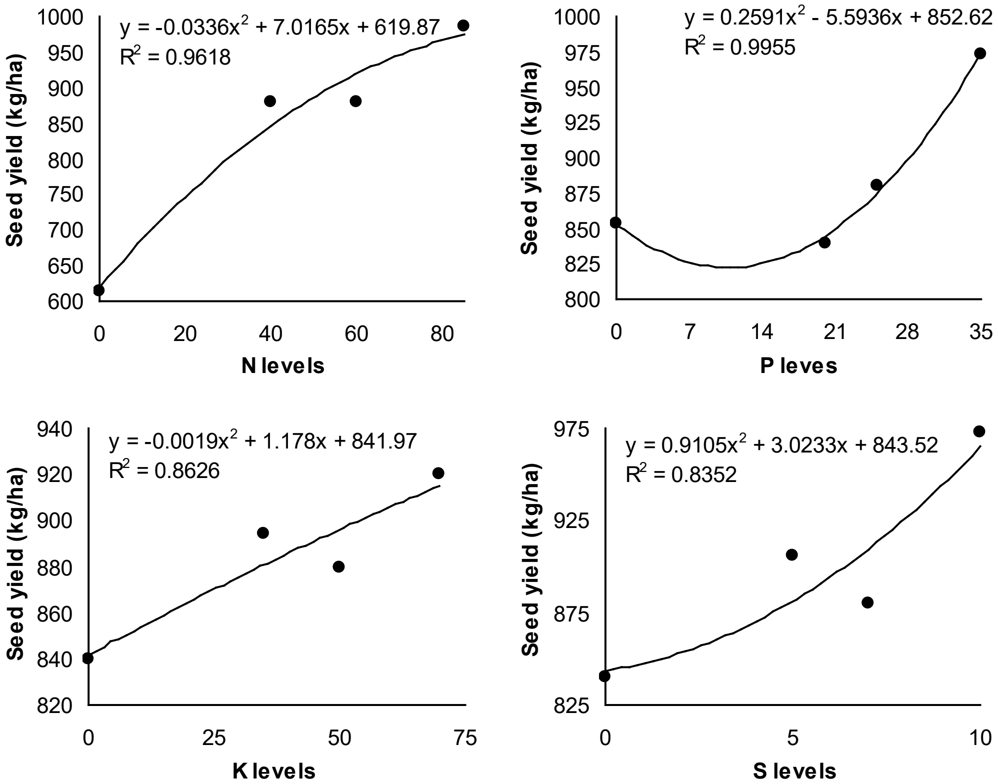



Figure 10. Response of Mustard to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern during 2000-01 at Muktagacha, Mymensingh

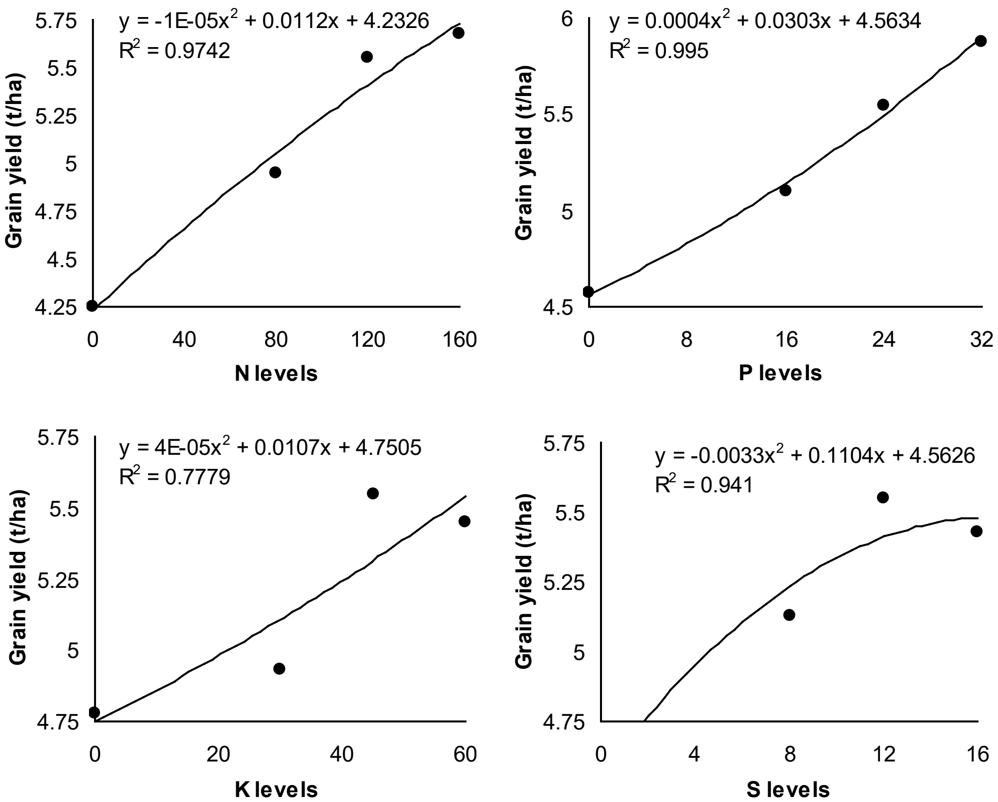



Figure 11. Response of Boro to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern during 2000-01 at Muktagacha, Mymensingh

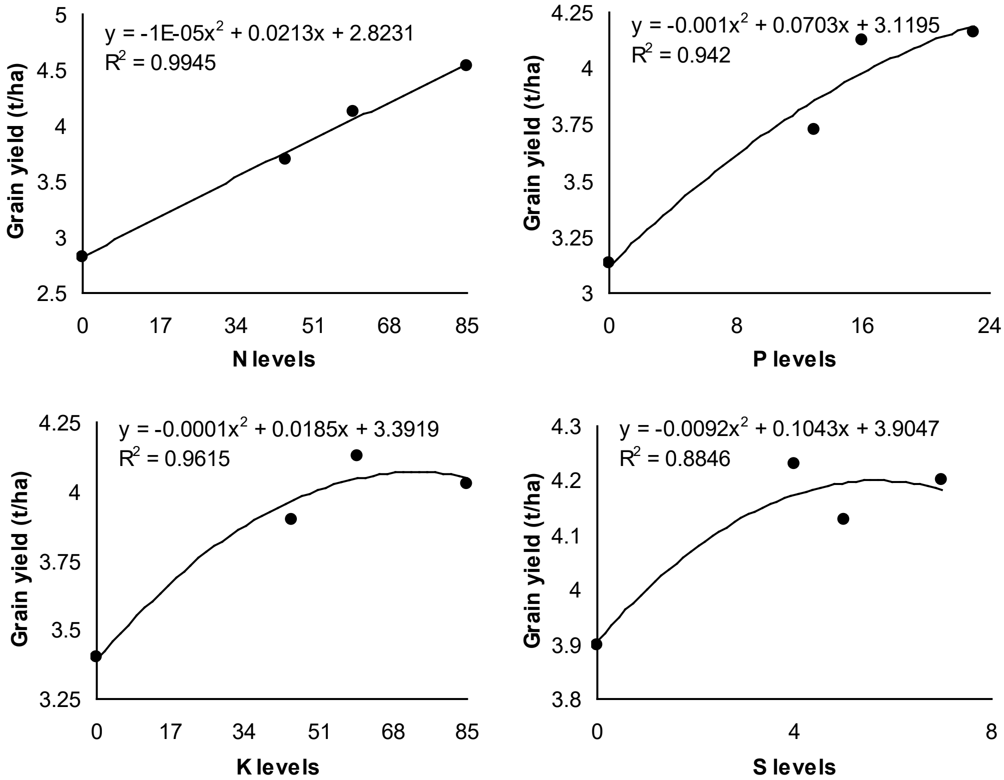



Figure 12. Response of T.Aman to added N, P, K & S grown in Mustard-Boro-T.Aman cropping pattern during 2000-01 at Muktagacha, Mymensingh

Table 6. Effects of different levels of fertilizer nutrients on the yield of crops in Mustard- Boro - T.Aman cropping pattern at Muktagacha, Mymensingh, 2000-01

| Nutrient levels (kg/ha) | | | Grain yield | | |
|---|---|---|---|---|---|
| Mustard | Boro | T.Aman | Mustard (kg/ha) | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | | | |
| 0 | 0 | 0 | 383 | 4.25 | 2.83 |
| 40 | 80 | 45 | 500 | 4.95 | 3.70 |
| 60 | 120 | 60 | 540 | 5.55 | 4.13 |
| 80 | 160 | 85 | 600 | 5.68 | 4.53 |
| P levels | | | | | |
| 0 | 0 | 0 | 420 | 4.57 | 3.13 |
| 20 | 16 | 13 | 480 | 5.10 | 3.73 |
| 25 | 24 | 16 | 540 | 5.55 | 4.13 |
| 35 | 32 | 23 | 484 | 5.88 | 4.16 |
| K levels | | | | | |
| 0 | 0 | 0 | 440 | 4.78 | 3.40 |
| 35 | 30 | 45 | 520 | 4.93 | 3.90 |
| 50 | 45 | 60 | 540 | 5.55 | 4.13 |
| 70 | 60 | 85 | 496 | 5.45 | 4.03 |
| S levels | | | | | |
| 0 | 0 | 0 | 410 | 4.58 | 3.90 |
| 5 | 8 | 4 | 480 | 5.13 | 4.23 |
| 7 | 12 | 5 | 540 | 5.55 | 4.13 |
| 10 | 16 | 7 | 500 | 5.43 | 4.20 |

**Location : Bagherpara, Jessore**
**Year of establishment : 2000-01**

### Mustard

In Mustard, a positive response of N was observed. Seed yield increased linearly with the increase of N level and the highest yield was recorded from the highest N level (120 kg/ha). But in case of P and S the response was not clear.

### Boro

In Boro rice, grain yield increased linearly with the increase of nitrogen level and the highest yield was obtained from highest level. As regards P and S grain yield also increased linearly but the trend was not very sharp.

### T.Aman

In T.Aman rice, grain yield increased sharply up to 80 kg N/ha and thereafter the trend of increase was very slow. P and S also showed a positive response to some extant and yield increased up to 8 kg/ha and 18 kg/ha, respectively.

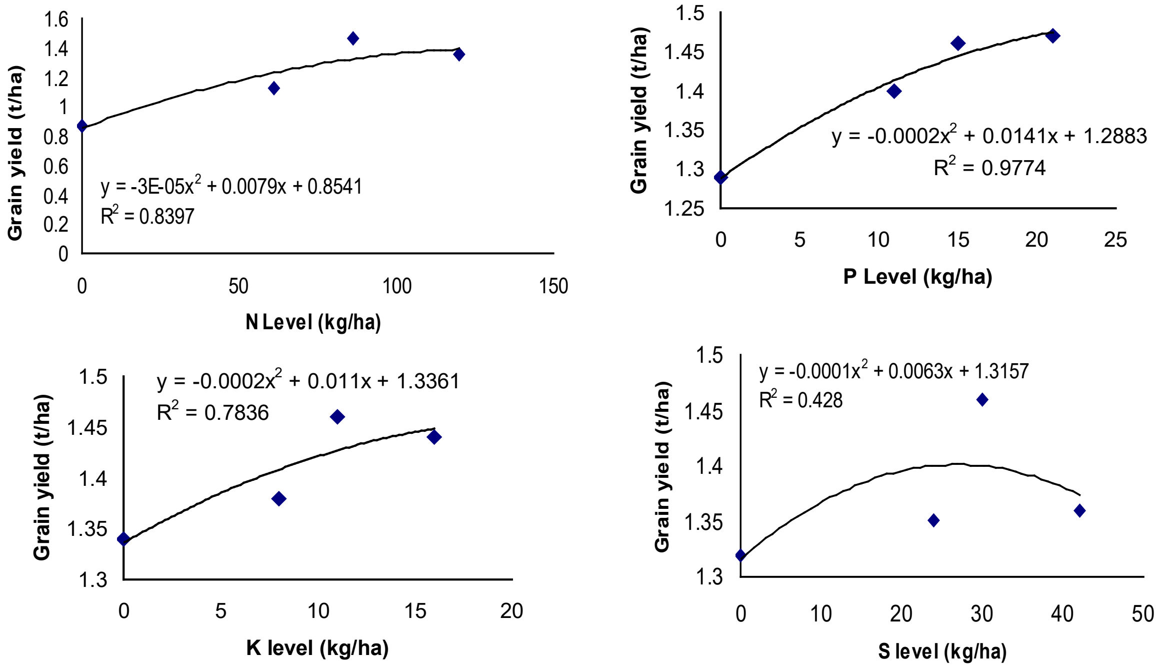



Figure 13. Response of Mustard to added N, P & K grown in Mustard-Boro-T.Aman cropping pattern at FSR site Bagherpara, Jessore during 2000-01

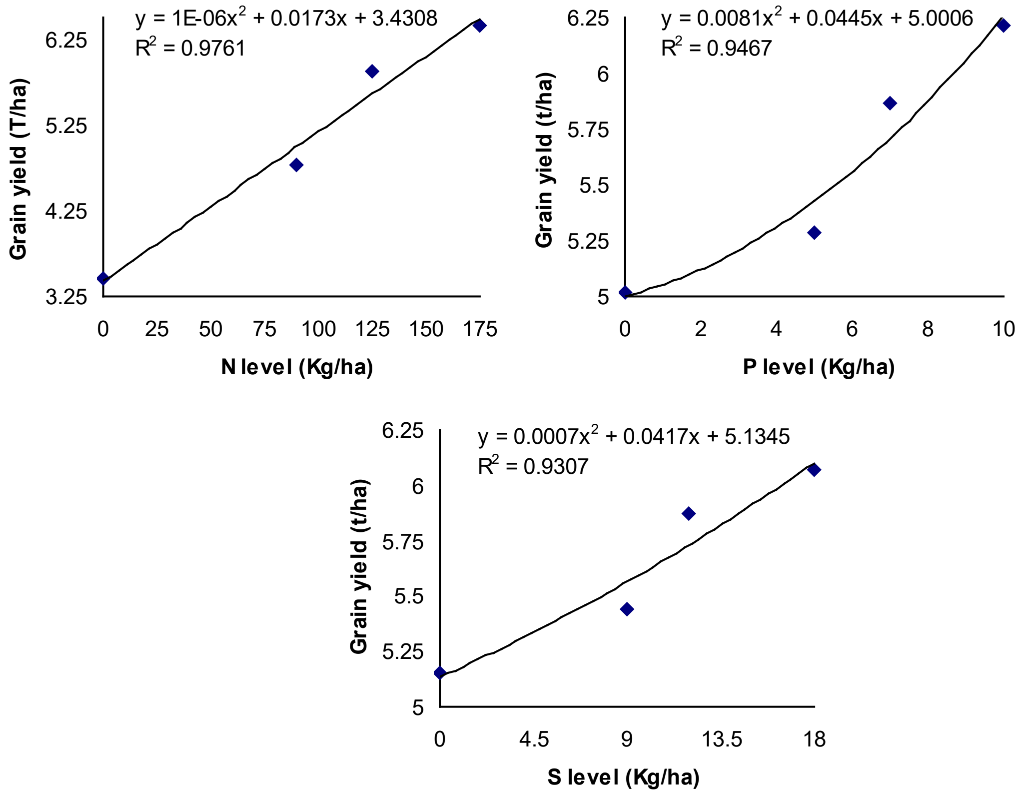



Figure 14. Response of Boro to added N, P & S grown in Mustard-Boro-T.Aman Cropping pattern at FSR site Bagherpara, Jessore during 2000-01

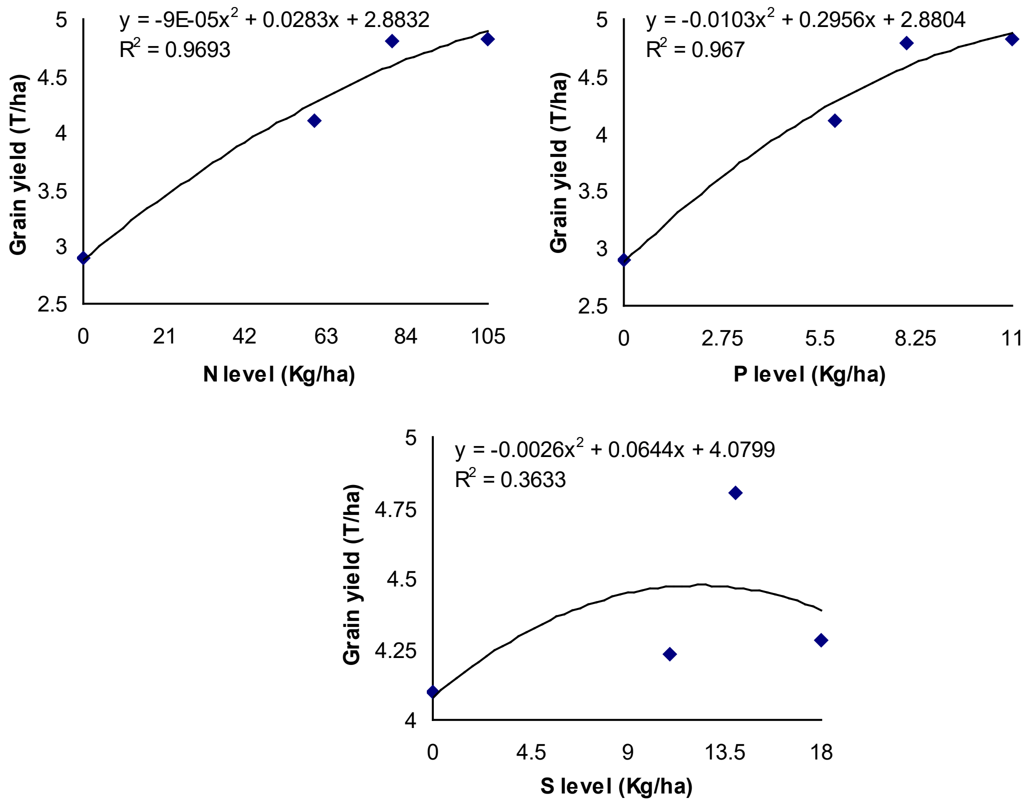



Figure 15. Response of Boro to added N, P & S grown in Mustard-Boro-T.Aman Cropping pattern at FSR site Bagherpara, Jessore during 2000-01

Table 7. Effects of different levels of fertilizer nutrients on the yield of crops in Mustard- Boro - T.Aman cropping pattern at Bagherpara, Jessore, 1999-2000

| Nutrient levels (kg/ha) | | | Grain yield | | |
|---|---|---|---|---|---|
| Mustard | Boro | T.Aman | Mustard (kg/ha) | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | | | |
| 0 | 0 | 0 | 0.65 | 3.46 | 2.90 |
| 61 | 90 | 60 | 0.92 | 4.78 | 4.11 |
| 86 | 125 | 80 | 1.06 | 5.87 | 4.80 |
| 120 | 175 | 105 | 1.11 | 6.41 | 4.82 |
| P levels | | | | | |
| 0 | 0 | 0 | 1.07 | 5.02 | 2.90 |
| 11 | 5 | 6 | 1.02 | 5.29 | 4.11 |
| 15 | 7 | 8 | 1.06 | 5.87 | 4.80 |
| 21 | 10 | 11 | 1.21 | 6.21 | 4.82 |
| S levels | | | | | |
| 0 | 0 | 0 | 1.11 | 5.15 | 4.10 |
| 24 | 9 | 11 | 1.02 | 5.44 | 4.23 |
| 30 | 12 | 14 | 1.06 | 5.87 | 4.80 |
| 42 | 18 | 18 | 1.14 | 6.07 | 4.28 |

**Cropping pattern : Wheat-Jute- T.Aman**
**Location : Sherpur MLT site, Jamalpur (AEZ 9)**
**Year of establishment : 2001-02**

**Wheat**

Grain yield of Wheat increased with the increase of N levels up to 135 kg/ha of N and then tended to decrease. Similarly, P, K and S showed a positive response towards the yield of Wheat. Grain yield increased up to 30 kg/ha, 75 kg/ha and 25 kg/ha of P, K and S, respectively. From the regression curve a quadratic relationship was found and the nutrient dose that maximizes yield and profit was found out. NPKS (kg/ha) 152-30-71-30 and 149-31-67-27 was found agronomically and economically optimum for Wheat.

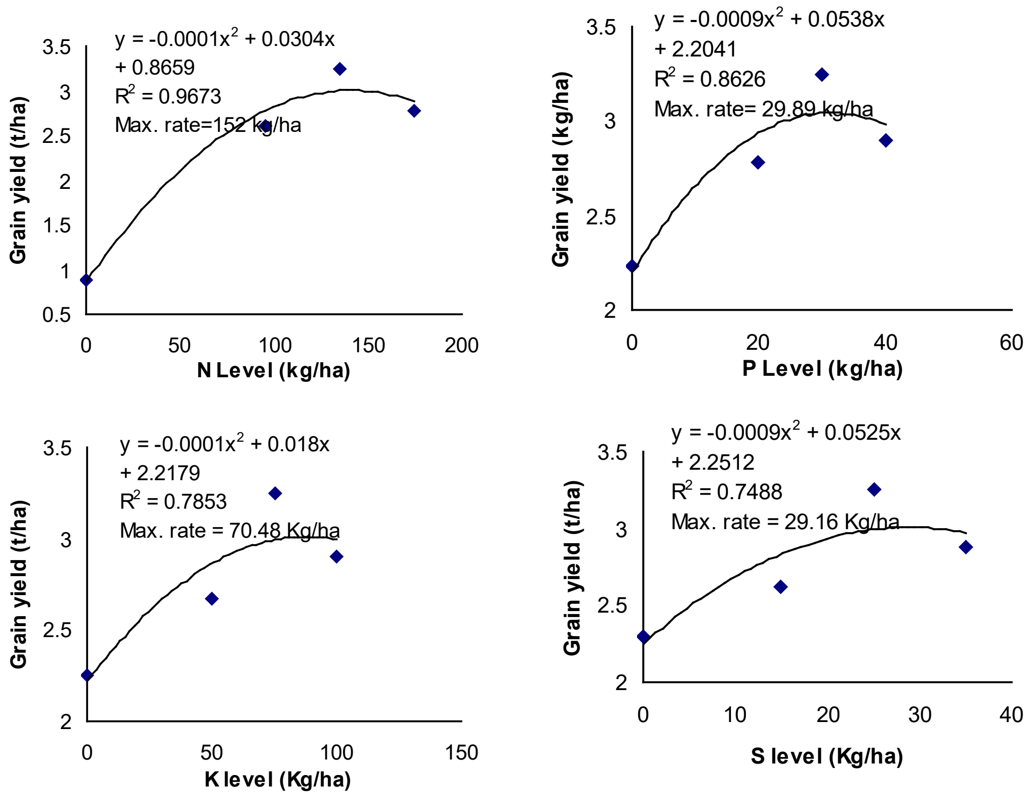



Figure 16. Response of Wheat to added N, P, K & S grown in Wheat-Jute-T.Aman cropping pattern at MLT site, Sherpur during 2001-02

Table 8. Effects of different levels of fertilizer nutrients on the yield of Wheat in Wheat- Jute - T.Aman cropping pattern at Sherpur MLT site, Jamalpur, 2001-02

| Nutrient levels (kg/ha) | | | Grain yield | | |
|---|---|---|---|---|---|
| Wheat | Jute | T.Aman | Wheat | Jute | T.Aman (t/ha) |
| N levels | | | | | |
| 0 | 0 | 0 | 0.89 | - | - |
| 95 | 80 | 70 | 2.20 | - | - |
| 135 | 120 | 100 | 3.25 | - | - |
| 175 | 160 | 130 | 2.78 | - | - |
| P levels | | | | | |
| 0 | 0 | 0 | 2.23 | - | - |
| 20 | 15 | 10 | 2.58 | - | - |
| 30 | 20 | 15 | 3.25 | - | - |
| 40 | 25 | 20 | 2.90 | - | - |
| K levels | | | | | |
| 0 | 0 | 0 | 2.25 | - | - |
| 50 | 50 | 40 | 2.75 | - | - |
| 75 | 80 | 50 | 3.25 | - | - |
| 100 | 110 | 60 | 2.87 | - | - |
| S levels | | | | | |
| 0 | 0 | 0 | 2.3 | - | - |
| 15 | 12 | 7 | 2.62 | - | - |
| 25 | 18 | 10 | 3.25 | - | - |
| 35 | 24 | 13 | 2.88 | - | - |

**Cropping pattern : Boro -T.Aman**
**Location : Phulpur, Mymensingh**
**Year of establishment : 2000-01**

### Boro

Grain yield was increased linearly with the increase of N levels and the highest yield was recorded from the highest level of N. Here yield growth is increase positively so we don’t know where the maximum dose or optimum dose up to the stated limit. The maximum may be the next higher does. In case of P, grain yield increased up to 12 kg P/ha and after that level grain yield was decreased slowly. Similarly, for K and S Grain yield was increased up to the application of 42 kg/ha and 28 kg/ha of K and S, respectively.

### T.Aman

Similar trend was found like Boro rice. Grain yield increased linearly with the increase of N and the highest yield was obtained from the highest level. In case of P, K and S a positive response was also observed and grain yield increased up to the application of 5 kg/ha, 28 kg/ha and 11 kg/ha of P, K and S, respectively. The relation ship is quadratic in case of P, K and S.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Boro | - | 10 | 30 | 25 | - | 8 | 14 | 10 |
| T.Aman | - | 5 | 20 | 10 | - | 5 | 18 | 8 |

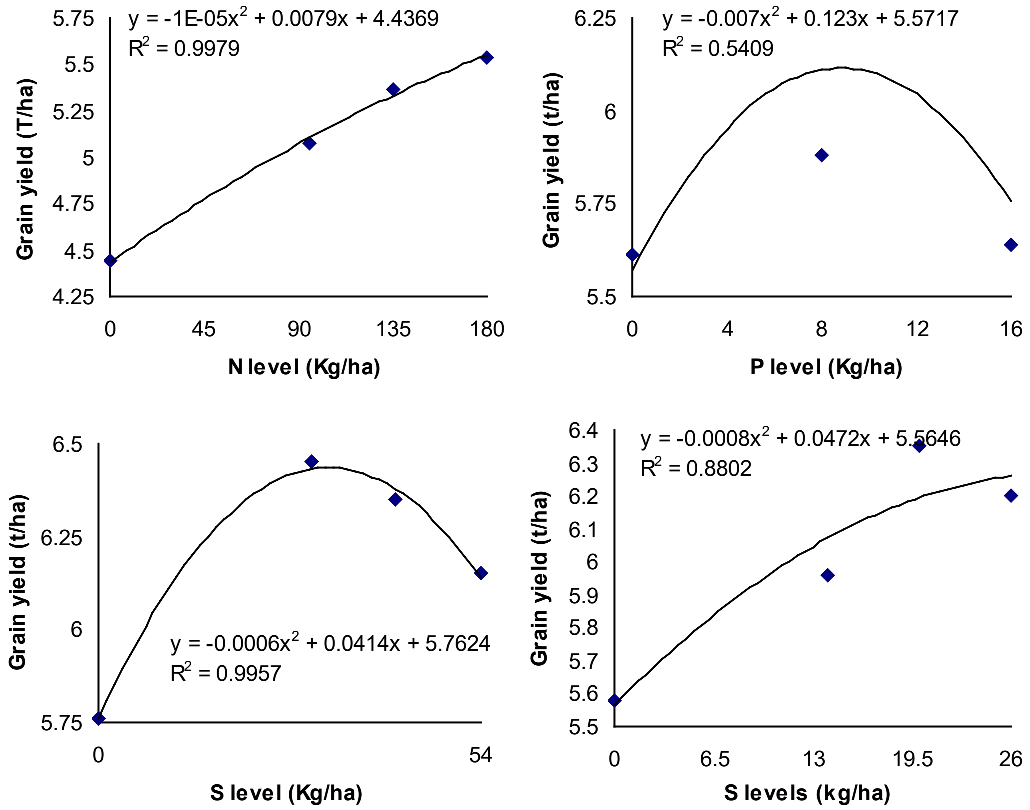



Figure 17. Response of Boro to added N, P, K & S grown in Boro-T.Aman cropping pattern at Phulpur, Mymensingh in 2001

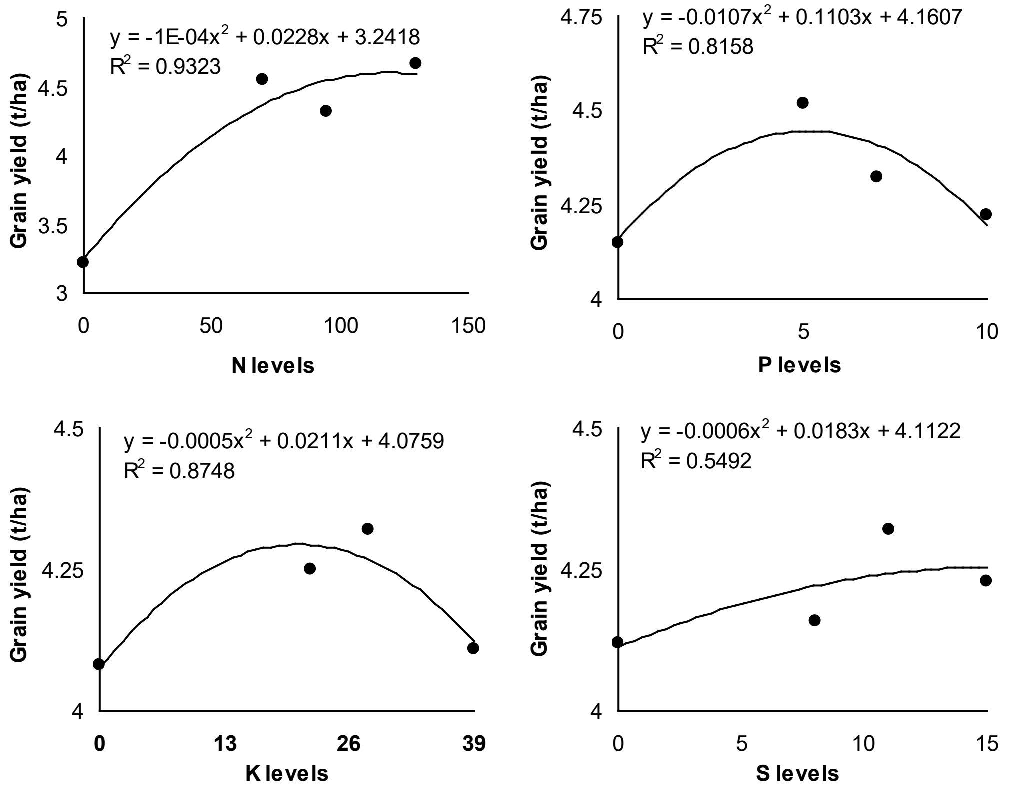



Figure 18. Response of T.Aman to added N, P, K & S grown in Boro-T.Aman cropping pattern at Phulpur, Mymensingh in 2001

Table 9. Effects of different levels of fertilizer nutrients on the yield of crops Boro -T.Aman cropping pattern at Phulpur MLT site, Mymensingh, 2000-01

| Nutrient levels (kg/ha) | | Grain yield | |
|---|---|---|---|
| Boro | T.Aman | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | |
| 0 | 0 | 4.44 | 3.22 |
| 95 | 70 | 5.08 | 4.32 |
| 135 | 95 | 5.36 | 4.55 |
| 180 | 130 | 5.54 | 4.66 |
| P levels | | | |
| 0 | 0 | 5.61 | 4.15 |
| 8 | 5 | 5.88 | 4.52 |
| 12 | 7 | 6.35 | 4.32 |
| 16 | 10 | 5.64 | 4.22 |
| K levels | | | |
| 0 | 0 | 5.76 | 4.08 |
| 30 | 22 | 6.45 | 4.25 |
| 42 | 28 | 6.35 | 4.32 |
| 54 | 39 | 6.15 | 4.11 |
| S levels | | | |
| 0 | 0 | 5.58 | 4.12 |
| 14 | 8 | 5.96 | 4.16 |
| 20 | 11 | 6.35 | 4.32 |
| 26 | 15 | 6.20 | 4.23 |

**Location : Netrakona, Mymensingh**
**Year of establishment: 2000-01**

### Boro

Grain yield was increased linearly with the increase of N levels and the highest yield was recorded from the highest level of N. Here yield growth is increase positively so we don't know where the maximum dose or optimum dose up to the stated limit. The maximum may be the next higher does.
In case of P and S a positive response was also observed to some extent. Grain yield increased slowly up to the application of 5 kg/ha and 11 kg/ha of P and S, respectively. The relation ship is quadratic in case of P and S. In case of K, a slow but linearly increasing trend of grain yield was noticed and the highest yield was recorded from the highest level of K.

### T.Aman

Similar trend was found in T.Aman rice like Boro rice. Grain yield increased linearly with the increase of N and the highest yield was obtained from the highest level. In case of P, K and S the response is not clear.

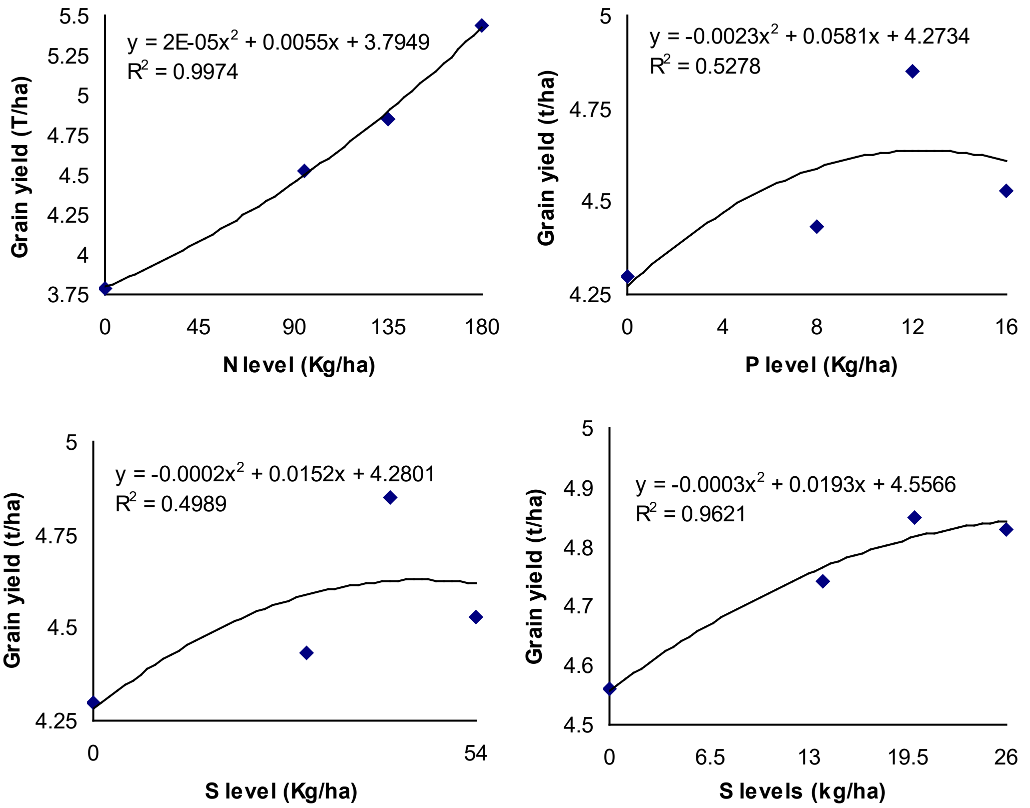



Figure 18. Response of Boro to added N, P, K & S grown in Boro-T.Aman cropping pattern at Netrakona, Mymensingh during 2000-01

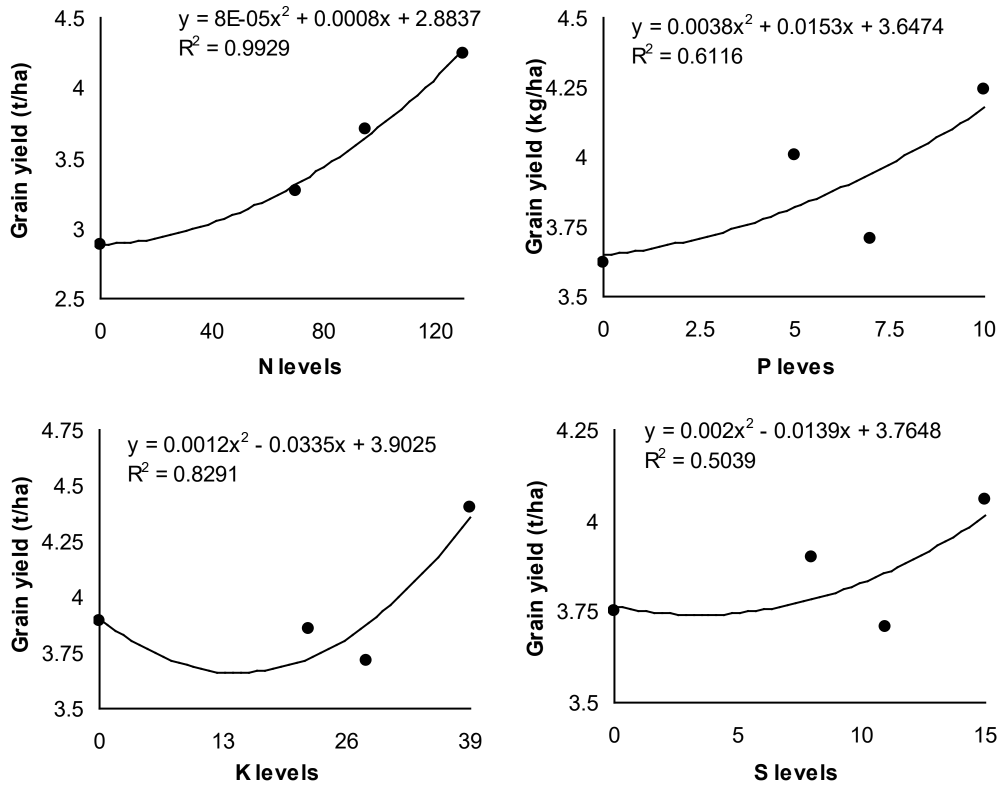



Figure 19. Response of T.Aman to added N, P, K & S grown in Boro-T.Aman cropping pattern at Netrakona, 2001

Table 10. Effects of different levels of fertilizer nutrients on the yield of crops Boro -T.Aman cropping pattern at Netrokona MLT site, Mymensingh, 2000-01

| Nutrient levels (kg/ha) | | Grain yield | |
|---|---|---|---|
| Boro | T.Aman | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | |
| 0 | 0 | 3.79 | 2.89 |
| 95 | 70 | 4.53 | 3.26 |
| 135 | 95 | 4.85 | 3.71 |
| 180 | 130 | 5.44 | 4.25 |
| P levels | | | |
| 0 | 0 | 4.30 | 3.62 |
| 8 | 5 | 4.43 | 4.01 |
| 12 | 7 | 4.85 | 3.71 |
| 16 | 10 | 4.53 | 4.24 |
| K levels | | | |
| 0 | 0 | 4.30 | 3.49 |
| 30 | 22 | 4.43 | 3.86 |
| 42 | 28 | 4.85 | 3.71 |
| 54 | 39 | 4.53 | 4.40 |
| S levels | | | |
| 0 | 0 | 4.56 | 3.75 |
| 14 | 8 | 4.74 | 3.90 |
| 20 | 11 | 4.85 | 3.71 |
| 26 | 15 | 4.83 | 4.06 |

**Location : Kishoregonj**
**Year of establishment: 2000-01**

### Boro

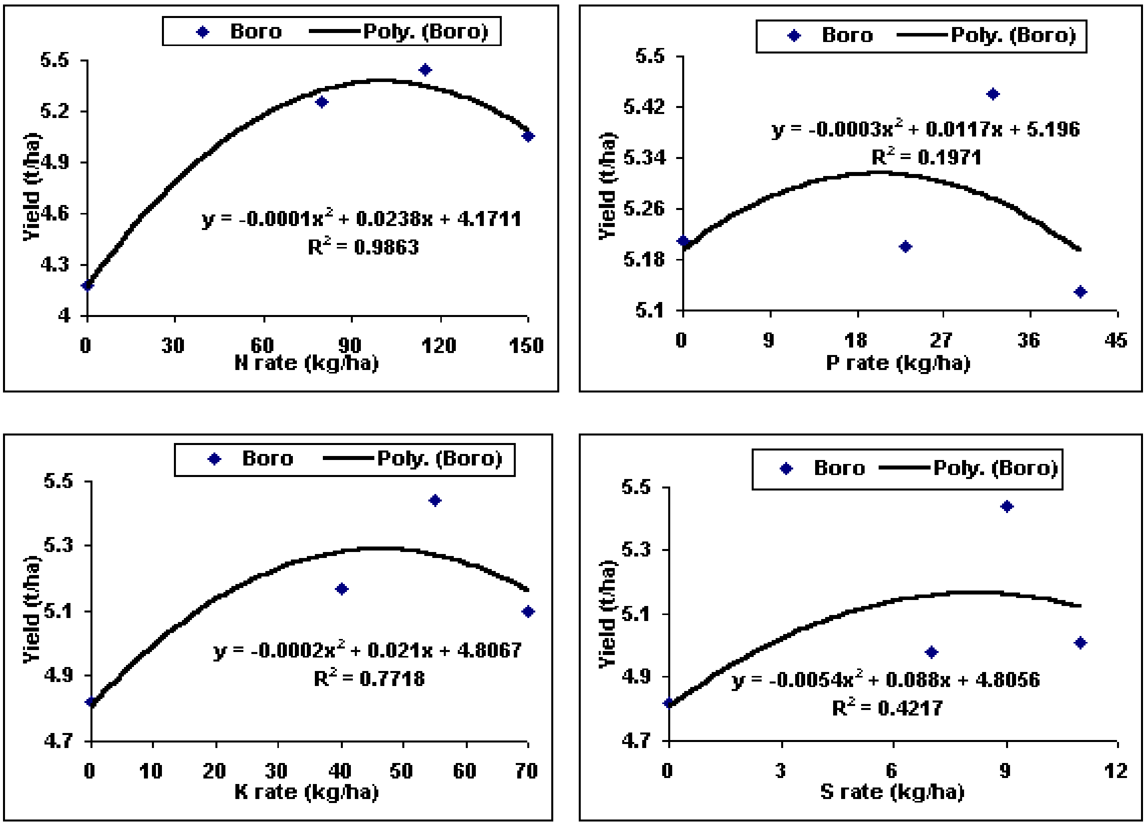
In Boro rice, grain yield increased markedly with the increase of nitrogen up to 115 kg N/ha and after that level tended to decrease. In case of P, K and S a slow but positive response was found and the yield increased up to the application of 32 kg, 55 kg and 9 kg/ha of P, K and S respectively.

### T.Aman

In T. Aman rice, a positive response of N was found and the grain yield increased up to 75 kg N/ha. Response of P, K and S was also observed to some extent and grain yield increased up to 21 kg, 36 kg and 5 kg/ha of P, K and S, respectively.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Boro | 119 | 20 | 52 | 8 | 100 | 20 | 49 | 8 |
| T.Aman | 72 | 15 | 38 | 4 | 64 | 16 | 34 | 4 |




20. Grain response of Boro rice to added N, P, K & S grown in Boro-T.Aman cropping pattern at Kishoregonj ,2001

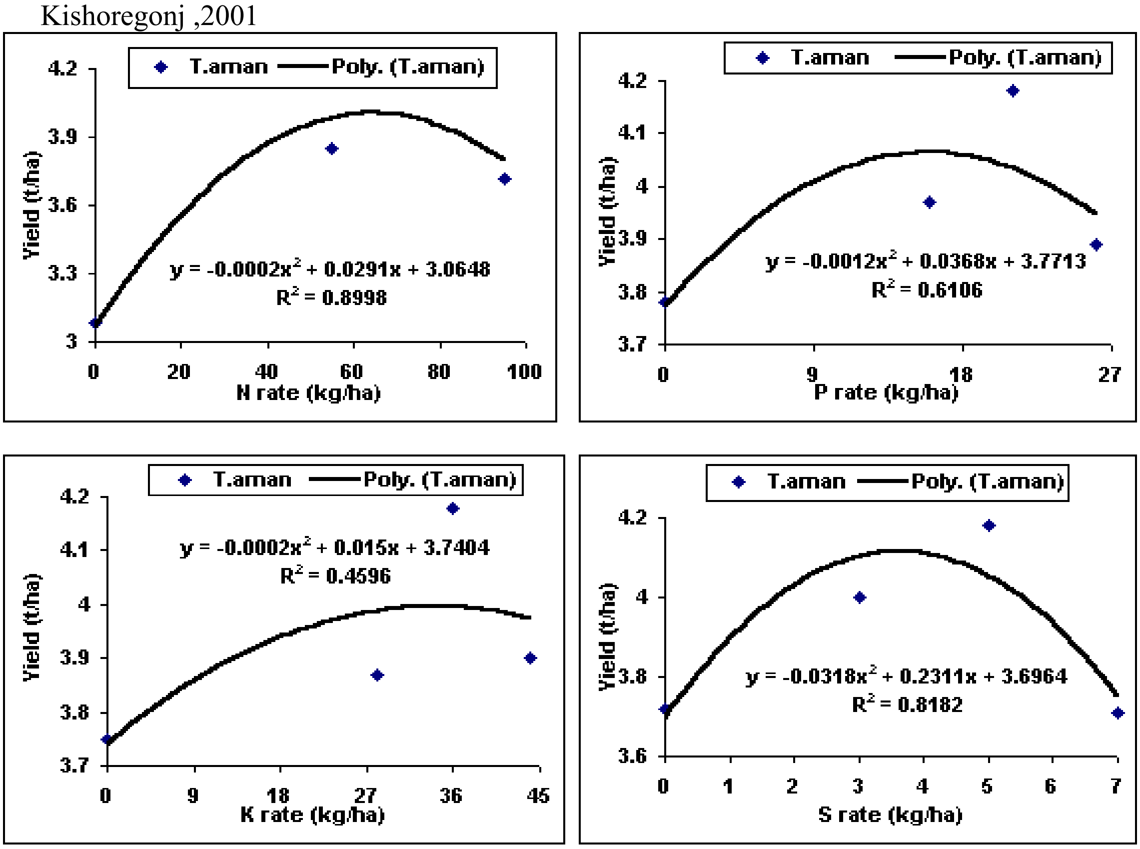



Figure 21. Response of T.Aman to added N, P, K & S grown in Boro-T.Aman cropping pattern at Kishoregonj, 2001

Table 11. Effects of different levels of fertilizer nutrients on the yield of crops in Boro-T.Aman cropping pattern at Kishoregonj, 2000-01

| Nutrient levels (kg/ha) | | Grain yield (t/ha) | |
|---|---|---|---|
| Boro | T.Aman | Boro | T.Aman |
| N levels | | | |
| 0 | 0 | 4.18 | 3.08 |
| 80 | 55 | 5.26 | 3.85 |
| 115 | 75 | 5.44 | 4.18 |
| 150 | 95 | 5.06 | 3.72 |
| P levels | | | |
| 0 | 0 | 5.21 | 3.78 |
| 23 | 16 | 5.20 | 3.97 |
| 32 | 21 | 5.44 | 4.18 |
| 41 | 26 | 5.13 | 3.89 |
| K Levels | | | |
| 0 | 0 | 4.82 | 3.75 |
| 40 | 28 | 5.17 | 3.87 |
| 55 | 36 | 5.44 | 4.18 |
| 70 | 44 | 5.10 | 3.90 |
| S Levels | | | |
| 0 | 0 | 4.82 | 3.72 |
| 7 | 3 | 4.98 | 4.00 |
| 9 | 5 | 5.44 | 4.18 |
| 11 | 7 | 5.01 | 3.71 |

**Location : Kendua MLT site, Kishoreganj**
**Year of establishment: 2000-01**

### Boro

In Boro rice, grain yield increased markedly with the increase of nitrogen up to 125 kg N/ha and after that level tended to decrease. In case of P, K and S a slow but positive response was found and the yield increased up to the application of 36 kg, 64 kg and 22 kg/ha of P, K and S respectively.

### T.Aman

In T.Aman rice, the response of different nutrients was not evident. Yield did not vary markedly due to increase of nutrient levels. However, a very slow increasing trend was found to some extent. Yield increased up to the application of 76 kg, 23 kg, 42 kg and 12 kg/ha of NPKS, respectively.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Boro | 126 | 33 | 68 | 18 | 133 | 33 | 62 | 22 |
| T.Aman | 72 | 15 | 38 | 9 | 70 | 16 | 37 | 9 |

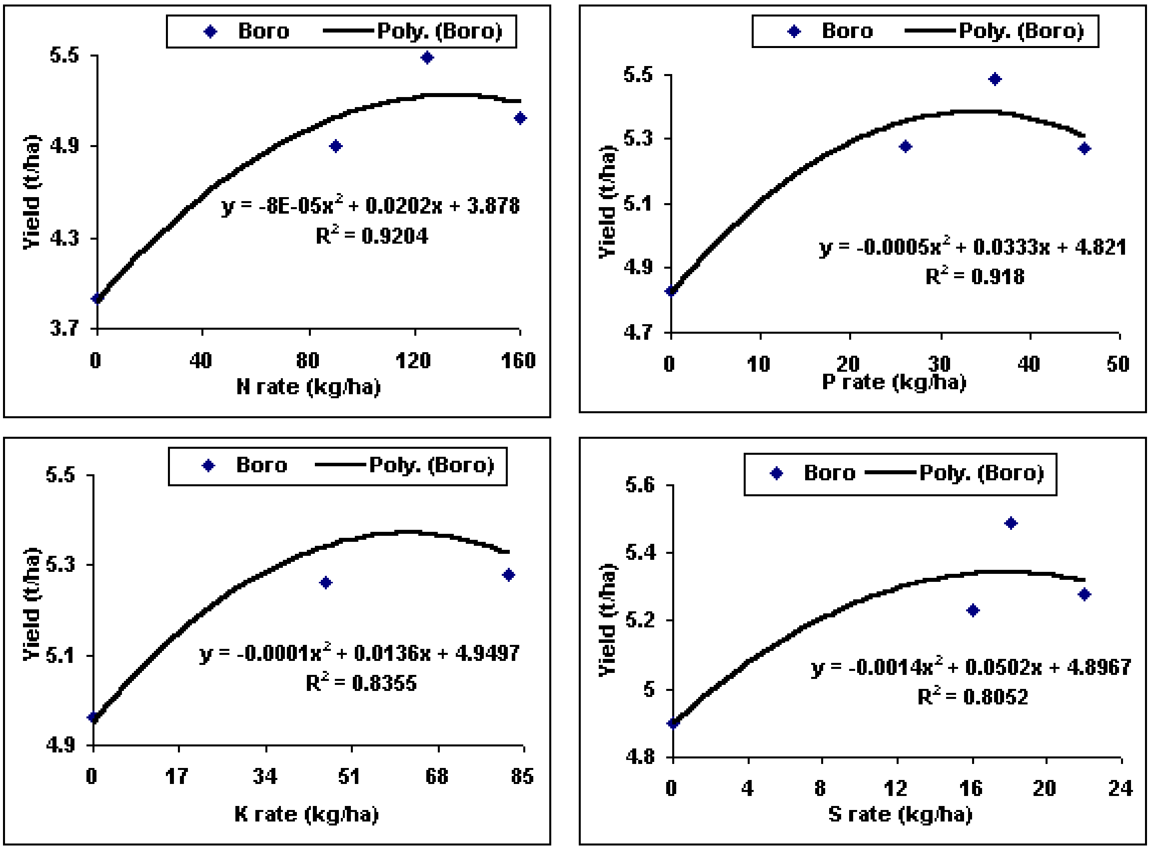



Figure 22. Response of Boro rice to added N, P, K & S grown in Boro-T.Aman rice cropping pattern at Kendua, 2001

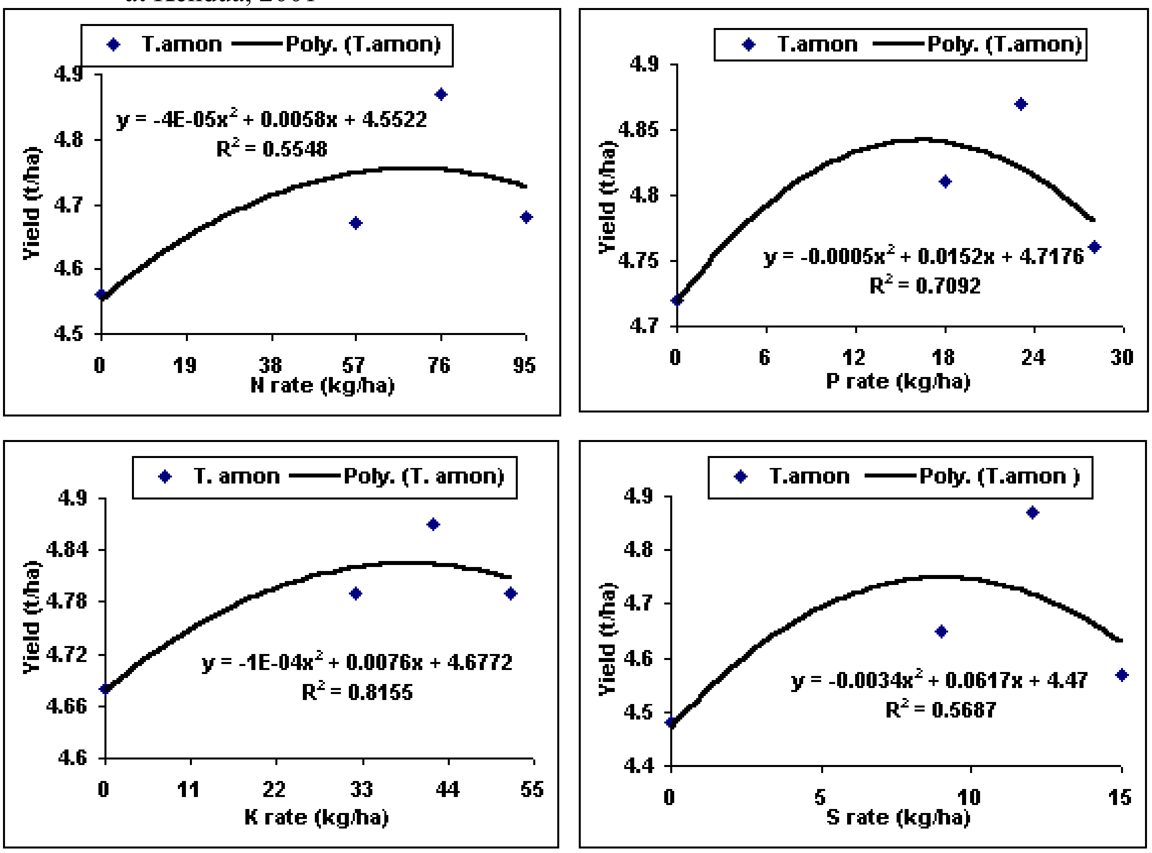



Figure 23. Response of T.Aman rice to added N, P, K & S grown in Boro-T.Aman rice cropping pattern at Kendua, 2001

Table 12. Effects of different levels of fertilizer nutrients on the yield of crops in Boro-T.Aman cropping pattern at Kendua MLT site, Kishoreganj, 2000-01

| Nutrient levels (kg/ha) | | Grain yield (t/ha) | |
|---|---|---|---|
| Boro | T.Aman | Boro | T.Aman |
| N levels | | | |
| 0 | 0 | 3.90 | 4.56 |
| 90 | 57 | 4.91 | 4.67 |
| 125 | 76 | 5.49 | 4.87 |
| 160 | 95 | 5.09 | 4.68 |
| P levels | | | |
| 0 | 0 | 4.83 | 4.72 |
| 26 | 18 | 5.28 | 4.81 |
| 36 | 23 | 5.49 | 4.87 |
| 46 | 28 | 5.27 | 4.76 |
| K Levels | | | |
| 0 | 0 | 4.96 | 4.68 |
| 46 | 32 | 5.26 | 4.79 |
| 64 | 42 | 5.49 | 4.87 |
| 82 | 52 | 5.28 | 4.79 |
| S Levels | | | |
| 0 | 0 | 4.90 | 4.48 |
| 16 | 9 | 5.23 | 4.65 |
| 22 | 12 | 5.49 | 4.87 |
| 28 | 15 | 5.28 | 4.57 |

**Location : Ishan Gopalpur FSRD site, Faridpur**
**Year of establishment : 2000-01**

**Boro**

Grain yield of Wheat markedly increased up to 100 kg N/ha and then started to reduce. Phosphorus, Potassium and Sulphur also show some response towards the yield and yield increase up to 26 kg, 83 kg and 30 kg/ha of P, K and S respectively.

**T.Aman**

In T.Aman rice, response of N was very distinct up to 60 kg N/ha. After that level tended to reduce. Phosphorus and Sulphur also show some response towards the yield and yield increase up to 16 kg and 10 kg/ha of P and S, respectively.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Boro | 125 | 30 | - | 18 | 102 | 17 | - | 18 |
| T.Aman | 75 | 15 | - | 10 | 35 | 6 | - | 10 |

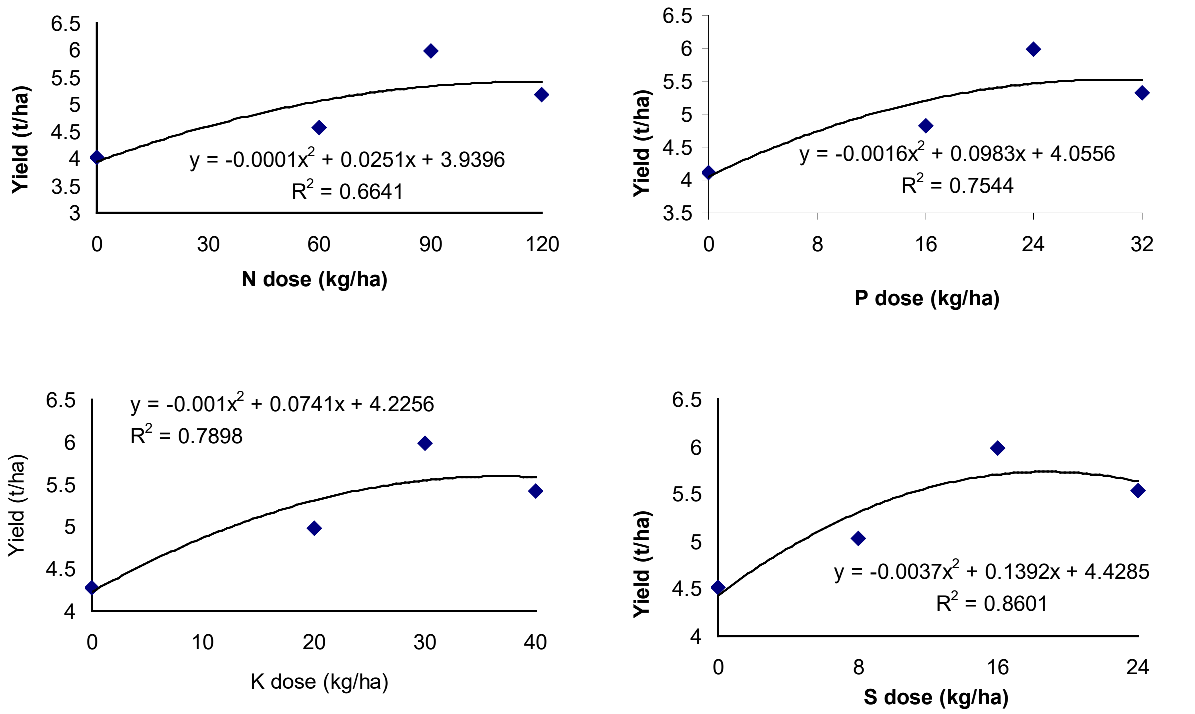



Figure 24. Response of Boro rice to added N, P, K and S grown in Boro-T.Aman rice cropping pattern at FSRD site, Ishan Gopalpur, Farid

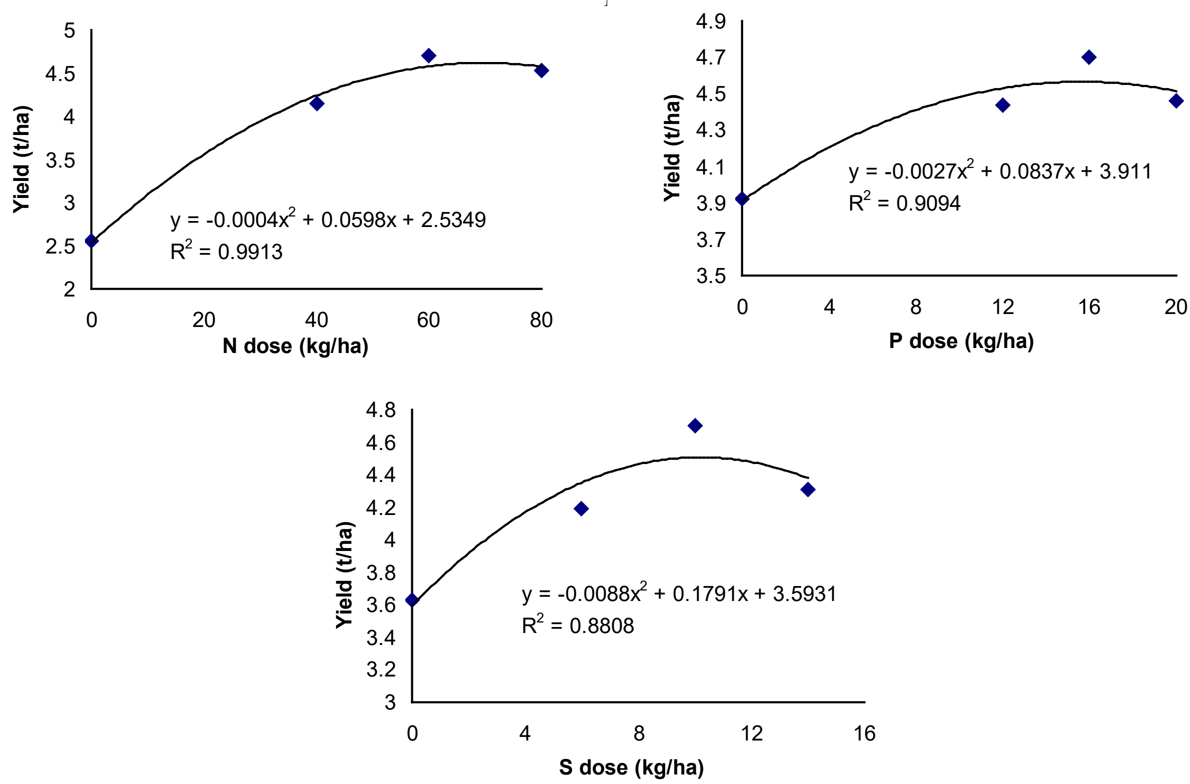



Figure 25. Response of T.Aman rice to added N, P & S grown in Boro-T.Aman rice cropping pattern at FSRD site, Ishan Gopalpur, Faridpur, 2001

Table 13. Effect of different levels of fertilizer nutrients on the yield of crops in Boro-T.Aman cropping pattern at Ishan Gopalpur, Faridpur 2000-2001

| Nutrient levels (kg/ha) | | | Grain yield (t/ha) | |
|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman |
| N levels | 0 | 0 | 4.02 | 2.55 |
| | 60 | 40 | 4.58 | 4.15 |
| | 90 | 60 | 5.98 | 4.70 |
| | 120 | 80 | 5.18 | 4.53 |
| P levels | 0 | 0 | 4.12 | 3.92 |
| | 16 | 12 | 4.82 | 4.44 |
| | 24 | 16 | 5.98 | 4.70 |
| | 32 | 20 | 5.32 | 4.46 |
| S levels | 0 | 0 | 4.52 | 3.63 |
| | 8 | 6 | 5.03 | 4.19 |
| | 16 | 10 | 5.98 | 4.70 |
| | 24 | 14 | 5.54 | 4.31 |

**Location : Kolaroa MLT site, Khulna**
**Year of establishment : 2000-01**

### Boro

A positive response of Boro rice was noticed to NPKS nutrients. Grain yield was increased with the increase of N levels up to 140 kg/ha of N and after that level started to decrease. Similarly, in case of P, K and S and yield increased up to the application of 35 kg/ha, 20 kg/ha and 20 kg/ha of P, K and S, respectively.

### T.Aman

Similar trend was found like Boro rice. Grain yield increased with the increase of N and the highest yield was obtained from 95 kg/ha of N. In case of P, K and S a positive response was also observed and grain yield increased up to the application of 20 kg/ha, 15 kg/ha and 15 kg/ha of P, K and S, respectively. A response curve was drawn from the yield data and a quadratic type of relationship was found.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Boro | 153 | 35 | 16 | 21 | - | - | - | - |
| T.Aman | 90 | 17 | 15 | 17 | - | - | - | - |

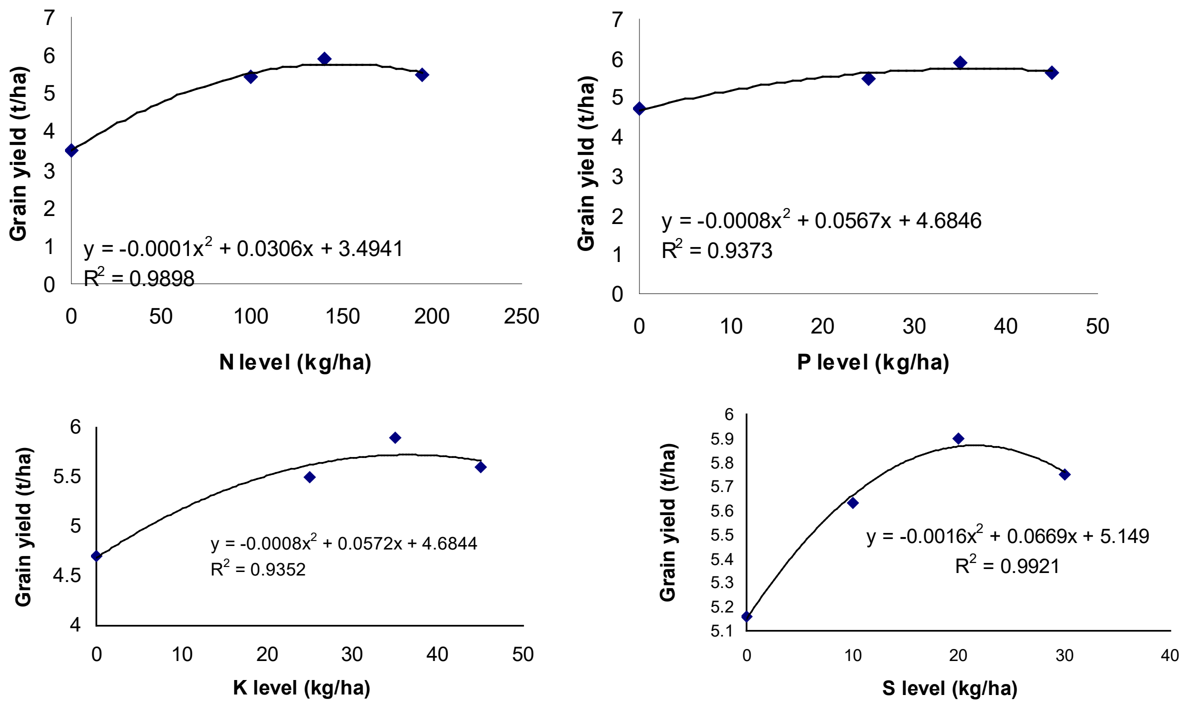



Figure 26. Response of Boro rice to added N, P, K and S grown in Boro- T.Aman cropping pattern at Kalaroa MLTS during 2000-2001

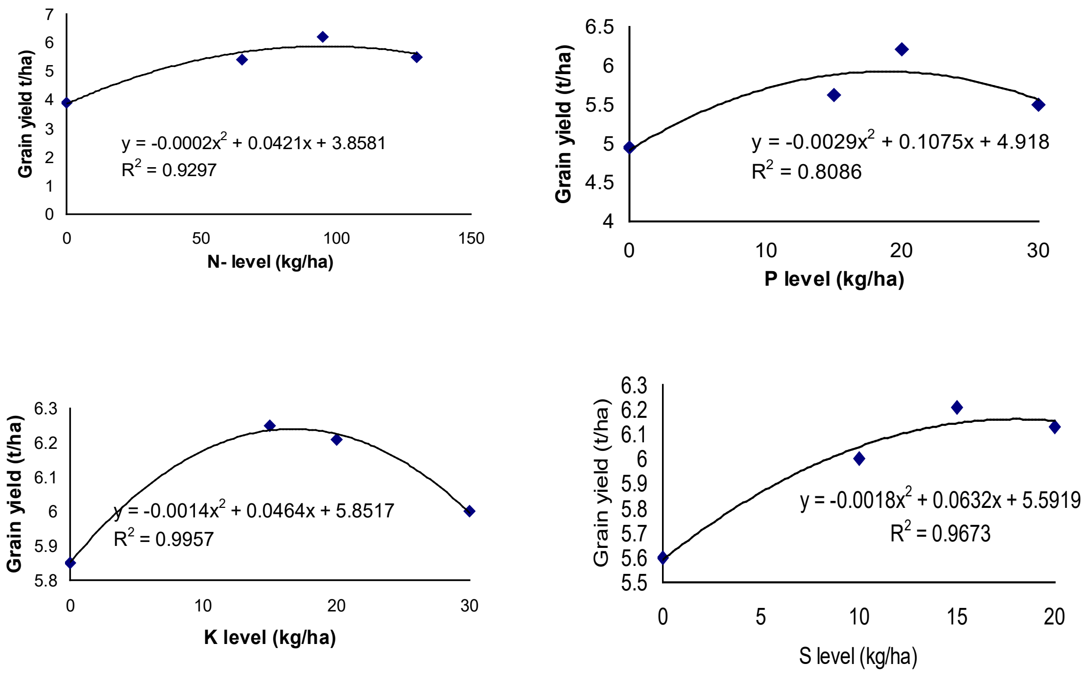



Figure 27. Response of T. Aman rice to added N, P, K and S fertilizer in Boro- T.Aman cropping pattern at Kalaroa MLT site during 2001

Table 14. Effects of different levels of fertilizer nutrients on the yield of crops Boro-T.Aman cropping pattern at Kolaroa MLT site, Khulna, 2000-01

| Nutrient levels (kg/ha) | | Grain yield | |
|---|---|---|---|
| Boro | T.Aman | Boro (t/ha) | T.Aman (t/ha) |
| N levels | | | |
| 0 | 0 | 3.51 | 3.90 |
| 100 | 65 | 5.41 | 5.40 |
| 140 | 95 | 5.90 | 6.21 |
| 195 | 130 | 5.50 | 5.51 |
| P levels | | | |
| 0 | 0 | 4.70 | 4.95 |
| 25 | 15 | 5.50 | 5.63 |
| 35 | 20 | 5.90 | 6.21 |
| 45 | 30 | 5.61 | 5.50 |
| K levels | | | |
| 0 | 0 | 5.85 | 5.85 |
| 20 | 15 | 6.11 | 6.25 |
| 30 | 20 | 5.90 | 6.21 |
| 40 | 30 | 5.60 | 6.00 |
| S levels | | | |
| 0 | 0 | 5.16 | 5.60 |
| 10 | 10 | 5.63 | 6.00 |
| 20 | 15 | 5.90 | 6.21 |
| 30 | 20 | 5.75 | 6.13 |

**Location : Bagerhat MLT site, Khulna**
**Year of establishment : 2000-01**

**Boro**

Initial soil status showed that soil is rich with K and S and varied from optimum level to high. Therefore, response of K and S was not studied at Bagerhat.

A positive response of Boro rice was noticed to NPKS nutrients. Grain yield was increased with the increase of N levels up to 130 kg/ha of N and after that level started to decrease. Similarly, in case of P, yield increased up to the application of 35 kg/ha.

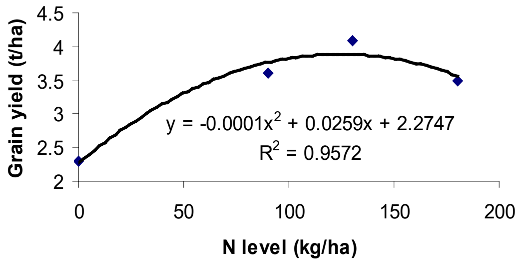
**T.Aman**

Similar trend was found like Boro rice. Grain yield increased with the increase of N and the highest yield was obtained from 90 kg/ha of N. In case of P a positive response was also observed and grain yield increased up to the application of 20 kg/ha of P.

A response curve was drawn from the yield data and a quadratic type of relationship was found.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Boro | 129 | 38 | - | - | - | - | - | - |
| T.Aman | 90 | 19 | - | - | - | - | - | - |



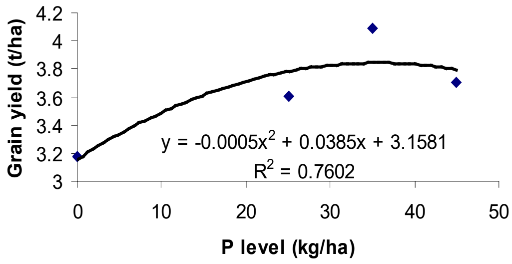
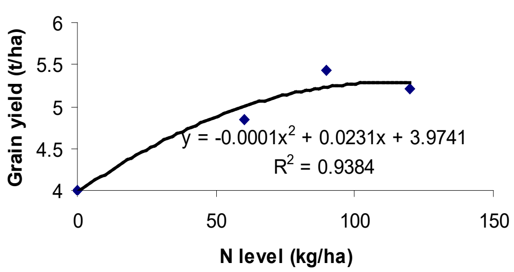




Figure 28. Response of Boro rice to N and P in Boro- T. Aman cropping pattern at Bagerhat 2000-01



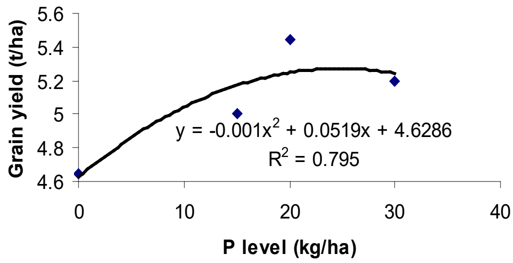




Figure 29. Response of T.Aman rice to added N and P in Boro- T. Aman cropping pattern at Bagerhat 2001

Table 15. Effects of different levels of fertilizer nutrients on the yield of crops in Boro-T.Aman cropping pattern at Bagerhat MLT site, Khulna, 2000-01

| Nutrient levels (kg/ha) | | Grain yield (t/ha) | |
|---|---|---|---|
| Boro | T.Aman | Boro | T.Aman |
| N levels | | | |
| 0 | 0 | 3.51 | 3.90 |
| 100 | 65 | 5.41 | 5.40 |
| 140 | 95 | 5.90 | 6.21 |
| 195 | 130 | 5.50 | 5.51 |
| P levels | | | |
| 0 | 0 | 4.70 | 4.95 |
| 25 | 15 | 5.50 | 5.63 |
| 35 | 20 | 5.90 | 6.21 |
| 45 | 30 | 5.61 | 5.50 |
| K levels | | | |
| 0 | 0 | 5.85 | 5.85 |
| 20 | 15 | 6.11 | 6.25 |
| 30 | 20 | 5.90 | 6.21 |
| 40 | 30 | 5.60 | 6.00 |
| S levels | | | |
| 0 | 0 | 5.16 | 5.60 |
| 10 | 10 | 5.63 | 6.00 |
| 20 | 15 | 5.90 | 6.21 |
| 30 | 20 | 5.75 | 6.13 |

**Location : Goyeshpur, Pabna**
**Cropping pattern : Wheat - T.Aman**
**Year of establishment : 2000-01**

### Wheat

Grain yield of Wheat markedly increased up to 70 kg N/ha but the yield increased slowly up to 100 kg N/ha and then started to reduce. Phosphorus and Potassium also show some response towards the yield and yield increase up to 30 kg/ha and 50 kg/ha of P and K, respectively. Regarding sulphur the grain yield increased linearly and the highest yield was recorded from the highest level of S.

### T.Aman

In T.Aman rice, response of N was very distinct and the grain yield increased linearly with the increase of nitrogen level. Similarly for phosphorus, grain yield increased linearly and the highest yield was obtained from the highest level. Potassium and Sulphur also show some response towards the yield and yield increase up to 20 kg and 10 kg/ha of K and S, respectively.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Wheat | 99 | 30 | 86 | 40 | 128 | 31 | 173 | - |
| T.Aman | - | - | 11 | 12 | - | - | 10 | 10 |

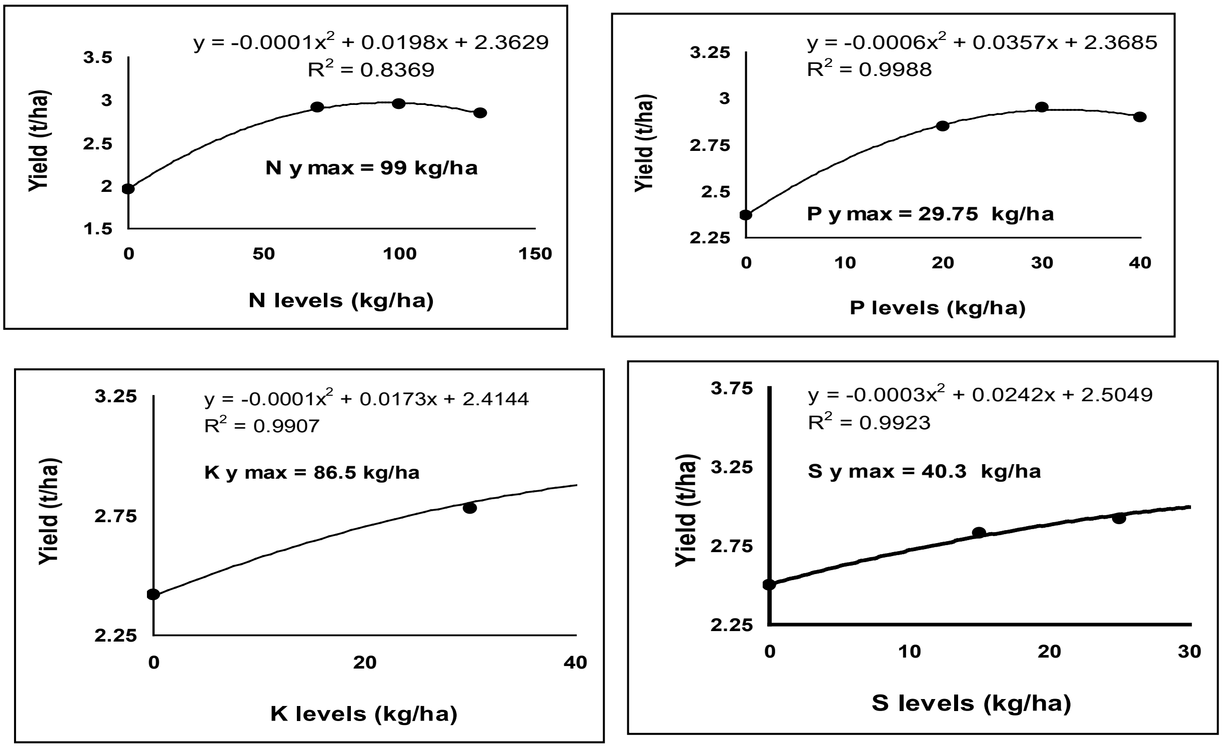



Figure 30. Response of Wheat to added N, P, K and S grown in Wheat-T.Aman Cropping pattern at Goyeshpur, Pabna, 2000-01

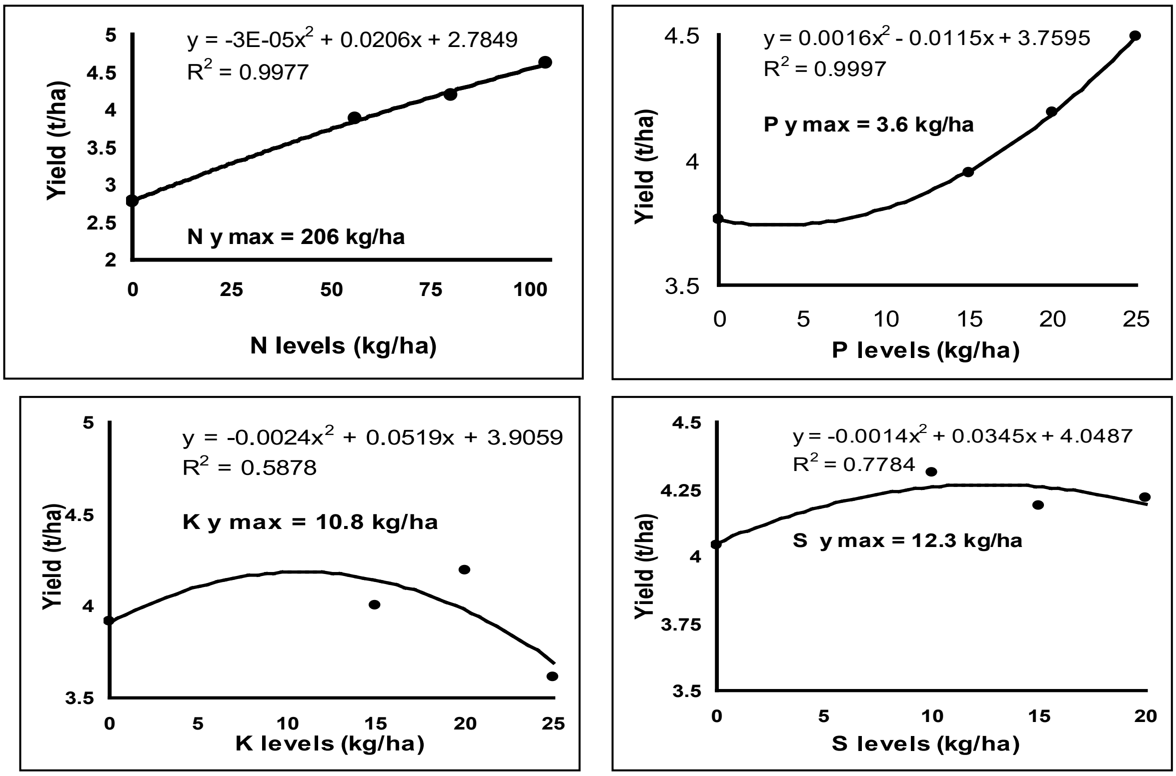



Figure 31. Response of T.Aman to added N, P, K & S grown in Wheat-T.Aman rice cropping pattern at FSRD, Goyeshpur, Pabna 2001

Table 16. Effects of different levels of fertilizer nutrients on the yield crops in Wheat-T.Aman cropping pattern at Goyeshpur, Pabna, 1999-2000 to 2000-01

| Nutrient levels (kg/ha) | | Grain yield (t/ha) | |
|---|---|---|---|
| Wheat | T.Aman | Wheat | T.Aman |
| N levels | | | |
| 0 | 0 | 1.96 | 2.78 |
| 70 | 56 | 2.91 | 3.88 |
| 100 | 80 | 2.95 | 4.19 |
| 130 | 104 | 2.85 | 4.62 |
| P levels | | | |
| 0 | 0 | 2.37 | 3.76 |
| 20 | 15 | 2.85 | 3.95 |
| 30 | 18 | 2.95 | 4.19 |
| 40 | 21 | 2.90 | 4.49 |
| K Levels2.40 | | | |
| 0 | 0 | 2.42 | 3.92 |
| 30 | 15 | 2.78 | 4.00 |
| 50 | 20 | 2.95 | 4.19 |
| 70 | 25 | 2.91 | 3.61 |
| S Levels | | | |
| 0 | 0 | 2.50 | 4.04 |
| 15 | 10 | 2.83 | 4.31 |
| 25 | 15 | 2.92 | 4.19 |
| 35 | 20 | 3.04 | 4.22 |

**Location : Barind, Rajshahi**
**Year of establishment: 2000-01**

### Wheat

Grain yield of Wheat markedly increased up to 100 kg N/ha and then started to reduce. Phosphorus, Potassium and Sulphur also show some response towards the yield and yield increase up to 26 kg, 83 kg and 30 kg/ha of P, K and S respectively.

### T.Aman

In T.Aman rice, response of N was very distinct up to 100 kg N/ha. After that level tended to reduce. Phosphorus, Potassium and Sulphur also show some response towards the yield and yield increase up to 15 kg, 20 kg and 7 kg/ha of P, K and S respectively.

From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Wheat | 154 | 28 | 97 | 36 | 120 | 41 | 72 | 33 |
| T.Aman | 122 | 13 | 19 | 6 | 131 | 11 | 13 | 10 |

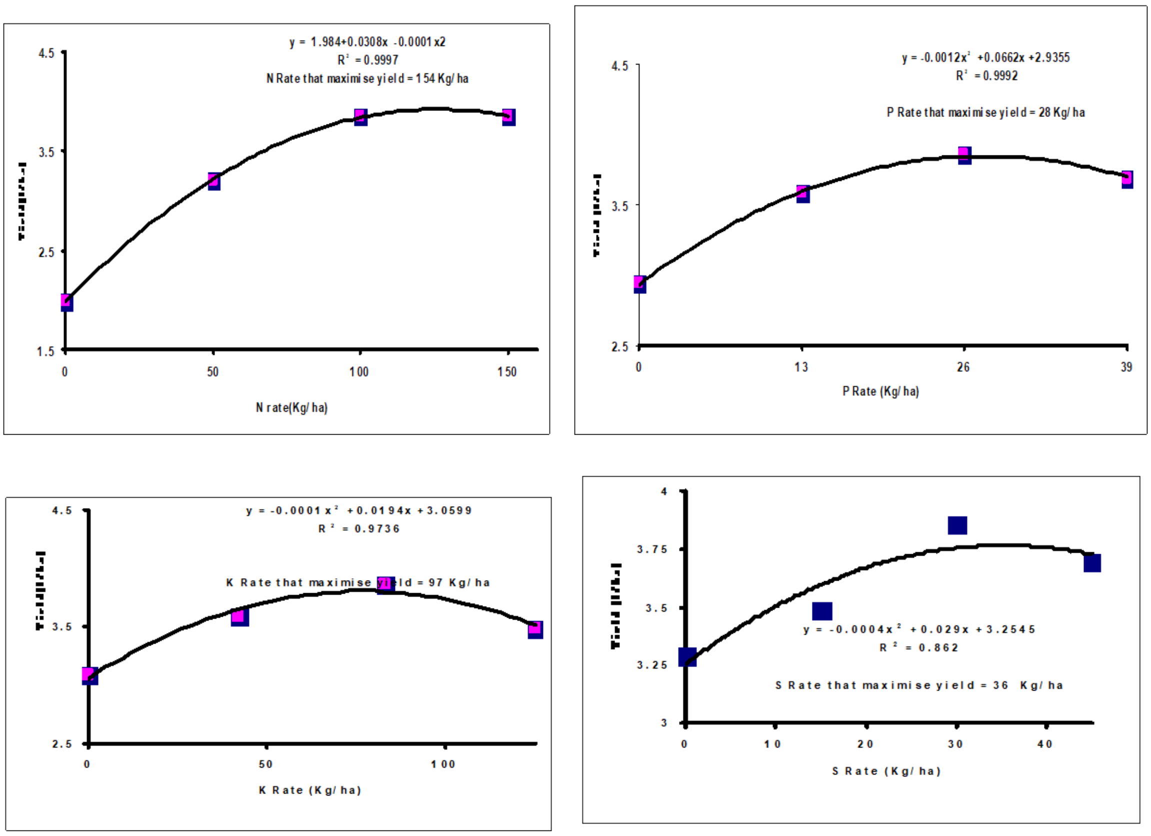



Figure 32. Response of Wheat to added to N, P, K & S grown in Wheat-T.Aman rice cropping pattern at Barind, Rajshahi, 2000-01

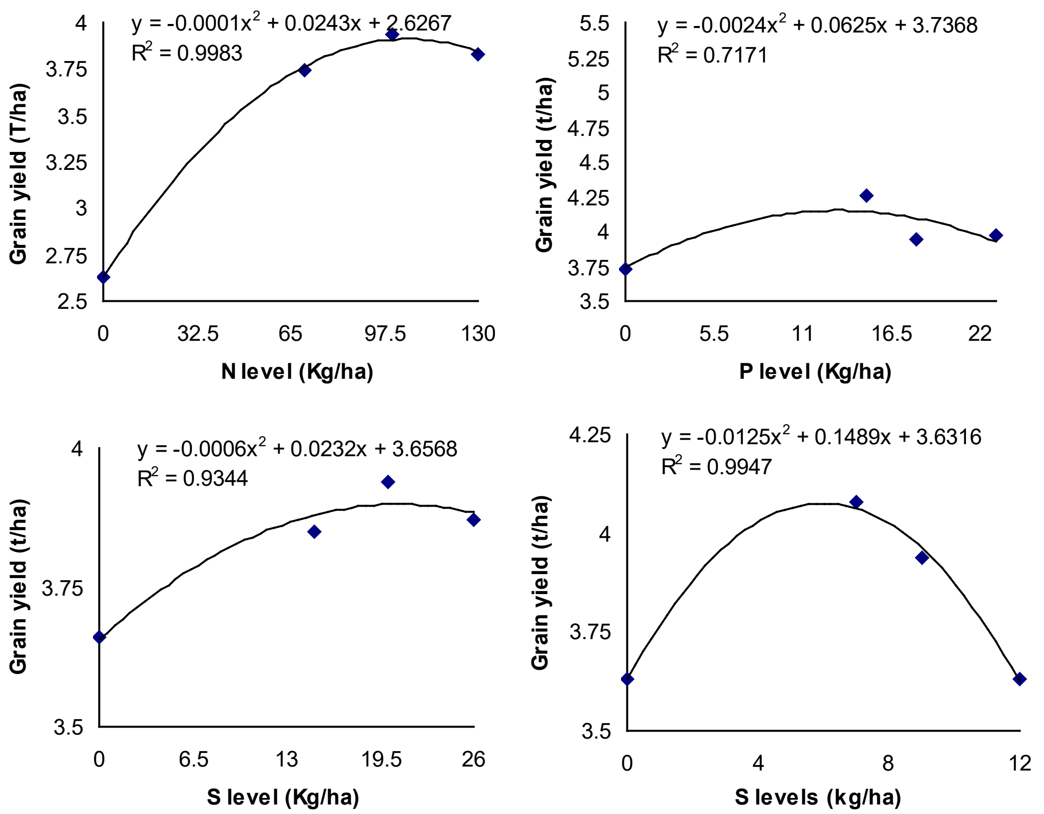



Figure 33. Response of T.Aman to added to N, P, K & S grown in Wheat-T.Aman rice cropping pattern at Barind, Rajshahi, 2000-01

Table 17. Effects of different levels of fertilizer nutrients on the yield of crops in Wheat-T.Aman cropping pattern at Barind, Rajshahi, 2000-01

| Nutrient levels (kg/ha) | | Grain yield (t/ha) | |
|---|---|---|---|
| Wheat | T.Aman | Wheat | T.Aman |
| N levels | | | |
| 0 | 0 | 1.99 | 2.63b |
| 50 | 70 | 3.20 | 3.74a |
| 100 | 100 | 3.86 | 3.94a |
| 150 | 130 | 3.85 | 3.83a |
| P levels | | | |
| 0 | 0 | 2.94 | 3.73b |
| 13 | 15 | 3.58 | 4.26a |
| 26 | 18 | 3.86 | 3.94ab |
| 39 | 23 | 3.69 | 3.97ab |
| K Levels | | | |
| 0 | 0 | 3.08 | 3.66 |
| 42 | 15 | 3.59 | 3.85 |
| 83 | 20 | 3.86 | 3.94 |
| 125 | 26 | 3.49 | 3.87 |
| S Levels | | | |
| 0 | 0 | 3.29 | 3.63 |
| 15 | 7 | 3.49 | 4.08 |
| 30 | 9 | 3.86 | 3.94 |
| 45 | 12 | 3.69 | 3.63 |

**Cropping pattern : Mungbean - T.Aus - T.Aman**
**Location : Bhola MLT site, Barisal**
**Year of establishment : 2000-01**

### Mungbean

A positive response of Mungbean to NPK and S was found. Seed yield increased with the increase of nitrogen up to 25 kg N/ha and thereafter tended to reduce. Similar response was observed in case of P and S and yield increased up to 15 kg and 2 kg/ha of P and S, respectively.

