Unfavourable Eco-System: Crop Production Under Hill and Haor Eco-System

Agronomy Division

Bangladesh Agricultural Research Institute

Joydebpur, Gazipur-1701

Crop Production Under Hill and Haor Eco-System

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Edited by

Dr. Md. Abdul Aziz
Dr. Md. Rafiqul Islam Mondal
Dr. Bhagya Rani Banik
Md. Hasan Hafizur Rahman

Compiled by

Dr. Md. Abdul Aziz
Dr. Md. Shamsul Alam
Dr. Md. Abul Khayer Mian
Dr. Jasmine Ara Chowdhury
Dr. Anjuman Ara Begum
Dr. Md. Shawquat Ali Khan
Dr. Sarker Saifun Kakon
Md. Jabied Ali montu
Mohammad Sarfuddin Bhuiyan
Shamima Akter
Santosh Kumar Paul

Agronomy Division
Bangladesh Agricultural Research Institute
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بسم الله الرحمن الرحيم

Minister
Ministry of Agriculture
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Republic of Bangladesh

Foreword

Agriculture is the main source of food energy, vigor, labor force and intellectual power which are indivisible and interrelated. Due to the relentless efforts of our agriculture and farmer- friendly government under the dynamic leadership of Jana-netri Sheikh Hasina, our country has become self sufficient in producing food and furthermore, it has already started exporting rice in a small scale. In 2014, Cornell University of the United States awarded Hon'ble Prime Minister Sheikh Hasina for her great contribution in attaining self-sufficiency in food production and for taking initiatives in using modern technology in agriculture. Earlier in 1999, in recognition of her contribution to the fight against hunger, the United Nations World Food Programme (FAO) awarded 'Ceres Medal' to Hon'ble Prime Minister Sheikh Hasina. Maintaining the continuity of development under the present people-friendly government, we will be able to make our country hunger free, happy and prosperous 'Sonar Bangla' dreamt by the father of the nation, Bangabandhu Sheikh Mujibur Rahman.

Sustained crop production in the problem areas of Bangladesh combating climate change through improvement of environmental stress research is regarded as increasingly important in national issues such as food security, poverty alleviation and land degradation and pollution control. Climate change is a concern today and researchers are engaged in understanding its impact on growth and yield of crops and also identifying suitable management options to sustain the crops' productivity under the climate change scenarios. In the hilly areas plain land is limited, so, it is essential to make intensive use of land by introducing modern technologies in order to get the highest yield and more income. The existing cropping pattern in the hill valley is mostly T.*aman*-Fallow-Fallow. After harvest of T.*aman* rice *rabi* crops could be grown with residual soil moisture.

Haor is a wetland ecosystem in the north eastern part of Bangladesh constitutes around 17% of the country's land area. Ecosystem, crop production practices, economic capability and the overall livelihoods of the farmers of haor areas are quite different from those of the other parts of the country. As a depressed as well as remote area, farmers are deprived of getting new technology for crop cultivation.

I am very glad to know that Agronomy Division of Bangladesh Agricultural Research Institute (BARI) is going to publish a compiled research report entitled **Unfavorable Eco-system: Crop Production Under Hill and Haor Eco-System** areas carried out during the period from 2010 to 2015. This report is very much relevant to the context of sustainable crop production in the hilly region and haor areas perspective to national food security. The publication will be helpful to the researcher, extension personnel, students of higher studies, GO and NGO personnel, other agriculture related stakeholder and national planners. I convey my thanks to the scientists of Agronomy Division, Bangladesh Agricultural Research Institute for the valuable research works.

Joy Bangla, Joy Bangabandhu,
Long live Bangladesh.

Matia Chowdhury

(Matia Chowdhury, MP)

Secretary
Ministry of Agriculture
The People's Republic of Bangladesh

Foreword

Bangladesh is recognized worldwide as one of the countries most vulnerable to the impacts of climate change because of its geographical location, physiographic features and high population density. About 76% of total populations in Bangladesh live in rural areas of which 90% of them are directly or Indirectly related with agriculture. Population density is increasing over time and thus food requirement that demand sustainable growth of agricultural sector. On the top of the problems, climate change is going to create big dents for the country including the problem of increasing the agricultural production to feed its ever growing population.

Hill agriculture is faced with challenges of stagnant productivity, economic unviability, unsustainable and exploitative natural resource management and lack of alternate employment. The land forms of the CHT are mainly composed of hills and valleys. The existing cropping pattern in the hill valley is mostly T.*aman*-fallow-fallow and after harvest of T.*aman* rice *rabi* crops could be grown with residual soil moisture.

Haor areas with its unique hydro-ecological setting offer considerable development potential. The available statistics indicate that, the total cultivated area in Sunamganj, Habiganj, Moulvibazar, Sylhet Sadar Upazila, as well as Kishoreganj and Netrokona districts is about 1.26 million hectares of which 0.68 million ha (nearly 66%) is under haor. There are some suitable lands namely "kanda", generally high land which become suitable for cultivation in early December. To cope with the new climate trends, adaptive practices need to be initiated and promoted and an enabling environment should follow as policy derivatives.

It is a great pleasure to me that Agronomy Division, Bangladesh Agricultural Research Institute (BARI) is going to publish a compiled research report entitled "Unfavorable Eco-system: Crop Production in Hill and Haor areas". This report is very much relevant to the context of sustainable crop production in the hilly region and haor areas perspective to national food security. The publication will be helpful to the researcher, extension personnel, students of higher studies, GO and NGO personnel, other agriculture related stakeholder and national planners. I express my sincere appreciation to the scientists of Agronomy Division, Bangladesh Agricultural Research Institute for this valuable research works.

Mohammad Moinuddin Abdullah
Secretary

Director General

Bangladesh Agricultural Research Institute
Joydebpur, Gazipur

Foreword

The Chittagong Hill Tracts region lies in the extreme southeast of Bangladesh between the latitudes of 21.11 and 23.450 N and longitudes of 91.42 and 92.420 E. The area consists of a series of anti-clinical ridges running parallel to one another and tending to the north-east direction. The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter. Soil texture varies from sandy loam to clay loam. About 55% of the population in this region is tribal (12 tribes) and the rest are Bengali. About 90% of the tribal population depends on agriculture for livelihood.

Haor is a wetland ecosystem covering 24265 sq. km area in the north eastern part of Bangladesh. This haor basin is an internationally important wetland ecosystem for conservation of biodiversity and environmental balance. It is situated in Sunamganj, Habiganj, Moulvibazar, Sylhet Sadar Upazila, as well as Kishorganj and Netrokona districts. It constitutes around 17% of the country's land area. This area is a naturally depressed during July to November due to overflow of rivers and heavy rainfall the areas go under 4 to 5 m depth of water and look like as a sea. During dry season (December to April) the water is completely drained out from the area by gravity and turns to very fertile land for crop production. As a depressed as well as remote area, farmers are deprived of getting new technology for crop cultivation.

I am very glad to know that Agronomy Division, Bangladesh Agricultural Research Institute (BARI) is going to publish a compiled research report entitled "Unfavorable Eco-system: Crop Production in Hill and Haor areas" carried out during the period from 2010 to 2015. This report is very much relevant to the context of sustainable crop production in the hill and haor areas perspective to national food security. I firmly believe that this publication will be helpful for the students, scientists and teachers in developing effective research programme on hill and haor eco-system. It will also help extension personnel and policy markers. I express my heartfelt thanks to the scientists of Agronomy Division for their sincere efforts for this publication.