### T.Aus

Application of NP&S fertilizers markedly increased the yield. The yield followed a quadratic trend with increasing the rate of NP&S and grain yield increased up to the application of 130 kg/ha, 15 kg/ha and 4 kg/ha of N, P and S, respectively.

### T.Aman

In T.Aman rice grain yield increased up to the application of 95 kg N/ha. Phosphorus and Sulphur also showed some response towards the grain yield. Grain yield increased up to 15 kg/ha and 4 kg/ha of P and S, respectively.

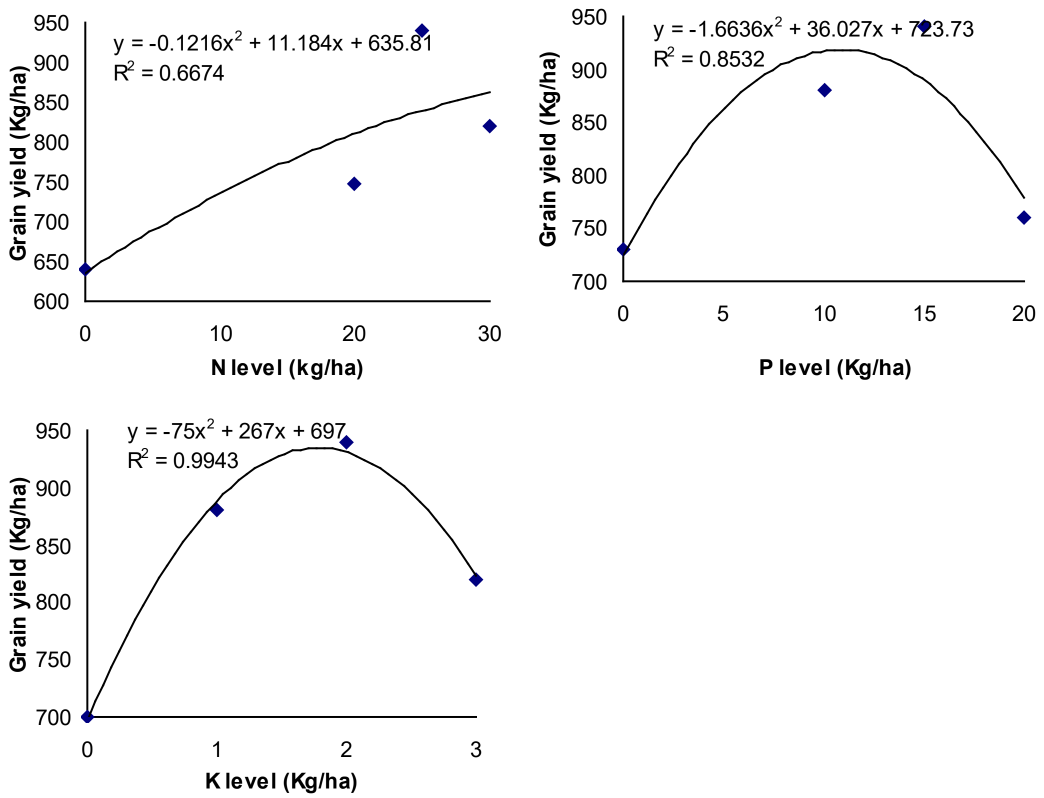



Figure 34. Response of NPK on yield of Mungbean under Mustard-T.Aus-T.Aman cropping pattern at FSRD site, Bhola, Barisal during 2000-01

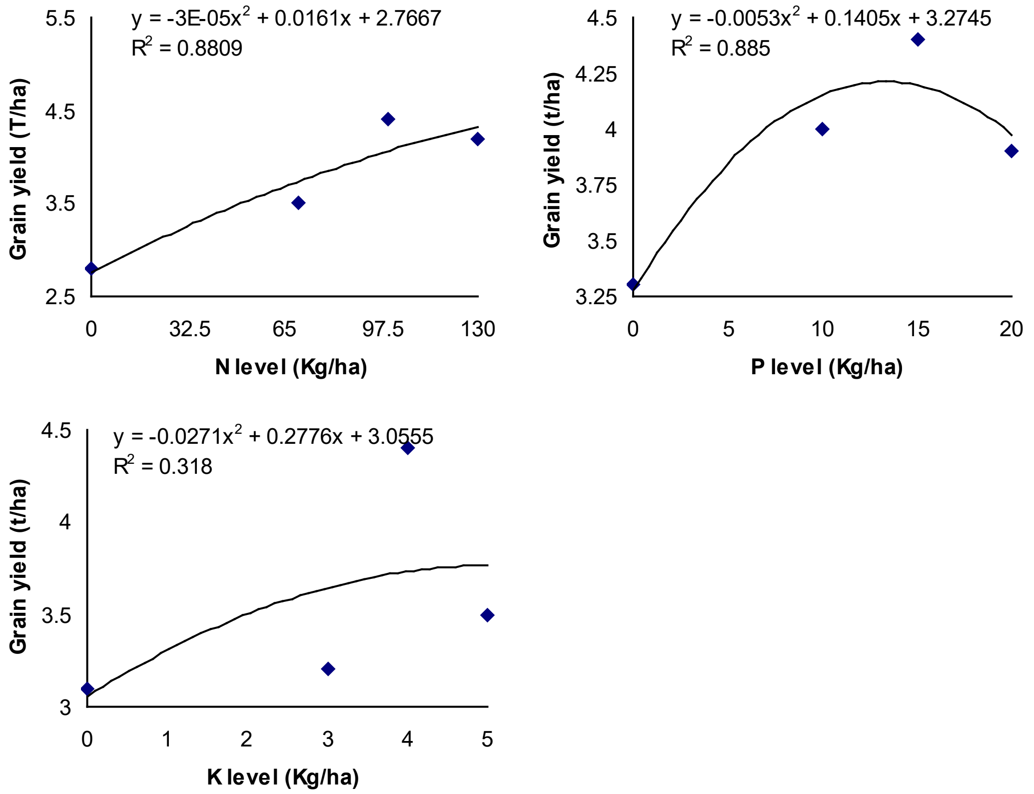



Figure 35. Response of T.Aus to added NPK under Mustard-T.Aus-T.Aman cropping pattern at Bhola, 2000-01

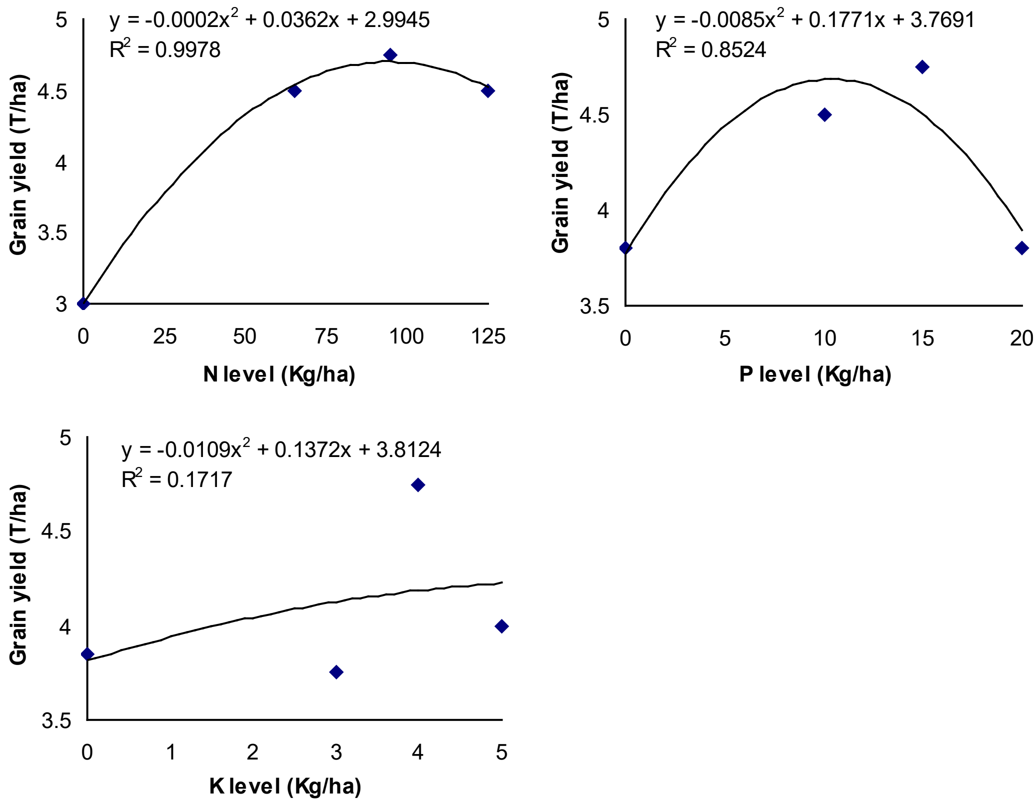



Figure 36. Response of T.Aman to NPK under Mustard-T.Aus-T.Aman cropping pattern at Bhola, 2000-01

Table 18. Effect of different levels of fertilizer nutrients on the yield of crops in Mungbean-T.Aus-T.Aman cropping pattern at Bhola 2000-01

| Nutrient levels (kg/ha) | | | Grain yield (kg/ha, t/ha) | | |
|---|---|---|---|---|---|
| Mungbean | T.Aus | T.Aman | Mungbean | T.Aus | T.Aman |
| N levels | | | | | |
| 0 | 0 | 0 | 640d | 2.80c | 3.00b |
| 20 | 70 | 65 | 748c | 3.50b | 4.50a |
| 25 | 100 | 95 | 940a | 4.40a | 4.75a |
| 30 | 130 | 125 | 820b | 4.20a | 4.50a |
| P levels | | | | | |
| 0 | 0 | 0 | 730c | 3.30c | 3.80c |
| 10 | 10 | 10 | 880b | 4.00b | 4.50b |
| 15 | 15 | 15 | 940a | 4.40a | 4.75a |
| 20 | 20 | 20 | 760c | 3.90b | 3.80c |
| S levels | | | | | |
| 0 | 0 | 0 | 700d | 3.10 | 3.85b |
| 1 | 3 | 3 | 880b | 3.20 | 3.75b |
| 2 | 4 | 4 | 940a | 4.40 | 4.75a |
| 3 | 5 | 5 | 820c | 3.50 | 4.00b |

**Location : Lebukhali, Patuakhali**
**Year of establishment : 2000-01**

**Mungbean**

Average of three years results showed that response of Mungbean, to NPK was very small. No marked variation in yield was observed due to increase of nutrient levels. However, seed yield of Mungbean increased up to the application of 10 kg/ha, 21 kg/ha and 5 kg/ha of P, K and S, respectively. Mungbean is a leguminous crop, therefore response was low to N fertilizer. Generally pulse crop are low responsive to high fertilization. So, marked response of crop yield was found to higher doses of PKS.

**T.Aus**

In T.Aus rice a considerable response of N was found towards the grain yield. Yield increased with the increase of N levels up to 75 kg/ha. Phosphorus and Potassium also produced some response towards the yield. Grain yield increased up to the application of 21 kg/ha and 18 kg/ha of p and K, respectively.

**T.Aman**

In T.Aman rice almost similar trend was found as observed in T.Aus rice. Grain yield increased up to the application of 75 kg N/ha. Phosphorus and Potassium also showed some response towards the grain yield. Grain yield increased up to 18 kg/ha and 14 kg/ha of P and K, respectively.

Based on three years data of yield a response curve was drawn and almost a quadratic type of relation ship was found. From the response curve the optimum doses of the nutrients for different crops were calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Mungbean | 13 | 15 | 5 | - | 12 | 13 | 4 | - |
| T.Aus | 85 | 24 | 15 | - | 80 | 22 | 14 | - |
| T.Aman | 63 | 13 | 11 | - | 60 | 12 | 10 | - |

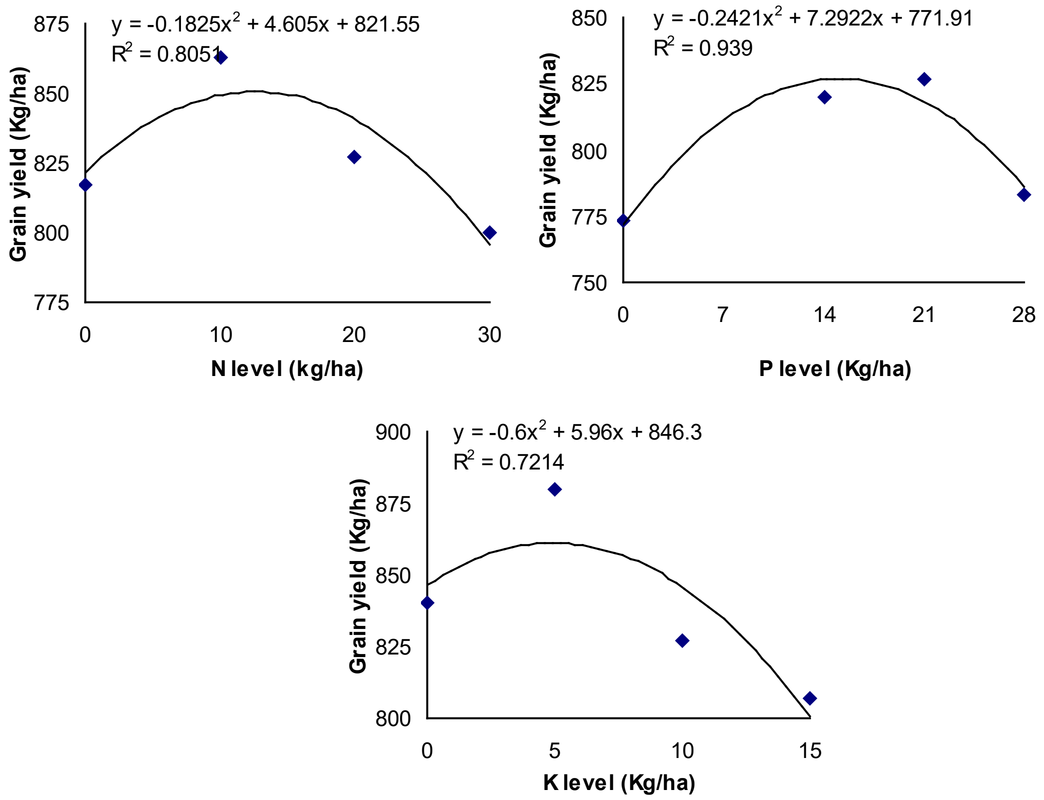



Figure 37. Response of Mungbean to NPK in Mungbean-Boro-T.Aman cropping pattern at FSRD site, Lebukhali, Patuakhali (Avg. of 1998-99 to 2000-01)

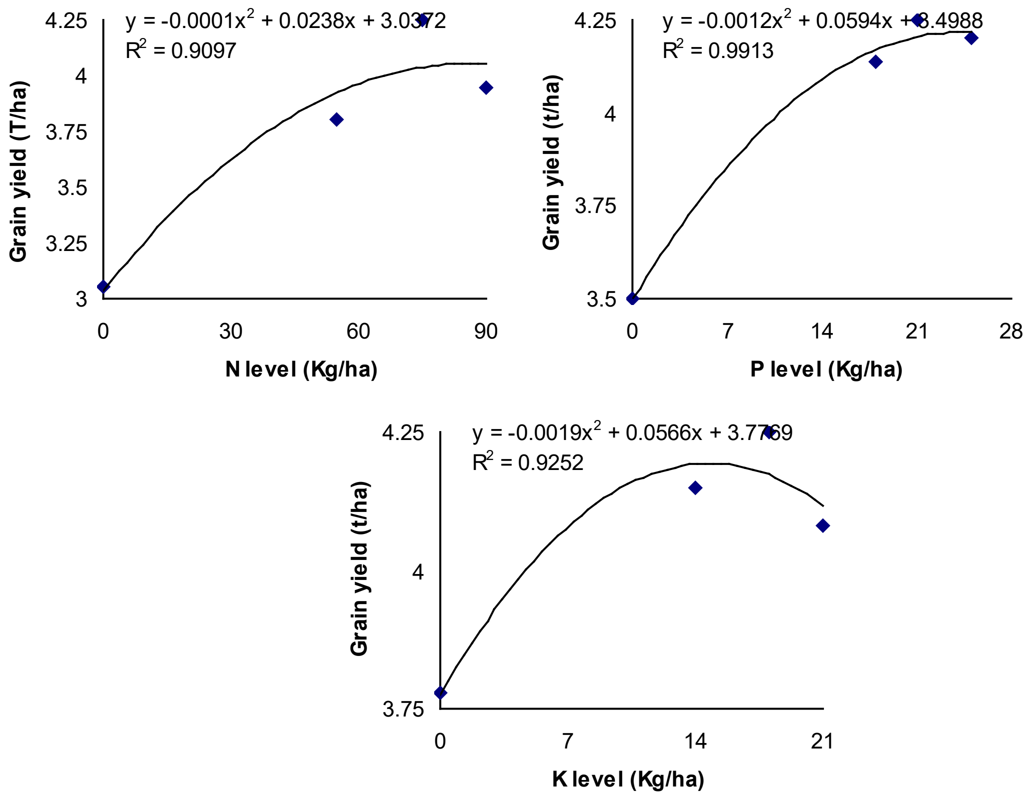



Figure 38. Response of T.Aus to NPK in Mungbean -Boro-T.Aman cropping pattern at FSRD site, Lebukhali, Patuakhali (Avg. of 1998-99 to 2000-01)

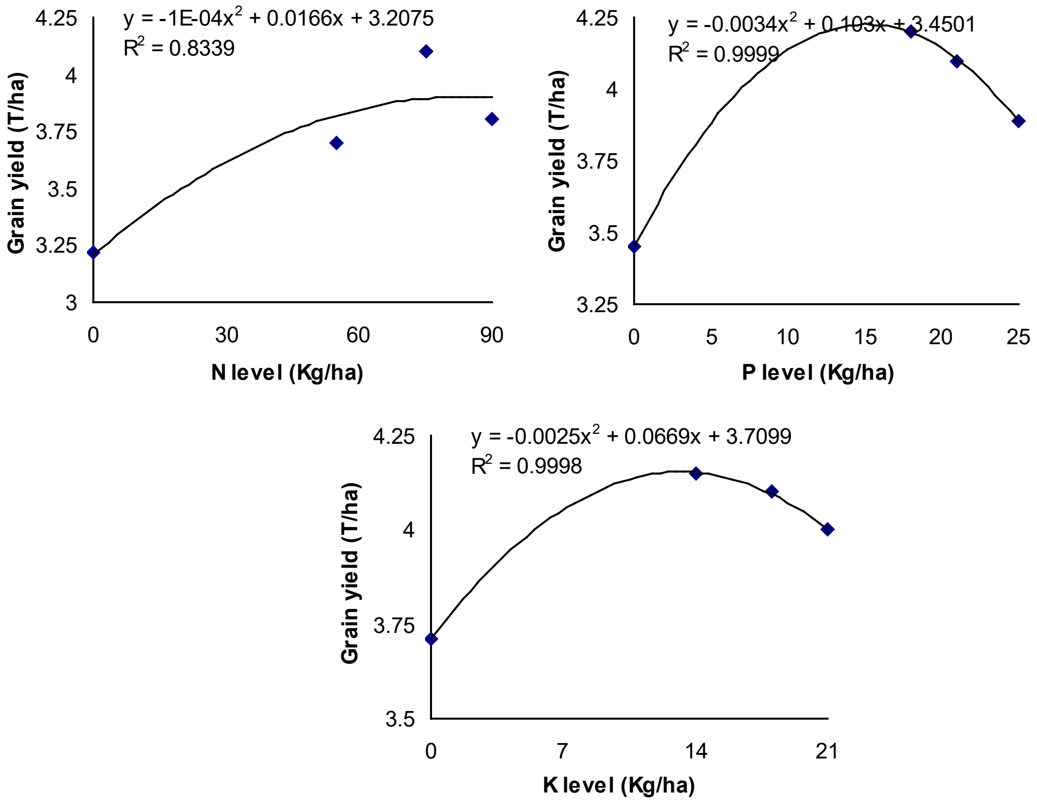



Figure 38. Response of T.Aman to NPK in Mungbean-Boro-T.Aman cropping pattern at FSRD site, Lebukhali, Patuakhali (1998-99-2000-01)

Table 19. Effect of different levels of fertilizer nutrients on the yield of crops in Mungbean-T.Aus-T.Aman cropping pattern at Lebukhali (Avg. of 1998-99 to 2000-01)

| Nutrient levels (kg/ha) | | | Grain yield (kg/ha, t/ha) | | |
|---|---|---|---|---|---|
| Mungbean | T.Aus | T.Aman | Mungbean | T.Aus | T.Aman |
| N levels | | | | | |
| 0 | 0 | 0 | 817 | 3.05 | 3.22 |
| 10 | 55 | 55 | 863 | 3.80 | 3.70 |
| 20 | 75 | 75 | 827 | 4.25 | 4.10 |
| 30 | 90 | 90 | 800 | 3.95 | 3.80 |
| P levels | | | | | |
| 0 | 0 | 0 | 773 | 3.50 | 3.45 |
| 14 | 18 | 18 | 820 | 4.14 | 4.20 |
| 21 | 21 | 21 | 827 | 4.25 | 4.10 |
| 28 | 25 | 25 | 783 | 4.20 | 3.89 |
| K levels | | | | | |
| 0 | 0 | 0 | 840 | 3.78 | 3.71 |
| 5 | 14 | 14 | 880 | 4.15 | 4.15 |
| 10 | 18 | 18 | 827 | 4.25 | 4.10 |
| 15 | 21 | 21 | 807 | 4.08 | 4.00 |

**Cropping pattern : Mustard-Boro**
**Location : Manikganj**
**Year of establishment : 2001-02**

**Mustard**

A positive response of Mustard to different nutrients was observed. Seed yield increased markedly with the increase of Nitrogen up to 80 kg/ha of N. Similarly, P, K and S also showed some response towards the yield and seed yield increased with the application of 20 kg/ha, 10 kg/ha and 15 kg/ha of P, K and S, respectively.

**Boro**

In Boro rice, a small but positive response was found to different nutrients. Grain yield increased linearly with the increase of nitrogen and the highest yield was recorded from the highest level of N. P, K and S also showed some response towards the yield. Grain yield increased up to the application of 20 kg/ha, 45 kg/ha and 8 kg/ha of P, K and S, respectively.

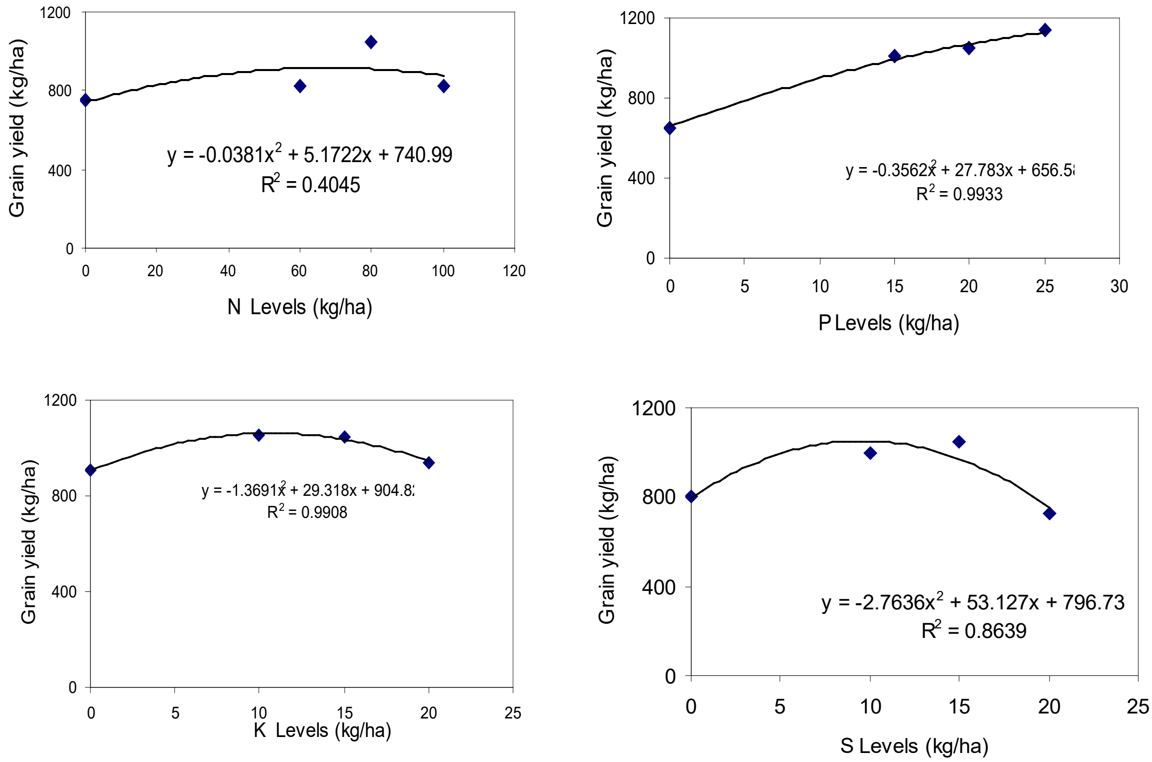



Figure 39. Response of Mustard to NPKS in Mustard-Boro cropping pattern at Manikganj, 2001-02

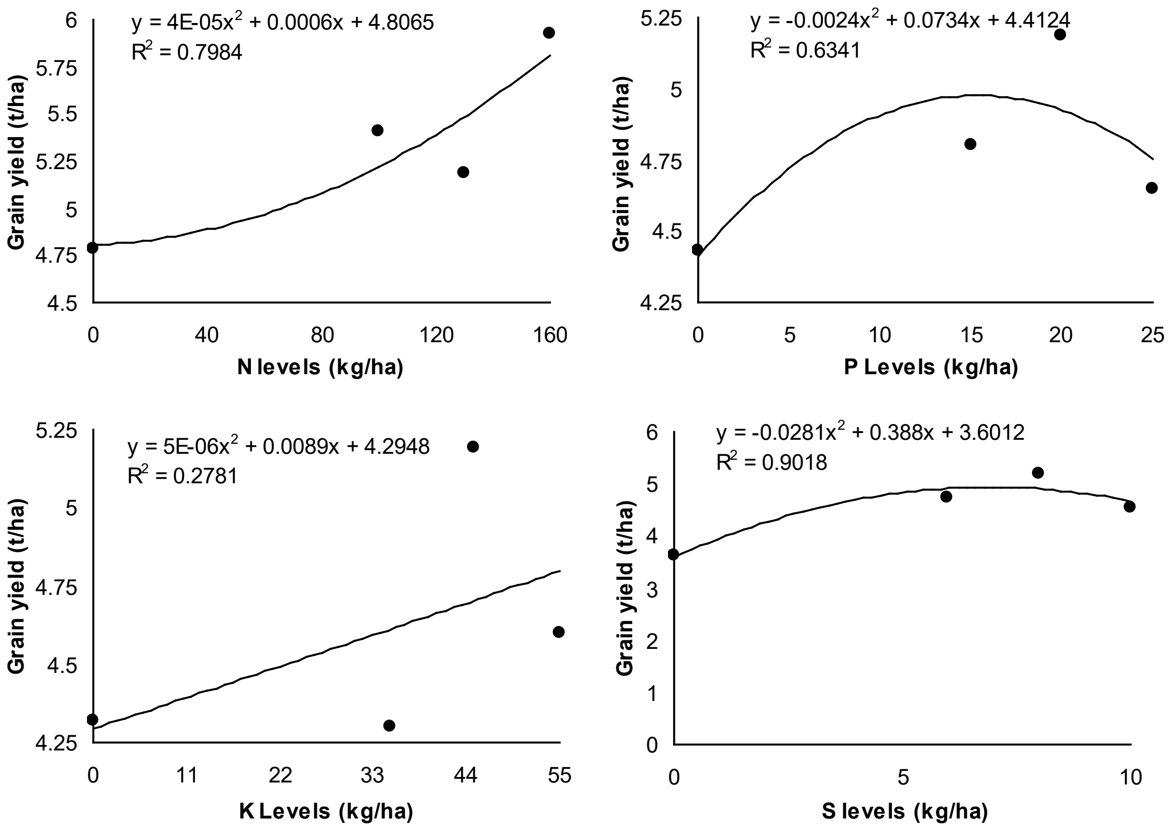



Figure 40. Response of Boro to NPKS in Mustard-Boro cropping pattern at Manikganj, 2001-02

Table 20. Effects of different levels of fertilizer nutrients on the yield crops in Mustard-Boro cropping pattern at Manikganj, 2001-02

| Nutrient levels (kg/ha) | | Grain yield (t/ha) | |
|---|---|---|---|
| Mustard | Boro | Mustard | Boro |
| N levels | | | |
| 0 | 0 | 750 | 4.79 |
| 60 | 100 | 824 | 5.41 |
| 80 | 130 | 1046 | 5.19 |
| 100 | 160 | 823 | 5.93 |
| P levels | | | |
| 0 | 0 | 655 | 4.43 |
| 15 | 15 | 1009 | 4.80 |
| 20 | 20 | 1046 | 5.19 |
| 25 | 25 | 1138 | 4.65 |
| K Levels | | | |
| 0 | 0 | 906 | 4.32 |
| 10 | 35 | 1054 | 4.50 |
| 15 | 45 | 1046 | 5.19 |
| 20 | 55 | 940 | 4.60 |
| S Levels | | | |
| 0 | 0 | 806 | 3.62 |
| 10 | 6 | 996 | 4.73 |
| 15 | 8 | 1046 | 5.19 |
| 20 | 10 | 726 | 4.56 |

**Cropping pattern : Groundnut-T.Aman**
**Location : Laxmipur MLT site, Noakhali**
**Year of establishment : 1999-2000 to 2000-01**

### Groundnut

Response of nitrogen towards the nut yield (Average, 99-00 & 2000-01) of groundnut was observed. Nut yield increased up to the application of nitrogen @ 30 kg/ha and then trended to decrease (Fig. 1). A little response of P was observed. Response of K was observed to some extent and yield increased up to 10 kg/ha.

### T.Aman

Response of N towards the grain yield of T.aman in kharif II season, 2000 was positive and yield increased up to 78 kg/ha and then tended to decrease. (Fig. 2). Similarly grain yield increased up to the application of 31 kg/ha and 27 kg/ha of P and K, respectively.

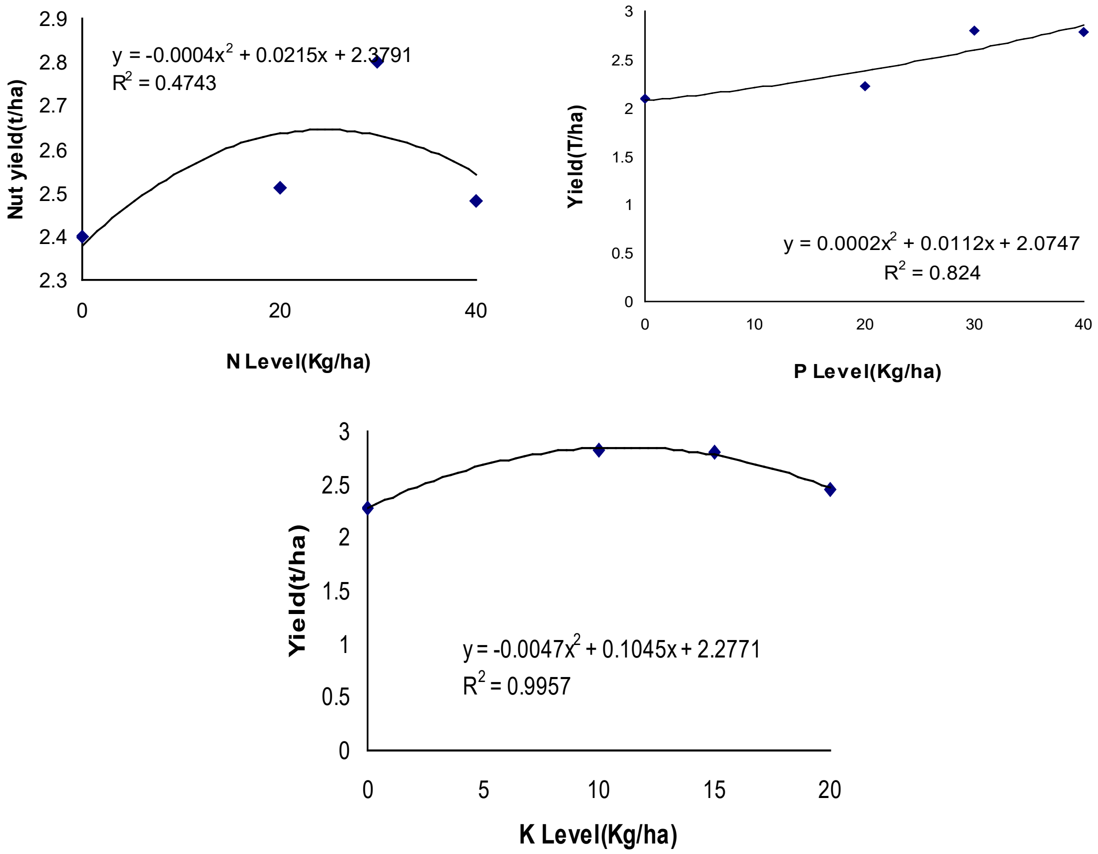



Figure 41. Response of Groundnut to NPK in Groundnut-T.Aman cropping pattern at MLT Lakshmipur during (Avg. of 1999-2000 to 2000-01)

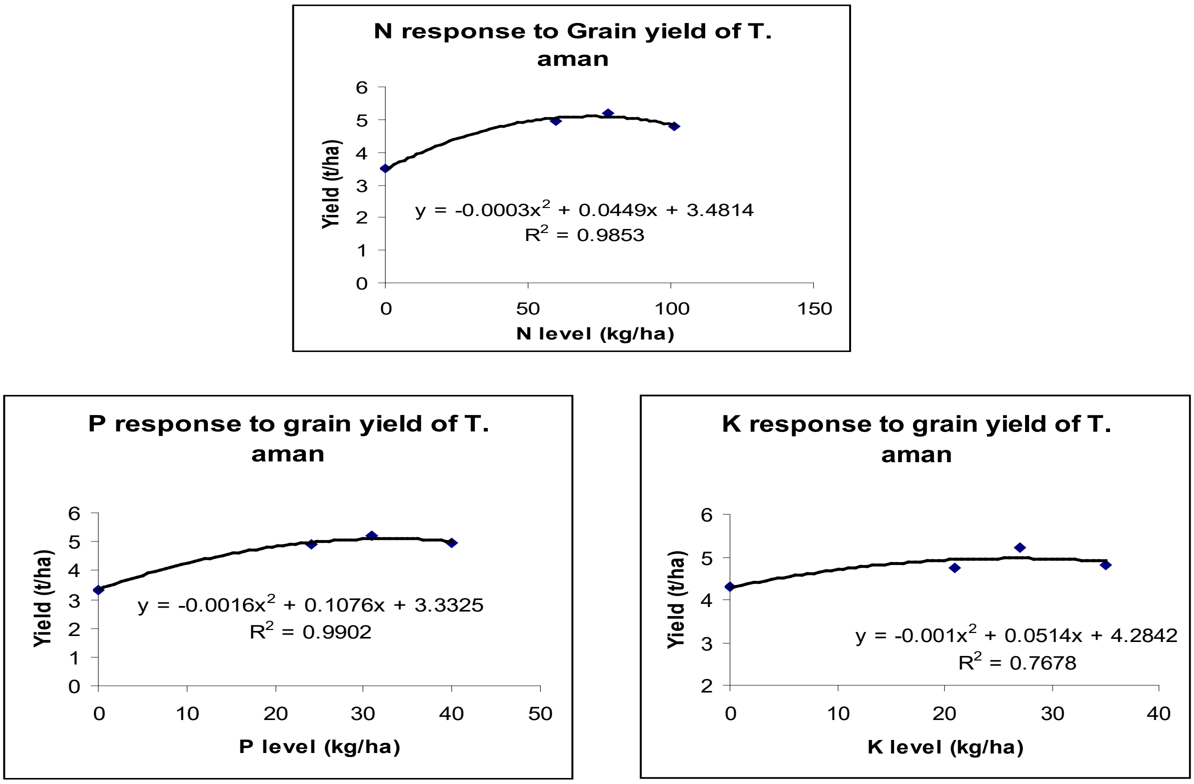



Figure 42. Response of T.Aman to NPK in Groundnut-T.Aman cropping pattern at MLT site Laksmipur during 2000-01

**Cropping pattern : Onion-B.Aman**
**Location : Baliakandi, Faridpur**
**Year of establishment : 2001-02**

## Onion

Bulb yield of onion increased with the increase of N and the highest yield (14.5 t/ha) was recorded from 100 kg N/ha. After that level bulb yield tended to decrease. Almost similar trend was found in case of P & S and the yield increased up to 80 kg 50 kg and 30 kg/ha of P, K and S respectively. From the data a response curve was drawn and relationship is quadratic. From the curve agronomically and economically optimum dose of onion was find out.

From the response curve the optimum doses of the nutrients for Onion was calculated.

| Crop | Agronomically optimum dose | | | | Economically optimum dose | | | |
|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S |
| Onion | 108 | 72 | 88 | 32 | 92 | 52 | 75 | 30 |

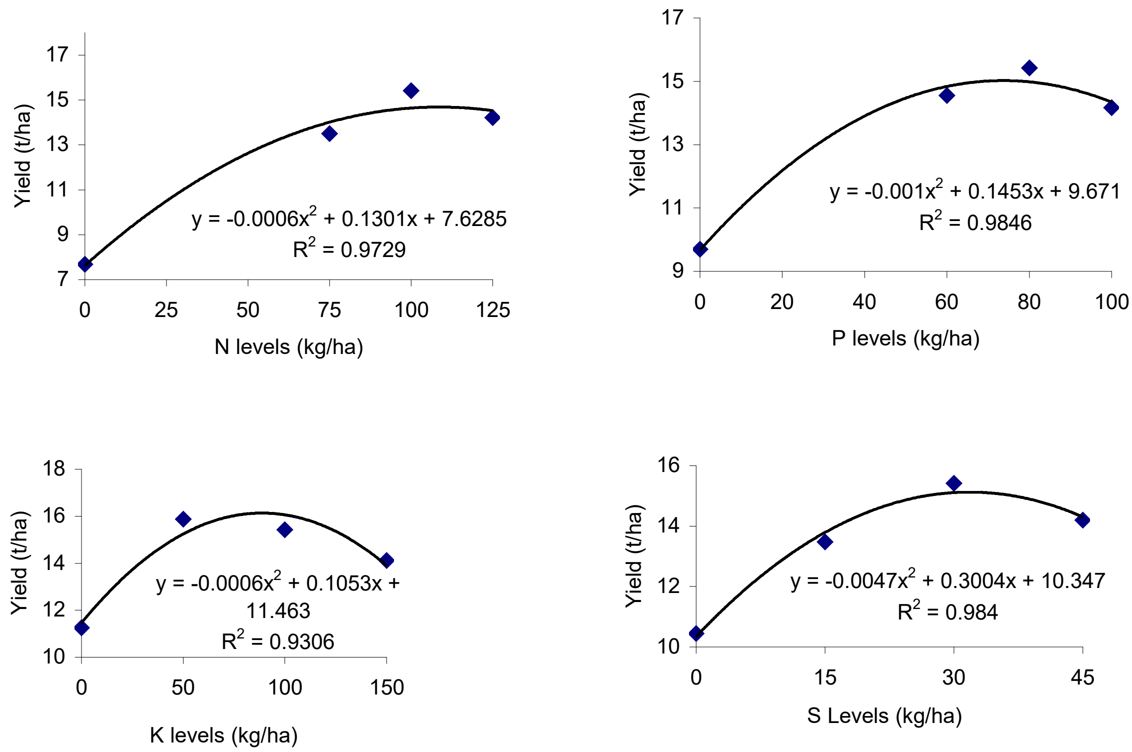



Figure 43. Response of Onion to NPKS in Onion-B.Aman cropping pattern at Baliakandi, Rajbari during 2001-02

Table 21. Effect of different levels of fertilizer nutrients on the yield of onion at Baliakandi MLT site, Faridpur, 2001-2002

| Nutrient levels (kg/ha) | | Bulb yield (t/ha) |
|---|---|---|
| | Onion | Onion |
| N levels | 0 | 7.68 |
| | 75 | 13.50 |
| | 100 | 15.42 |
| | 125 | 14.22 |
| P levels | 0 | 9.70 |
| | 60 | 14.55 |
| | 80 | 15.42 |
| | 100 | 14.17 |
| K levels | 0 | 11.25 |
| | 50 | 15.88 |
| | 100 | 15.42 |
| | 150 | 14.12 |
| S levels | 0 | 10.45 |
| | 15 | 13.48 |
| | 30 | 15.42 |
| | 45 | 14.20 |

**Cropping pattern : T.Aus- T.Aman**
**Location : Golapganj FSRD site & Moulvibazar MLT site, Sylhet**
**Year of establishment : 2001-02**

## T. Aus rice

Results of two years studies indicated that at two locations (Golapgonj, Sylhet and Moulvibazar) grain yield of T.Aus rice increased up to 95 kg N/ha at Golapgonj and up to 90 kg N/ha at Moulvibazar and there after the yield reduced. Almost similar trend was observed in case of P, K, and S and grain yield increased up to the application 22, 60 and 6 kg/ha and 15, 35 and 6 kg/ha of P,K, and S, at Golapganj FSRD site and Moulvibazar MLT site, respectively.

## T.Aman rice

Grain yield increased with the increase of N levels up to 95 kg N/ha at Golapgonj and 90 kg N/ha at Moulvibazar. Similarly the response was found in P, K and S up to 11, 60 and 3 kg/ha and 7, 35 and 3 kg/ha of P, K and S at Golapganj FSRD site and Moulvibazar MLT site, respectively.

From the response curve both agronomically and economically optimum level of different nutrients was calculated and it was observed that the agronomically optimum level is little higher than economically optimum level.

| Crop | Agronomically optimum dose Kg/ha) | | | | Economically optimum dose (Kg/ha) | | | | Figure no. |
|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S | |
| FSRD Site, Golapgonj | | | | | | | | | |
| T. Aus | 103 | 22 | 70 | 6 | 101 | 22 | 62 | 6 | 1 |
| T. Aman | 105 | 11 | 64 | 3 | 103 | 11 | 57 | 3 | 2 |
| MLT Site, Moulvibazar | | | | | | | | | |
| T. Aus | 103 | 17 | 42 | 6 | 100 | 16 | 40 | 6 | 3 |
| T. Aman | 99 | 8 | 40 | 3 | 97 | 8 | 38 | 3 | 4 |

Table 22. Effect of different level of fertilizer nutrient on the yield of T.Aus in T.Aus-T.Aman-Fallow cropping pattern at FSRD Site, Golapgonj, Sylhet (2000 to 2001)

| Treatment | | 2000 | | 2001 | | Mean | |
|---|---|---|---|---|---|---|---|
| T. Aus | T.Aman | T. Aus | T.Aman | T. Aus | T.Aman | T. Aus | T.Aman |
| Nitrogen rate (Kg/ha) | | | | | | | |
| 0 | 0 | 1.99 | 2.48 | 2.71 | 2.3 | 2.35 | 2.39 |
| 70 | 70 | 2.97 | 3.48 | 5.19 | 4.82 | 4.08 | 4.15 |
| 95 | 95 | 3.04 | 3.648 | 5.56 | 5.112 | 4.3 | 4.38 |
| 120 | 120 | 2.93 | 3.516 | 5.13 | 4.684 | 4.03 | 4.1 |
| Phosphorus rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.55 | 3.06 | 4.45 | 3.76 | 3.5 | 3.41 |
| 17 | 9 | 2.98 | 3.576 | 5.32 | 4.824 | 4.15 | 4.2 |
| 22 | 11 | 3.04 | 3.648 | 5.56 | 5.112 | 4.3 | 4.38 |
| 27 | 13 | 2.94 | 3.528 | 5.38 | 4.952 | 4.16 | 4.24 |
| Potassium rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.42 | 2.76 | 5.2 | 5.08 | 3.81 | 3.92 |
| 48 | 48 | 2.86 | 3.44 | 5.48 | 5.14 | 4.17 | 4.29 |
| 60 | 60 | 3.04 | 3.648 | 5.56 | 5.112 | 4.3 | 4.38 |
| 72 | 72 | 2.92 | 3.52 | 5.46 | 5.14 | 4.19 | 4.33 |
| Sulphur rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.71 | 3.38 | 4.11 | 4.3 | 3.41 | 3.84 |
| 4.5 | 2 | 2.98 | 3.6 | 5.38 | 4.9 | 4.18 | 4.25 |
| 6 | 3 | 3.04 | 3.648 | 5.56 | 5.112 | 4.3 | 4.38 |
| 7.5 | 4 | 2.95 | 3.59 | 5.47 | 5.01 | 4.21 | 4.3 |

Table 23. Effect of different level of fertilizer nutrient on the yield of T.Aman in T.Aus-T.Aman cropping pattern at MLT Site, Moulvibazar (2000 to 2001)

| Treatment | | 2000 | | 2001 | | Mean | |
|---|---|---|---|---|---|---|---|
| T. Aus | T.Aman | T. Aus | T.Aman | T. Aus | T.Aman | T. Aus | T.Aman |
| Nitrogen rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.24 | 2.51 | 2.60 | 3.19 | 2.42 | 2.85 |
| 70 | 70 | 3.11 | 3.51 | 5.19 | 5.53 | 4.15 | 4.52 |
| 90 | 90 | 3.28 | 3.8 | 5.42 | 5.68 | 4.35 | 4.74 |
| 110 | 110 | 3.16 | 3.76 | 5.24 | 5.4 | 4.2 | 4.58 |
| Phosphorus rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.78 | 3.25 | 4.22 | 4.13 | 3.5 | 3.69 |
| 12 | 6 | 3.10 | 3.62 | 5.20 | 5.38 | 4.15 | 4.5 |
| 15 | 7 | 3.28 | 3.8 | 5.42 | 5.68 | 4.35 | 4.74 |
| 18 | 8 | 3.18 | 3.72 | 5.26 | 5.4 | 4.22 | 4.56 |
| Potassium rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.62 | 3.12 | 5.08 | 5.36 | 3.85 | 4.24 |
| 25 | 25 | 3.12 | 3.67 | 5.32 | 5.61 | 4.22 | 4.64 |
| 35 | 35 | 3.28 | 3.8 | 5.42 | 5.68 | 4.35 | 4.74 |
| 45 | 45 | 3.15 | 3.75 | 5.35 | 5.67 | 4.25 | 4.71 |
| Sulphur rate (Kg/ha) | | | | | | | |
| 0 | 0 | 2.95 | 3.58 | 3.93 | 4.74 | 3.44 | 4.16 |
| 4. | 2 | 3.22 | 3.75 | 5.24 | 5.45 | 4.23 | 4.6 |
| 6 | 3 | 3.28 | 3.8 | 5.42 | 5.68 | 4.35 | 4.74 |
| 8 | 4 | 3.18 | 3.72 | 5.34 | 5.58 | 4.26 | 4.65 |

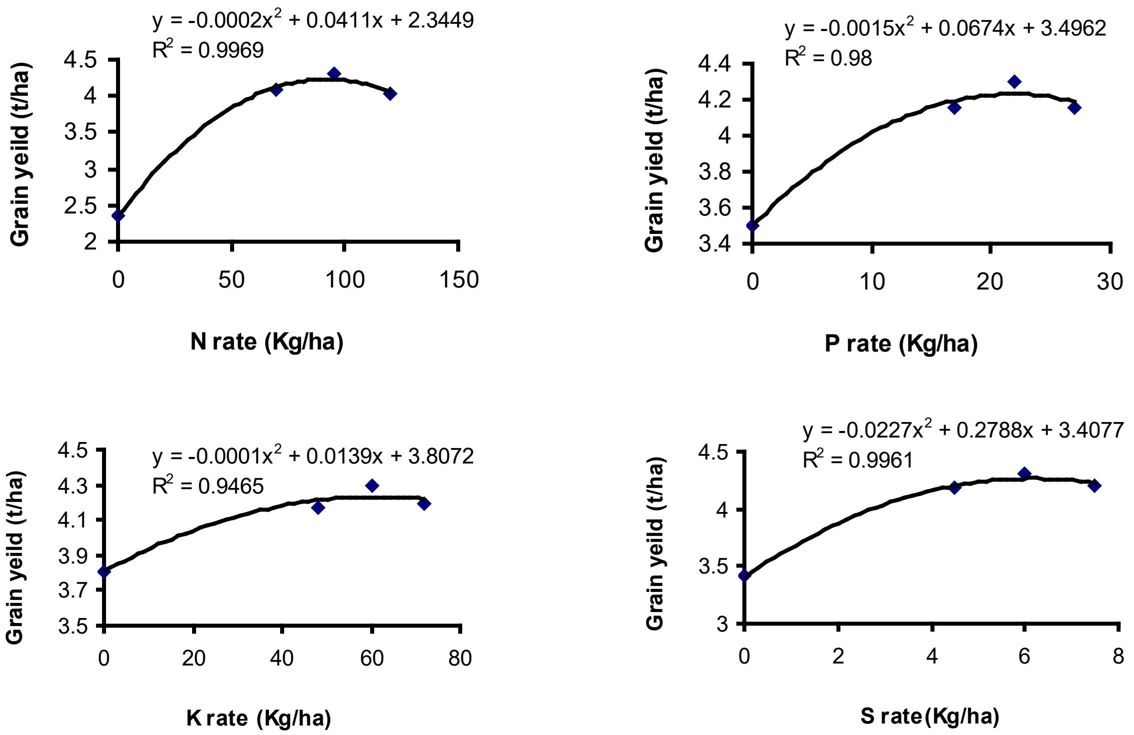



Figure 44. Response of T.Aus to NKPS in T.Aus- T.Aman cropping pattern at FSRD site, Golapgonj, Sylhet, 2000-01

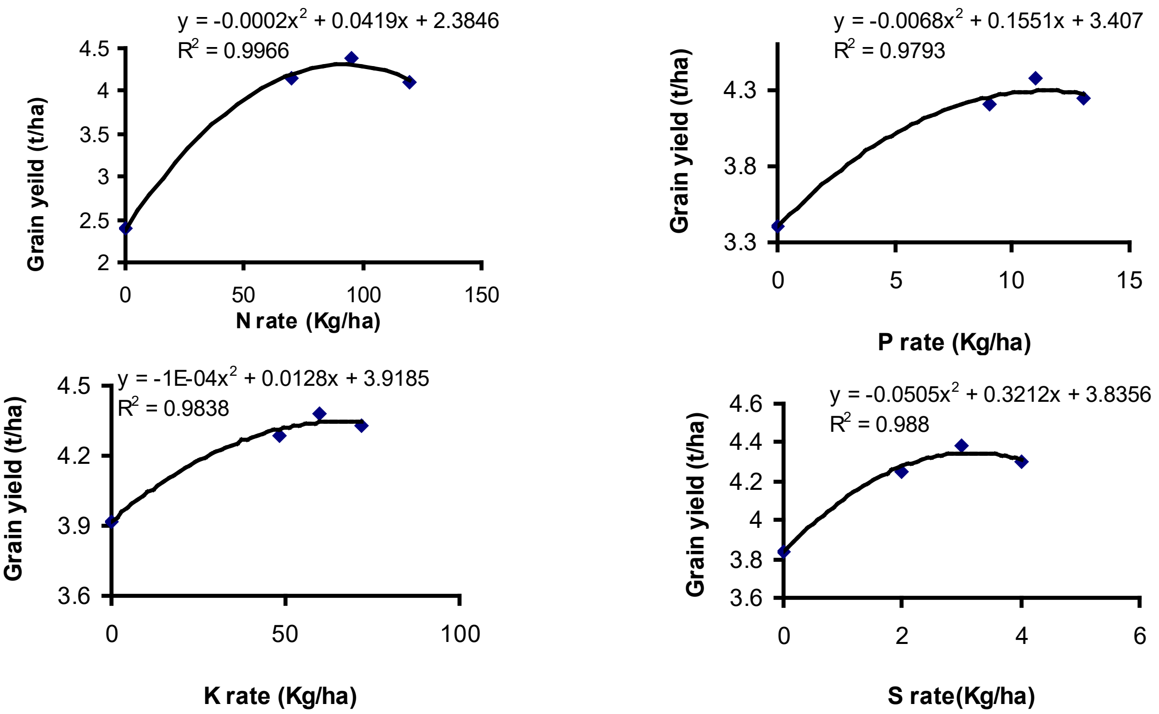



Figure 45. Response of T.Aman to NPKS in T.Aus- T.Aman cropping pattern at FSRD site, Golapganj, Sylhet, 2000-01

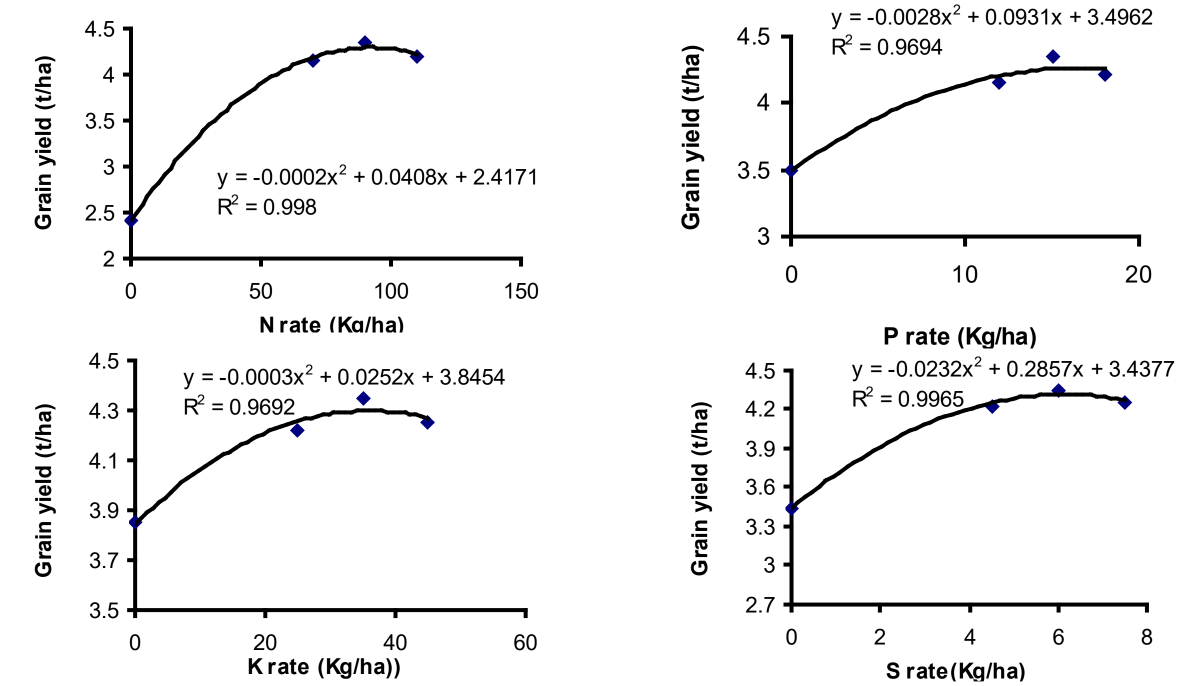



Figure 46. Response of T. Aus to T. Aus- T.Aman cropping pattern at MLT Site, Moulvibazar, 2000-01

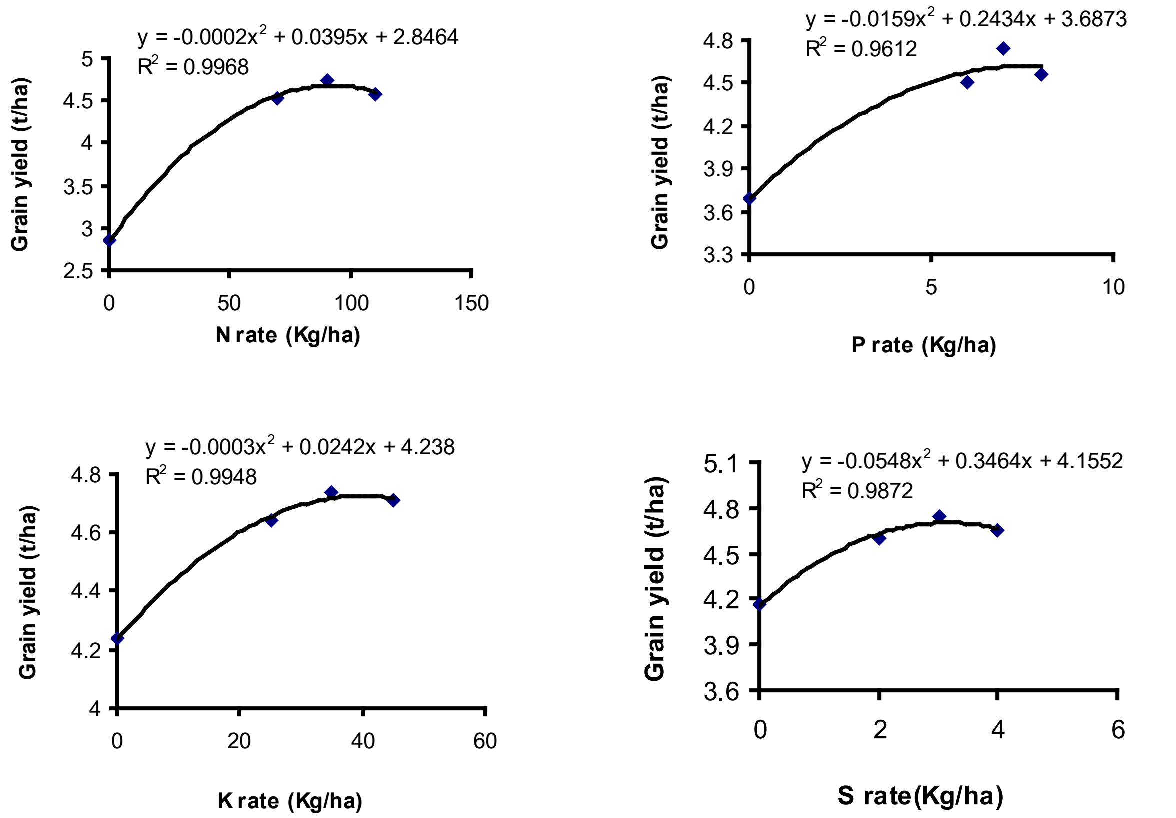



Figure 47. Response of T.Aman to NPK in T.Aus- T.Aman cropping pattern at MLT Site, Moulvibazar, 2000-01.

**Cropping pattern : Fallow-Fallow-T.Aman**
**Location : Atkapalia FSRD site, Noakhali**
**Year of establishment: 1999-2001**

**T.Aman**

Average of three years data showed that a positive response of N was evident. Grain yield of T.Aman rice was increased with the increase of N levels up to 140 kg N/ha and thereafter additional N could not increase the yield. Similarly for P and K a positive response towards the yield was observed and yield increased up to the application of 25 kg/ha and 17 kg/ha of P and K, respectively. From the average data a response curve was drawn and the agronomically as well as economically optimum dose for T.Aman rice was find out.

| Optimum dose | Nutrient rate (kg/ha) | | |
|---|---|---|---|
| | N | P | K |
| Agronomically optimum dose | 117 | 20 | 12 |
| Economically optimum dose | 117 | 19 | 10 |

Table 24. Effect of different levels of NPK on the yield of T.Aman rice at Atkapalia FSRD site, Noakhali, 1999-2001

| Nutrient levels (Kg/ha) | Grain yield (t/ha) |
|---|---|
| N levels | |
| $N_0$ | 3.55 |
| $N_{103}$ | 3.97 |
| $N_{140}$ | 4.55 |
| $N_{182}$ | 3.93 |
| P levels | |
| $P_0$ | 3.29 |
| $P_{21}$ | 4.26 |
| $P_{25}$ | 4.55 |
| $P_{28}$ | 4.10 |
| K levels | |
| $K_0$ | 4.21 |
| $K_{13}$ | 4.23 |
| $K_{17}$ | 4.55 |
| $K_{22}$ | 4.14 |

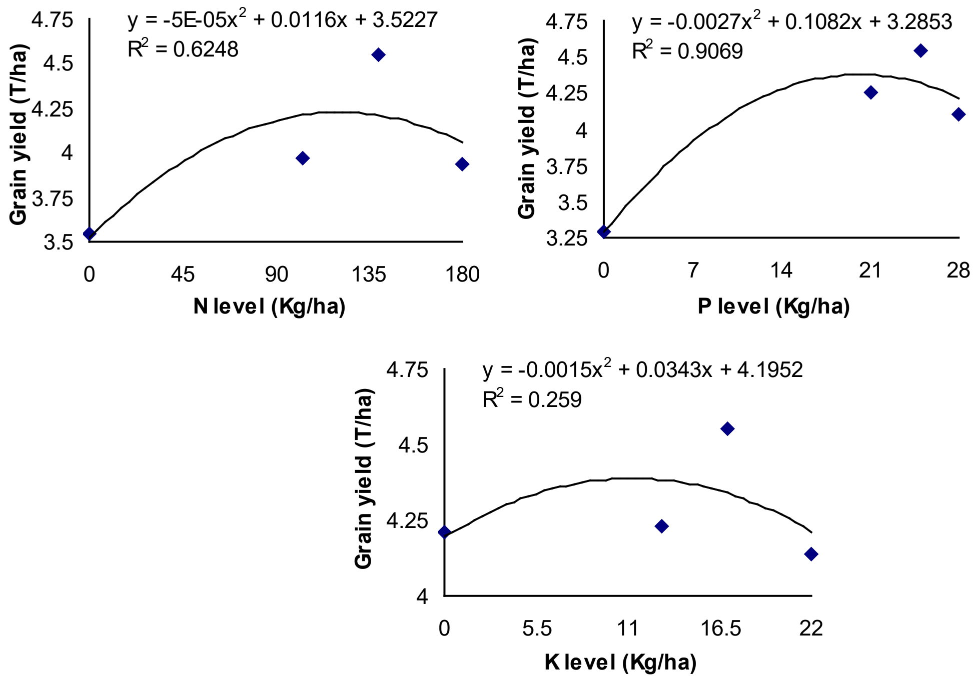



Figure 48. Response of T.Aman rice to NPK at Atkapalia, Noakhali, during 1999 to 2001

# Appendices

Appendix table 1. Initial soil status of the experimental site

| Location with AEZ | Land type | R/I | pH | O.C (%) | Total N (%) | K (m.eq./100g soil) | P | S | Zn | B |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ppm | | | |
| Muktagacha (9) | MHL | I | 5.56 | 1.98 | 0.171(L) | 0.085 (VL) | 7.33 (VL) | 28.3 (Opt.) | - | - |
| 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) |
| 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) |
| Palima (9) | MHL | I | 5.3 | 2.08 | 0.10 (L) | 0.12 (L) | 5.0 (VL) | 51.0 (H) | 2.42(H) | - |
| Kendua (9) | MHL | I | - | - | 0.15 (L) | 0.12 (L) | 1.59 (VL) | 16.6 (L) | 1.08 (M) | - |
| Kishoreganj | MHL | I | - | - | 0.09 (L) | 0.31 (M) | 4.11 (VL) | 21.9 (M) | 1.27 (M) | - |
| Lebukhali (13) | MHL | R | 5.3 | 1.44 | 0.08 (VL) | 0.28 (Opt) | 4.4 (VL) | 33.46(Opt) | 0.34(VL) | - |
| Barind (26) | MHL | I | 8.48 | 1.53 | 0.08 (VL) | 0.16 (L) | 5.16 (L) | 19.5 (M) | 0.65 (L) | 0.29 (L) |
| Atkapalia (18) | MHL | R | 7.06 | 1.41 | 0.03 | 0.23 | 5.7 | 65.2 | 0.66 | - |
| Laxmipur (18) | MHL | R | 6.6 | 2.12 | 0.12 (L) | 0.19 (M) | 1.5 (VL) | 31.3 (VH) | 0.85 (L) | 0.47 (O) |
| Bagherpara (11) | MHL | I | - | - | 0.11 (L) | 0.39 (H) | 17.9 (M) | 7.34 (VL) | 3.29 (VH) | 0.4 (M) |
| Norail (11) | MHL | I | - | - | 0.11 (L) | 0.27 (M) | 1.88 (VL) | 36.0 (H) | 2.57 VH) | 0.82 (O) |
| 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) |
| Baliakandi (12) | MHL | I | 6.3 | - | 0.16 (L) | 0.44 (VH) | 1.84 (VL) | 18.5 (M) | - | - |
| Ishan Gopalpur (12) | MHL | I | 7.5 | - | 0.18 (M) | 0.42 (VH) | 9.03 (L) | 18.0 (M) | - | - |
| Golapganj (20) | MHL | R | 5.20 | 1.70 | 0.08 (VL) | 0.05 (VL) | 3.25 (VL) | 22.5 (M) | 0.73 (L) | 0.36 (M) |
| Moulvibazar (20) | MHL | R | 4.74 | 1.95 | 0.09 (VL) | 0.17 (M) | 9.56 (L) | 22.3 (M) | 3.30 (VH) | 0.58 (O) |
| Bhola (13) | MHL | R | 7.1 | - | 0.57 (VL) | 0.50 (VH) | 8.8 (L) | 27.2 (O) | 1.59 (O) | 0.48 (O) |
| Bagerhat (13) | MHL | I | 8.0 | 2.14 | 0.10 (L) | 0.42 (VH) | 4.94 (VL) | 178.0 (VH) | 0.50 (L) | - |
| Kolaroa (11) | MHL | I | 8.1 | 1.88 | 0.09 (L) | 0.22 (M) | 4.80 (VL) | 13.2 (L) | 0.51 (L) | - |
| Manikganj (8) | MLL | I | 7.15 | 1.47 | 0.09 (L) | 0.20 (M) | 3.31 (VL) | 13.1 (L) | 0.62 (L) | 0.05 (VL) |

Appendix table 2. Crop management practices

| Site | Cropping pattern | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Muktagacha | Mustard | Tori-7 | 10 | 4th week of Nov | 1st week of Feb |
| | Boro | BR 28 | 40 | 2nd week of Feb | 3rd week of May |
| | T.Aman | BRRI Dhan 33 | 40 | 4th week of July | 1st week of Nov |
| Bagherpara | Mustard | Tori-7 | 08 | 3rd week of Nov | 2nd week of Feb |
| | Boro | BR 28 | 40 | 3rd week of Feb | Last week of May |
| | T.Aman | BR 11 | 40 | Last week of July | 4th 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 |
| Palima | Mustard | Tori-7 | 10 | 3rd week of Nov | 3rd week of Jan |
| | Boro | BRRI Dhan 29 | 40 | 1st week of Feb. | 3rd week of May |
| | T.Aman | BRRI Dhan 33 | 40 | 2nd week of Aug | 2nd week of Nov |
| Narikeli | Wheat | Kanchan | 100 | 4th week of Nov | 4th week of March |
| | Jute | O-9897 | 10 | 1st week of April | 1st week of Aug |
| | T.Aman | BRRI Dhan 32 | 50 | 1st week of Aug | 2nd week of Nov |
| Lebukhali | Mungbean | Kanti | 40 | 2nd week of Feb | 4th week of April |
| | T.Aus | BR 2 | 40 | 1st week of May | 3rd week of Aug. |
| | T.Aman | BR 23 | 40 | Last week of Aug | Last week of Dec |
| Kishoregonj | Boro | BR 3 | 40 | 1st week of Feb. | 3rd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | Last week of July | 3rd week of Nov |
| Kendua | Boro | BR 3 | 40 | 1st week of Feb. | 3rd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | Last week of July | 3rd week of Nov |
| Phulpur | Boro | BRRI Dhan 28 | 40 | Last week of Jan. | 1st week of May |
| | T.Aman | BRRI Dhan 33 | 40 | Last week of July | Last week of Oct. |
| Netrokona | Boro | Pajam | 40 | 1st week of Feb. | 2nd week of May |
| | T.Aman | BRRI Dhan 33 | 40 | Last week of July | Last week of Oct. |

| Site | Cropping pattern | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Norail | Boro | BRRI Dhan 28 | 40 | 1st week of Feb. | 3rd week of May |
| | T.Aman | BR 11 | 40 | 3rd week of July | Last week of Nov |
| Barind | Wheat | Kanchan | 120 | Last week of Nov | 4th week of March |
| | T.Aman | BRRI Dhan 29 | 40 | 2nd week of July | 1st week of Nov |
| Atkapalia | T.Aman | BRRI Dhan 32 | 40 | Last week of July | Last week of Nov |
| Laxmipur | G.nut | Dhaka-1 | - | 3rd week of Dec. | 3rd week of May |
| | T.Aman | BRRI Dhan 32 | 40 | Last week of July | Last week of Nov. |
| Goyeshpur | Wheat | Kanchan | 120 | 1st week of Dec. | 3rd week of March |
| | Jute | O-9897 | 08 | 3rd week of April | 3rd week of July |
| | T.Aman | BR 11 | 50 | Last week of July | 3rd week of Nov |
| Bhola | M.bean | BARI M.bean-2 | 60 | 2nd week of Feb | Mid April |
| | T.Aus | BR-14 | 40 | 2nd week of May | 3rd week of July |
| | T.Aman | BR-23 | 40 | Last week of July | Last week of Nov. |
| Bagerhat | Boro | BRRI Dhan 28 | 40 | Last week of Jan. | 2nd week of May |
| | T.Aman | BRRI Dhan 23 | 40 | 3rd week of July | 3rd week of Nov. |
| Kolaroa | Boro | BRRI Dhan 28 | 40 | Last week of Jan. | 1st week of May |
| | T.Aman | BR-11 | 40 | Mid. Aug. | 3rd week of Dec. |
| Golapganj | T.Aus | BR 26 | 40 | 1st week of June | Mid. Aug. |
| | T.Aman | BRRI Dhan 32 | 40 | 1st week of Sept. | Last week of Nov. |
| Moulvibazar | T.Aus | BR 26 | 40 | 1st week of June | Mid. Aug. |
| | T.Aman | BRRI Dhan 32 | 40 | 1st week of Sept. | Last week of Nov. |
| Manikganj | Mustard | Tori-7 | 8 | 3rd week of Nov | Last week of Jan. |
| | Boro | BRRI Dhan 29 | 40 | 2nd week of Feb. | Last week of May |

Table 3. Effect of N P K and S on yield of Boro and T.Aman rice grown in Boro-T.Aman cropping pattern at Phulpur, 1999-2000

| Boro rice | | | T. aman rice | | |
|---|---|---|---|---|---|
| Nutrient doses (kg $ha^{-1}$) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) | Nutrient doses (kg $ha^{-1}$) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
| N | | | | | |
| 0 | 3.85b | 4.88 | 0 | 2.83 c | 4.50b |
| 95 | 4.79a | 5.12 | 70 | 4.44 b | 5.10 ab |
| 135 | 4.84a | 5.28 | 95 | 4.55 ab | 5.18 ab |
| 180 | 4.40ab | 5.20 | 130 | 5.10 a | 5.80 a |
| LSD | 0.62* | NS | LSD | 0.56 ** | 0.72** |
| CV (%) | 10.04 | 4.39 | CV(%) | 5.81 | 4.28 |
| P | | | | | |
| 0 | 4.28 | 5.48 | 0 | 4.35 | 4.90 |
| 8 | 4.43 | 5.28 | 5 | 4.88 | 5.36 |
| 12 | 4.84 | 5.28 | 7 | 4.55 | 5.18 |
| 16 | 4.40 | 5.08 | 10 | 4.34 | 5.19 |
| LSD | NS | NS | LSD | NS | NS |
| CV (%) | 9.82 | 7.75 | CV(%) | 7.76 | 5.52 |
| K | | | | | |
| 0 | 4.40b | 5.39 | 0 | 4.13 | 5.23 |
| 30 | 4.91a | 5.41 | 22 | 4.28 | 4.76 |
| 42 | 4.84a | 5.28 | 28 | 4.55 | 5.18 |
| 54 | 4.50ab | 5.30 | 39 | 4.30 | 5.04 |
| LSD | 0.41* | NS | LSD | NS | NS |
| CV (%) | 8.60 | 6.40 | CV(%) | 9.98 | 6.75 |
| S | | | | | |
| 0 | 4.58ab | 5.47 | 0 | 4.18 | 4.78 |
| 14 | 4.92a | 5.29 | 8 | 4.28 | 4.84 |
| 20 | 4.48a | 5.28 | 11 | 4.55 | 5.18 |
| 26 | 4.26b | 5.08 | 15 | 4.24 | 4.95 |
| LSD | 0.43 | NS | LSD | NS | NS |
| CV (%) | 9.26 | 6.67 | CV(%) | 6.42 | 4.46 |

Table 4. Effect of N P K and S on yield of T.Aman rice grown in Boro-T.Aman cropping pattern at Netrakona, 1999-2000

| Boro rice | | | T. aman rice | | |
|---|---|---|---|---|---|
| Nutrient doses (kg $ha^{-1}$) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) | Nutrient doses (kg $ha^{-1}$) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
| N | | | | | |
| 0 | 3.20b | 4.24 | 0 | 2.65b | 4.10 c |
| 130 | 3.73ab | 4.34 | 70 | 4.22a | 5.01 b |
| 185 | 3.94a | 4.88 | 95 | 4.45a | 5.21ab |
| 240 | 4.11a | 4.91 | 130 | 4.43a | 5.98 a |
| LSD | 0.63** | NS | LSD | 0.86** | 0.86** |
| CV(%) | 7.26 | 8.42 | CV(%) | 9.46 | 7.39 |
| P | | | | | |
| 0 | 3.61 | 4.96 | 0 | 4.25 | 4.78 |
| 30 | 3.83 | 4.51 | 9 | 4.60 | 5.18 |
| 45 | 3.94 | 4.88 | 13 | 4.45 | 5.21 |
| 60 | 3.98 | 4.80 | 17 | 4.63 | 5.49 |
| LSD | NS | NS | LSD | NS | NS |
| CV(%) | 11.31 | 8.11 | CV(%) | 7.25 | 9.30 |
| K | | | | | |
| 0 | 3.97 | 4.78 | 0 | 3.85 | 4.10c |
| 25 | 4.04 | 4.48 | 14 | 3.83 | 5.01b |
| 30 | 3.94 | 4.88 | 18 | 4.45 | 5.21ab |
| 55 | 3.78 | 4.35 | 25 | 4.15 | 5.98a |
| LSD | NS | NS | LSD | NS | 0.86 |
| CV(%) | 10.78 | 10.15 | CV(%) | 7.80 | 5.92 |
| S | | | | | |
| 0 | 4.00 | 4.99 | 0 | 4.18 | 5.29 |
| 20 | 4.03 | 4.90 | 5 | 4.33 | 5.12 |
| 30 | 3.94 | 4.88 | 7 | 4.45 | 5.21 |
| 40 | 4.01 | 5.06 | 10 | 4.67 | 5.63 |
| LSD | NS | NS | LSD | NS | NS |
| CV(%) | 5.94 | 5.01 | CV(%) | 6.42 | 4.46 |

Table 5. Effect of N, P and K on yield and cost and return analysis of T.aman in Fallow-Fallow-T.aman cropping pattern at Atkapalia, Noakhali (Average, 1999-01)

| Treatment | Nutrient level | Yield (t/ha) | | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin |
|---|---|---|---|---|---|---|
| | | Grain | Straw | | | |
| $T_1$ | $N_0$ | 3.55 | 4.70 | 33100 | 2118 | 30982 |
| $T_2$ | $N_{103}$ | 3.97 | 4.90 | 36660 | 3462 | 33198 |
| $T_3$ | $N_{140}$ | 4.55 | 5.84 | 42240 | 3942 | 38298 |
| $T_4$ | $N_{182}$ | 3.93 | 5.99 | 37430 | 4488 | 32942 |
| $T_5$ | $P_0$ | 3.29 | 4.73 | 31050 | 2164 | 28886 |
| $T_6$ | $P_{21}$ | 4.26 | 5.40 | 39480 | 3662 | 35818 |
| $T_3$ | $P_{25}$ | 4.55 | 5.84 | 42240 | 3942 | 38298 |
| $T_7$ | $P_{28}$ | 4.10 | 5.19 | 37990 | 4152 | 33838 |
| $T_8$ | $K_0$ | 4.21 | 5.20 | 38880 | 3602 | 35278 |
| $T_9$ | $K_{13}$ | 4.23 | 5.14 | 38980 | 3862 | 35118 |
| $T_3$ | $K_{17}$ | 4.55 | 5.84 | 42240 | 3942 | 38298 |
| $T_{10}$ | $K_{22}$ | 4.14 | 4.97 | 38090 | 4042 | 34048 |

Price of inputs: Urea @ Tk.6.00/Kg, TSP @ Tk.13.00/Kg, MP @ Tk.10.00/Kg,
Price of outputs: Grain @ Tk. 8.00/Kg, Straw @ Tk.1.00/Kg

Table 6. Cost and return analysis of different fertilizer nutrients in Wheat-Mungbean-T.aman cropping pattern at FSRD site Goyeshpur, Pabna, during 1999-2000 and 2000-01.

| Fertilizer nutrients(kg/ha) | | Gross return(Tk/ha) | | Variable cost (Tk/ha) | | Gross margin (Tk/ha) | | MBCR | |
|---|---|---|---|---|---|---|---|---|---|
| Wheat | T.aman | Wheat | T.aman | Wheat | T.aman | Wheat | T.aman | Wheat | T.aman |
| N level | | | | | | | | | |
| 0 | 0 | 18055 | 23310 | 15658 | 11325 | 2397 | 11985 | - | - |
| 70 | 56 | 26560 | 32170 | 16570 | 12054 | 9990 | 20116 | 8.33 | 11.15 |
| 100 | 80 | 26670 | 34675 | 16960 | 12367 | 9710 | 22308 | 5.62 | 9.91 |
| 130 | 104 | 26175 | 37700 | 17350 | 12679 | 8825 | 25021 | 3.80 | 9.63 |
| P level | | | | | | | | | |
| 0 | 0 | 21875 | 30980 | 14757 | 11325 | 7118 | 19655 | - | - |
| 20 | 15 | 26060 | 32405 | 16357 | 12236 | 9703 | 20169 | 1.62 | 0.56 |
| 30 | 18 | 27030 | 34675 | 16960 | 12419 | 10070 | 22256 | 1.34 | 2.38 |
| 40 | 21 | 26510 | 37085 | 17557 | 12601 | 8953 | 24484 | 0.66 | 3.78 |
| K level | | | | | | | | | |
| 0 | 0 | 22375 | 32400 | 16124 | 11325 | 6251 | 21075 | - | - |
| 30 | 15 | 25505 | 32925 | 16625 | 11567 | 8880 | 21358 | 5.25 | 1.17 |
| 50 | 20 | 27030 | 34675 | 16960 | 11648 | 10070 | 23027 | 4.57 | 6.04 |
| 70 | 25 | 26630 | 29830 | 17291 | 11728 | 9339 | 18102 | 2.65 | -3.69 |
| S level | | | | | | | | | |
| 0 | 0 | 22995 | 37240 | 16575 | 11325 | 6420 | 25915 | - | - |
| 15 | 10 | 25900 | 35440 | 16806 | 11479 | 9094 | 23921 | 11.58 | -12.95 |
| 25 | 15 | 27030 | 34675 | 16960 | 11556 | 10070 | 23119 | 9.48 | -12.10 |
| 35 | 20 | 27835 | 34595 | 17114 | 11633 | 10721 | 22962 | 7.98 | -9.56 |

Table 7. Effect of different fertilizer nutrients on the agro-economic performance of Wheat in Wheat-M.bean-T.Aman cropping pattern at FSRD site, Goyeshpur, Pabna during 2001-2002

| 3 a Effect of N | | | | | |
|---|---|---|---|---|---|
| N-rate (kg/ha) | Grain yield (t/ha) | Straw yield (t/ha) | GR (Tk/ha) | TVC (Tk/ha) | GM (Tk/ha) |
| | | 3a (Effect of N) | | | |
| 0 | 2.15 | 1.57 | 17985 | 12150 | 5835 |
| 70 | 2.88 | 3.24 | 24660 | 13061 | 11599 |
| 105 | 2.96 | 4.22 | 25790 | 13517 | 12273 |
| 140 | 3.15 | 4.83 | 27615 | 13973 | 13642 |
| 3 b Effect of P | | | | | |
| P-rate (kg/ha) | | | | | |
| 0 | 2.2 | 3.62 | 19410 | 12150 | 7260 |
| 20 | 2.84 | 4.87 | 25155 | 13365 | 11790 |
| 30 | 2.96 | 4.22 | 25790 | 13973 | 11817 |
| 40 | 2.98 | 4.78 | 26230 | 14580 | 11650 |
| 3 c Effect of K | | | | | |
| K-rate (kg/ha) | | | | | |
| 0 | 2.08 | 3.89 | 18585 | 12150 | 6435 |
| 20 | 2.82 | 4.83 | 24975 | 12473 | 12502 |
| 30 | 2.96 | 4.22 | 25790 | 12634 | 13156 |
| 40 | 2.92 | 4.26 | 25490 | 12795 | 12695 |
| 3 d Effect of S | | | | | |
| S-rate (kg/ha) | | | | | |
| 0 | 2.33 | 3.58 | 20430 | 12150 | 8280 |
| 10 | 2.84 | 4.84 | 25140 | 12304 | 12836 |
| 20 | 2.96 | 4.22 | 25790 | 12458 | 13332 |
| 30 | 2.94 | 4.64 | 25840 | 12612 | 13228 |

Table 8. Effect of N, P, K and S on the agro-economic performance of wheat in wheat-T.Aman cropping pattern at Pabna, during 2001-02

| Treatments (kg $ha^{-1}$) | | Grain Yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) | Gross return (Tk $ha^{-1}$) | Variable cost (Tk $ha^{-1}$) | Gross margin (Tk $ha^{-1}$) |
|---|---|---|---|---|---|---|
| 4 a. Effect of N | | | | | | |
| $T_1$ | 0 | 1.12d | 1.38c | 24900 | 3909 | 23236 |
| $T_2$ | 50 | 1.81c | 2.85b | 35570 | 4580 | 32895 |
| $T_3$ | 100 | 2.85a | 3.90a | 38270 | 5211 | 35154 |
| $T_4$ | 150 | 2.35b | 3.61a | 37140 | 5862 | 33999 |
| CV% | | 5.74 | 12.59 | | | |
| LSD | | 0.2278 | 0.7395 | | | |
| 4 b. Effect of P | | | | | | |
| $T_5$ | 0 | 1.84b | 3.09 | 35890 | 3465 | 34030 |
| $T_6$ | 13 | 2.16ab | 3.15 | 40430 | 4334 | 37557 |
| $T_3$ | 26 | 2.85a | 3.90 | 38270 | 5211 | 35154 |
| $T_7$ | 39 | 1.95b | 3.16 | 38950 | 6089 | 35487 |
| CV% | | 17.58 | 15.11 | | | |
| LSD | | 0.6969 | NS | | | |
| 4 c. Effect of K | | | | | | |
| $T_8$ | 0 | 2.11b | 3.12 | 35830 | 3717 | 33065 |
| $T_9$ | 42 | 2.31b | 3.32 | 37350 | 4473 | 34359 |
| $T_3$ | 83 | 2.85a | 3.90 | 38270 | 5211 | 35154 |
| $T_{10}$ | 125 | 2.22b | 3.44 | 37540 | 5967 | 33307 |
| CV% | | 7.72 | 15.18 | | | |
| LSD | | 0.3629 | NS | | | |
| 4 d. Effect of S | | | | | | |
| $T_{11}$ | 0 | 2.11b | 3.64 | 35540 | 4551 | 32663 |
| $T_{12}$ | 15 | 2.45ab | 3.60 | 39140 | 4881 | 36109 |
| $T_3$ | 30 | 2.85a | 3.90 | 38270 | 5211 | 35154 |
| $T_{13}$ | 45 | 2.65a | 3.68 | 35960 | 5541 | 32769 |
| CV% | | 9.27 | 8.17 | | | |
| LSD | | 0.46 | NS | | | |

## Subproject: Verification of Fertilizer Management Practices

# EFFECT OF UREA SUPER GRANULE (USG) AS A SOURCE OF NITROGENOUS FERTILIZER ON UPLAND VEGETABLES AND FRUITS


### Abstract

The experiment was conducted at Narsinghdi, Tangail, Rangpur and Pabna during 1999-2000 to 2000-01 to see the effect of Urea Super Granule (USG) on upland vegetables and fruits crops. Different vegetables crops viz. Cabbage, Cauliflower, Tomato, Potato and fruits crops viz. Papaya and Banana were included in the trial. Recommended dose of USG, 10% and 20% less of recommended USG were tested along with recommended dose of prilled Urea and Farmers' practice. Results revealed that yield of crops increased significantly due to application of USG over prilled urea. In most cases, 10-20% less of N as USG also produced identical yield with recommended dose of prilled urea. About 10-20% nitrogen could be saved by using USG instead of prilled urea. Regarding economics, the higher returns were also obtained from USG treatments.