Dr. Md. Rafiqul Islam Mondal

Chief Scientific Officer

Bangladesh Agricultural Research Institute
Joydebpur, Gazipur

Preface

The Chittagong Hill Tracts has high potential for agricultural development. The total area of the Chittagong Hill Tracts is estimated around 13,237 sq. km, which is about one tenth of the country. Annual average temperature: maximum 34.60C, minimum 13.00C; annual rainfall 3031 mm. Despite of hilly terrain high rainfall and prolonged wet season, it remains well drained and offers an attractive scope for year-round agricultural production. The valleys and hilltops in this region are rich in natural resources. Among the existing cropping patterns 54% of the farmers follow T.aman rice-fallow-fallow patterns. It was also observed that about 71% of farmers harvest T.aman rice in the month of October and 29% in November. It indicated that there is enough scope of growing winter crops after harvesting of T.aman rice in the hilly areas.

Haor basin is a remote and adverse area that is flooded every year during monsoon. Geographically, most of the haors are situated in seven districts of North-East of Bangladesh. There are as many as 423 small or large haors in Bangladesh. The Hakaloki haor, Sumir haor, Dakhar haor, Tanguyar haor, Gungiajuri haor, Mukhar haor, Kaowadighir haor etc are the prominent haors in Bangladesh. The maximum number of haors is lying in Sunamgonj, Netrokona and Kishoregonj district. As in adverse ecosystem, crop production practices, and economic activities and overall livelihoods of the farmers of hoar areas are quite different from those of the other parts of the country.

It is a great pleasure to me that Agronomy Division, BARI is going to publish a compiled report entitled "Unfavorable Eco-system: Crop Production under Hill and Hoar Eco-system" carried out during the period from 2010 to 2015. The results of those research works are published sporadically elsewhere which necessitates to compile those results in systematic way. This report will be helpful to the scientists in reviewing the past research results for preparing effective future research programmes on hill and hoar areas. I am very much grateful to the scientists of Agronomy Division for compiling the results of important hill and hoar research. If this publication helps to any body in any way, then the efforts would be meaningful worthy.

Dr. Md. Abdul Aziz

Hill Eco-system

AGRO-ECOLOGIAL SURVEY AND MONITORING OF CROPS AND CROPPING IN THE HILLY AREAS OF BANGLADESH

Md. Abdul Aziz, M. A Rahman, M. Monnem Remi Chakma and Mostaqu Ahmed

Abstract

The study was conducted to know socio-agro-economic conditions of hilly farmers and to find out the existing crops and cropping in the hill valley areas with production technologies. A total of 80 farmers from 4 different locations Dighinala, Khagrachari, Ramgarh and Raikhali were selected randomly. Socio-economic profilies of the hill farmers indicated that the average family size was 5.01 with age 46 years. More than 60% farmers have no formal education. The average farm size was 0.55 ha but having more complex land ownership pattern. Rice based cropping pattern is predominant in the hill valley and 54% of responded farmers follow T.aman-Fallow-Fallow pattern. Ninety three percent farmers transplant t.aman in the month of July and 71% of them harvest in the month of October. It also showed that about 45% of the rice growing soil is loam and clay loam where residual moisture prevails after harvest of T.aman rice. Moreover, there are also sources near the hill "chhara". It indicates that there enough scope of growing short duration winter crop after harvest of T.aman rice. Prolonged winter season in the hilly areas could also be helpful to sustain winter crops. The study should be repeated in the next season for proper monitoring and final conclusion.

Introduction

The Chittagong Hill Tracts region lies in the extreme southeast of Bangladesh between the latitudes of 21.11 and 23.450 N and longitudes of 91.42 and 92.420 E. (BBS, 2000). The area consists of a series of anti-clinical ridges running parallel to one another and tending to the north-east direction. The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter. Soil texture varies from sandy loam to clay loam. About 55% of the population in this region is tribal then (12 tribes) and the rest are Bengali. About 90% of the tribal population depend on agriculture for livelihood (Firoz and Uddin, 2001).

The Chittagong Hill Tracts has high potential for agricultural development. After signing of the Peace Accord in 1997, development activities in different sectors, especially on agricultural in hill districts got momentum. Despite hilly terrain high rainfall and prolonged wet season, it remains well drained and offers an attractive scope for year-round agricultural production. Therefore, the possibilities of increasing agricultural productivity in the hilly area need survey and monitoring of existing crops and cropping and improvement of the same by modern crop production technology. The present study was undertaken to find out the crops and cropping in the hill valley areas as well as to find out the production technology of each crops.

Materials and Methods

Selection of Study Areas and Sample Size

A multistage random sampling technique was used to select location and hill farmers for the present study. At the first stage, an exploratory visit was made in the hill areas of Khagrachari and chittagong districts for finding out suitable locations keeping in mind the objectives of the study. Finally, Dighinala, Khagrachari, Ramgorh and Raikhali locations were selected for the study as

BARI had research station in this area and logistics were available for field survey. A total of 80 farmers, taking about 20 farmers from each of the location were randomly selected for the study. Before selecting the farmers, a pilot survey was conducted at Hajchora Jorabridge village of Dighinal Upazila.

Preparation of interview Schedules

A draft interview schedule was prepared and pre tested before preparing final interview schedules. The suggestions by agroeconomics M., Monaem was also taken into consideration before finalizing the questionnaires. The final interview schedules were developed in the ligistic sequence so that sample farmers could answer systematically. The interview schedules has been covered, socio-demographic information's, land ownership pattern, detailed information on crops. cropping pattern, crop production technology. Constraints of production and information on the livelihood of the farmers.

Techniques of Data collection

Data for the present study were gathered by personal interviews. Many tribal people have problem with understand Bengali language and hesitate to meet with strangers. Therefore, scientific officers and trained local enumerators belonged to tribal community were employed during collection of data. The aim and purpose of the study were explained to each of the farmer before taking interview. Then the necessary questions were asked in a very simple manner with explanation of questions where necessary so that they could provide authentic data and information regarding crops and croppings.

Data and information were collected during March-April 2006. Monitoring of collected data and information left behind because of fund crisis and other constraints. Secondary information was collected from statistical bureau, PhD thesis, research report, web site etc. The collected data were analysed following Excel program.

Results and Discussion

Socio-economic profiles of Respondents

In order to get a complete picture of livelihood of the hill farmers, some important characteristics such as family composition, age distribution, level of education, occupation, farm size, land ownership pattern, social membership and source of fund have been considered in this study and discussed below.

Family size : A family size have been defined as the total member of persons of either sex living together and taking meals from the same kitchen under the administration of a single head of the family. It was found that 41% and 35% hill family members are male and female and 14% and 10% are son and daughter (less than 13 yrs.) respectively. The average family size was 5.01 (Table 1)

Age: Out of the total hill farmers, 50% belonged to the age group 31-45 years. Twenty eight percent and 20% farmers fell in to the age groups of 46 to 60 years and above 60 years respectively. The average ages of the hill farmers was 46 years with a minimum age of 27 years and maximum of 70 years. It was found that most of the family members were aged 31-45 years followed by the age group of 46-60 years (Table 2).

Education levels: It is expected that literate farmers can have better access to the relevant technical information about modern crop production technology and can move rational production

decision. It reveals from Table 2 that more than 60% hill farmers had no formal education, 26% and 6% farmers had up to primary and secondary level education respectively (Table 2).

Occupation : It was evident that most of the hill farmers (78%) are dependent on agriculture for maintaining their family. Fifteen percent hill farmers worked as wage labour and 8% business as subsidiary occupation.

Farm size : Farm size is the amount of land. which is operated by a farmer. It appears from Table 2 that the average farm size was 0.55 ha with minimum 0.11 ha and maximum of 3.24 ha for the hill farmers. Forty one percent of hill farmers belongs to the farm size group 0.21 – 0.40 ha of land and 21% farmers have farm size less than 0.20 ha.

Land ownership pattern : The data presented in Table indicated that 91% of the hill farmers had their own land for cultivation. It also revealed that in addition to own land some farmers followed ranted in (15%) and ranted out (6%) pattern. Very few farmers follow share cropped in (4%(and share cropped out (3%) pattern. About 73% of the respondents have homestead area where homestead gardening programme could be possible.

Social membership : About 70% of the hill farmers left behind the social organizations. Thirty percent of farmers follow different social organizations of which 10% in gazed in BRDB and 5% in NGO.

Source of fund : Most of farmers (85%) utilize their own fund for agricultural production and 15% took loan from different sources such as bank (3), NGO (4), BRDB (3) and money lender (2).

3. Existing cropping pattern : The predominant croppping patterns followed by the hill farmers is rice based. Among the existing cropping patterns 54% of the farmers follow T.aman-fallow-fallow-followed by T.aman-boro-fallow (29%). Fourteen percent farmers follow fallow-boro-fallow pattern (Table 3). About 47 farmers follow T.aman-boro-aus.

4. Plot information : Information regarding the surveyed hill farmers plot indicated that 96% of the farmers practiced rainfed agriculture. About 4% follow irrigated agriculture but with traditional system as the source of irrigation is only hill charra (Table 4). Soil topography showed that 70% hill valley land was medium high with 26% medium low. The soil type was mostly clay (44%) followed by clay loam (24%) as s result rice based cropping pattern is dominated. Twenty one percent of land was loam where residual soil moisture prevails after harvest of T.aman rice. The soil fertility status of most of the soil (84%) was moderate.

5. Agronomic Profiles : In the study area major crops were identified as T.aman, Boro and Aus rice grown in the hill valley. The crops grow in three different seasons there were rice 8 varieties used by the hill farmers and BR-11 was most popular in T.aman (62%), followed by China IRRI (43%) in boro and 67% in aus season). Most of the farmers plough their land 4 times (68% T.aman, 65% boro and 67% aus) followed by laddering 3 times. Ninety three percent of farmers transplant T.aman in the month of July, boro (57%) in January and aus (100%) in March. Majority of the farmers followed traditional method of transplanting. Among the respondents 92% of farmers applied basal fertilizers and most of them apply only TSP and MP (67 in T.aman, 49% in boro and 100% in aus), and top dressed urea one time (68, 62 and 100% in T.aman, boro and aus respectively). One time (54%) weeding practiced in T.aman and 2 times in boro (65%) and aus (67%) respectively. About 57% of farmers only irrigate boro rice and used pesticides in T.aman (40%) and boro (68%). Seventy one percent of the farmers harvest T.aman in the month

of October and 29% in November. It indicated that there is enough scope of growing short duration winter crops after harvest of T.aman rice.

6. Cost of Cultivation for Rice Cropping : The total cost of production of rice was higher in boro (Tk. 18515 /ha) followed by aus (Tk. 14380/ha) and T.aman (Tk 14188/ha). The higher cost in boro was mainly due to the use of more labour, fertilizes and perticeds (Table 6). Considering human labour cost compared to total production cost it was maximum in Aus (59%) followed by boro (58%) and T.aman (54%). The fertilizer cost was more or less same for T.aman (9%), boro (9%) and aus (10%) compared to total production cost.

7. Comparative cost and returns of Rice cropping : On avarage, rice yield was maximum in boro (3781 kg/ha) followed by T.aman (2919 kg/ha) and aus (2563 kg/ha). Similarly gross return was maximum in boro rice (Tk. 3436/h) followed by T.aman rice (Tk. 26271/ha) and aus rice (Tk. 21145/ha). The net return (Tk/ha) followed the same trend as gross return (Table 7). The benefit cost ratio (BCR) was higher in T.ama (2.03 Tk/Tk) followed by boro (1.86 Tk/Tk.) and aus (1.62 Tk/Tk.). Higher BCR in T.aman might bedue to the lower cost of production. The per unit cost of production was higher in aus (Tk. 5.61/kg) followed by boro (Tk. 4.90/kg) and T.aman (Tk./ 4.86/kg).

8. The Jhum Cultivation in the hilly area: Jhum cultivation is an old-age traditional crop cultivation system of the people in the hill area. This system is completely different from normal cultivation practiced in the plain areas. After cultivation crops, farmers generally leave the hill for rejuvenation of top soils and back to the same hill after 3-10 years for crop production. This cultivation system is, therefore called as shifting cultivation. Slashing and subsequent burning are preconditions for Jhum cultivation. That's why this cultivation system is also called slash and burn cultivation. Jhum cultivation in the study areas is discussed below.

8.1. Selection of Jhum Land : The hills of the CHT are government property. After signing of the Peace Accord with Jatiya Sanghati Samity (a party of freedom fighters) of CHT in 1997, the government gave 5 acres of hilly land to each of the member of the terrorist groups who back to their normal life. Although some hill farmers claimed that all hills are allotted to different tribal farmers, the scientists of BARI mentioned that the ownership of the hills is not clearly defined.

Tribal farmers in CHT select their *Jhum* lands based on some criteria and religious beliefs. Selection of Jhum land is mostly depended on a good dream. Usually, they take a bath, wear clean clothes, offer prayers and go out in search of a likely *Jhum* site. If a suitable site is found, they collect a lump of soil from the site for a "dream test". The soil sample is placed secretly in a holy place, besides the pillow or bed in the house. If they dream well (big fish, water, fruit, woman wearing with dress, flower, corn field, etc), they select the land for cultivation. If the dream is unfavorable (animal, shake, insects, fire, etc.), they contact the local priest for and explanation for the dream and solicit advice to overcome the difficulties. Usually, the priest asks them to offer some special prayers or to make sacrifices by offering poultry or other animals. If this endeavor does not lead to a good dream, they reject the site and look for another area. The process is repeated until a good dream; they reject the site and look for another area. The process is repeated until a good dream is dreamt. Due to shortage of land for *Jhum*, the choice of the farmers in selecting Jhum field is narrowed more and more.

8.2 Slashing, Burning and Dibbling of Seeds : Traditionally, Jhumias start and end the *Jhum* cultivation in a ceremonial way. After selecting a hill, they invite all the neighbours for a party. After the party they go together to the field and start slashing the vegetation. After few days they

burn this dry vegetation for *Jhum* cultivation. In the study areas, Jhumias started slashing the vegetation from early January and burning them during March-April. It is reported that the off-site effects of fire very often, extend to areas for beyond its required premises destroying horticultural gardens and accelerating communal, regional and administrative conflicts in the area.

Traditionally, they start dibbling of seeds i the cleaned hill at a holy day (i.e. Friday and Monday). After the initiation of first rain in April, *Jhum* farmers dibble different crop seeds in a hole, using hoe at the same time. In this system sowing of seed is done without major topsoil disturbance. In the study areas, most farmers dibbled rice and turmeric seeds within the period of 01-15 May. They broadcasted or dibbled seeds of all other crops, except rice and turmeric, in April. They broadcasted smaller seeds like sesame and chilli, and dibbled relatively bigger and mixed seeds of rice, maize, cotton etc. They cultivated turmeric and aroids mostly as mixed crop. The important *Jhum* crops were found to be brinjal, turmeric, rice, chilli, sesame, marpha, arum, sweet-gourd and cotton. The other less important *Jhum* crops are maize bottle gourd, tassel gourd, yard-long bean, and yam (Table 8).

9. Constraints to Agricultural Production: The respondents mentioned major constraints to crop production. Sixty six percent of the farmers reported non-availability of HYV seeds/ About 78% farmers claimed that they have no technical knowledge about modern technologies. About 65% fermers reported lack of cash as a problem. About 82 farmers opined that irrigation problem in dry season was the major constraints for crop production. Land ownership was the other problem which clamad 50% of the farmers. About 65-68% of the farmers reported higher price and non-availability of fertilizer and pesticides. Marketing of agricultural product is another problem especially for perishable goods which opined 66% of farmers. About 48% farmers reported that natural hazard like heavy rainfall, flash flood and cyclone was the major constraints for crop production (Table 8). There are some other constraints for agricultural development. These are steep slope on most of the land, flash flood in valleys, remoteness of interior area from urban markets, tribal land ownership or illicit land ownership by plains people, heavy monsoon rainfall, difficulties to get loan from formal institution etc.