### Introduction

Nitrogen is the most deficient nutrient element in Bangladesh soil. In general, farmers' of the country apply at least nitrogenous fertilizer to their crops for better yield. There are different types of nitrogenous fertilizers are now available in the market. Recently, Urea super Granule (USG) has become available in the market and used in wetland rice as well as upland crops. It is said that USG is more efficient than prilled urea in supplying N to crops as it is minimize loss by leaching and volatilization. USG is mostly used by farmers in boro rice and it is reported that 20-30% nitrogen could be saved by using USG compared to prilled urea. During the last couple of years farmers' in some parts of the country using USG in upland vegetables and fruit crops like brinjal, cabbage, cauliflower, tomato, papaya and banana. However, there is no recommendation of USG on upland crops are so far available and research findings in this regard are very scanty. Environment in wetland rice is quite different from upland condition and efficiency of USG on upland crops are yet to be ascertained. In this context the experiment was designed with the following objectives-

**Objectives**

i) To see the efficiency of USG on upland vegetables and fruits.
ii) To determine the optimum and economic dose of USG for upland crops.

### Materials and Methods

The experiment was conducted at farmers' field of Shibpur, Narsinghdi, FSRD site Palima and MLT site Modhupur, Tangail, FSRD site Goyeshpur, Pabna and Rangpur. The experiment was started with Cabbage and brinjal at Tangail during rabi season of 2000-01 and in 2001-02 extended in some new sites with new crops. Different vegetables viz. Cabbage, Cauliflower, Tomato, Potato and fruit crops viz. Papaya and Banana were included in the trial. Details about site characteristics and soils, crop management and fertilization are provided inn appendix Table 1 and 2, respectively. The experiment was laid out in RCB design with 6 dispersed replications. Unit plot size was varied from 40 $m^2$ to 80 $m^2$. There were five treatments viz. ($T_1$) Recommended dose of N as prilled urea; ($T_2$) Recommended dose of N as USG; ($T_3$) 10% less N than recommended dose as USG; ($T_4$) 20% less N than recommended dose as USG and ($T_5$) Farmers' practice. Other nutrient elements PKSZN were applied in recommended rate. Yield attributes were collected from 10 randomly selected plants and yield was harvested from 10 $m^2$ area. All the data were analyzed statistically. Market price of the crop at harvest was recorded to calculate economics.

## Results and Discussion

**Location : Shibpur, Narsinghdi**
**Crop : Cabbage**

Plant height and yield attributes of cabbage were significantly affected by different treatments. Generally, 10% less or recommended USG produced higher and identical values (Appendix Table 1). The highest head yield was obtained from treatment $T_2$ which was statistically identical to all other treatments except $T_4$. In $T_4$, where 20% less than recommended USG was applied significantly reduced the head yield of cabbage.

Higher gross return, gross margin and benefit-cost ratio was obtained from treatment $T_2$ that was very close to $T_3$. Farmers' dose showed lower benefit-cost ratio than all other treatments because high cost of fertilizer involved. So, recommended dose of N as USG or 10% less N than recommended dose as USG are found optimum for cabbage at Narsinghdi.

Table 1. Agro-economic performance of cabbage as affected by USG application (Shibpur MLT site, Narsinghdi, 2001-02)

| Treatment | Head yield (t/ha) | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | Benefit-cost ratio |
|---|---|---|---|---|---|
| T1 | 91.984ab | 367936 | 75490 | 292446 | 4.87 |
| T2 | 93.451a | 373804 | 74150 | 299654 | 5.04 |
| T3 | 92.567ab | 370268 | 74000 | 296268 | 5.00 |
| T4 | 87.036b | 348144 | 73840 | 274304 | 4.71 |
| T5 | 89.750ab | 359000 | 77100 | 281900 | 4.66 |

Market price of cabbage = Tk. 4.00/kg

## Cauliflower

Significantly higher curd yield was recorded from $T_2$ and $T_3$. Application of 20% less USG than recommended USG markedly reduce the yield. However, it was identical to recommended N as prilled urea and farmers' practice.

Cost and return analysis showed that higher gross return, gross margin and benefit cost ratio was obtained from $T_2$ and $T_3$. Farmers' dose showed lower return from other treatments because of high fertilizer cost. So, either $T_2$ or $T_3$ i.e. recommended dose of N as USG or 10% less N than recommended dose of USG are found suitable for growing cauliflower at Narsinghdi.

Table 2. Agro-economic performance of cauliflower as affected by USG application (Shibpur MLT site Narsinghdi, 2001-02)

| Treatment | Curd yield (t/ha) | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | Benefit-cost ratio |
|---|---|---|---|---|---|
| $T_1$ | 23.774b | 118870 | 62275 | 56595 | 1.90 |
| $T_2$ | 24.921a | 124605 | 60525 | 64080 | 2.06 |
| $T_3$ | 24.443ab | 122215 | 60160 | 62055 | 2.03 |
| $T_4$ | 23.554b | 117770 | 59920 | 57850 | 1.96 |
| $T_5$ | 23.645b | 118225 | 63695 | 54530 | 1.86 |

Market price of cauliflower = Tk. 5.00/kg

**Location : Palima, Tangail**
**Crop : Cabbage**

Results revealed that (Table 3) that in 2000-01 recommended USG gave the highest head yield, however it was identical with USG (10% < Recom.). In 2001-02 USG (10% < Recom) produced the highest head yield and it was statistically similar to recommended USG. In both years farmers dose gave the lowest head yield. Even USG (20% < Recom.) gave apparently higher yield in 2000-01 and significantly superior head yield over recommended prilled urea in 2001-02. It may be mentioned that presently farmers are applying prilled urea in cabbage. Thus even 20 % less urea fertilizer in the form of USG proved to be better over recommended prilled urea fertilizer. The reason behind this is that in USG form, loss of nitrogen ($NO_3$-N and $NH_4$-N) through volatilization and denitrification is being reduced. Recommended USG and USG (10% < recom.) gave the highest gross margin as well as BCR. Even USG (20% < recom.) dose gave superior gross margin and BCR over recommended prilled urea.

Thus all the three USG doses were superior over presently used prilled urea. Therefore by applying USG in cabbage head yield could be increased along with higher economic return.

Table 3. Effect of USG on yield and economics of Cabbage production (Palima, Tangail 2000-01 to 2001-02)

| Treatment | Yield of head (t/ha) | | Average of two years | | | |
|---|---|---|---|---|---|---|
| | 2000-01 | 2001-02 | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
| Prilled urea (Rec.) | 56.94b | 82.47c | 174263 | 89727 | 84536 | 1.94 |
| USG (Rec.) | 65.04a | 91.73ab | 195963 | 89727 | 106236 | 2.18 |
| USG (10%<Rec | 60.14ab | 94.81a | 193688 | 88377 | 105311 | 2.19 |
| USG (20%<Rec.) | 55.09b | 88.77b | 179825 | 88852 | 90973 | 2.02 |
| Farmer's dose | 46.16c | 75.68d | 152300 | 74730 | 77570 | 2.03 |
| CV% | 9.38 | 2.88 | - | - | - | - |

**Crop: Brinjal**

Plant height, yield and yield attributes were significantly influenced by different fertilizer treatments (Appen.Table-3) in both the years except length of fruit was insignificant in 2001-2002. Similar trend was followed in both the years in case of fruit /plant where higher number of fruit was recorded from USG (10%, Rec.) followed by recommended USG. Significantly highest fruit weight (kg/plant) was obtained from USG (10%< rec.) followed by recommended USG. Similarly, the highest fruit yield (Table 4) was obtained from the same treatment and fruits/plant and fruit weight (kg/plant) mainly contributed to the yield. Same trend was observed over the year.

Cost and return analysis showed that highest gross return and gross margin were recorded from 10% less than recommended USG application ($T_3$). Benefit cost ratio was also highest in the same treatment followed by recommended USG and recommended prilled urea.

From two years results, it was found that the USG (10%<rec.) performed better in terms of yield and economic return. USG (20%<rec.) dose application also gave higher yield and economic return over recommended prilled urea.

Table 4. Effect of USG on yield and economics of Brinjal production (Palima, Tangail 2000-01 to 2001-02)

| Treatment | Yield (t/ha) | | Average of two years | | | |
|---|---|---|---|---|---|---|
| | 2000-01 | 2001-02 | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
| Prilled urea (Rec.) | 48.05c | 58.05c | 318300 | 48503 | 269797 | 6.56 |
| USG (Rec.) | 58.18b | 63.30b | 364440 | 50973 | 313467 | 7.15 |
| USG (10%<Rec | 68.35a | 69.30a | 412950 | 50825 | 362125 | 8.12 |
| USG (20%<Rec.) | 51.94c | 57.80c | 329220 | 50677 | 278543 | 6.50 |
| Farmer's dose | 39.64d | 51.61d | 273750 | 42131 | 231619 | 6.50 |
| CV% | 7.12 | 4.80 | - | - | - | - |

Market price: Fruit =@Tk. 6/kg

**Crop: Cauliflower**

Significantly highest head yield was recorded from recommended USG (Table 5). There was a trend to decrease yield with the decrease of recommended fertilizer dose of USG. Effect of USG over prilled urea was very evident and even 20% less of recommended USG produced significantly higher yield than recommended prilled urea. The lowest yield was recorded from farmers' dose but statistically at par to recommended prilled Urea.

From cost and return analysis it showed that the highest gross return and gross margin was recorded from recommended USG followed by 10% less and 20% less of recommended USG. Regarding BCR, the same trend was followed.

From one year result showed that higher yield and monetary benefit could be achieved from recommended USG application and even 20% less of recommended USG showed better performance over prilled urea.

Table 5. Effect of USG on yield and economics of Cauliflower production (Palima, Tangail 2001-02)

| Treatment | Yield of head (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|
| Prilled urea (Rec.) | 48.10c | 192400 | 55053 | 137347 | 3.49 |
| USG (Rec.) | 63.15a | 252600 | 55053 | 197547 | 4.59 |
| USG (10%<Rec.) | 56.67b | 226680 | 54981 | 171700 | 4.12 |
| USG (20%<Rec | 54.17b | 216680 | 54909 | 161771 | 3.95 |
| Farmer's practice | 45.88c | 183520 | 54217 | 129303 | 3.38 |

Market price: TK. 4.00/ kg curd

**Crop: Tomato**

Different yield contributing characters varied significantly due to different fertilizer treatments. Fruits/plant was significantly higher in recommended USG ($T_2$) followed by $T_1$, $T_3$ and $T_4$. Individual fruit weight and fruit weight (kg/plant) almost follow the same trend (Appendix table 5). Significantly highest fruit yield was recorded from recommended USG.

Cost and return analysis showed that the highest gross return, gross margin and BCR was obtained from recommended USG. However, 10% less rec. USG and rec. prilled urea gave similar economic return. From one year of study it was found that USG application was highly profitable in comparison to prilled urea application.

Table 7. Effect of USG on yield and economics of Tomato (Palima, Tangail 2001-02)

| Treatment | Yield (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|
| Prilled urea (Rec.) | 92.78b | 463900 | 79685 | 384215 | 5.82 |
| USG (Rec.) | 119.5a | 597500 | 83022 | 514478 | 7.20 |
| USG (10%<Rec.) | 96.09b | 480450 | 82828 | 397622 | 5.80 |
| USG (20%<Rec.) | 75.75c | 378750 | 82604 | 296146 | 4.58 |
| Farmer's practice | 51.68d | 258400 | 77428 | 180972 | 3.34 |

Market price: Tomato @ Tk= 5/k

**Location : Modhupur, Tangail**
**Crop : Potato**

The effects of USG on different parameters of potato are presented in the Appendix table 7. Higher number of tuber/plant was recorded from recommended USG which statistically at par to recommended prilled urea and 10% less than recommended N as USG. But significantly higher tuber weight was recorded from recommended USG. The highest tuber yield was recorded from recommended USG which was also identical to 10% less of recommended USG.

Regarding tuber grade, the highest percentage (51.59 %) of large sized tubers (>45mm) was produced with recommended USG. The percentage of small sized tubers (<28mm) was highest in the farmer's practice. The percentage of medium sized tubers (28-45mm) was highest with recommended prilled urea which was statistically identical to USG (Appen. table 6).

The cost and return analysis showed that the highest gross margin (Tk. 73932/ha) was obtained from the USG (Rec.) dose followed by USG (10%<Rec). The same trend was followed in benefit cost ratio.

From one year result it was found that USG application was profitable in comparison to prilled urea. Even 10% less urea when applied as USG produced more tuber yield and economic return over recommended prilled urea dose.

Table 8. Cost and return analysis of effect of USG on Potato production (MLT site, Modhupur, Tangail during 2001-2002)

| Treatment | Tuber yield (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|
| $T_1$=(Rec. prilled) | 24.46b | 97840 | 34988 | 62852 | 2.80 |
| $T_2$= (Rec. USG) | 27.23a | 108920 | 34988 | 73932 | 3.11 |
| $T_3$= (10% <Rec.N as USG) | 25.90ab | 103600 | 34823 | 68777 | 2.97 |
| $T_4$= (20% <Rec.N as USG) | 22.79c | 91160 | 34674 | 56486 | 2.63 |
| $T_5$=(Farmer's practice) | 23.80bc | 95200 | 40116 | 55084 | 2.37 |

Market price:Potato@Tk= 4.00/kg

**Crop: Banana**

The highest yield (58.4t/ha) of banana was obtained from farmers' practice followed by 10% less of recommended USG (Table 9). However, the lowest yield was recorded from prilled urea. Similar trend was found in weight/bunch. In farmers' practice a higher dose of chemical fertilizers was applied and that may be contributed to the higher yield. Different growth and yield contributing character did not vary markedly (Appendix table 9).

From cost and return analysis it was found that the highest gross margin (Tk.118447/ha) given by USG (20%<Rec.) dose followed by USG (10%<Rec.) dose (Tk.118336/ha). Similarly, the highest BCR (2.99) was obtained from USG (20%<Rec.) dose. Due to higher fertilization cost the lowest gross margin and BCR was obtained from farmers' practice.

Table 9. Effect of USG on yield and economics of Banana production (Modhupur, Tangail 2001-02)

| Treatment | Yield (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|
| $T_1$ | 47.88 | 147470 | 59800 | 87670 | 2.47 |
| $T_2$ | 51.77 | 172394 | 61825 | 110569 | 2.79 |
| $T_3$ | 54.63 | 179186 | 60850 | 118336 | 2.94 |
| $T_4$ | 53.55 | 178322 | 59875 | 118447 | 2.99 |
| $T_5$ | 58.41 | 194505 | 138800 | 55705 | 1.40 |

**Location : Syedpur FSRD site, Rangpur**
**Crop : Potato**

The results presented in Table 1 revealed that there was significant difference among the treatments in respect of all the characters studied (Appendix table 10). Higher tuber yield (30.29 t/ha) was recorded from the treatment $T_2$ where recommended dose of N (140 kg/ha) from USG was applied and it was statistically identical to other treatments except 20% less of recommended USG ($T_4$). However the yield obtained from $T_4$ was also identical to other treatments except recommended USG ($T_2$). Among the yield attributes weight of tuber/plant mainly contributed to the yield.

The cost and return analysis showed that the highest gross return (Tk. 90873/ha), gross margin (Tk. 48701/ha) as well as benefit cost ratio (2.15) was calculated from recommended USG followed by 10% less recommended USG and recommended prilled urea.

From one year study it was clear that N use efficiency markedly increase over prilled urea and even 10% less of recommended USG produced similar yield and return to prilled urea.

Table 10. Effect of USG on yield and economics of Potato (FSRD site, Syedpur, Rangpur, 2001-02)

| Treatment | Tuber yield (t/ha) | Gross return (Tk/ha) | Total variable cost (Tk/ha) | Gross margin (Tk./ha) | BCR |
|---|---|---|---|---|---|
| $T_1$ | 27.11ab | 81330 | 41855 | 39475 | 1.94 |
| $T_2$ | 30.29a | 90873 | 42169 | 48701 | 2.15 |
| $T_3$ | 27.02ab | 81060 | 41956 | 39104 | 1.93 |
| $T_4$ | 26.37b | 79110 | 41743 | 37367 | 1.89 |
| $T_5$ | 27.41ab | 82230 | 41575 | 40652 | 1.98 |

Price : Tk./kg (2001-2002)

Urea (prilled) : 6.00 Urea (USG): 7.00 TSP: 13.00 MP: 8.70 Gypsum: 3.00 Zincsulphate: 35.00 Borax : 40.00
Cowdung:0.25 Potato seed :10.00 Potato : 3.00

**Crop: Tomato**

The results (Appendix table 11) revealed that there was significant difference among the treatments in respect of all the characters studied except plant population at harvest. Higher yield (79.13 t/ha) of tomato was recorded from the treatment $T_2$ where recommended doses (150 kg/ha) of N from USG were applied and it was statistically identical to $T_3$ where 10% less of recommended USG. Recommended dose of prilled urea produced similar yield to 20% less of recommended USG. The lowest yield (58.53 t/ha) was calculated from the farmer's dose. The higher yield of $T_2$ might be due to higher number of fruits per plant as well as yield per plant. This result indicated that urea super granule had significant effect on tomato as compare to prillled urea.

The cost and return analysis results showed that the highest gross return (Tk. 158200/ha), gross margin (Tk. 113215/ha) and benefit cost ratio (3.52) was obtained from recommended USG followed by 10% less of recommended USG This results implied that use of urea super granule found to be economically viable compared to prilled urea.

Table 11. Effect of USG on yield and economics of Tomato at FSRD site, Syedpur, Rangpur during Rabi, 2001-2002

| Treatment | Yield (t/ha) | Gross return (Tk/ha) | Total variable cost (Tk/ha) | Gross margin (Tk./ha) | BCR |
|---|---|---|---|---|---|
| $T_1$ | 67.22b | 134400 | 44658 | 89742 | 3.01 |
| $T_2$ | 79.13a | 158200 | 44985 | 113215 | 3.52 |
| $T_3$ | 73.69ab | 147400 | 44756 | 102644 | 3.29 |
| $T_4$ | 68.13b | 136200 | 44528 | 91672 | 3.06 |
| $T_5$ | 58.53d | 117700 | 38280 | 78720 | 3.06 |

Price : Tk./kg (2001-2002)

| | | | |
|---|---|---|---|
| Urea (prilled): 6.00 | Urea (USG): 7.00 | TSP:13.00 | MP: 8.70 |
| Gypsum: 3.00 | Zinc sulphate: 35.00 | Borax: 40.00 | Cowdung:0.25 |
| Tomato: 2.00 | Seedling: 10 Tk/100 seedlings | | |

**Location : Goyeshpur, FSRD site, Pabna**
**Crop : Papaya**

The results showed that the different growth and yield parameters did not varied significantly among the treatments except with farmers' practice (Appendix table 12). The highest fruit yield (t/ha) was obtained from recommended USG which was at par with other treatments except farmers' practice. About 14% yield increased due to application of USG over prilled urea. The reason behind the higher yield might be the cumulative effect of number of fruits/plant and individual fruit weight.

From economic point of view, the highest gross return, gross margin and BCR were obtained from recommended USG followed by 10% less of recommended USG and recommended prilled urea.

Therefore, from the one year of experimentation it is evident that efficiency of USG is higher than prilled urea in respect of yield and return.

Table 12. Effect of USG on yield and economics of Papaya (FSRD site Goyeshpur, Pabna 2001-02)

| Treatment | Yield (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|
| $T_1$=Prilled urea rec.dose | 102.06 | 306180 | 83221 | 222959 | 3.68 |
| $T_2$=USG as rec.dose of prilled urea | 116.17 | 348510 | 84595 | 263915 | 4.12 |
| $T_3$=10% less USG | 101.51 | 304530 | 83707 | 220823 | 3.64 |
| $T_4$= 20% less USG | 86.43 | 259290 | 82804 | 176486 | 3.13 |
| $T_5$= Farmers practice | 80.16 | 240480 | 79442 | 161038 | 3.02 |

Price: Papaya : 3.00 Tk/kg

Appendix table 1. Site characteristics

| Location | AEZ | Soil texture | $P^H$ | OM (%) | Total N (%) | K (meq/100 g soil) | Available nutrients (mg/g soil) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | P | S | Zn | B |
| Shibpur, Norshingdi | 9 | CL | 5.2 | 1.86 | 0.14 | 94.5 | 15.5 | 23.8 | 3.54 | - |
| Palima, Tangail | 8 | SCL | 5.8 | 1.72 | 0.07 | 0.10 | 5.20 | 13.0 | 7.54 | - |
| Modhupur, Tangail | 28 | SC | 5.02 | 1.56 | 0.10 | 0.05 | 25.9 | 4.13 | 1.01 | 0.04 |
| Syedpur, Rangpur | 3 | CL | - | - | - | - | - | - | - | - |
| Goyeshpur, Pabna | 11 | SCL | 8.4 | - | 0.75 | 0.26 | 5.0 | 4.45 | 0.48 | 0.46 |

Appendix table 2. Crop management and fertilization

**Management**

| Site | Crop | Variety | Spacing (cm) | Planting time | Harvesting time | Irrig. (No.) | Pesticide use |
|---|---|---|---|---|---|---|---|
| Shibpur | Cabbage | Atlas-70 | 60 x45 cm | Last week of Nov. | 28 Jan-2 Feb. | 3 | Dursban Dithane M-45 |
| | Cauliflower | Agrahayani | 60 x60 cm | Last week of Nov. | 1st wk. of Feb. | 3 | Dursban Dithane M-45 |
| Palima | Brinjal | Singhnath | 60 x60 cm | 1st wk. of Nov. | 18 Feb.-20 Mar. | 3 | - |
| | Cabbage | Atlas-70 | 60 x60 cm | Last wk. of Oct. – 1st wk. of Nov. | Mid. Jan. | 2 | - |
| | Cauliflower | - | 60 x60 cm | 12-22 Oct. | 20 Dec.-20 Jan. | 2 | - |
| | Tomato | BARI Tomato-8 | 60 x40 cm | 3rd wk. of Nov. | Mid. Jan.- mid. Feb. | 2 | - |
| Modhupur | Potato | Diamont | 60 x20 cm | 2nd wk. of Dec. | 2nd wk. of Mar. | 3 | Dimecrone Dithane M-45 |
| | Banana | Amritsagar | 2 x 2m | - | - | - | - |
| Syedpur | Potato | | 60 x25 cm | 8-9 Dec. | 1st wk. of Mar. | 3 | - |
| | Tomato | Ratan | 60 x45 cm | 1st wk. of Dec. | 9 Mar.-6 April | 3 | - |
| Goyeshpur | Papaya | - | 2 x 2m | - | 1st wk. of Dec.- 2nd wk. of April | - | Darsban, Dimecrone, Calthan |

**Fertilization**

| Site | Crop | Fertilizer rate (NPKSZn in kg/ha) | Application (Method & time) |
|---|---|---|---|
| Shibpur | Cabbage | RF = 138-24-60-20 + CD @4t/ha<br>FP = 173-38-62 + CD @4t/ha | All PKS and CD were applied during final land preparation and prilled urea was topdressed in 3 equal splits at 20, 50, 65 DAT and 15, 30, 45 DAT for Cabbage and Cauliflower, respectively.<br>USG was applied at 15 and 20 DAT for Cabbage and Cauliflower, respectively, as ring method 4 inches apart from each plant and 3 inches deep in soil. |
| | Cauliflower | RF = 100-26-67-20 + CD @4t/ha<br>FP = 173-44-42 + CD @4t/ha | |
| Palima | Cabbage | RF = 195-56-162-13 + CD 3t/ha<br>FP = 105-25-90 + CD @5t/ha | All PKS and CD were applied during final land preparation and prilled urea was topdressed in 3 equal splits at 20, 50, 65 DAT and 15, 30, 45 DAT for Cabbage and Cauliflower, respectively.<br>USG was applied at 15 and 20 DAT for Cabbage and Cauliflower, respectively, as ring method 3-4 inches apart from each plant and 2-3 inches deep in soil. |
| | Cauliflower | RF = 97-50-80-10 + CD @5t/ha<br>FP = 103-22-37+ CD @5t/ha | |
| | Brinjal | RF = 78-36-66-3+ CD @3t/ha<br>FP = 60-35-60+ CD @5t/ha | In Brinjal, USG was applied at 21 DAT in 7.5-10 inches apart from plant and 5-7 inches depth of soil. But prilled urea was applied in three equal splits at 21, 35 and 55 DAT. |
| | Tomato | RF = 172-21-163-37<br>FP = 128-36-78 | In Tomato USG was applied at 15 DAT in 7.5-10 inches apart from plant and 5-7.5 inches depth of soil. But prilled urea was applied in two equal splits at 13 and 35 DAT. |

| Site | Crop | Fertilizer rate (NPKSZn in kg/ha) | Application (Method & time) |
|---|---|---|---|
| Modhupur | Potato | RF = 136-6-139-21-1<br>FP = 115-75-190-15-2.5 | In Potato, all PKS and 1\2 prilled urea applied as basal and rest half urea was side dressed at 30 DAP. USG was applied between tuber in ground level at the time of planting. |
| | Banana | RF =650 g-400 g-300 g + CD @4 kg/pit<br>FP = 750 g- 1.0 kg- 1.0 kg + CD @5 kg/pit | In Banana, 50% of cowdung during land preparation. Rest 50% CD + 50% P during pit preparation. 25% N + 50% P + 50% K was applied at 60 DAP. Rest 50% K + 50% N applied at 135 DAP and rest 25% N was applied at flowering stage. USG and MOC were applied as ring method ai 3 equal splits at 60, 135 DAP and before flowering stage. |
| Syedpur | Potato | RF = 97-50-80-10 + CD @5t/ha<br>FP = 103-22-37+ CD @5t/ha | In Potato, all PKS and 1\2 prilled urea applied as basal and rest half urea was side dressed at 30 DAP. USG was applied between tuber in ground level at the time of planting. |
| | Tomato | RF = 150-40-140-30-4-1+ CD @5t/ha<br>FP = 101-34-62-9+ CD @2t/ha | In Tomato USG was applied at 15 DAT in 7.5-10 inches apart from plant and 5-7.5 inches depth of soil. But prilled urea was applied in two equal splits at 13 and 35 DAT. |
| Goyeshpur | Papaya | RF = 633-277-690-113-8-18 + CD @3.5t/ha + MOC@ 750 kg/ha<br>FP = 60 kg N/ha | All PSZNB and CD and 50% K was applied in pit 7 days before planting. Rest 25% and 2/3$^{rd}$ N was applied at 30 DAP. Remaining N and K was applied at 60 DAP. |

Appendix table 3. Yield and yield attributes of cabbage as affected by USG application at Shibpur, Narsingdi during rabi 2001-02

| Treatment | Plant height (cm) | Head diameter (cm) | Head length (cm) | Head pericycle (cm) | Head wt. with leaves (kg) | Head wt. without leaves (kg) | Head yield (t/ha) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 18.47b | 22.92ab | 15.10b | 65.57b | 3.32 | 2.84ab | 91.984ab |
| $T_2$ | 20.67a | 23.70a | 16.03a | 68.37a | 3.46 | 2.98a | 93.451a |
| $T_3$ | 21.30a | 23.47a | 15.27ab | 67.47ab | 3.42 | 2.88ab | 92.567ab |
| $T_4$ | 18.83b | 21.95ab | 14.60b | 66.03b | 3.34 | 2.71b | 87.036b |
| $T_5$ | 19.07b | 21.33b | 14.93b | 65.70b | 3.28 | 2.72b | 89.750ab |
| LSD.05 | 1.59 | 1.71 | 0.88 | 2.08 | NS | 0.18 | 4.14 |
| CV (%) | 6.7 | 6.3 | 4.8 | 2.6 | 3.9 | 5.4 | 5.12 |

Appendix table 4. Yield and yield attributes of cauliflower as affected by USG application at Shibpur, Narsingdi during rabi 2001-02

| Treat-ment | Plant height (cm) | Curd diameter (cm) | Curd length (cm) | Curd pericycle (cm) | Curd weight with leaves (kg) | Curd weight without leaves (kg) | Curd yield (t/ha) |
|---|---|---|---|---|---|---|---|
| T1 | 53.18bc | 15.58ab | 13.83ab | 52.38b | 1.56ab | 0.75ab | 23.774b |
| T2 | 54.98a | 15.81a | 14.18a | 53.47a | 1.58ab | 0.79a | 24.921a |
| T3 | 54.22ab | 15.63ab | 13.63ab | 53.38a | 1.65a | 0.77ab | 24.443ab |
| T4 | 52.30c | 15.11c | 12.20c | 52.30c | 1.44b | 0.71b | 23.554b |
| T5 | 53.00bc | 15.41b | 13.02bc | 52.42c | 1.55ab | 0.74ab | 23.645b |
| LSD.05 | 1.44 | 0.22 | 0.92 | 0.29 | 0.13 | 0.04 | 1.02 |
| CV (%) | 2.2 | 7.3 | 5.7 | 2.5 | 6.8 | 4.4 | 3.5 |

Appendix table 5.Effect of Urea Super Granule (USG) on plant height, yield and yield contributing characters of Tomato (FSRD site, Palima, Tangail, 2001-2002

| Treatment | Plant height (cm) | Branches /plant | Fruit pericycle (cm) | Length of fruit (cm) | Fruit/ plant (No.) | Individual Fruit wt. (g) | Fruit wt./plant (kg) | Fruit yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| Prilled urea (Rec.) | 62.60c | 4.86c | 17.67b | 5.40b | 30.00b | 74.33bc | 2.23b | 92.78b |
| USG (Rec.) | 85.47a | 6.00a | 20.47a | 6.70a | 35.00a | 81.67a | 2.85a | 119.5a |
| USG (10%<Rec.) | 81.20b | 5.40b | 19.80a | 6.37a | 29.67b | 77.67ab | 2.31b | 96.09b |
| USG (20%<Rec.) | 79.60b | 4.93c | 19.67a | 6.17a | 26.33b | 69.00c | 1.82c | 75.75c |
| Farmer's dose | 58.27d | 4.13d | 14.07c | 4.63c | 20.33c | 60.67d | 1.24d | 51.68d |
| CV % | 1.25 | 4.01 | 2.57 | 5.21 | 7.53 | 5.24 | 7.18 | 7.31 |

Appendix table 6. Effect of Urea Super Granule (USG) on the performance of Brinjal at Palima during 2000-01 to 2001-02

| Treatment | Plant height (cm) | | No. of fruit/plant | | Yield (kg/plant) | | Yield (t/ha) | |
|---|---|---|---|---|---|---|---|---|
| | 2000-01 | 01-02 | 2000-01 | 01-02 | 2000-01 | 01-02 | 2000-01 | 01-02 |
| Prilled urea (Rec.) | 112.1b | 117.7a | 20b | 13bc | 1.82c | 2.09c | 48.05c | 58.05c |
| USG (Rec.) | 141.0a | 124.8a | 23a | 14ab | 2.20b | 2.28b | 58.18b | 63.30b |
| USG (10%<Rec.) | 137.9a | 123.1a | 25a | 15a | 2.58a | 2.50a | 68.35a | 69.30a |
| USG (20%<Rec.) | 138.1a | 120.8a | 20b | 12c | 1.96c | 2.08c | 51.94c | 57.80c |
| Farmer's dose | 138.7a | 103.6b | 18c | 12c | 1.50d | 1.86d | 39.64d | 51.61d |
| CV % | 3.55 | 7.21 | 6.64 | 9.63 | 7.10 | 4.80 | 7.12 | 4.80 |

Means followed by same letter (s) do not differ significantly at 5% level of significance

Appendix table 7. Effect of prilled urea and Urea Super Granule (USG) on the performance of Potato at Modhupur, Tangail during 2001-2002

| Treatment | Plant height (cm) | No. of branch /plant | No. of leaves /plant | Fresh biomass wt (kg/plant) | No. of tuber/ plant | Wt. of tubers /plant (kg)) | Tuber yield (t/ha) |
|---|---|---|---|---|---|---|---|
| $T_1=N_{136}P_6K_{139}S_{21}Zn_1$ (Rec. Prilled urea) | 76.80ab | 2.13 | 32.47b | 0.31a | 7.53ab | 0.56b | 24.46b |
| $T_2=N_{136}P_6K_{139}S_{21}Zn_1$ (Rec. USG) | 81.40a | 2.53 | 39.27a | 0.33a | 8.40a | 0.62a | 27.23a |
| $T_3=N_{125}P_6K_{139}S_{21}Zn_1$ (10% <Rec.N as USG) | 71.73bc | 2.46 | 35.27ab | 0.30a | 7.27ab | 0.52bc | 25.90ab |
| $T_4=N_{109}P_6K_{139}S_{21}Zn1$ 20% <Rec.N as USG) | 69.47c | 1.73 | 33.20b | 0.21b | 6.73b | 0.47d | 22.79c |
| $T_5=N_{115}P_{75}K_{190}S_{15}Zn_{2.5}$ (Farmer's practice) | 69.53c | 2.00 | 34.20ab | 0.24ab | 7.07b | 0.49cd | 23.80bc |
| CV % | 7.62 | 21.92 | 8.85 | 17.76 | 2.84 | 5.03 | 3.59 |

Means followed by same letter is not significantly different at 5% level by DMRT test.

Appendix table 8.Different grades of potato as influenced by USG and prilled urea at Modhupur, Tangail

| Treatment | Tuber grades (t/ha) | | |
|---|---|---|---|
| | <28mm | 28-45mm | >45mm |
| $T_1=N_{136}P_6K_{139}S_{21}Zn_1$(Rec.prilled) | 6.99a (28.57%) | 8.73a (35.69%) | 8.73b (35.96) |
| $T_2=N_{136}P6K_{139}S_{21}Zn_1$(Rec. USG) | 5.71ab (20.95%) | 7.47ab (27.43%) | 14.05a (51.59) |
| $T_3=N_{125}P_6K_{139}S_{21}Zn_1$(10% <Rec.N as USG) | 5.98ab (23.83%) | 7.96ab (30.77%) | 11.95ab (46.14%) |
| $T_4=N_{109}P_6K_{139}S_{21}Zn_1$ (20% <Rec.N as USG) | 6.30ab (27.64%) | 7.76ab (34.05%) | 8.73b (38.31%) |
| $T_5=N_{115}P_{75}K_{190}S_{15}Zn_{2.5}$ (Farmer's practice) | 6.80ab (28.57%) | 7.28ab (30.58%) | 9.71b (40.80%) |
| CV% | 37.92 | 29.89 | 19.55 |

Appendix table 9. Effect USG on the growth, yield and yield contributing characters of Banana Madhupur, Tangail, 2001

| Treatment | Sucker /plant (No.) | Leaves /plant (No.) | Banana/ chhary | length of banana (cm) | Girth of banana (cm) | Weight/ chhary (kg) | No of banana/ kg | Price (Tk/ chhary) | Plant. flowered /ha | Banana yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 6.33 | 13.47 | 119.7 | 21.93 | 11.79 | 19.00 | 6.13 | 60 | 2417 | 47.88 |
| T2 | 5.77 | 13.40 | 121.8 | 20.86 | 11.70 | 23.17 | 6.17 | 65 | 2342 | 51.77 |
| T3 | 6.13 | 13.37 | 121.4 | 21.93 | 11.92 | 22.83 | 5.70 | 65 | 2308 | 54.63 |
| T4 | 6.80 | 13.97 | 126.0 | 21.68 | 11.77 | 22.00 | 6.15 | 65 | 2375 | 53.55 |
| T5 | 7.93 | 15.07 | 129.8 | 21.63 | 11.91 | 23.36 | 5.55 | 70 | 2400 | 58.41 |
| CV% | 12.64 | 4.52 | 7.53 | 4.04 | 3.04 | 5.24 | 1.45 | 0.001 | 3.07 | - |

Appendix table 10. Effect of urea super granule (USG) as a source of N on the yield and yield attributes of Potato (var. Cardinal) during Rabi 2001-2002 at Syedpur FSRD site, OFRD Rangpur.

| Treatment | Days to maturity | Plant height (cm) | Plants/hill (no.) | Tubers/hill (no.) | Weight of tuber/hill (g) | Tuber yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 79.83 b | 66.18 b | 4.10a | 7.60 a | 466.83 ab | 27.11 ab |
| $T_2$ | 81.83 a | 71.56 a | 4.21a | 8.05 a | 519.67 a | 30.29 a |
| $T_3$ | 79.50 b | 69.00 ab | 4.05a | 7.9 a | 464.67 ab | 27.02 ab |
| $T_4$ | 79.33 b | 68.83 ab | 4.12a | 7.33 a | 453.17 b | 26.37 b |
| $T_5$ | 79.00 b | 66.78 ab | 4.16a | 7.33 a | 472.67 ab | 27.41 ab |
| CV(%) | 1.8 | 5.5 | 9.6 | 10.8 | 10.3 | 9.3 |

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

Appendix table 11. Effect of urea super granule (USG) as a source of N on the yield and yield attributes of tomato during Rabi 2001-2002 at Syedpur FSRD site, OFRD Rangpur

| Treatment | Plant height at 1st harvest (cm) | Number of plants/$m^2$ at harvest | Number of fruits/plant | Fruit weight /plant (kg) | Yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$ | 92.4 a | 3.68 | 29.7 b | 1.98 b | 67.22 b |
| $T_2$ | 95.4 a | 3.65 | 33.5 a | 2.42 a | 79.13 a |
| $T_3$ | 92.2 a | 3.68 | 29.5 b | 2.15 b | 73.69 ab |
| $T_4$ | 91.4 a | 3.65 | 27.6 b | 2.07 b | 68.13 b |
| $T_5$ | 87.0 b | 3.7 | 26.7 b | 1.72 c | 58.53 d |
| CV(%) | 3.4 | 1.9 | 9.1 | 10.1 | 9.2 |

Appendix table 12. Effect of different nitrogen sources on the yield and yield contributing characters of Papaya at FSRD site, Goyeshpur, Pabna during 2001-02

| Treatment | Plant height (cm) | Fruit breadth (cm) | Fruit length (cm) | No. of fruit/ plant | Individual weight of fruit (kg) | Yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$=Prilled urea rec.dose | 266.33a | 13.17a | 20.00a | 28.75ab | 1.52a | 102.06ab |
| $T_2$=USG as rec. dose of prilled Urea | 257.95a | 12.83a | 19.14ab | 30.50a | 1.54a | 116.17a |
| $T_3$=10% less USG | 268.75a | 12.81a | 19.18ab | 28.75ab | 1.53a | 101.51ab |
| $T_4$= 20% less USG | 267.10a | 12.73a | 18.67ab | 26.75ab | 1.45a | 86.42ab |
| $T_5$= Farmers practice | 218.21b | 11.02b | 17.91ab | 20.25b | 1.21b | 80.16b |
| CV (%) | 10.4 | 8.7 | 6.3 | 21.2 | 5.7 | 18.7 |

# EFFECT OF DIFFERENT LEVELS AND METHODS OF NITROGEN APPLICATION ON THE GROWTH AND YIELD OF CAULIFLOWER


## Abstract

An experiment was conducted at Farming System Research and Development (FSRD) site, Goyeshpur, Pabna during the Rabi season of 2001-2002 to evaluate the optimum nitrogen fertilizer dose and the best method of fertilizer application for cauliflower production. Four fertilizer doses along with absolute control treatment and three management practices were employed for the study. Higher nitrogen fertilizer with 50% basal nitrogen and two equal split at 30 and 45 DAP gave significant higher yield of cauliflower.


## Introduction

Cauliflower (Brassica *oleracea* var. *botrytis*) is an important winter vegetable crop in Bangladesh and its annual production of 79 metric tons (BBS, 1997-98). It is a high value cash crop for early and late growers in winter season. In Pabna district it is very popular winter crop to the farmers and they grow it as a commercial crop. A field survey result also revealed that variety 'White contessa' performed well in FSRD site, Goyeshpur, Pabna. But the farmers of the area did not follow the recommended fertilizer dose especially nitrogenous fertilizer and have very little knowledge about the method of application. As a result, the yield is not at satisfactory level. The efficiency of nitrogen fertilizer could be increased more than 30% of existing by its proper management. Keeping these views in mind, the present study was undertaken with the following objectives.

### Objectives

i. To find out optimum nitrogen dose and the best method of application;
ii. To find out a economic nitrogen dose for cauliflower.

## Materials and Methods

The experiment was conducted at FSRD site, Goyeshpur, Pabna during the winter season of 2001-2002 in High Ganges River Flood plain agro-ecological zone (AEZ 11). Before starting the experiment a composite soil sample was collected and analyzed (Appendix 1). The experiment was laid out in two-factor RCB design with three replications. Four level of nitrogen fertilizer were used e.g. Control (No), Medium Yield Goal (MYG=68kgN/ha), High Yield Goal (HYG=98kg N/ha) and Farmers Practice (FP=120kgN/ha). Three management practices were $M_1$= Half of N was be applied as basal and rest two equal splits at 30 and 45 DAP, $M_2$ = In three equal installment at 15,30 and 45 DAP (Farmers Practice), $M_3$= In two equal installments at 15 and 35 DAP (Rec. practice) as top dress. Except nitrogen other fertilizer were used at the rate of 34-80-20-7.5 kg P- K-S-B/ha ( Recom. dose) and at the rate of 38-112.5-19-1..5 Kg P-K-S-B/ha (Farmers Practice). The unit plot size was 3.6m x 3m. Cauliflower (var. White contessa) 35 days seedling were transplanted on November 13, 2001 with 60 cm x45 cm spacing. Nitrogen fertilizer was used as per treatment and others fertilizers were used during final land preparation. Pesticide 'Fifanon' was used three times against leaf borer and crops were irrigated two times at 15 and 45 DAP. 50% curd initiation were started at 35-40 DAP. Other intercultural operations were done as and when required. Crops were harvested on January 7 to 13, 2002. Necessary data were collected and analyzed statistically.

## Results and Discussion

The result showed that the highest plant height was obtained from HYG +$M_1$ and FP + $M_1$ treatment which were at par with all other treatment combinations accept control and MYG + $M_2$ treatment. The result also revealed that the significant highest whole plant weight and marketable weight were obtained from HYG+ $M_1$ treatment. The highest yield were achieved from high yield goal (HYG) with $M_1$ treatment where 50% nitrogen was used as basal and two equal top dressed used at 30 and 45 DAP. This yield was at par to farmer's practice with M1 and $M_2$ management. The reason behind the higher yield were obtained due to higher nitrogen fertilizer was used and 50% was applied as basal. Significant cumulative effects on yield contributing characters were supported the result.

From economic point of view the highest gross return, gross margin and MBCR were obtained from high yield goal with $M_1$ management where 50% basal and two equal nitrogen was applied at 30 and 45 DAP (Table 2). Nutrient input and output were calculated and prepared a nutrient balance sheet which was shown in Appendix table 3.

## Conclusion

Higher rate of nitrogen fertilizer with 50% basal and two equal split of top dress at 30 and 45 DAP had significant positive effect on the yield. The trial should be continued to draw conclusion.

Table 1. Yield and yield contributing characters of cauliflower with different fertilizer doses and different management

| Treatment | Plant height (cm) | Whole plant weight (kg) | Marketable curd weight (kg) | Yield (t/ha ) |
|---|---|---|---|---|
| $T_1$ (control) | 35.00d | 0.45e | 0.25e | 9.27f |
| MYG+$M_1$ | 45.45ab | 1.09bc | 0.66bc | 24.34bcd |
| MYG+$M_2$ | 40.85c | 1.04bc | 0.62c | 22.45cd |
| MYG+$M_3$ | 45.63ab | 0.75d | 0.47d | 17.47c |
| HYG+$M_1$ | 47.70a | 1.31a | 0.79a | 29.23a |
| HYG +$M_2$ | 43.85abc | 1.05bc | 0.65bc | 23.82bcd |
| HYG+ $M_3$ | 41.75bc | 0.92cd | 0.60c | 21.15de |
| FP+$M_1$ | 46.10a | 1.20ab | 0.75ab | 27.72ab |
| FP+$M_2$ | 45.25ab | 1.12b | 0.70abc | 25.81abc |
| FP+$M_3$ | 44.00abc | 1.08bc | 0.69abc | 24.92a-d |
| CV(%) | 5.5 | 11.8 | 11.7 | 12.3 |

Table 2: Cost and return analysis of Cauliflower affected by different fertilizer doses and different management at Pabna, 2001-02

| Treatment | Yield (t/ha) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | MBCR |
|---|---|---|---|---|---|
| No | 9.27 | 46350 | 38859 | 7491 | - |
| MYG+$M_1$ | 24.34 | 121700 | 39973 | 81727 | 66.64 |
| MYG+$M_2$ | 22.45 | 112250 | 39853 | 72397 | 65.30 |
| MYG+$M_3$ | 17.47 | 87350 | 39673 | 47677 | 49.37 |
| H YG+$M_1$ | 29.23 | 146150 | 40029 | 106121 | 84.30 |
| HYG +$M_2$ | 23.82 | 119100 | 40209 | 78891 | 52.89 |
| HYG+ $M_3$ | 21.15 | 105750 | 40029 | 65721 | 49.77 |
| FP+$M_1$ | 27.72 | 138600 | 40291 | 98309 | 63.42 |
| FP+$M_2$ | 25.81 | 129050 | 40471 | 88579 | 50.30 |
| FP+$M_3$ | 24.92 | 124600 | 40291 | 84309 | 53.64 |

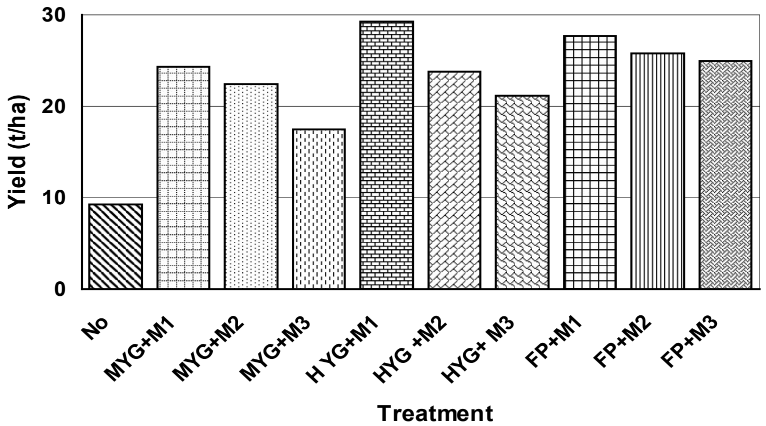



Figure. Effect of N on the yield of Cauliflower under different management

Appendix table 1. Nutrient status of the initial soil sample (0.15cm depth) at FSRD site, Goyeshpur, Pabna

| Sample | $P^H$ | K | % total N | P | S | B | Zn |
|---|---|---|---|---|---|---|---|
| | | meq/100g soil | | microgram/100g soil | | | |
| Sample-1 | 8.5 | 0.26 | 0.07 | 6 | 5.0 | 0.60 | 0.42 |
| Critical limit | Alkaline | Medium | VL | VL | VL | Optimum | Optimum |

Table 2. Yield and yield contributing characters of cauliflower with different fertilizer doses and different management

| Treatment | Plant height (cm) | Whole plant weight(kg) | Marketable curd weight (kg) | Curd size (cm) | | Curd yield/ha (t) |
|---|---|---|---|---|---|---|
| | | | | length | breadth | |
| $T_1$ (control) | 35.00d | 0.45e | 0.25e | 4.75d | 9.57c | 9.27f |
| MYG+$M_1$ | 45.45ab | 1.09bc | 0.66bc | 7.02ab | 13.20ab | 24.34bcd |
| MYG+$M_2$ | 40.85c | 1.04bc | 0.62c | 6.48b | 12.78ab | 22.45cd |
| MYG+$M_3$ | 45.63ab | 0.75d | 0.47d | 5.68c | 11.67b | 17.47c |
| HYG+$M_1$ | 47.70a | 1.31a | 0.79a | 7.53a | 14.52a | 29.23a |
| HYG +$M_2$ | 43.85abc | 1.05bc | 0.65bc | 6.79ab | 13.62a | 23.82bcd |
| HYG+ $M_3$ | 41.75bc | 0.92cd | 0.60c | 6.60b | 13.35a | 21.15de |
| FP+$M_1$ | 46.10a | 1.80ab | 0.75ab | 7.34ab | 14.45a | 27.72ab |
| FP+$M_2$ | 45.25ab | 1.12b | 0.70abc | 6.72ab | 14.12a | 25.81abc |
| FP+$M_3$ | 44.00abc | 1.08bc | 0.69abc | 6.74ab | 14.11a | 24.92a-d |
| CV(%) | 5.5 | 11.8 | 11.7 | 8.3 | 8.0 | 12.3 |

Cost of input

Urea = Tk. 5.5/kg
TSP = Tk.13.00/kg
MP = Tk. 9.00/kg
Zyp = Tk. 3.00 /kg
Borax = Tk. 40.00/kg
Seedling= Tk. 0.40/ Seedling
Plough = Tk. 1200/hectare
Labour = 200 labour/8hrs @ Tk. 60

Price of out put

Cauliflower = Tk.5.00/kg

Appendix table 3. Nutrient (N, P, K) balance in cauliflower

| Crops in CP | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance (+/ -) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | In Org. | Org. | BNF | Total | In Org. | Org | BNF | Total | |
| MYG+M1 | 24.34 | N | 170 | 68 | - | - | 68 | 24 | - | - | 24 | -146 |
| | | P | 21 | 34 | - | - | 34 | 7 | - | - | 7 | -14 |
| | | K | 141 | 80 | - | - | 80 | 40 | - | - | 40 | -101 |
| MYG+M2 | 22.45 | N | 157 | 68 | - | - | 68 | 24 | - | - | 24 | -133 |
| | | P | 20 | 34 | - | - | 34 | 7 | - | - | 7 | -13 |
| | | K | 130 | 80 | - | - | 80 | 40 | - | - | 40 | -90 |
| MYG+M3 | 17.47 | N | 122 | 68 | - | - | 68 | 24 | - | - | 24 | -98 |
| | | P | 15 | 34 | - | - | 34 | 7 | - | - | 7 | -8 |
| | | K | 101 | 80 | - | - | 80 | 40 | - | - | 40 | -61 |
| HYG+M1 | 29.23 | N | 205 | 98 | - | - | 98 | 34 | - | - | 34 | 171 |
| | | P | 26 | 34 | - | - | 34 | 7 | - | - | 7 | -19 |
| | | K | 170 | 80 | - | - | 80 | 40 | - | - | 40 | 130 |
| HYG+M2 | 23.82 | N | 167 | 98 | - | - | 98 | 34 | - | - | 34 | 133 |
| | | P | 21 | 34 | - | - | 34 | 7 | - | - | 7 | -14 |
| | | K | 138 | 80 | - | - | 80 | 40 | - | - | 40 | -94 |
| HYG+M3 | 21.15 | N | 148 | 98 | - | - | 98 | 34 | - | - | 34 | -114 |
| | | P | 19 | 34 | - | - | 34 | 7 | - | - | 7 | -12 |
| | | K | 123 | 80 | - | - | 80 | 40 | - | - | 40 | -83 |
| FP+M1 | 27.72 | N | 194 | 120 | - | - | 120 | 42 | - | - | 42 | -152 |
| | | P | 24 | 38 | - | - | 38 | 8 | - | - | 8 | -16 |
| | | K | 161 | 112.5 | - | - | 112.5 | 56 | - | - | 56 | -105 |
| FP+M2 | 25.81 | N | 181 | 120 | - | - | 120 | 42 | - | - | 42 | -139 |
| | | P | 23 | 38 | - | - | 38 | 8 | - | - | 8 | -15 |
| | | K | 150 | 112.5 | - | - | 112.5 | 56 | - | - | 56 | -94 |
| FP+M3 | 24.92 | N | 174 | 120 | - | - | 120 | 42 | - | - | 42 | -132 |
| | | P | 22 | 38 | - | - | 38 | 8 | - | - | 8 | -14 |
| | | K | 145 | 112.5 | - | - | 112.5 | 56 | - | - | 56 | - 89 |

# MULTILOCATION VERIFICATION OF TRIAL OF PROMISING CROPPING PATTERNS


## Abstract

The experiment was conducted at Tangail, Jessore and Pabna during 1998-99 to 2000-01 to verify the productivity and profitability of the current and new fertilizer recommendation in a wider agro-climatic condition. Three dominant cropping patterns-(i) Mustard-Boro-T.Aman at Tangail, (ii) Boro-GM-T.Aman at Jessore and (iii) Wheat-GM-T.Aman at Pabna were tested against three fertilizer packages-(i) Current recommendation (FRG'97) (ii) New recommendation and (iii) Farmers' fertilization practice. Results revealed that the new fertilizer recommendation performed better than current recommendation in respect of yield and profit irrespective of cropping patterns and locations. At Tangail the highest yield and return was obtained from farmers' fertilization practice. New fertilizer recommendation is more location specific and showed better performance than BARC recommendation.


## Introduction

Cropping pattern is now considered for any fertilizer recommendation instead of single crop. Because many of the fertilizer nutrients have considerable residual effect on the succeeding crops. The fertilizer applied in 1st crop not necessarily utilized by the crop and a substantial amount remains in the soil which made available to next crop. In this context Bangladesh Agricultural Research Council (BARC) has developed a national fertilizer recommendation guide (FRG '97) giving emphasis on AEZ basis fertilizer recommendation for dominant cropping patterns. Similarly, different FSR sites of OFRD have already developed some location specific pattern based fertilizer recommendation during last couple of years. This recommendation needs to be verified in a wider agro-ecological situation. The present study was therefore, conducted to verify the productivity and profitability of the alternate fertilizer recommendation in a wider agro-ecological sub-zone and to create awareness among the farmers and extension personnel about the new recommendation.

## Materials and Methods

The experiment was conducted at three different locations with 2 dominant cropping patterns during 2000-01. Location and cropping pattern tested are shown below. Three fertilizer packages; i) BARC recommendation (current recommendation), ii) OFRD recommendation (new recommendation) and iii) Farmers' practice was tested. The experiment was laid out in RCB design with 6 dispersed replications. The crops were grown with recommended management. At harvesting data on yield and yield components were recorded and analyzed statistically. Different crop management practices of different locations are given in appendix 1.

**Location and cropping patterns tested are shown below-**

| Cropping pattern | Location |
|---|---|
| Mustard Boro-T.Aman | Palima, Tangail |
| Boro-GM-T.Aman | Magura and Jhenaidah MLT site, Jessore |
| Wheat-GM-T.Aman | Goyeshpur FSRD & Chatmohar MLT site, Pabna |

**Fertilizer doses (kg/ha)**

Site: Tangail

| Treatment | N-P-K-S-Zn (kg/ha) | | |
|---|---|---|---|
| | Mustard | Boro | T.Aman |
| Current dose | 70-10-20-20-1 | 100-15-35-6 | 70-8-25-4 |
| New dose | 100-26-33-20-0 | 80-6-25-0 | 70-5-20-4 |
| Farmers' dose | 100-15-20-0-0 | 110-10-20-0 | 45-12-20-0 |

Site: Magura and Jhenaidah

| Treatment | N-P-K-S-Zn (kg/ha) | |
|---|---|---|
| | Boro | T.Aman |
| Current dose | 100-20-35-10-1.5 | 50-6-20-4-0 |
| New dose | 120-60-40-20-2 | 55-30-20-10-2 |
| Farmers' dose | 108-60-28-16-6 | 90-50-25-10-0 |

Site: Goyeshpur & Chatmohar

| Treatment | N-P-K-S-Zn-B (kg/ha) | |
|---|---|---|
| | Wheat | T.Aman |
| Current dose | 90-20-35-10-2-0.5 | 70-6-20-4 |
| New dose | 80-26-33 | 55-14-17-20-4 |
| Farmers' dose (Goyeshpur) | 86-26-17 | 75-16-29-4-6 |
| Farmers' dose (Chatmohar) | 64-26-17 | 75-16-29-4-6 |

## Results and Discussion

**Cropping pattern : Mustard-Boro-T.Aman**
**Location : Tangail**
**Year : 1998-99 to 2000-01**

Average of three years data showed that yield difference among the fertilizer packages was very small. The highest seed yield of Mustard was recorded from new fertilizer recommendation and the lowest from farmers practice. Traditionally the farmers' did not apply sulphur in mustard and therefore, the yield is less as Mustard is a sulphur loving crop. But in Boro and T.Aman rice the grain yield was not differed significantly among the fertilizer doses. However, the farmers practice gave higher yield over recommended fertilizer packages.

From economic point of view, the highest gross margin and BCR was calculated from the farmers' fertilization practice. New fertilizer recommendation gave higher economic return than present BARC fertilizer recommendation.

Table 1. Yield of Mustard-Boro-T.Aman cropping pattern as affected by different fertilizer recommendation at Palima, Tangail during 2000-01

| Treatment | Grain yield (t/ha) | | | TVC (Tk/ha) | GM (Tk/ha) | BCR |
|---|---|---|---|---|---|---|
| | Mustard | Boro | T.Aman | | | |
| Current dose | 0.86 | 6.16 | 3.35 | 42484 | 42843 | 2.01 |
| New dose | 0.90 | 6.19 | 3.34 | 41219 | 44638 | 2.08 |
| Farmers dose | 0.78 | 6.20 | 3.82 | 40085 | 48136 | 2.20 |

**Cropping pattern : Boro-GM-T.Aman**
**Location : Magura & Jhenaidah**
**Year : 2000-01**

Different fertilizer packages were found to influence the yield of different crops in Boro-GM-T.Aman cropping pattern. At Magura, significantly higher grain yield of Boro rice was obtained from new fertilizer recommendation followed by farmers' practice. The current BARC recommendation produced the lowest yield. In T.Aman rice significantly higher yield was obtained from new recommendation and farmers practice.

But at Jhenaidah, the highest yield of Boro rice was found in farmers' practice followed by new recommendation. Similar trend was observed in T.Aman rice also. The current fertilizer recommendation of BARC produced the lowest yield in both the location.

Cost and return analysis of the pattern also showed similar trend like yield. The highest return at Magura was obtained from the new fertilizer recommendation followed by farmers' practice. At Jhenaidah, the highest return was recorded from farmers' practice followed by new recommendation.

Fertilizer dose recommended by BARC is quite lower than new fertilizer recommendation and it is found no longer superior in respect of yield and economic return.

Table 2. Yield of Boro-GM-T.Aman cropping pattern as affected by different fertilizer recommendation at Magura MLT site, Jessore during 2000-01

| Treatment | Grain yield (t/ha) | | TVC (Tk/ha) | GM (Tk/ha) | BCR |
|---|---|---|---|---|---|
| | Boro | T.Aman | | | |
| Current dose | 4.19c | 4.16b | 24070 | 37550 | 2.56 |
| New dose | 4.86a | 4.60a | 26769 | 43106 | 2.61 |
| Farmers dose | 4.55b | 4.74a | 27724 | 40981 | 2.47 |

Table 3. Yield of Boro-GM-T.Aman cropping pattern as affected by different fertilizer recommendation at Jhenaidah MLT site, Jessore during 2000-01

| Treatment | Grain yield (t/ha) | | TVC (Tk/ha) | GM (Tk/ha) | BCR |
|---|---|---|---|---|---|
| | Boro | T.Aman | | | |
| Current dose | 4.20c | 3.32c | 24070 | 31505 | 2.31 |
| New dose | 5.77b | 4.05b | 26713 | 45047 | 2.69 |
| Farmers dose | 6.52a | 4.74a | 28079 | 54666 | 2.95 |

**Cropping pattern : Wheat-GM-T.Aman**
**Location : Goyeshpur FSRD site and Chatmohar MLT site, Pabna**
**Year : 1998-99 to 2000-01**

Average of three years results showed that similar yield of wheat was obtained from current and new fertilizer recommendation at Goyeshpur. The lowest yield was recorded from farmers' practice. Almost similar trend was found in T.Aman rice also. From cost and return analysis it was found that both the recommended fertilizer packages gave higher gross margin and BCR.

At Chatmohar, similar result was found as observed at Goyeshpur. Both the recommended fertilizer packages produced higher yield and return over farmers' practice.

After three years of experimentation it was observed that the present fertilizer recommendation and new fertilizer recommendation produced identical yield at both the locations. However, the fertilizer dose in new recommendation is comparatively lower than present recommendation which produced a little bit higher economic return.

Table 4. Yield of Wheat-GM-T.Aman cropping pattern as affected by different fertilizer recommendation at Goyeshpur, Pabna (Avg. of 1998-99 to 2000-01)

| Treatment | Grain yield (t/ha) | | TVC (Tk/ha) | GM (Tk/ha) | BCR |
|---|---|---|---|---|---|
| | Wheat | T.Aman | | | |
| Current dose | 2.72 | 4.25 | 17619 | 42047 | 3.39 |
| New dose | 2.70 | 4.28 | 17577 | 42811 | 3.43 |
| Farmers dose | 2.09 | 3.94 | 18547 | 33630 | 2.81 |

Table 5. Yield of Wheat-GM-T.Aman cropping pattern as affected by different fertilizer recommendation at Chatmohar, Pabna (Avg. of 1998-99 to 2000-01)

| Treatment | Grain yield (t/ha) | | TVC (Tk/ha) | GM (Tk/ha) | BCR |
|---|---|---|---|---|---|
| | Wheat | T.Aman | | | |
| Current dose | 2.86 | 4.73 | 18722 | 46130 | 3.46 |
| New dose | 2.97 | 4.88 | 18993 | 48533 | 3.55 |
| Farmers dose | 2.52 | 4.29 | 19883 | 48360 | 3.43 |

Appendix table 1. Crop management practices

| Site | Croppping pattern | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Palima | Mustard | Tori-7 | 10 | Last week of Oct. | 3rd week of Jan. |
| | Boro | BRRIDhan29 | 40 | Last week of Jan. | Last week of May |
| | T.Aman | BRRIDhan33 | 40 | 1st week of Aug. | 3rd week of Oct. |
| Magura | Boro | BRRIDhan28 | 40 | 1st week of Feb. | 3rd week of May |
| | GM | | 50 | 2nd week of May | 2nd week of July |
| | T.Aman | BR11 | 40 | 3rd week of July | Last week of Nov |
| Jhenaidah | Boro | BRRIDhan28 | 40 | 1st week of Feb. | 3rd week of May |
| | GM | | 50 | 2nd week of May | 2nd week of July |
| | T.Aman | BR11 | 40 | 3rd week of July | Last week of Nov |
| Goyeshpur | Wheat | Kanchan | 120 | 1st week of Dec. | 3rd week of March |
| | GM | | 50 | 2nd week of May | 2nd week of July |
| | T.Aman | BRRIDhan39 | 40 | Last week of July | 3rd week of Nov |
| Chatmohar | Wheat | Kanchan | 120 | 1st week of Dec. | 3rd week of March |
| | GM | | 50 | 2nd week of May | 2nd week of July |
| | T.Aman | BRRIDhan39 | 40 | Last week of July | 3rd week of Nov |

# EFEECT OF BORON ON YIELD OF MUSTARD UNDER OLD BRAHMAPUTRA FLOODPLAIN SOILS OF AEZ 9


## Abstract

A field experiment was conducted at two locations of Mymensingh greater district (Phulpur, and Netrakona) during rabi season of 2001-02 to evaluate the effect of boron on the growth and yield of mustard and identify a most suitable dose of boron for mustard under Old Brahmaputra Floodplain soils of Bangladesh (AEZ 9). Four treatments such as $T_0$= control (no fertilizer), $T_1$= recommended package of NPKSZn with 1 kg B ha$^{-1}$, $T_2$= alternate package of NPKSZn + 1.5 kg B ha$^{-1}$ and $T_3$= Farmers' practice 50, 30, 4, and 4 kg NPKS ha$^{-1}$ with 5 t cowdung ha$^{-1}$ were tested. Application of boron significantly influenced plant height, branches per plant, siliqua per plant, seeds per siliqua, 1000-seed weight, seed yield and stover yield of mustard. The highest seed yield was obtained from $T_2$ in both locations (Phulpur and Netrakona) respectively.


## Introduction

Mustard is the principal oleaginous crop of Bangladesh. It covers 58.6% of the total oilseed area and produces 52.2% of the total oilseed production in the country (BBS 1998). The average yield of mustard per unit area in Bangladesh is very low compared with other mustard producing countries. It has been identified that micro-nutrient deficiency problem on many crops have been warranted due to intensive cropping with rice and other crops. The practice of intensive cropping with modern varieties causes a dramatic depletion of inherent nutrient reserves of some other nutrients such as S, Zn and B are being observed in many parts of the country. In Phulpur and Netrakona under Mymensingh greater district, organic matter and boron content of the soil is poor for which results poor yield of mustard. This is mainly due to less pod as well as siliqua formation. In general *Brassica* needs higher requirement of boron and they are not responsing positively with lower supply, and severe deficiency may result in floral abortion and significant drop in seed production. Boron increases the number of siliqua and yield of mustard. The application of Boron @ 10 kg ha$^{-1}$ in conjugation with Sulphur @ 20 kg ha$^{-1}$ caused 42% increased seed yield of mustard. The present investigation was, therefore, undertaken to evaluate the effect of boron on the growth and yield performance of mustard and to find out the suitable boron fertilizer dose for mustard in Old Brahmaputra Floodplain soil.

## Materials and Methods

The experiment was conducted at the MLT sites Phulpur and Netrokona of greater Mymensingh district during rabi season of 2000-2001. The experiment was laid out in randomized complete block design with 5 replications and 4 treatments in each site viz.

$T_1$ = Control (without any fertilizer)
$T_2$ = Recommended package (Recommended NPKSZn + 1 kg B ha$^{-1}$)
$T_3$ = Alternate package (Recommended NPKSZn + 1.5 kg B ha$^{-1}$), and
$T_4$ = Farmer's practice (50, 30, 40, 4 kg N, P, K, S with 5 tons Cowdung ha$^{-1}$)

Note:
Recommended package (Phulpur) = 95, 10, 52, 29, and 4 kg N, P, K, S, and Zn ha$^{-1}$.
Recommended package (Netrakona) = 95, 17, 51, 19, and 4 kg N, P, K, S, and Zn ha$^{-1}$.

Initial soil samples were collected from both locations and analyzed for physical and chemical characteristics of soil (Table 1) following standard methods. NPKSZn fertilizer was applied for recommended and alternate package at the rate of 95, 10, 52, 29, and 4 kg N, P, K, S, and Zn ha$^{-1}$ for Phulpur and 95, 17, 51, 19, and 4 kg N, P, K, S, and Zn ha$^{-1}$ for Netrakona on the basis of soil test values with the help of Fertilizer Recommendation Guide (BARC, 1997). Boric acid was used as the source of boron. Full amount of PKSZnB fertilizers and half of N (urea) were applied as basal. Rest half was applied as top dress at the time of flowering. Recommended seed rate (9 kg/ha) were sown as broadcast method on November 10-12, 2001. Insecticide application and intercultural operation were done as per requirement equally to get better yield. The crop was harvested on January 30-February 2,

2001. Data on plant height, branches per plant, siliqua per plant, seeds per siliqua, 1000 seed weight, seed and stover yield were recorded and the data were analyzed by using a suitable package (MSTAT) following ANOVA technique. The differences among the treatment means were evaluated by Duncan's New Multiple Range Test (DMRT).

## Results and Discussion

### Yield components

The yield components of mustard as influenced by boron application in Phulpur and Netrakona have been presented in Table 2. It is evident from the table that all the studied yield contributing characters of mustard were increased significantly due to boron application. Plant height of the crop responded significantly to boron application in both Phulpur and Netrokona locations. Between two locations, the plants were taller at Netrakona than at Phulpur site. In both locations the highest plant heights were obtained with $T_2$ treatment receiving site specific recommended doses of NPKSZn and 1.5 kg B $ha^{-1}$ and the lowest values were found with control. Regarding the branches per plant, in both locations the highest number of branches per plant was found in $T_2$, Which was statistically similar with $T_1$ receiving site specific recommended doses of NPKSZn and 1 kg B $ha^{-1}$ at Phulpur. And the lowest values were observed in control. It was noted that the number of branches per plant was slight higher at Netrokona than at Phulpur irrespective of treatments. The number of total siliqua per plant was significantly influenced by boron application in both Phulpur and Netrakona locations. In both sites the highest number of total siliqua per plant was produced by $T_2$ which was statistically identical with $T_1$ and the lowest value was given by $T_0$ treatment. The application of boron increased significantly the number of l siliqua per plant, number of seeds per siliqua and seed yield of mustard. Considering seeds per siliqua the results were found a little bit higher at Phulpur than at Netrakona location irrespective of treatments. The trend of the results was at par with siliqua per plant. In case of 1000-seed weight the highest values were recorded from $T_2$ in both locations followed by $T_1$ and $T_3$ treatments while the lowest values were recorded from control.

### Seed yield

Seed yield of mustard was markedly influenced by boron application in both locations (Table 3). In Phulpur the highest seed yield of 1042 kg $ha^{-1}$ was obtained with application of 1.5 kg B $ha^{-1}$ ($T_2$) followed by the yield of 950 kg $ha^{-1}$ obtained with application of 1 kg B $ha^{-1}$ ($T_1$) and the lowest value of 314 kg $ha^{-1}$was obtained with control. Although $T_2$ gave higher seed yield than $T_1$, they were statistically similar. In case of Netrakona $T_2$ gave the highest seed yield of 1167 kg $ha^{-1}$which was 11.14% higher than that given by $T_1$ (1050 kg $ha^{-1}$). The lowest value of 366 kg $ha^{-1}$ was found in control. The highest plant height, branches per plant, pods per plant, seeds per pod and 1000-seed weight contributed to the highest seed yield in the treatment $T_2$ in both locations. In both locations, farmers' practice ($T_3$) showed third highest yield. The yield difference between the $T_2$ (alternate package) and $T_3$ (farmer's practice) was 456.8 Kg $ha^{-1}$ (78.01%) in Phulpur and 572.0 $Kgha^{-1}$ (96.13%) in Netrakona location. These results found that application of boron significantly increased the yield of mustard. Comparing the location effect, seed yield in Netrakona site was higher than that in Phulpur. This difference in yield was resulted from the difference in branches per plant, siliqua per plant, seeds per siliqua and 1000-seed weight between Phulpur and Netrakona locations.

### Stover yield

The effect of boron on the stover yield of mustard was highly significant in both Phulpur and Netrakona locations (Table 3). The highest stover yield was obtained with the application of 1.5 kg B $ha^{-1}$ ($T_2$) that was statistically at par with $T_1$ (1 kg B $ha^{-1}$). The treatment $T_3$ ranked the next position in stover yield. The lowest stover yield was found in control in both locations. The results of the present study support that the stover yield of mustard crop was increased significantly by boron application.

The overall results indicate that for obtaining satisfactory yield of mustard both Phulpur and Netrakona sites of Old Brahmaputra Floodplain soil need to be fertilized with 1.5 kg B $ha^{-1}$with site specific recommended rates of N, P, K, S and Zn. Further, the experiment can be repeated with different varieties of mustard to examine the varietal response to the added B for making final recommendation.

Table 1. Effect of Boron on different parameters of mustard at Phulpur and Netrakona, Rabi (2000-01)

| Parameters | Location | Treatments | | | | CV (%) |
|---|---|---|---|---|---|---|
| | | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
| Plant height (cm) | Phulpur | 36.2d | 61.5b | 66.8a | 50.9c | 4.5 |
| | Netrokona | 42.5c | 59.7a | 64.7a | 49.7b | 5.8 |
| No. of Siliqua plant$^{-1}$ | Phulpur | 19.2c | 56.7a | 58.4a | 38.2b | 9.9 |
| | Netrokona | 22.4c | 59.8a | 65.9a | 37.9b | 15.7 |
| No. of Seeds Siliqua$^{-1}$ | Phulpur | 9.1c | 14.7a | 15.6a | 11.5b | 7.8 |
| | Netrokona | 9.7c | 13.1a | 14.7a | 11.4b | 7.8 |
| Weight of 1000-seed (g) | Phulpur | 2.24c | 3.2a | 3.17a | 2.57b | 5.0 |
| | Netrokona | 2.27c | 3.1a | 3.21a | 2.65b | 5.9 |
| Seed yield (kg ha$^{-1}$) | Phulpur | 314c | 950a | 1042a | 585b | 13.1 |
| | Netrokona | 367c | 1050a | 1167a | 595b | 12.6 |
| Stover yield (kg ha$^{-1}$) | Phulpur | 687 c | 1608a | 1663a | 992b | 11.1 |
| | Netrokona | 780 b | 1621a | 1804a | 1087b | 13.8 |

Figures in row having common letter (s) do not differ significantly (LSD 0.05)

Table 2. Effect of Boron on different parameters of mustard at Phulpur and Netrakona, rabi (2001-02)

| Parameters | Location | Treatments | | | | CV (%) |
|---|---|---|---|---|---|---|
| | | $T_1$ | $T_2$ | $T_3$ | $T_4$ | |
| Plant height (cm) | Phulpur | 29.0c | 66.9ab | 67.3a | 60.0b | 8.2 |
| | Netrokona | 36.5d | 70.5b | 75.7a | 65.7c | 1.1 |
| No. of Siliqua plant$^{-1}$ | Phulpur | 17.8c | 44.1a | 42.1a | 36.0b | 5.3 |
| | Netrokona | 16.9d | 35.7b | 39.0a | 30.0c | 3.7 |
| No. of Seeds Siliqua$^{-1}$ | Phulpur | 6.1c | 9.9a | 10.4a | 8.0b | 9.5 |
| | Netrokona | 9.2d | 15.9b | 18.5a | 14.7c | 4.1 |
| Weight of 1000-seed (g) | Phulpur | 2.25c | 2.47a | 2.50a | 2.38b | 1.4 |
| | Netrokona | 1.83c | 2.75b | 2.90a | 2.65b | 2.8 |
| Seed yield (kg ha$^{-1}$) | Phulpur | 220c | 850a | 952a | 592b | 19.8 |
| | Netrokona | 338d | 990b | 1102a | 900c | 3.4 |
| Stover yield (kg ha$^{-1}$) | Phulpur | 368c | 1416a | 1584a | 1023b | 17.6 |
| | Netrokona | 612d | 1335b | 1415a | 1250c | 2.2 |

Figures in row having common letter (s) do not differ significantly (LSD 0.05)

Appendix Table 1. Physico-chemical characteristics of Phulpur and Netrakuna soils (0-15 cm)

| Characteristics | Phulpur | Interpretation | Netrakona | Interpretation |
|---|---|---|---|---|
| PHYSICAL | | | | |
| Sand (%) | 28 | | 19 | |
| Silt (%) | 61 | | 59 | |
| Clay (%) | 11 | | 22 | |
| Textural class | Silt Loam | | Silt Loam | |
| CHEMICAL | | | | |
| pH | 5.65 | - | 5.20 | - |
| O M (%) | 1.58 | - | 1.22 | - |
| Total N (%) | 0.084 | Low | 0.084 | Low |
| Avail. P (ppm) | 22.0 | Optimum | Medium | |
| Exch. K (me/100gm soil) | 0.064 | Low | 0.074 | Low |
| Avail. S (ppm) | 8.25 | Low | 8.11 | Low |
| Availble Zn (ppm) | 1.34 | Optimum | 1.29 | Optimum |
| Avail. B (ppm) | 0.18 | Low | 0.20 | Low |

# RESPONSE OF SHAHI PAPAYA TO ITS BORON FERTILIZATION


## Abstract

An experiment was conducted at ARS, Rangpur during 1999-2002 to observe the performance of papaya verities with its response to boron fertilization in Rangpur region. Two varieties of papaya viz. Shahi and local were assigned in the main plots and eight doses of boron (0, 1, 2 and 3 kg/ha as basal and 0.0,0.5, 1.0 & 1.5 kg/ha as foliar) were assigned in the sub plots. The Shahi papaya preformed better compared to local variety. The Shahi gave the highest fruit yield of 52.24 t/ha (average of three years) using 1.0 kg/ha of boron as foliar application.


## Introduction

For the last few years, it has been observed that the yield of papaya is reducing due to dropping and deformation of fruits in Tista Meander Floodplain soil of greater Rangpur region. Malformed small leaves and wrinkled papaya (fruits) are usually observed. It has, already, been reported that micro-nutrient status of the soil in this region particularly boron, is below the critical level. Previous studies also revealed that crops like chickpea, mustard and some vegetables failed to produce reasonable yields due to boron deficiency. Boron, as micro-nutrient is involved in cell division, carbohydrate and water metabolism, protein synthesis etc. Boron is not translocated within the plant like other elements. So, for better harvest of papaya in this region, boron application is deemed necessary. The yield potential of existing papaya variety is poor. BARI has developed a variety "Shahi papaya" that has high yield potential and good taste. Therefore, the experiment was conducted to determine the optimum dose of boron and to find out the suitable application method of boron for papaya in Rangpur region.

## Materials and Methods

The trial was conducted at OFRD, ARS, Rangpur during 1999-2002 of three consecutive years. It was laidout in split-plot design with four replications. Two papaya variety shahi and local were kept in the main plot and eight doses of boron were in the sub plot. Of the eight doses of boron first four doses viz. 0,1,2 & 3 kg/ha were applied as basal and the last four viz. 0,0.5,1.0 & 1.5 kg/ha were applied as foliar in two splits. Seedlings of 40-50 days old were planted during April 20 to May 10 irrespective of years. Unit plot size was 6m x 2m having planting spacing 2m x 2m ie. a plot contained three pits and three seedlings per pit were planted. The pit size was 60 x 60 x 60cm. The crop was fertilized with 12000-1250-560-560-900-10-4 kg/ha cowdung-oilcake-N-$P_2O_5$-$K_2O$-S and Zn. Out of three plants per pit two inferior plants were removed during flower initiation period ensuring a female plant in each pit. For every 20 female plants, one male plant was allowed for ensuring pollination. The foliar application of boron (as borax) was done in twice after attaining the plants 55-60 days old having an interval of 10 days. Magnesium sulphate was applied as foliar in all plots by 3-5 times when they showed Mg deficiency symptoms. Irrigation, weeding, mulching and other intercultural operations were done as and when necessary. Harvesting started from the last week of October and continued till the end of April. About 12 to 18 time harvests were done for different treatments. Data on yield and yield components were recorded and analyzed statistically.

## Results and Discussion

It is evident from the tables (Table 1 & 5) that there was remarkable response of papaya to boron fertilization in each year.

**Variety:** The yield and yield attributes were significantly influenced by variety. The number of fruits per plant (16.5) and fruit yield (40.95 t/ha) was significantly higher in Shahi compared to local cultivar (11.5 & 29.72 t/ha) respectively. The percentage of normal fruits was also higher (77%) in Shahi compared to local one (73%) (Table 1). This indicated that Shahi is superior to local variety in respect of yield and yield attributes. Similar trend in yield was also obtained in all the three consecutive years (Table-3).

**Dosage of boron:** The highest number of abnormal or deform fruits (47-50%) were obtained from the plants those received no boron (control plots) which significantly differed with boron treated plots. Deform fruits drastically reduce market prize. The number of total fruits (15-16/plant) obtained in boron treated plants was significantly higher compared to those of non-treated plants (10). Similar trend was also reflected for yield (Table-2). This indicates that boron has positive effects on the yield and yield attributes of papaya of the three basal doses. Significantly the highest fruit number /plant (15) was obtained plants treated with 2 kg boron which reflected on the yield (36.63 t/ha). Of the three foliar doses the highest fruit number (18) was obtained from the plants needed with 1.0 and 1.5 kg B, which significantly differ with 0.5 kg B similar trend was obtained in yield. A remarkable significant yield difference was also obtained by dosage of boron in all the three consecutive years.

**Application method:** Significantly the highest number of fruits /plant (16-19) and higher number of normal fruits (85%) were obtained from the plants treated with B as foliar. It was only 82% where plants received boron as basal. Similar trend was also observed in yield. It indicated that foliar application would be more effective compared to basal application.

**Interaction:** Shahi papaya treated with 1.0 kg/ha B foliarly gave the highest fruit yield of 52.24 t/ha over the three years. The local variety was performed better with foliar application of boron @ 1 kg/ha but much lower yield than Shahi papaya.

## Conclusion and Recommendation

The yield potentiality of Shahi papaya observed was significantly higher compared to local one. The shape and size were better, and the percentage of normal fruits was also higher in Shahi. Besides, the deep yellow color and sweet taste of Shahi attracted the attention of the consumers. Boron had positive impact on fruit size, shape and yield. On the basis of results, 1 kg B/ha as foliar or 2 kg B/ha as basal application could be recommended for cultivation Shahi papaya for higher yield, color and shape.

Table 1. Yield and yield attributes of papaya varieties (averaged over different dosage and method of boron application) ARS, Rangpur during 2001-2002

| Variety | Fruits/ plant (no.) | Fruit length (cm) | Fruit breadth (cm) | Normal fruits/plant (%) | Deform fruits/plant (%) | Fruit yield | |
|---|---|---|---|---|---|---|---|
| | | | | | | kg/ plant | (t/ha) |
| Shahi | 16.5 | 16.9 | 29.8 | 76.5 | 23.5 | 16.41 | 40.95 |
| Local | 11.5 | 20.8 | 22.7 | 73 | 25.9 | 11.85 | 29.72 |
| CV (%) | 13.3 | 5.2 | 3.8 | 4.3 | 11.9 | 4.5 | 4.3 |
| LSD (0.05) | 1.48 | 0.78 | 0.79 | 2.58 | 2.32 | 0.50 | 1.20 |

Table 2. Effects of different dosage of boron with method of application on the yield and yield attributes of papaya (averaged over varieties) ARS, Rangpur during 2001-2002

| Dosage of boron with application method | Fruits/ plant (no.) | Fruit length (cm) | Fruit breadth (cm) | Normal fruits/ plant (%) | Deform fruits/plant (%) | Fruit yield | |
|---|---|---|---|---|---|---|---|
| | | | | | | kg/ plant | (t/ha) |
| 0.0 kg/ha as basal | 10.3 | 14.8 | 22.1 | 52.6 | 47.4 | 9.93 | 24.64 |
| 1.0 kg/ha as basal | 14.0 | 19.3 | 27.4 | 82.3 | 17.8 | 14.13 | 34.73 |
| 2.0 kg/ha as basal | 15.1 | 20.6 | 27.7 | 80.1 | 19.9 | 14.65 | 36.63 |
| 3.0 kg/ha as basal | 14.0 | 19.9 | 27.7 | 82.1 | 17.6 | 14.50 | 36.26 |
| 0.0 kg/ha as foliar | 9.6 | 14.8 | 22.3 | 50.4 | 49.6 | 10.29 | 25.72 |
| 0.5 kg/ha as foliar | 16.2 | 20.2 | 27.1 | 85.0 | 14.9 | 16.31 | 38.87 |
| 1.0 kg/ha as foliar | 17.8 | 20.1 | 28.0 | 85.0 | 15.0 | 16.47 | 41.02 |
| 1.5 kg/ha as foliar | 17.8 | 21.0 | 27.8 | 84.5 | 15.4 | 14.79 | 41.97 |
| CV (%) | 9.4 | 4.7 | 2.4 | 3.2 | 9.7 | 5.0 | 5.1 |
| LSD (5%) | 0.87 | 0.90 | 0.67 | 2.46 | 2.88 | 0.72 | 1.81 |

Table 3. Yield performance of different papaya verities (averaged over different dose & method of B application) ARS, Rangpur during three consecutive year 1999-2002

| Variety | Fruit yield (t/ha) | | | |
|---|---|---|---|---|
| | 1999-2000 | 2000-2001 | 2001-2002 | Mean |
| Shahi | 45.12 | 52.28 | 40.95 | 46.12 |
| Local | 35.27 | 35.48 | 29.72 | 33.49 |
| CV (%) | 10.4 | 5.7 | 4.3 | - |
| LSD (0.05) | - | 1.99 | 1.20 | - |

Table 4. Effects of different dosage and application method of B on the yield of Papaya (averaged over varieties) ARS, Rangpur during three consecutive year 1999-2002

| Dose of Boron | Fruit yield (t/ha) | | | |
|---|---|---|---|---|
| | 1999-2000 | 2000-2001 | 2001-2002 | Mean |
| 0.0 kg B/ha as basal | 32.95 | 35.69 | 24.64 | 31.09 |
| 1.0 kg B/ha as basal | 38.70 | 46.17 | 35.53 | 40.13 |
| 2.0 kg B/ha as basal | 42.82 | 42.81 | 36.63 | 40.75 |
| 3.0 kg B/ha as basal | 42.71 | 46.66 | 36.26 | 41.87 |
| 0.0 kg B/ha as foliar | 32.28 | 35.34 | 25.72 | 31.11 |
| 0.5 kg B/ha as foliar | 41.57 | 48.52 | 40.87 | 43.65 |
| 1.0 kg B/ha as foliar | 45.95 | 47.17 | 41.02 | 44.71 |
| 1.5 kg B/ha as foliar | 44.62 | 48.70 | 41.97 | 45.09 |
| CV (%) | 10.4 | 6.2 | 5.1 | - |
| LSD (0.05) | - | 2.76 | 1.81 | - |

Table 5. Interaction effects of variety and dosage of boron with application method on the yield of papaya ARS, Rangpur during 1999-2002

| Variety | Dose of B | Fruit yield (t/ha) | | | |
|---|---|---|---|---|---|
| | | 1999-2000 | 2000-2001 | 2001-2002 | Mean |
| Shahi | 0.0 kg B/ha as basal | 35.63 | 40.51 | 28.73 | 34.96 |
| | 1.0 kg B/ha as basal | 43.28 | 54.09 | 41.09 | 46.15 |
| | 2.0 kg B/ha as basal | 48.50 | 49.38 | 42.82 | 46.9 |
| | 3.0 kg B/ha as basal | 48.75 | 56.94 | 42.46 | 49.38 |
| | 0.0 kg B/ha as foliar | 34.75 | 40.81 | 29.86 | 35.14 |
| | 0.5 kg B/ha as foliar | 47.88 | 57.94 | 42.06 | 49.29 |
| | 1.0 kg B/ha as foliar | 52.00 | 57.72 | 47.01 | 52.24 |
| | 1.5 kg B/ha as foliar | 50.23 | 57.88 | 47.00 | 51.70 |
| Local | 0.0 kg B/ha as basal | 30.27 | 30.88 | 20.56 | 27.24 |
| | 1.0 kg B/ha as basal | 34.12 | 38.25 | 29.96 | 34.11 |
| | 2.0 kg B/ha as basal | 37.11 | 36.25 | 30.45 | 34.60 |
| | 3.0 kg B/ha as basal | 36.67 | 36.38 | 30.05 | 34.37 |
| | 0.0 kg B/ha as foliar | 29.80 | 29.88 | 21.57 | 27.08 |
| | 0.5 kg B/ha as foliar | 35.26 | 34.09 | 34.67 | 35.34 |
| | 1.0 kg B/ha as foliar | 39.90 | 36.63 | 35.11 | 37.21 |
| | 1.5 kg B/ha as foliar | 39.00 | 36.53 | 35.08 | 36.87 |
| CV (%) | | 10.4 | 6.2 | 5.1 | - |
| LSD (0.05) | | - | 3.8 | 2.51 | - |

# EFFECT OF BORON ON THE YIELD OF BARI SHARISHA-9 AT FSRD SITE, PALIMA, TANGAIL, DURING RABI 2001-2002


## Abstract

A field experiment was conducted at FSRD site Palima, Tangail during the rabi season of 2001-2002 in old Brahmaputra and Young Jamuna Floodplain soil to show the effect of boron application on yield and yield attributes of mustard. The experiment involved four boron levels viz. 0, 1, 2 and 3 kg B/ha. Applied boron had significant influence on all the studied characters except 1000-seed weight. Application of 2kg B/ha of boron gave the highest yield.


## Introduction

Mustard is the principal oilseed crop of Bangladesh but seed yield is very low compared to other mustard growing countries of the world. There is an ever-increasing demand of edible oil in the country and the local production can meet up only one third of the requirement. Increase the productivity of oilseed crops by developing new high yielding varieties with a package of production technologies is essential. The seed yield of mustard is greatly influenced by boron particularly where soil is deficient. The soil analysis revealed that the soil of Tangail area contains trace amount (0.2-0.3mg/g soil) of boron. Mehrotra *et al.*(1977) observed a seed yield increase ranging from 16 to 69% due to boron application. Thus, the present study was undertaken to examine the effect of boron application on yield and yield attributes of mustard at Tangail region.