Research Priorities

The following aspects may be considered for the development of existing hill forming system in the hill valley area:

1. Further intensive monitoring of crops and cropping through out the year.
2. Improvement of intensive crop production in hill valleys
3. Promotion of sustainable field crop production for hill valley farming
4. Screening of rabi crops in hill valley in order to identify suitable high yielding varieties.
5. Adaptive trial with modern crop varieties should be undertaken.

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Table 1. Gender wise distribution of family members of the respondents (Family size)

Gender group	No. of persons	%	Average (Persons/family)
Male	165	41	2.06
Female	140	35	1.75
Sun (<13 yrs)	55	14	0.69
Daughter (<13 yrs.)	41	10	0.51
Total	401	100	5.01

Table 2. Socio economic profiles of the sample hill farmers

Socio economic characters	No. of responded (N)	Percentage (%)	Socio economic characters	No. of responded (N)	Percentage (%)
1. Age (year)			**2. Education status**		
20-30 Years	2	2.50	Illiterate	23	28.75
31-45 years	40	50.00	Primary	48	60.00
46-60 years	22	27.50	SSC	5	6.25
Above 60 years	16	20.00	HSC	3	3.75
			Degree and Higher	1	1.25
3. Occupation			**4. Farm size (dec.)**		
Agriculture	74	92.50	<50	17	21.25
Business	-	-	51-100	33	41.25
Agriculture + Business	6	7.50	101-150	9	11.25
			151-200	16	20.00
			>200	5	6.25
5. Land ownership pattern			**6. Social membership**		
Own cultivated land	73	91.25	BRDB	8	10.00
Ranted in	12	15.00	NGO	4	5.00
Ranted out	5	6.25	Other	12	15.00
Share cropped in	3	3.75	No	56	70.00
Share cropped out	2	2.50			
Homestead area	58	72.50			
Garden	46	57.50			
Fallow	4	5.00			
7. Source of fund					
Own	68	85.00			
Loan	12	15.00			
Bank	3	25.00			
NGO	4	33.00			
BRDB	3	25.00			
Money lender	2	17.00			

Table 3. Existing cropping patterns in hill areas

Cropping patterns	No. of responded	Percentage (%)
1. T.aman-fallow	43	53.75
2. T.aman-boro rice	23	28.75
3. Fallow-Boro-fallow	11	13.75
4. T.aman-Boro-Aus	3	3.75
5.T.aman-vegetable	-	-

Table 4. Information regarding the surveyed hill farmers plot

Plot information	No. of responded	Percentage (%)
1. Operational status		
Own operate	71	88.75
Rented in (cash)	2	2.50
Ranted out (cash)	3	3.75
Share cropped in	2	2.50
Share cropped out	2	2.50
2. Mode of irrigation		
Rainfed	77	96.25
Traditional	3	3.75
Other	-	-
3. Topography		
High	-	-
Medium high	56	70.00
Medium low	21	26.25
Low	3	3.75
4. Soil type		
Clay	35	43.75
Clay loam	19	23.75
Loam	17	21.25
Sandy loam	9	11.25
5. Soil fertility		
Good	11	13.75
Average	67	83.75
Poor	2	2.50

Table 5. Agronomic profiles of rice crops in the hill areas

Agronomic profiles	T.aman		Boro		Aus	
	N	%	N	%	N	%
1. Variety						
BR-3	7	10.14	3	8.11	-	
BR-8	2	2.90	-	-	-	
BR-11	43	62.32	9	24.32	1	33.33
BR-28	3	4.35	4	10.81	-	-
BR-29	2	2.90	-	-	-	-
China IRRI	-	-	16	43.24	2	66.67
Local	12	17.39	5	13.52	-	-
2. No. of plouhing						
5 times	15	21.74	2	5.41	-	-
4 times	47	68.12	24	64.86	2	66.67
3 times	7	10.14	7	18.92	1	33.33
2 times	-	-	4	10.81	-	-
3. No. of laddering						
5 times	3	4.35	-	-	-	-
4 times	9	13.04	-	-	-	-
3 times	44	63.77	17	45.95	2	66.67
2 times	13	18.84	13	35.14	1	33.33
1 times	-	-	7	18.91	-	-
4. Time of transplanting						

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Agronomic profiles	T.aman		Boro		Aus	
	N	%	N	%	N	%
T.aman						-
June	5	7.25	-	-	-	-
July	64	92.75	-	-	-	
Boro						
November	-	-	14	37.84	-	-
December	-	-	1	2.70	-	-
January	-	-	21	56.76	-	-
February	-	-	1	2.70	-	-
Aus						
March		-	-	-	3	100.00
5. Method of transplanting						
Line	11	15.94	15	40.54	-	-
Traditional	58	84.06	22	59.46	3	100.00
6. Spacing (line to line)						
20 cm	6	54.55	9	60.00	-	-
15 cm	5	45.45	6	40.00	-	-
7. Basal fertilizer application						
Urea, TSP, MP	7	101.14	3	8.11	-	-
Urea, TSP	4	5.80	12	32.43	-	-
TSP, MP	46	66.67	18	48.65	3	100.00
No	12	17.39	4	10.81	-	-
8. No. of top dress						
2 times	19	27.54	11	29.73	-	
1 times	47	68.12	23	62.16	3	
No	3	4.34	3	8.11	-	
9. No. of weeding						
2 times	21	30.44	24	64.87	2	66.67
1 times	37	53.62	9	24.32	1	33.33
No	11	15.94	4	10.81	-	
10. No. of irrigation						
4 times and above	-	-	9	24.32	-	
3 times	-	-	5	13.51	-	
2 times	-	-	7	18.92	-	
No	-	-	16	43.24		
11. No. of pesticides spray						
2 times	12	17.39	9	24.32		
1 times	16	23.19	16	43.24		
No	41	59.42	12	32.44		
12. Month of harvest						
T.aman						
October	49	71.021	-	-		
November	20	28.99	-	-		
Boro						
February	-	-	13	35.14		
March	-	-	3	8.11		
April	-	-	16	43.24		
May	-	-	5	13.51		
Aus						
June	-	-	-	-	3	100.00

Table 6. Cost and return of rice cropping in the hilly areas

Agronomic profiles	T.aman	Boro	Aus
Human labor	7788 (54)	10800 (58)	8516 (59)
Animal labor (Tk/ha)	3510	4023	3210
Fertilizer (Tk/ha)	1262 (9)	1721 (9)	1419 (10)
Urea	361	458	309
TSP	641	982	861
MP	260	281	249
Pesticide (Tk/ha)	398	423	-
Seed/seedling	1230 (9)	1348 (7)	1235 (9)
Total cost of production (Tk/ha)	14188	18515	14380

Figure in the paranthesis indicates the percentage of total cultivation cost.