## Materials and Methods

The experiment was conducted at Farming Systems Research and Development site Palima, Tangail during the rabi season of 2001-2002. The experimental field belongs to Sonatola Soil Series under the Agro-ecological region Old Brahmaputra and Young Jamuna Floodplain (AEZ-8). The trial consisted of four boron levels viz. 0, 1, 2 and3kgB/ha and the variety was BARI sharisha-9.The experiment was laid out in RCB design with four replications. The unit plot size was 4m x 5m. The plots were finally prepared and uniformly fertilized with 78-19-33-7 kg NPKS/ha. Elements N, P, K, S and B were applied in the form of urea, triple superphosphate, muriate of potash, gypsum and boric acid, respectively. The crop was sown on 7$^{th}$ November, 2001 and harvested on 25$^{th}$ January, 2002 at maturity. Intercultural operations such as thinning and weeding were done whenever required. Observations were made on plant population /m$^2$, number of branches / plant, number of pods / plant, number of seeds /pod, 1000-seed weight and seed yield / ha. Data were analyzed and means were compared by Duncun's New Multiple Range Test (DMRT).

## Result and Discussion

The result showed that branches, pods/plant, seeds/pod and seed yield were significantly affected by the treatments. The higher number of branches/plant showed from 3 kg B/ha but statistically at par to 2 kg B/ha. With the increase of boron dose, number of branches/plant was increased. Identical number of pods/plant was observed from boron doses 1 to 3 kg/ha. Significantly highest number of seeds/pod was obtained from boron dose 2 kg/ha. Seed weight was not influenced with the increase or decrease of boron but higher seed weight obtained from 2 kg/ha dose of boron. There was trend to increase seed yield up to 2 kg B/ha but doses 2-3 kg/ha showed similar yielder. The seed yield was much higher than without boron. Biomass yield was not significantly influenced by different doses of boron. Gross return, gross margin and benefit cost ratio showed higher from 2 kg B/ha. The above results suggest that boron should be applied along with other fertilizers in BARI Sharisha-9 for the AEZ-8 area of Tangail region. However, further investigation is needed for confirmation.

## Conclusion

Boron fertilizer may be applied at the rate of 2 kg/ha for successful Mustard cultivation. The experiment should be continued for confirmation.

## References

Mehrotra, O. N., R. D. L. Srivastava and P. H. Misra. 1977. Effect of micronutrient on the growth, yield and quality of Indian mustard. Indian J. Agric. Chem. 10: 81-86.

Table 1. Effect of boron application on seed yield and yield attributes of BARI Sharisha-9

| Boron (kg/ha) | Number. of branches/ plant | Number of pods / plant | Number of seeds / pod | 1000-seed weight (g) | Seed yield (t/ha) | Biomass yield (t/ha) |
|---|---|---|---|---|---|---|
| 0 | 4.70c | 49b | 14.c | 3.01 | 0.99c | 1.98 |
| 1 | 5.15bc | 69a | 16c | 3.85 | 1.15b | 2.16 |
| 2 | 5.8ab | 76a | 21a | 4.00 | 1.38a | 2.25 |
| 3 | 6.15a | 71a | 18bc | 3.79 | 1.19ab | 2.29 |
| CV(%) | 7.12 | 4.94 | 8.35 | 3.32 | 7.65 | 4.62 |

Table 2. Benefit Cost ratio of BARI Sharisha-9 production at FSRD site Palima, Tangail during rabi 2001-02

| Boron (kg/ha) | Gross return (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | BCR |
|---|---|---|---|---|
| 0 | 15765 | 6843 | 8922 | 1.73 |
| 1 | 18330 | 8772 | 9558 | 1.92 |
| 2 | 21825 | 11631 | 10194 | 2.14 |
| 3 | 18995 | 8165 | 10830 | 1.75 |

Cultivation cost = Tk. 7.00/dec.
Labour Cost = Tk. 50.00/day
Market price of Mustard = Tk.15.00/kg
LBiomass price of Mustard= Tk.0.50/kg

Urea= Tk. 6.00/kg
TSP= Tk. 14.00/kg
MP= Tk. 10.00/kg
Gypsum= Tk. 5.00/kg
Borax= Tk. 70.00/kg

# TESTING OF NPKS MULTI-NUTRIENT FERTILIZERS UNDER FARMER'S CONDITION


## Abstract

An experiment was conducted at Tangail, Jessore and Rangpur during the Rabi season of 1999-2000 to 2000-01 to see the performance of multinutrient fertilizers on the yield of Boro rice. Two different levels (MYG & HYG) of single and multi nutrient fertilizers along with farmers' practice and no fertilizer were studied. Results revealed that no significant yield difference of Boro rice was noticed due to application of multinutrient fertilizer irrespective of locations. Single and multinutrient fertilizers produced identical yield in a particular yield goal. Cost and return analysis also showed similar trend. However a little bit higher return was found in multi nutrient fertilizer for MYG.


## Introduction

To meet the expanding food demand for the ever-increasing population the land resources in Bangladesh are intensively used for agricultural production. Because of such high food demand soil fertility and productive capacity of lands in most cases is ignored and is not considered seriously. Consequently, fertility of the agricultural lands and productivity thereby is gradually going down. The situation is alarming for sustaining future production. Because of ignorance and efforts to minimize decreasing trend in yield most of the farmers in Bangladesh use imbalance doses of fertilizers. Use of high doses of certain element(s) without considering the others is a common practice in Bangladesh agriculture. Farmers have the tendency to use high doses of nitrogen fertilizers. Sometimes the dose is even higher than the recommended dose. Such high dose of certain element(s) might be antagonistic to the others and affect their uptake by crop plants. Use of multi-nutrient fertilizers might reduce the use of such imbalance nutrient application to a great extent. Recently, a fertilizer company NAAFCO has imported two grades of multi-nutrient fertilizers (N:P2O5:K2O:S: 10-24-17-6 for rice and 12-16-22-6-5 for wheat). It is felt that these fertilizers could benefit farmers by supplying a more balanced dose in more labour efficient manner. NAAFCO has tested these fertilizers in their own demonstrations, which were successful according to them. It was felt to test these multi-nutrient fertilizers under farmer's condition in a wider agro-ecological region. Present study was therefore conducted with the following objectives:

i. To test the utility of multi-nutrient fertilizers in terms of productivity and labour cost.
ii. To enhance balance application of fertilizer nutrients.

## Materials and Methods

The experiment was conducted at 3 locations during 1999-2000 and eight different location across the Bangladesh during 2000-01. The following treatments were studied:

$T_1$ = Absolute control (0-0-0-0-)
$T_2$ = Farmers practice
$T_3$ = Multinutrient fertilizer for MYG (100-20-30-10)
$T_4$ = Multinutrient fertilizer for HYG (140-28-42-14)
$T_5$ = Single fertilizer for MYG (100-20-30-10)
$T_6$ = Single fertilizer for HYG (140-28-42-14)

Multi-nutrient and equivalent amount of single fertilizers was applied as basal. In addition N was top dressed twice. Boro rice was used as the test crop. Irrigation and other intercultural operations were done as and when necessary. At harvesting data on yield and yield components of rice were recorded and analyzed statistically. Different crop management practices of different locations are given in appendix-I.

## Results and Discussion

### Performance of Boro rice at different locations

**Location : Tangail**
**Year : 1999-2000 to 2000-01**

A significant difference was found in case of grain and straw yield of Boro rice due to different fertilizers. During 2000, the highest grain yield (6.150t/ha) was recorded from Multi-nutrient fertilizer for HYG ($T_4$) which was also identical to Multi-nutrient fertilizer for MYG ($T_3$), single fertilizer for HYG ($T_6$) and farmers' practice ($T_2$). But in 2001, no significant yield difference was found among the treatments except no fertilizer treatment ($T_1$). Regarding straw yield, no significant difference was observed except with farmers' practice and no fertilizer.

Cost and return analysis showed that the highest gross margin as well as MBCR was obtained from Multi-nutrient fertilizer for MYG ($T_3$).

From two years of study it revealed that there was no significant yield difference between multi nutrient and single fertilizers. However, yield (4%) and economic return is little bit higher in multinutrient fertilizer compared to single fertilizer.

Table1. Effect of multi-nutrients on yield and economics of Boro rice at Palima, Tangail, 2000 to 2001

| Treatment | Grain yield (t/ha) | | Straw yield (t/ha) | | Two years average | | | MBCR |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | G R (Tk/ha) | TVC (Tk/ha) | GM (Tk/ha) | |
| $T_1$ | 4.90c | 5.06b | 5.80c | 6.60c | 33593 | 19098 | 14495 | - |
| $T_2$ | 5.70ab | 6.80a | 6.10bc | 8.00b | 41738 | 21727 | 20011 | 3.10 |
| $T_3$ | 5.90ab | 7.50a | 6.45ab | 9.00a | 44800 | 22656 | 22144 | 3.15 |
| $T_4$ | 6.15a | 7.20a | 6.64a | 8.40ab | 44579 | 24050 | 20529 | 2.22 |
| $T_5$ | 5.65b | 6.95a | 6.70a | 8.30ab | 42257 | 22656 | 19601 | 2.44 |
| $T_6$ | 5.85ab | 7.10a | 6.70a | 8.40ab | 43357 | 24050 | 19307 | 1.97 |

Means followed by a common letter is not significantly different at 5% level of significance by DMRT test.

Market price: Grain @Tk.6.25, Straw @ Tk.0.50

**Location : Jessore**
**Year : 1999-2000 to 2000-01**

Multi nutrient fertilizers failed to show superior performance over single fertilizer in respect of yield. The highest grain yield was recorded from farmers' practice which was identical to single fertilizer for HYG. Single fertilizer and multnutrient fertilizer produced identical yield at each yield goal level. Regarding straw yield, more or less similar trend was observed.

Cost and return analysis showed that the highest gross margin was recorded from farmers' practice and the highest MBCR was calculated from Multi-nutrient fertilizer for MYG ($T_3$).

Table 2. Effect of multi-nutrients on yield and economics of Boro rice at Bagherpara, Jessore, 2000 -01

| Treatment | Grain yield (t/ha) | Straw yield (t/ha) | Two years average | | | MBCR |
|---|---|---|---|---|---|---|
| | | | G R (Tk/ha) | TVC (Tk/ha) | GM (Tk/ha) | |
| $T_1$ | 2.35d | 2.92c | 20735 | 0 | 20735 | - |
| $T_2$ | 6.10a | 6.11a | 44330 | 3860 | 40470 | 6.11 |
| $T_3$ | 5.03c | 5.54ab | 39325 | 2525 | 36800 | 7.36 |
| $T_4$ | 5.53b | 5.72ab | 42340 | 3395 | 38945 | 6.36 |
| $T_5$ | 4.70c | 5.12b | 36790 | 2525 | 34265 | 6.36 |
| $T_6$ | 5.82ab | 5.94a | 42965 | 3395 | 39570 | 6.55 |

**Location : Rangpur**
**Year : 1999-2000 to 2000-01**

The experiment was conducted at Syedpur FSRD site and Nilphamari MLT site of Rangpur. Results of two years experimentation revealed that no significant difference on the yield of Boro rice was found between single fertilizer and multinutrient fertilizers. Identical yield was obtained from single and multinutrient fertilizers for a particular yield goal. However, a significant difference was found between two yield goals (HYG & MYG) and higher yield was obtained from HYG. Similar result was found over the locations and years. For straw yield the trend was almost same.

From cost and return analysis it was found that higher gross margin as well as BCR was obtained from Multinutrient fertilizer for HYG (T4) and single fertilizer for HYG (T6). But the MBCR was higher in single fertilizer compared to multinutrient fertilizer. The trend was same in both the locations-Syedpur and Nilphamari.

Table 3. Effect of NPKS multi-nutrient fertilizer on the yield of Boro rice at Syedpur FSRD and Nilphamari MLT sites, Rangpur during 1999-2000 and 2000-2001

| Treatment | Syedpur FSRD Site | | | *Nilphamari MLT site* | | |
|---|---|---|---|---|---|---|
| | 1999-00 | 2000-01 | Mean | 1999-00 | 2000-01 | Mean |
| | | | Grain yield (t/ha) | | | |
| $T_1$ | 2.14c | 2.04c | 2.09 | 2.01c | 2.28c | 2.15 |
| $T_2$ | 6.15b | 6.23b | 6.19 | 5.80b | 5.90b | 5.85 |
| $T_3$ | 5.96b | 6.02b | 5.99 | 5.88b | 5.94b | 5.91 |
| $T_4$ | 7.40a | 7.52a | 7.46 | 7.11a | 7.38a | 7.25 |
| T5 | 5.89b | 5.84b | 5.87 | 5.90b | 5.82b | 5.86 |
| $T_6$ | 7.26a | 7.39a | 7.33 | 6.99a | 7.16a | 7.08 |
| CV(%) | 7.20 | 7.1 | - | 9.20 | 7.4 | - |
| | | | Straw yield | | | |
| $T_1$ | 3.22c | 3.11c | 3.17 | 2.94c | 3.08c | 3.01 |
| $T_2$ | 7.34b | 8.80a | 8.07 | 6.78b | 7.15b | 6.97 |
| $T_3$ | 7.12b | 7.26b | 7.19 | 6.74b | 7.0b | 6.92 |
| $T_4$ | 8.61a | 8.70a | 8.66 | 7.72a | 8.46a | 8.09 |
| T5 | 7.22b | 7.32b | 7.27 | 6.80b | 7.05b | 6.93 |
| $T_6$ | 8.67a | 8.68a | 8.68 | 8.01a | 8.31a | 8.16 |
| CV(%) | 8.50 | 7.8 | - | 8.10 | 8.5 | - |

Mean followed by the common letter(s) are not significantly different at the 5% level by DMRT.

Table 4. Cost and return of NPKS multi-nutrient fertilizer at FSRD site Syedpur and Nilphamari MLT site, Rangpur during 1999-2000 & 2000-01

| Treatment | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR | MBCR (over control) |
|---|---|---|---|---|---|
| | | Syedpur FSRD site | | | |
| $T_1$ | 17498 | 12095 | 5403 | 1.45 | - |
| $T_2$ | 52709 | 17556 | 35153 | 3.00 | 6.45 |
| $T_3$ | 51515 | 16282 | 35233 | 3.16 | 8.12 |
| $T_4$ | 64008 | 17950 | 46058 | 3.57 | 7.94 |
| $T_5$ | 50555 | 15990 | 34565 | 3.16 | 8.49 |
| $T_6$ | 62938 | 17266 | 45672 | 3.65 | 8.79 |

Table 4. Contd.

| Treatment | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | BCR | MBCR (over control) |
|---|---|---|---|---|---|
| Nilphamari MLT site | | | | | |
| $T_1$ | 18665 | 12162 | 6502 | 1.53 | - |
| $T_2$ | 50283 | 17701 | 32582 | 2.84 | 5.71 |
| $T_3$ | 50740 | 16480 | 34260 | 3.08 | 7.43 |
| $T_4$ | 62005 | 18149 | 43857 | 3.42 | 7.24 |
| $T_5$ | 50343 | 15989 | 34354 | 3.15 | 8.28 |
| $T_6$ | 60680 | 17265 | 43416 | 3.51 | 8.24 |

**Price (Tk/kg):**

| Year | Urea | TSP | MP | Gypsum | Zinc Sulphate | CD | MN | Rice seed | Rice grain | Rice straw |
|---|---|---|---|---|---|---|---|---|---|---|
| 1999-00 | 5.60 | 12.40 | 8.40 | 3.00 | 35.00 | 0.25 | 13.00 | 12.00 | 8.00 | 0.50 |
| 2000-01 | 5.70 | 13.14 | 8.70 | 2.75 | 35.00 | 0.25 | 13.00 | 14.50 | 8.00 | 0.50 |

CD= Cow dung, MN= Multi-nutrient

Appendix table 1. Crop management practices

| Site | Crop | Variety | Seed rate (kg/ha) | Planting time | Harvesting time |
|---|---|---|---|---|---|
| Bagherpara | Boro | LIV | 40 | Last week of Jan. | 1st week of May |
| Palima | Boro | BRRI Dhan 29 | 40 | 1st week of Feb | 3rd week of May |
| Syedpur | Boro | BRRI Dhan 29 | 40<br>40 | Last week of Jan. | 1st week of May |
| Nilphamari | Boro | BRRI Dhan 29 | 40 | Last week of Jan. | 1st week of May |

# RESPONSE OF BUSHBEAN TO DIFFERENT NITROGEN FERTILIZER LEVELS


## Abstract

An experiment was conducted at ARS, OFRD, BARI, Rangpur during rabi seasons of 2000-01 and 2001-02 to find out optimum and economic dose of N for bushbean (cv. BARI Bushbean-1) cultivation. N levels did not influence most of the plant characters. Highest number of pods and pod weight per plant, and highest yield were obtained from 120 kg N/ha. The optimum dose of N found from response curve was 104 kg $ha^{-1}$. Economic analysis revealed that bushbean can be grown economically using 30-120 kg N $ha^{-1}$.


## Introduction

Bushbean, a newly introduced vegetable, could be grown in Bangladesh in winter season. BARI has released a variety of bushbean namely BARI Bushbean-1. As a new crop, it needs a fertilizer recommendation for its production and extension. Bushbean is a leguminous crop. Initially N, P and K were recommended at the rate of other bean like leguminous crops, but the dose of N became controversial. Leguminous crops may need some amount of N as a starter dose, but for the frequent harvesting of edible pods as vegetable may need more N. It appears to be important to develop fertilizer N recommendation for bushbean production. Therefore, an experiment was conducted to find out optimum and economic dose of N for bushbean.

## Materials and Methods

The experiment was conducted at the ARS, OFRD, BARI, Rangpur during rabi seasons of 2000-01 and 2001-02. Bushbean (cv. BARI Bushbean -1) was grown with 6 levels of N fertilizer viz., 0, 30, 60, 90, 120 and 150 kg $ha^{-1}$. A blanket dose of P-K-S-Zn-B-CD was applied at the rate of 33-75-20-4-1-10,000 kg $ha^{-1}$. Half of N and K, and total amount of other fertilizers were used as basal application. Rest of the N and K was applied in two equal splits as top dressing at 23 and 40 days after sowing (DAS) in 2000-01 and 25 and 41 DAS in 2001-02. Seeds were sown at a spacing of 40 × 15 cm on 11 Dec., 2000 and 27 Nov., 2001. The experiment was laid out in a RCB design with 4 replicates. Plot size was 4.8 × 3.9 m. Ten plants were selected for measuring different plant characters and yield contributing characters *viz*., plant height, days to 50% flowering, pod length, pod width, number of pods and weight of pods per plant. An area of 9.36 $m^2$ was selected for edible pod yield. All the data obtained were analyzed statistically.

## Results and Discussion

Number of pod/plant, weight of pods/plant and pod yields were significantly influenced by N levels but other characters were statistically at par (Table 1). The pods/plant increased with the increase of N level up to 120 kg/ha and the declined in both the years. Similar trend was followed in case of weight of pods/plant. The higher pod yield was obtained from 120 kg N/ha in both the years but significantly similar to 60 and 90 kg/ha. Pod yield was gradually increased with the increase of N level up to 120 kg/ha and then declined.

Highest gross return was obtained from 120 kg N/ha but this treatment also involved higher cost of cultivation. Similar benefit was obtained from 90 and 120 kg N/ha but from economic point view 90 kg N/ha is suitable dose for bushbean cultivation but reasonable yield and benefit can be obtained from 30 kg N/ha at Rangpur region.

*SFM*

Table 1. Effect of N level on plant characters of bush bean at ARS, OFRD, BARI, Rangpur during rabi seasons of 2000-01 and 2001-02

| N level (kg ha$^{-1}$) | Plant height (cm) | | Days to 50% flowering | | Pod length (cm) | | Pod width (cm) | |
|---|---|---|---|---|---|---|---|---|
| | 00-01 | 01-02 | 00-01 | 01-02 | 00-01 | 01-02 | 00-01 | 01-02 |
| 0 | 28.7 | 34.6 | 55.0 | 42.0 | 13.2 | 11.1 | 0.93 | 0.87 |
| 30 | 29.4 | 33.7 | 53.8 | 41.3 | 12.8 | 12.3 | 0.91 | 0.87 |
| 60 | 30.7 | 32.9 | 53.3 | 41.3 | 13.4 | 11.6 | 0.91 | 0.87 |
| 90 | 28.9 | 32.6 | 54.0 | 41.3 | 13.7 | 12.5 | 0.95 | 0.87 |
| 120 | 28.2 | 34.0 | 54.5 | 41.5 | 13.6 | 12.4 | 0.92 | 0.86 |
| 150 | 29.5 | 32.6 | 54.8 | 41.3 | 13.7 | 11.2 | 0.95 | 0.87 |
| $LSD_{0.05}$ | ns | ns | 0.85 | ns | ns | ns | ns | ns |
| CV (%) | 6.15 | 5.76 | 1.04 | 1.22 | 5.56 | 7.96 | 5.12 | 8.77 |

Table 2. Effect of N level on yield and yield attributes of bush bean at ARS, OFRD, BARI, Rangpur during rabi seasons of 2000-01 and 2001-02

| N level (kg ha$^{-1}$) | Plant population (×1000 ha$^{-1}$) | | Number of pods plant$^{-1}$ | | Wt. of pods plant$^{-1}$ (g) | | Pod yield (t ha$^{-1}$) | |
|---|---|---|---|---|---|---|---|---|
| | 00-01 | 01-02 | 00-01 | 01-02 | 00-01 | 01-02 | 00-01 | 01-02 |
| 0 | 138.6 | 162.1 | 9.3 | 13.7 | 52.3 | 66.0 | 4.7 | 7.0 |
| 30 | 145.0 | 158.1 | 9.9 | 17.0 | 69.4 | 97.5 | 8.4 | 11.4 |
| 60 | 143.2 | 157.1 | 10.9 | 18.4 | 77.8 | 101.0 | 9.3 | 12.0 |
| 90 | 142.9 | 157.1 | 11.5 | 19.6 | 83.0 | 106.5 | 9.6 | 12.9 |
| 120 | 140.2 | 156.8 | 12.3 | 20.0 | 87.0 | 114.8 | 10.3 | 13.5 |
| 150 | 145.3 | 156.5 | 11.3 | 18.7 | 83.3 | 105.0 | 9.4 | 13.1 |
| $LSD_{0.05}$ | ns | ns | 1.34 | 2.22 | 10.3 | 17.1 | 1.16 | 2.24 |
| CV (%) | 5.40 | 2.19 | 8.22 | 8.24 | 9.09 | 11.5 | 8.91 | 12.8 |

Table 3. Partial budget analysis of bushbean grown with N levels at ARS, OFRD, BARI, Rangpur during rabi, 2000-2001 and 2001-2002

| N level (kg ha$^{-1}$) | Variable cost* (Tk. ha$^{-1}$) | | Gross return (Tk. ha$^{-1}$) | | MRR (%) | |
|---|---|---|---|---|---|---|
| | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 |
| 0 | 0 | 0 | 23,550 | 34,800 | - | - |
| 30 | 442 | 461 | 42,200 | 56,800 | 4,119 | 467 |
| 60 | 814 | 852 | 46,700 | 59,750 | 1,110 | 654 |
| 90 | 1,186 | 1,243 | 48,300 | 64,350 | 330 | 1,076 |
| 120 | 1,557 | 1,635 | 51,650 | 67,600 | 801 | 731 |
| 150 | 1,949 | 2,026 | 46,800 | 65,350 | -1,409 | -675 |

*Variable cost = Price of N + cost of N application

**Price of input and output (Tk./kg):** Bushbean: 5.00, Urea: 5.70 (2000-01) Urea: 6.00 (2001-02).

# EFFECT OF LIMING ON WHEAT-DHAINCHA (GM)-T.AMAN RICE CROPPING PATTERN IN A PROBLEM SOIL UNDER AGRO-ECOLOGICAL ZONE-3


## Abstract

Effect of liming on the performance of the cropping pattern Wheat - Dhaincha (GM)-T.Aman was studied at the ARS, OFRD, BARI, Rangpur for three successive years from 1998-99 to 2001-2002. The pH of the study area was 4.6. Lime was added only once at the rate of 0, 1, 2 and 3 t/ha before the first crop wheat. Liming significantly influenced the yields of wheat and Dhaincha of the pattern up to the third year (cycle). Yields were increased with the increase in amount of lime. Wheat yield of fourth cycle indicated that 1 t/ha lime to be added after every 3 years.


## Introduction

The highland and medium highland area of the agro-ecological zone-3 (AEZ#3 i.e., Tista Meander Flood Plain) are suitable for year round crop production with adequate drainage facilities. The soils are generally loamy, rapidly permeable in the upper part of the ridges and slowly permeable silt loam in the lower part of the ridges and basins. The organic matter content in the upper ridges is generally below 1.0%. Moderate to widespread sulfur, zinc and boron deficiencies due to continuous cropping with HYV cereals (mainly in the irrigated areas) are important constraints to crop production. The soils have generally moderate to low pH. Block No. 14 of Agricultural Research Station, OFRD, BARI, Rangpur has low pH ranging from 4.3 to 5.2. Production of wheat was severely affected in the said plot during Rabi, 1997-98 due to uneven stand and growth of the plants. The lower pH might be responsible for the hindrance of uptake of some nutrients specially P, K and S. It has been reported in many books and journals that liming increases the pH of a particular soil and creates congenial atmosphere for the uptake of nutrients by the plants. The 2 years experiments, conducted at Wheat Research Centre, Nashipur, Dinajpur, indicated that the application of 2 t lime/ha enhanced the wheat yield to a desired level. With those things in mind the present study was initiated.

## Materials and Methods

The study in its third year was initiated at the Agricultural Research Station, OFRD, BARI, Rangpur during 1998-2002.

The pH of the soil ranged from 4.38 to 4.66 over the field prior to liming with the mean of 4.57. Lime at the rate of 0, 1, 2 and 3 t/ha were applied about 25 days before the final land preparation for wheat and well mixed with the soil. The field was irrigated also to ensure uniform distribution of lime within the respective limed plots. The experiment was laid out in a RCB design with 5 replications. The unit plot size was 12.8 × 7.0 m. The wheat plots was fertilized with 100-26-33-20-4-1 kg N, P, K, S, Zn and B, respectively. In wheat two-third of N and all other fertilizers were applied as basal at the time of final land preparation. The rest of N was applied at crown root initiation (CRI) stage followed by irrigation. Three more irrigations were given at 5, 8 and 11 weeks after seeding. The crop was harvested during last seek of March in all the 4 years.

Initial status of soil of the experimental plot prior to liming at ARS, OFRD, BARI, Rangpur

| pH | OM (%) | AA | Ca | Mg | K | N | P | S | B | Cu | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (ml q/100g soil | | | (%) | ($\mu$g /g soil) | | | | | | |
| 4.57 | 2.41 | 1.46 | 3.65 | 0.07 | 0.12 | 0.13 | 123.5 | 18.74 | 0.44 | 1.6 | 110.7 | 4.17 | 1.5 |
| L | Med | | Med | VL | L | L | VH | Med | Med | VH | VH | VH | Opt |

The Dhaincha was sown during last week of April to 2nd week of May. At the time of final land preparation 22 kg P/ha was added to the soil prior to the seeding and biomass was mixed with the soil. The T.aman rice crop was fertilized by 75-0-33-20-2 kg N-P-K-S-Zn/ha. Three weeks old seedlings of BR-11 were transplanted during the month of July. The crop was harvested during the month of

November, after it attained maturity. Data on the yield and yield attributes were recorded and analyzed statistically.

## Results and Discussion

The grain yield of wheat increased with the increase of lime dose in 1998-99 but lime dose 2 & 3 t/ha was identical in yield in 1999-2000. In 2000-01, grain yield was at par to 1 to 3 t/ha lime. Similar trend was followed in 2001-02 (Table 1). Grain yield was increased with the increase in amount of lime. It means that large amount of lime helped in increasing the soil pH to neutrality for higher yield. The Dhaincha (biomass) and T.aman rice yields were present in Table 2. Significantly highest biomass was obtained in 1999-2000 but lime dose 1, 2 & 3 t/ha showed identical grain yield in 1998-99. Similar trend of T.Aman rice was followed in 2000-01.

Grain yield of T.Aman rice was not significant in 1998-99 and 2000-01 but significant difference in yield was found in 1999-2000 where lime dose 2 & 3 t/ha was statistically identical. In second year, rice yield was affected by drought at flower initiation stage. Total cereal grains in all the three years showed that 2 and 3 t/ha lime were statistically identical but higher than control. The total cereal yield of the pattern sustained during 3 years irrespective of lime levels. The sustained yield reflected the residual effect of different levels to liming.

### Changes in pH

The pH value of the soil ranged from 4.38 to 4.66 over the field prior to liming with the mean value of 4.57. After liming the pH were recorded again at 17 (after wheat seeding), 95 (before wheat heading) and 140 (after wheat harvesting) days. The soil pH data following liming have been presented in Table 3. It is evident from the table that pH value of the soils marked a steady rise over time with the treatment plots including control. However, the increments were found to be higher with the increased lime dosage. At 140 days after liming (DAL)significantly highest pH value of 6.14 was recorded in the plots which received 3 t lime/ha. The lowest pH value (4.82) was recorded with the control plot at 140 DAL.

### Economics

The economic analyses of the three complete cycles of the cropping pattern have been presented in Table 4. It is revealed from the table that highest gross margin was obtained with the application of 1 t lime/ha when considered three years cycles. The highest BCR was recorded with 1 t lime/ha and it declined with increased lime dosage. This is due to the fact that the cost of ordinary lime is high and the investment progressively increases with higher lime dose. The MBCR was also found higher with the treatment 1 t lime/ha which was fairly remunerative. However, so long as the crops of the pattern respond to lime dosage the investment will become more remunerative.

## Conclusion

The results of Wheat-Dhaincha (GM)-T.Aman rice cropping pattern indicated that the addition of lime significantly influenced the yield of the crops of the pattern. After every three years of experimentation it may conducted that 1 t/ha lime is needed for higher yield and benefit. The economic analysis of the pattern indicated that longer the response of crops continues the investment due to liming would be remunerative. The trial should be continued.

Table 1. Effect of liming on the yield of wheat under the cropping pattern Wheat - Dhaincha (GM) - T.Aman rice at ARS, OFRD, BARI, Rangpur for 4 years (Avg. of 1998-99 to 2001-02)

| Lime dose (t/ha) | Grain yield (t/ha) | | | |
|---|---|---|---|---|
| | 1998-99 | 1999-00 | 2000-01 | 2001-02 |
| 0 | 1.65c | 2.79c | 2.67b | 2.69b |
| 1 | 1.82c | 3.35b | 3.00a | 2.90ab |
| 2 | 2.31b | 3.52ab | 3.05a | 3.09a |
| 3 | 2.63a | 3.85a | 3.13a | 3.16a |
| CV (%) | 6.2 | 9.3 | - | 6.96 |

Table 2. Effect of liming on the yields of Dhaincha and T.Aman rice (Avg. of 1998-99 to 2000-01)

| Lime dose (t/ha) | Dhaincha biomass (t/ha) | | | T.Aman (t/ha) | | | Total cereal yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 98-99 | 99-00 | 00-01 | 98-99 | 99-00 | 00-01 | 98-99 | 99-00 | 00-01 |
| 0 | 20.4b | 16.4b | 24.5b | 4.18 | 3.17c | 4.22 | 5.83c | 5.96c | 6.89c |
| 1 | 26.3a | 16.2b | 27.0ab | 5.09 | 3.83b | 4.47 | 6.91b | 7.18b | 7.47b |
| 2 | 28.1a | 17.6b | 29.7a | 4.88 | 4.33a | 4.55 | 7.19a | 7.85a | 7.60ab |
| 3 | 28.1a | 21.2a | 29.4a | 4.71 | 4.27a | 4.70 | 7.34a | 8.12a | 7.83a |
| CV (%) | | | 9.45 | 18.5 | | 5.96 | | | 4.72 |

Table 3. Effect of liming on soil pH at ARS, OFRD, Rangpur during 1998-99

| Lime dose (t/ha) | pH before liming | pH before liming | | |
|---|---|---|---|---|
| | | 17 DAL* (after wheat seeding) | 95 DAL (before wheat heading) | 140 DAL (after wheat harvest) |
| 0 t/ha | 4.38 | 4.62 | 4.88 b | 4.82c |
| 1 t/ha | 4.66 | 4.56 | 5.00 b | 5.20bc |
| 2 t/ha | 4.56 | 4.50 | 5.24 b | 5.46b |
| 3 t/ha | 4.46 | 4.54 | 5.86 a | 6.14a |
| Mean | 4.57 | - | - | - |

* DAL = Days after liming.

Table 4. Economics of liming on the cropping pattern Wheat-Dhaincha (GM)-T.Aman of rice (Avg. of 1998-99 to 2000-01)

| Lime dose (t/ha) | Gross return (Tk./ha) | TVC (Tk./ha) | Gross margin (Tk./ha) | BCR | MBCR |
|---|---|---|---|---|---|
| 0 | 147,200 | 83,988 | 63,212 | 1.75 | - |
| 1 | 169,895 | 88,888 | 88,007 | 1.91 | 4.63 |
| 2 | 178,205 | 93,878 | 84,327 | 1.89 | 1.67 |
| 3 | 183,380 | 98,688 | 84,692 | 1.86 | 1.08 |

Price of output (Tk./kg):

| Item | 1998-99 | 1999-00 | 2000-01 |
|---|---|---|---|
| Wheat | 7.50 | 7.50 | 8.00 |
| Wheat Straw | 0.50 | 0.50 | 0.50 |
| Rice | 8.00 | 8.00 | 8.00 |
| Rice straw | 0.50 | 0.50 | 0.50 |

Price of input (Tk./kg):

| Item | 1998-99 | 1999-00 | 2000-01 |
|---|---|---|---|
| Urea | 5.50 | 5.50 | 5.70 |
| TSP | 13.00 | 13.00 | 13.40 |
| MP | 9.50 | 9.50 | 8.70 |
| Gypsum | 3.00 | 3.00 | 2.75 |
| Zinc sulphate | 60.00 | 60.00 | 35.00 |
| Borax | 35.00 | 35.00 | 35.00 |
| Lime | 4.90 | 4.90 | 4.90 |

# ON-FARM ADAPTABILITY TRIAL OF SOME PROMISING RAPE MUSTARD VARIETIES/LINES


## Abstract

The experiment was conducted in medium high land at FSRD site of BARI, Palima Tangail, Ishan Gopalpur, Faridpur, Golapgonj, Sylhet, MLT site Bagherpara, Chowgacha & Keshobpur, Jessore and Bogra during rabi 2001-02 to evaluate the performance of some promising variety/lines of rape mustard seeds under farmer's field condition. From the above result it showed that BARI Sharisha-10 and Jamalpur-1 at Tangail, BARI Sharisha-7 and SS-75 at Faridpur, BARI Sharisha-6 at Sylhet, BARI Sharisha-8 at Chowgacha, BARI Sharisha-7 at Bagherpara, TS-72 at Keshobpur, BARI Sharisha-8 or SS-75 or BARI Sharisha-7 at Kushtia and Jamalpur-1 or Ishurdi local at Bogra is found suitable for mustard but this need further trial for confirmation.


## 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% 0f 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 new line/variety under farmer's field condition.

## Materials and Methods

The trial was conducted at FSRD site, Palima, Tangail, Ishan Gopalpur, Faridpur, Golapgonj, Sylhet, MLT site, Bagherpara, Chowgacha, Keshobpur, Jessore, Kushtia and Bogra during rabi 2001-2002 in farmer's field. The design of the experiment was RCBD with three replications. Tested cultivars were BARI sharisha-6, BARI sharisha-7, BARI sharisha-8, BARI sharisha-9 BARI sharisha-10, Jamalpur-1, Ishurdi local, Rai-5, PT-303, TS-72, SS-75, Daulat and Tori-7. Plot size was 6 m×4 m. Seeds were sown on 11 Nov., 5 Nov., 7 Nov., 17 Nov. & 5 Nov. at Faridpur, Sylhet, Jessore (3 sites) and Kushtia, respectively with a spacing of 30 cm × 6 cm. Fertilizer doses were 120-80-60-40-4-2 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 was done on18 DAS. The crops were harvested variety wise during January 26 to Febuary12, 29 Jan. to 12 Feb., 25 March at Tangail, Faridpur and Sylhet. 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 Discussion

### Site: Palima, Tangail

Growth duration, plant/m$^2$, plant height, yield and yield attributes were significantly influenced by different variety/line. The result showed that short duration variety identified was Tori-7, PT-303, TS-72, BARI Sharisha-9, medium duration was BARI Sharisha-6 and BARI Sharisha-8 and rest were BARI Sharisha-10, BARI Sharisha-7, SS-75, Jamalpur-1, Ishurdi local, Rai-5 and Daulat, respectively. Significantly highest plant height was observed from variety BARI Sharisha-10 whereas shorter height was shown in variety Tori-7 and TS-72.The variety Tori-7 and TS-72 showed highest number of branch/plant. Number of pod/plant revealed higher from variety Ishurdi local that was statistically identical to Jamalpur-1.The variety TS-72 showed highest number of seeds/pod, which was significantly different from other variety/line. BARI Sharisha-8, BARI Sharisha-7 and SS-75 showed similar grain weight and bolder in size than the other variety. Among the varieties, BARI Sharisha-10, BARI Sharisha-8, BARI Sharisha-9, Jamalpur-1, Ishurdi local, Rai-5, Tori-7, TS-72, PT-303 revealed statistically similar grain yield but former two varieties showed more yield than other showed similar and variety. The existing variety (Tori-7) showed similar and reasonable grain yield and took less time than the other variety.

**Site: Ishan Gopalpur, Faridpur**

Plants/$m^2$, siliqua/plant, seeds/pod, 1000-seed wt. and seed yields were significantly influenced by different groups of mustard (Table 2). Among the duration shortest duration from variety PT-303, BARI Sharisha-9, TS-72 which was similar to Tori-7. Higher siliqua/plant was obtained from TS-72 which was at par to BARI Sharisha-9, BARI Sharisha-10, Rai-5, Daulat, Jamalpur-1, ISD Local. The lowest siliqua was recorded from BARI Sharisha-8 which was statistically identical to BARI Sharisha-7 and BARI Sharisha-6. Significantly highest seeds/pod was obtained from TS-75. Higher seed weight revealed from TS-72 which was statistically identical to BARI Sharisha-6. The variety BARI Sharisha-7, SS-75, BARI Sharisha-8 and BARI Sharisha-6 were statistically identical in respect of seed yield and higher than other varieties and took longer duration (94-100 days). Among the short duration, TS-72 followed BARI Sharisha-9 showed higher yield.

**Site: Golapgonj, Sylhet**

Plant height, days to maturity, yield attributes, and seed weights were significantly influenced by different varieties. Highest plant height was recorded from Jamalpur-1 which was followed by Rai-5, Daulat and BARI Sharisha-6 and lowest plant height from Tori-7. More branches/plant was recorded from Jamalpur-1 followed from Daulat and BARI Sharisha-6. Highest siliqua/plant was obtained from Ishurdi local followed by Jamalpur-1, BARI Sharisha-9 and BARI Sharisha-7. Significantly highest seeds/siliqua was recorded from SS-75. BARI Sharisha-6, SS-75 and Jamalpur-1 revealed higher seed weight. Significantly highest seed yield (1725 kg/ha) was obtained from BARI Sharisha-6 which mature 94 days. Though Tori-7 much earlier (821 days) but yield was much less than BARI Sharisha-6.

**Site: MLT site Chowgacha, Jessore**

Plant height, days to maturity, plants/$m^2$, yield attributes and yields were significantly influenced by variety (Table 4). Highest plant from Rai-5 followed by Daulat, ISD local, Jamalpur and shortest from BARI-7 followed by PT-303. Similar trend was followed in case of days to maturity. Highest branches/plant was recorded from BARI Sharisha-7. Pods/plant showed highest from Daulat which was at par to Rai-5, BARI Sharisha-10 and Jamalpur-1. But highest seeds/pod was recorded from BARI Sharisha-8 followed by BARI Sharisha-6. Significantly highest from yield was recorded from BARI Sharisha-8 which took 94 days.

**Site: FSRD Site, Bagherpara, Jessore**

Different variety showed significant influenced by plant height, days to maturity, plants/$m^2$, yield attributes and yield (Table 5). Highest plant height from Rai-5 followed by Daulat ISD local and shortest from BARI Sharisha-7. Longer duration took from recently improved variety and shortest duration from BARI Sharisha-7. The variety Daulat showed highest pods/plant and lowest from BARI Sharisha-8. Significantly highest seeds/pod was recorded from BARI Sharisha-6. Seed yield was comparatively lower than other site. The variety BARI Sharisha- revealed higher yield (1.05 t/ha) followed by BARI Sharisha-9 and SS-75. These three varieties took 94 days to mature.

**Site: MLT site, Keshobpur, Jessore**

All the characters were significantly influenced by different group of varieties. Plant height was much higher than all other site. Highest plant height was recorded from Rai-5 followed Daulat and ISD local and shortest from BARI Sharisha-8. Significantly highest seeds/siliqua was obtained from variety SS-75 which showed lowest siliqua/plant. Average seed yield was much lower than other site due to lower no. of seeds/siliqua. Among the varieties higher seed yield was obtained from TS-72 followed by BARI Sharisha-6, BARI Sharisha-9, Rai-5 and BARI Sharisha-8. It is interesting to note that TS-72 took lowest time to maturity with higher yield.

**Site: MLT site, Kushtia**

All the characters were significantly influenced by different variety except days to maturity (Table 7). Highest plant height from Jamalpur-1 followed by Rai-5 and Daulat whereas shortest from Tori-7. Higher siliqua/plant was recorded from Rai-5 closely followed by Jamalpur-1, Daulat. But BARI Sharisha-8 showed higher seed/siliqua closely followed by SS-75. Highest seed yield was obtained from BARI Sharisha-8, which was statistically identical to BARI Sharisha-2 and SS-75. These three varieties took same days to mature.

**Site: ARS, Bogra**

All the characters were significantly affected by different varieties (Table 8). The variety Jamalpur-1 showed significantly highest plant height and lowest from TS-72 followed by Tori-7. Significantly highest pods/plant was recorded from BARI Sharisha-1. But seeds/pod showed from SS-75 which was significantly different from other variety. Similarly highest seed weight was recorded from SS-75. All the yield contributing character higher from SS-75 but failed to show higher yield than Jamalpur-1 followed by Ishurdi local. Significantly highest straw yield was obtained from BARI Sharisha-6.

## Conclusion

From the above result it showed that BARI Sharisha-10 and Jamalpur-1 at Tangail, BARI Sharisha-7 and SS-75 at Faridpur, BARI Sharisha-6 at Sylhet, BARI Sharisha-8 at Chowgacha, BARI Sharisha-7 at Bagherpara, TS-72 at Keshobpur, BARI Sharisha-8 or SS-75 or BARI Sharisha-7 at Kushtia and Jamalpur-1 or Ishurdi local at Bogra is found suitable for mustard but this need further trial for confirmation.

Table 1. Duration, plant/m$^2$, plant height**,** yield and yield contributing characters of some promising rape mustard varieties/lines (FSRD site, Palima, Tangail during rabi 2001- 2002)

| Variety /Line | Duration (days) | Plant pop$^n$/ m$^2$ | Plant ht.(cm) | No. of branch/ plant. | No. of pod/pt. | No. of seeds/ pod | 1000-grain wt.(g) | Grain yield (t/ha) | Biomass (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | | | |
| Tori-7 | 73e | 59abc | 118.0f | 6.20a | 126ef | 14.73f | 2.55ef | 1.42ab | 3.3de |
| BARI Sharisha-6 | 83c | 59abc | 144.5d | 2.40h | 110g | 10.40i | 2.83de | 1.007d | 4.2bcd |
| BARI Sharisha -9 | 76d | 56bc | 129.9e | 5.67b | 130de | 14.80f | 3.00bcd | 1.48ab | 3.5cde |
| PT-303 | 74e | 56bc | 128.5e | 4.80c | 137cd | 15.80e | 3.02bcd | 1.36abc | 2.5e |
| TS-72 | 74e | 56c | 120.8f | 6.0a | 143bc | 30.40a | 3.00bcd | 1.42ab | 3.2de |
| SS-75 | 86b | 61a | 158.5c | 2.13h | 78h | 29.40b | 3.22abc | 0.97d | 4.2bcd |
| ***Brassica juncia* L.** | | | | | | | | | |
| BARI Sharisha-10 | 88a | 59abc | 194.8a | 2.80g | 127def | 11.00h | 2.87cde | 1.69a | 4.8abc |
| Ishurdi local | 88a | 60ab | 172.8b | 3.60e | 156a | 8.93k | 2.56ef | 1.53ab | 5.0ab |
| Rai-5 | 89a | 57bc | 171.5b | 4.47d | 136cde | 9.47jk | 2.45f | 1.43ab | 4.7abc |
| Daulat | 89a | 60abc | 159.5c | 3.87e | 119fg | 13.20g | 2.68def | 1.19bcd | 4.2bcd |
| Jamalpur-1 | 88a | 59abc | 163.9c | 5.40b | 147ab | 9.56j | 2.52ef | 1.69a | 5.5a |
| ***Brassica napus* L.** | | | | | | | | | |
| BARI Sharisha -7 | 86b | 58abc | 104.7g | 3.13f | 68i | 18.80d | 3.35ab | 1.05cd | 4.0bcd |
| BARI Sharisha -8 | 82c | 62a | 131.8e | 3.03fg | 78h | 22.27c | 3.55a | 1.61a | 4.4abcd |
| CV (%) | 1.26 | 3.75 | 2.28 | 4.35 | 4.72 | 1.98 | 6.74 | 14.03 | 16.58 |

Means followed by same letter is not significantly different at 5% level by DMRT test.

Table 2. Yield and yield attributes of rapeseed and mustard varieties tested at FSRD site, Ishan Gopalpur, Faridpur during Rabi 2001-2002

| Variety | Plant po. /$m^2$ | Duration (day) | Siliqua/ Plants (no.) | Seed/pods (no.) | 1000 seeds wt. | Seed yield (t/ha) |
|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | |
| Tori-7 | 71.3bc | 86 | 69.0be | 16.7ed | 2.03ef | 1.04e |
| TS-72 | 59.0e | 86 | 90.0a | 17.7ed | 2.17de | 1.42cd |
| SS=75 | 60.3de | 100 | 56.7cd | 30.0a | 2.97a | 1.87a |
| BARI Sharisha-6 | 75.0ab | 94 | 43.3de | 24.3b | 2.40abc | 1.73ab |
| BARI Sharisha -9 | 59.7de | 86 | 83.0ab | 18.7c | 2.53b | 1.34d |
| PT-303 | 78.0ab | 86 | 49.3de | 17.0cd | 2.30cd | 1.05e |
| ***Brassica juncia* L.** | | | | | | |
| BARI Sharisha -10 | 69.3bcd | 94 | 79.3ab | 14.7de | 1.57h | 0.74f |
| ISD local | 74.0ab | 100 | 75.7ab | 15.0de | 1.90tg | 1.11e |
| Jamalpur-1 | 62.7cde | 100 | 78.7ab | 17.7cd | 2.60b | 1.58be |
| Rai-5 | 72.0abc | 100 | 85.0ab | 12.7e | 1.77gh | 0.95ef |
| Daulat | 79.0ab | 94 | 81.3ab | 12.7e | 1.93tg | 1.10e |
| ***Brassica napus* L.** | | | | | | |
| BARI Sharisha -7 | 73.7ab | 100 | 44.0de | 25.3b | 2.43bc | 1.89a |
| BARI Sharisha -8 | 82.3a | 100 | 37.7e | 26.7b | 2.30cd | 1.82a |

Table 3. Yield and yield contributing characters of mustard and rapeseed varieties at FSRD site, Golapgonj, Sylhet

| Variety | Plant height (cm) | Days to maturity | Branches/ plant (no.) | Siliqua/ plant (no.) | Seeds/ siliqua (no.) | 1000 seed wt. (g) | Seed yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | |
| Tori-7 | 63.4 | 72 | 3.3 | 41.2 | 15.1 | 2.2 | 821 |
| TS-72 | 74.2 | 79 | 4.0 | 62.4 | 15.2 | 2.3 | 960 |
| SS-75 | 96.4 | 94 | 3.6 | 42.5 | 32.6 | 3.5 | 1108 |
| PT-303 | 71.6 | 79 | 3.8 | 64.0 | 14.6 | 3.0 | 980 |
| BARI Sharisha-6 | 102.4 | 97 | 4.6 | 68.4 | 25.8 | 3.7 | 1725 |
| BARI Sharisha-9 | 85.6 | 83 | 3.9 | 88.2 | 16.1 | 2.7 | 1195 |
| ***Brassica juncia* L.** | | | | | | | |
| Rai-5 | 107.4 | 92 | 4.1 | 68.4 | 12.4 | 2.1 | 960 |
| Daulat | 103.8 | 92 | 4.6 | 14.2 | 12.5 | 2.1 | 1020 |
| BARI Sharisha-10 | 98.4 | 94 | 4.3 | 85.3 | 14.0 | 2.3 | 1055 |
| Ishuardi local | 103.4 | 95 | 4.2 | 92.5 | 15.6 | 2.6 | 1125 |
| Jamalpur-1 | 112.7 | 97 | 5.3 | 91.6 | 12.2 | 3.3 | 1079 |
| ***Brassica napus* L.** | | | | | | | |
| BARI Sharisha-7 | 83.4 | 95 | 3.4 | 84.0 | 25.0 | 2.7 | 1656 |
| BARI Sharisha-8 | 85.9 | 96 | 3.9 | 76.0 | 26.5 | 2.6 | 1502 |
| $LSD_{(0.01)}$ | 12.23 | 1.29 | 0.958 | 8.49 | 2.93 | 1.35 | 143.7 |
| CV (%) | 5.86 | 0.63 | 10.29 | 5.50 | 7.02 | 6.97 | 5.39 |

Table 4. Performance of mustard varieties at the MLT site, Chowgacha, Jessore during 2001-2002

| Treatments | Plant height (cm) | Days to maturity | Plant pop./ $m^2$ | Branch/plant | Pod/ plant | Seed/ pod | 1000 grain wt. (g) | Grain yield (t/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | | | |
| Tori-7 | 105.50c | 86f | 22b | 5.4ab | 160b | 16cd | 3.01e | 0.925c | 2.96d |
| TS-72 | 113.80c | 88e | 21b | 5.4ab | 177b | 17c | 3.02de | 1.245bc | 3.82bcd |
| SS-75 | 113.10c | 90d | 23ab | 4.8ab | 108b | 21b | 4.45a | 1.230bcd | 2.98d |
| BARI Sharisha-6 | 147.05b | 91d | 26a | 4.5b | 176b | 24ab | 4.08b | 1.115cde | 4.46abc |
| BARI Sharisha-9 | 110.70c | 88e | 24ab | 4.8ab | 223ab | 15cd | 3.24d | 1.375b | 3.85bcd |
| PT-303 | 114.10c | 87ef | 22b | 5.8ab | 179b | 16cd | 3.04de | 1.333bc | 4.31abc |
| ***Brassica juncia* L.** | | | | | | | | | |
| Rai-5 | 180.85a | 99a | 22b | 4.1b | 311a | 13d | 3.02de | 1.012de | 4.35abc |
| Daulat | 176.18a | 98a | 25ab | 4.5b | 323a | 14cd | 2.68f | 1.020de | 5.51a |
| BARI Sharisha-10 | 174.25a | 93e | 28a | 4.2b | 308a | 13d | 3.18de | 1.313bc | 5.02ab |
| Jamalpur-1 | 175.70a | 98a | 25a | 4.2b | 298a | 14cd | 3.08de | 1.015de | 4.40bc |
| ISD local | 175.35a | 98a | 23ab | 4.5b | 294a | 14cd | 2.78f | 1.140cde | 4.88abc |
| ***Brassica napus* L.** | | | | | | | | | |
| BARI Sharisha -7 | 92.00c | 95b | 22b | 6.5a | 185b | 22b | 3.05de | 1.290bc | 3.68cd |
| BARI Sharisha -8 | 106.30c | 94bc | 22b | 4.8ab | 185b | 26a | 3.07de | 1.753a | 5.17a |

Table 5. Performance of mustard varieties at the FSR site, Bagherpara, Jessore, during 2001-2002

| Treatment | Plant height (cm) | Days to maturity | Plant/$m^2$ | Pod/ plant | Seed/pod | 1000-seed yield (g) | Seed yield (t/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | | |
| TS-72 | 857.5d | 82b | 119 | 71abc | 16.00bcd | 1.55bc | 0.921ab | 2.128d |
| SS-75 | 108.75bc | 94a | 124 | 47de | 17.75bc | 1.62bc | 1.047a | 2.171d |
| PT-303 | 85.25d | 82b | 121 | 56b-e | 15.25b-e | 1.65bc | 0.865ab | 2.156d |
| Tori-7 | 87.00d | 82b | 123 | 73abc | 14.25cde | 1.60bc | 0.826ab | 1.966d |
| BARl Sharisha-6 | 104.50c | 93a | 115 | 45de | 23.50a | 2.18ab | 0.742ab | 2.626bcd |
| BARI Sharisha-9 | 89.75J | 84b | 111 | 79ab | 15.50b | 1.63bc | 1.039a | 2.570cd |
| ***Brassica juncia* L.** | | | | | | | | |
| BARI Sharisha-10 | 111.75bc | 91a | 126 | 78ab | 13.00def | 1.97abc | 0.908ab | 3.522a |
| Rai-5 | 127.50a | 92a | 120 | 64a-e | 11.75def | 1.74bc | 0.679b | 3.771a |
| Daulat | 126.25a | 92a | 118 | 86a | 11.25ef | 1.84bc | 0.854ab | 3.688a |
| ISD local | 122.00ab | 92a | 103 | 78ab | 12.25def | 2.08abc | 0.862ab | 3.402ab |
| Jamalpur-1 | 111.50bc | 94a | 118 | 67a-d | 9.75f | 1.60bc | 0.693b | 3.313abc |
| ***Brassica napus* L.** | | | | | | | | |
| BARI Sharisha-7 | 817.5d | 94a | 119 | 53cde | 19.00b | 2.08abc | 1.052a | 2.374d |
| BARI Sharisha-8 | 86.75d | 94a | 102 | 41e | 24.00a | 2.46a | 0.868ab | 2.333d |

Table 6. Performance of mustard varieties at the MLT site, Keshobpur, Jessore during 2001-2002

| Treatments | Plant height (cm) | Plant/m$^2$ | Days to maturity | No. of siliqua/ plant | No. of seed/ siliqua | 1000-grain wt. (g) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | |
| TS-72 | 113.88c | 58.75bcd | 80c | 77abc | 18b | 2.65a | 0.854a |
| SS-75 | 123.3c | 63.54abc | 9la | 29d | 25a | 2.75a | 0.608b |
| Tori-7 | 108.05c | 62.08a-d | 84bc | 67bc | 17b | 2.73a | 0.722ab |
| BARI Sharisha-6 | 145.90b | 60.12a-d | 95a | 64bc | 18b | 2.78a | 0.708ab |
| BARI Sharisha-9 | 113.03c | 60.41a-d | 81c | 74abc | 16b | 2.60a | 0.701ab |
| PT-303 | 117.03c | 59.65a-d | 8c | 66bc | 14bcd | 2.78a | 0.730ab |
| ***Brassica juncia* L.** | | | | | | | |
| Rai-5 | 162.93a | 56.80cd | 94a | 92ab | 12cd | 1.75b | 0.778ab |
| Daulat | 162.43a | 65.27ab | 92a | 98a | 12cd | 1.70b | 0.619b |
| BARI Sharisha-10 | 146.90ab | 66.87a | 94a | 97a | 11cd | 1.85b | 0.729ab |
| ISD local | 16.05a | 55.55d | 93a | 79abc | 11d | 2.43a | 0.586b |
| Jamalpur | 159.55ab | 63.12abc | 93a | 65bc | 10d | 2.70a | 0.580b |
| ***Brassica napus* L.** | | | | | | | |
| BARI Sharisha-7 | I12.83c | 60.08a-d | 93a | 88ab | 15bc | 2.73a | 0.626b |
| BARl Sharisha -8 | 106.40e | 58.55bcd | 89ab | 52ed | 17b | 2.73a | 0.964ab |
| F-test | ** | * | ** | ** | ** | ** | ** |

Table 7. Yield and yield attributes of different varieties/lines of mustard in Kushtia during 2001-2002

| Name of variety | Field duration (days) | Plant pop. /m$^2$ | Plant height (cm) | Siliqua/ plant (no.) | Seed/ Siliqua (No.) | 1000 seed wt. (gm) | Seed yield (kg/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | | |
| Tori-7 | 86 | 36.00ab | 77.7g | 104.0bcd | 12.67d-g | 2.33bcd | 1102.7de | 2.72c-f |
| BARI Sharisha-6 | 96 | 32.00bc | 110.7cd | 117.3abc | 15.67cd | 2.55bcd | 1437.7bc | 2.97bcd |
| BARI Sharisha-9 | 86 | 33.67abc | 92.7efg | 101.3bc | 17.33bc | 2.34bcd | 1229.3def | 2.66def |
| TS-72 | 86 | 37.00ab | 85.0fg | 90.3d | 15.00cde | 2.40bcd | 1213.3de | 2.55f |
| PT-303 | 87 | 35.67ab | 90.3efg | 88.2d | 14.67c-f | 2.49bcd | 1177.7de | 2.60f |
| SS-75 | 97 | 31.67bc | 101.3de | 89.7de | **25.00a** | 2.69ab | 1591.0ab | 2.96b-e |
| ***Brassica juncia* L.** | | | | | | | | |
| BARI Sharisha-10 | 100 | 35.33ab | 95.0ef | 105.0bcd | 12.67d-g | 2.51bcd | 1210.3de | 2.64ef |
| ISD Local | 104 | 36.67ab | 111.7cd | 112.0abc | 11.33fg | 2.30cd | 1168.7de | 2.80c-f |
| Jamalpur-1 | 104 | 38.33a | 135.0a | 126.0a | 10.00g | 2.39bcd | 1265.7cd | 2.97bcd |
| Rai-5 | 102 | 31.33bc | 127.3ab | 126.7a | 11.67efg | 2.22d | 1020.7e | 3.04bc |
| Doulat | 102 | 34.67ab | 120.3abc | 123.0a | 13.00d-g | 2.23d | 1241.3cde | 2.83c-f |
| ***Brassica napus* L.** | | | | | | | | |
| BARI Sharisha-7 | 96 | 32.67abc | 99.7def | 120.0ab | 19.00b | 2.62abc | 1629.3ab | 3.25ab |
| BARI Sharisha-8 | 96 | 28.00c | 118.3bc | 111.0abc | **23.00a** | **2.93 a** | **1652.3a** | **3.38a** |
| Jata Rai | 103 | 30.30 bc | 99.3def | 103.9bcd | 12.30e-g | 2.26ed | 1035.6e | 3.12bc |
| CV (%) | - | 8.9 | 8.4 | 11.8 | 8.9 | 8.1 | 8.9 | 6.5 |
| F-test | - | * | ** | ** | ** | ** | ** | ** |

Table 8. Performance of different characters of mustard varieties at level Barind soil of ARS, OFRD, BARI, Bogra during Rabi 2001-2002

| Varieties | Duration of crop (days) | Plant height (cm) | No. of primary branches | Pods/plant (no.) | Seeds/ pod (no.) | 1000-grain wt. (gm) | Grain yield (t/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| ***Brassica campestris* L.** | | | | | | | | |
| Tori-7 | 80h | 93.50d | 4.26a-c | 96.67d | 16.67cd | 2.763e | 1.073f | 3.80d |
| TS-72 | 84g | 93.23d | 4.83ab | 110.3cd | 16.67cd | 2.667ef | 1.157f | 3.60de |
| SS-75 | 99c | 112.7c | 5.33a | 77.0e | 25.0a | 4.173a | 1.350ef | 3.44de |
| PT-303 | 91ef | 109c | 4.33a-c | 129.3b | 14.67de | 2.667ef | 1.317f | 3.23e |
| BARI Sharisha-6 | 95d | 125.3b | 4.5a-c | 62.67e | 21.33b | 3.307d | 1.930cd | 5.46a |
| BARI Sharisha-9 | 88f | 109c | 4.26a-c | 117.0bc | 16.67cd | 2.643ef | 1.223f | 3.56de |
| ***Brassica juncia* L.** | | | | | | | | |
| Jamalpur-1 | 104b | 143.4a | 3.66cd | 122.3bc | 11.67fg | 3.530c | 2.35a | 4.74bc |
| BARI Sharisha-10 | 90ef | 122.1b | 3.66cd | 201.3a | 14.0d-f | 2.577f | 1.733cd | 4.34c |
| Ishurdi local | 104b | 136.8a | 4.0b-d | 121.7bc | 9.66g | 3.687b | 2.30ab | 4.48bc |
| Rai-5 | 109a | 123.3b | 2.90d | 100.7d | 13.33ef | 2.433g | 1.017f | 4.66bc |
| Daulat | 108a | 127.5b | 3.83b-d | 132.7b | 14.0d-f | 2.077h | 1.160f | 437c |
| ***Brassica napus* L.** | | | | | | | | |
| BARI Sharisha-7 | 93de | 109.1c | 3.56cd | 94.67d | 18.67c | 3.797b | 2.017bc | 4.71bc |
| BARI Sharisha-8 | 102bc | 122.7b | 2.93d | 73.67e | 17.67c | 3.697b | 1.637de | 4.89b |
| F-Test | *** | *** | *** | *** | *** | *** | *** | *** |
| CV (%) | 1.88 | 3.80 | 8.98 | 8.71 | 7.92 | 2.46 | 11.44 | 5.66 |

Figure(s) followed by different letters in the same column are statistically significant at 0.1% level of probability

## EFFECT OF DIFFERENT MANAGEMENT PRACTICE ON THE PERFORMANCE OF LATE SOWN RAPESEED MUSTARD

The experiment was conducted at the FSR site, Bagherpara, Jessore during rabi 2000-01 to observe the performance of yield of late season rapeseed mustard. The study was laid out with three management practices such high, medium and low. The unit plot was 4 x 5 m. The seed was sown on 22 Nov. 2001 using 6 kg seed/ha. A hailstorm followed by rainfall (38 mm) affected the crop on 21 February 2001 at the pod formation stage resulting 90%, lodging of plants. The crop was harvested on 18 to 26 February 2001. Necessary data were recorded, analyzed and presented in Table.

Plant height, siliqua/plant and grain yield was significantly influenced by different treatments. Plant/m$^2$, seeds/siliqua and seed weight were statistically identical. Medium and high management showed similar height but higher than low management. Similar trend was followed in case of siliqua/plant. Seed yield was similar respect of high and low management but statistically higher than low management. Overall grain yield was low due to hailstorm followed by rainfall at pod filling stage.

The experiment needs to further verification.

Table 1. Performance of late sown rapeseed mustard at Bagherpara, Jessore during rabi 2001-02

| Variety/lines | Plant height (cm) | Plants pop./m$^2$ | Siliqua/plant (no.) | Seeds/plant (no.) | 1000-seed wt. (g) | Seed yield (t/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Low management | 107.33b | 73.30 | 29b | 23 | 2.60 | 0.383b | 3.16 |
| Medium management | 128.33a | 74.67 | 50a | 23 | 2.60 | 0.970a | 4.66 |
| High management | 19.00a | 65.33 | 44ab | 26 | 2.67 | 0.997a | 4.54 |
| F-test | * | ns | ** | ns | ns | ** | ns |

# FARMERS FIELD TRIAL OF CHICKPEA

## Introduction

In Bangladesh Chickpea *(Cicer arietinum* L.) is the third most important pulse in respect of area and production with an average yield of 765 kg/ha. Its field is probably most unstable among pulses due to its more sensitivity to micro environment. On the other hand, it has got the highest yield potentiality under favorable environment. Chickpea is found to be a very suitable dry land rabi crop with residual soil moisture condition. Under Barind stress situation it can be successfully grown after harvesting of short duration T.Aman rice. Farmers' are convinced to grow this crop in different location of Bangladesh. In this situation an experiment was undertaken to evaluate the performance of the newly developed lines in the farmers' field.

## Materials and Methods

The trial was conducted at FSRD site, Chabbishnagar, Rajshahi and MLT site, Nachole, Faridpur and Pabna during rabi season in 2001-2002. The experiment was laid out in a randomized complete block design with four replications. The unit plot size was 10 m x 10 m. Three lines/varieties of chickpea viz. BCX - 84021, BARI chola 5 and local were included in tile study. The seeds were sown in 30cm row spacing with continuous sowing. The seeds were sown on November 18, 2001 at FSRD site, Chabbishnagar and Nachole in November 20, 2001, December 11 at Faridpur and ......... The seed rate was maintained 50 kg/ha. Nitrogen, phosphorus, potassium were applied as basal during final land preparation at the rate of 20 kg N, 40 kg $P_2O_5$ and 20 kg $K_2O$ per hectare in the form of urea, Triple super phosphate and Murate of potash, respectively. The crops were harvested on March 28 at Chabbishnagar and March 31 of 2002 at Nachole, and March 14 at Faridpur and ..........., respectively. Data were collected on different yield component and yield, analyzed statistically and the differences between treatments means were evaluated LSD.

## Results and Discussion

### Site: Chabbishnagar, FSRD

A significant variation was observed in seed yield and 1000 seed weight of chickpea at Chabbishnagar. The variety BCX84021 and BARI 5 were statistically identical is respect of 100-seed weight whereas local variety showed lowest seed weight. Significantly highest seed yield was obtained from line BCX84021. Other two varieties were statistically at par. Straw yield and crop duration were not significantly influenced by different variety/line. Seed yield was higher from BCX84021 due to higher seeds/pod and 100-seed weight (Table 1).

### Site: Nachole, MLT

Plant height, crop duration, yield and yield attributes were not significantly influenced by different variety/line.

### Site: Ishan Gopalpur, Faridpur

Plants/$m^2$, pods/plant, seed weight, seeds/pod and seed yield were significantly different by the treatments. The BARI chola 5 showed higher no. of plant/$m^2$ but statisitically identical to local variety. Significantly higher pods/plant was obtained from BARI Chola 5 but seeds/pod was highest from line BCX84021. Seed weight also higher from BARI chola 5. Signfificantly highest seed yield was recorded from variety BARI chola 5 due to higher no. of pods/plant and 100-seed weight.

### Site: Goyeshpur, Pabna

Yield and yielding contributing characters are presented in Table 1. Though BARI chola 5 variety showed higher pods/plant and 100-seed weight but seed yield was similar to line BCX84021.

The variety BARI Chola 5 performed better at all sites but this trial needs further verification.

Table 1. Performance of different varieties of chickpea during 2001-02

| Treatment | Plant height (cm) | Pods/plant (no.) | 100-seed weight (g) | Seed yield (t/ha) | Straw yield (t/ha) | Field duration (days) |
|---|---|---|---|---|---|---|
| Chabbishnagar, Rajshahi | | | | | | |
| V1 (BCX84021 | 29.67 | 26.00 | 11.43a | 1.17a | 1.27 | 125.33 |
| V2 (BARI Chola 5) | 28.93 | 25.67 | 10.73ab | 1.09b | 1.24 | 126.00 |
| V3 ( Local) | 28.27 | 24.33 | 9.77b | 1.05b | 1.23 | 123.33 |
| CV (%) | 7.47 | 20.0 | 4.18 | 3.31 | 5.71 | 1.69 |
| LSD (0.05) | ns | ns | 1.009 | 0.07 | ns | ns |
| Nachole, Chapainababgonj | | | | | | |
| V1 (BCX84021 | 37.47 | 29.80 | 12.17 | 1.01 | 1.21 | 124 |
| V2 (BARI Chola 5) | 31.87 | 33.53 | 11.50 | 0.95 | 1.32 | 126 |
| V3( Local) | 32.20 | 25.20 | 11.17 | 0.83 | 1.39 | 128 |
| CV (%) | 9.88 | 18.79 | 5.47 | 9.34 | 11.5 | 1.01 |
| LSD (0.05) | ns | ns | ns | ns | ns | ns |

Table 2. Yield and yield attributes of chickpea at FSRD site, Ishan Gopalpur, Faridpur 2001-02

| Variety | Plant Pop./$m^2$ | Plant height (cm) | Pods/Plant | No. of seed/pod | 1000 seeds wt. (gm) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|
| BCX-84021 | 11.5b | 48.8 | 43.5 c | 1.82 a | 112.8 | 1.37 b |
| BARI Chola-5 | 14.3a | 52.5 | 49.0 a | 1.75 b | 117.3 | 1.44 a |
| Local | 13.3ab | 47.3 | 38.0 b | 1.20 c | 10.65 | 0.65 c |
| CV (%) | 10.2 | 6.6 | 8.3 | 4.5 | 2.3 | 17.5 |
| LSD (0.01) | - | - | ** | ** | ** | ** |

Table 3. Yield and yield attributes of Chickpea (Goyeshpur, 2001-02)

| Variety | Days to flowering | Days to maturity | Plant height (cm) | Pods/plant (no.) | 100-seed weight (g) | Seed yield (t/ha) |
|---|---|---|---|---|---|---|
| BCX-84021 | 83 | 112 | 52.0 | 31 | 10.41 | 0.83 |
| BARI Chola-5 | 84 | 113 | 50.67 | 39 | 11.31 | 0.84 |
| Local | 81 | 114 | 52.00 | 22 | 10.24 | 0.62 |

# BREAD WHEAT ADAPTIVE LINE TRIALS AT FARMER'S FIELD CONDITION

## Abstract

The experiment was conducted in medium high land at FSRD site, Palima, Tangail, Jessore, Comilla, Jamalpur, Pabna and Rangpur during rabi 2001-2002 to assess the yield performance of bread wheat lines in different agro-climatic zones under farmer's field condition. It was observed that the higher grain yield recorded from variety Shatabdi in all sites and also BAW966 at Tangail.

## Introduction

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

## Materials and Methods

The experiment was undertaken at the farmer's field of FSRD site, Palima, Tangail, Keshobpur, Jessore, Chandina, Comilla, Melandah and Sherpur, Jamalpur, Pabna and Rangpur during rabi 2001-2002.Four advanced bread wheat lines were BAW966, BAW969, BAW1004 and BAW1006 compared with released variety Kanchan and Shatabdi in medium high land under irrigated condition The experiment was laid out in a randomized block design with three replications. The unit plot size was 4m x 5m. The land was fertilized with 220 kg urea, 132 kg TSP, 68 kg MP, and 117 kg gypsum/ha. Two-third of urea and all amount of fertilizer were applied at final land preparation. Seeds were sown on 22 Nov., 25 Nov., 9 Dec., 20-23 Nov., 4-6 Dec. & 29 Nov. at Tangail, Jessore, Comilla, Jamalpur, Pabna and Rangpur. The crop was sowing with 120 kg seed/ha at a spacing 20 m in solid line. One irrigation was applied at 23 days after sowing (DAS) followed by rest urea as top dress. One hand weeding was done at 27 days after sowing. The crop was harvested on 16-20 March at Jamalpur, 19 March at Chandina, 22-26 March, Pabna. All necessary data were collected and analyzed statistically.

## Result and Discussion

### Site: Palima, Tangail

Heading days, days to maturity, yield and yield attributes were significantly influenced by different variety /line except number of grain/spike which was insignificant. The lowest head days was observed in line BAW966, which was statistically identical to BAW969. The highest head days was obtained from Shatabdi which was statistically different from other line/variety. Similar trend was followed in case of days to maturity. The variety Kanchan, Shatabdi and line BAW1006 showed higher plant height and statistically identical whereas shortest height was recorded from BAW969. Grain/spike was not significantly influenced by different variety/line but higher number of spike was obtained from BAW969.Significantly highest spike length was recorded from BAW1004 but number of grain/spike was obtained from BAW966 though significant difference was not found among variety/line. Bold grain size showed in line BAW1004 and BAW1006 and other lines/varieties grain size statistically similar. Higher grain yield was obtained from lineBAW966, which was at par to line Shatabdi, but 11% higher grain yield was achieved from former one. The line BAW966 showed 52 and 11% higher grain yield than Kanchan and Shatabdi. The higher grain yield was achieved due to higher number of spikes/m$^2$. Straw yield showed higher from BAW966 followed by all other variety/line except BAW1004.

**Site: Keshobpur, Jessore**

Performance of wheat varieties/lines in the farmer's field is presented in table 1. The check variety Satabdi produced the significantly higher grain yield (5.10 t/ha) over Kanchan (4.27 t/ha) and BAW 969 (4.43 t/ha) respectively, it was not different from the grain yield obtained with BAW 966, BAW 1004 and BAW 1006. The check variety Kanchan produced the lowest grain yield (4.27 t/ha) among the lines/varieties tested. The highest grain yield of Satabdi was mainly influenced by spike length and number of grains/spike. The line BAW 1004 (46.47 g) and BAW 1006 (47.07 g) was produced significantly higher 1000 grain weight and the seeds were bolded among different variety/lines. The line BAW 1006 produced the higher spike length. From the results and discussion it is evident that check variety Satabdi was superior to the control variety Kanchan and other lines tested in respect of yield. The lines BAW 966, BAW 1004 and BAW 1006 were identical to Satabdi but the control variety Kanchan was inferior to other lines and varieties.

**Site: Chandina, Comilla**

Days to flowering, maturity day, grains/spike, 1000-seed weight and grain yields were significantly influenced by different varieties (Table 3). Significantly highest grains/spike was obtained from BAW-966. The lowest grain/spike was recorded from Kanchan but at par to BAW-1004 & BAW-1006. But Kanchan showed significantly highest grain weight among the varieties. Grain yield was not significantly influenced by variety but all the variety/line showed higher grain yield. Among the variety, BAW969 revealed slightly higher yield with shortest maturity days (91) as compared to other variety.

**Site: Sherpur & Melandah, Jamalpur**

Plant height, days to maturity, plants/$m^2$, grain yield and yield attributes were not significantly influenced by variety (Table 4). Only plant height was significant. Among the variety Satabdi, BAW-1006 took longer time at Sherpur and BAW-1006 at Melandah. Plant/m2 varied among the variety is both the location. Though grain yield was not found significant but higher yield was obtained from Shatabdi at both sites. All the variety/line showed higher yield than kanchan.

**Site: Sujanagar & Chatmohor MLT site, Pabna**

At Sujanagar, grains/spike, 1000-grain weight and grain yields were significantly influenced by variety/line. Significantly higher grains/spike was obtained from Shatabdi. The line BAW-1004 showed higher grain weight but statistically identical to BAW-1004 and Shatabdi. The variety shatabdi revealed higher grain yield but at par to BAW-1004 and BAW-1006 and kanchan.

At Chatmohor, grains/spike, 1000-grain weight and grain yield were significantly affected by variety/line. The line BAW-1004, Shatabdi, BAW-966 and BAW-1006 showed similar grains/spike. Significantly highest grain weight was recorded from BAW-1004. The line BAW-1006 showed higher grain yield followed by Shatabdi and BAW-966.

**Site: Nilphamari, Rangpur**

The result revealed that there was significant difference in respect of all the characters studied except plant population, grain and straw yield (Table 7). The advanced lines were found to be earlier than the released varieties. BAW-1006, BAW-966, BAW-969 and BAW-1004 took only 102, 104, 104 and 106 days, respectively to attain its maturity while Kanchan and Shatabdi took 109 and 112 days respectively. Significantly the higher 1000 seed weights (50 g and 51 g) were recorded from BAW-1004 and BAW-1006. Though there was no significant difference in respect of grain yield among the advance lines and released varieties numerically the highest yield (5.01 t/ha) was obtained from BAW-966. The yield of all the tested lines and varieties was found to be reasonably good (4.32-5.10 t/ha).

From the above result it showed that Shatabdi performance better in all the sites and also BAW-966 at Tangail. The experiment was conducted only one year so it needs another year trial for confirmation.

Table 1. Yield and yield contributing characters of newly released wheat lines/varieties (FSRD site, Palima, Tangail during 2001-2002)

| Varieties /Lines | Heading days | Days to maturity | Plant height (cm) | Spike length (cm) | No. of spike/ $m^2$ | No. of grain /spike | 1000-grain wt.(g) | Grain yield ( t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| Kanchan | 63b | 112b | 106.7a | 9.33d | 286 | 32 e | 41.04b | 2.90c | 5.87ab |
| Shatabdi | 66a | 116a | 107.0a | 10.77b | 288 | 53a | 41.29b | 3.97ab | 5.53ab |
| BAW966 | 58e | 106d | 103.5c | 9.93c | 292 | 47b | 39.05b | 4.43a | 6.63a |
| BAW-969 | 60de | 108cd | 92.33d | 9.18d | 283 | 37d | 39.00b | 3.57bc | 5.13ab |
| BAW1004 | 63bc | 111b | 105.2b | 11.20a | 288 | 43c | 46.99a | 3.33bc | 4.67b |
| BAW1006 | 61cd | 108cd | 107.3a | 10.53b | 284 | 38d | 48.65a | 3.50bc | 6.53a |
| CV% | 1.72 | 1.01 | 1.88 | 2.21 | 2.94 | 2.45 | 6.89 | 10.36 | 13.59 |

Table 2. Performance of wheat varieties/lines at Magura MLT site, Jessore during rabi 2001-02

| Variety/lines | Number of panicle/ $m^2$ | Plant height (cm) | Spike length (cm) | Number of grains/ spike | 1000 grain wt. (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Kanchan | 475ab | 95.97a | 9.40ab | 31.53c | 41.57bc | 4.27b | 5.17c |
| Satabdi | 506a | 98.77a | 10.21ab | 44.73a | 42.63b | 5.10a | 5.63abc |
| BAW 966 | 453b | 100.10a | 9.47ab | 43.23a | 39.73c | 4.80ab | 5.23bc |
| BAW 969 | 442b | 81.43b | 9.25b | 45.53bc | 41.63bc | 4.43b | 5.20bc |
| BAW 1004 | 485ab | 98.67a | 9.77ab | 32.67bc | 46.47a | 4.47ab | 5.80a |
| BAW 1006 | 502a | 101.10a | 10.57a | 39.07ab | 47.07a | 4.83ab | 5.70ab |
| F-test | * | ** | ** | ** | ** | ** | * |

Table 3. Yield and yield attributes of bread wheat variety/lines at Chandina, rabi 2001-02

| Variety/line | Days to 50% flowering | Maturity (days) | Plant height (cm) | Effective tiller/hill | Length of spikelate (cm) | Grain/ spike | 1000-seed wt. (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| Kanchan | 60 | 100 | 93 | 4.3 | 14 | 33 | 43.7 | 3.44 |
| Shatabdi | 62 | 100 | 98 | 4.3 | 15 | 39 | 41.3 | 3.76 |
| BAW-966 | 56 | 96 | 96 | 4.0 | 15 | 48 | 32.4 | 3.72 |
| BAW-969 | 53 | 91 | 86 | 4.0 | 15 | 38 | 33.5 | 4.0 |
| BAW-1004 | 56 | 93 | 99 | 4.6 | 15 | 33 | 41.5 | 3.96 |
| BAW-1006 | 56 | 93 | 100 | 4.3 | 16 | 33 | 40.8 | 3.96 |
| LSD (0.05) | 4.0 | ns | ns | ns | 4.5 | 2.9 | 4.5 | ns |

Table 4. Plant height, days to maturity, yield and yield attributes of wheat at Jamalpur, 2001-02

| Location | Variety/lines | Plant ht. (cm) | Days to maturity | Spike length (cm) | Grains/ spike (no.) | Plant/m$^2$ | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Sherpur | Kanchan | 94.87a | 100 | 8.43 | 37 | 439.00 | 3.34 |
| | Shatabdi | 94.67a | 105 | 9.20 | 43 | 396.00 | 5.00 |
| | BAW966 | 93.63ab | 100 | 8.47 | 39 | 360.00 | 4.03 |
| | BAW-969 | 79.20c | 99 | 8.63 | 40 | 444.67 | 4.44 |
| | BAW-1004 | 96.57a | 102 | 8.90 | 45 | 363.33 | 4.67 |
| | BAW1006 | 94.20ab | 105 | 8.60 | 45 | 431.67 | 4.00 |
| Melandah | Kanchan | 95.67a | 97 | 9.27 | 45 | 433.33 | 2.95 |
| | Shatabdi | 94.73a | 98 | 10.93 | 51 | 350.33 | 3.40 |
| | BAW966 | 92.73ab | 95 | 9.67 | 44 | 311.33 | 3.20 |
| | BAW-969 | 83.87bc | 94 | 8.83 | 44 | 366.67 | 2.77 |
| | BAW-1004 | 91.47ab | 97 | 9.83 | 53 | 298.67 | 3.20 |
| | BAW1006 | 96.13a | 100 | 11.87 | 53 | 351.00 | 2.97 |
| | F test | ** | ns | ns | ns | ns | ns |
| | CV (%) | 4.46 | 1.10 | 8.57 | 4.07 | 7.05 | 9.76 |

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

Table 5. Performance of yield and yield contributing characters of Wheat varieties at MLT site, Sujanagar, Pabna during 2001-2002

| Treatment | Days to heading | Days to maturity | No. of grains/spike | 1000-grain wt. (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|
| Kanchan | 64 | 102 | 35.80bc | 37.10bc | 2.84ab |
| Shatabdi | 70 | 110 | 48.90a | 43.10a | 3.36a |
| BAW-966 | 65 | 104 | 32.40c | 35.30c | 2.04c |
| BAW-969 | 68 | 106 | 40.60b | 39.20b | 2.74b |
| BAW-1004 | 67 | 106 | 39.40b | 45.00a | 3.06ab |
| BAW-1006 | 69 | 108 | 36.30bc | 44.60a | 2.92ab |
| CV(%) | - | | 7.9 | 3.5 | 9.9 |

Table 6. Performance of yield and yield contributing characters of Wheat varieties at MLT site, Chatmohar, Pabna during 2001-2002

| Varieties/ lines | Days to heading | Days to maturity | No. of grains/Spike | 1000 grain wt. (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|
| Kanchan | 61 | 100 | 36.00c | 32.40d | 2.09c |
| Shatabdi | 66 | 107 | 42.33a | 39.40b | 2.70ab |
| BAW-966 | 62 | 102 | 41.33ab | 32.37d | 2.33bc |
| BAW-969 | 63 | 104 | 38.00bc | 34.63c | 2.37bc |
| BAW-1004 | 63 | 104 | 42.67a | 41.17a | 3.02a |
| BAW-1006 | 65 | 105 | 39.33abc | 34.83c | 2.07c |
| CV (%) | - | - | 5.4 | 1.7 | 12.4 |

Table 7. Yield and yield contributing characters of different advance lines/varieties of wheat at Nilphamari MLT site of OFRD, Rangpur during rabi 2001-2002

| Treatment | Days to maturity | Plant height (cm) | Spicks/m2 (no) | Grains/Spick (no) | 1000 seed wt. (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|
| Kanchan | 109b | 103b | 424 | 40b | 43b | 4.61 | 6.73 |
| Shatabdi | 112a | 101b | 386 | 41ab | 44b | 4.52 | 6.58 |
| BAW-966 | 103de | 109a | 395 | 48a | 44b | 5.10 | 7.42 |
| BAW-969 | 104d | 90c | 416 | 39b | 41c | 4.32 | 6.40 |
| BAW-1004 | 106c | 109a | 427 | 35b | 50a | 4.74 | 7.12 |
| BAW-1006 | 102e | 101b | 414 | 35b | 51a | 4.68 | 6.84 |
| CV (%) | 1.1 | 1.2 | 6.6 | 9.8 | 1.6 | 8.6 | 10.3 |

# ON FARM VERIFICATION TRIAL OF HYBRID MAIZE


## Abstract

Two advanced line (CMS933072 and BMS9902) along with BARI Hybrid Maize-1 and Pacific-11 were evaluated at OFRD, ARS, Rangpur and Goyeshpur, Pabna during rabi seasons of 2001-02. At Rangpur, the hybrid line CMS933072 (9.37 t/ha) and BMS9902 (8.60 t/ha) could not out yielded the check variety of Pacific-11 (9.65 t/ha). But the yield of CMS 933072 was statistically identical to the yield of Pacific-11. BARI hybrid maize-1 was found susceptible to bacterial leaf blight at the maturity stage, which might have contributed to the lower yield. At Pabna, highest grain yield was obtained from Pacific-11 due to higher no. of grains/cob and 1000-grain weight.


## Introduction

In Rangpur region (greater Rangpur and Dinajpur districts) farmers, in association with the GO and NGO's are involved in hybrid maize cultivation since 1990's. Bangladesh Agricultural Research Institute has recently released a hybrid maize variety BARI hybrid maize-1. Besides this, some other advance lines were identified. The variety /line is said to be higher yielder. It was felt necessary to evaluate the performance of the said variety across the locations all over the country. Considering above the present study was initiated with the following objectives i) to observe the yield potential of BARI hybrid maize-1 compared to the check varieties and ii) to select the suitable hybrid maize variety(s) for Rangpur region.

## Materials and Methods

The experiment was conducted at OFRD, ARS, Rangpur and Goyeshpur, Pabna during rabi seasons of 2001-2002. The experiment was laid out in Randomized Complete Block Design with three replications. The unit plot measured 4.5 x 5.0 m. Two advanced lines of hybrid maize viz. CMS933072, BMS9902 along with BARI hybrid maize-1 and Pacific-11 (Imported) were included in the study. The crop was fertilized with 250-120-170-40-5-2-10 kg N-$P_2O_5$-$K_2O$-S-Zn-B-Mg/ha. One-third N and all other fertilizers were applied as basal. The remaining N was applied as top-dress in two equal splits at 8-12 leaf stage and at tasseling stage. The seeds were sown on Nov. 13, 2001 at Rangpur and 22 Dec. at Goyeshpur. The seeds were sown maintaining a spacing of 75 x 25 cm with seed rate 20 kg/ha. Irrigation and other intercultural operations were done as and when necessary. The varieties/advance lines took around 160 and 90 days to maturity. The crop was harvested on 21-24 March 2002. Data on the yield and yield contributing characters were recorded and analyzed statistically.

## Results and Discussion

### Site: ARS, Rangpur

The yield and yield contributing characters of different varieties/lines during rabi season of 2001-2002, have been presented in Table 1. It observed from the table 1 that days to tasseling and silking in BMS 9902 and BHM1 was earlier than CMS933072 and pacific-11. The variety Pacific-11 was delayed to mature, and all the BARI developed hybrids were comparatively early maturing. Number of cobs per plant was almost one in all entries. BMS9902 produced the highest number of grains per cob, which was followed by CMS933072 and these were statistically similar. Numbers of grain per cob was lowest in BHM1, which was similar to Pacific-11. Largest seed size was obtained by CMS933072 which was similar to Pacific-11, BHM1 and BMS9902 produced comparatively lower than control variety. The variety Pacific-11 showed higher grain yield but statistically identical to CMS933072. These two variety/lines gave higher yield due to bolder size of seed. The lowest grain yield was obtained from BHM1but statistically at par to BMS9902. Though slightly high grain yield was recorded from Pacific-11 but CMS933072 showed 7 days earlier is maturity. The lower yield of BARI hybrid maize-1 and two advanced lines is due to significantly lower weight of 1000-seed weight. Moreover, the yield of grain of BARI hybrid maize 1 was also affected by the bacterial leaf blight. The lines CMS933072 and BMS9902 found to be promising. These two lines could be tested next year for further verification. However, the maize breeders of BARI should give more emphasis on the development of hybrid materials with higher yield potential and resistance to diseases.

**Site: Goyeshpur, Pabna**

Yield and contributing characters of hybrid maize variety/lines were presented in Table 2. Highest plant population (119.67 no.) was obtained from variety pacific-11 which was followed by line CMS-9330722 (118.33 no.). Plant height and cob length did not show any significant difference among the variety/lines. Highest number of grain per cob and 1000 grain wt. were obtained from the variety pacific-11 which was statistically difference from other lines. Highest grain yield (8.41t/ha) was obtained from variety pacific-11 which was followed by line CMS-9330722. Highest stover yield (9.36t/ha) was obtained from variety pacific-11 which was at par with line CMS-9330722. Yield contributing characters supported this yield.

The experiment was conducted only one year so, the experiment should be continued another year.

Table 1. Days to maturity and yield contributing characters of different hybrid maize during rabi, 2001-2002 at OFRD, ARS, BARI, Rangpur

| Hybrid maize | Days to tasseling (80%) | Days to silking (80%) | Days to maturity (80%) | Plant height at maturity (cm) | Plant pop./$m^2$ (no.) | Cobs/ plant (no.) | Grains/ cob (no.) | 100-seed wt. (g) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| CMS933072 | 104a | 105a | 154b | 222.92a | 5.13b | 1.15 | 503.28a | 41.9a | 9.37ab |
| BMS9902 | 94b | 96b | 148c | 198.8b | 5.31a | 1.07 | 528.53a | 31.3d | 8.60bc |
| BHM1 | 94b | 96b | 155b | 183.23c | 5.09b | 1.17 | 405.28b | 37.3c | 8.11c |
| Pacific-11 | 98ab | 101ab | 161a | 187.73c | 5.29a | 1.18 | 421.53b | 40.0a | 9.65a |
| CV (%) | 5.6 | 5.9 | 0.8 | 3.3 | 2.4 | 8.9 | 4.9 | 3.6 | 8.8 |

Table 2. Yield and yield contributing characters of hybrid maize varieties/lines at FSRD site Goyeshpur, Pabna during 2001-02

| Variety/line | Plant population /plot (no.) | Plant height (cm) | Cob length (cm) | Grains /cob (no.) | 1000-grain wt. (gm) | Grain yield (t/ha) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|---|
| CMS-9330722 | 118.33ab | 207.83a | 15.83a | 483.00ab | 314.90b | 7.83ab | 8.36a |
| BMS-9902 | 116.33b | 206.17a | 14.50a | 453.17b | 235.07c | 7.03b | 6.24b |
| BHM-1 | 116.50b | 198.00a | 15.50a | 447.50b | 315.77b | 7.22b | 6.73b |
| Pacific-11 | 119.67a | 204.67a | 15.17a | 519.33a | 340.40a | 8.41a | 9.36a |
| CV(%) | 1.3 | 4.3 | 7.7 | 8.7 | 4.2 | 8.7 | 11.7 |

# ON-FARM TRIAL OF RADISH VARIETIES


## Abstract

An on-farm trial was conducted at FSRD site Palima, Tangail, Atkapalia, Noakhali, Jamalpur, MLT site, Golapgonj and Sunamgonj during rabi 2001-2002 to observe the performance of newly developed radish varieties BARI Radish-2 (Pinky) and BARI Radish-3 (Druti) at different farmers' fields. At Jamalpur, the variety BARI Radish-3 and BARI Radish-2 showed average yield of 51.30 and 46.11 t/ha, respectively. Higher gross return and margin was recorded from variety Druti which involved higher cost but higher benefit cost ratio from the same. At Noakhali, higher yield from Druti but due to low price, pinky showed higher BCR. At Jamalpur, there was no difference in yield between two varieties but Druti showed higher yield at Golapgonj and Pinky at Sunamgonj.


## Introduction

Radish is a winter vegetable in our country. It is widely grown vegetable in Bangladesh. BARI has already released three improved radish varieties which are grown in specific areas. On the other hand, normally the developed varieties in the farmer's field under cultivation gradually degenerate overtime. So, it is necessary to replace it by new one. Therefore, newly released variety was put under trial at different locations for their adaptability and acceptability at farmers' level.

## Materials and Methods

The trial was conducted at FSRD site Palima, Tangail, Atkapalia, Noakhali, Jamalpur and Golapgonj, Sylhet MLT site at Sunamgonj during rabi 2001-2002. BARI Radish-2 and BARI Radish-3 were used. The unit plot size was 200 sq.m for each variety. One demonstration plot constituted 2 unit plots. Plot to plot distance was 75 cm and plant spacing was 30 x 30 cm with two seeds/hill at the seed rate of 50 g/200sq.m$^2$. Seeds were sown in 1$^{st}$ week of November at Palima, Tangail, November 18 to December 5 at Noakhali, 15 October at Jamalpur, 20-24 November at Golapgonj and 25 October – 8 November at Sumgonj. The fertilizer were applied at the rate of 10 t/ha cowdung and 375 -155-255 kg/ha of urea, TSP and MP. The entire quantity of cowdung, TSP and half of urea and MP were applied during land preparation. The rest of urea and MP are to be applied as top dressing after 20 and 30 days of sowing. Intercultural operations such as weeding and irrigation were done whenever required but rainfed at Noakhali. The crop was harvested at marketable size. Observations were made on root weight/plant (g), root yield (t/ha) and farmer's reaction.

## Result and Discussion

### Site: Palima, Tangail

The data on yield and yield components of radish varieties are presented in Table 1. Average root height of Pinky and Druti were 23.34 and 25.46 respectively. Average root weight and root yield without leaf of Pinky variety were 415 g/plant and 46.11 t/ha. On the other hand, Average root weight and root yield without leaf of Druti variety were 461.60 g/plant and 51.30 t/ha .On an average, higher root height and root weight was recorded from the variety Druti which reflected higher yield. Gross return and margin was higher from the variety Druti which involved higher cost of cultivation. But due to higher yield and price, higher benefit cost ratio was obtained from the variety Druti. There was no attack of insect pest and disease in demonstration plot but partial damage the crop by poultry during seedling stage. There was not insect-pest and disease but partial damage by poultry seedling stage.

### Site: Atkapalia, Noakhali

Root length, root weight were significantly influenced by different varieties but yield was insignificant (Tabe 2). Significantly highest root length was obtained from Tasakisan but root weight between Druit and Tasakisan were statistically identical. There was no significant difference was found in different variety but slightly higher yield from Druti. Highest gross return was recorded from Pinky which also showed higher benefit cost ratio. Yield was lower than other site that the experiment was conducted at Charland under rainfed conditions.

**Site: Jamalpur and Sylhet**

Root weight/plant, no. of root/$m^2$ and root yields was statistically identical at Jamalpur (Table 3). At Golapgonj higher yield was obtained from Druti but at Sunamgonj highest yield from Pinky.

**Farmers' reaction**

- Farmers were very much interested to cultivate Druti variety for its colour and market price.
- They react positively to cultivate this vegetable in next season if seeds are available in proper time.
- Market price of Pinky is less than Druti for its red colour.

Table 1. Yield, yield attributes and cost benefit analysis of Radish

Site: FSRD, Palima, Tangail

| No. of demo. | Variety | Root height ( cm) | Root wt./plant (g) | Root yield (t/ha) | Gross Return (Tk/ha) | Total variable cost (Tk/ha) | BCR |
|---|---|---|---|---|---|---|---|
| 1 | Pinky | 26.0 | 385 | 42.78 | 106950 | 32573 | 3.28 |
| | Druti | 28.2 | 440 | 48.98 | 146940 | 33573 | 4.38 |
| 2 | Pinky | 24.6 | 365 | 40.56 | 101400 | 29332 | 3.46 |
| | Druti | 25.6 | 425 | 47.22 | 141660 | 30832 | 4.59 |
| 3 | Pinky | 21.6 | 435 | 48.33 | 120825 | 32073 | 3.77 |
| | Druti | 24.5 | 445 | 49.44 | 148320 | 32573 | 4.55 |
| 4 | Pinky | 21.2 | 435 | 48.33 | 120825 | 32573 | 3.71 |
| | Druti | 25.0 | 495 | 54.99 | 164970 | 33073 | 4.99 |
| 5 | Pinky | 23.3 | 455 | 50.56 | 126400 | 31073 | 4.07 |
| | Druti | 24.0 | 503 | 55.89 | 167670 | 32073 | 5.22 |
| Average | Pinky | 23.34 | 415.00 | 46.11 | 115280 | 31525 | 3.66 |
| | Druti | 25.46 | 461.60 | 51.30 | 153912 | 32425 | 4.75 |

**Price (Tk./kg):** Pinky= 2.50, Druti = 3.00

Table 2. Yield, yield attributes and cost benefit analysis of radish

Site: FSRD, Atkapalia, Noakhali

| Variety | Root length (cm) | Root wt. (g) | Root yield (t/ha) | VC (Tk./ha) | Gross return (Tk./ha) | BCR |
|---|---|---|---|---|---|---|
| Pinky | 13.18b | 203.5b | 17.19 | 29835 | 85950 | 2.88 |
| Druti | 13.25b | 309.0a | 17.30 | 29835 | 69200 | 2.32 |
| Tasakisan | 15.95a | 272.8a | 16.94 | 29835 | 67760 | 2.29 |
| LSD (0.05) | 2.27 | 65.03 | ns | | | |
| CV (%) | 12.50 | 19.31 | 24.88 | | | |

**Price (Tk./kg):** Druti= 4.00, Pinky= 5.00 and Tasakisan= 5.00

Table 3. Root weight and no. of root and root yield of radish

Site: FSRD, Narikeli, Jamalpur and Golapgonj and MLT site, Sylhet

| Variety | Root wt./plant (9) | No. of roots/$m^2$ | Root yield (t/ha) | | |
|---|---|---|---|---|---|
| | | | Jamalpur | Golapgonj | Sunamgonj |
| Pinky | 469.3 | 12 | 55 | 51 | 54 |
| Druti | 470.3 | 12 | 56 | 56 | 42 |
| LSD (0.05) | ns | ns | ns | ns | 5.6 |

# ON-FARM TRIAL OF TOMATO VARIETIES


## Abstract

The experiment was conducted during Rabi season of 2001-2002 at the FSRD site, Ishan Gopalpur, Faridpur, Goyeshpur, Pabna, Golapgonj, Sylhet and MLT site Sunamgonj & Molvibazar, Sylhet and Lebukhali, Patuakhali. The results showed that BARI Tomato-7 gave higher yield (103.2 t/ha) at Ishan Gopalpur, BARI Tomato-6 at Goyeshpur (67.8 t/ha), BARI Tomato-6 at Golapgonj (74 t/ha), Molvibazer (59.5 t/ha) and BARI Tomato-8 at Sunamgonj (93.2 t/ha) and Lebukhali (70.0 t/ha).


## Introduction

Tomato is a good source of vitamin and it is grown as a winter vegetable. In the year 1996-97 the cultivation of tomato was thirteen thousand ha, and the total tomato production was 93 thousand ton. Tomato has contain a rich amount of protein, calcium, vitamin 'A' and vitamin 'C'. In Bangladesh a large number of children has been suffering from blind disease due to the deficit of vitamin 'A'. In cause of nutrition value tomato is a very important vegetables. Tomato is the most economic vegetable crop, which is commercially grown in many areas of Bangladesh. Hence there is a need to study the performance of the existing varieties at farmers' field at different location of Bangladesh.

## Materials and Methods

The experiment was conducted at the FSRD site, Ishan Gopalpur, Faridpur, Goyeshpur, Pabna, Golapgonj, Sylhet and MLT site Sunamgonj and Moulvibazer and Lebukhali, Patuakhali, respectively during Rabi season in 2001-2002. A discussion meeting was arranged with co-operator farmers for implementation of the program. Farmers were motivated and agreed to co-operate with the site team. The site team supplied good quality seeds of BARI tomato-2, 6, 7 and 8 to the farmers. Six farmers were selected and each farmers plot was considered as one replication. The treatment imposed on each replication was four BARI tomato varieties. The experiment was laid out in RCB design with six dispersed replications. The unit plot size was 4.8mx1m (Eight plot will continue one unit plot). 20-30 days old seedling were planted on 29 Nov., Nov. 30, 21-28 Nov., 2-5 Nov., 1-4 Dec. and 15 Nov. 2001 at Ishan Gopalpur, Goyeshpur, Golapgonj, Sunamgonj and Moulvibazer and Lebukhali spacing was 60 x 40 cm. The crop was fertilized with cowdung 10 t/ha and Urea TSP and MP at the rate of 550-450-250 kg/ha. Half quantity of cowdung and full dose of TSP were applied as basal during final land preparation. Remaining cowdung were applied during pit preparation. The Urea and MP were applied in two equal splits at 21 and 35 days after seedling transplantation. Dimecron/Ridomil/ Diethane were applied at 25 and 40 days after seedling transplantation and other intercultural operation were done as and when necessary. Harvesting started at 20 February`2002 and harvesting competed on 1$^{st}$ week April`2002 at Ishan Gopalpur.

## Results and Discussion

### Site: Ishan Gopalpur, Faridpur

Only fruit/plant, yield/plant and yield (t/ha) was recorded which showed significant influenced by different variety. The variety BARI Tomato-6 showed higher fruit/plant but statistically identical to BARI Tomato-2 and BARI Tomato-8. But significantly highest yield/plant was recorded from BARI Tomato-7. Similar trend was followed in yield (t/ha). Higher yield was obtained from BARI Tomato-7.

### Site: Goyeshpur, Pabna

Plant height, fruits/plant, weight of fruit/plant and yield (t/ha) was significantly influenced by different variety. Highest plant height was recorded from BARI Toamto-7 which was at par to BARI Tomato-8. Significantly highest fruits/plant was obtained from BARI Toamto-11 but this variety showed significantly lowest fruit weight. There was no significant difference in yield among the three varieties i.e. BARI Tomato-6, BARI Tomato-7 and BARI Tomato-8 but significantly higher than BARI Tomato-11.

**Site: Golapgonj, Sunamgonj and Moulvibazer, Sylhet**

Statistical analysis was not done is any of the characters. From average mean data it showed that at BARI Tomato-6 performed better at Golapgonj and Moulvibazer but BARI Tomato-8 at Sunamgonj. Although BARI Tomato showed higher no. of fruits/plant but due to less weight/plant revealed lower yield.

**Site: Lebukhali, Patuakhali**

The result showed that no. of fruits/plant, yield/plant and yields were significantly influenced by variety. Significantly highest fruits/plant was obtained from BARI Tomato-11, whereas BARI Tomato-8 showed highest yield/plant. This resulted highest yield in BARI Tomato-8 and significantly different from other variety.

From the above result it showed that BARI Tomato-7 gave higher yield at Ishan Gopalpur, BARI Tomato-6 & 7 at Goyeshpur but BARI Tomato-6 at Golapgon and Moulvibazer and BARI Tomato-8 at Sunamgonj and Lebukhali, Patuakhali, respectively.

The experiment was conducted only from one year so it needs another trial for confirmation.

Table 1. Comparative yield performance of different Tomato varieties at different location (Rabi, 2001-02)

| Location | Variety | Plant height (cm) | Fruits/plant (no.) | Yield/plant (kg) | Fruit yield (t/ha) |
|---|---|---|---|---|---|
| Ishan Gopalpur, Faridpur | BARI Tomato-2 | - | 23ab | 1.67 | 69.22b |
| | BAR Tomato-6 | - | 25a | 1.73b | 71.75b |
| | BAR Tomato-7 | - | 21b | 2.48a | 103.22a |
| | BAR Tomato-8 | - | 22ab | 1.90b | 79.02b |
| | CV (%) | | 14.0 | 11.4 | 11.4 |
| Goyeshpur, Pabna | BARI Tomato-6 | 142.20bc | 27b | 1.63a | 67.77a |
| | BAR Tomato-7 | 169.20a | 29b | 1.63a | 67.78a |
| | BAR Tomato-8 | 154.40ab | 25b | 1.53a | 63.57a |
| | BAR Tomato-11 | 125.40c | 190a | 0.92b | 39.08b |
| | CV (%) | 9.30 | 29.40 | 15.0 | 16.10 |
| Golapgonj, Sylhet | BARI Tomato-6 | - | 28 | 2.24 | 74.0 |
| | BAR Tomato-7 | - | 16 | 1.52 | 51.9 |
| | BAR Tomato-8 | - | 20 | 1.80 | 62.9 |
| | BAR Tomato-11 | - | 110 | 1.32 | 40.1 |
| Sunamgonj, Sylhet | BARI Tomato-6 | - | 24 | 2.04 | 65.8 |
| | BAR Tomato-7 | - | 18 | 1.52 | 61.6 |
| | BAR Tomato-8 | - | 27 | 1.80 | 93.2 |
| | BAR Tomato-11 | - | 101 | 1.32 | 33.4 |
| Moulvibazer, Sylhet | BARI Tomato-6 | - | 22 | 1.65 | 59.5 |
| | BAR Tomato-7 | - | 15 | 1.50 | 51.3 |
| | BAR Tomato-8 | - | 18 | 1.69 | 86.5 |
| Lebukhali Patuakhali | BARI Tomato-6 | - | 24a | 1.94b | 63.0b |
| | BAR Tomato-7 | - | 23a | 1.97b | 64.0b |
| | BAR Tomato-8 | - | 23a | 2.13a | 70.0a |
| | BAR Tomato-11 | - | 19b | 1.89b | 62.0b |

# STUDY ON THE LATE PLANTING POTENTIAL OF SOME TOMATO VARTIEIES IN RABI SEASON


## Abstract

An experiment was conducted at the RARS, Rahmatpur, Barisal and Lebukhali, Patuakhali during Rabi 2001-2002. Four tomato varieties (BARI Tomato-4, BARI Tomato-5, BARI Tomato-6 & BARI Tomato-10) were planted in four different sowing dates (16 December 2001, 01 & 16 January 2002 and 01 February 2002). BARI tomato-4 planted at 16 December performed better and showed that late planting is feasible with reasonable good yield (61.67 t/ha). At Lebukhali, reasonable good yield was obtained from variety BARI Tomato-6 and BARI Tomato-2 which could be grown from Dec. 2 to Jan. 16.


## Introduction

Gradual increase in the price of tomato after the period of seasonal abundance offers an opportunity of growing tomato late in the season to avail the benefit of high market price. Growing a long duration variety that gives good yield towards the end of the growing season or planting suitable varieties as late crop might be useful in this regard. For satisfactory production, such varieties should have high temperature tolerance. However, suitable varieties have not yet been available for such conditions in Bangladesh. In this situation, it is worth while to study the late planting potential of existing varieties and select better one(s) for late planting in different AEZ of the country. So, the trial has been designed to find out the suitable tomato variety for late Rabi.

## Materials and Methods

An experiment was conducted at the RARS, Rahmatpur, Barisal and Lebukhali, Patuakhali during Rabi season 2001-2002 to find out the potential tomato variety for late Rabi season. The trial was set up in a split plot design with 3 replications. Four planting dates (16 December, 01 & 16 January and 01 February) were assigned in the main plots and four tomato varieties (BARI Tomato-5, BARI Tomato-6 and BARI Tomato-10) were assigned in the sub plots. Unit plot size was 3x4 $m^2$ and the seedlings were transplanted following 60 x 50 cm spacing. Recommended fertilizer dose and cultural practices were followed as and when necessary. Diethene M-45 and Ridomil were sprayed before flowering. Collected data were analyzed statistically. For mean comparison Duncan Multiple Range Test was calculated.

## Results and Discussions

### Site: Rahmatpur, Barisal

Among four different planting dates, 16 December planting performed better in all respect and gave the highest yield (43.93 t/ha). It is remarkable that plant height, fruit bearing, fruit size, fruit weight as well as Total Soluble Sugar (TSS) decreased with increasing temperature that is planting after December (Table 1).

Among four tomato varieties, BARI Tomato-4 gave the significantly highest yield (25.9 t/ha). Significantly bigger fruit (39g) was produced from BARI tomato-6. Plant height (84.75cm), fruit size, weight and percent TSS (2.46) were higher in BARI Tomato-6 but bearing was less (6.08 fruit/plant). BARI Tomato-4 and BARI Tomato-5 showed higher bearing habit (20.92 and 20.75 fruits/plant).

Interaction between sowing date and variety was found significant in respect of plant height, fruits/plant, fruit length and diameter, TSS (%) and yield (Table 3). Significantly highest plant height was obtained from D1V3. The treatment D1V1 and D2V2 showed similar fruits/plant and higher than all other treatments. Fruit length and diameter revealed higher from treatments D2V3. Weight of fruit/plant varied from 18 to 52 gm but insignificant. Higher weight from D1V3. Al the varieties sown on December 16 showed higher TSS (%). Significantly highest fruit yield was recorded from December 16 sowing of BARI Tomato-4 variety. All the varieties showed lower fruit weight after January 16 sowing. BARI Tomato-6 did not paper well in all dates of sowing.

**Site: Lebukhali, Patuakhali**

Days to flowering, no. of fruits/plant, fruit wt., yield/plant and yield (t/ha) was significantly influenced by sowing date and variety (Table 4). Sowing from Dec. 2 with variety BARI Tomato-6 and BARI Tomato-2 showed higher no. of fruits/plant. Similar trend was followed in case of fruits wt. BARI Tomato-6 and BARI Tomato-2 gave highest yield/plant which resulted higher yield.

From above result it showed that under late planting (December 15) BARI Tomato-4 performed better with reasonable gave yield at Barisal region. But at Lebukhali, BARI Tomato-6 and BARI Tomato-2 could be grown from Dec. 2 to Jan. 6 with good yield. The experiments need to be continued another year for confirmation.

Table 1. Effect of sowing dates on the yield and yield components of different Tomato varieties (Rahmatpur, 2001-02)

| Treatments | Plant height (cm) | Days to 50% flowering | Fruits/ cluster | Fruits/ plants | Fruit length (cm) | Fruit dia (cm) | Weight/ fruit (gm) | TSS (%) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| $D_1$ (Dec.16) | 99.5a | 35a | 5.42a | 27.58a | 3.91a | 3.66a | 38.67a | 2.66a | 43.93a |
| $D_2$ (Jan. 01) | 81.25b | 34b | 5.00a | 20.08b | 3.80a | 3.67a | 34.58b | 2.25b | 22.90b |
| $D_3$ (Jan. 16) | 64.42c | 33c | 3.85b | 11.16c | 3.68a | 3.54a | 25.08c | 2.15c | 6.25c |
| $D_4$ (Feb. 01) | 58.08d | 32d | 3.80b | 8.08d | 3.37b | 3.22b | 19.67d | 2.12c | 2.38c |
| CV(%) | 6.78 | 1.87 | 13.43 | 8.76 | 5.11 | 5.69 | 11.10 | 4.92 | 22.97 |

Table 2. Effect of variety on the yield and yield components of different Tomato varieties (Rahmatpur, 2001-02)

| Treatments | Plant height (cm) | Days to 50% flowering | Fruits/ cluster | Fruits/ plants | Fruit length (cm) | Fruit dia (cm) | Weight /fruit (gm) | TSS (%) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| $V_1$ (BARI Tomato-4) | 71.00b | 30.92c | 4.57 | 20.92a | 3.70ab | 3.30b | 27.66b | 2.23b | 25.9a |
| $V_2$ (BARI Tomato-5) | 75.50b | 33.50b | 4.50 | 20.75a | 3.61b | 3.18b | 24.50c | 2.26b | 19.17b |
| $V_3$ (BARI Tomato-6) | 84.75a | 40.25a | 4.53 | 6.08c | 3.84a | 4.28a | 39.00ab | 2.46a | 11.63c |
| $V_4$(BARI tomato-10) | 72.00b | 30.75c | 4.47 | 19.17b | 3.68ab | 3.30b | 26.83c | 2.30b | 18.79b |
| CV (%) | 6.78 | 1.87 | 13.43 | 8.76 | 5.11 | 5.69 | 11.10 | 4.92 | 22.97 |

Table 3. Interaction effect of different sowing dates and varieties on yield and yield components of Tomato (Rahmatpur, 2001-02)

| Treatments | Plant height (cm) | Days to 50% flowering | Fruits/ cluster | Fruits/ plant | Fruit length (cm) | Fruit dia (cm) | Weight/ fruit (gm) | TSS (%) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| D1V1 | 49.67bc | 32 | 5.13 | 36.33a | 3.96abc | 3.38cd | 37.00 | 2.65a | 61.97a |
| D1V2 | 97.00b | 35 | 5.53 | 34.67a | 3.75cde | 3.22cd | 33.33 | 2.67a | 46.75b |
| D1V3 | 115.33a | 42 | 5.47 | 9.67gh | 4.29c | 4.73a | 51.67 | 2.72a | 27.33cd |
| D1V4 | 96.00b | 32 | 5.53 | 29.67b | 3.65cde | 3.31cd | 32.67 | 2.59ab | 39.67b |
| D2V1 | 75.33de | 32 | 4.93 | 22.00d | 3.67cde | 3.34cd | 33.67 | 2.12def | 30.42c |
| D2V2 | 83.00cd | 34 | 5.27 | 26.00c | 3.74cde | 3.20cd | 30.00 | 2.20def | 23.17cde |
| D2V3 | 94.33b | 41 | 5.27 | 7.00ij | 4.15ab | 4.72a | 44.33 | 2.45bc | 16.00ef |
| D2V4 | 72.33ef | 31 | 4.53 | 2.33c | 3.89bc | 3.42cd | 30.33 | 2.25cd | 22.17de |
| D3V1 | 59.00g | 30 | 4.13 | 14.33e | 3.77cd | 3.35cd | 20.67 | 2.02ef | 7.67gh |
| D3V2 | 62.33g | 32 | 3.53 | 12.33efg | 3.90def | 3.29cd | 19.67 | 2.05def | 4.42gh |
| D3V3 | 72.33ef | 40 | 3.73 | 4.67jk | 3.68cde | 4.14b | 33.67 | 2.44bc | 2.50gh |
| D3V4 | 64.00fg | 31 | 4.00 | 13.33ef | 3.79cd | 3.45cd | 26.33 | 2.10def | 1.42fg |
| D4V1 | 60.00g | 30 | 4.07 | 11.00fgh | 3.42def | 3.12d | 29.33 | 2.14def | 3.55gh |
| D4V2 | 59.67g | 32 | 3.67 | 10.00gh | 3.46ef | 3.09d | 15.00 | 2.14def | 2.33gh |
| D4V3 | 57.00g | 38 | 3.67 | 3.00k | 3.22f | 3.59d | 26.33 | 2.23de | 2.00h |
| D4V4 | 55.67g | 29 | 3.80 | 8.33hi | 3.39ef | 3.13d | 18.00 | 1.98f | 8.75gh |
| CV (%) | 6.78 | 1.87 | 13.43 | 8.76 | 5.11 | 5.69 | 11.10 | 4.92 | 22.97 |

Table 4. Interaction effect of planting time and variety on the yield of tomato (Lebukhali, 2001-02)

| Planting time | Variety | Days to 50% flowering | No. of fruits/ plant | Average fruit wt. (gm) | Yield (kg/plant) | Yield (ton/ha) |
|---|---|---|---|---|---|---|
| Dec. 2 | BARI Tomato-4 | 40d | 20cd | 34ef | 0.692fg | 23fg |
| | BARI Tomato-5 | 41d | 21c | 35e | 0.738f | 25f |
| | BARI Tomato-6 | 48a | 26ab | 83a | 2.175a | 72a |
| | BARI Tomato-2 | 48a | 26ab | 83a | 2.176a | 73a |
| Dec. 16 | BARI Tomato-4 | 41d | 20cde | 32efgh | 0.623fgh | 21fgh |
| | BARI Tomato-5 | 41d | 20cd | 31fgh | 0.642fgh | 21fgh |
| | BARI Tomato-6 | 47b | 27a | 83a | 2.117ab | 71ab |
| | BARI Tomato-2 | 46b | 26ab | 83a | 2.033bc | 68bc |
| Jan. 1 | BARI Tomato-4 | 36g | 19de | 34ef | 0.607fgh | 20fgh |
| | BARI Tomato-5 | 36g | 19de | 33efg | 0.632fgh | 21fgh |
| | BARI Tomato-6 | 43c | 25b | 79b | 2.047ab | 68ab |
| | BARI Tomato-2 | 43c | 24b | 79b | 2.033bc | 68bc |
| Jan. 16 | BARI Tomato-4 | 34h | 19cde | 30gh | 0.567gh | 19gh |
| | BARI Tomato-5 | 34h | 19cde | 30gh | 0.577gh | 19h |
| | BARI Tomato-6 | 43c | 25ab | 74c | 1.856d | 62d |
| | BARI Tomato-2 | 38e | 26ab | 73c | 1.896cd | 63cd |
| Feb. 1 | BARI Tomato-4 | 32i | 18e | 29h | 0.512h | 17h |
| | BARI Tomato-5 | 32i | 19cde | 29h | 0.557gh | 19gh |
| | BARI Tomato-6 | 41d | 19cde | 72cd | 1.043e | 48e |
| | BARI Tomato-2 | 37f | 21c | 70d | 1.463e | 49e |
| | CV (%) | 0.97 | 4.73 | 2.73 | 4.89 | 4.86 |
| | LSD(.01) | .84 | 2.26 | 3.25 | 0.14 | 4.46 |

# EVALUATION OF CHERRY TOMATO VARIETIES IN DIFFERENT AGRO-ECOLOGICAL REGIONS


## Abstract

An experiment was conducted at Agricultural Research station Bogra during 2000-01 and 2001-02 to find out adaptability and performance of cherry tomato varieties in different agro-ecological zone. After two years experimentation, it was found that the variety AT-112 (60.76 t/ha) gave highest yield due to weight of fruit and yield/plant.


## Introduction

Cherry tomato varieties have recently been introduced in Bangladesh. These are vary rich source of carotene as well as vitamin-C and can play a vital role in improving the nutrition of vast rural masses. However, the recently introduced varieties have not been evaluated in the diverse Agro-ecological regions of the country and farmers' acceptance of the varieties has not been evaluated. Considering the above facts, the trial was undertaken to evaluate the performance of available varieties in different Agro-ecological regions of the country.

## Materials and Methods

The experiment was conducted at Agricultural Research Station, Bogra during Rabi season from 2000-01 to 2001-2002. The soil was silty loam in texture which belongs to Karatoya-Bangali flood plain Agro-ecological zone (AEZ-25). The experiment was laid out in Randomized Complete Block design with three replications. The unit plot size was 3 m x 3 m and the plant spacing was 60 cm x 50 cm. Four varieties AT-110, AT-111, AT-112 and AT-113 obtained from AVRDC and two from BARI (BCT-4 and BCT-5) were tested. The land was thoroughly prepared and fertilization was done with cowdung, Urea, TSP, MP, Gypsum, Boric acid and NH4-molibdate @ 10 t/ha, 100 N, 75 $P_2O_5$, 125 $K_2O$, 40 S, 7.5 B kg/ha and 550 gm/ha respectively. Half of the cowdung, $P_2O_5$ and total amount of Gypsum, Boricacid and NH4-Molibdate were applied during final land preparation. The remaining 50% cowdung and $P_2O_5$ were applied during pit preparation prior to planting. The rest N and $K_2O$ were applied in 2 equal installments at 21 and 35 days after transplantation followed by irrigation. Thirty days old seedlings were transplanted. Azodrin and Ridomil were used for controlling the Aphids and late blight of tomato respectively. Data on date of 50% flowering, plant height, fruit/plant, fruit /cluster, average weight of fruit, seed/fruit, marketable yield/ plant/ha, date of 1st and last harvest were recorded. Duration of harvest of different varieties of tomato was recorded which showed variation i.e. AT-110 (27 days, 2-24 April), AT-111 (22 days, 2-24 April), At-112 (21 days, 2-23 April), At-113 (22 days, 2-24 April), BCT-5 (18 days, 22 March-9 April) & BCT-6 (18 days, 22 March-9 April). Slight variation was noticed in 2001-02.

## Results and Discussion

Days to flowering, plant height, yield and yield contributing characters were significantly influenced by different varieties of tomato (Table 1).

Maximum days to 50% flowering (58-60 days) was recorded from variety AT-110, AT-111, AT-112, AT-113 and minimum from BCT-4 and BCT-5 (39-43 days). Significantly highest plant height was recorded from variety AT-113 in 2001-02 but same variety also showed higher but statistically at par to AT-110 in 2000-01. In both the year variety BCT-4 showed lowest height. Highest fruit/plant was recorded from variety BCT-5 in 2000-01 but in 2001-02, BCT-4 and BCT-5 were statistically identical. Almost similar trend was followed in case fruit/cluster. But seed/fruit was significantly highest from variety AT-110 in both the years. Significantly highest fruit weight was obtained from variety AT-112 in 2000-01. Similar trend was followed in 2001-02. Highest yield/plant was recorded from variety AT-112 in 2000-01 but AT-112 and At-111 showed similar yield. Similar trend was followed in case of yield (t/ha). Although higher no. of fruits/plant and fruit/cluster in variety BCT-4 and BCT-5 but failed to gave higher yield than At-112 due to less weight of fruit and yield/plant.

From two years showed that the variety AT-112 gave highest yield (60.76 t/ha) but moderate yield could be obtained from variety AT-111, At-113 and AT-110 (48.96-54.80 t/ha). Though BCT-4 and BCT-5 showed lowest yield but farmers are interested due to its colour, shape and size.

Table 1. Performance of different characters of six cherry tomato varieties at ARS, Bogra, 2000-2001

| Varieties | Days to 50% flowering | | Plant height (cm) | | Fruit/plant | | Fruit/cluster | |
|---|---|---|---|---|---|---|---|---|
| | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 |
| AT-110 | 58a | 60a | 155.4b | 194.6ab | 35.60c | 42.8d | 2.64c | 2.29c |
| AT-111 | 54b | 60a | 162.9b | 186.9b | 45.70c | 48.93d | 2.738c | 2.62c |
| AT-112 | 58a | 59a | 160.2b | 185.7b | 39.63c | 41.18d | 2.437c | 2.46c |
| AT-113 | 50c | 59a | 191.0a | 198.7a | 89.75b | 103.5c | 5.055b | 3.60b |
| BCT-4 | 43d | 39c | 95.67d | 102.1d | 322.0a | 452.6b | 7.448a | 9.49a |
| BCT-5 | 43b | 40b | 123.7c | 148.5c | 293.1a | 476.0a | 7.195a | 8.90a |
| F-Test | *** | *** | *** | *** | *** | *** | *** | *** |
| CV (%) | 3.13 | 2.21 | 4.41 | 5.15 | 14.84 | 9.98 | 11.66 | 10.87 |

Table 1. Contd.

| Varieties | Seed/fruit (no.) | | Average fruit weight. (g) | | Yield/plant (kg) | | Yield (t/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 | 2000-01 | 2001-02 | Mean |
| AT-110 | 100.3a | 99.0a | 38.82b | 36.83b | 1.378c | 1.56c | 45.83c | 52.08c | 48.96 |
| AT-111 | 74.17b | 76.33b | 33.12c | 36.83b | 1.507bc | 1.79ab | 49.74bc | 59.85ab | 54.80 |
| AT-112 | 75.50b | 80.5b | 46.57a | 44.93a | 1.798a | 1.85a | 59.96a | 61.55a | 60.76 |
| AT-113 | 48.50c | 59.33c | 17.61d | 15.74c | 1.578b | 1.62bc | 52.61b | 54.01bc | 53.31 |
| BCT-4 | 8.50d | 10.33d | 2.518c | 1.85d | 0.804d | 0.836d | 26.69d | 27.85d | 27.27 |
| BCT-5 | 13.83d | 15.67d | 2.533c | 2.11d | 0.815d | 1.002d | 27.16d | 33.39d | 30.27 |
| F-Test | *** | *** | *** | *** | *** | *** | *** | *** | |
| CV (%) | 11.23 | 12.25 | 11.31 | 13.28 | 13.28 | 12.28 | 14.15 | 12.29 | |

Figure(s) followed by different letters in same column are statistically significant at 0.1% level of probability.

# ON-FARM TRIAL OF EARLY GARDEN PEA VARIETY BARI MOTORSHUTI-3 (AGURI)


## Abstract

An on-farm trial was conducted at FSRD site Palima, Tangail, Goyeshpur, Jamalpur, Golapgonj and Sunamgonj during rabi 2001-02 to observe the performance of newly developed garden pea variety BARI Motorshuti-3 (Aguri) at different farmers' fields. BARI Motorshuti-3 gave 5080.4 kg/ha marketable yield with average benefit cost ratio 4.68 at Palima. Seed yield (t/ha) also similar among two varieties at Jamalpur where only one variety used at Golaopgonj and Sunamgonj. The yield from Jamalpur, Goyeshpur, Golapgonj and Sunamgonj were 2.61, 8.5, 5.5 and 7.0 t/ha, respectively.


## Introduction

Garden pea is one of the nutritious winter vegetables. It is rich in protein, calcium, vitamin and iron. 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 three- motorshuti variety (BARI motorshuti-1, BARI motorshuti-2 and BARI motorshuti-3). First two already have got popularity in farmer's level. BARI motorshuti-3 is one new motorshuti variety. To observe the performance of BARI motorshuti-3 in the farmer's field, the trial was conducted at farm level.

## Materials and Methods

The trial was conducted at FSRD site, Narikeli, Jamalpur, Goyeshpur, Pabna, Palima, Tangail and Sunamgonj & Golapgonj, Sylhet during rabi 2001-2002. Two motorshuti variety viz. BARI motorshuti-1 (check) and BARI motorshuti-3 was sown on 15 October 2001 at different farmer's field at Jamalpur, 24 Nov. to 4 Dec. 01 at Sylhet and 12 Nov. 01 FSRD site, Goyeshpur, Pabna. The plot size was 3 x 2 m. The trial was set at randomized complete block design with six dispersed replication. Fertilizer was used at the rate of 150, 150, 100 kg/ha Urea, TSP and Mp, respectively and also used 10 t/ha cowdung. The entire amount of cowdung, TSP and half urea and Mp were used at final land preparation. The rest of urea and MP were used at two top dresses at 20 and 30 days after sowing. Data were recorded from whole plot basis.

## Result and discussion

From the table, it is revealed that plant/m$^2$ was identical. Pods/m$^2$ have no significant difference but numerically higher pods/plant was observed in BARI motorshuti-3. Seed yield (t/ha) also similar among two varieties at Jamalpur where only one variety used at Golaopgonj and Sunamgonj. The yield from Jamalpur, Goyeshpur, Golapgon and Sunamgonj were 2.61, 8.5, 5.5 and 7.0 t/ha, respectively (Table 1 & 2).

At Palima, the data on yield and yield components of BARI Motorshuti-3 are presented in Table 3. Total number of pod/plant ranged from 12 to 14. Days to first harvest were 54 to 55 days. Total number of plants at last harvest was 26 to 30 at different demonstration plots. Average marketable yield was 5080 kg/ha . The benefit cost ratio indicated that this technology has better acceptance and adoption to the farmers. There was no attack of insect pest and disease in demonstration plot but partial damage the crop by poultry during seedling stage.

### Farmer's reaction

Farmer's at FSRD site, Narikeli, Jamalpur FSRD site gave their highly positive reaction to produce the BARI motorshuti-3 because of its earliness. Farmers of Goyeshpur also showed keen interest as its short duration. Farmers were very positive with new vegetable market price. They showed much interest to cultivate this vegetable in next season if seeds are available in proper time. Farmers opined that BARI Motorshuti-3 is insect pest and disease free.

Table 1. Yield of garden pea in the farmer's field at FSRD site, Narikeli, Jamalpur

| Treatment | Plant/m$^2$ | Pods/m$^2$ | Yield (t/ha) | | |
|---|---|---|---|---|---|
| | | | Jamalpur | Golapgonj | Sunamgonj |
| BARI motorshuti-1 | 27.7 | 578 | 2.50 | - | - |
| BARI motorshuti-3 | 27.8 | 583 | 2.61 | 5.5 | 7.0 |
| CV(%) | 2.98 | 6.18 | 5.53 | - | - |
| F-test | ns | ns | ns | - | - |

Table 2. Days to flowering and harvest, pods/plant and pod yield of BARI Motorshuti-3 (Aguri) Goyeshpur, Pabna

| Variety | Days to 50% flowering | Days to harvest | Pods/plant | Pod yield (t/ha) |
|---|---|---|---|---|
| BARI Motorshuti-3 (Aguri) | 38 | 63 | 11 | 8.5 |

Table 3. Performance of BARI Motorshuti-3 production at FSRD site Palima, Tangail during rabi 2001-2002

| No of Demo. | Total no. of pod harvested /plant | Days to first harvested | Total no. of plant at last harvest | Marketable yield (kg/ha) | Gross Return (Tk/ha) | Total variable cost (Tk/ha) | BCR |
|---|---|---|---|---|---|---|---|
| 1 | 13 | 54 | 30 | 5135 | 61620 | 12979 | 4.75 |
| 2 | 12 | 54 | 27 | 5018 | 60216 | 12779 | 4.71 |
| 3 | 13 | 55 | 29 | 5099 | 61188 | 12899 | 4.74 |
| 4 | 13 | 55 | 26 | 4997 | 59964 | 12589 | 4.76 |
| 5 | 14 | 55 | 30 | 5153 | 61836 | 13979 | 4.42 |
| Average | 13 | 55 | 28 | 5080 | 60950 | 13045 | 4.68 |

- Cultivation Cost = Tk. 7/ dec.
- Labour Cost = Tk. 50/ day
- Motorshuti = Tk. 12/kg
- Urea = Tk. 6.0 /kg
- TSP = Tk. 15 /kg
- MP = Tk. 10 /kg

# ON-FARM ADAPTABILITY TRIAL OF COUNTRY BEAN VARIETIES AT MADHUPUR MLT SITE, TANGAIL


## Abstract

On-Farm adaptability trial of six promising bean varieties BARI Seem-1, BARI Seem-2, IPSA Seem-2, Karti Koda Seem (MCC), Madhupur Seem (MCC), Bata Sheem Seem (MCC) against Local check was conducted at Madhupur MLT site.Although variety BARI seem-1 showed higher yield /pit but statistically identical to IPSA seem-2, Karti kuda seem and Modhupur seem in 2001-02. Similar trend was followed in 2000-01. Early flowering was observed by 51 days for BARI Seem-2 over local variety (103 days).The days required for 1st harvest to last harvest for BARI Seem-2, Bata Sheem Seem, Karti koda Seem , BARI Seem-1, IPSA Seem-2 and local were 97-168, 103-177, 125-201, 135-206, 132- 201 and 135-205 respectively.


## Introduction

In Bangladesh, a person consumes 104 g vegetables per day where as 200g per day is needed. More than 75% people of Bangladesh live below the poverty line (Hossain, 1985) and most of whom can not affort costly food like meet, egg, fish and milk. In this situation vegetables can play significant role to meet up the nutritional requirement of these people. In terms of dry matter, Calorie, Protein, fat, minerals, vitamins, pods of bean are superior to most other vegetables of creeping nature (Ahmad, 1982). The bean is used as well as vegetables, matured seeds as pulses and the plants as fodder. But the production of vegetables is not sufficient to meet the demand of the country. Country bean is widely grown vegetable in Bangladesh. So, far BARI and IPSA each has released two improved varieties of country bean which are now grown in a few localized pocket areas. Besides, MCC has a germplasm collection and improvement program where three improved genotypes were selected. It is essential to evaluate all these varieties/germplasms in different agro-ecological regions of the country to study their suitability for different location. Considering the above facts six promising varieties of country bean were taken for adaptability study at MLT site, Madhupur, Tangail, during 2001-2002.

## Materials and Methods

The experiment was conducted at the MLT site, Madhupur, Tangail during 2001-2002, on medium high land. The varieties were used i) BARI Seem-1 ii) BARI Seem-2 iii) IPSA Seem-2 iv) Karti koda Seem (MCC) v) Madhupur Seem (MCC) vi) Bata Sheem Seem (MCC) and vii) Local Check. The experiment was laid out in randomized complete block design with six replications having unit plot size 5.5mx5.5m and plant spacing 1.5 x 1.5 m. Cowdung, Urea, TSP, MP, Gypsum bad Boric acid were applied at the rate of 10t/ha, and 15-22-33-1-1 Kg NPKSB/ha. Total amount of cowdung, gypsum and Boric acid were applied during the final land preparation. The remaining total TSP, half of Urea and MP were applied during pit preparation prior to sowing. The rest urea and MP were applied in two equal installments at 21 and 35 days after sowing. Four seeds were sown in the pit on 16th August, 2001 and harvest was done from December 2001 to March, 2002 on the basis of variety. Finally only one healthy seedling was kept per pit. Darsban was used as a plant protection measure against aphid at the rate of 1ml /litre water after seven days interval. Bamboo made platform was used as support for bean. Two weeding one at 15-20 and another at 35-40 days after sowing were done to keep the crop weed free. Data on 50% flowering, first and last harvest date, pod / plant, seed / pod and yield/pit were recorded from each plot. The collected data were analyzed statistically.

## Results and Discussion

The result showed that pod/plant, seed/pod and yield/pit were significantly influenced by different variety (Table 1). The variety BARI seem-2 showed early flowering and harvest than other varieties. Local (check) revealed larger duration of harvest and similar to BARI seem-1, IPSA seem-2, Karti Koda seem and Modhupur seem. Significantly highest number of pods/plant was obtained from Modhupur seem. In case of seeds/pod, IPSA seem-2 and BARI seem-1 showed similar number of seeds/pod and higher than other varieties. Although variety BARI seem-1 showed higher yield/pit but statistically identical to IPSA seem-2, Karti koda seem and Modhupur seem in 2001-02. Similar trend was followed in case of yield in 2000-01. The variety Modhupur seem showed much higher pod/plant than the BARI seem-1 but seeds/pod was less which ultimately failed to show higher yield.On an average, the result showed that BARI seem-2 could be grown for higher yield and early maturity.

## Conclusion

The variety BARI Seem-2 gave higher yield and it was 38 days earlier than local variety. Moreover, further research program is needed to find out variety, which is same or better than local variety in respect of cooking quality and taste.

### Farmer's Reaction

Among the seven tested varieties farmers preferred local variety because of its taste, easy boiling quality and making smash. However, among new varieties they preferred BARI Seem-2 for its early fruiting and high market price.

### References


Ahmed, K.U. 1982, Gardener's Book of production and nutrition vol.1, published by Mr. Mumtuz Kamal, Krishi Sarak, Farmgate, Dhaka-15.

Hossain, A. 1985, Key notepaper on Fruit Vegetable Research in Bangladesh, BARC, Farmgate, Dhaka-15.


Table 1. Agronomic and Yield performance of different country bean varieties (MLT site, Madhupur, Tangail, 2001-2002)

| Variety | Days to 50% flowering | Harvest period (days) | Pod/ plant (no.) | Seed /pod (no.) | Yield/pit (kg) | | Average yield (kg/pit) |
|---|---|---|---|---|---|---|---|
| | | | | | 2001-02 | 2000-01 | |
| BARI Seem-1 | 92 | 135-206 | 364bc | 4.89a | 3.62a | 3.51a | 3.57 |
| BARI Seem-2 | 74 | 97-188 | 335.28c | 3.99b | 2.56b | 2.25b | 2.41 |
| IPSA Seem-2 | 97 | 132-201 | 118.57ef | 4.98a | 3.47a | 3.46a | 3.47 |
| Karti Koda Seem | 95 | 125-201 | 267.00d | 4.23b | 3.35a | 3.39a | 3.37 |
| Madhupur Seem | 90 | 136-202 | 796.25a | 2.92c | 3.15a | 3.24a | 3.20 |
| Bata Sheem Seem | 86 | 103-177 | 112.19f | 4.19b | 2.37b | 2.24b | 2.31 |
| Local (Check) | 90 | 135-205 | 105.76f | 4.04b | 2.10c | 2.12b | 2.11 |
| CV (%) | - | - | 13.24 | 8.51 | 5.84 | 8.45 | - |

# EFFECT OF PLANTING TIME ON THE PERFORMANCE OF BUSHBEAN


## Abstract

An experiment was conducted at RARS, Rahmatpur, Barisal in 2001-02 and Agricultural Research station, Bogra during 1999-2001 to determine the optimum range of planting for BARI bush bean-1. Average over the year, it revealed that BARI bushbean-1 gave highest marketable green pod yield from Nov. 16 sowing (20 t/ha). Desirable yield was also obtained from Nov. 22 (17.11-19.61 t/ha) and Dec. 1 (16.99-16.66 t/ha) sowing. December 8 sowing at Bogra but at Rahmatpur, 15 December gave significantly highest yield (11.57 t/ha) among the sowing date.


## Introduction

Bushbean a newly introduced vegetable is grown in Bangladesh in a limited scale. The only variety BARI Bush bean-1 is available which a short duration crop with highly synchronous bearing. Bushbean is a potential crop with high yield potential. The crop is not grown in Bogra and Barisal area so it is completely new crop in that region. So, an experiment was undertaken to find out the optimum time of sowing of BARI Jharseem-1 for higher yield at Barisal and Bogra region.

## Materials and Methods

The experiment was conducted at RARS, Rahmatpur, Barisal in 2000-01 and Agricultural Research station, Bogra during rabi season from 1999-00 to 2001-02. The soil of Bogra was silty loam in texture which belongs to Karatoya Bangali floodplain Agro-ecological zone of Bangladesh (AEZ-25). The experiment was laid out in Randomized complete block Design with 3 replications. The unit plot size was 2.1 m x 1. 6 m. Eight sowing dates Nov. 16, 22, Dec. 1, 8, 15, 22, Jan. 1 and Jan 8 were tested. The land was thoroughly prepared and fertilization was done with cowdung, Urea, TSP, MP @ 10 t/ha, 25 N, 75 $P_2O_5$ and 90 $K_2O$ kg/ha, respectively. The variety of crop was BARI-Jharseem-1 and plant spacing was 40 cm x 15 cm. First irrigation was done at 30 days after sowing followed by top dressing. Second and 3rd irrigation were done at flowering and at pod development stage respectively. Azodrin and Ridomil were used for controlling Jassid and collar rot respectively. Date of 50% flowering, plant height, number of pod per plant, length of pod, harvesting date and marketable yield were recorded.

## Results and Discussion

### Bogra site

Date of flowering, plant height, pods/plant, length of pod and yield was significantly influenced by different dates of sowing (Table 1). Plant height was higher in Nov. 16 to Nov. 22 sowing, December sowing showed lowest plant height might be due to cold temperature prevails during this time. Significantly higher pods/plant was obtained from November 16 and than was trend to decrease pods/plant with the advancement of days. Long of pod was not shown in different trend. Pod yield between Nov. 16 to Nov. 22 was statistically identical and higher than other dates of sowing in 2001-02 but statistically highest pod yield was recorded from November 16 sowing in 2000-01. On an average, early sowing (November 16) showed higher yield.

### Barisal site

Plant height, pods/plant, length and width of pod and pod yields were significantly influenced by different dates of sowing (Table 1). Higher no. of pods/plant was obtained from December 15 which was statistically identical to December 8 and January 1 sowing. Significantly highest pods/plant was recorded from December 15 sowing. Pod length was statistically identical to December 1 to December 15 sowing but width of pod was different i.e. December 15 to January 1 sowing was at par. Significantly highest pod yield was obtained from December 15 sowing due to higher no. of pods/plant and width of pod.

## Conclusion

Two years result showed that Bushbean could be grown from November 16 to November 22 but substantial yield possible up to December 1 sowing at Bogra. From Barisal showed that December 15 sowing is the optimum time but it needs another year trial for confirmation.

Table 1. Mean performance of Bush bean cv. BARI Jharseem-1 at different sowing dates at level Barind soil of ARS, OFRD, Bogra

| Sowing time | Date of 50% flowering | Plant height (cm) | Pod/plant (no.) | Length of pod (cm) | Marketable yield (t/ha) | |
|---|---|---|---|---|---|---|
| | | | | | 2001-02 | 2000-01 |
| Nov. 16 | 41d | 31.90a | 26.87a | 11.55d | 20.28a | 20.12a |
| Nov. 22 | 44bc | 31.97a | 22.63b | 12.36cd | 19.61a | 17.11b |
| Dec. 01 | 45ab | 22.73c | 18.33c | 12.91bc | 16.66b | 16.90b |
| Dec. 08 | 46a | 22.67c | 14.33d | 14.35a | 15.00c | 8.63c |
| Dec. 15 | 45ab | 26.40b | 12.17d | 14.07ab | 11.11d | 9.17c |
| Dec. 22 | 42cd | 26.43b | 9.43e | 13.43abc | 7.26e | 8.78dc |
| Jan. 01 | 42cd | 28.77b | 8.86e | 13.28abc | 6.26ef | 5.74d |
| Jan.08 | 41d | 27.00b | 8.33e | 13.67ab | 5.60f | 5.54d |
| F-test | *** | *** | *** | *** | *** | *** |
| CV (%) | 2.55 | 5.77 | 8.33 | 4.82 | 5.81 | 7.79 |

Figure (s) followed by different letters in same column are statistically significant at 0.1 % level of probability.

Table 2. Yield and frequency of harvest of BARI bush bean per plot against different sowing dates

| Sowing date | Frequency of harvest | Date of harvest | Pod harvested/plot | Total vegetable pod. (Kg) |
|---|---|---|---|---|
| Nov. 16/2001 | 1st harvest | Jan. 24/02 | 4.26 (62.56%) | 6.81 |
| | 2nd harvest | Feb. 9/02 | 2.55 (37.44%) | |
| Nov.22/2001 | 1st ,, | Jan.28/02 | 2.41 (36.63%) | 6.58 |
| | 2nd ,, | Feb. 9/02 | 4.17 (63.37%) | |
| Dec. 01/2001 | 1st ,, | Feb. 12/02 | 3.92 (70.%) | 5.60 |
| | 2nd ,, | Feb. 20/02 | 1.68 (30%) | |
| Dec. 08/2001 | 1st ,, | Feb. 27/02 | 3.64 (72.2%) | 5.04 |
| | 2nd ,, | Mar.4/02 | 1.4 (27.8%) | |
| Dec.15/2001 | 1st ,, | Mar. 4/02 | 2.8 (75.06%) | 3.73 |
| | 2nd ,, | Mar. 10/02 | 0.93 (24.94%) | |
| Dec.22/2001 | 1st ,, | Mar. 8/02 | 2.44 (100%) | 2.44 |
| Jan.01/2002 | 1st ,, | Mar. 10/02 | 2.10 (100%) | 2.10 |
| Jan. 08/2002 | 1st ,, | Mar. 14/02 | 1.88 (100%) | 1.88 |

Table 3. Effect of different sowing dates on the yield and yield contributing characters of Bushbean at Rahmatpur, Barisal

| Treatments | Plant height (cm) | Pods/plant (no.) | Length of pod (cm) | Width of pod (cm) | Yield of pod (t/ha) |
|---|---|---|---|---|---|
| Nov. 22 | 26.67c | 5.73b | 10.10c | 7.48c | 6.15c |
| Dec. 01 | 26.43c | 6.98b | 12.88a | 8.38b | 8.91b |
| Dec. 08 | 31.60a | 6.52b | 12.27ab | 8.43b | 9.23b |
| Dec. 15 | 31.87a | 10.00a | 11.93ab | 9.51a | 11.57a |
| Dec.22 | 27.17bc | 7.50b | 11.64b | 8.95ab | 9.27b |
| Jan. 01 | 29.47ab | 6.99b | 11.84b | 8.90ab | 7.62bc |
| Jan.08 | 27.63bc | 5.57b | 8.61d | 6.24d | 7.0bc |
| CV (%) | 4.68 | 15.16 | 4.70 | 5.40 | 14.35 |

**ON-FARM EVALUATION OF BARI DATA-1 (Laboni)**

The experiment was conducted at the MLT site, Magura, Jessore during kharif 2001 to observe the performance of edible data. The experiment was laid out with 10 dispersed replications. The unit plot was $120m^2$. The seed was sown on 10 June, 2001 maintaining a spacing 30 x 15 cm. Fertilizers were applied at the rate of urea 186.75 kg, TSP 119.52 kg, MP 149.40 kg and cowdung 14.94 tons/ha. Cowdung, potassic phosphatic half of urea and potassic fertilizers were applied at the time of final land preparation. Rest urea and MP were applied as top dressing after 20 days, 30 days and 40 days of sowing. Data on plant height, weight/plant and yield/ha were recorded. Harvesting on done during 5 August to 28 August 2001.

Results revealed that the yield of edible danta (BARI Data-1) ranged from 30.0 t/ha to 40 ton/ha with an average yield of 36 t/ha. Farmers are interested to grow this variety because of its tolerance of high rainfall, tasty, less fibre and high market price.

Table 1. Mean performance of edible data (BARI Data-1) tested at the MLT site Magura, Jessore during kharif 2001

| Treatment | Plant height | Weight /plant | Yield (t/ha) |
|---|---|---|---|
| BARI Data-1 | 90 | 8.6 | 36.0 |

# PERFORMANCE OF DIFFERENT VEGETABLE CROPS AT FARMER'S FIELD

## Introduction

Stem amaranth, Indian spinach and chilli are the common cash crops which are commercially grown in many areas of Bangladesh. Stem amaranth and Indian spinach are very popular as Kharif vegetables. Chilli is an important popular spices in Bangladesh but its yield is very low due to lack of improve variety and proper management practices. The farmers of Bangladesh are traditionally cultivated with local varieties so, they can not able to harvest good crop. Recently BARI has developed some variety of stem amaranth (BARI data-1) Indian spinach (BARI puishak-1) and chilli (BARI morich-1) with high yield potential and good quality. Keeping this view, the program was undertaken with the objectives to popularize the new variety as vegetable for commercial purpose at farmer's level.

## Materials and Methods

A production program was carried out at FSRD site, Goyeshpur, Pabna during summer season 2001. Stem amaranth (BARI data-1), Indian spinach (BARI puishak-1) and chilli (BARI marich-1) were tested. Crop stem amaranth and Indian spinach were fertilized at the rate of 25-15 –20 kg Urea-TSP-MP/ha and CD 2 t/ha. The entire quantity of cowdung, full doses of TSP, half of Urea and MP were applied during final land preparation. Rest Urea and MP were applied as top dress in three equal installments at 20, 30 and 40 DAS. Chilli was fertilized at the rate of 210- 330- 200-110 kg Urea-TSP – MP-Gypsum/ha and CD 10t/ha. Total Cowdung, TSP, Zypsum and $^{1}/_{3}$ MP were applied during final land preparation and full doses of Urea and remaining MP were applied in three split at 25,50 and 70 DAP. Stem amaranth (Laboni) and Indian spinach (Chitra) were sown on August 15 and 23, 2001 respectively. Chilli (Banglalanka) 35 days old seedling was transplanted on June 25-28, 2001. Stem amaranth and Indian spinach were harvested from July, 20 to 30 and July 10 to September 12 respectively. Chilli was harvested on August 12 to September 16, 2001.

## Results and Discussion

**Stem amaranth**: The yield performance of stem amaranth was satisfactory and encouraging with yield of 23.79 t/ha. As a year round and short duration crop stem amaranth is popular to the growers as cash crop.

**Indian spinach:** The performance of BARI puishak-1 (Chitra) was also very encouraging with high yield (18.98 t/ha) and less risk crop.

**Chilli:** Yield of BARI morich-1(Banglalanka) was not satisfactory (Table-1) at farmer's field due to late planting and excessive rainfall during growing period. But fruit size, color and bearing habit of chilli were very much attractive.

**Farmer's reaction**: Farmers were happy with good yield and excellent taste both the vegetables. Moreover they showed interest to increase area of BARI data-1 and BARI puishak-1. Bearing habit, attractive colour of Bangla-lanka was encouraging but optimum planting time and proper management is necessary to ensure good yield.

Table 1. Yield performance of stem amaranth, Indian spinach and chilli at FSRD site, Goyeshpur during Kharif, 2001

| Name of crop | Variety | Area ($m^2$) | Yield/plot (kg) | Yield(t/ha) |
|---|---|---|---|---|
| Stem amaranth | BARI data-1 (Laboni) | 20 | 47.58 | 23.79 |
| Indian spinach | BARI puishak-1 (Chitra) | 20 | 37.96 | 18.98 |
| Chilli | BARI morich-1(Banglalanka) | 40 | 7.50 | 1.88 |

## FARMERS FIELD TRIAL OF BARI MARICH-1 (BANGLA LANGA)

The trial was conducted during kharif season 2001 at the MLT site, Magura, Jessore to observe the performance of yield. The experiment was laid out in RCBD with 10dispersed replications. The unit plot was 20m x 10m. The seed was sown on 23 July 2001 maintaining spacing of 40 x 30cm. Fertilizers were applied at the rate of urea 250 kg, TSP 350 kg, MP 225 kg, gypsum 125 kg and cowdung 1 ton/ha. Half of the cowdung were applied at the time of final land preparation. Rest half of cowdung, all TSP, 1/3 MP were applied in the pit after 2-3 days of transplanting. Rest fertilizers were applied as top dressing after 25, 50 and 70 days of transplanting. Data on plant height, no. of primary branch, length/fruit, breadth/fruit and yield were collected.

Results revealed that the yield of this variety is higher than the local variety. Farmers are interested to grow this variety because of its shorter plant height and early flowering than local variety. Market price and germination percentage is high and also not susceptible to insect and diseases of this variety.

Table 1. Mean yield and yield component of Chilli (BARI Marich-1) tested at the MLT site Magura, Jessore during rabi 2001.

| Variety/line | Plant height | No. of primary branch | Length (cm)/fruit | Breadth/fruit (cm) | Yield (t/ha) |
|---|---|---|---|---|---|
| BARI Marich-1 | 54.4 | 5.3 | 5.25 | 2.78 | 4.4 |

# STUDY ON YIELD PERFORMANCE OF TWO SUMMER ONION VARIETIES

## Introduction

Onion (*Allium cepa*) is one of the most important spices of Bangladesh. It was cultivated only in winter season of Bangladesh. Recently BARI has developed two variety of onion which can be successfully grown in summer season. Therefore, the trial was conducted to see the performance of summer onion varieties at farmer's field.

## Materials and Methods

The trial was conducted at farmer's field at FSRD site, Goyeshpur, Pabna and MLT site, Magura, Jessore during summer season 2001. Two onion variety (BARI Piaz-2) and (BARI Piaz-3) were tested. Unit plot size was 4m x 1.2m. with 15cm x 10 cm spacing. Uniform and healthy seedlings were transplanted in farmers field on August 3 and 13 September at Pabna & Jessore, 2001. The crop was fertilized at the rate of 200-275-150-110 kg Urea-TSP-MP-Gypsum and CD 5 t/ha. The entire quantity of cowdung, TSP, MP, Gypsum, and $^2/_3$ of Urea were applied during land preparation. Remaining $^1/_3$ of Urea was used as top dress at 20 DAP. Weeding, irrigation, drainage and pest management were done as and when required. Harvesting was done on December 25, 2001. Yield and yield contributing characters, mean data were recorded.

## Results and Discussion

### Site: Goyeshpur, Pabna

Yield and yield contributing characters of summer onion are presented in Table 1. BARI Piaz-2 was slightly taller than BARI Piaz-3. BARI piaz-2 produced maximum number of leaves/plant compare to BARI Pize-3. The highest bulb weight was obtained from BARI Piaz-2 compare to BARI Piaz-3. But number of bulb/kg showed higher in BARI Piaz-3. Highest yield of onion was recorded from BARI Piaz-2 (9.34 t/ha) while the lowest was recorded from BARI Piaz-3 (7.58t/ha).s

### Site: Magura, Jessore

Plant height was slightly taller in variety BARI Piaz-3 than BARI Piaz-2. But no. of leaves/plant was higher in BARI Piaz-2 than BARI Piaz-3. Similar tread was followed in case of BARI Piaz-2. Number of bulb was almost similar in two varieties but slightly higher bulb yield was obtained from BARI Piaz-2.

In both sides BARI Piaz-2 showed higher yield due to its higher yield attributes.

### Farmer's reaction

Farmer's were happy with off-season onion variety. Moreover they showed their deep satisfaction with good yield. They were very much interested to increase area under summer onion cultivation in next season.

Table 1. Yield and yield component of Onion varieties (Kharif-1, 2001)

| Variety | plant height (cm) | | No. of leaves/plant | | Bulb wt. /plant | | No. of bulb/Kg | | Yield (t/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $L_1$ | $L_2$ | $L_1$ | $L_2$ | $L_1$ | $L_2$ | $L_1$ | $L_2$ | $L_1$ | $L_2$ |
| BARI Piaz-2 | 50.45 | 38.20 | 10.85 | 8.6 | 23.25 | 30.19 | 60.00 | 34.67 | 9.34 | 6.60 |
| BARI Piaz-3 | 50.00 | 40.73 | 10.60 | 7.6 | 22.75 | 28.67 | 68.50 | 34.33 | 7.58 | 6.11 |

$L_1$= Goyeshpur, $L_2$= Magura

# ON-FARM TRIAL OF EARLY BRINJAL VARIETY (KAZLA AND NAYANTARA)


## Abstract

The experiment was conducted at Farming System Research and Development (FSRD) site, Lebukhali, Patuakhali in rabi, 2001-02 with released two Brinjal variety viz. Kazla and Nayantara to observe their performance at farmers' field. Under normal cultivation practice yield of Kazla was 52 ton/ha and Nayantara was 46 t/ha. There was no wilting disease and infestation of borer was not severe. Farmers have shown keen interest grow these varieties.


## Introduction

Southern region of Bangladesh follows mainly rice based cropping system. Cultivation of vegetables is very low. It is a vegetable deficit area mainly for two reasons- (i) lack of vegetable cultivable land and (ii) farmers use local varieties or early released varieties which have been degenerate their productibility and resistance power against pest and disease over time in farmers' field cultivation. As a result production and quality of vegetables are degrading day by day. So, it is necessary to replace local or early released varieties by new varieties. With this view newly released brinjal variety viz. Kazla and Nayantara were put under trial at different farmers' field to find out their adaptability and acceptability at farmers level.

## Materials and Methods

The experiment was conducted at FSRD site, Lebukhali, Patuakhali during rabi 2001-2002. Newly released BARI brinjal variety- Kazla and Nayantara were used. Unit plot size varied from 20 $m^2$ to 50 $m^2$ and spacing was 70cmX70cm. For Nayantara 10 demonstrations and Kazla 30 demonstrations were done in different farmers' homestead. Date of sowing was 2nd week of September and 30-40 days old seedlings were transplanted in the 2nd to 3rd week of October, 2001.Fertilizer doses were Cowdung -10 ton/ha, Urea - 375 kg/ha, TSP -150 kg/ha and MP - 250 kg/ha. The entire quantity of cowdung, TSP and half of urea and MP were applied during land preparation. The rest of Urea and MP were top dressed after 20 and 30 days of transplanting. Other intercultural operations were done as per requirement. Irrigation was done after top dress of urea.

## Results and Discussion

The experiment showed that the two newly released BARI brinjal varieties viz. Kazla and Nayantara showed yield of 52.0 and 46.0 t/ha, respectively which showed satisfactory yield in Patuakhali region. Besides, there was minimum infestation of pod borer (2 fruits/plot) and no wilting problem (Table 1). The trial should carried out for another year and site by site large scale demonstration trials might be continued.

### Farmers' Reaction

Yield of Kazla is comparatively high. Disease resistance and taste of Kazlla was comparatively better. Nayantara was sold at a slight high price due to its round shape and size. Both of the varieties were preferred by the farmers at the site.

Table 1. Performance of brinjal variety- Kazla and Nayantara

| Variety | No. of fruits/ plant | No. of borer infected fruits/plant | Yield of fruits (kg/plant) | Yield of fruits (t/ha) |
|---|---|---|---|---|
| Kazla | 72 | 2 | 2.55 | 52 |
| Nayantara | 23 | 2 | 2.25 | 46 |

# DESSEMINATION OF BARI DEVELOPED FARM POWER MACHINERY AND PROCESS EQUIPMENT IN FSRD SITE, NARIKELI, JAMALPUR


## Abstract

A study on Agricultural machinery was undertaken to develop and to recommend operation specific and economically feasible appropriate machines both for pre-production and post-production operation of crops like wheat, maize, pulse, oilseed, potato etc. Seven Categories of BARI developed machine eg. BARI plough, BARI IJO multipurpose seeder, dry land weeder, wetland weeder, BARI four cylinder pump, pedal wheat and paddy thresher, hand maize sheller were distributed among the farmers at the Farming System Research and Development (FSRD) Site, Narikeli, Jamalpur. Out of this machine BARI plough, IJO BARI seeder and pedal thresher of wheat and rice results were evaluated. The results of these machines were satisfied and popularized among the farmers. Farmers showed keen interest to use BARI Farm power machinery.


## Introduction

Power demand in Agricultural activities has drastically been increased with the increase of cropping intensity. Rural male labour forces started to shift from agricultural section to the other section e.g. road transportation, industry, small trade etc. creating on acute agricultural labour shortage, during peak land preparation, planting, intercultural operation and harvesting period. Traditionally paddy threshing (bullock treading) causes a considerable grain loss. Use of power thresher can minimize grain loss. Timely harvesting and quick threshing is common problem in wheat and rice crop. Tillage and weeding problem is also affect the production of crop. Keeping the views in mind, the experiment was undertaken.

1. to determine the acceptability of different BARI-development agricultural machines at farm level
2. to test the suitability and reliability of the farm machinery among the farmers
3. to encourage the local enterprises for manufacturing agricultural machinery and
4. to study the impact of machine use among farmers and related groups.

## Materials and Method

The team members of OFRD visited FSRD, site, Narikeli, Jamalpur farmers' field and selected some co-operator farmers. A field day was organized and advantage of the machine was discussed. Then the BARI developed machine e.g. BARI plough, BARI-IJO multipurpose seeder, dry and wet land weeder, BARI four cylinder pamp, Hand maize sheller, wheat and paddy padel thresher were distributed among the co-operative farmers. The experiment was conducted at the FSRD site Narikeli, Jamalpur during the period of 2001-2002. Wheat seeds were sown by broadcast and line sowing by BARI seeder from 4 Dec. 01 to 10 Dec. 01 and were harvested from 18 to 21 March 2002 depending on the maturity of the crops. Beside, performance of BARI-IJO seeder was used for sowing Jute seed from 3 April to 6 April, 2002 and were harvested from 24 to 26 July, 2001 depending on the maturity of the crops. The variety of wheat and Jute were Protiva & 0-9897. The seed rate for wheat were 120 and 90 kg/ha for broad casting and for IJO BARI seeder. The seed rate for Jute production were 9 and 8 kg/ha for broadcasting and IJO BARI seeder. The fertilizer, Irrigation and other cultural operation was done as and when necessary.

## Results and Discussion

### Crop: Wheat

The result showed that plants/m$^2$, plant height panicle length, spikes/m2, spikelet/spike, grain/spike, grain and straw yield were significantly influenced by different treatment (Table 1). Country and BARI plough showed significantly higher plants/m$^2$ whereas BARI seeder produced lower plants/m$^2$. Significantly highest plant height was obtained from BARI plough (IJO BARI seeder) other plough levels were statistically identical in respect of plant height but lower than BARI plough. Similar trend was followed in case of spikes/m$^2$, spikelet/spike and grains/spike. Significantly highest grain yield was obtained from BARI plough due to higher yield attributing characters. Straw yield was also showed similar trend as in case of grain yield (Table 1). Country plough cutting depth (3.5-4.5 cm) of soil is low as compared to BARI plough (6-7cm).

**Crop: Jute**

Plant/$m^2$, plant height, base, middle and top diameter, fibre yield and stick were significantly influenced by different treatment (Table 2). Plant/$m^2$ was statistically similar in country and BARI plough which was higher than BARI plough (IJO seeder). BARI plough (150 seeder) showed significantly highest plant height as compared to other plough. Similar trend was followed is case of base, middle and top diameter. Fibre yield was higher from BARI plough (IJO seeder) but statistically identical to BARI plough. Significantly highest stick yield was recorded from BARI plough (IJO BARI seeder). Higher fibre yield was recorded from BARI plough (IJO BARI seeder) due to higher yield contributing characters.

A denonatration on BARI pedal thresher was made at the site. The result showed that 37.3 kg/hour wheat could be threshed against 22.9kg/hour in local practice and time saved 39.18%. In case of paddy, 93.7 kg/hour paddy could be threshed against 55.6 kg/hour in local practice and time saved 40-63%.

**Impact of Machine and Farmer's Reaction**

Every farmers wanted to buy BARI plough, wet land weeder, hand maize corm sheller and pedal thresher. Some farmers want to buy power thresher of wheat and Rice. Some farmers reaction their opinion to disadvantage of IJO BARI seeder. They suggest modified IJO BARI seeder for easy use. Because this machine need to maintenance efficient person. Mahabub engineering workshop already supplying the plough, power Rice thresher, power maize sheller, Hand maize Sheller, weeder and other agricultural machinery to the farmers of Jamalpur district.

Table 1. Effect of different tillage implement and sowing method on yield of wheat

| Treatment | Plant/sqm (no.) | Plant height (cm) | Penicle length (cm) | Spike/ sqm (no.) | Spikelet /spike (no) | Grain/ spike (no) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| Country plough (Broadcasting) | 182.750a | 82.125c | 7.678c | 277.50c | 13.00c | 25.75b | 3.17b | 4.50b |
| BARI plough (Broadcasting) | 184.750a | 88.000b | 8.663b | 302.75b | 14.42b | 28.21b | 3.43b | 4.57b |
| BARI plough (BARI IJO seeder) | 139.375b | 93.762a | 10.15a | 331.00a | 17.12a | 33.56a | 4.01a | 5.31a |
| C V(%) | 9.51 | 3.45 | 6.09 | 5.03 | 6.03 | 10.15 | 8.98 | 8.81 |
| F-test | ** | ** | ** | ** | ** | ** | ** | ** |

Figure in a column having similar letters do not differ significantly

Table 2. Effect of different tillage implement and sowing method on yield and yield attributes of jute

| Treatment | Plant/sqm (no.) | Plant height (m) | Base diameter (cm) | Middle diameter (cm) | Top diameter (cm) | Yield of fibre (t/ha) | Yield of stick (t/ha) |
|---|---|---|---|---|---|---|---|
| Country plough (Broadcasting) | 94.67a | 2.26b | 2.03c | 1.40b | 1.00c | 2.15b | 3.17c |
| BARI plough (Broadcasting) | 97.00a | 3.01b | 2.30b | 1.57b | 1.17b | 2.40ab | 3.55b |
| BARI plough (IJO BARI seeder) | 93.67b | 3.26a | 2.82a | 2.13a | 1.33a | 2.62a | 3.95a |
| CV(%) | 6.47 | 4.27 | 6.08 | 5.68 | 7.34 | 7.48 | 4.81 |
| F-test | ** | ** | ** | ** | ** | ** | ** |

Figure in a column having similar letters do not differ significantly

# PERFORMANCE OF WHEAT THROUGH POWER SEEDER COMPARE TO TRADITIONAL METHOD

## Introduction

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

## Materials and Methods

A cultivation program was conducted at the FSRD site, Goyeshpur, Pabna during 2001-2002 to compare the traditional practice of wheat production with mechanical method. Before starting the program a motivational meeting was organized for successful implementation of the program. Ten cooperator farmers were selected in same land categories. The production program covered 4.30 hectares of land. Wheat variety Protiva was used. The crop was fertilized at the rate of 200-150-50-120-7.5-7.5kg Urea-TSP-MP-Gypsum-Zincoxide and Borax/ha. The seeds were sown on December 7, 2001. Intercultural operation and plant protection measures were done as and when required. Crop was harvested on March 22 –27, 2002.

## Results and Discussion

Comparative and economical results are presented in Table 1. The highest grain yield (2.32t/ha) was obtained where mechanical seeder was used for wheat cultivation which was 4% higher than traditional broadcast method. Gross return (Tk.21885/ha), gross margin (Tk.11310/ha) and benefit cost ratio (2.06) were obtained from mechanical seeding method. These were also higher than the traditional broadcast method. This comparative study indicated that use of power seeder total production cost reduced and higher profit could be possible compare to traditional production method.

## Conclusion

Production program of wheat through mechanical seeder was found promising method for cultivation. Moreover, the program was easy profitable and minimize the turn around time. So, the program can be recommended for large scale extension at farmers' field.

### Farmers reaction

Farmers showed very much positive response with new mechanical seeder. They expressed their satisfaction with less production cost and recover the turn around time and they also opined that the price of seeder is too high.

Table 1. Comparative performance of Wheat (Var. Protiva) in between power seeder and traditional production method

| Method | No. of monitored farmers | Area covered (ha) | Grain yield /ha (t) | Stover yield /ha (t) | Gross return (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | BCR |
|---|---|---|---|---|---|---|---|---|
| Seeding with power seeder | 5 | 2.15 | 2.32 | 4.13 | 21885 | 10575 | 11310 | 2.06 |
| Traditional broadcast method | 5 | 2.15 | 2.25 | 3.95 | 21100 | 11607 | 9493 | 1.81 |

# Mature Technology

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| **1. Name of technology** | **:** | **Performance of potato yam grown on the existing homestead** |
| Study period | : | 1997-98 to 2000-2001 |
| Test location | : | Farming Systems Research and Development site, Narikeli, Jamalpur |
| Target group | : | Landless and marginal farmers |
| Location of application | : | Non-calcareous dark gray flood plain soils under Old Brahmaputtra Floodplain AEZ 9 |
| Key characteristics of technology | : | This climbing vegetable can be easily grown without care on the homestead trees like drumstick, ziga, mander, pitraj, etc. successfully. Average per plant bulbil yield is about 6 kg. Farmers easily can sell by Tk. 12.00/kg |

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| **2. Name of technology** | **:** | **Performance of alternative cropping pattern (Potato-Sesame-T.Aman) over farmer's existing pattern (Boro-T.aman)** |
| Study period | : | 1997-98 to 1991-2000 |
| Test location | : | Farming Systems Research and Development site, Narikeli, Jamalpur |
| Target group | : | Small and medium farmer |
| Location of application | : | Non-calcareous dark gray flood plain soils under Old Brahmaputtra Floodplain AEZ 9. |
| Key characteristics of technology | : | Introduction of traditional winter vegetable and oilseed crop because of rapid expansion of HYV boro rice which virtually eliminated these crops. Potato-Sesame-T.Aman provides higher BCR than the farmers' pattern Boro-T.Aman-Fallow. Improve soil health because of appropriate nutrient mining |

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| **3. Name of technology** | **:** | **Fertilizer recommendation for Mustard-Boro-T.Aman cropping pattern under irrigated medium highland** |
| Study period | : | 1998-99 to 2000-2001 |
| Test location | : | Farming Systems Research and Development site, Narikeli, and Multilocation Testing Site, Melandha, Jamalpur |
| Target group | : | Small and medium farmer |
| Location of application | : | Non-calcareous dark gray flood plain soils under Old Brahmaputtra Floodplain AEZ 9. |
| Key characteristics of technology | : | Balanced fertilization helps to reduce the high cost of fertilizer which virtually beneficial for the crop. |

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| **4. Name of technology** | **:** | **Fertilizer recommendation for Wheat-Jute-T.Aman cropping pattern under irrigated medium highland condition** |
| Study period | : | 1998-99 to 2000-2001 |
| Test location | : | Farming Systems Research and Development site, Narikeli, Jamalpur |
| Target group | : | Small and medium farmer |
| Location of application | : | Non-calcareous dark gray flood plain soils under Old Brahmaputtra Floodplain AEZ 9. |
| Key characteristics of technology | : | Balanced fertilization helps to reduce the high cost of fertilizer which virtually beneficial for the crop, for the environment as well as to same money of the farmers. |

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| **5. Name of technology** | **:** | **Sustaining soil fertility with the inclusion of Sesbania in Boro-T.Aman cropping pattern under irrigated medium highland.** |
| Study period | : | 1997-98 to 1991-2000 |
| Test location | : | Farming Systems Research and Development site, Narikeli, Jamalpur |
| Target group | : | Small and medium farmer |
| Location of application | : | Non-calcareous dark gray flood plain soils under Old Brahmaputtra Floodplain AEZ 9. |
| Key characteristics of technology | : | Green manure, *Sesbania aculeata* improve soil organic matter by symbiotically fixed N when incorporated in the soil and increase rice yield by 25-30%. Green manuring with mineral fertilizers increase use efficiency of applied fertilizer. |

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| **6. Name of technology** | **:** | **Improvement, evaluation and extension of BARI Chula at farmers' level** |
| Study period | : | 1997-98 to 2000-2001 |
| Test location | : | Farming Systems Research and Development site, Narikeli, Jamalpur |
| Target group | : | Small, medium and Large family |
| Location of application | : | Small family (Member 2-4), Medium family (Member 5-7) & Large family (Member 8-10) |
| Key characteristics of technology | : | Fuel save (30-35%), Time same (20-25%), Easily transferable & important role play at the time of flood |

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| **7. Name of technology** | **:** | **Dissemination of BARI Development Farm Machinery and Process Equipment** |
| Name of equipment | : | 1. BARI plough, 2. Dry land weeder, 3. Wetland weeder, 4. Padel thresher of Rice and Wheat, 5. 4-cylinder padel pump & 5. IJO BARI seeder. |
| Study period | : | 1997-98 to 2000-2001 |

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|---|---|---|
| Test location | : | Farming Systems Research and Development site, Narikeli, Jamalpur |
| Target group | : | Small, medium and large farmer |
| Location of application | : | Non-calcareous dark gray flood plain soils under Old Brahmaputtra Floodplain AEZ 9. |
| Key characteristics of technology | : | a. BARI plough: Easy to use , Cutting depth is 5-6 inches, Capacity is 0.05 ha/hour<br>b. Dry land weeder: Time same 50%, Capacity-0.19 ha/hour & Labour save<br>c. Wetland weeder: Labour save, Time save-50%, Capacity-0.19 ha/hour<br>d. Padel thresher of rice and wheat: Time same- 40%, Labour same Capacity- 45 kg/hour (wheat) & 115 kg/hour (rice)<br>E. Four cylinder padel pump: Time same & Labour save |

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| **8. Name of Technology** | : | **Production program of improved cropping pattern Maize (hybrid) –GM-T.Aman maintaining soil fertility** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |
| 4. Target group | : | Medium to large |
| 5. Location of application | : | Medium high land area of calcareous dark grey flood plain soils of Pabna under AEZ-11 |
| 6. Key characteristics of technology | : | Total yield of improved cropping patterns is increase by 76% over farmers existing cropping pattern Wheat-Fallow-T.aman. Maintain soil fertility through introduction of Dhaincha as green manuring |

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| **9. Name of Technology** | : | **Performance of Wheat-Mungbean-T.Aman cropping pattern instead of Wheat-Fallow-T.Aman pattern.** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |
| 4. Target group | : | Medium to large |
| 5. Location of application | : | Medium high land area of calcareous dark grey flood plain soils of Pabna under AEZ-11 |
| 6. Key characteristics of technology | : | Total yield of improved cropping patterns is increase by 83% over farmers existing cropping pattern Wheat-Fallow-T.aman. Maintain soil fertility through introduction of Mungbean as green manuring crop (after harvesting of pods plants should be incorporated in soils). |

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| **10. Name of Technology** | : | **Performance of Mustard-Mungbean-T.Aman cropping pattern** |
| 2. Study period | : | 1999-2000 to 2001-2002 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |

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| 4. Target group | : | Medium to medium farm |
| 5. Location of application | : | Medium high land of Dark Grey Flood plain soils of Pabna Sadar under AEZ-11 |
| 6. Key characteristics of technology | : | Net benefit is 86% higher compare to farmers traditional cropping pattern Mustard (Tori-7)-Fallow-T.Aman. Maintain soil fertility through introduction of Mungbean green manuring (after harvesting of pods, plants should be incorporated in soil). |

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| **11. Name of Technology** | : | **Cultivation of papaya as commercial crop** |
| 2. Study period | : | 1998-1999 to 2001-2002 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |
| 4. Target group | : | Small to Medium farm |
| 5. Location of application | : | Medium high land area of calcareous dark grey flood plain soils of Pabna sadar under AEZ-11 |
| 6. Key characteristics of technology | : | Proming for continuous income generation round the year whereas farmers utilize the cash for their family education, purchase fertilizer, seeds and other family needs. |

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| **12. Name of Technology** | : | **Growing of high value vegetable crops** |
| 2. Study period | : | 1999-2000 to 2001-2002 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |
| 4. Target group | : | Small to Medium |
| 5. Location of application | : | High land and Medium land of dark grey flood plain soils of Pabna under AEZ-11 |
| 6. Key characteristics of technology | : | Economic return is higher than other cereal crops due to high market price. Early growing of these vegetables make ensure two to three times higher economic return than timely growing. Create a good market channel through Agribusiness |

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| **13. Name of Technology** | : | **Utilization of homestead area with fruits and vegetables** |
| 2. Study period | : | 1998-1999 to 2001-2002 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |
| 4. Target group | : | Small to Medium farm |
| 5. Location of application | : | High land to Medium highland dark grey flood plain soils of Pabna under AEZ-11 & 12. |
| 6. Key characteristics of technology | : | To promote better utilization and income of homestead area. Consumption and production is higher than requirement/day/family |

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| **14. Name of Technology** | : | **Controlling of mango hopper by low cost involvement** |
| 2. Study period | : | 1998-1999 to 2001-2002 |
| 3. Test location | : | FSRD site, Goyeshpur, Pabna |

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|---|---|---|
| 4. Target group | : | All categories of farmers |
| 5. Location of application | : | High land area (homestead based) of FSRD site, Pabna |
| 6. Key characteristics of technology | : | Production of mango is increased with low cost involvement and generate additional cash income. Easily practicable and cheaper. Average fruit yield per sprayed tree is obtained 74 kg where as non sprayed tree was almost non bearing or with very few fruit. |

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| **15. Name of Technology** | : | **Cultivation Potato using mulch in saline area** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | FSRD site, Atkapalia, Noakhali |
| 4. Target group | : | Small to Medium farm |
| 5. Location of application | : | Moderate to high saline soil under medium highland |
| 6. Key characteristics of technology | : | Minimize soil salinity and evaporation by conserving moisture in soil, and enhance root growth. 40-60% increase of yield compare to conventional method. Suppress weed in the field. Add organic matter in soil |

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| **16. Name of Technology** | : | **Cultivation Tomato using mulch in saline area** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | FSRD site, Atkapalia, Noakhali |
| 4. Target group | : | Small to Medium farm |
| 5. Location of application | : | Moderate to high saline soil under medium highland |
| 6. Key characteristics of technology | : | Minimize soil salinity and evaporation by conserving moisture in soil, and enhance root growth. 30-35% increase of yield compare to conventional method. Suppress weed in the field. Add organic matter in soil |

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| **17. Name of Technology** | : | **Wheat cultivation under minimum tillage in saline area** |
| 2. Study period | : | 1999-1999 to 2000-2001 |
| 3. Test location | : | FSRD site, Atkapalia, Noakhali |
| 4. Target group | : | Small to Medium farm |
| 5. Location of application | : | Moderate to high saline soil under medium highland |
| 6. Key characteristics of technology | : | Enhance soil moisture conservation and moisture availability and good germination of seed. Early sowing can minimize the effect of salinity |

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| **18. Name of Technology** | : | **Mustard cultivation under minimum tillage in saline area** |
| 2. Study period | : | 1998-1999 to 2000-2001 |
| 3. Test location | : | FSRD site, Atkapalia, Noakhali |
| 4. Target group | : | Small to Medium farm |
| 5. Location of application | : | Moderate to high saline soil under medium highland |

| | | |
|---|---|---|
| 6. Key characteristics of technology | : | Enhance soil moisture conservation and moisture availability and good germination of seed. Considerable yield (900-1000 kg/ha). Mustard can be harvested before the appearance of higher degrees of salinity |

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| **19. Name of Technology** | : | **Performance of alternative cropping pattern Mustard-Boro-T.Aman for medium high land** |
| 2. Study period | : | 1987-88 to 1989-90 |
| 3. Test location | : | FSRD site, Palima, Tangail |
| 4. Target group | : | Small to large farm |
| 5. Location of application | : | Medium high land of Tangail along with similar areas of AEZ-8 |
| 6. Key characteristics of technology | : | Mustard could be grown in between T.Aman-Boro cropping pattern which was 38% higher than traditional pattern (Boro-T.Aman) |

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| **20. Name of Technology** | : | **Performance of Potato-Boro-T.Aman cropping pattern for medium high land instead of Mustard-Boro-T.aman rice cropping pattern** |
| 2. Study period | : | 1998-99 to 2000-2001 |
| 3. Test location | : | FSRD site, Palima, Tangail |
| 4. Target group | : | Large farm |
| 5. Location of application | : | Medium high land of Tangail along with similar areas of AEZ-8 |
| 6. Key characteristics of technology | : | Potato-Boro-T.Aman cropping pattern is found viable which was 475% higher than traditional pattern |

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| **21. Name of Technology** | : | **Homestead vegetable production round the year reducing poverty and nutritional deficiency for small farms** |
| 2. Study period | : | 1998 to 2001 |
| 3. Test location | : | FSRD site, Palima, Tangail |
| 4. Target group | : | Marginal to Small farm |
| 5. Location of application | : | High land of homestead and adjoining “Palan area” of Tangail along with similar areas of AEZ-8 |
| 6. Key characteristics of technology | : | Optimization of homestead land use, availability of vegetable round the year. Utilization of women and child labour, adequate supply of Vit A and C, also supply of good quantity of iron, calcium and thiamin |

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| **22. Name of Technology** | **:** | **Intercropping of turmeric with Gimakolmi** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | ARS, Daulatpur, Khulna |
| 4. Target group | : | Small to medium farm |
| 5. Location of application | : | AEZ-11, Non saline high land of Khulna, Bagerhat and Satkhia districts. |

| | | |
|---|---|---|
| 6. Key characteristics of technology | : | Turmeric – Gimakolmi inter cropping system is higher return than that of sole turmeric. Provides 27% higher net benefit. Ensure vegetables in kharif season |