Table 7. Comparative cost and returns of T.Aman Boro and Aus rice in the hilly areas

Items	T.Aman	Boro	Aus
Rice yield (kg/ha)	2919	3781	2563
Gross Returns (Tk/ha	28736	34364	23285
Rice (Tk/ha)	26271	32139	21145
Straw (Tk/ha)	2465	2225	2140
Price of rice (Tk/kg)	9.00	8.50	8.25
Total cost of production (Tk/ha)	14188	18515	14380
Net Returns (Tk/ha)	14585	15849	8905
Benefit cost ratio	2.03	1.86	1.62
Per unit cost of production (Tk/kg)	4.86	4.90	5.61

Table 8. Different crops grown under *Jhum* cultivation in the hilly area

Sl. No.	Name of crop	Variety	Source of seed
1.	Rice	Local	Own
2.	Brinjal	Local	Own
3.	Tuemeric	Local	Own
4.	Chilli	Local	Own
5.	Marpha	Local	Own
6.	Aram	Local	Own
7.	Sweet-gourd	Local	Own
8.	Bitter-gourd	Local	Own
9.	Other gourds	Local	Own
10.	Potato	Local	Own
11.	Okra	Local	Own
12.	Shenel	Local	Own
13.	Ribbedgourd	Local	Own
14.	Snakegourd	Local	Own
15.	Shimul alu	Local	Own
16.	Maize	Local	Own
17.	Yard-long bean	Local	Own
18.	Measak	Local	Own
19.	Tassel gourd	Local	Own
20.	Sabarang	Local	Own
21.	Yam	Local	Own
22.	Puji	Local	Own
23.	Cotton	Local	Own

Sl. No.	Name of crop	Variety	Source of seed
24.	Bottlegourd	Local	Own
25.	Sesame	Local	Own
26.	Cucumber		

Table 9. Constraint to agricultural production in the hilly area

Constraint	**Percent fermers responded**
Non-availability of HYV seed/seedlings	66
Lack of technical know-how	78
Lack of cash	65
Lack of irrigation facilities	82
Land ownership problem	50
Non availability of fertilizers	65
High price of fertilizers and other inputs	68
Lack of spray equipments	39
Lack of draft animal	25
Marketing problem	66
Natural hazards like flash flood	48
heavy rainfall and cyclone etc.	0

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

PERFORMANCE OF MUSTARD VARIETIES IN THE HILL VALLEY AREAS

M. Abdul Aziz, M. A. Rahman, Remi Chakma and M. Mostaque Ahmed

Abstract

A field trial was conducted at the BARI Technology village of Khagrachari, ARS, ramgarh and at farmers field of Dighnala of Khagrachari during the period from November 2005 to February 2006 to find out the performance of mustard varieties in the hill valley areas. Five varieties of mustard was teste in a RCB design with three replications. Among the varieties BARI Sarisha-11 showed maximum growth (plant height) performance and took maximum days for grain growth. The same variety gave the highest number of siliqua for plant, higher seed size and the highest yield. BARI Sarisha-11 may be recommended for hill valey areas after harvest of T.aman rice. The study should be repeated in the next season for final conformation.

Introduction

The total area of the Chittagong Hill Tracts is estimated around 13,237 sq. km, which is about one tenth of the country (Brammer, 1997). The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter. Annual average temperature: maximum 34.6^0C, minimum 13.0^0C; annual rainfall 3031 mm (BBS, 2004). The hills have mild to steep slopes often breaking or ending in cliffs. Recent alluviums occupy the valley floors. The Chittagong Hill Tract has high potential for agricultural development. Despite hilly terrain high rainfall and prolonged wet season, it remains well drained and offers an attractive scope for year-round agricultural production. The valleys and hilltops in this region are rich in natural resources. The existing cropping pattern in the hill valley is mostly T.aman-fallow-fallow. After harvest of T.aman rice short duration crops like mustard can be grown with residual soil moisture. Some farmers grow local variety of mustard with low yield potential. The present study was therefore, undertaken to select suitable variety of mustard for hilly areas of Bangladesh and to increase cropping intensity of the hilly areas.

Materials and Methods

The study was conducted at the BARI technology village of Khagrachari near HARS, Khagrachari, ARS, ramgorh and farmers field of Hajchora Jorabridge, Dighnala, Khagrachari after T.aman rice harvest during the period from November 2005 to February 2006. The trial was laid out in a RCB design with three replications. Five mustard varieties viz. Improved Tori-7, BARI sarisha-6, BARI sarasha-9, BARI sarisha-11 and local variety were included in the experiment. Seeds were sown on 25 November 2005 @ 8 kg/ha in solid line with 30 cm row spacing. The unit plot size was 5m x 4m. Fertilizers @ 120-80-60-40 and 4 kg N, P_2O_5, K_2O, S and Zn respectively were applied. Half of N and all other fertilizers were applied as basal and the remaining half N was applied before flowering at 25 days after sowing. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when necessary. The data were collected on days to flowering, days to maturity, grain growth period, plant population at harvest, plant height, No. of branches per plant, siliqua per plant, seed per siliqua, 1000-seed weight and grain yield. Collected data were statistically analyzed following "MSTAT" program. The differences between the means were compared using the least significant difference (LSD) test.

Results and Discussion

Khagrachari

Growth duration and some physio-morphological characters of mustard varieties are presented in Table 1 and yield and yield components are presented in Table 2. Days to flowering (23 to 33 days) and days to maturity (72 to 94 days) varied among the varieties (Table 1). BARI sarisha-11 took maximum days to flowering (33 days) and maturity (94 days) and local variety took minimum days to flowering (23 days) and days to maturity (72 days) respectively. Grain growth duration also varied among the varieties. Maximum grain growth period (61 days) was observed in BARI sarisha-11 followed by BARI sarisha-9 (52 days). Tori-7, BARI sarisha-6 and local variety was more or less similar in grain growth duration (49-50 days). The plant height varied significantly among the varieties. Highest plant height of 125 cm was observed in BARI sarisha-11. BARI sarisha-6, BARI sarisha-9 and local variety gave identical plant height. Tori-7 was significantly shortest plant (53.33 cm). Significantly highest number of branches per plant was found in BARI sarisha-9 (3.73) which was identical with BARI sarisha-11 (3.40), Tori-7 (3.20) and local (3.07). The lowest number of branches was observed in BARI sarisha-6 (2.43).

Significant variation in population/m^2 at harvest was observed among the varieties that might be due to management practices i.e. thinning operation. Minimum population/m^2 was observed in Tori-7 (Table 2). BARI sarisha-11 produced significantly the highest number of siliqua per plant (95.83) followed by BARI sarisha-9 (53.67). Tori-7 (41.47) and BARI sarisha-6 (40.73) produced identical number of siliqua per plant. Local variety gave significantly the lowest number of siliqua per plant (25.60). Number of seed per siliqua also varied significantly among the varieties and it was maximum in BARI sarisha-6 (16.9) which was similar with BARI sarisha-9 (14.9) and Tor-7 (13.8) followed by BARI sarisha-11 (12.6). The lowest number of seed per siliqua was observed in local variety (10.5). Significantly the highest seed weight was found in BARI sarisha-11 (3.03 g/1000 seed) and was identical with BARI sarisha-6 (3.00 g/1000 seed), BARI sarisha-9 (2.77 g/1000 seed) and Tori-7 (2.53 g/1000 seed). Local variety was significantly lowest in seed weight (2.37 g/1000 seed) but was similar with Tori-7 and BARI sarisha-9. BARI sarisha-11 gave significantly the highest yields (1740 kg/ha) which was identical with BARI sarisha-9 (1590 kg/ha). Significantly the lowest yield was obtained from local variety (1050 kg/ha). The highest yield in BARI sarisha-11 may be due to the maximum number of siliqua per plant, maximum seed weight and maximum grain growth duration Mondal *et. al.* (2003) reported that BARI sarisha-11 was highest yielder in a varital trial at Joydebpur which was due to maximum siliqua per plant maximum seed per siliqua and maximum grain weight.