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| **23. Name of Technology** | **:** | **Production of Potato Yam on Ziga plant** |
| 2. Study period | : | 1996-97 to 1998-99 |
| 3. Test location | : | MLT site, Bagerhat |
| 4. Target group | : | Small to medium farm |
| 5. Location of application | : | AEZ-11, Non saline high land of Khulna, Bagerhat and Satkhia districts. |
| 6. Key characteristics of technology | : | Ensure vegetables in early kharif season |

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|---|---|---|
| **24. Name of Technology** | **:** | **Country bean intercropping with turmeric in the Sylhet region** |
| 2. Study period | : | 2000-2001 |
| 3. Test location | : | FSRD site, Golapgonj, Sylhet |
| 4. Target group | : | Small to medium farm |
| 5. Location of application | : | Highland to medium highland of Sylhet and Moulvibazar Districts and hilly areas of the country |
| 6. Key characteristics of technology | : | Farmers of Sylhet region usually grow country bean in vast areas mainly as highland field crops. The local variety called “Bohalghadda” is used. It is very popular to Sylhet’s peoples and also exporting at ethnic market in UK. Turmeric can be easily cultivated under the country bean macha (bamboo support) as a bonus crop. |

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| **25. Name of Technology** | **:** | **Maize cultivation for fodder and grain purpose** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | MLT site, Sunamgonj, Sylhet |
| 4. Target group | : | Medium to large farm |
| 5. Location of application | : | All over the country |
| 6. Key characteristics of technology | : | Insufficient and imbalance supply of feed is one of the major factors of poor health of animal and poultry. Scarcity of quality green fodder and poultry productivity, there are indispensable to increase fodder and feed production in the country. Farmers got both grain and fodder at a time that could be helpful to meet up nutritional requirement of livestock and poultry. |

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| **26. Name of Technology** | **:** | **Alternative cropping pattern (Mustard-T.Aus-T.Aman) existing cropping pattern (T-Aus-T.Aman-Fallow)** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | FSRD site, Golapgonj, Sylhet |

| | | |
|---|---|---|
| 4. Target group | : | Small to Large farm |
| 5. Location of application | : | Medium highland of Sylhet and Moulvibazar Districts |
| 6. Key characteristics of technology | : | T.Aus-T.Aman-Fallow is the major cropping pattern in Sylhet. Farmers cultivate rice crops mainly in rainfed condition. Transplantation of T. Aus being dependent on rainfall, its seeds are sown during early moonson (May), consequently. T.Aman transplanting is also late. Due to late harvesting of T.Aman, rabi crops are not possible to grown in this situation. On-Farm Research Division, BARI, introduced Mustard crop in the fallow period. Introduction of high yielding early maturing and non-photosensitive rice varieties (BR 26 or 27 and BRRI Dhan 32) instead of China (local) and Pajam in T.Aus and T.Aman season, respectively. |

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| **27. Name of Technology** | **:** | **Raising of early winter vegetable seedlings at high rainfall Sylhet region.** |
| 2. Study period | : | 1999-2000 to 2000-2001 |
| 3. Test location | : | FSRD site, Golapgonj, Sylhet |
| 4. Target group | : | Small to large farm |
| 5. Location of application | : | Highland to medium highland of greater Sylhet Districts |
| 6. Key characteristics of technology | : | Predominately Sylhet is a high rainfall area. Annual rainfall in Sylhet region is above 4000 mm. Due to long term and high rainfall in the this region, it is not possible to raise vegetable seedling in early season. On the other hand due to excess soil moisture it becomes impossible to save seeding from “Damping-Off” disease. So raising of early winter vegetable seeding techniques should be popularize in the Sylhet region. Mortality percentage of seedlings in the seedbed are almost nil. |

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| **28. Name of Technology** | **:** | **Seed production of Kangkong through twig transplantation** |
| 2. Study period | : | 1999-2000 and 2000-2001 |
| 3. Test Locations | : | ARS Rangpur and farmers fields of three BARI-GKF Collaborative farms (Lalmonirhat, Kurigram, and Pirganj) |
| 4. Target group | : | All categories of farms |
| 5. Location of application | : | High and medium high land of AEZ # 3 and 27 |
| 6. Key characteristics of the technology | : | Transplanting of 15-20 cm twig of 20-25 days old during 15-30 August can produce maximum quality seed. |

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| **29. Name of Technology** | **:** | **Production of BARI Lau-1 as field crop** |
| 2. Study period | : | 1997-98, 1998-99 and 1999-2000 |
| 3. Test Locations | : | FSRD site (Syedpur), MLT Sites (Polasbari, Nilphamari and Lalmonirhat) and BARI-GKF farms ( Lalmonirhat, Kurigram and Rangpur). |
| 4. Target group | : | All categories of farmers |
| 5. Location of application | : | High land of AEZ # 3 and 27 |

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| 6. Key characteristics of the technology | : | It can be grown as field crop with enormous bearing, early harvest, better yield and economic return than local ones. After the harvest of crop, the same trailee can be utilized for summer vegetables cultivation to economize the cost of production. |
| **30. Name of Technology** | : | **Production of BARI Sim-1 as field crop** |
| 2. Study period | : | 1997-98, 1998-1999 and 1999-2000 |
| 3. Test Locations | : | FSRD site ( Syedpur), MLT sites (Polashbari, Nilphamari and Lalmonirhat) and BARI-GKF farms ( Lalmonirhat, Kurigram and Rangpur) |
| 4. Target group | : | All categories of farms |
| 5. Location of application | : | High land of AEZ # 3 and 27 |
| 6. Key characteristics of the technology | : | It can be produced as field crop. Bamboo or plant branches can be used as support instead of trailee to minimize the production cost. Higher yielder than local one. Better market price can be get for early harvest. |
| **31. Name of Technology** | : | **Production of BARI Dherosh-1 as field crop** |
| 2. Study period | : | 1998, 1999 and 2000 |
| 3. Test Locations | : | FSRD site (Syedpur), MLT Sites (Polasbari, Nilphamari and Lalmonirhat) and BARI-GKF farms (Lalmonirhat, Kurigram, Rangpur) |
| 4. Target group | : | All categories of farmers |
| 5. Location of application | : | High land of AEZ # 3 and 27 |
| 6. Key characteristics of the technology | : | Higher yielder and more tolerant to virus. Generated continuous cash income and it started at 50-55 days after sowing and continued for a long period (around 100 days) |
| **32. Name of Technology** | : | **Boron fertilization to Shahi papaya** |
| 2. Study period | : | 1999-2000, 2000-2001 and 2001-2002 |
| 3. Test Locations | : | ARS, Rangpur and FSRD site, Syedpur, Pirgacha, Rangpur |
| 4. Target group | : | All categories of farmers |
| 5. Location of application | : | High land of AEZ#3. |
| 6. Key characteristics of the technology | : | Shahi Papaya is higher yielder (30-35%) than local one. Better in respect of taste, size and colour. Application of 1 kg B as foliar or 2 kg B in soil as basal gives about two times higher yield and economic return with normal shape and size than control (without B). |
| **33. Name of Technology** | : | **Production of summer vegetables on the trailee followed by bottle gourd.** |
| 2. Study period | : | 1998-99, 1999-2000 and 2000-2001 |
| 3. Test Locations | : | FSRD site (Syedpur) and MLT sites (Polasbari, Lalmonirhat and Nilphamari) |
| 4. Target group | : | All categories of farmers, |
| 5. Location of application | : | High land of AEZ # 3 |

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| 6. Key characteristics of the technology | | Sequentially two vegetables (Bottlegourd – Ashgourd / Bottlegourd – Bittergourd / Bottlegourd – Snakegourd / Bottle gourd-Ribbed gourd) can be grown round the year with higher economic return by using the same trailee. |
| **34. Name of Technology** | **:** | **Optimum and economic dose of urea for bushbean cultivation** |
| 2. Study period | : | 2000-01 and 2001-02. |
| 3. Test Locations | : | ARS, OFRD, BARI, Rangpur. |
| 4. Target group | : | All categories of farmers. |
| 5. Location of application | : | High land and medium high land of AEZ# 3 |
| 6. Key characteristics of the technology | : | Bushbean, a newly introduced vegetable, could be grown in Bangladesh in winter season. Initially Urea, TSP and MP were recommended at the rate of other bean like leguminous crops, but the dose of urea became controversial. After two years experiments optimum and economic doses of urea were developed by OFRD, BARI, Rangpur. Using higher amount of urea, farmers can harvest more edible pods. |
| **35. Name of Technology** | **:** | **Fertilizer recommendation for the cropping pattern Maize (Hybrid) – T.aman rice (MV) under irrigated condition** |
| 2. Study period | : | 1998-1999, 1999-2000 and 2000-2001 |
| 3 Test Locations | : | ARS, OFRD, BARI, Rangpur |
| 4. Target group | : | Small to large farmers who are practicing the cropping pattern " Maize (hybrid)- T.aman rice (MV)" |
| 5. Location of application | : | High and medium highlands of AEZ # 3 |
| 6. Key characteristics of the technology | : | Farmers in greater Rangpur and Dinajpur districts are practicing the cropping pattern ***" Maize (hybrid)- T.aman rice (MV)"*** under irrigated condition in the high and medium high lands. The developed recommendation of the fertilizers for this cropping pattern is profitable and economically viable. Using this recommended amount of fertilizer farmers can minimize the use of excess fertilizer for individual crop basis.<br><br>Recommended dose of fertilizer for maize (***175-37-100-30-3.5-1*** kg NPKSZnB /ha) for moderate yield goal is good enough. Maize can be planted after harvest of T.aman without any yield loses compared to planting before mid-November. There is enough turn around time. It saves money for using recommended dose of fertilizers for T.aman. |
| **26. Name of Technology** | **:** | **Fertilizer dose for *Boro - T.aman* cropping pattern under irrigated condition** |
| 2. Study period | : | 1998-1999, 1999-2000 and 2000 –2001 |
| 3. Test Locations | : | FSRD site (Syedpur, Rangpur:AEZ # 3b), MLT sites (Polashbari: AEZ # 3c and Nilphamari: AEZ # 3a) |
| 4. Target group | : | All categories of farmers |

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| 5. Location of application | : | High and medium high land of AEZ # 3 |
| 6. Key characteristics of the technology | : | Integrated plant nutrient systems (IPNS) ie chemical fertilizer along with organic fertilizer (cow dung) and fertilizer dose for medium yield goal as per FRG' 97, BARC are better in respect of economic return. |

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| **37.Name of Technology** | **On farm Performance of summer tomato varieties in tidal flooded region** |
| 2.Study period | 1998 to 2000 |
| 3.Test Location | FSR & D site Lebukhali, Patuakhali |
| 4.Target group | Landless, marginal and small |
| 5.Location of application | Non saline tidal medium highland of Patuakhali (AEZ-13) |
| 6.Key characteristics of technology | Tomato yielded 25 t/ha and could be sold @ Tk. 30/kg. The technology could be adopted in high land only (Homestead) and requires intensive care for disease control. Hormone availability is essential. Tunnel covered with white polythene (thickness 0.01mm) is essential. |

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| **38. Name of Technology** | **Performance of promising sweet potato varieties developed by BARI** |
| 2.Study period | 1997-98 to 1999-2000 |
| 3.Test Location | MLT site Barguna & FSRD site Patuakhali |
| 4.Target group | All group |
| 5.Location of application | Non saline tidal medium highland of areas of AEZ-13 |
| 6.Key characteristics of technology | Daultpuri yielded 30% higher (32 t/ha) than local with no comprise for taste and market preference . |

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| **39. Name of Technology** | **On Farm performance of promising groundnut varieties developed by BARI** |
| 2.Study period | 1997-98 to 2000-2001 |
| 3.Test Location | FSRD site Lebukhali and MLT site Kalapara, Patuakhali |
| 4.Target group | All categories |
| 5.Location of application | Non saline tidal medium highland of Patuakhali (AEZ-13) |
| 6.Key characteristics of technology | 1. ACC-12 &DG-2 yielded 30% higher than local in both location |
| | 2. Conserve soil health through addition of Ground nut residue |
| **40. Name of Technology** | **Screening of different rabi crops in saline area** |
| 2.Study period | 1998-99 to 2000-2001 |

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| 3.Test Location | MLT site Kalapara ,Patuakhali |
| 4.Target group | All group |
| 5.Location of application | Saline tidal medium highland of Patuakhali AEZ-13 |
| 6.Key characteristics of technology | Chilli , Sesame, Cowpea was considered viable for this location |

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| **41. Name of Technology** | **Effect of soaking before sowing on the yield of BARI-mung-5** |
| 2.Study period | 1998-99 to 2000-2001 |
| 3.Test Location | FSRD site Lebukhali Patuakhali |
| 4.Target group | All group |
| 5.Location of application | Non saline tidal medium highland of Patuakhali AEZ-13 |
| 6.Key characteristics of technology | Average grain yield of BARI mung-5 (1500kg/ha)was 45 % higher With 4 hours soaking before sowing. Provides 100% higher net benefit. Conserve soil health through addition of mungbean residue |

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| **42.** | **Name of technology** | **On-Farm performance of cowpea treated with Rhizobium inoculants in tidally flooded non saline zone.** |
| 2. | Study period | 1997-98 to 1999-2000 |
| 3. | Test location | FSRD site Lebukhali, Patuakhali |
| 4. | Target group | All group |
| 5. | Location of application | Non saline tidal medium highland of Patuakhali sadar area (AEZ-13) |
| 6. | Key characteristics of technology | Average grain yield (1100kg/ha) with inoculum treated 15% higher than N treatment. Conserve soil health through BNF technology. Provides 96% net benefit. |

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| **43.** | **Name of technology** | **On-Farm performance of mungbean varieties** |
| 2. | Study period | 1995 to 1998 |
| 3. | Test location | Lebukhali, Patuakhali |
| 4. | Target group | All group |
| 5. | Location of application | Medium high land of AEZ-13 |
| 6. | Key characteristics of technology | Grain yield of kanti ( 700- 100kg/ha ) and of BARI mung-5 1200- 1500 kg/ha which is respectively 50-100% and 100-200% higher than local varieties. |

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| **44.** | Name of technology | On-Farm performance of tomato varieties |
| 2. | Study period | 1999 to 2002 |
| 3. | Test location | Lebukhali Patuakhali |
| 4. | Target group | All group |
| 5. | Location of application | Medium high land and Home stead area of AEZ-13. |
| 6. | Key characteristics of technology | Yield and market price of BARI tomato –7 and 8 respectively 64 ton/ha and 70 ton/ha. Market price and consumes preference were high. |

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| **45.** | Name of technology | Sorjan Cropping in tidally flooded area. |
| 2. | Study period | 1990 to 1993 |
| 3. | Test location | Lebukhali, Patuakhali |
| 4. | Target group | All group |
| 5. | Location of application | Non saline tidal medium highland of Patuakhali AEZ-13. |
| 6. | Key characteristics of technology | 28m long and 11m wide land was needed . Alternate ridge and furrows (1.5m wide ) were made to grow vegetable and quick growing fruits in the ridge bed and creeper vegetable on trailies on furrows . The technology was very high profitable than any other existing cropping pattern . Production practices as described in booklet should be followed for maximum benefit. |

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| **46.** | Name of technology | Agro-fishery minipond |
| 2. | Study period | 1990 to 2000 |
| 3. | Test location | Lebukhali, Patuakhali |
| 4. | Target group | All group. |
| 5. | Location of application | Non saline tidal medium highland of Patuakhali AEZ-13. |
| 6. | Key characteristics of technology | Total land : 20m x 18m Vegetables<br>Pond : 12m x 10 m<br>Pond bank : 3m wide<br>Vegetables , Quick fruit and fishes are produced from a piece of land with easy irrigation facilities for vegetables production |

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| **47.** | Name of technology | Potato (No tillage) – T . Aus(BRRI dhan-27) – T. Aman ( L/Improved) |
| 2. | Study period | 1997 to 2001 |
| 3. | Test location | Lebukhali Patuakhali |
| 4. | Target group | All group |

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| 5. | Location of application | Non-saline tidal medium highland of Patuakhali with similar areas AEZ-13. |
| 6. | Key characteristics of technology | Potato covered with water hyacinth by preservation of water and protection of sunny rays. T. aus and T aman should be well fertilizer and weed free. |

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| **48.** | **Name of technology** | **Mungbean – T. aus- T – aman cropping pattern** |
| 2. | Study period | 1998 to 2001 |
| 3. | Test location | FSRD site Lebukhali , Patuakhali |
| 4. | Target group | All group |
| 5. | Location of application | Non-saline tidal medium highland of Patuakhali with similar areas AEZ-13. |
| 6. | Key characteristics of technology | Average grain yield of rice grown in Rice- Rice-mungbean system is305 higher than that of Rice –Rice system. Improve soil health through addition of mungbean residues. |

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| **49.** | **Name of technology** | **Vegetable production round the year ( Lebukhali model)** |
| 2. | Study period | 1989 to 2001 |
| 3. | Test location | FSRD site Lebukhali, Patuakhali |
| 4. | Target group | All group |
| 5. | Location of application | Homestead area of non-saline tidal medium highland of Patuakhali with similar area of AEZ-13. |
| 6. | Key characteristics of technology | To be needed 9m x 9m in sunny land near the living house.<br>To be need women work facility. Production and consumption of vegetables for family members round the year. |

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| **50.** | **Name of technology** | **Development of fertilizer recommendation for Mungbean-T.aus-T.aman cropping pattern under AEZ-13** |
| 2. | Study period | 1998 to 2001 |
| 3. | Test location | FSRD site Lebukhali, Patuakhali |
| 4. | Target group | Small to medium farmer |
| 5. | Location of application | Non-saline tidal medium highland of Patuakhali |
| 6. | Key characteristics of technology | Cropping pattern based fertilizer recommendation.<br>Economic dose of fertilizers for the cropping pattern. |

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| 51. | Name of technology | Response of crops grown in Mungbean-T.aus-T.aman cropping pattern under AEZ-13 to added fertilizer nutrients. |
| 2. | Study period | 1998 to 2001 |
| 3. | Test location | FSRD site Lebukhali, Patuakhali |
| 4. | Target group | Small to medium farmer |
| 5. | Location of application | Non-saline tidal medium highland of Patuakhali |
| 6. | Key characteristics of technology | Optimum and economic dose of nutrients for Mungbean-T.aus-T.aman cropping patten. |
| 52. | Name of technology | Production package of BARI Mashur-3 |
| 2. | Test location | FSRD site Ishangopalpur, Faridpur |
| 3. | Target group | Marginal farmers |
| 4. | Location of application | Low Ganges River Flood plain soils (AEZ-12) |
| 53. | Name of technology | Production package of Late sowing Wheat after harvesting of T.Aman rice |
| 2. | Test location | FSRD site Ishangopalpur, Faridpur |
| 3. | Location of application | Low Ganges River Flood plain soils (AEZ-12) |
| 54. | Name of technology | Production package of Potato yam grown on bamboo support |
| 2. | Study period | 1998-99 to 2000-2001 |
| 3. | Test location | FSRD site Ishangopalpur, Faridpur |
| 4. | Target group | Land less and Marginal farmers |
| 5. | Location of application | Low Ganges River Flood plain soils (AEZ-12) |
| 6. | Key characteristics of technology | This climbing vegetable can be easily grown without care on the homestead trees like drumstick, ziga, mander, pitraj, etc. successfully. |
| 55. | Name of technology | Production package of BARI Chola-5 treatment with bavistin |
| 2. | Test location | FSRD site Ishangopalpur, Faridpur |
| 3. | Location of application | Low Ganges River Flood plain soils (AEZ-12) |

# INTEGRATED FARMING

The subsistence farms of Bangladesh are highly diversified with complex relationships among the various sub-systems and the enterprises within a sub-system. While there are different production alternatives, farmers have a limited set of resources. These resources must be utilized in such a manner that maximizes farm productivity, farmer's benefit and resource use efficiency in an environmentally sound and sustainable way. A holistic approach to technology generation and packaging is essential to achieve this result through maximizing the complementary interactions among the different farming enterprises/ production system and the biophysical and socio-economic environment. Traditional commodity oriented agricultural research has seldom considered these realities and the technologies developed through such research could not be adopted by the farmers to any satisfactory level. Even, it has been observed that farmers could not derive full benefit of location and clientele specific technologies developed through on-farm research with farmers' participation as they could not fully integrate these technologies with their existing system for one reason or other. As a result, the objective of promoting equitable socio-economic development of poor and marginal farmers could not be achieved and the economic hardships of the small and marginal farmers have continued to aggravate.

In this context, during the last few years of BARI's FSRD program, an effort was made to package the available proven technologies of the component sub-systems in whole farm perspectives to develop integrated farming system modules for different environment and clientele groups to improve whole farm system operation to maximize farm productivity, farmers' income and farm resource use efficiency as well as for eventual transfer of these modules to the target farmers.

## Methodology

As the effort of packaging and testing technologies for developing integrated farming practices for highly complex and subsistence livelihood system in whole farm perspective is new, there is no recommended methodology for such studies. Accordingly, a 5-step new methodology developed through an evolutionary process of trial and error using the experiences of the farming system research practitioners of OFRD, BARI over a long period was adopted.

Step 1. Identification of proven/recommended technologies: A comprehensive list of all packages of recommended technologies of crops, livestock, fisheries and other components of the farming system for specific location/environment was prepared to help selection of appropriate technologies for intervention.

Step 2. Selection of farmer Cooperator: The cooperator farmers representing small and marginal farmers with farming as major profession, having major components of farming and sizable homestead under single ownership were selected at each site. The number of farmers selected at different sites ranged from two to more than 10.

Step 3. Accounting of pre-intervention status: The pre-intervention status of the selected farms was evaluated through case studies/surveys. In the process, the existing farm resources, assets, liabilities, present use of resources, existing farming practices and technologies used, level of input use and outputs obtained, performances of different enterprises, farm income and expenditure status, etc. was assessed for each farm.

Step 4. Analysis of existing system and selection of technologies for intervention: Based on the pre-intervention status, the system performance was analyzed in the context of existing biophysical and socio-economic environment of the farm and constraints and potentials were identified. To ensure maximum utilization of existing farm resources, alternate/new packages of technologies for different enterprises of all components of the farm were identified and finally selected on the basis of farmers' option. The number of new technologies/practices taken for intervention for different sub-systems varied from farm to farm depending on farmers' option and perceived potentials of the technologies. It may be mentioned that in the intervention plan, some of the farmer's earlier adopted practices were retained while some new practices replaced the traditional practices. To use the unexploited resources/opportunities, a large number of new practices were also included.

Step 5. Implementation of intervention and performance evaluation: After finalizing the proposed interventions, the farmers were motivated through all possible ways to utilize their own resources to adopt the interventions. However, in implementing some new technologies, a few critical inputs were provided free of cost and/or on credit. Throughout the entire period of implementation, regular technical support was provided on as and when necessary basis and the performance of different interventions were monitored regularly and necessary data were collected directly using standard methods.

**Result and Discussion**

More than 50 farms in 9 FSRD sited have been intervened for a period of 1-3 years each. From each farm, a tremendous volume of data has been generated for both pre-intervention and intervention periods. Since each farm is unique in its own setting and resource use practices in both pre-intervention and intervention periods, it is virtually impossible, and perhaps, useless to attempt any systematic statistical analysis to compare the performance of different farms. Accordingly an attempt has been made to view each farm separately and system performance of pre-intervention and intervention periods have been compared to asses the impact of interventions on farm productivity, income and employment generation and other relevant parameters. In the following section, the result obtained at different sites will be presented.

The studies at all sites revealed that an individual farm consist of several resources like homestead, cropland, ponds, livestock, poultry and fisheries etc. Before intervention, these resources were not utilized properly for production purposes. But after proper motivation and introduction of several alternatives for each production units, the farmers adopted several new technologies according to their goals, preferences and availability of resources. The farm productivity, income, employment opportunity of the existing farming improved tremendously due to integration of technologies through holistic approach which led to improved livelihoods at all locations. The summary of findings at different sites is briefly presented below. From each farm, a tremendous volume of data has been generated for both pre-intervention and intervention periods. Since each farm is unique in its own setting and resource use practices in both pre-intervention and intervention periods, it is virtually impossible, and perhaps, useless to attempt any systematic statistical analysis to compare the performance of different farms. Accordingly an attempt has been made to view each farm separately and system performance of pre-intervention and intervention periods have been compared to asses the impact of interventions on farm productivity, income and employment generation and other relevant parameters. In the following section, the result obtained at different sites will be presented.

**Ishan Gopalpur FSRD Site, Faridpur**

Two farmers, one representing marginal and the other small category were intervened. The small farm (Farm 1) was using 13 and the marginal farm (Farm 2) 8 recommended technologies before the intervention. The resource base of the small farm was intervened with 34 technologies in 1999-2000 and 37 technologies in 2000-2001 while in the marginal farm 24 technologies in 1999-2000 and 31 technologies in 2000-2001 were applied (Table-1).

Table 1. Number of technologies used at Ishan Gopalpur, Faridpur during 1998-1999 to 2000-01

| Sub-system | # of RT used PI | | # of RT used DI | | | |
|---|---|---|---|---|---|---|
| | Farm1 | Farm 2 | Farm 1 | | Farm 2 | |
| | 1998-99 | 1998-99 | 1999-00 | 2000-01 | 1999-00 | 2000-01 |
| Crops | 7 | 3 | 10 | 10 | 4 | 5 |
| Homestead | 5 | 5 | 20 | 22 | 17 | 21 |
| Livestock | -- | -- | 3 | 4 | 2 | 4 |
| Fisheries | 1 | -- | 1 | 1 | 1 | 1 |
| Total | 13 | 8 | 34 | 37 | 24 | 31 |

**RT = Recommended technologies; PI = Pre-intervention; DI = During Intervention**

***Farm productivity:***

It was observed that the farm productivity of all sub-sectors and enterprises increased tremendously due to adoption of improved technologies and utilization of unexploited resources. The number of commodities produced on the farm and the volume of production increased several folds in both the farms as compared to that of the pre-intervention period (Table 2).

Table 2. Effect of Integrated farming on productivity at FSRD site, Ishan Gopalpur, Faridpur

| Sector and Sub-sectors | Farmer – 1 | | | Farmer – 2 | | |
|---|---|---|---|---|---|---|
| | Before Intervention (1998-99) | After Intervention | | Before Intervention (1998-99) | After Intervention | |
| | | 2000-01 | 2001-02 | | 2000-01 | 2001-02 |
| **Crops** | | | | | | |
| Cereals | 2870 | 4000 | 4526 | 740 | 1460 | 2315 |
| Allied Fibers | 670 | 1485 | 1580 | 290 | 380 | 265 |
| Pulses | 410 | 85 | 85 | 110 | 145 | 80 |
| Oil seeds | - | 150 | 150 | - | - | - |
| Vegetables | | | | | | |
| Radish | - | 6200 | 6200 | - | - | - |
| Tomato | - | 500 | 500 | - | - | - |
| **Homestaead** | | | | | | |
| Creepers | 78 | 177 | 316 | 85 | 480 | 206 |
| Roots | - | 70 | 74 | - | 81 | 63 |
| Leafy | - | 80 | -- | - | 30 | - |
| **Homestead (Trees)** | | | | | | |
| Coconut * | 200 | 310 | 280 | 30 | 58 | 80 |
| Mango | 28 | 200 | 180 | 40 | 70 | 50 |
| Jackfruit * | 18 | 22 | 30 | 20 | 41 | 47 |
| Jujubee | - | 10 | 15 | 14 | 30 | 5 |
| Bamboo * | 20 | 20 | 18 | 20 | 41 | 32 |
| **Livestock** | | | | | | |
| Egg | 800 | 1300 | 2000 | 500 | 900 | 2760 |
| Milk | 400 | 700 | 720 | - | - | 300 |
| Meat | 100 | 120 | 150 | - | - | 25 |
| **Fisheries** | | | | | | |
| Fish | 31 | 80 | 100 | - | 25 | 25 |

Note: * indicates number

***Financial benefit:***

To accommodate new enterprises and adopt recommended production and management practices, each farm required to invest more than double the amount as compared to the pre-intervention period. In the very first year of intervention, the TVC of Farm 1 and Farm 2 increased from Tk. 29836/- and Tk. 6695/- to Tk. 42957/- and Tk. 14855/-, respectively (Table 3). As a result, the gross margin of the Small Farm (Farm 1) increased from Tk. 30725/- (during pre-intervention period) to Tk. 55432/-, Tk. 58214/- and 69800/- during 1999-00, 2000-01 and 2002-02, respectively. (Table-3). Similar trend in farm income and expenditure was also observed in the marginal farm. Use of improved technologies increased the gross margin from Tk. 22993/- to Tk. 32832, 39872 and 42159 in the 1st, 2nd and the 3rd year of intervention.

The relative contribution of different sub-sectors in terms of gross margin was in to order of crop > livestock > homestead > fisheries. The high contribution of the livestock sector was due to introduction of broiler/layer chicken raring. The marginal benefit cost ratio (MBCR) for both the farms was the highest for homestead system (Table 3).

Table 3. Cost and benefit of integrated farming at FSRD site, Faridpur during 1998-99 to 2001-02

| *Sector* | *Pre-intervention (98-99)* | | *Post- intervention (1999-2002)* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *TVC (Tk.)* | *GM (Tk.)* | *TVC (Tk.)* | | | *GM (Tk.)* | | | *MBCR* | | |
| | | | *99-00* | *00-01* | *01-02* | *99-00* | *00-01* | *01-02* | *99-00* | *00-01* | *01-02* |
| *Farmer 1* | | | | | | | | | | | |
| Crop | 22311 | 16789 | 35138 | 34445 | 35155 | 35442 | 36842 | 35205 | 2.45 | 2.65 | 2.43 |
| Homestead | 239 | 2421 | 869 | 934 | 836 | 6180 | 6602 | 7045 | 6.96 | 7.02 | 8.75 |
| Livestock | 6200 | 9400 | 5480 | 5500 | 6090 | 10650 | 10895 | 12850 | -0.74 | -1.14 | -30.36 |
| Fisheries | 610 | 615 | 970 | 1050 | 1050 | 1660 | 2375 | 3200 | 3.90 | 5.00 | 6.88 |
| Off farm | 500 | 1500 | 500 | 500 | 13500 | 1500 | 1500 | 11500 | -- | -- | 1.77 |
| Total | 29860 | 30725 | 42957 | 42429 | 56631 | 55432 | 58214 | 69800 | 2.89 | 3.19 | 2.46 |
| *Farmer 2* | | | | | | | | | | | |
| Crop | 6505 | 8258 | 10480 | 11055 | 11820 | 11530 | 14540 | 10839 | 1.82 | 2.38 | 1.49 |
| Homestead | 190 | 1845 | 695 | 735 | 658 | 5632 | 6092 | 6710 | 8.49 | 8.79 | 11.40 |
| Livestock | 0 | 1590 | 3200 | 9230 | 3505 | 3700 | 7590 | 11035 | 1.66 | 1.65 | 3.69 |
| Fisheries | 0 | 0 | 480 | 350 | 875 | 970 | 650 | 2075 | 3.02 | 2.86 | 3.37 |
| Off farm | 0 | 11300 | 0 | 0 | 0 | 11000 | 11000 | 11500 | 0 | 0 | 0 |
| Total | 6695 | 22993 | 14855 | 21370 | 16858 | 32832 | 39872 | 42159 | 2.21 | 2.15 | 2.89 |

GM = Gross Margin, TVC = Total Variable Cost, MBCR = Marginal Benefit Cost Ratio

***Farm income and expenditure:***

The farm income and expenditure increased progressively during the intervention period in both the farms. Interestingly, it was observed that the farm expenditure increased as the income increased. The income balance was much less as compared to increases in income in both farms. This indicates that the additional income earned through integrated farming was reinvested in production as well as improving family welfare. The summary of income and expenditure statement of the farms is shown in Tables-4 and 5.

Table 4. Income and expenditure pattern of small farm (Farm-1) before and during intervention at FSRD site, Ishan Gopalpur, Faridpur

| *Source* | *Farmer-1* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Before intervention 1998-1999* | | *After intervention 1999-2000* | | *After intervention 2000-2001* | | *After intervention 2001-2002* | |
| | *Income (Tk.)* | *Expenditure (Tk.)* | *Income (Tk.)* | *Expenditure (Tk.)* | *Income (Tk.)* | *Expenditure (Tk.)* | *Income (Tk.)* | *Expenditure (Tk.)* |
| Crop sub sector | 39100 | 22311 | 70580 | 35138 | 71287 | 34445 | 70360 | 35155 |
| Homestead sub sector | 2660 | 239 | 7049 | 869 | 7536 | 934 | 7881 | 836 |
| Livestock sub sector | 15600 | 6200 | 16130 | 5480 | 16395 | 5500 | 18940 | 6090 |
| Fisheries sub sector | 1225 | 610 | 2630 | 970 | 3425 | 1050 | 4250 | 1050 |
| Off farm sub sector | 2000 | 500 | 2000 | 500 | 2000 | 500 | 25000 | 13500 |
| Loan taken | -- | -- | -- | -- | 10000 | -- | -- | -- |
| *Living cost sector* | | | | | | | -- | -- |
| Kacha Bazar | -- | 9125 | -- | 10950 | -- | 10000 | -- | 9785 |
| Foods | -- | 2800 | -- | 2200 | -- | 2200 | -- | 2200 |
| Cloths | -- | 2500 | -- | 3000 | -- | 3500 | -- | 4000 |
| Education | -- | 1000 | -- | 1500 | -- | 2000 | -- | 2000 |
| Medical | -- | 2500 | -- | 2000 | -- | 2000 | -- | 1500 |
| Repairing | -- | 2400 | -- | 2500 | -- | 1500 | -- | 2000 |
| Investment | -- | -- | -- | 3500 | -- | 27000 | -- | 25000 |
| Others | -- | 6400 | -- | 6970 | -- | 8000 | -- | 10500 |
| Housing | -- | -- | -- | 2000 | -- | 500 | -- | 300 |
| Refreshment | -- | 1200 | -- | 1500 | -- | 2000 | -- | 2500 |
| Distribution | -- | 500 | -- | 800 | -- | 1000 | -- | 1200 |
| Balance | -- | 2300 | -- | 20312 | -- | 8514 | -- | 8815 |
| Total | 60585 | 60585 | 98389 | 98389 | 110643 | 110643 | 126431 | 126431 |

Table 4. Income and expenditure pattern of small farm (Farm-1) before and during intervention at FSRD site, Ishan Gopalpur, Faridpur

| *Source* | *Farmer-2* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Before intervention 1998-1999* | | *After intervention 1999-2000* | | *After intervention 2000-2001* | | *After intervention 2001-2002* | |
| | *Income (Tk.)* | *Expendi-ture(Tk.)* | *Income (Tk.)* | *Expendi-ture(Tk.)* | *Income (Tk.)* | *Expendi-tureTk.)* | *Income (Tk.)* | *Expendi - tureTk.)* |
| Crop sector | 14763 | 6505 | 22010 | 10480 | 25595 | 11055 | 22659 | 11820 |
| Homestead | 2035 | 190 | 6327 | 695 | 6827 | 735 | 7368 | 658 |
| Livestock sector | 1590 | -- | 6900 | 3200 | 16820 | 9230 | 14540 | 3505 |
| Fisheries sector | -- | -- | 1450 | 480 | 1000 | 350 | 2950 | 875 |
| Off farm | 11300 | -- | 11000 | -- | 11000 | -- | 11500 | -- |
| Loan taken | 382 | -- | -- | -- | -- | -- | -- | -- |
| ***Living cost*** | | | | | | | -- | -- |
| Kacha Bazar | -- | 5475 | -- | 6200 | -- | 5500 | -- | 5000 |
| Foods | -- | 11000 | -- | 11000 | -- | 11500 | -- | 12800 |
| Cloths | -- | 2000 | -- | 2000 | -- | 2000 | -- | 2500 |
| Education | -- | 400 | -- | 800 | -- | 1000 | -- | 1000 |
| Medical | -- | 1200 | -- | 800 | -- | 700 | -- | 500 |
| Repairing | -- | 500 | -- | 3600 | -- | -- | -- | 500 |
| Investment | -- | -- | -- | 2000 | -- | 5000 | -- | 3000 |
| Others | -- | 2000 | -- | 2000 | -- | 2000 | -- | 3000 |
| Housing | -- | -- | -- | 200 | -- | 4500 | -- | 1000 |
| Refreshment | -- | 500 | -- | 500 | -- | 500 | -- | 500 |
| Distribution | -- | 300 | -- | 500 | -- | 500 | -- | 500 |
| Balance | -- | -- | -- | 3232 | -- | 6672 | -- | 11859 |
| **Total** | **30070** | **30070** | **47687** | **47687** | **61242** | **61242** | **59017** | **59017** |

**Goyeshpur FSRD Site, Pabna**

***Farm productivity***

Several farms from each of marginal, medium and small categories were included in the study and each intervened for 2-3 years with a large number of recommended technologies for field crops, homestead farming, livestock and fisheries, etc. (Table 1). Result showed tremendous increases in farm productivity of almost all enterprises of each sub-sectors. However, considering the volume, the data is not presented here.

Table 1: Improved/ recommended technologies used for integrated farming systems at FSRD Site, Goyeshpur, Pabna

| Resources | | | Technologies for intervention |
|---|---|---|---|
| **A. Homestead: New year round vegetable model** | | | |
| Open land | Bed 1 | : | Radish (Tasaki)-Stem amaranth (LIV)- Indian spinach |
| | Bed 2 | : | Cabbage (Atlas 70) - Brinjal – Red amaranth |
| | Bed 3 | : | Tomato (Raton) + Spinach – Okra (BARI Dheros 1) |
| Roofs | | : | Bottle gourd (BARI Lau 1) – White gourd |
| Trellis | | : | Bottle gourd (BARI Lau 1) – Sweet gourd |
| Trees (fruitless) | | : | Potato yam/Country bean/Sponge gourd |
| Partially shady area | | : | Elephant foot yam, Leaf aroid, Ginger |
| Marshy land | | : | Water taro |
| Fence | | : | Bitter gourd, Yard long bean |
| House boundary | | : | Papaya, Lemon, Guava |
| Back yard | | : | Laizna, Plantain banana |
| **Other development activities of the homestead**: | | | |
| Existing trees | | : | Manuring, fertilization, pest control, irrigation, drainage, top working of the existing fruit and forest species. |
| New plantation of HY varieties | | : | Mango, Litchi, Pumelo |
| Grafting nursery for HYV fruit trees | | : | Grafting of mango/Litchi/Jujube seedling |
| Environment friendly cooking oven | | : | BARI cooking oven |
| Use of organic wastes for cooking, lighting and use as fertilizer | | : | i. Biogas plant with cattle/poultry excreta<br>ii. Composting with house waste |
| Seed preservation | | : | Using scientific method for seed preservation |
| **B. Pond (perennial & seasonal)** | | | ⇨ Polyculture of Pangas and crap fish<br>⇨ Monoculture of Pangas<br>⇨ Integrated poultry/duck-cum-fish + vegetables production<br>⇨ Polyculture of carp fish<br>⇨ GIF Tilapia in ditch or seasonal pond<br>⇨ Fingerling production of different fish species |

**C. Livestock:**

- ⇨ Broiler production
- ⇨ Bull fattening
- ⇨ Milking cow rearing
- ⇨ Pigeon rearing
- ⇨ Layer (HYV) rearing (Improved breed)
- ⇨ Goat rearing

**D. Crop land:**

| | | |
|---|---|---|
| i. High land | : | Carrot (Hybrid new coruda) - Sesame (HYV) - T.Aman (BRRIDhan32) |
| | | Bulb Onion (HYV) - Mungbean (HYV) - T.Aman (BRRIDhan31) |
| | | Papaya (LIV) - (Two year cycle) |
| | | Mustard (BARI-8) - Mungbean (BINA 5) - T.Aman (BRRIDhan33) |
| | | Lentil (BARI-4) - Jute (O-9897) - T.Aman (BRRIDhan31) |
| | | Cauliflower (White contesa) - Sweet gourd - Red amaranth |
| | | Cabbage (Atlas 70) - Lady's finger (BARI-1) - Red amaranth |
| | | Tomato (Raton) - Bitter gourd (LIV) - Red amaranth |
| | | Spinach (Kupi) - White gourd (IPSA) - Red amaranth |
| | | Bottle gourd (BARI 1) Bitter gourd (LIV) - with or without trellis |
| ii. Medium high land | : | Wheat - GM - T.Aman (BRRIDhan31) |
| | | Maize (Hybrid) - GM - T.Aman (BRRIDhan32) |
| | | Mustard (BARI-8) - Jute (O-9897) - T.Aman (BRRIDhan31) |
| | | Onion (BARI 1) - Sesame (T6) - T.Aman (BRRIDhan31) |
| | | Grass pea - Jute (O-9897) - T.Aman (BRRIDhan32) |
| iii. Medium lowland | : | Boro (BRRIDhan29) - Fallow - - T.Aman (BR11) |
| | | Boro (BRRIDhan29) - Fallow - T.Aman (BRRIDhan31) |

### *Farm income*

Every subsystem's income increased remarkably with whole farm intervention and the income varied widely with different farm categories. In marginal farms, the gross margin from homestead, crop, livestock, fisheries and business increased by 107, 27, 832, 103 and 52 percent respectively (Table-2). The overall increase of gross margin of the farm was 74 percent over pre-intervention period. The result revealed that in marginal farms, income increased remarkably due to intensive use of resources of all subsystems. In case of small farms, the gross margin obtained from the respective subsystems were 50, 15, 382, 287 and –33.95 percent and considering all resources the gross margin increased by 9.20% over pre project status (Table-3). The highest net benefit was obtained from livestock sector, probably due to introduction of new technologies like UMS diet, vaccination, and deworming of cattle etc in marginal farm category. In case of medium farm the gross margin from homestead, crop, livestock, fisheries and business subsystems increased by 75, 28, 74, 78, and 13 percent respectively and the overall increase of gross margin of the farm was 59 percent over pre project status (Table-4). The gross margin as well as net income of the farm increased by 74 in marginal farms as against 9.2 percent in small and 59 percent in medium farms. This was because, though the marginal farmer owned less farm resources than small and medium farmers, they used their resources and technologies intensively and efficiently. The MBCR was found 68.72, -0.25 and 86.78 in marginal, small and medium farm category respectively, considering all farm resources.

Table-2: Cost and returns from different subsystems of integrated farming of marginal farms at FSRD site Goyeshpur, Pabna (2001-02).

| Resource | Marginal | | | | |
|---|---|---|---|---|---|
| | Pre-intervention | | During intervention | | |
| | TVC (Tk/farm) | GM (Tk/farm) | TVC (Tk/farm) | GM (Tk/farm) | MBCR |
| Homestead (107%) | 390 | 4048 | 1119 | 8389 | 5.95 |
| Crop (27%) | 8528 | 4719 | 5988 | 6006 | -0.51 |
| Livestock (832%) | 1975 | 545 | 10671 | 5077 | 0.52 |
| Fisheries (103%) | 3635 | 2668 | 1362 | 5412 | 1.21 |
| Business (52%) | 20971 | 17989 | 16683 | 27352 | -2.18 |
| Total (74%) | 35499 | 29969 | 35823 | 52236 | 68.72 |

*Average net income increased 74% over whole resources*

'able 3. Cost and returns from different subsystems of integrated farming of small farms at FSRD site Goyeshpur, Pabna (2001-02).

| Resource | Small | | | | |
|---|---|---|---|---|---|
| | Pre-intervention | | During intervention | | |
| | TVC (Tk/farm) | GM (Tk/farm) | TVC (Tk/farm) | GM (Tk/farm) | MBCR |
| Homestead (50%) | 338 | 4478 | 888 | 6735 | 4.10 |
| Crop (15%) | 14620 | 30019 | 15341 | 24533 | 6.26 |
| Livestock (382%) | 1240 | 1971 | 4778 | 9507 | 2.13 |
| Fisheries (287%) | 741 | 1685 | 1003 | 6526 | 18.48 |
| Business (-33.95%) | 69021 | 36248 | 36864 | 23942 | 0.38 |
| Total (9.20%) | 85960 | 74401 | 58874 | 81243 | -0.25 |

*Average net income increased 9.20% over whole resources*

Table 2. Cost and returns from different subsystems of integrated farming of medium farms at FSRD site Goyeshpur, Pabna (2001-02).

| Resource | Medium | | | | |
|---|---|---|---|---|---|
| | Pre-intervention | | During intervention | | |
| | TVC (Tk/farm) | GM (Tk/farm) | TVC (Tk/farm) | GM (Tk/farm) | MBCR |
| Homestead (75%) | 195 | 3264 | 935 | 5709 | 3.30 |
| Crop (28%) | 33081 | 33083 | 28670 | 42365 | -2.10 |
| Livestock (74%) | 1384 | 5740 | 6476 | 10002 | 0.84 |
| Fisheries(782%) | 962 | 2494 | 3991 | 21989 | 6.44 |
| Business (13%) | 12760 | 20600 | 8750 | 23300 | -0.67 |
| Total (59%) | 48382 | 65181 | 48829 | 103565 | 86.78 |

*Average net income increased 59% over whole resources*

***Food habit***

*IF*

During the pre-intervention period, the farmers consumed much less amount of vegetables, fruits and animal protein as compared to post-intervention period. Introduction of the newly developed year round vegetable production model, raring of layer and broiler chickens, fish polyculture in seasonal and perennial ponds and ditches, etc. ensured availability of and consumption of balanced and nutritious food to all members of the households. The per day vegetable production averaged 1.57 kg/farm with the new model, which can fulfill the requirement of five member farm family.

### *Family labour utilization pattern*

Utilization of surplus family (viz. women, children) and hired labor increased due to huge intervention of technologies in integrated farming. The higher participation of women in agricultural activities made positive impact on equity issues within the family and the community as a whole.

### *Development sustainability*

The sustainability issue in development of the integrated farming model is discussed here in context of family income, nutrition, resource use, knowledge and skill, adoption of innovation, soil health, employment, microenvironment, social status, marketing channel and competitiveness with specific indicators (Table-5). Conway (1985, 1994) also reported that the sustainable development of a farming system has the four desirable properties of productivity, stability, resilience and equity.

Table 5: Systems sustainability consideration in holistic approach of integrated farming at FSRD site, Goyeshpur during 2001-2002

| Sl # | Area of consideration | Impacts created | Indicators to asses the sustainability |
|---|---|---|---|
| 1 | Income | Net income increased by 16% | – Used modern varieties<br>– Innovative technologies<br>– Use of more area under cultivation/production<br>– Increased production skill due to training and on the spot demonstration |
| 2 | Family nutrition | Improved satisfactorily | – Consumption of vegetables, fruits, egg, meat ,milk and fish increased by more than 100%<br>– Changed in consumption habit towards vegetables & fruits<br>– Reduced number of disease and frequency of attack<br>– Good appearance of family members |
| 3 | Soil health | Maintained/ increased | – Used leguminous crop in cropping pattern<br>– Use of organic matter increased due to increase production<br>– Use of chemicals/poison decreased due to use of organic matter and integrated pest management<br>– Use of cropping pattern detrimental to soil health (cereal - cereal) has been reduced. |
| 4 | Resource use pattern (left adjustment) | Increased | – Used of homestead by 100%<br>– Intensive cropping with appropriate cropping pattern<br>– Introduction of new production units (Broiler, poultry - cum -fish, Papaya garden, Homestead production model etc.) |

| | | | |
|---|---|---|---|
| 5 | Technical knowledge | Technical knowledge increased sharply | a) The young boys & girl house nice are engaged for implementation of the new technologies<br>- cash grow many new crops/items independently.<br>b) Training, field days, exchange of views with different types of people<br>– Wife, son daughter speaks to visitors and farmers<br>– Farmer explains his skills in different forums and gatherings. |
| 6 | Adoption of innovation | Increased(by75 %) | – New crops, vegetables varieties including hybrids are in use<br>– Use of recommended fertilizer (organic, inorganic) doses<br>– Use of different preventive & curative measurement of crop livestock, poultry and fish species<br>– Use of integrated technologies. |
| 7 | Employment | Increased | – Use of unutilized family labour e.g. children (10%)<br>– Women participation in agricultural activities (increased 85%), made positive effect on equity within the family and the community<br>– Huge hired labour used to integrated farming intervention and created employment.(60%) |
| 8 | Micro-environment | Preserved and improved | – Household wastes being used for composting (100%) and their use in cropping<br>– Use of improved oven reduced fuel biomass use(by 37%)<br>– Use of IPM saved environment from pollution<br>– New plantation increased vegetation (by about 60%) contributed to the favorable environment<br>– Irrigation to crops and trees added to positive microenvironment. |
| 9 | Social status | Improved | – Increased access to people specially of high status in the society<br>– Increased acceptability to people due to interaction with various technical, economic aspects and national publicity media e.g. Radio, BTV and Newspaper<br>– Improved mental strength due to higher income, development in skill on technologies and public conduct. |
| 10 | Market channel | Improved | – Created new market channel due to adoption of different. technologies of vegetables, crops, livestock, poultry and fisheries<br>– Farmers directly sold their farm products to the traders at the farm gate with reasonable price<br>– Increased access to the town and capital city for purchase and selling of farm input and output |
| 11 | Competitiveness | Increased | – Grown confidence about technologies after farmers tried in their own situation and increased competitiveness to shift quickly towards high demand and high value technologies<br>– Management practice improved for bumper production and became the best producer among the farmers<br>– Nominated for awarding as the best growers |
| 12 | Sanitation | Improved | – Created awareness about family health through of pacca latrine instead of katcha one. |

***Impacts***

The following general impacts were observed after intervention of technologies through holistic approach in integrated farming:

1. In integrated farming system (IFS) farmers are preserved the kitchen waste, manures, crop residues, animal waste, poultry litter, cowdung at their farm level scientifically and using properly for crop production, which ultimately helped to improve soil fertility and moisture conservation, thereby reducing environmental pollution in order to get sustainable agricultural production.
2. Through holistic approach each and every production unit was effectively utilized for generating more cash income.
3. Unlike traditional practices of agriculture activity where the cash is expected only at the time of disposal of the output, the integrated farming provides flow of cash to the farmers round the year from different enterprises like egg, milk, meat, vegetables, fish, fruits etc.
4. Timely application of recommended seeds, fertilizers and plant protection measure in holistic approach helped to boost production. The same technology was rapidly disseminated to many farmers around the program.
5. The holistic farm approach directly and indirectly changed in food habit, nutritional status, health care, clothing and sanitation, saving pattern and borrowing of the practicing farmers.
6. Integration of crop enterprise with livestock and fisheries got advantage of complementary and supplementary relationship among them, which have created more employment opportunity and better utilization of resources.
7. Integrated farm units were used as centers of agricultural development in the local area, where neighbor and other farmers and visitors are acquiring new technical know how leading to quickly dissemination of farm innovations

**Narikeli FSRD Site, Jamalpur**

Ten farmers, representing the marginal and small category were brought under whole farm intervention at the site.

**Farm productivity**

As in other sites, a large number of recommended technologies for field crop production, homestead farming, livestock and fish production were included for intervening the farms (Table 1). However, depending on resources availability, the number of technologies adopted by a specific farm varied widely. The overall productivity of important technologies is presented in Table 2. It was observed that throughout the entire period of intervention the productivity of existing farming improved to a great extent.

Table 1. List of interventions in each sub-systems separately and the method of selecting the interventions and intervening process

**Crop Sector**

1. T. Aman- BRRI Dhan 32 instead of pajam
2. Wheat- Kanchan, Shourab, Ghourab instead of Sonalika
3. Mustard- BARI Sarisha-8, Tori-7 instead of local
4. Boro – BRRI Dhan-29, BRRI Dhan-28, BR-11 instead of local

## Homestead

### *Homestead vegetable production model*

1. White gourd on roof
2. Sweet gourd on roof
3. Bitter gourd on the fence
4. Sweet gourd on trail's
5. Indian spinach on trail's
6. Bottle gourd on pond trails (BARI Lau-1)
7. Mukhi kachu in partial shade area
8. Turmeric in partial shade area
9. Zinger in partial shade area
10. Kachu in waste land-(Latiraj)
11. Potato Yam on the Homestead trees (Ziga, Mandar, Drumstick,
12. Jujube, Betel nut, Coconut, mango and also on bamboo support)
13. BARI Shim-1, BARI Lau-1 on the trail's

### *Homestead trees*

1. Mango hopper control, management and fertilization practices of different fruit trees
2. Fertilization and water management in Betel nut, Coconut, Guava and Jackfruit
3. Top working of Jujube
4. Mango hopper and parasite control
5. New plantation of mango (Khirshapati, Gopalbogh, Langra, Fazli, BARI mango-3, BARI mango-4), Litchi (China-3), Guava (BARI Guava-1 and 2), Sofeda, Seedless Lemon, Drumstick, Coconut, Betel nut, Kamranga, Neem, Papaya, Pome granite, Amra, Amloki, Sarifa, Tissue cultured jackfruit and banana, Mahogany

## Livestock system

1. Deworming of cattle
2. Vaccination of poultry
3. Rearing of poultry (broiler and layer)
4. Introduction of goat

Table 2. Productivity of different technologies before and after intervention at FSRD site, Narikeli, Jamalpur

| Resource | Before intervention | | After intervention | | Remarks |
|---|---|---|---|---|---|
| | Variety/item | Yield (t/ha) | Variety/item | Yield | |
| T. Aman | Pajam | 2.44 | BR-11 | 4.17 t/ha | |
| Boro | BR-14 | 3.95 | BR-29 | 6.66 t/ha | |
| Jute | Local | 1.29 | O-9897 | 2.56 t/ha | |
| Homestead | White gourd | 19 N | Local | 32 N/pit | Fertilization |
| | Bottle gourd | 16 N | BARI Lau-1 | 50 N/pit | |
| | Sweet gourd | 12 N | Snake gourd | 16 kg/pit | |
| | - | | Pointed gourd | 18 kg/pit | |
| | - | | Cucumber | 16 kg/pit | |
| | - | | Bitter gourd | 15 kg/pit | |
| | - | | Indian spinach | 21 kg/pit | |
| Partial shady area | - | | Turmeric | 12 kg/dec. | |
| | - | | Ginger | 17 kg/dec. | |
| | - | | Mukhi kachu | 21 kg/dec. | |
| | - | | Elephant taro | 12 kg/dec. | |
| Tralis | - | | Potato yam | 20 kg/pit | |
| | - | | BARI shim | 15 kg/pit | |
| Ponds surroundings | - | | White gourd | 20 N | |
| | - | | Bottle gourd | 40 N | |
| Livestock | Ox (Traditional) | 40 kg/ox | Ox (improved management) | 80 kg | Meat/ox/year |
| | Local hen | Egg 33 | Exotic | 200 N | N/hen/year |
| Fisheries | Pond (Traditional) | 18 kg | Mixed culture | 40 kg | 3 dec./year |

***Financial benefit***

Every subsystem's income was increased remarkably. The net benefit from crop sector, homestead, livestock, fisheries and off-farm business were 59, 677, 201, 114 and 46 percent, respectively (Table 3). The average net income (Tk.13456) was 118 percent higher than the test year. The average net return Tk. 20412 (each farmer) was 113 percent higher after intervention (Table 3).

Table 3. Cost and returns from different subsystems of integrated farming of medium farms at FSRD site Narikeli, Jamalpur

| Farmers | Resource | Before intervention | | After intervention | | MBCR | | MRR (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | GM (Tk) | TVC (Tk) | GM (Tk) | TVC (Tk) | 2000 | 2001 | 2000 | 2001 |
| Farmer-1 | Crop | 12250 | 5000 | 17440 | 5800 | 14.06 | 14.82 | 1190 | 1257 |
| Shamsul Haque | Homestead | 277 | 95 | 3170 | 800 | 36.71 | 39.85 | 2971 | 3220 |
| | Livestock | 420 | 200 | 5600 | 1800 | 4.23 | 4.50 | 323 | 343 |
| | Fisheries | 900 | 450 | 1650 | 700 | 4.00 | 4.20 | 300 | 315 |
| | Total | 13847 | 5745 | 27860 | 9100 | 59.00 | 63.37 | 4784 | 5135 |
| Farmer-2 | Crop | 19580 | 9500 | 28810 | 12000 | 10.24 | 10.6 | 824 | 851 |
| Razia Sultana | Homestead | 140 | 375 | 2370 | 610 | 27.48 | 29.6 | 2248 | 2416 |
| | Livestock | 525 | 230 | 6175 | 2120 | 3.98 | 4.10 | 298 | 360 |
| | Fisheries | 1600 | 750 | 3400 | 1500 | 3.66 | 3.90 | 240 | 255 |
| | Total | 21845 | 10855 | 40755 | 16230 | 45.36 | 48.2 | 3610 | 3828 |
| Farmer-3 | Crop | 9210 | 4150 | 13830 | 5350 | 10.77 | 11.7 | 877 | 954 |
| Shuli Begum | Homestead | 384 | 120 | 3060 | 890 | 27.5 | 30.1 | 2205 | 2413 |
| | Livestock | 7750 | 4820 | 17000 | 7680 | 10.0 | 10.70 | 800 | 854 |
| | Total | 17344 | 9090 | 33890 | 13920 | 48.27 | 52.5 | 3882 | 4221 |
| Farmer -4 | Crop | 3800 | 2100 | 5200 | 3200 | 2.27 | 2.60 | 127 | 145 |
| Abdul Khaleque | Homestead | 496 | 180 | 2380 | 830 | 24.63 | 27.55 | 1869 | 2079 |
| | Livestock | 3555 | 2400 | 17040 | 7800 | 6.78 | 7.45 | 478 | 524 |
| | Total | 7851 | 4680 | 24620 | 11830 | 33.68 | 37.6 | 2474 | 2748 |
| Farmer-5 | Crop | 2310 | 1150 | 2512 | 1700 | 1.36 | 1.60 | 36.72 | 42 |
| Ranju Fakir | Homestead | 225 | 75 | 3500 | 650 | 28.54 | 30.65 | 2354 | 2522 |
| | Livestock | 325 | 2180 | 6460 | 3260 | 6.46 | 7.40 | 446 | 512 |
| | Off-Farm | 1000 | 400 | 1500 | 450 | 11.00 | 14.0 | 1000 | 1272 |
| | Total | 6740 | 3805 | 13972 | 6160 | 47.36 | 53.65 | 3836 | 4348 |
| Farmer-6 | Crop | 9440 | 4300 | 11685 | 5350 | 6.33 | 7.1 | 433 | 482 |
| Shamsul Haque Akanda | Homestead | 600 | 170 | 5800 | 1270 | 41.96 | 44.60 | 3510 | 3726 |
| | Livestock | 7080 | 4340 | 17750 | 8570 | 12.65 | 13.7 | 965 | 1043 |
| | Fisheries | 1500 | 800 | 3600 | 1600 | 3.62 | 4 | 262 | 289 |
| | Total | 18620 | 10620 | 38835 | 16790 | 64.56 | 69.40 | 5170 | 5540 |

Table 3. Continued.

| Farmers | Resource | Before intervention | | After intervention | | MBCR | | MRR (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | GM (Tk) | TVC (Tk) | GM (Tk) | TVC (Tk) | 00 | 01 | 00 | 01 |
| Farmer-7 | Crop | 3700 | 1200 | 5220 | 1500 | 6.06 | 6.50 | 506 | 546 |
| Abdur Razzaque | Homestead | 300 | 110 | 2440 | 670 | 23.08 | 24.95 | 1808 | 1953 |
| | Livestock | 395 | 170 | 5870 | 1860 | 4.23 | 4.85 | 323 | 370 |
| | Off-Farm activities | 2000 | 400 | 3000 | 600 | 6 | 6.90 | 500 | 575 |
| | Total | 6395 | 1880 | 16530 | 4630 | 39.37 | 43.20 | 3137 | 3440 |
| Farmer-8 | Crop | 10460 | 4800 | 22715 | 8000 | 9.71 | 10.65 | 772 | 846 |
| Abu Taleb | Homestead | 265 | 122 | 2315 | 605 | 32.36 | 34.95 | 2636 | 2846 |
| | Livestock | 3097 | 2120 | 11020 | 5090 | 7.34 | 7.97 | 534 | 580 |
| | Fisheries | 400 | 310 | 1300 | 620 | 3.90 | 4.00 | 290 | 297 |
| | Off-Farm activities | 2000 | 500 | 2800 | 620 | 7.60 | 7.95 | 666 | 696 |
| | Total | 16222 | 7852 | 40150 | 14935 | 60.91 | 65.52 | 4963 | 5265 |
| Farmer - 9 | Crop | 3550 | 1700 | 4750 | 1890 | 7.31 | 7.85 | 631 | 678 |
| Aktar Hossain | Homestead | 245 | 80 | 2020 | 520 | 25.28 | 27.45 | 2028 | 2198 |
| | Livestock | 390 | 160 | 5880 | 2260 | 3.61 | 3.90 | 261 | 281 |
| | Off-Farm activities | 1000 | 400 | 1800 | 500 | 9 | 10 | 8.00 | 888 |
| | Total | 5185 | 2340 | 14450 | 5170 | 45.2 | 49.2 | 3720 | 4045 |
| Farmer-10 | Crop | 4540 | 1600 | 6000 | 1820 | 7.63 | 7.95 | 663 | 690 |
| Ruhul Amin | Homestead | 525 | 230 | 2990 | 800 | 28.13 | 30.15 | 2313 | 2477 |
| | Livestock | 270 | 120 | 360 | 180 | 2.50 | 2.90 | 150 | 174 |
| | Off-Farm activities | 2500 | 400 | 3500 | 800 | 3.50 | 3.90 | 250 | 278 |
| | Total | 7835 | 2350 | 12850 | 3600 | 41.76 | 44.90 | 3376 | 3619 |
| Net return increased | Crop | Total return=114340 | | Total return=182552 | | Net return Increases = 59% | | | |
| | Homestead | Total return=5014 | | Total return=38960 | | Net return Increases = 677% | | | |
| | Livestock | Total return=44437 | | Total return=133775 | | Net return Increases = 201% | | | |
| | Fisheries | Total return=6710 | | Total return=14370 | | Net return Increases =114% | | | |
| | Off-Farm activities | Total return=10600 | | Total return=15570 | | Net return Increases = 46% | | | |
| Net income increased =118% | Gross margin= 113384 | | | Gross margin= 247952 | | | | | |

***Impacts on labor utilization and family welfare***

Use of family labour increased (women 75%, children 10% and male labour 15%) increased due to huge intervention of technologies in integrated farming. More participation of women in agricultural activities made positive impact on gender equity issues within the family and the community as a whole. It was observed that increased farm production and income together with motivation with new knowledge and skills improved the livelihood in all the farms intervened.

Table 4. Impacts of integrated farming intervention on the improvement of the livelihood systems at FSRD sire, Narikeli, Jamalpur

| Name | Assets developed | Living standard | | | | Children education | Savings |
|---|---|---|---|---|---|---|---|
| | | Food | Living condition | Sanitation | Medicare | | |
| 1. Md. Shamsul Haque | Improvement of residence by tin replacing thatching housel | Intake of vegetable, milk, meat and fish | Increase social acceptability for economic upliftment | Use of hygienic sanitary latrine | Better health service | Son- Class XI<br>Daughter- Class X<br>Son- Class V | Repaying loan of different NGOs |
| 2. Razia Sultana | Brick wall with tin roof instead or ordinary ceiling | Intake of vegetable, milk, meat, fruits and fish | Self reliance in doing homestead activities | Use of hygienic pucca latrine | More conscious about health care | Daughter- KG I<br>Son- Baby | Savings in Banks |
| 3. Sheuli Begum | Bricks wall with tin roof instead of ordinary ceiling | Icreased intake of vegetable, milk, meat, fruits and fish | Self reliance in doing homestead activities | Use of hygienic pucca latrine | More conscious about health care | Daughter- Married<br>Daughter- Married<br>Daughter-XI | Savings in Banks |
| 4. Md. Abdul Khaleque | Buying of 2 calves, improvement of kitchen room by fencing, roof with tin and earth working | Better intake of vegetables | Increase social acceptance | Use of hygienic sanitary latrine | Better health care | Daughter- Married<br>Son- Married (Service)<br>Son- Class IX<br>Daughter- Baby | Loan repaying |
| 5. Md. Ranju Fakir | Improvement of kitchen, development of homestead area by earth working | Better intake of vegetable, fishes, egg and fruits | Increase social status due to economic upliftment | Use of hygienic sanitary latrine | Better health care | Daughter KG - I<br>Son- Baby | Loan repaying |
| 6. Md. Shamsul Haque Akanda | Improvement of residence by tin in lieu of thatching material | Intake of vegetable, fruits, milk, meat and egg | Better social acceptance | Use of sanitary latrine | More conscious about health care | Daughter- Married<br>Son- Agriculture | Savings in Bank |
| 7. Md. Abdur Razzaque | Development of residence | Better intake of vegetable, egg | Increasing social acceptance | Use of sanitary latrine | Better health care | Daughter- married<br>Daughter- garments worker<br>Son- Class X | Repay loans |
| 8. Abu Taleb | Improvement of dwelling house by tin replacing thatched house, buying of new land | Better intake of vegetable, fish, egg fruits | Increasing social status due to economic upliftment | Use of hygienic sanitary latrine | Better health care | Daughter- KG I<br>Son- Baby | Loan repaying |
| 9. Md. Akther Ali | Enlarge of dwelling house by tin, repairing rickshaw and shallow machine | Better intake of vegetable, egg | Increasing social acceptability | Use of hygienic sanitary latrine | Better health care | Daughter- Works in BRAC<br>Son- Class VII<br>Son- Class-I | Repaying loans of different NGOs |
| 10. Md. Ruhul Amin | Improvement of kitchen room | Better intake of vegetable | Increasing social acceptability | Use of hygienic sanitary latrine | Better health care | Daughter -Class V<br>Son- Class II<br>Son- Baby | Loan repaying |

**Sustainability of improved practices/technologies and reaction of other farmers**

For the last few years, the FSRD site, Narikeli, Jamalpur has developed a good number of location specific technologies and implemented of integrated interventions covering cropping systems, homestead farming, livestock, fish culture and agroforestry. The FSRD program has created excellent impacts to the participating farmers and increased their farm productivity, economic benefits and maximized farm resource use efficiency. Some of the important ones are listed below:

1. Growing potato yam on the homestead trees has created good response among the farmers. This potato yam not only cultivated in the site, it has extended by the different NGOs in the neighboring villages.
2. Homestead gardening of integrated farmers have not only met their family consumption and improved nutrition but also helped to earn extra income for better livelihood management.
3. BARI improved Chula has bean familiarized among the farmers because of fuel and time saving, easily portable and very useful during the flood than the traditional one.
4. Controlling mango hopper by spraying Simbush or Ripcord in the homestead as well as surrounding areas has created awareness among the farmers because of heavy bearing. This year FSRD team only supplied the sprayer machine and the farmers' sprayed the fruit trees themselves.
5. Rearing small-scale exotic poultry breed for egg production has created a wonderful practice for standby income generation of landless and marginal farmers. Farmers other than integrated farming cooperators became interested and adopted the practice.
6. The farmers, because of higher cash income within a very short time, have accepted the practice of vaccination and UMS diet of cattle. Several farmers at the site and surrounding areas now adopted this practice.
7. Bringing seasonal ponds of the homestead under seasonal fish culture not only meet the family nutrition but also proved to be an income generating process.
8. Growing of Latiraj Kachu, turmeric, ginger etc. in the shady areas are accepted by the farmers and has disseminated to the other farmers by the seed exchange.
9. Demand of BARI Dharesh-1, BARI Shim-1 and BARI lau-1 is increasing rapidly.
10. Plantation of improved fruit trees (seedless lemon, BARI Guava, Tissue cultured banana, Shahi papaya) is increasing rapidly to their heavy bearing.
11. Some of the sweet potato varieties developed by BARI, specially SP-4, SP-5 has bean accepted by the farmers because of its higher yield than the local.
12. Farmers around the site mainly grow Boro-T. aman with the local varieties. The FSRD team developed alternate pattern i.e, Potato- Sesame-T. aman with high yielding verities which is widely accepted.
13. Boron fertilization to mustard has been popularized.

**Syedpur FSRD Site, Rangpur**

After taking into account of the resources of the co-operator farmers the list of intervention technologies were finalized with the consent of the respective farmers. The list of the technologies practiced in the farms of three co-operator farmers have been presented in the Table 1. The interventions in the farm were started from the month of July 1999 at a slow but steady pace over the period of time. Intervention was made both with full and partial packages taking into account of the co-operator farmer's existing resources and financial ability. The annual production of different crops and others (fruit, fuel, egg, milk and fish) under each farm have been shown in Table 2 and 3, respectively. Economics of individual farms is shown in Table 4 and the annual income and expenditure in table 5, 6 and 7, respectively. The tables also explain the comparison of the productivity and economics of the technologies before and after intervention based on the resources of the co-operator farmers.

Table 1. Number of technologies used in three farms at Syedpur FSRD site during 1998-99 to 2001-02

| Sector | Number of Technologies Used | | | |
|---|---|---|---|---|
| | Before intervention | After intervention | | |
| | 1998-99 | 1999-00 | 2000-01 | 2001-02 |
| **Farm 1 (Mr. Md. Mohshin Ali, Small Farmer)** | | | | |
| Crop | 10 | 15 | 15 | 15 |
| Homestead | 5 | 16 | 16 | 16 |
| Livestock | - | 5 | 5 | 5 |
| Fisheries | - | - | - | - |
| Total | 15 | 36 | 36 | 36 |
| **Increased over 98-99** | - | 140% | 140% | 140% |
| **Farm 2 (Mr. Md. Shamsul Haque, Small Farmer)** | | | | |
| Crop | 2 | 4 | 4 | 4 |
| Homestead | 5 | 10 | 10 | 10 |
| Livestock | - | 5 | 5 | 4 |
| Fisheries | 2 | 5 | 5 | 5 |
| Total | 9 | 24 | 24 | 24 |
| Increased over 98-99 | - | 166% | 166% | 166% |
| **Farm 3 (Sree Moti Shudha Rani, Small Farmer )** | | | | |
| Crop | 5 | 6 | 7 | 7 |
| Homestead | 7 | 12 | 12 | 11 |
| Livestock's | - | 4 | 3 | 3 |
| Fisheries | - | - | - | - |
| Total | 12 | 22 | 23 | 22 |
| Increased over 98-99 | - | 83% | 92% | 83% |

**Homestead**

It is evident from tables that the cooperator farmer could effectively utilize the roof top, open field, partially shady places and boundary of the homestead which previously remained either unutilized or underutilized. The annual production of the vegetables of all the cooperator farmers in the homestead increased tremendously after intervention each year as compared to the control year. Increased production of vegetables lead to increased consumption in the family and contributed in earning cash income. The cooperator farmers used the farm waste effectively and utilized the compost in the vegetable and potato production.

***Plantation crops***

Due to better management of the fruit trees of the farm, fruit yield was higher than the production of control year. The principal increment of fruits accrued from mango, jackfruit and guava. Increased production of fruits paved the way for increased consumption by the family members and increased income to the farm. Fuel yield also registered an increase over the control year due to pruning management. Saplings of improved varieties of litchi (BARI Litchi 1) and mango (Gopalbhog) were planted in the homestead.

Table 2. Annual production of different crops and their share to the total productivity before and during intervention in the 3 farmers at FSRD site Syedpur, Rangpur

| Crop | Pre-interven. (1998-99) | | After intervention (1999-00) | | | After intervention (2000-01) | | | After intervention (2001-02) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Prodn (Kg) | % of total | Prodn (Kg) | % of total | % In-crease | Prodn (Kg) | % of total | % In-crease | Prodn (Kg) | % of total | % In-crease |
| **Farmer 1: (Mr. Md. Mohsin Ali)** | | | | | | | | | | | |
| Potato | 3569 | 41 | 7266 | 55 | 104 | 7320 | 46 | 105 | 7105 | 45 | 99 |
| Rice | 2392 | 28 | 3056 | 23 | 28 | 3156 | 20 | 32 | 3095 | 20 | 29 |
| Jute | 85 | 1 | 148 | 1 | 74 | 150 | 1 | 76 | 155 | 1 | 82 |
| Banana | 1480 | 17 | * | - | - | 1588 | 10 | 7 | 2000 | 13 | 55 |
| Vegetable | 808 | 9 | 2776 | 21 | 244 | 3270 | 21 | 305 | 3308 | 20 | 309 |
| Spice | 374 | 4 | 10 | T | - | 245 | 2 | - | 186 | 1 | - |
| Jute seed | - | - | 7.5 | T | - | 8 | T | - | 9 | T | - |
| *Total* | *8708* | *100* | *13262* | *100* | *52* | *15737* | *100* | *81* | *15858* | *100* | *82* |
| **Farmer 2:(Mr. Md. Samsul Haque)** | | | | | | | | | | | |
| Potato | 13112 | 77 | 17271 | 75 | 32 | 18171 | 74 | 39 | 18250 | 75 | 39 |
| Rice | 2883 | 17 | 3343 | 14 | 16 | 3372 | 14 | 17 | 3400 | 14 | 18 |
| Jute | - | - | 857 | 4 | T | 1249 | 5 | - | 900 | 4 | - |
| Vegetable | 1109 | 6 | 1608 | 6 | 45 | 1618 | 6 | 46 | 1730 | 7 | 56 |
| Spice | 19 | T | 31 | 1 | 63 | 35 | 1 | 84 | 50 | 3 | 163 |
| *Total* | *17123* | *100* | *23110* | *100* | *35* | *24445* | *100* | *43* | *24330* | *100* | *42* |
| **Farmer 3:(Mrs. Sree Moti Shudha Rani)** | | | | | | | | | | | |
| Potato | 2267 | 42 | 2986 | 40 | 31 | 8358 | 67 | 269 | 8467 | 66 | 273 |
| Rice | 256 | 5 | 522 | 7 | 104 | 465 | 4 | 82 | 525 | 4 | 105 |
| Jute | 130 | 2 | 282 | 4 | 117 | 675 | 5 | 419 | 595 | 5 | 358 |
| Banana | 2215 | 42 | - | - | - | - | - | - | - | - | - |
| Vegetable | 370 | 7 | 3506 | 47 | 848 | 2932 | 23 | 692 | 3030 | 24 | 719 |
| Spice | 31 | T | 150 | 2 | 384 | 157 | 1 | 406 | 210 | 1 | 577 |
| *Total* | *5269* | *100* | *7446* | *100* | *41* | *12587* | *100* | *139* | 12827 | *100* | *143* |

**** = Crop was in the field*** ***T = Trace***

### *Crops and Cropping Patterns*

Use of improved varieties, better quality seeds and recommended production practice increased the yield of different crops of the farm substantially. Total productivity of the field crops increased significantly in both the years over the control year (Table 5). The increased production came mainly through potato, vegetables, rice and jute due to the use of better quality seed and optimum management by the framers. The vegetable yield increased substantially over the control year. The increased production of the vegetables contributed to the better nutrition of the family. The continuous cash generated from vegetable sale proceed was reinvested for farming subsequently and also to meet up the daily necessities.

Table 3. Annual production of fruit, fuel, egg, milk and fish before and after intervention of 3 farmers at FSRD site Syedpur, Rangpur

| Item | Pre-intervention (1998-99) | After intervention (1999-00) | | After intervention (2000-01) | | After intervention (2001-02) | |
|---|---|---|---|---|---|---|---|
| | Production (Kg) | Production (Kg) | % Incr-ease | Production (Kg) | % Incr-ease | Production (Kg) | % Incr-ease |
| **Farm 1 (Mr. Md. Mohsin Ali)** | | | | | | | |
| Fruit | 700 | 1373 | 96 | 1401 | 100 | 1464 | 109 |
| Fuel | 369 | 483 | 30 | 507 | 37 | 545 | 48 |
| Milk | 68 | 96 | 41 | 0 | - | 96 | 41 |
| Egg | 90 N | 936N | 940 | 2950 N | 3178 | 650 N | 622 |
| **Farm 2 (Mr. Md. Samsul Haque)** | | | | | | | |
| Fruit | 525 | 1292 | 146 | 1361 | 169 | 1405 | 168 |
| Fuel | 123 | 322 | 162 | 350 | 185 | 355 | 189 |
| Milk | 55 | 110 | 100 | 4 | 64 | 0 | - |
| Egg | 0 | 3182 N | - | 3269 N. | - | 770 N | - |
| Fish | 124 | 229 | 81 | 340 | 183 | 360 | 190 |
| **Farm 3 (Mrs. Sree Moti Shudha Rani)** | | | | | | | |
| Fruit | 587 | 1452 | 147 | 1315 | 124 | 1490 | 154 |
| Fuel | 85 | 145 | 71 | 167 | 96 | 205 | 141 |
| Milk | 0 | 25 | - | 95 | - | 35 | - |
| Egg | 0 | 200 N | - | 225 N | - | 200 N | - |

***Livestock***

The body weight gain and milk production of the cows of the farm increased over the control year due to better management. Egg production of the farm increased sharply following the introduction of hybrid layers in the farm. This has contributed a lot for income generation of the family and effective participation of the women members of the family.

***Fisheries***

Out of the three co-operator farmers, only one framer practiced polyculture in his perennial pond. He also utilized a small ditch adjacent to his homestead for seasonal fish production. He also cultured fish in association with taro during monsoon. Fish production and economic return were two and three times higher in each year as compared to control year. The increased production of fish was mainly due to use of recommended package of the technology particularly utilization of poultry fetches. This also minimized the cost of feed for fishes, which ultimately increased economic, return.

**Economics**

The economics of sector wise production in the farm of cooperator farmers have been presented in table 8. It is evident from the tables that the gross margin increased each year substantially in all the sectors of the cooperators under study. After intervention of the technologies, the gross margin from the farm of Mr. Mohsin, Mr. Shamsul and Shudha Rani were Tk. 59875, Tk. 100131 and Tk. 42667 respectively, during 1999-2000. These gross margins were 63%, 48% and 55%, higher than the control year (1998-99). The increased trend of gross margin continued during the next two years also in all the farmers. Higher gross margin was due to higher investment by 37-65%, 33-51% and 46-69% in the farms of Mr. Mohsin, Mr. Shamsul and Shudha Rani, respectively over the control year. The investment capacity of the cooperators increased due to continuous cash flow from vegetables, egg and milk production. The higher output of the field crops as well as production from fisheries contributes a lot for subsequent farming activities.

Table 4. Economics of sector wise production in three farms at Syedpur FSRD site, Rangpur before and during intervention with improved technologies

| . Item | Pre-intervention | | After intervention | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TVC (Tk) | GM (Tk) | TVC (Tk) | | | GM (Tk) | | | MBCR | | |
| | 98-99 | | 99-00 | 00-01 | 01-02 | 99-00 | 00-01 | 01-02 | 99-00 | 00-01 | 01-02 |
| **Farmer 1: Mr. Md. Mohshin Ali ( Small Farmer )** | | | | | | | | | | | |
| Crop | 21278 | 24304 | 25961 | 28080 | 26420 | 39302 | 43243 | 50594 | 4.20 | 3.78 | 4.62 |
| Homestead | 484 | 9997 | 2523 | 3603 | 3667 | 14154 | 17725 | 16576 | 3.04 | 3.48 | 3.07 |
| Livestock | 6930 | 2420 | 11150 | 15565 | 9361 | 6419 | 6672 | 8430 | 1.95 | 1.49 | 3.47 |
| ***Total*** | ***28692*** | ***36721*** | ***39634*** | ***47248*** | ***39448*** | ***59875*** | ***67642*** | ***75990*** | ***3.12*** | ***2.67*** | ***3.47*** |
| **Increase over 98-99** | **-** | **-** | **38%** | **65%** | **37%** | **63%** | **84%** | **107%** | **-** | **-** | **-** |
| **Farmer 2: Mr. Md. Shamsul Haque ( Small Farmer )** | | | | | | | | | | | |
| Crop | 33670 | 51154 | 44989 | 45739 | 40350 | 65108 | 63143 | 58340 | 2.23 | 1.99 | 2.08 |
| Homestead | 480 | 5022 | 1370 | 1517 | 1490 | 11813 | 12094 | 11338 | 8.63 | 7.81 | 7.25 |
| Livestocks | 1780 | 5500 | 8852 | 8764 | 8070 | 12339 | 12231 | 10112 | 1.96 | 1.96 | 1.73 |
| Fisheries* | 2345 | 5890 | 2010 | 1920 | 2240 | 10871 | 15860 | 14440 | - | - | - |
| ***Total*** | ***38275*** | ***67566*** | ***57221*** | ***57940*** | ***50809*** | ***100131*** | ***103328*** | ***94230*** | ***2.72*** | ***2.82*** | ***3.13*** |
| **Increase over 98-99** | **-** | **-** | **49%** | **51%** | **33%** | **48%** | **53%** | **40%** | **-** | **-** | **-** |
| **Farmer 3: Sree Moti Shudha Rani ( Small Farmer )** | | | | | | | | | | | |
| Crop | 10999 | 12824 | 14250 | 15639 | 14040 | 20485 | 21898 | 19558 | 3.35 | 2.95 | 3.21 |
| Homestead | 634 | 6712 | 2162 | 2074 | 1838 | 12487 | 10944 | 10112 | 4.77 | 3.93 | 3.82 |
| Livestock | 1880 | 7945 | 3285 | 5835 | 4976 | 9695 | 15855 | 14990 | 2.24 | 3.00 | 3.28 |
| ***Total*** | ***13513*** | ***27481*** | ***19697*** | ***22948*** | ***20854*** | ***42667*** | ***48697*** | ***44660*** | ***3.76*** | ***3.20*** | ***3.34*** |
| **Increased over 98-99** | **-** | **-** | **46%** | **69%** | **54%** | **55%** | **77%** | **63%** | **-** | **-** | **-** |

*** Integrated fisheries: Fish cum vegetable**

Table 5 : Annual income and expenditure of Md. Mohsin Ali at FSRD site Syedpur Pirgacha, Rangpur before and during intervention.

| Item | Before intervention (1998-99) | | After intervention (1999-00) | | After intervention (2000-01) | | After intervention (2001-02) | |
|---|---|---|---|---|---|---|---|---|
| | Income | Exp. | Income | Exp. | Income | Exp. | Income | Exp. |
| 1. Homestead | 2608 | 234 | 3750 | 1398 | 8568 | 1013 | 6844 | 963 |
| 2. Plantation crops | 7873 | 250 | 12927 | 1125 | 12762 | 2590 | 13789 | 2704 |
| 3. Crop | 45582 | 21278 | 65263 | 25961 | 71323 | 28080 | 77014 | 26420 |
| 4. Livestock | 9350 | 6930 | 17569 | 11150 | 22237 | 15565 | 17791 | 9361 |
| Sub total | 65413 | 28692 | 99509 | 39634 | 114890 | 47248 | 115438 | 36523 |
| 5. Off farm (Imamoti) | 9600 | - | 9600 | - | 9600 | - | 9600 | - |
| 6. Food & Grocery | - | 40800 | - | 45600 | - | 48800 | - | 52250 |
| 7. Medical | - | 600 | - | 400 | - | 500 | - | 500 |
| 8. Clothing | - | 1200 | - | 2000 | - | 2500 | - | 3000 |
| 9. Schooling | - | 1500 | - | 3000 | - | 3400 | - | 4000 |
| 10. Housing | - | - | - | - | - | 5000 | - | 5000 |
| 11. Misc | - | 1500 | - | 2500 | - | 3000 | - | 4000 |
| *Total* | *75013* | *74292* | *109109* | *93134* | *124490* | *107048* | *125038* | *108198* |
| *Increased over control (%)* | | | *45* | *25* | *66* | *44* | *67* | *47* |
| Balance (Tk.) | 75013 – 74292 = 721 | | 109109 – 93134 = 15975 | | 124490-107048=17442 | | 125038-108198=16840 | |

**Income and Expenditure**

During control year, the annual income and expenditure accounted from the farm of Mr.. Mohsin Ali was Tk. 75013 and Tk. 74292, respectively (Table 5). And it was Tk. 128841 and Tk. 126775, respectively from the farm of Mr. Samsul and; Tk. 47494 and Tk. 46713, respectively from the farm of Mrs. Shudha Rani (Table 6 and 7). With intervention, the annual income increased by 45-67, 37-42 and 60-69 percent from the farms of Mr. Mohsin, Mr. Samsul and Mrs. Shudha Rani, respectively. Similarly, the annual expenditure of Mr. Mohsin, Mr. Samsul and Mrs. Shudha Rani increased by 25-47, 22-40 and 44-57 percent respectively, during the study period . The calculated balance was positive in each farm in control year and it was Tk. 721 of Mr. Mohsin, Tk. 1066 of Mr. Samsul and Tk. 781 of Mrs. Shudha Rani. After intervention, the calculated balance of each farm was also increased significantly. These result indicated that the livelihood of each farm was improved.

Table 6. Annual income and expenditure of Md. Samsul Haque at FSRD site Syedpur Pirgacha, Rangpur during 1998-1999, 1999-2000, 2000-2001 and 2001-2002

| Item | Before intervention (1998-99) | | After intervention (1999-00) | | After intervention (2000-01) | | After intervention (2001-02) | |
|---|---|---|---|---|---|---|---|---|
| | Income | Exp. | Income | Exp. | Income | Exp. | Income | Exp. |
| 1. Homestead | 5502 | 480 | 13183 | 1370 | 13611 | 1517 | 12828 | 1490 |
| 2. Crop | 84824 | 33670 | 110097 | 44989 | 108882 | 45739 | 98690 | 40350 |
| 3. Livestock | 7280 | 1780 | 21191 | 8852 | 20995 | 8764 | 18182 | 8070 |
| 4. Fisheries | 8235 | 2345 | 12881 | 2010 | 17780 | 1920 | 16680 | 2240 |
| Sub total | 105841 | 38275 | 157352 | 57221 | 161268 | 57940 | 145039 | 50809 |
| 5. Off-farm (Business) | 23000 | 17500 | 26000 | 19000 | 28000 | 19500 | 32000 | 20000 |
| 6. Food & Grocery | - | 39000 | - | 46500 | - | 49000 | - | 52500 |
| 7. Medical | - | 3000 | - | 2500 | - | 4500 | - | 3000 |
| 8. Clothing | - | 4000 | - | 6000 | - | 6000 | | 6500 |
| 9. Schooling | - | 5000 | - | 6000 | - | 5000 | - | 7000 |
| 10. Housing | - | 5000 | - | 10000 | - | - | - | 3500 |
| 11. Land leased in | - | 8000 | - | 10000 | - | - | - | 5000 |
| 12. Marriage | - | - | - | - | - | 30000 | - | - |
| 13. Misc | - | 5000 | - | 6500 | - | 5000 | - | 6000 |
| *Total* | *128841* | *126775* | *183352* | *163721* | *189268* | *176940* | *177039* | *154309* |
| *Increased over control (%)* | | | *42* | *29* | *47* | *40* | *37* | *22* |
| Balance (Tk.) | *128841-127775=1066* | | *183352-163721=19631* | | *189268-176940=12328* | | *177039-154309=22730* | |

Table 7. Annual income and expenditure of Sreemoti Sudha Rani, FSRD site Syedpur Pirgacha, Rangpur during 1998-1999, 1999-2000, 2000-2001 and 2001-2002

| Item | Before intervention (1998-99) | | After intervention (1999-00) | | After intervention (2000-01) | | After intervention (2001-02) | |
|---|---|---|---|---|---|---|---|---|
| | Income | Exp. | Income | Exp. | Income | Exp. | Income | Exp. |
| 1. Homestead | 7346 | 634 | 14649 | 2162 | 13018 | 2074 | 11950 | 1838 |
| 2. Crop | 23823 | 10999 | 34735 | 14250 | 37537 | 15639 | 33598 | 14040 |
| 3. Livestock | 9825 | 1880 | 12980 | 3285 | 21690 | 5835 | 19966 | 4976 |
| Sub total | 40994 | 13513 | 62364 | 19697 | 71645 | 22948 | 65514 | 20854 |
| 4. Tree sell | - | - | 5500 | - | - | - | 2000 | - |
| .5. Off farm (Labour sell) | 6500 | - | 8000 | - | 8500 | - | 9000 | - |
| 6. Food & Grocery | - | 27000 | - | 31500 | - | 34000 | - | 38000 |
| 7. Medical | - | 1500 | - | 1000 | - | 900 | - | 1100 |
| 8. Clothing | - | 2000 | - | 2500 | - | 3200 | - | 3550 |
| 9. Schooling | - | 200 | - | 800 | - | 1200 | - | 1800 |
| 10. Housing | - | 1500 | - | 2000 | - | 4500 | - | 2500 |
| 11. Free the leased out land | - | - | - | 10000 | - | 6500 | - | - |
| 12. Misc | - | 2000 | - | 2500 | - | 3000 | - | 5500 |
| *Total* | *47494* | *46713* | *75864* | *70497* | *80145* | *67248* | *76514* | *73304* |
| *Increased over control (%)* | | | *60* | *51* | *69* | *44* | 61 | *57* |
| Balance | *47494-46713=781* | | *75864-70497=5367* | | *80145-67248=3897* | | 76514- | |
| (Tk.) | | | | | | | *64604=3210* | |

## Other aspects of intervention

The nutrition, resource use, knowledge and skill of the members, social acceptance and the micro-environment of the families were improved a lot following the intervention. If the co-operator farmers continue to practice the technologies more benefit will, definitely, be accrued to the farm.