Ramgorh

Significant differences were observed among the plant characters studied except plant height and 1000-seed weight (Table 3). Days to maturity varies from 98 to 92 days. RARI sarisha-11 took significantly highest days to maturity (98 days) followed by BARI sarisha-9 and it was minimum for local variety. Plant height varied from 103.88 cm for local variety to 116.46 cm in BARI sarisha-11 although it was insignificant. Significantly the maximum branching was observed in BARI Sarisha-11 (5.20) but was identical with improved Tori-7, BARI sarisha-6 and local. BARI sarisha-9 gave the lowest number of branches (3.70). Siliqua per plant varied significantly among the varieties. The highest number of siliqua per plant was found in BARI sarisha-11 (96.87) which was identical with BARI sarisha-9 (95.00) followed by improved

Tori-7 (87.07). Local variety gave significantly the lowest number of siliqua per plant (70.30). Tori-7 gave significantly the highest number of seed per siliqua (16.64) but was similar with BARI sarisha-11 (15.33). BARI sarisha-6 produced minimum number of seed per siliqua (9.94) which was identical with BARI sarisha-9 (10.92) and local (12.34). 1000-seed weight although varied insignificatly was higher in BARI sarisha-6 (2.46 g) followed by Tori-7 (2.43 g), BARI sarisha-11, (2.40 g) and local variety gave the minimum seed weight (1.70 g). Seed yield varied significantly among the varieties and it was highest in BARI sarisha-11 (930.66 kg/ha) followed by Tori-7 (875.67 kg/ha). Local variety gave significantly the lowest yield (547.67 kg/ha). The highest yield in BARI sarisha-11 was attributed due to maximum number of siliqua per plant, seed per siliqua and miximum growth duration. Similar result was also observed at Khagrachari and by Mandal *et al.* (2003).

Hajchara zorabridge village, Dighinala, Khagrachari

The varieties BARI sarisha-9, BARI sarisha-11 and Tori-7 grown in the field of Ratan Kumar and Buddo Kumar at Hijchara Zora bridge village indicated that BARI sarisha-11 performed better than other varieties. 1367 kg/ha yield was obtained from BARI sarisha-11 although it was grown under rainfed condition with residual soil moisture after T.aman rice harvest. The higher yield in BARI sarisha-11 was attributed for its maximum growth, highest number of siliqua per plant, maximum seed per siliqua and maximum seed weight.

It might be concluded that BARI sarisha-11 would be suitable for cultivation in the hill valey areas of Bangladesh after T.aman harvest. The experiment should be repeated in the next season with more dispersed locations for final conclusion.

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Table 1. Growth duration and some physio-morphological characters of mustard varieties grown in the hill valey area of Khagrachari

Variety	Days to flowering	Days to maturity	Grain growth period (Days)	Plant height (cm)	Branches/plant
BARI sharisha-6	32	82	50	75.33	2.43
BARI sharisha-9	31	83	52	73.33	3.73
BARI sharisha-11	33	94	61	125.0	3.40
Improved Tori-7	28	78	50	53.33	3.20
Local	23	72	49	70.33	3.07
LSD (0.05)	-	-	-	5.94	0.72
CV%	-	-	-	3.97	13.85

Table 2. Yield and yield components of mustard varieties grown in the hill valley area of Khagrachari

Variety	Population/m^2	Siliqua/ plant	Seed/ Siliqua	1000-seed weight (g)	Yield/ha (kg)
BARI sharisha-6	101	40.73	16.9	3.00	1410
BARI sharisha-9	106	53.67	14.8	2.77	1590
BARI sharisha-11	98	95.83	12.6	3.03	1740

Hill Eco-System

Variety	Population/m^2	Siliqua/ plant	Seed/ Siliqua	1000-seed weight (g)	Yield/ha (kg)
Improve Tori-7	91	41.47	13.8	2.53	1200
Local	108	25.60	10.5	2.37	1050
LSD (0.05)	14.81	10.25	3.20	0.56	157.0
CV%	7.84	10.58	8.56	5.93	10.79

Table 3. Growth parameters yield and yield contributing characteristics of mustard varieties grown in the hill valey area of Ramgorh

Variety	Days of maturity	Plant height (cm)	Branches/ plant	Siliqua/ plant	Siliqua/ pod	1000-seed weight (gh)	Yield (kg/ha)
BARI sharisha-6	95	107.35	4.06	82.70	9.94	2.46	732.67
BARI sharisha-9	96	114.44	3.70	95.00	10.92	2.17	827.67
BARI sharisha-11	98	116.46	5.20	96.87	15.33	2.40	930.66
Improved Tori-7	94	109.55	4.26	87.07	16.64	2.43	875.67
Local	92	103.88	4.06	70.30	12.34	1.70	547.67
LSD (0.05)	0.48	33.25	1.43	3.41	2.55	0.81	31.54
CV%	0.27	16.01	17.85	2.10	10.42	19.46	2.14

Table 4. Performance of mustard varieties grown in the farmer's field of hill valley area of Hajchara, Dighinala, Khagrachari

Variety	Plant height (cm)	Branches/plant	Siliqua plant	Seed/ siliqua	1000-seed weight (g)	Yield (kg/ha)
BARI sharisha-9	132.6	4.00	93.20	13.05	2.80	946
BARI sarisha-11	138.2	4.20	109.85	14.28	3.22	1367
Tori-7	79.8	3.60	80.20	12.00	2.44	890
Local	-	-	-	-	-	-
LSD (0.05)	21.1	NS	16.54	0.88	0.57	125
CV%	10.83	17.37	11.00	5.25	5.99	8.03

PERFORMANCE OF MUNGBEAN VARIETIES IN THE HILL VALLEY AREAS AFTER HARVEST OF MUSTARD/POTATO IN T.AMAN-FALLOW-FALLOW CROPPING PATTERN

Md. Abdul Aziz, M. A. Rahman, Remi Chakma and Mostaque Ahmed

Abstract

The experiment was conducted at the Hill Agricultural Research Stations (HARS) of Khagrachari, Ramgorh and Raikhali after harvest of mustard in T.aman-Fallow-Fallow croping pattern during Kharif-1 season of 2006. Six mugbean varieties viz. BARI mug 2, BARI mug 3, BARI mug 4, BARI mug 5, BINA mug 2 and BINA mug 5 was adopted in a RCB design with three replications. The trial was sown in last week of March 2006. The results indicated that mugbean could be grown after harvest of mustard in the hill valley areas. BARI mug 4 yielded (983 kg/ha) followed by BARI mug 3 (853 kg/ha) in Khagrachari BINA mug 2 (843 kg/ha) following BARI mug 5 (800 kg/ha) in Ramgorh and BARI mug 5 (1327 kg/ha) performed better in Raikhali areas. The experiment may be repeated in the next season for final conformation.

Introduction

The total area of the Chittagong Hill Tracts is estimated around 13,237 sq. km, which is about one tenth of the country (Brammer, 1997). The hills have mild to steep slopes often breaking or ending in cliffs. Recent alluviums occupy the valley floors. The Chittagong Hill Tracts has high potential for agricultural development. Despite hilly terrain high rainfall and prolonged wet season, it ramains well drained and offers an attractive scope for year-round agricultural production. The valleys and hilltops in this region are rich in natural resources. The existing cropping pattern in the hill valley is mostly T.aman-fallow-fallow. After harvest of T.aman rice in the last rabi season mustard could successfully grown with residual soil moisture

Through field visit at the time of mustard harvest it was observed that the existing residual soil moisture retained in the soil could also be enough for growth and production of summer short duration crop in the kharif-1 season. Short duration mungbean could be possible to fit in the existing cropping pattern after harvest of mustard. The present study was therefore, undertaken to find out the performance of mungbean and to select suitable variety of mungbean for hill valley areas of Bangladesh during Kharif-1 season.

Materials and Methods

The study was conducted at the Hill Agricultural Research Stations of Khagrachari, Ramgorh and Raikhali after harvest of mustard potato in T.aman-mustard/potato-fallow cropping pattern during the period from March to June 2006. The trial was laid out in a RCB design with three replications. Six mungbean varieties viz. BARI mug 2, BARI mug 3, BARI mug 4, BARI mug 5, BINA mug 2 and BINA mug 5 were included in the experiment. Seeds were sown on 2 March at Khagramchari and 22 March at Ramgorh @ 25 kg/ha in solid line with 30 cm row spacing. The unit plot size was 4m x 3m. Fertilizers @ 40-60-20-20-5 kg N, P_2O_5, K_2O S and Zn respectively were applied. Half of N and all other fertilizers were applied as basal and the remaining half N was applied before flowering at 25 days after sowing following irrigation. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when

necessary. The data were collected on days to flowering, plant height, no. of branches per plant, pods per plant, seed per pod, 1000-seed weight and grain yield. Collected data were statistically analyzed following "MSTAT" program. The differences between the means were compared using the least significant difference (LSD) test.

Results and Discussion

Khagrachari

The performance of mungbean after harvest of potato at Khagrachari (Table 1) indicated that variation in plant growth among the mungbean varieties was observed. The significant highest plant height (65.33 cm) was obtained from BARI mug 3. The shortest plant height (52.33 cm) was obtained from BARI mug 5. The branching (4.67) did not vary in BARI mug 3 but showed better growth performance of the same in the hill valley areas of Khagrachari compared to other varieties. The number of pods per plant varied significantly among the varieties and it was highest in BARI mug 2 (14.47). BINA mug 2 produced significantly the lowest number of pods per plant (9.67). The seed per pod was maximum in BARI mug 4 (10.13) and minimum in BINA mug 5 (9.13) but the variation was insignificant. The highest seed weight was found in BARI mug 5 (45.88 g/1000-seed) which was identical with BARI mug 4 (43.95 g/1000-seed) and BINA mug 5 (42.06 g/1000-seed). The seed weight of BINA mug 2 was the lowest (38.26 g/1000-seed). All the yield contributing characters finally contributed to the grain yield. Significantly the highest yield (983 kg/ha) was obtained from BARI mug 4 which was statistically similar with BARI mug 3 (853 kg/ha). BARI mug 2 produced significantly the lowest yield (626 kg/ha).

Ramgorh

Performance of mungbean in the hill valley areas of Ramgorh after harvest of mustard have been presented in Table 2. All the characters such as plant growth performance, yield components and yield significantly varied among the varieties. BINA mug 2 took maximum days to flowering (42 days) which was identical with BARI mug 3 (40.33 days), BARI mug 4 (41.33 days), BARI mug 5 (41.00) and BINA mug 2. Day to flowering was lowest in BARI mug 2 (40.00 days). Significantly the highest plant height was observed in BINA mug 2 (36.69 cm). Plant height of BARI mug 3, BARI mug 4, BARI mug 5 and BINA mug 5 was identical. BARI mug 2 produced the shortest plant (23.59 cm). Significantly the maximum pods per plant was obtained from BINA mug 2 (16.43) which was similar with BARI mug 3 (16.03). Minimum pods per plant was obtained from BARI mug 2 (14.37) but was identical with BARI mug 4 (14.43), BARI mug 5 (15.27) and BINA mug 5 (15.30). BINA mug 2 produced significantly the highest number of seed per pod (9.65). The lowest number of seed per pod (7.90) was obtained from BARI mug 3. 1000 grain weight was also highest in BINA mug 2 (44.37 g seed). Minimum grain weight was found in BARI mug 4 (39.13 g/1000-seed). The same variety BINA mug 2 produced significantly the highest yield per plant (2.59 g) and the highest yield per hectare (843 kg). The lowest yield was obtained from BINA mug 2 (1.98 g/plant and 633 kg/ha).

Raikhali

The results (Table 3 and Table 4) indicated that plant population, plant height at different growth stages, yield components and yield significantly varied among the mugbean varieties. The highest population/m^2 was obtained from BARI mug 5 (33.80 plants) which was identical with BARI mug 2 (33.28 plants). The lowest population/m^2 was in BINA mug 5 (25.57 plants) followed by BINA mug 2 (26.33 plants). The plant height varied significantly among the varieties and at

different growth stages. BINA mug 2 was the tallest plant among the six mungbean varieties. Its growth found maximum at all the growth stages; vegetative, flowering, pod development and maturity stages. BARI mug 5 produced significantly the highest number of pod per plant (12.40) which was identical with BINA (12.17). BINA mug 5 gave the lowest number of pod per plant (10.17) and was similar with BINA mug 2 (10.35). Seed per pod was highest in BARI mug 5 (11.53) and it was identical with BARI mug 2 (11.14). BINA mug 5 gave significantly the lowest number of seed per pod (9.2). The 1000-seed weight was maximum in BINA mug 2 (38.40 g) which was statistically similar with BARI mug 5 (38.31 g) and BINA mug 5 (38.20 g). BARI mug 3 gave the lowest 1000-seed weight (30.31 g) followed by BARI mug 4 (31.5 g). The heighest yield was obtained from BARI mug 5 (1327 kg/ha). BINA mug 5 gave significantly the lowest yield (930 kg/ha) followed by BINA mug 2 (986 kg/ha).

In may be concluded that after harvest of mustard in T.aman-fallow-fallow pattern (farmers pattern) mungbean could be grown in the hill valley areas of Khagrachari, Ramgarh and Raikhali. BARI mug 4 followed by BARI mug 3 performed batter in Khagrachari, BINA mug 2 performed better in Ramgorh and BARI mug 5 performed better in Raikhali areas. The experiment should be repeated in the next season for final conclusion.

Reference:

Brammer, H. 1977. Agriculture Development possibilities in Bangladesh. University Press Ltd.

Table 1. Performance of mungbean in the hill valley of Khagrachari after harvest of potato

Variety	Plant height (cm)	Branches/ plant	Pods/ plant	Seed/pod	1000-seed weight (g)	Yield (kg/ha)
BARI mug 2	53.00	4.33	14.47	9.50	38.91	626
BARI mug 3	65.33	4.67	11.47	9.63	39.83	853
BARI mug 4	57.33	4.40	11.87	10.13	43.95	983
BARI mug 5	52.33	3.93	10.87	10.07	45.88	784
BINA mug 2	52.67	4.07	9.67	9.93	38.26	723
BINA mug 5	53.67	4.00	10.43	9.13	42.06	760
LSD(0.5)	7.53	NS	4.03	NS	4.16	198.01
CV%	8.29	6.23	7.02	6.68	5.63	9.45

Table 2. Performance of mungbean in the hill valley of of Ramgar after harvest of mustard

Variety	Days to 50% flowering	Plant height (cm)	Pods/ plant	Seed/pod	1000-seed weight (g)	Yield/ plant	Yield (kg/ha)
BARI mug 2	40.00	23.59	14.37	8.76	41.22	1.98	633
BARI mug 3	40.33	28.55	16.03	7.90	39.52	2.06	699
BARI mug 4	41.33	32.18	14.43	8.68	39.13	2.19	710
BARI mug 5	41.00	32.16	15.27	9.03	39.43	2.35	762
BINA mug 2	41.33	36.69	16.43	9.65	44.37	2.59	843
BINA mug 5	42.00	31.98	15.30	8.36	40.17	2.46	800
LSD(0.5)	1.96	3.94	1.17	1.29	3.56	0.43	90.84
CV%	2.63	7.02	4.22	8.13	4.82	10.61	6.74

Hill Eco-System

Table 3. Plant population, and plant height of mungbean varieties at Raikhali after harvest of mustard

Variety	Plant population/ m^2	Plant height (cm)			
		Vegetative stage	Flowering stage	Pod development stage	Harvesting stage
BARI mug 2	33.28	6.83	15.73	30.77	46
BARI mug 3	30.33	7.03	17.77	35.87	58.8
BARI mug 4	29.17	5.33	12.93	32.87	58.4
BARI mug 5	33.8	7.4	15.1	29.13	45.07
BINA mug 2	26.33	7.8	23.1	42.47	66.47
BINA mug 5	25.57	6.2	18.47	35.67	57.8
LSD 0.05	1.8	0.66	1.15	1.29	2.73
CV%	4.57	5.36	3.68	4.06	6.71

Table 4. Yield and yield components of mungbean varieties at Raikhali after harvest of mustard