**Golapganj FSRD Site, Sylhet**

**Farm productivity before and after intervention:**

Two marginal and one small farm were intervened with a large number of technologies for a period of three years. The technologies used are shown in Table 1.

Table 1. List of interventions in different sub systems of three farms at FSRD site, Golapganj, Sylhet.

| Farm 1 | Farm 2 | Farm 3 |
|---|---|---|
| **Crop sector**<br>i) T. Aus – BR 26<br>ii) T. Aman - BRRI Dhan 32<br>iii) Tomato - Manik, Ratan<br>iv) Onion - Tahirpuri<br>v) Cabbage - Atlas-70<br>vi) Boro - BINA-6<br>vii) Mustard - Improved Tori-7, BARI Sarisha-9<br>viii) Khira and Sweet gourd - using bait trap for controlling fruit fly.<br>**Homestead sector**<br>i) Country bean – intercropped with mukhikachu and turmeric.<br>ii) Vegetable seedling raising technology<br>iii) Sapling of different fruits<br>iv) Mukhikachu - Bilashi<br>v) Bottle gourd – BARI Lau-1<br>vi) Guava - Kazi piara, BARI Piara-1<br>vii) Lemon - Seedless<br>viii) Potato yam- on existing trees.<br>ix) Tomato - Manik, Ratan<br>x) Panikachu - Latiraj<br>xi) Ribbed gourd<br>xii) Okra – BARI Dherosh-1<br>xiii) Top working of jujube<br>xiv) Fertilization of existing fruit trees<br>**Livestock**<br>i) Fayoumi rearing<br>ii) Vaccination of poultry<br>**Fisheries**<br>i) Mixed polyculture | **Crop sector (Leased land)**<br>i) Tomato - Manik, Ratan<br>ii) S. gourd using bait trap for controlling fruit fly.<br>iii) Radish – Pinky and Tasaki<br>iv) Brinjal – Uttra and Islampuri<br>**Homestead**<br>i) Tomato - Manik, Ratan<br>ii) Country bean – intercropped with mukhikachu and turmeric.<br>iii) Amaranth<br>iv) Yard long bean<br>v) Mukhikachu - Bilashi<br>vi) Lalshak<br>vii) Laishak<br>viii) Top working of jujube<br>ix) Fertilization of existing fruit trees<br>x) Ol-kachu, turmeric in shady areas<br>xi) New plantation of guava, lemon, litchi<br>**Livestock**<br>i) Fayoumi rearing<br>ii) Vaccination of poultry<br>**Fisheries**<br>i) Mixed polyculture | **Crop sector**<br>i) T. Aus – BR 26<br>ii) T. Aman - BRRI Dhan 32<br>iii) Tomato - Manik, Ratan<br>iv) Mukhikachu - Bilashi<br>**Homestead**<br>i) Amaranth<br>ii) Lalshak – BARI Lalshak-1<br>iii) Radish – Pinky and Tasaki<br>iv) Country bean – intercropped with mukhikachu and turmeric.<br>v) Wax gourd<br>vi) Turmeric and Ol-kachu in shady areas<br>vii) Mukhikachu - Bilashi<br>viii) Bottle gourd - using bait trap for controlling fruit fly.<br>ix) Fertilization of existing fruit trees<br>x) New plantation of guava, lemon, litchi<br>**Livestock**<br>i) Beef fattening<br>ii) Deworming and vaccination of cattle<br>iii) Fayoumi rearing<br>iv) Vaccination of poultry<br>**Fisheries**<br>i) Mixed polyculture |

The productivity of different commodities before intervention was very low in all the three farms as compared to the intervened period due to adoption of improved technologies and better utilization of farm resources. In farm 1, in medium high land-1 (21d) and medium high land-2 (8d) the farmer got only 697 kg paddy/year in Rice-Rice-Fallow cropping pattern. By the cultivation of HYV rice, the yield almost doubled and in addition he utilized the fallow land by introducing tomato, cabbage, cauliflower and onion. In 2001-02, he got 3950 kg tomato, 80 kg onion and 218 kg cabbage.

Encouraged by getting higher yield, the farmer leased in two plots of land of 80 and 70 decimal during the year 1999-00 and 2000-01, respectively. He got about 2095 kg of paddy and 45 kg mustard during 2001-02. He sowed khira, squash and sweet gourd on foot path of the surrounding land of 8d using bait-trap technology for controlling fruit fly.

Before intervention, he cultivated country bean in 17d of open land in the homestead and got 1710 kg bean. After intervention, he produced country bean and wax gourd on trellis in 8d homestead land and under the trellis he planted mukhi kachu and turmeric. Rest 9 decimal land was used for year round vegetable production (tomato, okra, yard long bean) and raising of vegetable seedlings and fruit sapling. Before intervention the ditch of 2d that remained unutilized, but during 1999-00 it was use for fish production together with vegetable on the trellis over it. New plantation of lemon and guava of 1998 begin to bear fruits from 2000-01. His existing two coconut trees were unproductive but using balanced fertilization coconut tree begin to bear fruits. After intervention farmer grew potato yam on betel nut trees and got 50 kg yam without reducing betel nut yield. Being encouraged he purchased 7.5 decimal homestead land in 2000 and cultivated tomato, pani kachu, ribbed gourd, country bean etc. and got 1091 kg vegetables during 2001-02 (Table 2) .

The farm had only 5 chicken of local breed, but after intervention he purchased 15 heads of Fayomi chicken and 5 ducks and got 2230 eggs during 2001-02. The farm own two ponds of 27 and got produced only 27 kg fish/ year. This water body was brought under improved fish culture in the 3rd year and produced 330 and 690 kg fish during 2000-01 and 2001-02, respectively.

In farm 2, the farmer cultivated vegetable in two rented plots of 15 and 5 decimals and got only 295 kg bottle gourd and 240 kg sweet gourd. But during intervention, tomato, radish, brinjal, chilli, lalshak, sweet gourd were grown and got 1998 kg of total production. During 2001-02, tomato, sweet gourd, radish and brinjal were grown which yielded 3991 kg in total.

Before intervention, the grew country bean and yard long bean in 7d of open land in homestead and got only 40 kg country bean. During intervention, the farmer adopted year round production system in 2000-01 and during 2001-02, tomato, country bean, amaranth, yard long bean, mukhi kachu, and lalshak were grown. In shady areas ol-kachu, ginger and turmeric were grown. In homestead boundary guava, lemon and coconut were planted. Improve management like manuring and fertilization of existing coconut and mango trees and improvement of jujube plant by top working.

In livestock sector he purchased only three local chicken birds. After intervention he reared 10 heads of fayoumi chicken bred and birds were properly vaccinated.

In fisheries sector they have a pond of 8d used for household purposes only. Due to this it was not possible to apply modern technology of fish cultivation. After intervention partial semi intensive technique applied for carp polyculture (Table 3).

Farm 3, In the base year 1999-2000 he cultivated Aus (local) and Aman (pajam) in MHL-1 (30d) and got only 768 kg paddy (Table 7). During test years he cultivated HYV rice and yielded 1300 kg paddy/year. In addition the farmer sowed tomato in this fallow land during 2001-2002 obtained 3840kg yield. In MHL-2 (15d) he normally practiced raising paddy seedlings for his own land and surplus seedling, sold to other farmers. After uprooted the seedlings he cultivated bottle gourd in this land and got only 750kg. After intervention he used 5d land for seedling raising and remaining 10d for cultivating mukhikachu and obtained 132kg mukhi. After that he used this land for tomato and radish cultivation.

Open land (5d), trellies (3d) and shady land (d) under homestead areas cultivated amaranth, country bean and mukhikachu, respectively in the base year and yielded 820 kg in total. In the test year he cultivated red amaranth, radish ,amaranth at open land, country bean and wax gourd at trellies, mukhikachu and turmeric at shady area and obtained 1555 kg vegetable in a year.

In livestock sector before intervention he used to purchase and sell bullock. After intervention he purchased weak and ill health 3 bullocks at low cost, fed them using beef fattening technology. Later he sold them at very high price just before Eid-ul Azha.Using dewarming and vaccination of cattle, he got additional 109 lit of milk/ annum. He also reared 10 fayomi birds with existing local bred chicken in the test year.

He has a pond of 7d and mainly it was used for household purposes. After intervention by using semi-intensive cultivation of carp polyculture he got 140kg fishes during 2001-02 (Table 4).

**Economic impacts of interventions:**

Farm 1

Before intervention the farmer obtained a gross margin of Tk. 15744 and their sectorial gross margin of crop, homestead, livestock and fisheries were Tk. 2514, 11430, 600 & 1200 respectively (Table 2). The total variable cost before intervention was Tk 7567. During intervention, the gross margin increased up to 554% (ave. of four year) and the sectorial contribution were Tk. 36738, 35036, 3393 and 12159 from crops, homestead, livestock and fisheries, respectively (Table 2). The average TVC of the integrated production system over four year was Tk. 25463.

Table 2. Economic comparison between farmer's old practice and newly adopted technologies of farmer-1 at FSRD Site, Golapgonj, Sylhet during 1997-98 to 2001-02.

| Resource | Before intervention (1997-98) | | After intervention (1998-99) | | | After intervention (1999-00) | | |
|---|---|---|---|---|---|---|---|---|
| | GM | TVC | GM | TVC | MBCR | GM | TVC | MBCR |
| Crop | 2514 | 2609 | 33742 | 9428 | 5.58 | 26089 | 13191 | 3.23 |
| Homestead | 11430 | 4358 | 23443 | 5300 | 13.76 | 40481 | 7820 | 9.39 |
| Livestock | 600 | 250 | 1000 | 300 | 9.00 | 3500 | 950 | 5.14 |
| Fisheries | 1200 | 350 | 4000 | 1200 | 4.29 | 8700 | 2800 | 4.06 |
| Total | 15744 | 7567 | 62185 | 16228 | 6.36 | 78770 | 24761 | 4.67 |

Table 2. contd.

| Resource | After intervention (2000-01) | | | After intervention (2001-02) | | | Average of 4 years (98-99 to 01-02) | | |
|---|---|---|---|---|---|---|---|---|---|
| | GM | TVC | MBCR | GM | TVC | MBCR | GM | TVC | MBCR |
| Crop | 29512 | 15503 | 3.09 | 57608 | 17775 | 4.63 | 36738 | 13974 | 4.01 |
| Homestead | 35194 | 6772 | 10.84 | 41027 | 9705 | 6.54 | 35036 | 7399 | 8.76 |
| Livestock | 4000 | 1020 | 5.42 | 5072 | 726 | 10.39 | 3393 | 749 | 6.59 |
| Fisheries | 14835 | 3465 | 5.38 | 21100 | 5900 | 4.59 | 12159 | 3341 | 4.66 |
| Total | 83541 | 26760 | 4.53 | 124807 | 34106 | 5.11 | 87326 | 25463 | 4.99 |

Table 3. Income and expenditure statement of farmer-1

| Resources | Before intervention (TK) 1997-98 | After intervention (TK) | | | |
|---|---|---|---|---|---|
| | | 1998-99 | 1999-00 | 2000-01 | 2001-02 |
| A. Income (Gross return) | | | | | |
| Crop sub sector | 5123 | 43170 | 39280 | 45015 | 75383 |
| Homestead sub sector | 15788 | 28743 | 48301 | 41966 | 50732 |
| Livestock sub sector | 850 | 1300 | 4450 | 5020 | 5798 |
| Fisheries sub sector | 1550 | 5200 | 11500 | 18300 | 27000 |
| Off-farm | - | - | 22000 | 20000 | 11000 |
| Total | 23311 | 78413 | 125531 | 130301 | 169913 |
| B. Expenditure | | | | | |
| Crop sub sector | 2609 | 9428 | 13191 | 15503 | 17775 |
| Homestead sub sector | 4358 | 5300 | 7820 | 6772 | 9705 |
| Livestock sub sector | 250 | 300 | 950 | 1020 | 726 |

Table 3. Cond.

| Resources | Before intervention (TK) 1997-98 | After intervention (TK) | | | |
|---|---|---|---|---|---|
| | | 1998-99 | 1999-00 | 2000-01 | 2001-02 |
| Fisheries sub sector | 350 | 1200 | 2800 | 3465 | 5900 |
| Kachabazar | 3700 | 4100 | 3800 | 4200 | 4500 |
| Food | 8000 | 9000 | 11000 | 12000 | 12500 |
| Clothing | 2300 | 4800 | 5650 | 6230 | 7500 |
| Education | 400 | 1650 | 1840 | 2200 | 2000 |
| Medical | 700 | 1200 | 900 | 3000 | 1400 |
| House-repairing | - | 2600 | 3050 | 20000 | 2000 |
| Refreshment | 400 | 1800 | 2300 | 2850 | 4000 |
| Land purchase | - | - | 25000 | - | - |
| Marriage ceremony | - | - | - | - | 40000 |
| Others | 220 | 800 | 1200 | 1500 | 1500 |
| Distribution | 100 | 800 | 1000 | 1000 | 1200 |
| Total | 23387 | 42978 | 80501 | 79740 | 110706 |
| Balance | -76 | 35435 | 45030 | 50561 | 59207 |

Farm 2

Before intervention the farmer obtained a gross margin of Tk. 2389 and the sectorial gross margin of homestead, livestock and fisheries were Tk. 1977, 62 and 350, respectively. At before intervention, total variable cost was Tk. 1194. At after intervention, gross margin increased up to Tk 29987 (av. of two years) and their sectorial contributions were Tk. 23906, 954 and 5128 from homestead, livestock and fisheries respectively. The average total variable cost of production in whole farm approach was Tk. 6591. The farmer has no cropland. Their leased area treated as homestead land because it locates just adjacent to homestead boundary.

Table 3. Economic comparison between farmer's old practice and newly adopted technologies of farmer-2 at FSRD Site, Golapgonj, Sylhet during 2000-01 to 2001-02.

| Resource | Before intervention (1999-00) | | After intervention (2000-01) | | | After intervention (2001-02) | | | Average of 2 years (00-01 to 01-02) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | GM | TVC | GM | TVC | MBCR | GM | TVC | MBCR | GM | TVC | MBCR |
| Homestead | 1977 | 894 | 18567 | 4757 | 5.29 | 29244 | 5760 | 6.60 | 23906 | 5259 | 6.02 |
| Livestock | 62 | 180 | 870 | 280 | 9.08 | 1038 | 340 | 7.10 | 954 | 310 | 7.86 |
| Fisheries | 350 | 120 | 3600 | 900 | 5.17 | 6655 | 1145 | 7.15 | 5128 | 1023 | 6.29 |
| Total | 2389 | 1194 | 23037 | 5937 | 5.35 | 36937 | 7245 | 6.71 | 29987 | 6591 | 6.11 |

Farm 3

Before intervention the farmer obtained a gross margin of Tk.24438 and their relative contribution to crop, homestead, fisheries and livestock were Tk. 9188, 3790, 10760 and 700, respectively (Table 7). The corresponding total variable cost at before intervention was Tk.24130. After two years intervention average gross margin of Akmal's farm from crop, homestead, livestock and fisheries by 403, 164, 198 and 747 %, respectively (Table 8) over the pre-intervention year. The corresponding total variable cost was 164% higher than that of base year.

Table 4. Economic comparison between farmer's old practice and newly adopted technologies of farmer-3 at FSRD Site, Golapgonj, Sylhet during 2000-01 to 2001-02.

| Resource | Before intervention (1999-00) | | After intervention (2000-01) | | | After intervention (2001-02) | | | Average of 2 years (2000-01 to 01-02) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | GM | TVC | GM | TVC | MBCR | GM | TVC | MBCR | GM | TVC | MBCR |
| Crop | 9188 | 3710 | 19986 | 6614 | 4.72 | 54127 | 10210 | 7.91 | 37057 | 8412 | 6.93 |
| Homestead | 3790 | 1100 | 6195 | 2175 | 3.24 | 6247 | 2213 | 3.21 | 6221 | 2194 | 3.22 |
| Livestock | 10760 | 19120 | 21180 | 25750 | 2.57 | 21605 | 29375 | 2.06 | 21393 | 27563 | 2.26 |
| Fisheries | 700 | 200 | 3000 | 700 | 5.6 | 7470 | 2130 | 4.51 | 5235 | 1415 | 4.73 |
| Total | 24438 | 24130 | 50361 | 35239 | 3.33 | 89449 | 43928 | 4.28 | 69905 | 39584 | 3.94 |

**Impacts of intervention of farm resource use efficiency:**

Before intervention he harvested single crop in homestead and double crop in field area. After intervention year round vegetable cultivation was practiced. In field land, he cultivated winter vegetable and mustard in fallow period. Due to intensive cultivation it creates scope for labour utilization round the year.

After intervention the average gross return is Tk. 112789 from the income be repaid to production cost of different agricultural sectors, value of rented land and purchased land, expansion and repaired his houses, meet up the educational expenses and gradual increase of living family standard.

**Employment generation and women labour utilization:**

Farm 1
After intervention more human labour was required to engage the whole farm activities. It was observed that unemployed labour of farm family had decreased with increase of crop intensification. The extra work created by intervention was shared among the family members. The sharing of work was done in the nature and types of works. The total work load borne by women was more than men, but heavy work such as land preparation, load carrying, making trellies and marketing was done by men . Harvesting of vegetable, feeding of poultry, mulching and weeding of vegetable, seed processing and storing were done by women. It was observed that about 75% labour was supplied from the farmer's own family. The rest was supplied by the hired casual labour particularly in transplanting weeding and harvesting of field crops which needed to be completed in time. In homestead areas hired labour was required in repairing drainage system, making trellies etc.

**Farm 2**
As male members of the family are skilled in building works, they engaged themselves as day labourer in building works, so they are to hire labour during pick time of cultivation. About 50% of the total labour man-days was supplied by the hired casual labour. During their off time, the two brothers supervise and work in their land. Female members of the family generally do work at house, side by side engage themselves in vegetable gardening.

**Farm 3**
After intervention there opportunity of labour utilization is increased. Female members did not help in agriculture at before intervention. Now, being encouraged they take part in vegetable gardening, beef fattening, compost making etc. About 20% labour was supplied from hired casual labour particularly in land preparation transplanting and harvesting of field crops, which needed to be completed in time; mulching of vegetable crops, making trellies etc.

**Impacts of interventions on family welfare:**

Child education, clothing, house repairing, agricultural sector and other cost increased due to enhanced income through interventions (Table 3). In the year 2000-2001 medical cost slightly increased due to old aged illness. Cost of kachabazar like vegetable, spices, fishes, eggs etc. gradually decreases whereas his standard of living increases day by day. He expanded his dwelling house and improved house sanitary system; he purchased new varieties of furniture. In June, 1999 his one of the son, experienced in vegetable farming was appointed in tea garden with the monthly salary of Tk 4000. The said person resigned from the service in January, 2002 and now deeply engaged himself in farming work at his homestead areas.

Gradually he was acquainted with different organization. As a result he collected books, booklets, posters for his family library. Simultaneously number of readers in his library increased gradually. At present members of the family take active part in various national and social programme. He gladly permit for management of immunization and family planning campaign in his residence. He purchased 7.5 d land near his homestead at cost of Tk. 25000 in the year 2000.

**Sustainability of technologies and farmers reaction:**

Now this family is treated as bank of seedlings of different vegetable and fruits. By using improved seedling raising technology, he sells seedlings of different vegetable in seasonwise and also distribute among poors. In the last three years he sold and distributed 105500(no.) vegetable seedling. He charted fertilizer doses of different fruits and showed in sign board, so that all the farmers of the area can be benefited. A 15-days training programme on integrated farming (both male and female participants) jointly organized by members associated with this library and OFRD, BARI. The associate members of library cultivated mustard and tomato taking lease of fallow land of the area and this created encouragement among the farmers of the locality. Thus his residence worked as a center for technology transfer.

Table 6. Income and expenditure statement of farmer-2

| Resources | Before intervention (TK) | After intervention(TK) | |
|---|---|---|---|
| | 1999-2000 | 2000-01 | 2001-02 |
| A. Income(Gross return) | | | |
| Homestead sub sector | 2871 | 23324 | 35004 |
| Livestock sub sector | 242 | 1150 | 1378 |
| Fisheries sub sector | 470 | 4500 | 7800 |
| Off-farm | 36000 | 34000 | 30000 |
| Total | 39583 | 62974 | 74182 |
| B. Expenditure | | | |
| Homestead sub sector | 894 | 4757 | 5760 |
| Livestock sub sector | 180 | 280 | 340 |
| Fisheries sub sector | 120 | 900 | 1145 |
| Kachabazar | 5500 | 5000 | 4600 |
| Food | 9500 | 1000 | 11000 |
| Clothing | 3200 | 5600 | 7000 |
| Education | 200 | 900 | 1500 |
| Medical | 1200 | 2800 | 1500 |
| House-repairing | 3500 | 6700 | 14000 |
| Refreshment | 2000 | 3560 | 2200 |
| Others | 300 | 800 | 500 |
| Distribution | 100 | 500 | 800 |
| Total | 26694 | 32797 | 50345 |
| Balance | 12889 | 30177 | 23837 |

Table 9. Income and expenditure statement of farmer3

| Resources | Before intervention (Tk) 1999-2000 | After intervention (Tk) | |
|---|---|---|---|
| | | 00-01 | 01-02 |
| A. Income (Gross return) | | | |
| Crop sub sector | 12898 | 26600 | 64337 |
| Homestead sub sector | 4890 | 8370 | 8460 |
| Livestock sub sector | 29880 | 46930 | 50980 |
| Fisheries sub sector | 900 | 3700 | 9600 |
| Total | 48568 | 85600 | 133377 |
| B. Expenditure | | | |
| Crop sub sector | 3710 | 6614 | 10210 |
| Homestead sub sector | 1100 | 2175 | 2213 |
| Livestock sub sector | 19120 | 25750 | 29375 |
| Fisheries sub sector | 200 | 700 | 2130 |
| Kanchabazar | 6800 | 5600 | 5500 |
| Food | 12000 | 14000 | 15000 |
| Clothing | 5400 | 6700 | 8000 |
| Education | 1200 | 1500 | 2000 |
| Medical | 2440 | 1800 | 1500 |
| House repairing | 4000 | 10000 | 2000 |
| Refreshment | 2950 | 3125 | 4000 |
| Land purchase | - | - | 30000 |
| Investment | 800 | 1200 | 1500 |
| Others | 500 | 800 | 1000 |
| Total | 36090 | 44725 | 70500 |
| Balance | 12478 | 40875 | 62877 |

## Appendix

**List of Scientists involved with On-Farm Research Division (2001-02)**

| Sl.no | Name | Designation | Remarks |
|---|---|---|---|
| | **Central station, Joydebpur** | | |
| 01 | Md. Fazlul Haq | CSO | On LPR |
| 02 | Dr. M Matiur Rahman | CSO | |
| 03 | Dr. M A Quayyum | PSO | |
| 04 | Md. Abdur Rouf | SSO | On LPR |
| 05 | Md. Amirul Islam | SSO | Transferred to ORC |
| 06 | Md. Rezaul Karim | SSO | Transferred to PRC |
| 07 | Dr. M Fokhrul Islam | SSO | |
| 08 | Dr. M Mustaque Ahmed | SSO | |
| 09 | Nadira Begum | SSO | Resigned from service |
| 10 | Md. Kamrul Hasan | SO | |
| 11 | Md. Rafiqul Islam | SO | |
| 12 | Dilwar A. Choudhury | SO | |
| 13 | Ch. Abdullah Al Faruque | SO | Transferred to HRC |
| 14 | Quamrun-Naher | SO | |
| | **Shaympur, Rajshahi** | | |
| 15 | A K M Hafizur Rahman | PSO | Transferred to RARS, Ishurdi |
| 16 | Dr. M Maznur Rahman | PSO (WRC) | |
| 17 | Md. Elias Hossain | SO (WRC) | |
| | **Barind, Rajshahi** | | |
| 18 | Md. Shafiqul Islam | SO | |
| 19 | Selim Ahmed | SO | |
| 20 | Md. Faruque Hossain | SO | |
| | **Pabna** | | |
| 21 | Md. Abdul Momin | SSO | Higher study |
| 22 | Ferdouse Islam | SO | |
| 23 | Md. Akkas Ali | SO | Higher study |
| 24 | Md. Aktar Hossain | SO | |
| 25 | Md. Rabiul Alam | SO | |
| 26 | Md. Shamim Hossain Mollah | SO | |
| 27 | Md. Obaidul Haque | SO | |
| | **Bogra** | | |
| 28 | Md. Abdur Rahim | SSO | |
| 29 | Md. Shahidullah | SSO | Transferred to ARS Burirhat |
| 33 | Nur-E-Alam Siddique | SO | |
| | **Dinajpur** | | |
| 31 | S M A Jabber | SO | |

| Sl.no | Name | Designation | Remarks |
|---|---|---|---|
| | **Rangpur** | | |
| 32 | Md. Akram Hossain | PSO | Transferred to SSD |
| 33 | Md. Badirul Islam | SSO | |
| 34 | Md. Abdul Mannaf | SSO | |
| 35 | Md. Mohi Uddin | SO | BARI-GKF program |
| 36 | Dr. M A Zaman Sarker | SO | |
| 37 | Md. Al Amin Talukder | SO | |
| 38 | Md. Abdus Salam | SO | BARI-RDRS program |
| 39 | A H M Mostofa Kamal | SO | |
| 40 | Selina Hasan | SO | Higher study |
| | **Jamalpur** | | |
| 41 | Md. F R Khan | PSO | Transferred to T & C |
| 42 | Dr. M Mahbubur Rahman Khan | SSO | Resigned from service |
| 43 | Md. Golam Moula | SSO | |
| 44 | Md. Shamsur Rahman | SO | |
| 45 | Md. Abdul Awal | SO | Transferred to Agril. Econ. |
| 46 | Md. Rajab Ali | SO | |
| 47 | Md. Atiqullah Bhuiyan | SO | |
| | **Tangail** | | |
| 48 | Md. Mukhlesur Rahman | SSO | |
| 49 | Dr. Md. Yousuf Ali | SSO | |
| 50 | Md. Abdul Helim Khan | SO | |
| 51 | Md. Jamal Hossain | SO | |
| 52 | Md. Aminur Rahman | SO | |
| | **Mymensingh** | | |
| 53 | Dr. Farid Uddin Miah | CSO (RARS) | |
| 54 | Dr. S M Asaduzzaman | SSO | |
| 55 | Habib M Naser | SO | Higher study |
| | **Kishoregonj** | | |
| 56 | M H Khurram | SO (ORC) | |
| | **Jessore** | | |
| 57 | Dr. M A Satter | SSO | Transferred to SSD |
| 58 | Nur Alam Mondal | SSO | |
| 59 | Kawser Uddin Ahmmed | SO | |
| 60 | Nargis Sultana | SO | |
| | **Patuakhali** | | |
| 61 | Sikder Rafiquzzaman | SSO | |
| 62 | Md. Golam Kibria | SO | Transferred to HRC |
| 63 | Md. Idris Ali Hawlader | SO | |
| 64 | Md. Abdur Razzaque | SO | |
| 65 | Md. Shahidul Islam | SO | |
| | **Faridpur** | | |
| 66 | Md. Serajul Islam | SSO | |
| 67 | Md. Kamruzzaman | SO | |
| 68 | Md. Ruhul Amin | SO | |

| Sl.no | Name | Designation | Remarks |
|---|---|---|---|
| | **Khulna** | | |
| 69 | S M Nurul Islam | SSO | Transferred to ORC |
| 70 | Sheikh Mostafa Zaman | SSO | |
| | **Kushtia** | | |
| 71 | Md. Alamgir Siddiki | SO | |
| | **Barisal** | | |
| 72 | Md. Shahidul Islam Khan | SO | |
| | **Hathazari** | | |
| 73 | S M A Shiblee | SO | Transferred to HRC |
| 74 | Parimal C. Sarker | SO | |
| | **Noakhali** | | |
| 75 | A F M Fazlur Rahman | PSO | |
| 76 | Dr. Md. Amin | SSO | |
| 77 | Md. Jillur Rahman | SO | Transferred to SSD |
| 78 | Md. Salim Uddin | SO | Transferred to Breeding |
| 79 | Anwarul K Chowdhury | SO | |
| 80 | Md. Kamrul Hasan | SO | |
| | **Sylhet** | | |
| 81 | Apurba K. Choudhury | SO | |
| 82 | Md. Obaidullah Kaisar | SO | |
| 83 | Md. Asaduzzaman | SO | |
| | **Bandarban** | | |
| 84 | Md. Jamal Uddin | SO | |
| | **Comilla** | | |
| 85 | Md. Shahidullah Khan | SSO | On LPR |
| 86 | Md. Safiqul Islam | SSO | |
| 87 | Md. Muktadir Alam | SO | |
| | **Khagrachari** | | |
| 88 | Mahmudul Islam Nazrul | SO | |
| | **Kishoregonj** | | |
| 89 | M H Khurram | SO (ORC) | |

## Appendices

Table 1a. Yield contributing characters of Mustard as affected by fertilizer levels in the cropping pattern Mustard-Boro-T.Aman at FSRD site, Narikeli during 2000-2001

| Treat | Plant ht. (cm) | Plants/m$^2$ (no.) | Siliqua/plant (no.) | Seeds/pod (no) | 1000 ssed wt (g) | Stover yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 94.64 ab | 129.4 a | 122.6 ab | 26.00 a | 2.96 ab | 2.41 a |
| $T_2$ | 95.98 a | 130.0 a | 123.8 a | 25.00 a | 3.08 a | 2.89 a |
| $T_3$ | 92.98 ab | 120.8 a | 127.6 a | 23.00 ab | 2.91 ab | 2.47 ab |
| $T_4$ | 88.78 b | 109.0 b | 101.4 bc | 20.00 b | 2.82 b | 1.82 bc |
| $T_5$ | 77.74 c | 86.2 c | 82.80 c | 15.40 c | 2.40 c | 1.08 c |
| F | * | ** | ** | ** | ** | ** |
| CV(%) | 9.06 | 4.89 | 10.38 | 11.37 | 6.72 | 13.59 |

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

Table 1b. Yield contributing characters of Boro as affected by fertilizer levels in the cropping pattern Mustard-Boro-T. Aman at FSRD site, Narikeli during 2000-2001

| Treat | Plant ht. (cm) | Tiller/hill (no.) | Panicle length (cm.) | Grains/panicle (no.) | 1000 seed wt (g) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 103.5 a | 15.86 a | 20.72 a | 151.2 a | 27.61 a | 6.92 a |
| $T_2$ | 101.7 ab | 15.22 ab | 20.26 a | 150.2 a | 25.93 ab | 6.08 a |
| $T_3$ | 99.8 ab | 15.48 ab | 20.34 a | 138.0 ab | 25.41 b | 6.86 a |
| $T_4$ | 96.9 b | 13.16 bc | 18.26 b | 127.4 bc | 22.20 c | 5.62 b |
| $T_5$ | 85.6 c | 11.54 c | 15.26 c | 118.2 c | 20.06 c | 3.12 c |
| F | ** | * | ** | ** | ** | ** |
| CV(%) | 8.28 | 9.01 | 4.72 | 5.96 | 4.81 | 12.54 |

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

Table 1c. Yield contributing characters of T.Aman as affected by fertilizer levels in the cropping pattern Mustard-Boro-T. Aman at FSRD site Narikeli during 2000-2001

| Treat | Plant ht. (cm) | Panicle length (cm) | Grains/panicle (no.) | Tiller/hill (no) | 1000 seed wt (g) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 96.08 a | 20.58 a | 151.0 a | 12.06 a | 25.86 a | 6.16 a |
| $T_2$ | 95.64 a | 19.96 a | 148.2 a | 11.68 a | 24.06 ab | 5.77 a |
| $T_3$ | 94.26 a | 19.42 a | 152.4 a | 11.64 a | 24.10 ab | 6.00 a |
| $T_4$ | 87.22 b | 17.20 b | 131.0 b | 9.36 b | 21.08 bc | 4.18 b |
| $T_5$ | 80.50 c | 15.04 c | 116.2 b | 7.70 b | 19.26 c | 2.93 c |
| F | * | ** | ** | ** | ** | ** |
| CV(%) | 11.77 | 4.27 | 5.87 | 8.90 | 7.97 | 9.56 |

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

Table 2a. Yield contributing characters of Mustard as affected by fertiliser levels in the cropping pattern Mustard- Boro-T. Aman during 2000-2001 at MLT Site Melandah

| Treatment | Plant height (cm) | Seliqua/plant (no.) | Seed/seliqua (no.) | 1000 seed wt. (g) | Stover yield (kg/ha) |
|---|---|---|---|---|---|
| $T_1$ | 96.12 a | 116.53 a | 21.50 a | 2.90 a | 4.55 a |
| $T_2$ | 97.26 a | 121.66 a | 20.66 ab | 3.10 b | 4.68 a |
| $T_3$ | 93.14 a | 115.47 ab | 20.06 b | 2.80 b | 4.43 a |
| $T_4$ | 92.82 a | 103.82 b | 18.16 c | 2.60 c | 3.41 b |
| $T_5$ | 60.12 b | 56.20 c | 12.00 d | 1.48 d | 1.29 c |
| F | ** | ** | ** | ** | ** |
| CV(%) | 2.84 | 6.36 | 3.56 | 3.11 | 4.47 |

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

Table 2b. Yield contributing characters of Boro as affected by fertiliser levels in the cropping pattern Mustard-Boro-T. Aman during 2001 at MLT Site Melandah

| Treatment | Plant height (cm) | Plant population/m$^2$ | Grain/panicle (no.) | 1000-grain weight (g) | Straw yield (Kg/ha) |
|---|---|---|---|---|---|
| $T_1$ | 89.83 a | 386.55 a | 116.03 a | 26.10 a | 6.80 a |
| $T_2$ | 91.70 a | 383.60 a | 100.77 a | 24.65 b | 6.61 ab |
| $T_3$ | 89.23 a | 371.05 a | 108.90 a | 24.38 c | 5.29 b |
| $T_4$ | 87.13 a | 358.47 a | 105.60 a | 22.30 d | 4.96 b |
| $T_5$ | 71.85 b | 261.87 b | 81.50 b | 20.50 e | 2.30 c |
| F | ** | ** | ** | ** | ** |
| CV% | 5.04 | 5.25 | 10.07 | 10.36 | 16.27 |

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

Table 2c. Yield contributing characters of T.Aman as affected by Fertiliser levels in the cropping pattern Mustard- Boro-T. Aman during 2001 at MLT Site Melandah

| Treatment | Plant height (cm) | Panicle/m$^2$ (no.) | Grain/panicle (no.) | 1000-grain weight (g) | Straw yield (kg/ha) |
|---|---|---|---|---|---|
| $T_1$ | 93.20 a | 289.33 a | 107.65 a | 22.50 a | 6.73 a |
| $T_2$ | 90.10 a | 282.67 ab | 101.27 ab | 21.75 ab | 6.06 b |
| $T_3$ | 88.05 a | 272.17 ab | 98.93 ab | 22.08 a | 5.75 b |
| $T_4$ | 90.57 a | 257.17 b | 103.93 a | 20.50 ab | 5.90 b |
| $T_5$ | 82.20 b | 224.83 c | 92.35 b | 19.60 b | 4.84 c |
| F | ** | ** | * | * | ** |
| CV% | 3.78 | 5.91 | 5.43 | 8.06 | 6.80 |

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

Table 3. Effect of different nutrient management packages on yield and yield parameters of Mustard, Boro and T. Aman rice under Mustard-Boro -T. Aman rice cropping pattern at MLT site Muktagacha, Mymensingh, 1999-2000

| Treatment | Plant population/ panicle m$^{-2}$ | Plant height (cm) | No. of siliquae plant$^{-1}$ | Filled grain panicle$^{-1}$ / seed siliquae$^{-1}$ | 1000-grain or seed wt. (g) | Grain/ Seed yield (kg/ton ha$^{-1}$) | Stover/ Straw yield (kg/ton ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| **MUSTARD (Variety Tori-7), Field duration 75 – 76 days (Seed to seed)** | | | | | | | |
| $T_1$ | 137 a | 44.0 b | 28.4 bc | 8 b | 2.5 b | 397 a | 510 b |
| $T_2$ | 138 a | 48.2 a | 31.8 ab | 9 ab | 2.6 ab | 460 a | 592 a |
| $T_3$ | 140 a | 46.7 ab | 33.8 a | 9 a | 2.6 ab | 447 a | 587 a |
| $T_4$ | 134 a | 44.3 b | 28.4 c | 8 ab | 2.7 a | 462 a | 608 a |
| $T_5$ | 133 a | 40.7 c | 23.9 d | 8 b | 2.6 ab | 415 a | 548 ab |
| $T_6$ | 126 b | 33.5 d | 16.2 e | 6 c | 2.5 b | 205 b | 353 c |
| CV (%) | 2.8 | 3.9 | 7.6 | 7.1 | 2.6 | 10.3 | 7.26 |
| BORO RICE (variety BRRI Dhan 28), Field duration 140-141 (Seed to seed) | | | | | | | |
| $T_1$ | 266 abc | 79.2 a | - | 78 a | 22.8 | 3.94 c | 4.94 a |
| $T_2$ | 254 c | 80.1 a | - | 81 a | 22.7 | 4.13 bc | 4.98 a |
| $T_3$ | 303 a | 80.7 a | - | 86 a | 22.8 | 4.63 a | 5.33 a |
| $T_4$ | 256 bc | 78.7 a | - | 81 a | 23.1 | 4.38 ab | 5.03 a |
| $T_5$ | 294 ab | 81.1 a | - | 83 a | 22.7 | 4.52 a | 5.40 a |
| $T_6$ | 213 d | 69.4 b | - | 67 b | 22.8 | 3.34 d | 3.82 b |
| CV % | 4.4 | 1.9 | - | 6.7 | 1.4 | 5.55 | 8.47 |
| T.AMAN RICE (variety BRRI Dhan 33), Field duration 124-127 day (Seed to seed) | | | | | | | |
| $T_1$ | 200 cd | 93.6 b | - | 90 c | 25.2 | 3.84 c | 4.52 b |
| $T_2$ | 231 ab | 100.5 a | - | 96 ab | 25.2 | 4.84 a | 5.53 a |
| $T_3$ | 240 a | 101.2 a | - | 99 a | 25.3 | 4.95 a | 5.63 a |
| $T_4$ | 206 bcd | 95.8 b | - | 93 bc | 25.1 | 4.33 b | 5.33 a |
| $T_5$ | 227 abc | 101.0 a | - | 97 ab | 25.3 | 4.93 a | 5.62 a |
| $T_6$ | 84 c | 83.8 c | - | 73 d | 25.1 | 3.08 d | 3.67 c |
| CV % | 7.9 | 2.9 | - | 3.3 | 1.6 | 4.7 | 5.9 |

Table 4. Effect of different nutrient management packages on yield and yield parameters of Mustard, Boro and T.Aman rice under Mustard-Boro-T.Aman rice cropping pattern at MLT site Muktagacha, Mymensingh, 2000-01

| Treatment | Plant population/panicle $m^{-2}$ | Plant height (cm) | No. of siliquae plant $^{-1}$ | Filled grain panicle$^{-1}$ / seed siliquae$^{-1}$ | 1000-grain or seed wt. (g) | Grain/ Seed yield (kg/ton $ha^{-1}$) | Stover/ Straw yield (kg/ton $ha^{-1}$) |
|---|---|---|---|---|---|---|---|
| MUSTARD (Variety Tori-7), Field duration 71 – 73 days (Seed to seed) | | | | | | | |
| $T_1$ | 136 ab | 45.2 a | 32.02b | 8.62a | 2.53a | 468.3b | 726.7ab |
| $T_2$ | 141 a | 47.9 a | 35.15ab | 9.17a | 2.60a | 543.3ab | 716.7b |
| $T_3$ | 143 a | 49.3 a | 39.05a | 9.02a | 2.62a | 601.7a | 796.7a |
| $T_4$ | 133 b | 47.0 a | 34.12ab | 8.32a | 2.55a | 530.0ab | 735.0ab |
| $T_5$ | 133 b | 48.7 a | 37.68a | 8.77a | 2.60a | 501.7ab | 771.7ab |
| $T_6$ | 124 c | 32.8 b | 17.22c | 6.05b | 2.27b | 246.2c | 463.3c |
| CV (%) | 3.21 | 5.94 | 8.92 | 8.31 | 2.81 | 15.57 | 5.79 |
| BORO RICE (variety BRRI Dhan 28), Field duration 133-138 (Seed to seed) | | | | | | | |
| $T_1$ | 285 b | 85.8 a | - | 85.50 | 23.00 | 4.51b | 5.61c |
| $T_2$ | 350 a | 89.3 | - | 92.70 | 22.91 | 5.36a | 6.18ab |
| $T_3$ | 352 a | 89.4 | - | 96.07 | 23.29 | 5.44a | 6.34a |
| $T_4$ | 337 a | 89.5 | - | 90.27 | 23.05 | 5.23a | 5.93bc |
| $T_5$ | 323 a | 88.9 | - | 83.83 | 23.00 | 4.49b | 5.69c |
| $T_6$ | 222 c | 68.2 | - | 75.70 | 23.01 | 3.44c | 4.75d |
| CV % | 6.49 | 2.60 | - | 3.32 | 1.46 | 4.63 | 3.58 |
| T. AMAN RICE (variety BRRI Dhan 33), Field duration 124-127 day (Seed to seed) | | | | | | | |
| $T_1$ | 172 a | 90.9 b | - | 83.1 b | 25.0 a | 3.46 c | 4.12 c |
| $T_2$ | 204 b | 93.9 a | - | 86.8 a | 24.9 a | 4.41 a | 5.01 ab |
| $T_3$ | 219 a | 96.0 a | - | 89.0 a | 25.0 a | 4.52 a | 5.10 a |
| $T_4$ | 190 c | 91.5 b | - | 83.9 b | 25.0 a | 3.90 b | 4.76 b |
| $T_5$ | 210 ab | 96.2 a | - | 88.1 a | 24.9 a | 4.40 a | 5.06 a |
| $T_6$ | 136 e | 77.5 c | - | 66.1 c | 24.9 a | 2.73 d | 3.24 d |
| CV % | 6.2 | 2.1 | - | 2.7 | 1.4 | 5.1 | 5.0 |

Figures in the column having same letter(s) in do not differ significantly

Table 5. Effect of different nutrient management packages on yield and yield parameters in Mustard -Boro -T.Aman rice cropping pattern at MLT site Muktagacha, Mymensingh, 2001-02

| Treatment | Plant population/ panicle $m^{-2}$ | Plant height (cm) | No. of siliquae plant $^{-1}$ | Filled grain panicle$^{-1}$ / seed siliquae$^{-1}$ | 1000-grain or seed wt. (g) | Grain/ Seed yield (kg/ton $ha^{-1}$) | Stover/ Straw yield (kg/ton $ha^{-1}$) |
|---|---|---|---|---|---|---|---|
| MUSTARD (Variety Tori-7), Field duration 71 – 73 days (Seed to seed) | | | | | | | |
| $T_1$ | - | 70.5 d | 42.2 c | 11.4 c | 2.53 c | 673 b | 1108 c |
| $T_2$ | - | 79.5 a | 49.9 ab | 15.7 b | 2.67 a | 980 a | 1645 ab |
| $T_3$ | - | 73.4 bc | 45.7 bc | 15.4 b | 2.58 bc | 967 a | 1720 a |
| $T_4$ | - | 74.7 b | 53.3 a | 15.1 a | 2.63 ab | 993 a | 1744 a |
| $T_5$ | - | 72.4 cd | 44.4 c | 15.6 b | 2.55 c | 960 a | 1580 b |
| $T_6$ | - | 55.2 e | 21.5d | 10.7 c | 2.27 d | 393 c | 893 d |
| CV (%) | - | 2.3 | 9.8 | 8.1 | 2.1 | 9.5 | 6.2 |

Table 6. Yield and other parameters of Mustard affected by different fertilizer packages at Gabtoli, Bogra, 2001-2002

| Treatments | Plant pop./$m^2$ | Plant height (cm) | No. of primary branch (no.) | Pod/plant (no.) | Seed/pod (no) | 1000 grain weight (g) | Grain yield (kg/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | 43.17a | 68.67a | 4.117ab | 31.73ab | 12.58a | 2.22b | 9567c | 2.66b |
| $T_2$ | 43.17a | 66.63a | 4.283a | 33.65a | 13.10a | 2.39a | 1092a | 3.04a |
| $T_3$ | 43.17a | 64.02a | 3.817b | 30.10b | 12.92a | 2.28b | 1023ab | 3.07a |
| $T_4$ | 39.67b | 66.72a | 3.90ab | 33.08a | 12.57a | 2.24b | 900cd | 2.74b |
| $T_5$ | 41.33ab | 66.68a | 3.833b | 30.20b | 12.60a | 2.22b | 8117e | 2.52b |
| $T_6$ | 26.67c | 41.27b | 2.283c | 18.30c | 8.75b | 1.90c | 3667f | 0.62c |
| F- test | *** | *** | *** | *** | *** | *** | *** | *** |
| cv(%) | 4.88 | 5.93 | 8.82 | 6.49 | 3.42 | 3.27 | 4.62 | 8.19 |

Table 7. Yield and yield components of mustard under CP: Mustard-Boro-T.Aman with different fertilizer treatments at the FSR site Bagharpara, Jessore during 2000-2001

| Treat-ment | Plant height (cm) | Plant population/m$^2$ | No. of pod/plant | No. of seeds/pod | 1000-seed wt. (g) | Straw yield (t/ha) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|
| $ED_1$ | 76.17ab | 118ab | 54ab | 19.17ab | 2.72ab | 2.18b | 0.715a |
| $ED_2$ | 81.17ab | 92bc | 75a | 22.33a | 2.70ab | 2.60ab | 0.887a |
| IPNS | 84.83a | 89c | 56ab | 21.67ab | 2.87a | 2.63ab | 0.872a |
| RF/97 | 76.50ab | 118ab | 56ab | 19.17ab | 2.67ab | 2.64ab | 0.897a |
| FP | 79.17ab | 122a | 45b | 21.50ab | 2.83a | 2.92a | 0.987a |
| Control | 75.83b | 93bc | 37b | 16.67b | 2.52b | 1.49c | 0.420b |

Table 8. Yield and yield components of rice crops under CP: Mustard-Boro-T.aman with different fertilizer treatments at the FSR site Bagharpara, Jessore during 2000-2001

| Treat-ment | Plant height (cm) | No. effective tillers/m2 | No. of grain/panicle | 1000-seed wt. (g) | Straw yield (t/ha) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|
| | | | Boro rice | | | |
| $ED_1$ | 75.00a | 421b | 66b | 21.02b | 5.110c | 4.966c |
| $ED_2$ | 79.80a | 438b | 68ab | 21.26ab | 5.518abc | 5.434b |
| IPNS | 76.80a | 446ab | 70ab | 21.20ab | 5.690ab | 5.476b |
| RF/97 | 83.80a | 470a | 73a | 21.60a | 5.938a | 5.972a |
| FP | 78.80a | 443ab | 72ab | 21.00b | 5.442bc | 5.600ab |
| Control | 59.00ab | 340c | 51c | 19.20c | 3.632d | 2.912d |
| | | | **T.aman rice** | | | |
| $ED_1$ | 84.60a | 338a | 73a | 25.24a | 4.252a | 4.338b |
| $ED_2$ | 91.80a | 370a | 77a | 25.14a | 4.588a | 4.578ab |
| IPNS | 90.60a | 366a | 83a | 24.96a | 4.518a | 5.146ab |
| RF/97 | 91.00a | 377a | 75a | 25.28a | 4.752a | 5.232a |
| FP | 89.60a | 399a | 75a | 25.08a | 5.140a | 5.102ab |
| Control | 66.00b | 242b | 57b | 23.64b | 2.242b | 2.396c |

Table 9. Yield and yield components of rice crops under CP: Boro-T.aman at MLT site, Narail during 2000-2001

| Treatment | Plant height (cm) | No. effective tillers/m$^2$ | No. of grain/ panicle | 1000-seed wt. (g) | Straw yield (t/ha) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|
| **Rice crops** | | | | | | |
| $ED_1$ | 74.57c | 357c | 64c | 20.48c | 3.74c | 4.03a |
| $ED_2$ | 79.23b | 426b | 71ab | 21.13bc | 4.23b | 4.52a |
| IPNS | 83.30a | 469a | 71ab | 22.15a | 4.74a | 4.90a |
| RF/97 | 80.05b | 412b | 68bc | 21.22bc | 4.13b | 4.60a |
| FP | 84.08a | 419b | 75a | 21.47ab | 4.79a | 4.98a |
| Control | 68.68d | 232d | 51d | 19.58d | 1.90d | 2.70b |
| F-test | ** | ** | ** | ** | ** | ** |
| **T.aman** | | | | | | |
| $ED_1$ | 110.63b | 250bc | 86a | 22.07b | 4.08c | 3.28b |
| $ED_2$ | 112.57ab | 263ab | 90a | 22.45ab | 5.17b | 4.22a |
| IPNS | 113.40a | 267a | 94a | 22.48ab | 5.46a | 4.47a |
| RF/97 | 112.40ab | 263ab | 88a | 22.90a | 5.44ab | 4.41a |
| FP | 112.23ab | 248c | 91a | 22.10ab | 5.52a | 4.54a |
| Control | 110.10b | 216d | 69b | 20.92c | 1.88d | 1.85c |
| F-test | * | ** | ** | ** | ** | ** |

Table 10. Yield contributing characters of Wheat as affected by fertilizer levels in the cropping pattern Wheat-Jute-T.Aman at FSRD site, Narikeli during 2000-2001

| Treatment | Plant ht. (cm) | Spikes/m$^2$ (no.) | Spikelets/spike (no.) | Spike length (cm) | Grains/spike (no.) | 1000 grain wt (g) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 99.6 a | 297.2 a | 18.1 a | 12.6 a | 37.0 a | 43.6 a | 4.13 a |
| $T_2$ | 98.7 a | 288.0 a | 17.0 ab | 12.0 a | 34.9 ab | 42.8 a | 3.78 a |
| $T_3$ | 98.8 a | 286.0 a | 16.5 bc | 11.7 a | 33.4 bc | 42.3 ab | 4.02 a |
| $T_4$ | 95.6 a | 258.2 b | 15.4 c | 10.4 b | 30.9 c | 40.4 b | 3.66 a |
| $T_5$ | 79.9 b | 209.0 c | 12.1 d | 9.2 c | 19.8 d | 34.0 c | 2.49b |
| F | ** | * | ** | ** | ** | ** | * |
| CV(%) | 12.37 | 9.48 | 13.7 | 5.95 | 5.42 | 4.72 | 12.26 |

Table 11. Yield contributing characters of Jute as affected by fertilizer levels in the cropping pattern Wheat-Jute-T. Aman at FSRD site, Narikeli during 2000-2001

| Treatment | Plant ht. (m) | Plants/m$^2$ (no.) | Base diameter (cm) | Stick yield (t/ha) |
|---|---|---|---|---|
| $T_1$ | 2.75 a | 64.76 a | 4.86 a | 3.78 a |
| $T_2$ | 2.79 a | 65.66 a | 4.44 ab | 3.81 a |
| $T_3$ | 2.58 a | 61.92 a | 4.00 bc | 3.79 a |
| $T_4$ | 2.22 b | 51.44 b | 3.44 c | 3.16 a |
| $T_5$ | 1.84 c | 43.10 b | 2.60 d | 2.12 b |
| F | * | ** | ** | ** |
| CV(%) | 6.76 | 9.39 | 9.43 | 13.57 |

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

Table 12. Yield contributing characters of T.Aman as affected by fertilizer levels in the cropping pattern Wheat-Jute-T. Aman at FSRD site Narikeli during 2000-2001

| Treatment | Plant ht. (cm) | Panicle length (cm) | Grains/panicle (no.) | Tiller/hill (no) | 1000 seed wt (g) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ | 99.7 a | 19.7 a | 158.7 a | 10.5 a | 26.0 a | 5.47 a |
| $T_2$ | 96.4 ab | 18.8 a | 154.1 a | 10.0 a | 25.5 a | 5.15 a |
| $T_3$ | 95.8 ab | 18.6 a | 155.2 a | 9.8 a | 25.5 a | 5.05 a |
| $T_4$ | 82.2 ab | 16.3 b | 136.0 b | 9.8 a | 24.0 a | 4.64 a |
| $T_5$ | 73.6 b | 14.2 c | 116.7 c | 7.0 b | 20.8 b | 3.03 b |
| F | * | ** | ** | ** | ** | ** |
| CV(%) | 12.01 | 4.28 | 5.88 | 6.89 | 3.82 | 9.91 |

Table 13. Yield and yield components of mustard under CP: Mustard-Boro-T.aman with different fertilizer treatments at the FSR site Bagharpara, Jessore during 2001-2002

| Treat-ment | Plant height (cm) | Plant population/ m2 | No. of pod/plant | No. of seeds/pod | 1000-seed wt. (g) | Straw yield (t/ha) | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|
| $ED_1$ | 66.00ab | 132 | 50a | 14.80 | 2.77a | 1.31ab | 0.660ab |
| $ED_2$ | 73.80a | 114 | 60a | 14.80 | 2.62ab | 1.31ab | 0.790a |
| IPNS | 65.80ab | 112 | 44ab | 15.40 | 2.68ab | 1.28ab | 0.613ab |
| RF/97 | 64.20ab | 130 | 49a | 15.60 | 2.75a | 1.21ab | 0.617ab |
| FP | 71.40a | 106 | 66a | 16.00 | 2.60ab | 1.59a | 0.766a |
| Control | 54.80b | 112 | 26b | 14.00 | 2.54b | 0.87b | 0.427b |

Table 14. Cost and return analysis of CP: Boro-T.aman with different fertilizers treatments at MLT site Narail, Jessore during 2000-2001

| Treatment | Gross return (Tk/ha) | Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|
| Control | 32435 | 0 | 32435 | - |
| $ED_1$ | 53365 | 3172 | 50193 | 6.60 |
| $ED_2$ | 63895 | 4335 | 59560 | 7.26 |
| IPNS | 68575 | 6135 | 62440 | 5.89 |
| RF/97 | 65780 | 4855 | 60925 | 6.87 |
| FP | 69615 | 8663 | 60952 | 4.29 |

Table 15. Effect of different nutrient management packages in Wheat-Jute–T.aman cropping pattern at MLT site, Kishoregonj Sadar , Kishoregonj,2001

| | | | **Wheat** | | | |
|---|---|---|---|---|---|---|
| Treatment | Spicks/m$^2$ | Plant height (cm) | Grain/ spick | 1000 Grain Wt.(gm) | Grain yield(t/ha) | Stover Wt.(t/ha) |
| $T_1$=$ED_1$ | 202.2ab | 81.9 | 23.2ab | 40.6ab | 1.32b | 1.53ab |
| $T_2$=$ED_2$ | 206.0a | 81.9 | 23.5ab | 40.8ab | 1.53a | 1.76a |
| $T_3$=INM | 207.2a | 86.1 | 25.04a | 41.8a | 1.59a | 1.72ab |
| $T_4$=FRG'97 | 186.8c | 76.4 | 22.4ab | 39.8bc | 1.28b | 1.62ab |
| $T_5$=FP | 187.2bc | 77.3 | 21.6b | 39.4bc | 1.29b | 1.48bc |
| $T_6$=Control | 160.4d | 74.9 | 16.4c | 38.6c | 1.00c | 1.25c |
| T-test | ** | NS | ** | * | ** | ** |
| LSD | 15.13 | | 2.809 | 1.465 | 0.1561 | 0.2503 |

Table 15. Contd.

| Jute | | | | | | |
|---|---|---|---|---|---|---|
| Treatment | Plant pop./$m^2$ | Plant height (m) | Plant Dia. (cm) | Stick yield (t/ha) | Fiber yield (t/ha) | |
| $T_1$=$ED_1$ | 31.8 | 2.95ab | 1.25b | 3.25ab | 2.55ab | |
| $T_2$=$ED_2$ | 27.6 | 2.96ab | 1.26b | 3.22ab | 2.71ab | |
| $T_3$=INM | 28.6 | 3.01a | 1.40a | 3.64a | 2.93a | |
| $T_4$=FRG'97 | 37.0 | 2.57cd | 1.22b | 2.85bc | 2.29bc | |
| $T_5$=FP | 32.8 | 2.72c | 1.08c | 3.15ab | 2.44ab | |
| $T_6$=Control | 32.6 | 2.42d | 0.89d | 2.41c | 1.85c | |
| T-test | ns | ** | ** | ** | * | |
| LSD | 9.807 | 0.2481 | 0.9857 | 0.3098 | 0.4954 | |
| **T.Aman** | | | | | | |
| Treatment | Panicle/m2 | Plant height(cm) | Grain /panicle | 1000 Grain wt.(gm) | Grain yield (t/ha) | Straw yield (t/ha) |
| $T_1$=$ED_1$ | 248.2ab | 97.3a | 143.6ab | 41.2ab | 3.90a | 4.82abc |
| $T_2$=$ED_2$ | 250.4ab | 96.2a | 143.0ab | 41.0ab | 4.05a | 5.34a |
| $T_3$=INM | 259.4a | 96.2a | 151.0a | 42.2a | 4.43a | 4.90ab |
| $T_4$=FRG'97 | 240.0b | 94.6a | 134.4b | 40.6b | 3.88a | 4.56bc |
| $T_5$=FP | 241.6b | 94.3a | 133.0b | 40.2bc | 3.9a | 4.69bc |
| $T_6$=Con. | 208.8c | 87.4b | 121.8c | 39.2c | 3.04b | 4.27c |
| T-test | ** | ** | ** | ** | ** | ** |
| LSD | 16.68 | 3.572 | 10.67 | 1.386 | 0.8266 | 0.5826 |

Table 16. Mean performance of yield (t/ha) of crops under Wheat Jute – T.aman cropping pattern during Year-2000-2001

| Treat-ment | Wheat | | | Jute | | | T.Aman | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | Mean | 2000 | 2001 | Mean | 2000 | 2001 | Mean |
| $T_1$ | 1.45 | 1.32 | 1.39 | 1.55 | 2.55 | 2.05 | 3.98 | 3.90 | 3.94 |
| $T_2$ | 1.57 | 1.53 | 1.55 | 1.49 | 2.71 | 2.1 | 4.11 | 4.05 | 4.08 |
| $T_3$ | 1.76 | 1.59 | 1.68 | 1.83 | 2.93 | 2.38 | 4.06 | 4.43 | 4.25 |
| $T_4$ | 1.36 | 1.28 | 1.32 | 1.31 | 2.29 | 1.8 | 3.56 | 3.88 | 3.62 |
| $T_5$ | 1.6 | 1.29 | 1.45 | 1.32 | 2.44 | 1.88 | 3.73 | 3.9 | 3.82 |
| $T_6$ | 1.03 | 1.00 | 1.02 | 0.99 | 1.85 | 1.42 | 3.01 | 3.04 | 3.03 |

Table 17. Apparent Nutrient sheet for Wheat under Wheat- Jute –T.aman cropping pattern at Kishoregonj 2001

| Tret | Yield (t/ha) | Nutrient Uptake (kg/ha) | | | | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 1.32 | 39.07 | 7.89 | 32.47 | 5.54 | 71 | 28 | 10 | 8 | 24.85 | 5.6 | 5 | 1.6 | -14.22 | -1.79 | -27.47 | -3.8 |
| $T_2$ | 1.53 | 45.29 | 8.57 | 37.64 | 6.43 | 101 | 38 | 15 | 12 | 35.35 | 7.6 | 7.5 | 2.4 | -9.94 | -0.97 | -30.14 | -4.03 |
| $T_3$ | 1.59 | 47.06 | 8.9 | 39.11 | 6.68 | 116 | 32 | 22 | 12 | 40.6 | 10.4 | 16 | 2.4 | -6.46 | +1.5 | -23.11 | -4.28 |
| $T_4$ | 1.28 | 37.89 | 7.17 | 31.49 | 5.38 | 50 | 30 | 25 | 7 | 17.5 | 2 | 12.5 | 1.4 | -20.39 | -5.17 | -18.99 | -3.98 |
| $T_5$ | 1.28 | 37.89 | 7.17 | 31.49 | 5.38 | 42 | 8 | 5 | 0 | 14.7 | 1.6 | 2.5 | 0 | -23.19 | -5.57 | -28.99 | -5.38 |
| $T_6$ | 1.00 | 29.6 | 5.6 | 24.6 | 4.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -29.6 | -5.6 | -24.6 | -4.2 |

Table 18. Apparent Nutrient sheet for Jute under Wheat- Jute –T.aman cropping pattern at Kishoregonj 2001

| Tret. | Yield (t/ha) | Nutrient Uptake (kg/ha) | | | | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 2.55 | 82.87 | 16.57 | 169.5 | 0 | 73 | 18 | 10 | 10 | 25.55 | 5.6 | 5 | 2 | -57.32 | -12.97 | -164.5 | +0.2 |
| $T_2$ | 2.71 | 80.70 | 17.61 | 180.2 | 0 | 103 | 25 | 14 | 14 | 36.05 | 5 | 7 | 2.8 | -44.65 | -10.61 | -177.4 | +2.8 |
| $T_3$ | 2.93 | 95.23 | 19.04 | 194.8 | 0 | 103 | 25 | 14 | 14 | 36.05 | 5 | 7 | 2.8 | -59.18 | -14.04 | -187.8 | +2.8 |
| $T_4$ | 2.29 | 74.42 | 14.88 | 152.2 | 0 | 30 | 4 | 15 | 0 | 10.5 | 0.8 | 7.5 | 0 | -63.92 | -14.08 | -144.7 | 0 |
| $T_5$ | 2.44 | 79.3 | 15.56 | 162.2 | 0 | 23 | 0 | 0 | 0 | 8.05 | 0 | 0 | 0 | -71.25 | -15.86 | -162.2 | 0 |
| $T_6$ | 1.85 | 60.12 | 12.02 | 123.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -60.12 | -12.02 | -123.0 | 0 |

Table 19. Apparent Nutrient sheet for T.aman under Wheat- Jute –T.aman cropping pattern at Kishoregonj 2001

| Tret. | Yield (t/ha) | Nutrient Uptake (kg/ha) | | | | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 3.90 | 70.2 | 10.17 | 78 | 7.13 | 64 | 17 | 17 | 4 | 22.4 | 3.4 | 8.5 | 0.8 | -47.8 | -6.77 | -69.5 | -6.33 |
| $T_2$ | 4.05 | 72.9 | 12.15 | 81 | 7.41 | 87 | 20 | 22 | 5 | 30.45 | 4.0 | 11 | 1 | -42.45 | -8.15 | -70.0 | -6.41 |
| $T_3$ | 4.43 | 79.74 | 13.29 | 88.6 | 8.10 | 87 | 20 | 22 | 5 | 30.45 | 4.0 | 11 | 1 | -49.29 | -9.29 | -77.6 | -7.1 |
| $T_4$ | 3.88 | 69.84 | 11.64 | 77.6 | 7.10 | 35 | 4 | 15 | 3 | 12.25 | 0.8 | 7.5 | 0.6 | -57.59 | -10.84 | -70.1 | -6.5 |
| $T_5$ | 3.90 | 70.2 | 11.7 | 78 | 7.13 | 64 | 10 | 13 | 0 | 22.4 | 2 | 6.5 | 0 | -47.8 | -9.7 | -71.5 | -7.13 |
| $T_6$ | 3.04 | 54.73 | 9.12 | 60.8 | 5.56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -54.72 | -9.12 | -60.8 | -5.56 |

Table 20. Apparent nutrient balance sheet (+/-) of Wheat- jute -T.aman cropping pattern

| Tret. | N (kg/ha) | | | | P (kg/ha) | | | | K (kg/ha) | | | | S(kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Wheat | Jute | T.am | Tot. | Wheat | Jute | T.am. | Tot. | Wheat | Jute | T.am. | Tot. | Wheat | Jute | T.am. | Tot. |
| $T_1$ | -14.2 | -57.32 | -47.8 | -119.3 | -1.79 | -12.97 | -6.77 | -21.5 | -27.47 | -164.5 | -69.5 | -2.61.5 | -3.8 | +0.2 | -6.33 | -9.93 |
| $T_2$ | -9.94 | -44.65 | -42.4 | -97.04 | -0.97 | -10.61 | -8.15 | -19.7 | -30.14 | -177.4 | -70.0 | -277.5 | -4.03 | +2.8 | -6.41 | -7.64 |
| $T_3$ | -6.46 | -59.18 | -49.2 | -114.9 | +1.5 | -14.04 | -9.29 | -21.8 | -23.11 | -187.8 | -77.6 | -288.5 | -4.28 | 0 | -7.1 | -11.38 |
| $T_4$ | -20.4 | -63.92 | -57.5 | -141.9 | -5.17 | -14.08 | -10.84 | -30.1 | -18.99 | -144.8 | -70.1 | -233.8 | -3.98 | 0 | -6.5 | -10.48 |
| $T_5$ | -23.2 | -71.25 | -47.8 | -142.4 | -5.57 | -15.86 | -9.7 | -31.1 | -28.99 | -162.3 | -71.5 | -262.7 | -5.38 | 0 | -7.13 | -12.51 |
| $T_6$ | -24.6 | -60.12 | -54.7 | -144.4 | -5.6 | -12.02 | -9.12 | -26.7 | -24.6 | -123.0 | -60.8 | -208.4 | -4.2 | 0 | -5.56 | -9.76 |

Table 21. Effect of different nutrient management packages in wheat - Jute - T.aman cropping pattern at FSRD site, Goyeshpur, Pabna during 1999 - 2000 to 2000 - 2001

| Treatment | 1999-2000 | | | 2000-2001 | | | Mean | | |
|---|---|---|---|---|---|---|---|---|---|
| | Wheat | Jute | T.aman | Wheat | Jute | T.aman | Wheat | Jute | T.aman |
| | | | | **Grain and fibre yield (t/ha)** | | | | | |
| MYG | 3.18a | 1.51ab | 3.50b | 2.60b | 1.50b | 4.40a | 2.89 | 1.51 | 3.95 |
| HYG | 3.29a | 1.12ab | 4.34a | 3.19a | 1.65ab | 4.46a | 3.24 | 1.39 | 4.40 |
| INM | 3.21a | 1.66a | 4.53a | 3.20a | 1.77a | 4.59a | 3.21 | 1.72 | 4.56 |
| FRG'97 | 3.10a | 1.50ab | 3.54b | 2.60b | 1.77a | 4.23a | 2.85 | 1.64 | 3.89 |
| FP | 2.89a | 1.27ab | 4.24a | 2.42b | 1.57ab | 4.14a | 2.66 | 1.42 | 4.19 |
| Control | 1.61b | 0.99b | 1.93c | 1.09c | 0.98c | 2.39b | 1.35 | 0.99 | 2.16 |
| CV(%) | 7.7 | 2.2 | 9.5 | 6.3 | 8.6 | 14.2 | | | |
| | | | | **Straw and stalk yield (t/ha)** | | | | | |
| MYG | 3.94a | 3.87a | 4.20b | 3.63b | 2.67a | 5.78a | 3.79 | 3.27 | 4.99 |
| HYG | 3.84a | 3.67a | 5.50a | 4.26a | 2.99a | 5.71a | 4.05 | 3.33 | 5.61 |
| INM | 3.45a | 3.90a | 5.90a | 4.43a | 3.10a | 5.99a | 3.94 | 3.50 | 5.95 |
| FRG'97 | 3.96a | 3.67a | 4.20b | 3.48b | 2.98a | 6.12a | 3.72 | 3.33 | 5.16 |
| FP | 4.10a | 2.92ab | 5.40a | 3.14c | 2.96a | 5.85a | 3.62 | 2.94 | 5.63 |
| Control | 1.99b | 2.51b | 2.40c | 1.60d | 1.82b | 4.24b | 1.80 | 2.17 | 3.32 |
| CV(%) | 13.6 | 15.4 | 9.4 | 6.5 | 11.1 | 11.2 | | | |

Table 22. Effect of different nutrient management packages on yield and yield contributing characters of wheat under wheat-Jute-T.aman cropping pattern at FSRD site Goyeshpur, Pabna

**Wheat-2001-2002**

| Treatment | Plant height (cm) | Spikelets/ spike (no.) | Grains/ spike (no.) | 1000-grain wt. (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| $ED_1$ | 79.33a | 14.33ab | 27.60a | 30.13ab | 2.11a | 4.09a |
| $ED_2$ | 94.67a | 16.00a | 28.53a | 30.13ab | 2.05a | 5.00a |
| INM | 81.00a | 16.33a | 31.63a | 30.87ab | 2.22a | 4.91a |
| FRG'97 | 81.00a | 16.00a | 30.17a | 32.87a | 2.06a | 4.27a |
| FP | 79.67a | 14.67ab | 27.80a | 30.00b | 2.08a | 4.08a |
| Control | 63.33b | 12.67b | 20.40b | 25.87c | 1.06b | 1.99b |
| CV(%) | 4.70 | 7.40 | 12.80 | 3.90 | 9.60 | 15.50 |

Table 23. Cost and return analysis of different nutrient management packages in wheat-Jute-T.Aman cropping pattern at FSRD site, Goyeshpur, Pabna, during 1999-2000 to 2000-2001

| Treatment | Gross return (Tk/ha) | Variable cost(Tk/ha) | Gross margin (Tk/ha) | MBCR |
|---|---|---|---|---|
| | | **1999-2000** | | |
| MYG | 104860 | 45645 | 59215 | 1.10 |
| HYG | 106083 | 47805 | 58278 | 0.95 |
| INM | 114864 | 47406 | 67458 | 1.38 |
| FRG'97 | 102648 | 45456 | 57192 | 1.01 |
| FP | 97389 | 45867 | 51522 | 0.72 |
| Control | 61686 | 25074 | 36612 | - |
| | | **2000-2001** | | |
| MYG | 95169 | 44475 | 50694 | 1.21 |
| HYG | 104979 | 47163 | 57816 | 1.39 |
| INM | 108318 | 45804 | 62514 | 1.73 |
| FRG'97 | 99540 | 44442 | 55098 | 1.45 |
| FP | 95085 | 44856 | 50229 | 1.16 |
| Control | 54480 | 26070 | 28410 | - |
| **Mean** | | | | |
| MYG | 100014 | 45060 | 54955 | 1.15 |
| HYG | 105531 | 47484 | 58047 | 1.17 |
| INM | 111591 | 46605 | 64986 | 1.54 |
| FRG'97 | 101094 | 44949 | 56145 | 1.22 |
| FP | 96237 | 45362 | 50875 | 0.93 |
| Control | 58083 | 25572 | 32511 | - |

Table 24. Nutrients (N, P, K) balance in wheat –GM- T.aman cropping pattern

**a.**

| Treatment | Crops in CP | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | In Org. | Org. | BNF | Total | In Org. | Org. | BNF | Total | |
| ED1 | Wheat | 2.89 | N | 86 | 75 | - | - | 75 | 26 | - | - | 26 | -60 |
| | | | P | 16 | 26 | - | - | 26 | 5 | - | - | 5 | -11 |
| | | | K | 73 | 17 | - | - | 17 | 9 | - | - | 9 | -64 |
| | Jute | 1.51 | N | 49 | 71 | - | - | 71 | 25 | - | - | 25 | -24 |
| | | | P | 10 | 8 | - | - | 8 | 2 | - | - | 2 | -8 |
| | | | K | 100 | 8 | - | - | 8 | 4 | - | - | 4 | -96 |
| | T.aman | 3.95 | N | 71 | 60 | - | - | 60 | 21 | - | - | 21 | -50 |
| | | | P | 12 | 8 | - | - | 8 | 2 | - | - | 2 | -10 |
| | | | K | 79 | 2 | - | - | 2 | 1 | - | - | 1 | -78 |
| | Total | | N | 206 | 206 | - | - | 206 | 72 | - | - | 72 | -134 |
| | | | P | 38 | 42 | - | - | 42 | 9 | - | - | 9 | -29 |
| | | | K | 252 | 27 | - | - | 27 | 24 | - | - | 24 | -238 |

**b.**

| Treat ment | Crops in CP | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | In Org. | Org. | BNF | Total | In Org. | Org. | BNF | Total | |
| ED2 | Wheat | 3.24 | N | 96 | 107 | - | - | 107 | 37 | - | - | 37 | -59 |
| | | | P | 18 | 35 | - | - | 35 | 7 | - | - | 7 | -11 |
| | | | K | 80 | 24 | - | - | 24 | 12 | - | - | 12 | -68 |
| | Jute | 1.39 | N | 45 | 94 | - | - | 94 | 33 | - | - | 33 | -12 |
| | | | P | 9 | 11 | - | - | 11 | 2 | - | - | 2 | -7 |
| | | | K | 92 | 11 | - | - | 11 | 6 | - | - | 6 | -86 |
| | T.aman | 4.40 | N | 79 | 80 | - | - | 80 | 28 | - | - | 28 | -51 |
| | | | P | 13 | 9 | - | - | 9 | 2 | - | - | 2 | -11 |
| | | | K | 88 | 3 | - | - | 3 | 2 | - | - | 2 | -86 |
| | Total | | N | 220 | 281 | - | - | 281 | 98 | - | - | 98 | -122 |
| | | | P | 40 | 55 | - | - | 55 | 11 | - | - | 11 | -23 |
| | | | K | 260 | 38 | - | - | 38 | 20 | - | - | 20 | -240 |

c.

| Treatment | Crops in CP | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | In Org. | Org. | BNF | Total | In Org. | Org. | BNF | Total | |
| INM | Wheat | 3.21 | N | 95 | 82 | 25 | - | 107 | 29 | 3 | - | 32 | -63 |
| | | | P | 18 | 26 | 20 | - | 46 | 5 | 2 | - | 7 | -11 |
| | | | K | 79 | 19 | 25 | - | 44 | 10 | 3 | - | 13 | -66 |
| | Jute | 1.72 | N | 56 | 94 | - | - | 94 | 33 | - | - | 33 | -23 |
| | | | P | 11 | 11 | - | - | 11 | 2 | - | - | 2 | -9 |
| | | | K | 114 | 11 | - | - | 11 | 6 | - | - | 6 | -108 |
| | T.aman | 4.56 | N | 82 | 80 | - | - | 80 | 28 | - | - | 28 | -54 |
| | | | P | 14 | 9 | - | - | 14 | 2 | - | - | 2 | -12 |
| | | | K | 91 | 3 | - | - | 3 | 2 | - | - | 2 | -89 |
| | Total | | N | 233 | 256 | 25 | - | 281 | 90 | 3 | - | 93 | -140 |
| | | | P | 43 | 46 | 20 | - | 71 | 9 | 2 | - | 11 | -32 |
| | | | K | 284 | 33 | 25 | - | 58 | 18 | 3 | - | 21 | -263 |

d.

| Treat. | Crops in CP | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | In Org. | Org. | BNF | Total | In Org. | Org. | BNF | Total | |
| FRG' 97 | Wheat | 2.85 | N | 84 | 90 | - | - | 90 | 32 | - | - | 32 | -52 |
| | | | P | 16 | 20 | - | - | 20 | 4 | - | - | 4 | -12 |
| | | | K | 70 | 35 | - | - | 35 | 18 | - | - | 18 | -52 |
| | Jute | 1.64 | N | 53 | 65 | - | - | 65 | 23 | - | - | 23 | -30 |
| | | | P | 11 | 7 | - | - | 7 | 1 | - | - | 1 | -10 |
| | | | K | 109 | 20 | - | - | 20 | 10 | - | - | 10 | -99 |
| | T.aman | 3.89 | N | 70 | 70 | - | - | 70 | 25 | - | - | 25 | -45 |
| | | | P | 12 | 8 | - | - | 8 | 2 | - | - | 2 | -10 |
| | | | K | 78 | 20 | - | - | 20 | 10 | - | - | 10 | -68 |
| | Total | | N | 207 | 225 | - | - | 225 | 80 | - | - | 80 | -127 |
| | | | P | 39 | 35 | - | - | 35 | 7 | - | - | 7 | -32 |
| | | | K | 257 | 75 | - | - | 75 | 38 | - | - | 38 | -219 |

e.

| Treatment | Crops in CP | Yield (t/ha) | Nutrient | Nutrient uptake (Kg/ha) | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | In Org. | Org. | BNF | Total | In Org. | Org. | BNF | Total | |
| FP | Wheat | 2.66 | N | 79 | 64 | - | - | 64 | 22 | - | - | 22 | -57 |
| | | | P | 15 | 26 | - | - | 26 | 5 | - | - | 5 | -10 |
| | | | K | 65 | 17 | - | - | 17 | 9 | - | - | 9 | -56 |
| | Jute | 1.42 | N | 46 | 35 | - | - | 35 | 12 | - | - | 12 | -34 |
| | | | P | 9 | 11 | - | - | 11 | 2 | - | - | 2 | -7 |
| | | | K | 94 | 25 | - | - | 25 | 13 | - | - | 13 | -81 |
| | T.aman | 4.19 | N | 75 | 75 | - | - | 75 | 26 | - | - | 26 | -49 |
| | | | P | 13 | 16 | - | - | 16 | 3 | - | - | 3 | -10 |
| | | | K | 84 | 29 | - | - | 29 | 15 | - | - | 15 | -69 |
| | Total | | N | 200 | 174 | - | - | 174 | 60 | - | - | 60 | -140 |
| | | | P | 37 | 53 | - | - | 53 | 10 | - | - | 10 | -27 |
| | | | K | 243 | 71 | - | - | 71 | 37 | - | - | 37 | -206 |

Table 25 Effect of different nutrient packages on yield contributing characters of crops grown in Boro-T.aman rice cropping pattern at MLT site, Kendua, Natrokuna, 2001

| Treatment (kg/ha of NPKSZn) | Panicle/$m^2$ | Grain/panicle | 1000 grain wt.(g) | Plant height (cm) |
|---|---|---|---|---|
| **Boro** | | | | |
| $T_1$=$ED_1$ | 169.68 bc | 94.167cd | 29.68 | 90.76 |
| $T_2$=$ED_2$ | 173.00ab | 99.50abc | 29.25 | 91.01 |
| $T_3$=INM | 177.17ab | 106.17a | 29.52 | 91.05 |
| $T_4$=FRG'97 | 179.17 a | 105.33ab | 29.99 | 90.58 |
| $T_5$=FP | 170.33bc | 98.17bcd | 30.20 | 93.16 |
| $T_6$=Control | 163.00 c | 91.50d | 29.10 | 89.71 |
| T-test | * | ** | NS | NS |
| LSD | 8.368 | 7.852 | 4.11 | 5.938 |
| **T.Aman** | | | | |
| $T_1$=$ED_1$ | 157.00 ab | 124.33 a | 21.66 | 118.40ab |
| $T_2$=$ED_2$ | 154.68b | 123.00 a | 21.16 | 119.72a |
| $T_3$=INM | 153.17b | 122.83 a | 21.16 | 119.52a |
| $T_4$=FRG '97 | 159.83 a | 122.83 a | 20.91 | 118.43ab |
| $T_5$=FP | 161.67a | 123.17a | 20.83 | 119.35a |
| $T_6$=Control | 142.00c | 120.33 b | 19.83 | 116.92b |
| T-test | ** | * | NS | * |
| LSD | 5.054 | 2.007 | 2.487 | 1.9 |

Table 26. Effect of different nutrient packages on yield of crops grown in Boro-T.aman cropping pattern at MLTsite, Kendua, Natrokuna,2001

| Treatments | Grain yield (t/ha) | | | | | |
|---|---|---|---|---|---|---|
| | Boro | | | T.Aman | | |
| | 2000 | 2001 | Mean | 2000 | 2001 | Mean |
| $T_1$=ED1 | 5.06 ab | 4.33b | 4.69 | 3.78 b | 4.31ab | 4.05 |
| $T_2$=ED2 | 5.41 a | 5.16a | 5.28 | 4.16 a | 4.38a | 4.27 |
| $T_3$=INM | 5.34 a | 5.21a | 5.27 | 3.74 b | 4.04ab | 3.89 |
| $T_4$=FRG'97 | 4.99 ab | 4.94ab | 4.96 | 3.77 b | 4.20ab | 3.99 |
| $T_5$=FP | 4.79 b | 5.13a | 4.96 | 3.74 b | 4.01b | 3.87 |
| $T_6$=Control | 3.12 c | 3.58c | 3.35 | 2.98 c | 3.15c | 3.07 |
| **T-test** | ** | ** | | ** | ** | |
| LSD | 0.5114 | 0.617 | | 0.3741 | 0.3501 | |
| | Straw Yield (t/ha) | | | | | |
| $T_1$=ED1 | 3.97 a | 4.55b | 4.26 | 4.51 a | 4.64a | 4.56 |
| $T_2$=ED2 | 4.25 a | 5.33a | 4.79 | 4.81 a | 4.64a | 4.73 |
| $T_3$=INM | 4.10 a | 5.70a | 4.90 | 4.45 a | 4.66a | 4.56 |
| $T_4$=FRG'97 | 4.08 a | 5.77a | 4.93 | 4.65 a | 4.58a | 4.62 |
| $T_5$=FP | 4.00 a | 5.48a | 4.74 | 4.82 a | 4.57a | 4.70 |
| $T_6$=Control | 3.31 b | 4.52b | 3.92 | 3.91 b | 3.73b | 3.82 |
| T-test | ** | ** | | ** | ** | |
| LSD | 0.4153 | 0.6149 | | 0.4204 | 0.5732 | |

**= Significance at 1% level

Table 27. Cost and return analysis of different nutrient management packages in Boro – T. aman cropping pattern at MLT site, Kendua, Natrokuna, 2001

| Treatment | Gross return (Tk/ha) | Variable cost(Tk/ha) | Gross margin (Tk/ha) | MBCR (over control) |
|---|---|---|---|---|
| | | Year-2000 | | |
| $T_1$=$ED_1$ | 63730 | 6652 | 57078 | 1.76 |
| $T_2$=$ED_2$ | 68872 | 9177 | 59695 | 1.56 |
| $T_3$=INM | 65300 | 7421 | 57879 | 1.69 |
| $T_4$=FRG'97 | 63480 | 5361 | 58119 | 2.38 |
| $T_5$=FP | 62132 | 6142 | 55990 | 1.73 |
| $T_6$=Control | 45345 | 0 | 45345 | - |
| | | **Year-2001** | | |
| $T_1$=$ED_1$ | 62712 | 6652 | 56060 | 1.51 |
| $T_2$=$ED_2$ | 72880 | 9177 | 63703 | 2.20 |
| $T_3$=INM | 71202 | 8131 | 63071 | 2.28 |
| $T_4$=FRG'97 | 70225 | 5361 | 64864 | 3.27 |
| $T_5$=FP | 70182 | 6152 | 64029 | 2.84 |
| $T_6$=Control | 52675 | 0 | 52675 | - |

Table 28. Apparent Nutrient sheet for Boro under Boro-T.Aman cropping pattern at Kendua,2001

| Treatment | Yield (t/ha) | Nutrient Uptake (kg/ha) | | | | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 4.33 | 77.94 | 13.00 | 86.6 | 7.92 | 75 | 26 | 48 | 10 | 26.25 | 5.2 | 24 | 2 | -51.69 | -7.8 | -62.6 | -592 |
| $T_2$ | 5.16 | 93.00 | 15.48 | 103.2 | 9.44 | 105 | 37 | 69 | 15 | 36.75 | 7.4 | 35 | 3 | -56.25 | -8.08 | -68.2 | -6.44 |
| $T_3$ | 5.21 | 93.78 | 15.63 | 104.2 | 9.53 | 117 | 45 | 100 | 15 | 40.95 | 9 | 50 | 3 | -52.83 | -6.63 | -54.2 | -6.53 |
| $T_4$ | 4.94 | 88.92 | 14.82 | 98.8 | 9.04 | 100 | 15 | 40 | 10 | 35 | 3 | 20 | 2 | -53.92 | -11.82 | -78.8 | -7.04 |
| $T_5$ | 5.13 | 92.34 | 15.39 | 102.6 | 9.39 | 105 | 24 | 37 | 13 | 36.75 | 4.8 | 19 | 2.6 | -55.6 | -10.59 | -83.6 | -7.13 |
| $T_6$ | 3.58 | 64.44 | 10.74 | 71.6 | 6.55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -64.44 | -10.74 | -71.6 | -6.55 |

Table 29. Apparent Nutrient sheet for T.aman under Boro –T.aman cropping pattern at Kendua, 2001

| Treatment | Yield (t/ha) | Nutrient Uptake (kg/ha) | | | | Nutrient added (kg/ha) | | | | Nutrient recovered (kg/ha) | | | | Balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 4.31 | 77.58 | 12.93 | 86.2 | 7.88 | 46 | 18 | 34 | 7 | 16.1 | 3.6 | 17 | 1.4 | -61.4 | -9.33 | -69.2 | -6.48 |
| $T_2$ | 4.38 | 78.84 | 13.14 | 87.6 | 8.01 | 70 | 22 | 43 | 9 | 24.5 | 4.4 | 22 | 1.8 | -54.34 | -8.74 | -65.6 | -6.21 |
| $T_3$ | 4.04 | 72.72 | 12.12 | 80.8 | 7.39 | 70 | 22 | 43 | 9 | 24.5 | 4.4 | 22 | 1.8 | -48.22 | -7.72 | -58.8 | -5.59 |
| $T_4$ | 4.20 | 75.6 | 12.6 | 84 | 7.68 | 60 | 8 | 30 | 4 | 21 | 1.6 | 15 | 0.8 | -54.6 | -11 | -69 | -6.88 |
| $T_5$ | 4.01 | 72.18 | 12.03 | 82 | 7.33 | 58 | 14 | 25 | 0 | 20.3 | 2.8 | 13 | 0 | -51.88 | -9.23 | -69 | -7.33 |
| $T_6$ | 3.15 | 58.7 | 9.45 | 63 | 5.76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -58.7 | -9.45 | -63 | -5.76 |

Table 30. Apparent nutrient balance sheet (+/-) of Boro- T.aman cropping pattern

| Treatment | N(kg/ha) | | | P(kg/ha) | | | K(kg/ha) | | | S(kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boro | T.aman | Total | Boro | T.aman | Total | Boro | T.aman | Total | Boro | T.aman | Total |
| $T_1$ | -51.69 | -61.4 | -113.09 | -7.8 | -9.33 | -17.13 | -62.6 | -69.2 | -131.8 | -5.92 | -6.48 | -12.4 |
| $T_2$ | -56.25 | -54.34 | -110.59 | -8.08 | -8.74 | -16.82 | -68.2 | -65.6 | -133.8 | -6.44 | -6.21 | -12.65 |
| $T_3$ | -52.83 | -48.22 | -101.05 | -6.63 | -7.72 | -14.35 | -54.2 | -58.8 | -113 | -6.53 | -5.59 | -12.43 |
| $T_4$ | -53.92 | -54.6 | -108.52 | -11.82 | -11 | -22.82 | -78.8 | -69 | -147.8 | -7.04 | -6.88 | -13.92 |
| $T_5$ | -55.6 | -51.88 | -107.48 | -10.59 | -9.23 | -19.82 | -83.6 | -69 | -152.6 | -7.13 | -7.33 | -14.46 |
| $T_6$ | -64.44 | -58.7 | -123.14 | -10.79 | -9.45 | -20.24 | -71.6 | -63 | -134.6 | -6.5 | -5.76 | -12.26 |

Table 31. Yield and yield parameters of Boro rice -T.Aman rice cropping pattern at MLT site PHULPUR, Mymensingh, 1999-2000

| Treatment | Plant height (cm) | No. of panicle sq.m$^{-1}$ | Filled grain panicle$^{-1}$ | Weight of 1000-grain wt. (g) | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|
| **Crop: Boro rice (variety BRRI Dhan 28), duration 137-138 (Seed to seed)** | | | | | | |
| $ED_1$ | 89.77 a | 333 ab | 107.7 ab | 24.17 a | 4.43 ab | 5.22 a |
| $ED_2$ | 84.90 b | 342 a | 113.5 a | 24.25 a | 4.92 a | 5.25 a |
| IFM | 85.50 b | 322 ab | 105.8 ab | 24.33 a | 4.14 ab | 5.27 a |
| FRG'97 | 86.43 b | 316 b | 115.5 a | 24.33 a | 4.85 a | 5.27 a |
| FP | 85.83 b | 329 ab | 115.0 a | 24.25 a | 4.77 a | 5.23 a |
| Control | 81.27 c | 310 b | 99.00 b | 23.58 b | 3.67 b | 4.64 b |
| CV % | 2.0 | 4.1 | 7.1 | 1.1 | 12.7 | 5.3 |
| **Crop: T.aman rice (variety BRRI Dhan 33), duration 123-125 (Seed to seed)** | | | | | | |
| $ED_1$ | 85.08 ab | 215 a | 116.7 b | 24.00 c | 4.03 b | 5.33 a |
| $ED_2$ | 86.82 a | 228 a | 122.8 a | 24.58 ab | 4.50 a | 5.57 a |
| IFM | 86.60 a | 226 a | 123.2 a | 24.67 a | 4.54 a | 5.59 a |
| FRG'97 | 85.02 ab | 219 a | 118.0 b | 24.00 c | 4.33 ab | 5.43 a |
| FP | 83.65 b | 219 a | 117.5 b | 24.17 bc | 4.08 b | 5.30 a |
| Control | 78.33 c | 194 b | 111.3 c | 24.08 c | 3.08 c | 4.12 b |
| CV % | 1.7 | 4.4 | 2.5 | 1.1 | 4.6 | 3.2 |

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

Table 32. Yield and yield parameters of Boro rice -T.Aman rice cropping pattern at MLT site NETRAKONA, Mymensingh, 1999-2000

| Treatment | Plant height (cm) | No. of panicle sq.m$^{-1}$ | Filled grain panicle$^{-1}$ | 1000 grain wt. (g) | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|
| **Crop: Boro rice (variety BRRI Dhan 28), duration 137-138 (Seed to seed)** | | | | | | |
| $ED_1$ | 92.52 a | 295 ab | 95.67 ab | 18.19 ab | 3.98 b | 5.13 b |
| $ED_2$ | 94.32 a | 326 a | 99.17 a | 18.08 ab | 4.57 a | 5.93 a |
| IFM | 93.27 a | 299 ab | 96.67 ab | 17.66 b | 4.12 b | 5.28 b |
| FRG'97 | 92.47 a | 281 b | 88.00 bc | 18.27 ab | 3.97 b | 5.12 b |
| FP | 90.86 a | 275 b | 91.00 ab | 18.71 a | 3.87 b | 4.95 b |
| Control | 77.67 b | 221 c | 81.17 c | 18.39 a | 2.88 c | 3.58 c |
| CV % | 2.2 | 7.1 | 5.8 | 2.2 | 6.3 | 7.1 |
| **Crop: T. aman rice (variety BRRI Dhan 33), duration 123-125 (Seed to seed)** | | | | | | |
| $ED_1$ | 85.85 a | 232 ab | 110.8 a | 24.78 | 4.18 a | 5.22 a |
| $ED_2$ | 87.68 a | 236 ab | 116.6 a | 24.99 | 4.44 a | 5.44 a |
| IFM | 88.85 a | 243 a | 118.1 a | 25.06 | 4.45 a | 5.50 a |
| FRG'97 | 89.00 a | 232 ab | 114.1 a | 24.83 | 4.33 a | 5.30 a |
| FP | 88.13 a | 270 a | 113.8 a | 24.84 | 4.31 a | 5.27 a |
| Control | 77.63 b | 186 b | 92.67 b | 24.03 | 2.88 b | 3.67 b |
| CV % | 3.6 | 17.4 | 5.7 | 3.1 | 4.8 | 5.18 |

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

Table 33. Yield and yield parameters of Boro rice -T.Aman rice cropping pattern at MLT site PHULPUR, Mymensingh, 2000-01

| Treatment | Plant height (cm) | No. of panicle sq. $m^{-1}$ | Filled grain $panicle^{-1}$ | 1000 grain wt. (g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **Crop: Boro rice (variety BRRI Dhan 28), duration 137-138 (Seed to seed)** | | | | | | |
| $ED_1$ | 83.93 a | 253 b | 118 b | 23.04 | 5.19 b | 5.97 bc |
| $ED_2$ | 85.93 a | 280 a | 129 a | 23.16 | 5.43 a | 6.17 ab |
| IFM | 85.73 a | 281 a | 130 a | 23.23 | 5.44 a | 6.25 a |
| FRG'97 | 81.57 b | 255 b | 115 b | 23.02 | 5.16 b | 5.87 c |
| FP | 79.67 b | 235 c | 108 c | 22.94 | 4.60 c | 5.36 d |
| Control | 73.93 c | 205 d | 102 c | 22.41 | 3.24 d | 4.20 e |
| CV % | 1.7 | 3.4 | 3.7 | 1.4 | 1.6 | 2.4 |
| **Crop: T. aman rice (variety BRRI Dhan 33), duration 123-125 (Seed to seed)** | | | | | | |
| $ED_1$ | 79.0 d | 187 b | 105 e | 24.00 b | 4.14 d | 5.13 d |
| $ED_2$ | 84.4 a | 200 a | 116 a | 24.30 a | 4.72 a | 5.79 a |
| IFM | 85.6 b | 188 b | 112 b | 24.15 a | 4.52 b | 5.66 ab |
| FRG'97 | 81.1 c | 187 b | 111 b | 24.00 a | 4.29 c | 5.51 bc |
| FP | 79.4 d | 180 c | 105 c | 24.00 b | 4.16 d | 5.36 c |
| Control | 75.6 e | 172 d | 96 d | 23.87 b | 3.24 e | 4.50 e |
| CV % | 1.0 | 2.7 | 2.0 | 1.0 | 1.9 | 2.4 |

Table 34. Yield and yield parameters of Boro rice -T.Aman rice cropping pattern at MLT site NETRAKONA, Mymensingh during 2000-01

| Treatment | Plant height (cm) | No. of panicle sq.$m^{-1}$ | Filled grain $panicle^{-1}$ | 1000 grain wt. (g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **Crop: Boro rice (variety BRRI Dhan 28), duration 137-138 (Seed to seed)** | | | | | | |
| $ED_1$ | 82.62 b | 236 a | 99.83 ab | 22.51 bc | 4.86 ab | 5.57 ab |
| $ED_2$ | 84.81 a | 244 a | 103.2 a | 23.01 ab | 5.15 a | 6.03 a |
| IFM | 84.49 ab | 243 a | 101.3 a | 22.99 ab | 5.12 a | 6.04 a |
| FRG'97 | 82.58 b | 239 a | 93.17 bc | 23.19 a | 4.53 b | 5.20 b |
| FP | 82.83 ab | 236 a | 96.33 ab | 22.87 a-c | 4.67 ab | 5.39 b |
| Control | 74.21 c | 189 b | 87.00 c | 22.44 c | 3.23 c | 3.64 c |
| CV % | 1.5 | 3.0 | 4.1 | 1.8 | 6.9 | 6.8 |
| **Crop: T.aman rice (variety BRRI Dhan 33), duration 123-125 (Seed to seed)** | | | | | | |
| $ED_1$ | 87.10 b | 196 c | 67.0 b | 24.03 b | 3.47 b | 3.55 b |
| $ED_2$ | 89.33 a | 207 ab | 70.5 a | 24.83 a | 3.96 a | 4.04 a |
| IFM | 89.70 a | 210 a | 70.2 a | 24.67 a | 3.97 a | 4.07 a |
| FRG'97 | 87.55 b | 195 a | 66.0 b | 24.63 a | 3.45 b | 3.53 b |
| FP | 87.74 b | 182 bc | 62.0 c | 24.08 b | 2.98 c | 3.03 c |
| Control | 74.58 c | 166 d | 57.2 d | 23.78 b | 2.52 d | 2.58 d |
| CV % | 1.8 | 3.8 | 3.0 | 10.3 | 4.2 | 4.3 |

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

Table 35. Cost and return analysis of different nutrient management packages in Boro-T. Aman cropping pattern at MLT site PHULPUR Mymensingh

| Treatment | Gross return (Tk $ha^{-1}$) | Variable cost* (Tk $ha^{-1}$) | Gross margin (Tk $ha^{-1}$) | MBCR (over control) |
|---|---|---|---|---|
| **1st Year 1999-2000** | | | | |
| $ED_1$ | 64495 | 6835 | 57660 | 1.88 |
| $ED_2$ | 71350 | 9098 | 62252 | 2.17 |
| IFM | 66190 | 8705 | 57485 | 1.67 |
| FRG'97 | 69610 | 7777 | 61833 | 2.31 |
| FP | 67215 | 8021 | 59194 | 1.94 |
| Control | 51630 | 0 | 51630 | - |
| **2nd Year 2000-01** | | | | |
| $ED_1$ | 70873 | 5729 | 65144 | 3.69 |
| $ED_2$ | 76994 | 7614 | 69380 | 3.58 |
| IFM | 75689 | 7965 | 67724 | 3.26 |
| FRG'97 | 71824 | 6136 | 65688 | 3.60 |
| FP | 66679 | 6675 | 60004 | 2.54 |
| Control | 49724 | - | 49724 | - |

Table 36. Cost and return analysis of different nutrient management packages in Boro-T. Aman cropping pattern at MLT site NETRAKONA, Mymensingh

| Treatment | Gross return (Tk $ha^{-1}$) | Variable cost* (Tk $ha^{-1}$) | Gross margin (Tk $ha^{-1}$) | MBCR (over control) |
|---|---|---|---|---|
| | | **1st Year 1999-2000** | | |
| $ED_1$ | 62295 | 8410.93 | 53884.07 | 2.18 |
| $ED_2$ | 68755 | 11242.42 | 57512.58 | 2.21 |
| IFM | 65380 | 10836.99 | 54543.01 | 1.98 |
| FRG'97 | 63310 | 8414.81 | 54895.19 | 2.30 |
| FP | 62370 | 8040.44 | 54329.56 | 2.29 |
| Control | 43945 | 0 | 43945.00 | - |
| | | **2nd Year 2000-01** | | |
| $ED_1$ | 65854 | 7005 | 58849 | 3.21 |
| $ED_2$ | 68802 | 9521 | 59281 | 2.67 |
| IFM | 68665 | 9701 | 58964 | 2.61 |
| FRG'97 | 60190 | 5725 | 54465 | 2.94 |
| FP | 57740 | 10862 | 46878 | 1.32 |
| Control | 43382 | - | - | - |

*Variable cost includes only fertilizer cost

Product price (2001-02):Rice grain = Tk. 7 $kg^{-1}$ Rice straw = Tk. 0.50 $kg^{-1}$

Mustard = Tk. 13 $kg^{-1}$; Stover Tk. 0.25 $kg^{-1}$

Table 37. Soil test values and interpretation of Phulpur and Netrokuna MLT site

| Element | pH | OM (%) | Total N (%) | P (ppm) | K (meq/100g) | S (ppm) | Zn (ppm) | B (ppm) |
|---|---|---|---|---|---|---|---|---|
| **Location : PHULPUR** | | | | | | | | |
| Value | 5.22 | 1.17 | 0.078 | 15.27 | 0.152 | 11.64 | 1.304 | 0.20 |
| Interpre-tation | - | - | Very Low | Medium | Medium | Low | Medium | Low |
| **Location : NETRAOKONA** | | | | | | | | |
| Value | 5.08 | 1.38 | 0.093 | 4.68 | 0.155 | 14.12 | 1.08 | 0.313 |
| Interpre-tation | - | - | Low | Very Low | Medium | Low | Medium | Medium |

Table 38. Yield and yield contributing characters of Boro under Boro-T.aman cropping pattern at Laksam MLT site during 2000-2001

| Treatment (N-P-K-S kg/ha) | Plant height (cm) | Tiller/ hill | Panicle/ hill | Grain/ Panicle | Panicle length (cm) | 1000 grain wt(g) | Straw wt (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$=52-12-58-8 | 79.5 | 18.6 | 16.45 | 157.25 | 23.85 | 24.31 | 7.5 | 6.25b |
| $T_2$=74-13-62-13 | 77.65 | 19.7 | 17.05 | 162.00 | 23.54 | 24.66 | 8.06 | 6.45ab |
| $T_3$=62-9-24-12 | 76.54 | 20.5 | 16.75 | 161.85 | 24.89 | 24.21 | 8.13 | 6.50a |
| $T_4$=45-7-25-4 | 78.9 | 19.6 | 17.00 | 160.90 | 23.12 | 24.98 | 7.8 | 6.28ab |
| $T_5$=95-45-52 | 77.6 | 21.5 | 17.25 | 163.30 | 24.61 | 24.25 | 8.1 | 6.48ab |
| $T_6$=(Control) | 75.6 | 15.4 | 12.55 | 115.75 | 22.54 | 23.64 | 3.01 | 2.50c |
| CV(%) | 7.5 | 4.1 | 6.9 | 12.7 | 3.2 | 1.2 | 3.6 | 2.3 |

Table 39. Yield and yield contributing characters of T.aman under Boro-T.aman cropping pattern at Laksam MLT site during 2000-2001

| Treatment (N-P-K-S Kg/ha) | Plant height (cm) | Tiller/ hill | Panicle/hill | Grain/ Panicle | Panicle length (cm) | 1000 grain wt(g) | Straw (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$=52-12-58-8 | 88.72 | 15.1 | 12.22 | 99.57 | 23.19 | 22.16 | 5.14 | 4.58bc |
| $T_2$=74-13-62-13 | 89.53 | 16.4 | 12.56 | 106.98 | 23.97 | 23.78 | 6.48 | 5.42ab |
| $T_3$=62-9-24-12 | 88.00 | 15.7 | 11.97 | 108.79 | 22.15 | 22.98 | 6.81 | 5.87a |
| $T_4$=45-7-25-4 | 89.43 | 16.1 | 13.15 | 112.50 | 24.57 | 23.47 | 6.97 | 5.17ab |
| $T_5$=95-45-52 | 89.93 | 17.8 | 14.89 | 104.26 | 24.26 | 23.98 | 5.9 | 4.93b |
| $T_6$=(Control) | 67.23 | 13.4 | 9.68 | 87.54 | 18.33 | 21.89 | 2.73 | 1.85c |
| CV (%) | 3.6 | 2.4 | 3.1 | 8.9 | 2.5 | 1.6 | 2.3 | 3.4 |

Table 40. Effect of fertilizer on Boro rice yield contributing characters of Boro-T.Aman rice cropping pattern conducted at Hathazari, Chittagong during 1999, 2000 and 2001

| Treat-ment | Panicle/ hill (no.) | | | Fertile grain/panicle (no.) | | | 1000 grain weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| $T_1$ | 12.15a | 12.43ab | 12.52b | 71.72ab | 91.87bc | 93.25c | 23.40a | 22.74 | 22.40 |
| $T_2$ | 13.45a | 13.57a | 13.63a | 80.60a | 98.82ab | 102.4ab | 26.41a | 21.76 | 22.68 |
| $T_3$ | 12.85a | 13.52a | 13.60a | 79.50b | 109.72a | 105.1a | 26.80a | 22.28 | 22.95 |
| $T_4$ | 12.41a | 11.97b | 12.25bc | 72.00ab | 100.25ab | 96.80bc | 22.19bc | 22.50 | 21.98 |
| $T_5$ | 12.30a | 12.40ab | 11.75c | 66.94ab | 82.50c | 94.50c | 21.63c | 21.32 | 22.05 |
| $T_6$ | 09.68a | 08.90c | 09.78d | 58.86b | 68.32d | 75.65d | 19.31d | 20.94 | 21.45 |
| CV (%) | 9.4 | 9.8 | 3.76 (0.6939)* | 14.4 | 11.9 | 4.84 (6.90)* | 4.6 | 5.2 | 3.06 (1.026)* |

* indicates LSD value at 5% level of significance

Table 41. Effect of fertilizer on T.Aman rice yield contributing characters of Boro-T.Aman rice cropping pattern conducted at Hathazari, Chittagong during 1999, 2000 and 2001

| Treat-ment | Panicle/ hill (no.) | | | Fertile grain/panicle (no.) | | | 1000 grain weight (g) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 |
| $T_1$ | 7.82b | 9.90ab | 10.25ab | 104.92a | 96.47ab | 103.9c | 20.41 | 22.01 | 22.66 |
| $T_2$ | 9.68a | 10.68a | 11.26ab | 106.30a | 87.58bc | 108.7b | 21.12 | 23.19 | 22.61 |
| $T_3$ | 9.80a | 10.33a | 11.00ab | 115.00a | 101.80a | 113.0a | 21.20 | 22.97 | 22.98 |
| $T_4$ | 7.34b | 10.73a | 12.10a | 102.66a | 95.57ab | 105.0bc | 21.49 | 22.03 | 22.93 |
| $T_5$ | 7.76b | 10.13ab | 11.13ab | 105.72a | 91.25a-c | 101.8c | 20.39 | 22.17 | 23.02 |
| $T_6$ | 6.80b | 9.00b | 9.53b | 83.16b | 82.73c | 93.50d | 21.27 | 20.40 | 22.43 |
| Cv (%) | 10.6 | 9.0 | 11.32 (1.856)* | 11.6 | 10.1 | 12.44 (3.835)* | 4.5 | 8.7 | 2.75 (0.756)* |

* indicates LSD value at 5% level of significance

Table 42. Effect of fertilizer on Boro rice yield contributing characters of Boro-T.Aman rice cropping pattern conducted at Satkaniya, Chittagong during 2000 and 2001

| [Treatment | Panicle/hill (no.) | | Fertile grain/panicle (no.) | | 1000 grain wt. (g) | |
|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| $T_1$ | 13.00b | 12.32b | 99.02b | 107.7a | 22.29 | 22.47 |
| $T_2$ | 15.60a | 13.42a | 114.92a | 110.2a | 22.96 | 22.58 |
| $T_3$ | 14.82ab | 13.56a | 109.65ab | 110.0a | 22.93 | 22.52 |
| $T_4$ | 14.10ab | 12.36b | 17.05b | 106.6a | 22.10 | 22.32 |
| $T_5$ | 12.65b | 12.24b | 98.45b | 101.2a | 23.03 | 22.60 |
| $T_6$ | 8.93c | 9.04c | 93.55b | 87.12b | 22.92 | 21.88 |
| Cv (%) | 13.3 | 5.85 (0.9385)* | 12.1 | 7.13 (9.766)* | 4.8 | 2.80 (0.826)* |

* indicates LSD value at 5% level of significance

Table 43. Effect of fertilizer on T.Aman rice yield contributing characters of Boro-T.Aman rice cropping pattern conducted at Satkaniya, Chittagong during 2000 and 2001

| Treatment | Panicle/hill (no.) | | Fertile grain/panicle (no.) | | 1000 grain wt. (g) | |
|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2000 | 2001 | 2000 | 2001 |
| $T_1$ | 12.70a | 11.50bc | 102.83bc | 104.1b | 22.21 | 22.48 |
| $T_2$ | 12.63ab | 12.28a | 113.92a | 115.2a | 22.54 | 22.54 |
| $T_3$ | 12.20b | 12.46a | 112.20ab | 116.5a | 22.30 | 22.38 |
| $T_4$ | 12.90a | 11.68b | 102.38bc | 102.4b | 22.10 | 22.51 |
| $T_5$ | 12.42ab | 11.18c | 100.58cd | 101.3b | 22.36 | 22.66 |
| $T_6$ | 9.52c | 9.00d | 91.92d | 84.6c | 22.36 | 22.52 |
| Cv (%) | 6.2 | 3.15 (3.15)* | 7.6 | 5.27 (7.244)* | 2.6 | 1.41 (0.4172)* |

* indicates LSD value at 5% level of significance

Table 44. Cost and return analysis of fertilizer on Boro-T.Aman rice cropping pattern conducted at Hathazari, Chittagong during 1999, 2000 and 2001

| Boro rice | T. Aman rice | GR (Tk./ha) | TVC (Tk.) | MBCR | MRR (%) |
|---|---|---|---|---|---|
| N P K S (kg/ha) | N P K S (kg/ha) | | | | |
| $T_1$= 89 20 54 16 | 61 7 38 4 | | | | |
| $T_2$= 126 28 75 23 | 84 9 48 7 | 75102 | 8326 | 4.29 | 239 |
| $T_3$= 116 22 65 23+10t.cd | 84 9 48 7 | 76202 | 12569 | 2.93 | - |
| $T_4$= 100 10 40 5 | 70 4 35 1 | 63167 | 4809 | 4.95 | 395 |
| $T_5$= 86 25 16 0 | 75 26 17 0 | 56840 | 6383 | 2.74 | - |
| $T_6$= 0 0 0 0 | 0 0 0 0 | 39349 | 0 | - | - |

Table 45. Cost and return analysis of fertilizer on Boro-T.Aman rice cropping pattern conducted at Satkaniya, Chittagong during 2000 and 2001

| Boro rice | T. Aman rice | GR (Tk./ha) | TVC (Tk.) | MBCR | MRR (%) |
|---|---|---|---|---|---|
| N P K S Kg/ha | N P K S Kg/ha | | | | |
| $T_1$= 100-25-60-11 | 68-9-41-4 | | | | |
| $T_2$= 140-36-83-16 | 93-11-53-5 | 76890 | 9447 | 3.88 | 96 |
| $T_3$= 130-30-73-16+10 t.cd | 93-11-53-5 | 77303 | 13690 | 2.71 | - |
| $T_4$=100-10-40-5 | 70-8-35-2 | 68380 | 5110 | 5.50 | 450 |
| $T_5$= 85-25-41-7 | 59-9-22-1 | 64038 | 5686 | 4.18 | - |
| $T_6$= 0-0-0-0 | 0-0-0-0 | 40266 | 0 | - | - |

**Price :**

| | | | |
|---|---|---|---|
| Urea | - | 6 Tk /Kg | Rice grain- 6,700/ton |
| TSP | - | 14 Tk /Kg | Rice straw – 500/ton |
| MP | - | 10 Tk /Kg | Cowdung – 500/ton |
| Gypsum - | | 3 Tk /Kg | |

Table 46. Yield and yield contributing characters of Boro under Boro-T.aman cropping pattern at Laksam MLT site during 2000-2001

| Treatment (N-P-K-S kg/ha) | Plant height (cm) | Tiller/ hill | Panicle/ hill | Grain/ Panicle | Panicle length (cm) | 1000 grain wt(g) | Straw wt (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$=52-12-58-8 | 79.5 | 18.6 | 16.45 | 157.25 | 23.85 | 24.31 | 7.5 | 6.25b |
| $T_2$=74-13-62-13 | 77.65 | 19.7 | 17.05 | 162.00 | 23.54 | 24.66 | 8.06 | 6.45ab |
| $T_3$=62-9-24-12 | 76.54 | 20.5 | 16.75 | 161.85 | 24.89 | 24.21 | 8.13 | 6.50a |
| $T_4$=45-7-25-4 | 78.9 | 19.6 | 17.00 | 160.90 | 23.12 | 24.98 | 7.8 | 6.28ab |
| $T_5$=95-45-52 | 77.6 | 21.5 | 17.25 | 163.30 | 24.61 | 24.25 | 8.1 | 6.48ab |
| $T_6$=(Control) | 75.6 | 15.4 | 12.55 | 115.75 | 22.54 | 23.64 | 3.01 | 2.50c |
| CV(%) | 7.5 | 4.1 | 6.9 | 12.7 | 3.2 | 1.2 | 3.6 | 2.3 |

Table 47. Yield and yield contributing characters of T.aman under Boro-T.aman cropping pattern at Laksam MLT site during 2000-2001

| Treatment (N-P-K-S Kg/ha) | Plant height (cm) | Tiller/ hill | Panicle/ hill | Grain/ Panicle | Panicle length (cm) | 1000 grain wt(g) | Straw (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$=52-12-58-8 | 88.72 | 15.1 | 12.22 | 99.57 | 23.19 | 22.16 | 5.14 | 4.58bc |
| $T_2$=74-13-62-13 | 89.53 | 16.4 | 12.56 | 106.98 | 23.97 | 23.78 | 6.48 | 5.42ab |
| $T_3$=62-9-24-12 | 88.00 | 15.7 | 11.97 | 108.79 | 22.15 | 22.98 | 6.81 | 5.87a |
| $T_4$=45-7-25-4 | 89.43 | 16.1 | 13.15 | 112.50 | 24.57 | 23.47 | 6.97 | 5.17ab |
| $T_5$=95-45-52 | 89.93 | 17.8 | 14.89 | 104.26 | 24.26 | 23.98 | 5.9 | 4.93b |
| $T_6$=(Control) | 67.23 | 13.4 | 9.68 | 87.54 | 18.33 | 21.89 | 2.73 | 1.85c |
| CV (%) | 3.6 | 2.4 | 3.1 | 8.9 | 2.5 | 1.6 | 2.3 | 3.4 |

Table 48. Effect of different fertilizer management packages on the yield of rice in Boro-T.Aman rice cropping pattern at Shibpur, Narsingdi (Average of 1999-2000 & 2000-01

| Treatment | 2000 | | 2001 | | Mean | | Total |
|---|---|---|---|---|---|---|---|
| | Boro | T.Aman | Boro | T.Aman | Boro | T.Aman | |
| **Grain yield (t/ha)** | | | | | | | |
| $ED_1=T_1$ | 5.10 | 3.62 | 5.12 | 4.11 | 5.11 | 3.86 | 8.97 |
| $ED_2=T_2$ | 5.41 | 4.20 | 5.45 | 4.09 | 5.43 | 4.15 | 9.58 |
| $INM=T_3$ | 6.46 | 4.86 | 6.38 | 4.55 | 6.42 | 4.70 | 11.12 |
| FRG '97=$T_4$ | 5.56 | 3.70 | 5.23 | 4.23 | 5.39 | 3.96 | 9.35 |
| $FP=T_5$ | 5.25 | 3.51 | 4.53 | 3.61 | 4.89 | 3.61 | 8.50 |
| Control=$T_6$ | 2.85 | 2.63 | 2.70 | 1.93 | 2.77 | 2.28 | 5.05 |
| **Straw yield (t/ha)** | | | | | | | |
| $ED_1=T_1$ | 6.74 | 3.95 | 7.19 | 4.78 | 6.96 | 5.57 | 12.53 |
| $ED_2=T_2$ | 6.96 | 4.41 | 7.41 | 4.81 | 7.19 | 4.61 | 11.80 |
| $INM=T_3$ | 6.46 | 4.86 | 7.96 | 5.32 | 7.21 | 5.09 | 12.30 |
| FRG '97=$T_4$ | 8.02 | 5.21 | 7.44 | 4.76 | 7.73 | 4.98 | 12.71 |
| $FP=T_5$ | 6.69 | 3.83 | 6.98 | 4.64 | 6.84 | 4.24 | 11.08 |
| Control=$T_6$ | 4.08 | 2.96 | 3.51 | 2.81 | 3.89 | 2.89 | 6.78 |

Table 49. Effect of different fertilizer management practices on yield the parameters, plant height, filled in Boro–T.Aman cropping pattern at MLT sites, Shibpur, Narsinghdi during 2000-01

| Treatment | Plant height (cm) | Tiller/hill (no.) | Grain/panicle (no.) | Filled grain/ panicle (no.) | 1000 grain weight (gm) |
|---|---|---|---|---|---|
| **Boro** | | | | | |
| $ED_1$ | 86.70 | 13.08 | 141.90 | 129.80 | 20.37 |
| $ED_2$ | 85.52 | 12.43 | 143.00 | 132.72 | 20.62 |
| INM | 85.20 | 14.22 | 150.37 | 140.07 | 22.15 |
| FRG'97 | 84.40 | 12.63 | 141.07 | 130.42 | 21.47 |
| FP | 82.67 | 11.98 | 129.97 | 122.60 | 20.77 |
| Control | 78.77 | 11.60 | 118.50 | 88.07 | 18.40 |
| **T.Aman** | | | | | |
| $ED_1$ | 94.17 | 11.18 | 138.60 | 113.53 | 21.24 |
| $ED_2$ | 87.38 | 11.72 | 140.93 | 116.87 | 20.99 |
| INM | 86.15 | 12.20 | 154.23 | 133.45 | 21.63 |
| FRG'97 | 89.63 | 10.43 | 145.70 | 121.30 | 21.27 |
| FP | 85.12 | 10.33 | 141.30 | 119.15 | 19.39 |
| Control | 75.38 | 9.18 | 99.03 | 73.27 | 18.48 |

Table 50. Cost and return analysis of different fertilizer management practices in Boro-T.Aman cropping pattern at MLT sites, Shibpur, Narshingdi 2000-01

| Treatment | Gross return (Tk/ha) | *Variable cost (Tk/ha) | Gross margin (Tk/ha) | MBCR over control |
|---|---|---|---|---|
| **Year-2** | | | | |
| $ED_1$ | 80690 | 5626 | 75064 | 6.11 |
| $ED_2$ | 83090 | 7707 | 75383 | 4.51 |
| INM | 94380 | 9592 | 84788 | 4.60 |
| FRG'97 | 82650 | 5702 | 76948 | 6.36 |
| FP | 72210 | 7173 | 65037 | 3.39 |
| Control | 40660 | 0 | 40660 | - |
| **Year-1** | | | | |
| $ED_1$ | 65152 | 5626 | 59526 | 3.27 |
| $ED_2$ | 70956 | 7707 | 63249 | 2.87 |
| INM | 83364 | 9592 | 73772 | 3.40 |
| FRG'97 | 68116 | 5702 | 62414 | 3.73 |
| FP | 64486 | 7173 | 57313 | 2.25 |
| Control | 41142 | 0 | 41142 | - |
| **Mean (1999-2000 and 2000-01)** | | | | |
| $ED_1$ | 72921 | 5626 | 67295 | 4.69 |
| $ED_2$ | 77023 | 7707 | 69316 | 3.69 |
| INM | 88872 | 9592 | 79280 | 4.00 |
| FRG'97 | 75383 | 5702 | 69681 | 5.05 |
| FP | 68348 | 7173 | 61175 | 2.83 |
| Control | 40901 | 0 | 40901 | - |

*Only fertilization cost included.

In year 2: Price of paddy: Price of elemental form of Nutrient:

| | | |
|---|---|---|
| Boro | = Tk. 7.00/kg | N= Tk. 13.00/kg |
| T.Aman | = Tk. 8.00/kg | P= Tk. 75.00/kg |
| Straw | = Tk. 1.00/kg | K= Tk. 18.00/kg |
| Labour rate | = Tk. 70.00 (standby) | S= Tk. 28.00/kg |

In year 1: Price of paddy

| | |
|---|---|
| Boro | = Tk. 6/kg |
| T.Aman | = Tk. 7/kg |
| Straw | = Tk. 0.80/kg |

Table 51. Effect of different fertilizer management packages on the soil nutrient balance in Boro-T.Aman rice cropping pattern at Shibpur, Narshinghdi (Average of 2000-01)

| Treat ment | Nutrient uptake (kg/ha) | | | | Nutrient added (Inorganic + others) (kg/ha) | | | | Apparent nutrient balance (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S | N | P | K | S |
| $T_1$ | 161.46 | 26.91 | 179.4 | 16.44 | 140 | 30 | 65 | 5 | -21.46 | 30.09 | -149.40 | -11.44 |
| $T_2$ | 172.44 | 29.55 | 191.6 | 17.56 | 194 | 42 | 87 | 8 | 21.56 | 12.45 | -104.66 | -9.56 |
| $T_3$ | 200.16 | 33.36 | 222.4 | 20.38 | 184 | 37 | 77 | 8 | -16.16 | 3.64 | -145.40 | -12.38 |
| $T_4$ | 168.30 | 28.85 | 187.0 | 17.13 | 160 | 23 | 70 | 14 | -8.30 | -5.85 | -117.00 | -3.13 |
| $T_5$ | 153.00 | 25.50 | 170.0 | 15.58 | 180 | 46 | 80 | 6 | 27.00 | 20.50 | -90.00 | -9.58 |
| $T_6$ | 90.90 | 15.15 | 101.0 | 9.25 | 0 | 0 | 0 | 0 | - | - | - | - |

Table 52. Effect of different nutrient management practices on the yield parameters, plant height, filled grain and 1000 grain weight in Boro-T.Aman cropping pattern at FSRD site, Ishan Gopalpur, Faridpur during 2000-200

| Treatments | Plant height (cm) | Panicle/m$^2$ (No.) | Filled grain/ panicle (no.) | 1000 grain wt. (g) |
|---|---|---|---|---|
| | | **Boro** | | |
| $ED_1$ | 85.2 b | 328.0 a | 108.2 d | 23.85 ab |
| $ED_2$ | 88.2 a | 326.2 b | 112.3 c | 23.90 a |
| INM | 88.5 a | 328.5 a | 118.3 a | 23.85 ab |
| FRG`97 | 88.0 a | 323.5 ab | 116.2 b | 23.77 bc |
| FP | 89.0 a | 327.5 a | 115.2 b | 23.67 cd |
| Control | 81.2 c | 251.8 c | 101.2 e | 23.57 d |
| Level of significance | ** | ** | ** | ** |
| CV (%) | 1.4 | 1.4 | 1.1 | 0.04 |
| | | **T.Aman** | | |
| $ED_1$ | 100.8 a | 238.3 c | 86.0 c | 22.78 c |
| $ED_2$ | 102.5 a | 242.0 b | 90.7 ab | 22.78 c |
| INM | 101.0 a | 245.3 a | 92.5 a | 22.98 a |
| FRG`97 | 102.3 a | 239.2 c | 89.2 b | 22.75 c |
| FP | 103.2 a | 239.5 c | 85.0 c | 22.88 b |
| Control | 90.0 a | 206.5 d | 80.3 d | 22.77 c |
| Level of significance | ** | ** | ** | ** |
| CV (%) | 2.4 | 0.09 | 2.2 | 0.3 |

** Significant at 1% level
Means followed by common letters are statistically similar

Table 53. Effect of different fertilizer doses on the economics of Boro rice, 1998-2001

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Average | |
|---|---|---|---|---|---|---|---|---|
| | TVC (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) |
| $ED_1$ | 26470 | 34440 | 25470 | 15450 | 28563 | 15437 | 26834 | 21776 |
| $ED_2$ | 27900 | 29290 | 26900 | 20300 | 30011 | 13958 | 28270 | 21183 |
| INM | 27560 | 26920 | 25560 | 16920 | 32294 | 13118 | 28471 | 18986 |
| FRG'97 | 26470 | 34250 | 26470 | 18250 | 29060 | 15896 | 27333 | 22799 |
| FP | 25670 | 22220 | 24670 | 13220 | 25829 | 14121 | 25390 | 16520 |
| Control | 22910 | 10910 | 20910 | 7910 | 19302 | 1180 | 21041 | 6667 |

Table 54. Effect of different fertilizer doses on the yield of T. aman rice, 1998-2001

| Treatment level N P K S Zn | Grain (t/ha) | | | | Straw (t/ha) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1998-1999 | 1999-2000 | 2000-2001 | Avg | 1998-1999 | 1999-2000 | 2000-2001 | Avg |
| $T_1$ 90 20 50 0 0 | 3.83a | 3.08b | 3.13ab | 3.35 | 5.97a | 4.32b | 4.45ab | 4.91 |
| $T_2$ 130 30 70 0 0 | 3.99ab | 3.80a | 3.62ab | 3.80 | 5.93a | 5.02a | 4.63ab | 5.19 |
| $T_3$ 123 25 57 0 0 | 4.19a | 3.72a | 3.78a | 3.90 | 6.45a | 4.50ab | 4.70a | 5.22 |
| $T_4$ 100 20 35 12 1 | 3.85b | 3.30c | 3.53ab | 3.56 | 5.95a | 4.38b | 4.30bc | 4.88 |
| $T_5$ 110 10 20 0 0 | 3.16c | 2.95b | 2.93b | 3.01 | 5.03b | 4.08b | 4.03c | 4.38 |
| $T_6$ 0 0 0 0 0 | 2.12d | 2.50c | 2.45c | 2.36 | 3.47c | 3.42c | 3.52d | 3.47 |

Table 55. Effect of different fertilizer doses on the economics of T.aman rice, 1998-2001

| Treatment | 1998-1999 | | 1999-2000 | | 2000-2001 | | Average | |
|---|---|---|---|---|---|---|---|---|
| | TVC (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) | TVC (Tk/ha) | Gross margin (Tk/ha) |
| $ED_1$ | 17970 | 10910 | 14040 | 14020 | 19505 | 6878 | 17172 | 10603 |
| $ED_2$ | 18030 | 11850 | 15050 | 19070 | 20523 | 9427 | 17868 | 13449 |
| INM | 17970 | 13530 | 15060 | 16310 | 20526 | 10657 | 17852 | 13499 |
| FRG'97 | 19200 | 9764 | 13440 | 16240 | 18908 | 10125 | 17183 | 12043 |
| FP | 17700 | 6110 | 13300 | 13480 | 18767 | 5799 | 16589 | 8463 |
| Control | 16000 | 34.50 | 11320 | 11310 | 16737 | 5059 | 14686 | 5468 |

Market price of different inputs and outputs:
Grain boro@Tk.6.25/kg.T.aman@Tk.7/kg, boro Straw2Tk.1/kg,T.aman straw@Tk.1.5/kg
Urea@Tk.6/kg,TSP@Tk.14/kg, MP@Tk.10/kg,Gypsump@TK.5/kg,Zinc Sulphate@Tk.55/Kg

Table 56. The average soil testing values for the selected experimental plots

| Crop | pH | O.M. (%) | N (%) | P (ppm) | K (meq/ 100g soil) | S (ppm) | Zn (ppm) |
|---|---|---|---|---|---|---|---|
| | 5.33 | 2.08 | 0.10 | 5.0 | 0.12 | 51.0 | 2.42 |
| Boro | - | - | Low | V. low | Low | V. high | V. high |
| T. aman | - | - | Low | V. low | Low | V. high | V. high |

Table 57. Nutrient uptake, addition and balance through different fertilizer management in Boro rice –T.aman rice cropping pattern 1998- 2000 at FSRD site, Palima,Tangail

| Treatment /Nutrient | Total uptake (kg/ha) | Added(kg/ha) | | | Partialnet balance (kg/ha) |
|---|---|---|---|---|---|
| | | inorganic | organic | Total | |
| $T_1$ N | 176.04 | 152.0 | 0 | 152.0 | -122.84 |
| P | 29.34 | 30.05 | 0 | 30.05 | + 0.71 |
| K | 195.6 | 82.0 | 0 | 82.0 | -113.6 |
| S | 17.79 | 0 | 0 | 0 | -17.79 |
| Zn | | 0 | 0 | 0 | |
| $T_2$ N | 184.32 | 217.0 | 0 | 217.0 | -108.37 |
| P | 30.72 | 50.0 | 0 | 50.0 | +19.28 |
| K | 204.8 | 115.0 | 0 | 115.0 | -89.8 |
| S | 18.73 | 0 | 0 | 0 | -18.73 |
| Zn | | 0 | 0 | 0 | |
| $T_3$ N | 183.96 | 206.0 | 30.0 | 236.0 | -101.36 |
| P | 30.66 | 42.0 | 10.0 | 52.0 | +21.34 |
| K | 204.4 | 93.0 | 30.0 | 123.0 | -81.4 |
| S | 18.7 | 0 | 0 | 0 | -18.7 |
| Zn | | 0 | 0 | 0 | |
| $T_4$N | 182.7 | 170.0 | 0 | 170.0 | -123.2 |
| P | 30.45 | 28.0 | 0 | 28.0 | -2.45 |
| K | 203.0 | 60.0 | 0 | 60.0 | -143.0 |
| S | 18.57 | 16.0 | 0 | 16.0 | -2.57 |
| Zn | | 1.0 | 0 | 1.0 | +1.00 |

Table 57. Contd.

| Treatment /Nutrient | Total uptake (kg/ha) | Added(kg/ha) | | | Partialnet balance (kg/ha) |
|---|---|---|---|---|---|
| | | inorganic | organic | Total | |
| $T_5$ N | 165.42 | 155.0 | 0 | 155.0 | -111.17 |
| P | 27.57 | 22.0 | 0 | 22.0 | -5.57 |
| K | 183.8 | 40.0 | 0 | 40.0 | -143.8 |
| S | 16.82 | 0 | 0 | 0 | -16.82 |
| Zn | | 0 | 0 | 0 | |
| $T_6$ N | 108.18 | 0 | 0 | 0 | -108.18 |
| P | 18.03 | 0 | 0 | 0 | -18.03 |
| K | 120.2 | 0 | 0 | 0 | -120.2 |
| S | 11.0 | 0 | 0 | 0 | -11.0 |
| Zn | | 0 | 0 | 0 | |

*The recovery of added nitrogen is considered 35%

Table 58. Effect of different nutrient management packages on yield parameters of crops grown in Boro – T. Aman cropping pattern at Kalaroa MLT site during 2000-2001

| Treatment | Plant height (cm) | Tiller/hill (no.) | Panicle length (cm) | Filled grain /panicle (no.) | 1000 grain wt. (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|---|
| | | | | **Boro** | | | |
| $ED_1$ | 102 c | 13.55 b | 21.92 b | 92 | 23.00 | 5.16 a | 4.75 b |
| $ED_2$ | 105 bc | 17.98 a | 25.52 a | 96 | 22.87 | 5.95 a | 5.81 a |
| IPNS | 112 a | 13.77 b | 26.52 a | 93 | 22.87 | 5.72 a | 5.69 a |
| RF | 103 bc | 17.80a | 27.17 a | 90 | 23.12 | 5.15 a | 4.81 b |
| FP | 105 b | 16.98 a | 26.52 a | 101 | 23.00 | 5.70 a | 5.10 b |
| Control | 86 d | 10.23 c | 19.92 c | 77 | 21.50 | 3.85 b | 3.37 c |
| CV (%) | 2.01 | 10.29 | 5.30 | 11.82 | 4.98 | 13.22 | 9.22 |
| | | | | **T.Aman** | | | |
| $ED_1$ | 117 bc | 11.95 c | 24.25 b | 96 bc | 22.75 b | 4.40 a | 4.95 a |
| $ED_2$ | 122 ab | 13.02 bc | 24.52 b | 106 a | 24.75 ab | 4.77 a | 5.15 a |
| IPNS | 128 a | 14.60 b | 28.52 a | 94 bc | 26.00 a | 4.45 a | 4.82 a |
| RF | 120 ab | 13.23 bc | 25.90 b | 98 b | 23.50 b | 4.40a | 4.90 a |
| FP | 127 a | 16.50 a | 29.02 a | 107 a | 22.75 b | 4.37 a | 4.70 a |
| Control | 109 c | 10.05 d | 19.70 c | 89 c | 23.00 b | 2.95 b | 3.65 b |
| CV (%) | 5.01 | 7.97 | 4.92 | 5.39 | 5.92 | 7.14 | 6.92 |

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

Table 59**.** Effect of different nutrient management packages on yield parameters of crops grown in Boro – T. Aman cropping pattern at Bagerhat MLT site during 2000-2001

| Treatment | Plant height (cm) | Tiller/hill (no.) | Filled grain /panicle (no.) | 1000 grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| | | | **Boro** | | | |
| $ED_1$ | 80.82 ab | 19.86 abc | 95.85 b | 17.99 c | 3.12 bc | 4.37 ab |
| $ED_2$ | 79.27 bc | 19.89 abc | 97.00 b | 18.46 bc | 3.25 bc | 4.78 ab |
| IPNS | 82.26 a | 21.83 a | 108.3 a | 21.90 a | 4.06 a | 5.25 a |
| RF | 79.92 bc | 21.24 ab | 98.40 b | 17.69 c | 2.95 bc | 4.18 ab |
| FP | 79.13 bc | 19.28 ac | 98.40 b | 19.43 b | 3.47 ab | 4.76 ab |
| Control | 78.73 c | 18.59 c | 91.05 c | 17.27 c | 2.71 c | 3.77 b |
| CV (%) | 1.05 | 5.40 | 1.40 | 3.34 | 9.33 | 12.53 |
| | | | **T. Aman** | | | |
| $ED_1$ | 148 bc | 15.60 c | 137 bc | 24.75 ab | 5.20 bc | 6.05 bc |
| $ED_2$ | 153 ab | 15.97 bc | 142 ab | 25.75 a | 5.42 b | 6.22 ab |
| IPNS | 158 b | 18.70 b | 143 a | 24.50 ab | 5.75 a | 6.52 a |
| RF | 143 c | 16.40 b | 136 c | 23.75 bc | 4.75 d | 5.77 c |
| FP | 143 c | 15.55 c | 145 a | 22.75 c | 5.07 a | 5.90 bc |
| Control | 135 d | 12.40 d | 124 d | 23.00 c | 3.72 c | 5.15 d |
| CV (%) | 3.09 | 2.87 | 2.15 | 3.64 | 3.27 | 3.79 |

Table 60. Yield and yield contributing characters of Potato as affected by fertilizer levels in the cropping pattern Potato-Jute-T.aman at FSRD site Narikeli, Jamalpur during 2001-2002

| Treat | Plant ht. (cm) | Leaves/ plant (no) | Tuber/ plant (no) | Tuber/m$^2$ (no.) | Wt. of tuber/ plant (g) | Tuber yield (t/ha) | Average tuber wt. (g) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 49.57 a | 46.50 a | 7.35 a | 62.67 | 419 a | 31 a | 50.29 |
| $T_2$ | 51.83 a | 44.17 ab | 6.80 ab | 59.17 | 391 a | 29 a | 50.79 |
| $T_3$ | 51.70 a | 45.83 a | 6.97 a | 62.00 | 729 a | 32 a | 52.36 |
| $T_4$ | 50.93 a | 46.00 a | 5.70 b | 53.83 | 378 a | 28 a | 54.51 |
| $T_5$ | 54.77 a | 46.67 a | 7.37 a | 60.50 | 391 a | 30 a | 51.01 |
| $T_6$ | 38.73 b | 39.67 b | 6.30 ab | 51.17 | 299 b | 20 b | 47.17 |
| CV(%) | 12.17 | 7.22 | 13.89 | 13.00 | 15.46 | 13.67 | 14.80 |
| F | ** | ** | * | NS | * | * | NS |

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

Table 61. Effect of different nutrient packages on the yield and yield contributing characters of Groundnut in the Groundnut -T.aman cropping pattern at MLT site Lakshmipur during rabi season of 2000-01

| Treatment | Plant height (cm) | Branch /plant (no.) | Pod/plant (no.) | 100 kernel weight. (gm) | Nut yield (Kg/ha) | Stover yield (Kg/ha) |
|---|---|---|---|---|---|---|
| $ED_1$ | 48.16c | 5.66 | 24.5b | 49.0 | 2452c | 2698bc |
| $ED_2$ | 52.33b | 5.83 | 25.5a | 50.5 | 2580b | 3157ab |
| INM | 56.5a | 6.0 | 25.66a | 47.33 | 2842a | 3253a |
| FRG'97 | 47.5c | 5.66 | 22.16c | 44.83 | 2190d | 2913abc |
| FP | 45.5d | 5.16 | 20.83d | 42.50 | 1723e | 2587c |
| Control | 31.33e | 5.0 | 16.83e | 38.16 | 1143f | 1488d |
| CV (%) | 13.09 | 9.82 | 19.88 | 1.77 | 4.11 | 15.09 |

Table 62. Effect of different nutrient packages on the yield and yield attributes of T.aman in Groundnut-T.aman cropping pattern at MLT site Lakshmipur During kharif- II season of 2001.

| Treatment | Plant height (cm) | No. of effective tiller/hill | Grain/ panicle | 1000 seed weight | Grain yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| $ED_1$ | 119.16 ab | 9.41 ab | 114.5 b | 21.90 ab | 4.25 b | 5.62 a |
| $ED_2$ | 121.2 ab | 9.75 ab | 120.2 a | 21.75 abc | 4.50 ab | 6.05 a |
| INM | 122.1 a | 9.90 a | 118.7 ab | 22.00 a | 4.85 a | 5.83 a |
| FRG'97 | 118.75 ab | 8.95 ab | 115.8 ab | 21.65 bc | 4.30 b | 5.05 b |
| FP | 118.00 b | 8.87 b | 115.3 ab | 21.8 abc | 3.75 c | 4.72 b |
| Control | 113.8 ab | 7.20 c | 107.2 c | 21.5 c | 3.10 b | 3.85 c |
| CV (%) | 15.30 | 9.33 | 3.65 | 1.29 | 7.11 | 7.11 |
| LSD(0.05) | 21.08 | 1.037 | 5.004 | 0.332 | 0.086 | 0.438 |

Table 63. A nutrient balance sheet for Groundnut –T.aman cropping pattern in respect of treatments for fertilizer developments

[

| Treatment | Yield (t/ha) | | Nutrien uptake[1] (Kg/ha) | | | | Nutrient added (Kg/ha) | | | | Nutrient recovered[3] (Kg/ha) | | Balance (+/-) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Inorganic | | | | | | |
| | G.nut | T.aman | | G.nut | T. aman | Total | G.nut | T.aman | Total | Org[2] | Inorg. | Org. | |
| ED1 | 2.45 | 4.25 | N | 208 | 77 | 285 | 20 | 60 | 80 | - | 28 | | -257 |
| | | | P | 16 | 13 | 29 | 30 | 12 | 42 | - | 8 | | -21 |
| | | | K | 111 | 85 | 196 | 10 | 14 | 24 | - | 12 | | -184 |
| ED2 | 2.58 | 4.50 | N | 219 | 81 | 300 | 30 | 80 | 110 | - | 36 | | -264 |
| | | | P | 17 | 14 | 31 | 40 | 15 | 55 | - | 11 | | -20 |
| | | | K | 117 | 90 | 207 | 15 | 23 | 38 | - | 19 | | -207 |
| INM | 2.84 | 4.85 | N | 241 | 87 | 328 | 18 | 80 | 98 | 50 | 34 | 5 | -289 |
| | | | P | 18 | 15 | 33 | 35 | 15 | 50 | 30 | 10 | 3 | -20 |
| | | | K | 129 | 97 | 226 | 10 | 16 | 26 | 60 | 13 | 6 | -201 |
| FRG'97 | 2.19 | 4.30 | N | 186 | 77 | 263 | 20 | 65 | 85 | - | 30 | | -233 |
| | | | P | 14 | 13 | 27 | 20 | 7 | 27 | - | 5 | | -22 |
| | | | K | 100 | 86 | 180 | 25 | 25 | 50 | - | 25 | | -155 |
| FP | 1.72 | 3.75 | N | 146 | 68 | 214 | 6 | 36 | 42 | - | 15 | | -199 |
| | | | P | 11 | 11 | 22 | 24 | 7 | 31 | - | 6 | | -16 |
| | | | K | 78 | 75 | 75 | - | - | - | - | - | | -153 |
| Control | 1.14 | 3.10 | N | 97 | 56 | 153 | - | - | - | - | - | | -153 |
| | | | P | 7 | 9 | 16 | - | - | - | - | - | | -16 |
| | | | K | 52 | 62 | 114 | - | - | - | - | - | | -114 |

[1] Follwing Fertilizer Recommendation Guide'97 (BARC'97)
[2] Considering 1%N, 0.6%P and 1.2%K present in cowdung.
[3] Considering recovery of different nutrients (N-35%, P-20%, K-50%)from inorganic fertilizers and all at 10% from animal manures.

Table 64. Effect of different nutrient management packages on the yield and yield attributes of crops grown in Wheat - T.aman rice cropping pattern at FSRD site, Chabbishnagar, Rajshahi during 1998-1999.

| Treatment | Plant height (cm) | Spike or Panicle $m^{-2}$ (No.) | Filled grain $panicle^{-1}$ or $spike^{-1}$ (No.) | 1000-grain weight (g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|
| | | | **Wheat** | | | |
| ED1 | 75ab | 203ab | 32ab | 42.90ab | 1.91ab | 2.20a |
| ED2 | 73b | 213b | 32ab | 41.12bc | 2.33a | 2.33a |
| INM | 76a | 192a | 37a | 44.70a | 2.33a | 2.21a |
| FRG' 97 | 75ab | 174ab | 30b | 41.8abc | 1.45bc | 1.62b |
| FP | 67c | 132c | 30b | 42.18ab | 1.09c | 1.23b |
| Control | 48d | 96d | 22c | 38.98c | 0.49d | 0.53c |
| CV (%) | 8.68 | 20.83 | 17.56 | 6.18 | 28.08 | 25.11 |
| LSD (0.05) | | | | | | |
| | | | **T.aman rice** | | | |
| ED1 | 107.58 | 286 | 74 | 12.63 | 3.83 | 5.50 |
| ED2 | 111.90 | 287 | 75 | 22.79 | 4.41 | 5.74 |
| INM | 110.60 | 291 | 75 | 21.85 | 4.39 | 5.72 |
| FRG' 97 | 107.90 | 281 | 72 | 21.59 | 4.30 | 5.60 |
| FP | 101.78 | 287 | 56 | 20.92 | 2.81 | 4.74 |
| Control | 95.54 | 198 | 53 | 20.70 | 2.08 | 3.76 |
| CV (%) | 5.32 | 1216 | 12.16 | 2.11 | 13.46 | 16.89 |
| LSD (0.05) | 20.88 | 1205 | 12.05 | 0.66 | 0.72 | 1.15 |

Table 65. Effect of different nutrient management packages on the yield and yield attributes of crops grown in Wheat - T.aman rice cropping pattern at FSRD site, Chabbishnagar, Rajshahi during 1999-2000.

| Treatment | Plant height (cm) | Spike or Panicle $m^{-2}$ (No.) | Filled grain panicle$^{-1}$ or spike$^{-1}$ (No.) | 1000-grain weight (g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **Wheat** | | | | | | |
| $ED_1$ | 80.54 | 281 | 27 | 40.80 | 2.93 | 3.23 |
| $ED_2$ | 83.66 | 306 | 28 | 41.38 | 3.10 | 2.95 |
| INM | 92.80 | 288 | 29 | 45.48 | 3.22 | 3.91 |
| FRG' 97 | 85.18 | 261 | 28 | 41.02 | 2.79 | 3.19 |
| FP | 86.00 | 260 | 23 | 38.10 | 2.09 | 2.83 |
| Control | 42.22 | 196 | 11 | 37.6 | 0.79 | 1.13 |
| CV (%) | 11.78 | 17.24 | 16.06 | 3.58 | 13.61 | 14.77 |
| LSD (0.05) | 11.14 | 56.11 | 5.44 | 1.80 | 0.40 | 0.50 |
| **T.aman rice** | | | | | | |
| $ED_1$ | 97.64bc | 246 | 83 | 25.56b | 3.84cd | 5.54abc |
| $ED_2$ | 102.16ab | 260 | 82 | 25.59a | 4.38ab | 5.94ab |
| INM | 105.88a | 246 | 83 | 25.63a | 4.73a | 6.17a |
| FRG' 97 | 96.92bc | 245 | 91 | 24.56b | 4.15bc | 4.50c |
| FP | 97.96bc | 255 | 75 | 24.39b | 3.67d | 4.27bc |
| Control | 91.84c | 226 | 82 | 23.49c | 1.88e | 3.68b |
| CV (%) | 5.15 | 1276 | 18.84 | 1.74 | 7.17 | 12.10 |
| LSD (0.05) | 6.67 | NS | NS | 0.5674 | 0.3564 | 0.7905 |

Table 66. Effect of different nutrient management packages on the yield and yield attributes of crops grown in Wheat - T.aman rice cropping pattern at FSRD site, Chabbishnagar, Rajshahi during 2000-2001

| Treatment | Plant height (cm) | Spike or Panicle $m^{-2}$ (No.) | Filled grain panicle$^{-1}$ or spike$^{-1}$ (No.) | 1000-grain weight (g) | Grain yield (t $ha^{-1}$) | Straw yield (t $ha^{-1}$) |
|---|---|---|---|---|---|---|
| **Wheat** | | | | | | |
| $ED_1$ | 81.17 | 257 | 40 | 28.07 | 2.39 | 3.98 |
| $ED_2$ | 82.63 | 284 | 37 | 28.30 | 2.79 | 3.17 |
| INM | 84.17 | 289 | 38 | 30.33 | 2.80 | 3.05 |
| FRG' 97 | 76.00 | 243 | 37 | 29.90 | 2.27 | 3.39 |
| FP | 75.40 | 232 | 36 | 29.83 | 2.34 | 3.54 |
| Control | 65.07 | 176 | 35 | 29.73 | 1.38 | 1.52 |
| CV (%) | 0.98 | 8.77 | 9.56 | 7.11 | 6.23 | 8.66 |
| LSD (0.05) | 9.83 | 15.4 | 6.17 | 3.79 | 0.26 | 0.54 |
| **T.aman rice** | | | | | | |
| $ED_1$ | 103.00 | 203 | 91 | 25.06 | 3.49 | 5.63 |
| $ED_2$ | 104.86 | 224 | 107 | 26.40 | 4.22 | 5.85 |
| INM | 108.36 | 241 | 109 | 26.33 | 4.44 | 5.82 |
| FRG' 97 | 102.26 | 210 | 86 | 25.00 | 3.66 | 5.05 |
| FP | 102.30 | 221 | 94 | 25.16 | 5.83 | 5.35 |
| Control | 95.76 | 199 | 88 | 24.53 | 2.77 | 4.05 |
| CV (%) | 3.18 | 6.97 | 11.21 | 2.15 | 11.48 | 7.88 |
| LSD (0.05) | 5.95 | 27.37 | 19.50 | 0.99 | 1.96 | 0.75 |

Table 67. Nutrient uptake, addition and balance through different fertilizer management packages in Wheat-T.aman cropping pattern during 1998-1999 to 2000-2001

| Treat | Nutrient uptake (kgha$^{-1}$) | | | | Nutrient addition (inorg.+org.) (kgha$^{-1}$) | | | | Apparent nutrient balance (kaha$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N | P | K | S | N | P | K | S |
| $ED_1$ | 137 | 27 | 132 | 17 | 185 | 40 | 41 | 17 | -72 | +13 | -91 | 0 |
| $ED_2$ | 159 | 31 | 154 | 20 | 255 | 54 | 56 | 25 | -69 | 23 | -98 | 5 |
| INM | 163 | 32 | 154 | 20 | 275 | 58 | 76 | 25 | -50 | 26 | -78 | 5 |
| FRG' 97 | 137 | 27 | 134 | 16 | 165 | 37 | 100 | 25 | -79 | 10 | -34 | 9 |
| FP | 116 | 22 | 114 | 14 | 124 | 38 | 31 | 16 | -72 | 16 | -83 | 2 |
| Control | 66 | 13 | 67 | 8 | 0 | 0 | 0 | 0 | -66 | -13 | -67 | -8 |

*The recovery of added nitrogen is considered 35%

Table 68. Effect of different nutrient management packages on the yield of crops grown in Onion-T.aus-T.aman cropping pattern at Kushtia sadar during 2000-2001.

| Treatment | Onion | | | T.aus | | | T.aman | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bulb yield (t/ha) | | | Grain yield (t/ha) | | Straw yield (t/ha) | Grain yield (t/ha) | | Straw yield (t/ha) |
| | 1999-00 | 2000-01 | 2001-2002 | 2000 | 2001 | 2001 | 2000 | 2001 | 2001 |
| $ED_1$ | 8.87b | 9.26 | 10.36bc | 3.16a | 3.75a | 3.96 | 4.45a | 3.69bc | 4.50 |
| $ED_2$ | 11.16a | 10.97 | 11.59ab | 3.43a | 3.90a | 4.12 | 4.60a | 4.28a | 4.58 |
| INM | 11.12a | 12.99 | 13.52a | 3.55a | 4.00a | 4.42 | 4.80a | 4.58a | 4.88 |
| FRG' 97 | 9.52ab | 11.48 | 11.21bc | 3.20ab | 3.98a | 4.42 | 4.55a | 4.24ab | 4.49 |
| FP | 9.87ab | 10.87 | 11.61ab | 3.25ab | 3.91a | 4.10 | 4.66a | 4.17ab | 4.91 |
| **Control** | 8.03b | 8.42 | 9.31c | 2.60b | 3.22b | 3.75 | 3.10b | 3.06c | 3.86 |
| CV% | 12.5 | 5.3 | 14.6 | 10.8 | 9.8 | 8.6 | 15.9 | 13.5 | 10.5 |
| F-Test | ** | ** | ** | ** | * | * | ** | ** | * |

Table 79. Yield attributes of onion in Onion-T.aus-T.aman cropping pattern as influenced by different nutrient management package at Kushtia sadar during 2000-2001

| Treatments | Plant height (cm) | No. of bulb /kg | |
|---|---|---|---|
| | | 2000-2001 | 2001-2002 |
| $ED_1$ | 32.42 | 78 | 69.7 |
| $ED_2$ | 33.56 | 73 | 68.7 |
| INM | 35.00 | 60 | 60.0 |
| FRG'97 | 34.43 | 70 | 62.5 |
| FP | 33.12 | 75 | 65.3 |
| Control | 31.26 | 81 | 71.1 |
| CV(%) | 8.7 | 7.2 | 9.5 |
| F-Test | ns | * | * |

Table 70. Yield attributes of T.aus in Onion-T.aus-T.aman cropping pattern as influenced by different nutrient management package at Kushtia sadar during 2001

| Treatments | Plant height (cm) | Penicle/$m^2$ (No.) | Grain/Panicle (No.) | 1000 Seed wt. (g) |
|---|---|---|---|---|
| $ED_1$ | 73.33 | 413.3 | 76.50 | 21.50 |
| $ED_2$ | 75.50 | 410.6 | 83.17 | 21.98 |
| INM | 76.17 | 431.8 | 87.00 | 23.14 |
| FRG'97 | 78.50 | 447.1 | 82.52 | 22.21 |
| FP | 79.67 | 422.5 | 85.33 | 22.15 |
| Control | 70.50 | 395.3 | 71.17 | 20.80 |
| CV(%) | 4.7 | 11.7 | 10.3 | 2.4 |
| F-Test | ns | ns | * | ns |

Table 71. Yield attributes of T.aman in Onion-T.aus-T.aman cropping pattern as influenced by different nutrient management package at Kushtia sadar during 2001-2002

| Treatments | Plant height (cm) | Penicle/$m^2$ (No.) | Grain/Panicle (No.) | 1000 Seed wt. (g) |
|---|---|---|---|---|
| $ED_1$ | 84.33 | 407.83 | 82.50 | 21.35 |
| $ED_2$ | 88.83 | 427.83 | 86.50 | 23.15 |
| INM | 89.67 | 458.00 | 91.83 | 23.24 |
| FRG'97 | 91.67 | 447.17 | 94.00 | 22.98 |
| FP | 90.67 | 448.33 | 89.67 | 22.74 |
| Control | 80.00 | 384.83 | 82.50 | 20.13 |
| CV(%) | 5.4 | 14.8 | 10.4 | 1.3 |
| F-Test | ns | ns | * | ns |

Table 72. Yield and yield contributing characters of Potato under Potato-T.aus-T.aman cropping pattern at Chandina MLT site during rabi, 2000-2001

| Fertilizer N-P-K-S-Zn(kg/ha) | Shoot/plant | No. of Tuber/ Plant | Wt. of Tuber/plant(g) | Haulm wt (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$=79-32-83-8-3.4 | 1.8 | 5.5 | 252 | 3.65 | 15.46c |
| $T_2$=111-44-119-11-5 | 2.3 | 6.1 | 305 | 4.54 | 18.23ab |
| $T_3$=77-12-83-11-5 +CD ( 5t/ha) | 2.0 | 6.2 | 288 | 3.456 | 15.92bc |
| $T_4$=95-42-67-6-3.4 | 2.0 | 6.2 | 288 | 3.456 | 15.92bc |
| $T_5$=101-167-135 | 2.3 | 8.0 | 446 | 9.71 | 20.88a |
| $T_6$=Control | 1.6 | 3.7 | 100 | 0.6 | 6.23d |
| CV(%) | 1.2 | 3.6 | 12.7 | 8.7 | 9.6 |

Table 73. Yield and yield contributing characters of T. aus under Potato-T. aus- T.aman cropping pattern at Chandina MLT site during Kharif I, 2001

| Treatment (N-P-K-S) | Plant height (cm) | Tiller no./hill | Grain/ Panicle | Length of Panicle (cm) | Panicle/m$^2$ | 1000 grain wt(g) | Straw wt(t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|
| $T_1$=51-10-55-8 | 106.32 | 11.04 | 121.5 | 23.98 | 259.60 | 22.35 | 6.1 | 4.80bc |
| $T_2$=72-12-60-12 | 105.76 | 11.76 | 128.9 | 23.86 | 276.40 | 22.65 | 6.25 | 5.00ab |
| $T_3$=44-10-40-12 | 106.92 | 12.00 | 129.4 | 24.82 | 287.00 | 22.54 | 6.6 | 5.10a |
| $T_4$=64-14-40-8 | 104.12 | 10.80 | 122.5 | 24.44 | 267.00 | 22.31 | 6.21 | 4.93b |
| $T_5$=90-59-100 | 110.84 | 12.20 | 131.5 | 27.72 | 300.80 | 22.65 | 6.36 | 5.09ab |
| $T_6$=Control | 92.96 | 9.28 | 104.6 | 20.54 | 216.20 | 22.21 | 3.94 | 3.52d |
| CV(%) | 9.6 | 5.1 | 8.7 | 2.3 | 9.1 | 1.2 | 5.6 | 6.4 |

Table 74. Yield and yield contributing characters of T.aman under Potato-T. aus –T.aman cropping pattern at Chandina MLT site during Kharif II, 2001

| Treatment (N-P-K-S) | Plant height (cm) | Tiller/ hill | Panicle/ hill | Grain/ Panicle | Length of Panicle (cm) | Panicle/ m$^2$ | 1000 grain wt(g) | Straw wt (t/ha) | Yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| $T_1$=51-10-55-8 | 83.26 | 11.24 | 10.4 | 125.7 | 20.36 | 237.20 | 22.34 | 4.3 | 3.43bc |
| $T_2$=72-12-60-12 | 86.14 | 12.04 | 11.6 | 1281 | 20.56 | 257.40 | 22.65 | 4.8 | 3.83b |
| $T_3$=44-10-40-12 | 82.45 | 13.46 | 11.9 | 135.6 | 20.68 | 233.80 | 22.54 | 5.4 | 4.32a |
| $T_4$=64-14-40-8 | 86.33 | 12.85 | 11.85 | 138.9 | 21.52 | 271.00 | 22.98 | 5.06 | 4.05a |
| $T_5$=90-59-100 | 90.06 | 12.44 | 11.68 | 133.6 | 22.08 | 265.80 | 22.99 | 5.15 | 4.12a |
| $T_6$=Control | 76.21 | 9.84 | 8.55 | 101.55 | 19.12 | 186.80 | 22.12 | 3.97 | 3.18c |

Table 75. Effect of different fertilizer levels on yield contributing parameters of crops grown in Fallow-T. Aus-T. Aman cropping pattern at FSRD Site, Golapgonj, 2001-2002

| Treatment | Plant height (cm) | Hill/m$^2$ (No.) | Tiller/ hill (no.) | Panicle length (cm) | No. of grain/ panicle | 1000 grain wt. (g) | Crop duration (days) |
|---|---|---|---|---|---|---|---|
| **T. Aus** | | | | | | | |
| $ED_1$ | 109.28 | 34.28 | 8.90 | 18.12 | 113.04 | 18.53 | 116 |
| $ED_2$ | 114.63 | 35.12 | 9.22 | 19.83 | 122.41 | 18.87 | 117 |
| INM | 112.20 | 34.55 | 9.16 | 19.61 | 117.02 | 18.67 | 116 |
| FRG'97 | 105.00 | 33.65 | 8.04 | 17.84 | 110.95 | 17.88 | 113 |
| FP | 106.96 | 34.02 | 8.56 | 18.34 | 111.67 | 18.40 | 116 |
| Control | 91.13 | 20.57 | 4.77 | 14.72 | 66.79 | 15.80 | 109 |
| **T. Aman** | | | | | | | |
| $ED_1$ | 105.46 | 32.43 | 8.69 | 16.59 | 105.58 | 17.33 | 131 |
| $ED_2$ | 110.62 | 33.22 | 9.00 | 18.16 | 114.33 | 17.65 | 132 |
| INM | 108.27 | 32.68 | 8.94 | 17.96 | 109.30 | 17.46 | 131 |
| FRG'97 | 101.33 | 31.83 | 7.85 | 16.34 | 103.62 | 16.72 | 128 |
| FP | 103.22 | 32.18 | 8.36 | 16.80 | 104.30 | 17.20 | 131 |
| Control | 86.85 | 19.46 | 4.66 | 15.82 | 62.39 | 14.78 | 123 |

Table 76. Effect of different fertilizer levels on yield contributing parameters of crops grown in Fallow-T. Aus-T. Aman cropping pattern at MLT Site, Moulvibazar, 2001-2002

| Treatment | Plant height (cm) | Hill/m$^2$ | Tiller/ hill | Panicle length (cm) | No. of grain/ panicle | 1000 grain wt. (g) | Crop duration (days) |
|---|---|---|---|---|---|---|---|
| **T. Aus** | | | | | | | |
| $ED_1$ | 112.01 | 34.54 | 9.41 | 18.62 | 114.84 | 19.14 | 117 |
| $ED_2$ | 121.40 | 36.29 | 9.89 | 19.84 | 120.64 | 19.07 | 118 |
| INM | 120.08 | 33.73 | 9.26 | 19.93 | 111.69 | 18.96 | 117 |
| FRG'97 | 109.65 | 33.81 | 7.94 | 18.19 | 108.74 | 18.57 | 112 |
| FP | 115.39 | 33.17 | 7.47 | 19.33 | 113.16 | 18.52 | 118 |
| Control | 95.89 | 20.55 | 4.23 | 15.07 | 69.42 | 15.97 | 110 |
| **T. Aman** | | | | | | | |
| $ED_1$ | 108.09 | 32.67 | 9.18 | 17.06 | 107.26 | 17.89 | 132 |
| $ED_2$ | 117.15 | 34.33 | 9.65 | 18.17 | 112.68 | 17.83 | 133 |
| INM | 115.88 | 31.91 | 9.04 | 18.26 | 104.32 | 17.73 | 132 |
| FRG'97 | 105.81 | 31.99 | 7.75 | 16.66 | 101.56 | 17.36 | 127 |
| FP | 111.35 | 31.38 | 7.30 | 17.71 | 105.69 | 17.31 | 133 |
| Control | 90.45 | 19.44 | 4.13 | 14.42 | 64.84 | 14.93 | 124 |

Table 77. Uptake, addition and balance of nutrients in relation to different treatments under T.Aus-T. Aman-Fallow cropping pattern at FSRD Site, Golapgonj in 2001-2002.

| Treat. | Crops | Uptake (kg/ha) | | | | Addition (kg/ha) | | | | Apperent balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S |
| $ED_1$ | T. Aus | 91.44 | 15.24 | 101.60 | 9.31 | - | - | - | - | - | - | - | - |
| | T. Aman | 78.30 | 13.05 | 87.00 | 7.97 | - | - | - | - | - | - | - | - |
| | Total | 169.74 | 28.29 | 188.60 | 17.29 | 136.00 | 26.00 | 94.00 | 6.80 | -33.74 | -2.29 | -94.60 | -10.49 |
| $ED_2$ | T. Aus | 97.20 | 16.20 | 108.00 | 9.90 | - | - | - | - | - | - | - | - |
| | T. Aman | 82.80 | 13.80 | 92.00 | 8.43 | - | - | - | - | - | - | - | - |
| | Total | 180.00 | 30.00 | 200.00 | 18.33 | 186.00 | 32.00 | 120.00 | 9.00 | 6.00 | 2.00 | -80.00 | -9.33 |
| INM | T. Aus | 94.50 | 15.75 | 105.00 | 9.62 | - | - | - | - | - | - | - | - |
| | T. Aman | 87.30 | 14.55 | 97.00 | 8.89 | - | - | - | - | - | - | - | - |
| | Total | 181.80 | 30.30 | 202.00 | 18.51 | 216.00 | 50.00 | 156.00 | 9.00 | 34.20 | 19.70 | -46.00 | -9.51 |
| FRG'97 | T. Aus | 73.80 | 12.30 | 82.00 | 7.52 | - | - | - | - | - | - | - | - |
| | T. Aman | 66.60 | 11.10 | 74.00 | 6.78 | - | - | - | - | - | - | - | - |
| | Total | 140.40 | 23.40 | 156.00 | 14.30 | 80.00 | 12.00 | 40.00 | 6.00 | -60.40 | -11.40 | -116.00 | -8.30 |
| FP | T. Aus | 81.00 | 13.50 | 90.00 | 8.25 | - | - | - | - | - | - | - | - |
| | T. Aman | 68.40 | 11.40 | 76.00 | 6.97 | - | - | - | - | - | - | - | - |
| | Total | 149.40 | 24.90 | 166.00 | 15.21 | 133.00 | 16.00 | 10.00 | 0.00 | -16.40 | -8.90 | -156.00 | -15.21 |
| Control | T. Aus | 50.40 | 8.40 | 56.00 | 5.13 | - | - | - | - | - | - | - | - |
| | T. Aman | 35.10 | 5.85 | 39.00 | 3.57 | - | - | - | - | - | - | - | - |
| | Total | 85.50 | 14.25 | 95.00 | 8.71 | 0.00 | 0.00 | 0.00 | 0.00 | -85.50 | -14.25 | -95.00 | -8.71 |

Table 78. Uptake, addition and balance of nutrients in relation to different treatments under T.Aus- T. Aman-Fallow cropping pattern at MLT site Mooulvibazar in 2001-2002.

| Treat. | Crops | Uptake (kg/ha) | | | | Addition (kg/ha) | | | | Apperent balance +/- (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | P | K | S | N | P | K | S | N | P | K | S |
| $ED_1$ | T. Aus | 88.74 | 14.79 | 98.60 | 9.04 | - | - | - | - | - | - | - | - |
| | T. Aman | 81.36 | 13.56 | 90.40 | 8.29 | - | - | - | - | - | - | - | - |
| | Total | 170.10 | 28.35 | 189.00 | 17.32 | 132.00 | 18.00 | 50.00 | 6.90 | -38.10 | -10.35 | -139.00 | -10.42 |
| $ED_2$ | T. Aus | 94.32 | 15.72 | 104.80 | 9.60 | - | - | - | - | - | - | - | - |
| | T. Aman | 86.94 | 14.49 | 96.60 | 8.85 | - | - | - | - | - | - | - | - |
| | Total | 181.26 | 30.21 | 201.40 | 18.46 | 180.00 | 21.00 | 64.00 | 9.00 | -1.26 | -9.21 | -137.40 | -9.46 |
| INM | T. Aus | 91.62 | 15.27 | 101.80 | 9.33 | - | - | - | - | - | - | - | - |
| | T. Aman | 90.72 | 15.12 | 100.80 | 9.24 | - | - | - | - | - | - | - | - |
| | Total | 182.34 | 30.39 | 202.60 | 18.57 | 210.00 | 39.00 | 100.00 | 9.00 | 27.66 | 8.61 | -102.60 | -9.57 |
| FRG'97 | T. Aus | 71.64 | 11.94 | 79.60 | 7.30 | - | - | - | - | - | - | - | - |
| | T. Aman | 70.02 | 11.67 | 77.80 | 7.13 | - | - | - | - | - | - | - | - |
| | Total | 141.66 | 23.61 | 157.40 | 14.43 | 80.00 | 12.00 | 40.00 | 6.00 | -61.66 | -11.61 | -117.40 | -8.43 |
| FP | T. Aus | 78.66 | 13.11 | 87.40 | 8.01 | - | - | - | - | - | - | - | - |
| | T. Aman | 71.10 | 11.85 | 79.00 | 7.24 | - | - | - | - | - | - | - | - |
| | Total | 149.76 | 24.96 | 166.40 | 15.25 | 149.00 | 30.00 | 0.00 | 0.00 | -0.76 | 5.04 | -166.40 | -15.25 |
| Control | T. Aus | 48.96 | 8.16 | 54.40 | 4.99 | - | - | - | - | - | - | - | - |
| | T. Aman | 36.72 | 6.12 | 40.80 | 3.74 | - | - | - | - | - | - | - | - |
| | Total | 85.68 | 14.28 | 95.20 | 8.73 | 0.00 | 0.00 | 0.00 | 0.00 | -85.68 | -14.28 | -95.20 | -8.73 |

Table 79. Effect of different fertilizer dose on mungbean in Mungbean - T.Aus -T. Aman cropping pattern

| Treatments | Plants/ $m^2$ | Pods /plant | Seeds/ pod | 1000 grain wt. (g) | Grain yield (kg/ha) |
|---|---|---|---|---|---|
| $T_1$ = Estimated mineral fertilizer dose for moderate yield goal | 23 | 18bc | 8ab | 29.0ab | 942 ab |
| $T_2$ = Estimated mineral fertilizer dose for high yield goal | 19 | 20ab | 9a | 30.0a | 1023 a |
| $T_3$ = IPNS basis fertilizer recommendation dose for high yield goal | 20 | 22a | 8ab | 30.7a | 1048 a |
| $T_4$ = Recommended fertilizer dose based on FRG'97 | 21 | 19bc | 9a | 27.6ab | 973 a |
| $T_5$ = Farmer's practice | 21 | 17c | 8ab | 26.3b | 736 b |
| $T_6$ = Control | 25 | 17c | 7b | 26.0b | 762 b |
| CV(%) | 13.04 | 7.82 | 7.07 | 6.37 | 11.94 |

Table 80. Effect of different fertilizer dose on T.aus in Mungbean- T.aus -T.aman cropping pattern

| Treatment | Hill/$m^2$ | Effective tillers/hill | Grain/ panicle | 1000 grain wt. (g) | Grain Yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$ = Estimated mineral fertilizer dose for moderate yield goal | 18 | 10a | 78cd | 21.97 | 3.12b |
| $T_2$ = Estimated mineral fertilizer dose for high yield goal | 20 | 10a | 81bc | 20.56 | 3.34a |
| $T_3$ = IPNS basis fertilizer recommendation dose for high yield goal | 19 | 10a | 87a | 20.75 | 3.46a |
| $T_4$ = Recommended fertilizer based on FRG'97 | 19 | 9ab | 83b | 20.84 | 3.98cb |
| $T_5$ = Farmer's practice | 18 | 9ab | 75d | 21.00 | 2.52c |
| $T_6$ = Control | 18 | 8b | 75d | 19.82 | 2.15d |
| CV (%) | 7.58 | 8.07 | 2.56 | 8.85 | 2.79 |

Table 81. Effect of different fertilizer dose on T.aman in Mungbean-T.aus -T.aman cropping pattern

| Treatment | Hill/ $m^2$ | Effective tillers/hill | Grain/ Panicle | 1000 grain weight (gm) | Grain yield (t/ha) | Straw weight (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ = Estimated mineral fertilizer dose for moderate yield goal | 19 | 11a | 84ab | 24.7 | 4.33b | 4.76c |
| $T_2$ = Estimated mineral fertilizer dose for high yield goal | 18 | 11a | 93a | 23.7 | 4.36b | 5.34a |
| $T_3$ = IPNS basis fertilizer recommendation for high yield goal | 19 | 11a | 90a | 25.0 | 4.75a | 5.28ab |
| $T_4$ = Recommended fertilizer based on FRG'97 | 18 | 10ab | 90a | 23.7 | 3.83ab | 5.22ab |
| $T_5$ = Farmer's practice | 18 | 10ab | 77b | 23.9 | 3.31c | 4.96bc |
| $T_5$ = Control | 18 | 9b | 78b | 22.1 | 2.79d | 3.56d |
| CV (%) | 7.83 | 8.55 | 5.81 | 7.86 | 3.59 | 3.77 |

Table 82. Effect of different fertilizer dose on T.aus in T.aus -T.aman - fallow cropping pattern

| Treatment | Hill /$m^2$ | Panicle /hill | Grain/ panicle | 1000 grain wt. (g) | Grain Yield (t/ha) |
|---|---|---|---|---|---|
| $T_1$ = Estimated mineral fertilizer dose for moderate yield goal | 16 | 10a | 75ab | 24.47 | 2.93c |
| $T_2$ = Estimated mineral fertilizer dose for high yield goal | 17 | 9b | 80a | 24.65 | 3.14b |
| $T_3$ = IPNS basis fertilizer recommendation dose for high yield goal | 17 | 10a | 77ab | 24.82 | 3.25a |
| $T_4$ = Recommended fertilizer based on FRG'97 | 16 | 10a | 75ab | 24.03 | 2.88c |
| $T_5$ = Farmer's practice | 16 | 9b | 77b | 24.96 | 2.78d |
| $T_6$ = Control | 16 | 8b | 71b | 23.23 | 2.14e |
| CV (%) | 6.02 | 8.11 | 5.38 | 2.61 | 1.41 |

Table 83. Effect of different fertilizer dose on T.aman in Fallow-T.aus -T.aman cropping pattern

| Treatment | Hill/ $m^2$ | Panicle /hill | Grain/ panicle | 1000 grain wt. (g) | Grain Yield (t/ha) | Straw yield (t/ha) |
|---|---|---|---|---|---|---|
| $T_1$ = Estimated mineral fertilizer dose for moderate yield goal | 19 | 11ab | 78b | 24.69cd | 4.02d | 5.86b |
| $T_2$ = Estimated mineral fertilizer dose for high Yield goal | 20 | 11ab | 77b | 24.22d | 4.10d | 6.10ab |
| $T_3$ = IPNS basis fertilizer recommendation Dose for high yield goal | 19 | 12a | 86a | 25.52a | 5.00a | 6.60a |
| $T_4$ = Recommended fertilizer based on FRG'97 | 20 | 11ab | 84a | 25.52a | 4.71b | 6.25ab |
| $T_5$ = Farmer's practice | 20 | 11ab | 84a | 24.81bc | 4.58c | 6.10ab |
| $T_6$ = Control | 19 | 10a | 73b | 25.62ab | 3.53e | 4.75c |
| CV (%) | 3.61 | 8.94 | 3.75 | 1.11 | 1.62 | 6.08 |

Table 84. Performance of Onion as affected by different levels of fertilizer at Faridpur

| Treatment | Bulb yield (t/ha) |
|---|---|
| $T_1$ ($ED_1$) = 75-62-40-25 kg NPKS/ha (moderate yield goal) | 14.68 c |
| $T_2$ ($ED_2$) = 95-82-50-33 kg NPKS/ha (high yield goal) | 15.55 a |
| $T_3$ (INM) = 80-77-35-33 kg NPKS/ha + 5 t/ha CD (high yield goal) | 14.87 b |
| $T_4$ (FRG`97) = 80-40-40-25 kg NPKS/ha (FRG`1997) | 14.28 d |
| $T_5$ (FP) = 80-80-100-25 (Farmer practice) | 13.98 e |
| $T_6$ (Control) = 0-0-0-0 kg NPKS/ha (absolute control) | 6.83 f |
| CV (%) | 0.5 |
| Level of significance | ** |

Table 85. Effect of different fertilizer management packages on the soil nutrient balance in onion at Baliakandi, Rajbari (average of 2000-2001 and 2001-2002)

| Treatment | Nutrient uptake (kg/ha) | | | | Nutrient added (inorg. + org.) kg/ha | | | | Nutrient balance (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | N * | P | K | S | N | P | K | S |
| $ED_1$ | 43.6 | 8.0 | 48.3 | 9.4 | 30 | 62 | 40 | 25 | -13.6 | 54 | -8.3 | 15.6 |
| $ED_2$ | 46.1 | 8.5 | 51.1 | 10.0 | 38 | 82 | 50 | 33 | -8.1 | 73.5 | -1.1 | 23.0 |
| INM | 43.6 | 8.0 | 48.3 | 9.4 | 38 | 82 | 50 | 33 | -5.6 | 74.0 | -1.7 | 23.6 |
| FRG`97 | 43.3 | 7.9 | 48.0 | 9.4 | 32 | 40 | 40 | 20 | -11.3 | 32.1 | -8.0 | 10.6 |
| FP | 42.1 | 7.7 | 46.6 | 9.1 | 32 | 80 | 100 | 25 | -10.1 | 72.3 | 53.4 | 15.9 |
| Control | 20.1 | 3.7 | 22.3 | 4.4 | 0 | 0 | 0 | 0 | -20.1 | -3.7 | -22.3 | -4.4 |

* 40% of applied fertilizer/manure N was considered effective

Table 86. Nutrient balance sheet for T.aman in Fallow- Fallow-T.aman cropping pattern with respect to nutrient packages

| Treatment | Yield (t/ha) | Nutrient uptake[1] (Kg/ha) | | Nutrient added (Kg/ha) | | | Nutrient recovered [3](Kg/ha) | | | Balance +/- |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Inorg. | Org.[2] | Total | Inorg. | Org. | Total | |
| $ED_1$ | 4.29 | N | 77 | 103 | - | 103 | 36 | - | 36 | - 41 |
| | | P | 13 | 21 | - | 21 | 4 | - | 4 | - 9 |
| | | K | 86 | 13 | - | 13 | 7 | - | 7 | - 79 |
| $ED_2$ | 4.56 | N | 82 | 140 | - | 140 | 49 | - | 49 | - 33 |
| | | P | 14 | 25 | - | 25 | 5 | - | 5 | - 9 |
| | | K | 91 | 17 | - | 17 | 9 | - | 9 | - 82 |
| INM | 4.16 | N | 75 | 130 | 100 | 230 | 46 | 10 | 46 | - 29 |
| | | P | 12 | 19 | 60 | 79 | 4 | 6 | 10 | - 2 |
| | | K | 83 | 5 | 120 | 125 | 3 | 12 | 15 | - 68 |
| FRG'97 | 4.14 | N | 75 | 65 | - | 65 | 23 | - | 23 | - 52 |
| | | P | 12 | 20 | - | 20 | 4 | - | 4 | - 8 |
| | | K | 83 | 25 | - | 25 | 13 | - | 13 | - 70 |
| FP | 3.53 | N | 64 | 38 | 13 | 51 | 13 | 1 | 14 | - 50 |
| | | P | 11 | 16 | 8 | 24 | 3 | 1 | 4 | - 7 |
| | | K | 71 | - | 15 | 15 | - | 2 | 2 | - 69 |
| Control | 2.87 | N | 52 | - | - | - | - | - | - | - 52 |
| | | P | 9 | - | - | - | - | - | - | - 9 |
| | | K | 57 | - | - | - | - | - | - | - 57 |

[1] Follwing Fertilizer Recommendation Guide'97 (BARC'97)
[2] Considering 1%N, 0.6%P and 1.2%K present in cow dung.
[3] Considering recovery of different nutrients (N-35%, P-20%, K-50%) from inorganic fertilizers and all at 10% from animal manures.

Table 87. Effect of different nutrient management packages on yield parameters of crops grown in Potato-Jute cropping pattern at Munshiganj during 2000-01

| Treatment | Potato | | Jute | |
|---|---|---|---|---|
| | Tubers/plant | Wt. of tubers/plant | Plant height (cm) | Plant diameter (cm) |
| $ED_1$ | 6.1a | 255.4 c | 180.3 c | 4.17 b |
| $ED_2$ | 6.5 a | 327.5 b | 191.8 b | 4.33 b |
| INM | 7.0 a | 357.2 a | 201.0 a | 4.93 a |
| FRG'97 | 6.8 a | 268.7 c | 187.9 b | 4.53 b |
| FP | 6.9 a | 360.5 a | 202.0 a | 4.97 a |
| Control | 5.3 b | 232.8 d | 104.3 d | 2.83 c |

Table 88. Effect of different fertilizer management packages on the soil nutrient balance in Potato-Jute cropping pattern at Munshiganj (average of 1999-2000 and 2000-01)

| Treatment | Nutrient uptake (kg/ha) | | | | Nutrient added (inorg. + org.) kg/ha | | | | Apparent nutrient balance (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | P | K | S | NT | P | K | S | N | P | K | S |
| $ED_1$ | 148.0 | 28.3 | 223.0 | 11.9 | 125 | 8 | 45 | 0 | -104.2 | -20.3 | -178.0 | -11.9 |
| $ED_2$ | 175.5 | 33.6 | 263.4 | 14.3 | 178 | 11 | 65 | 0 | -113.2 | -22.6 | -198.4 | -14.3 |
| INM | 185.3 | 35.5 | 279.2 | 15.0 | 168 | 16 | 85 | 0 | -116.0 | -19.5 | -194.2 | -15.0 |
| FRG'97 | 155.1 | 29.7 | 234.6 | 12.4 | 130 | 150 | 400 | 23 | -109.6 | -4.7 | -154.6 | 10.6 |
| FP | 182.5 | 35.0 | 275.5 | 14.6 | 460 | 25 | 80 | 0 | -21.5 | 115 | 124.5 | -14.6 |
| Control | 94.1 | 18.0 | 142.8 | 7.4 | 0 | 0 | 0 | 0 | -94.2 | -18.0 | -142.8 | -7.4 |

- 40% of applied fertilizer/manure N was considered effective