Variety	Pods /plant	Seeds /pod	1000-seed weight (g)	Yield (kg/ha)
BARI mug 3	11.33	9.63	30.31	1128
BARI mug 4	11.2	9.4	31.5	1002
BARI mug 5	12.4	11.53	38.31	1327
BINA mug 2	10.35	9.3	38.4	986
BINA mug 5	10.17	9.2	38.2	930
LSD 0.05	0.47	0.4	1.37	125
CV%	4.82	4.27	3.17	7.75

PERFORMANCE OF BARI HYBRID MAIZE VARIETIES IN THE HILLY AREAS OF BANGLADESH

Md. Abdul Aziz, A.F.M. Rahman, Remi Chakma and M. Ahmed

Abstract

A field trail was conducted at the hill agricultural research station, Khagrachari, Boropara, Khagrachari and Ramgorh during the rabi season of 2006-2007 to find out the agro-ecological influence on growth, development, yield and to compare the performances of BARI hybrid maize with commercial hybrid maize at hilly areas. Five varieties of hybrid maize were tasted in a RCB design with three replications. Among the varieties BARI hybrid maize 5 produced maximum yield at all the locations (Khagrachari 10.07 t/ha, Boropara 9.71 t/ha and Ramgorh 6.71 t/ha). The lowest yield was obtained from Pacific 984 (7.53 t/ha) at Khagrachari, BARI hybrid of maize 2 (6.42 t/ha) at Boropara and BARI hybrid maize 3 (4.51 t/ha) at Ramgorh,. BARI hybrid maize 5 may be suitable for cultivation in the hilly areas of Bangladesh. The study should be repeated in the next season for final conformation**.**

Introduction

Maize stands in third position among cereal crops in Bangladesh after rice and wheat. It can be grown through out the year because it is photo-insensitiveness. Its popularity increasingly day by day in Bangladesh because of its multipurpose uses. The Chittagong Hill Tracts has high potential for agricultural development (Brammer, 1197). The climate of the region is sub–tropical monsoon. Hot and humid rainy season alternates with dry and cool winter (Riessen, 2000). The climate of Bangladesh is most suitable for cultivation of maize including hilly region. In the hilly areas plain land is limited, so, it is essential to make intensive use of land by introducing hybrid varieties in order to get highest yield and more income. On the other hand, the tribal farmers are cultivating hybrid maize in the valley and in Jhum culture in small scale for food purpose and feed for poultry. Therefore, the present study was undertaken to find out the influence of hilly environment on growth, development and yield of hybrid maize and to select suitable variety for hilly region.

Materials and Methods

The study was conducted at the hill agricultural research station, Khagrachari, Boropara, Khagrachari and Ramgorh during the rabi season of 2006-07. The trail was laid out in a RCB design with three replications. Five hybrid maize varieties viz. BARI hybrid maize 2, BARI hybrid maize 3, BARI hybrid maize 5, Pacific 11 and Pacific 984 were included in the experiment. Seeds were sown on 29 November 2006 to 12 December 2007 with a spacing of 75 cm × 25 cm. The unit plot size was 4.5m × 3m. Fertilizers @ 250-60-100-30-5-1 kg/ha N, P, K, S, Zn and B and respectively were applied. $^1/_3$ of N and all other fertilizers were applied as basal and the remaining N was applied at two splits, at 30 DAE and at 50 DAE. Other intercultural operations such as weeding, thinning, earthing up, irrigation, pesticide application were done as and when necessary. The data were collected on days to taseling, days to silking, cob height, no. of cobs per plant, length of cob, diameter of cob, no. of seed per cob, 1000-seed wt. and grain yield. Collected data were statistically analyzed following MSTAT program. The differences between the means were compared using by DMRT.

Hill Eco-System

Results and Discussion

The yield and yield components of hybrid maize as influenced by hill-agro-ecological environment at Khagrachari, Boropara (farmers field) and Ramgorh are presented in Table 1. The results indicated that cob height varied significantly among the varieties at all the three locations except Khagrachari. The cob height was higher in BARI hybrid maize 2 at all the locations followed by BARI hybrid maize 3. Pacific 984 was the shorter in respect of cob height at all the locations. The number of cobs per plant varied significantly among the varieties at all the locations except Ramgorh. At Khagrachari. Pacific 11 gave maximum number of cob per plant (1.34) which was identical with BARI hybrid maize 5 (1.30) and BARI hybrid maize 2 (1.28) Pacific 984 gave minimum number of cob per plant (1.01) followed by BARI hybrid maize 3 (1.11). At Boropara, Pacific 11 (1.96) BARI hybrid maize 5 (1.93) and Pacific 984 (1.92) gave identical number of cob per plant. BARI hybrid maize 2 gave significantly the minimum number of cob per plant (1.29) followed by BARI hybrid maize 3 (1.44) cob length also varied significantly at all the locations except Ramgorh. At Khagrachari, signficantly the cob length was recorded from BARI hybrid maize 5 (19.03 cm) which was identical with Pacific 11 (18.87 cm). The lowest cob length was recorded from BARI hybrid maize 3 (18.48 cm) followed by BARI hybrid maize 2 (18.62 cm). A Boropara, BARI hybrid maize 5 (21.80 cm) followed by BARI hybrid maize 3 (21.60 cm) gave the highest cob length followed by BARI hybrid maize 2 (18.40 cm). The number of grains per cob significantly varied among the varieties at all the locations. At Khagrachari, the maximum number of grains per cob was obtained from BARI hybrid maize 5 (563.9) which was identical with BARI hybrid maize 3 (550.0) gave similar grain number per cob with Pacific 984 (530.4). The lowest number of grain per cob was obtained from Pacific 11 (511.5). At Boropara, the highest number of grain per cob was recorded from BARI hybrid maize 3 (563.8) which was identical with BARI hybrid maize 5 (559.7). BARI hybrid maize 2 (412.0) gave significantly the number of grain per cob. At Ramgorh, the highest number of grain per cob was recorded from BARI hybrid maize 5 (377.4) followed from BARI hybrid maize 5 (377.4) followed by Pacific 984 (322.2) and BARI hybrid maize 3 (305.1). BARI hybrid maize 2 (267.9) gave the lowest number of grain per cob followed by Pacific 11 (252.3). The 1000-grain weight varied significantly among the varieties at all locations except Khagrachari. At Boropara, Pacific 11 gave maximum 1000-grain weight was found in Pacific 11 (410.0 g) which was identical with BARI hybrid maize 5 (390.8 g), Pacific 984 (390.2 g) followed by BARI hybrid maize 2 (380.0 g). BARI hybrid maize 3 gave significantly the lowest 1000-grain weight which was identical with BARI hybrid maize 5 (363.3 g). BARI hybrid maize 3 gave the lowest 1000-grain weight (307.3 g). Finally the grain yield of hybrid maize significantly varied at all the locations. BARI hybrid maize 5 gave significantly the highest yield at all the three locations (10.07 t/ha at Khagrachari, 971 t/ha at Boropara and 6.71 t/ha at Ramgourh). The lowest yield was obtained from Pacific 984 (7.53 t/ha) at Boropara and BARI hybrid maize 3 (4.51 t/ha) at Ramgorh.

It was revealed from one year study that BARI hybrid maize 5 gave the highest yield at Khagrachari, Boropara farms filed and Ramgorh. Therefore, it might be concluded that BARI hybrid maize 5 would be suitable for cultivation in the hilly agro-ecological region of Bangladesh. The experiment should be repeated in the next year for final confirmation.

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Table 1. Yield and yield component of hybrid maize variety as influenced by hill agro-ecological environment at HARS, Ramgorh, Khagrachari and Boropara (Farmers field).

Varieties	Cob height (cm)			Cob/ plant			Cob length (cm)		
	Ram.	Boro	Khag	Ram.	Boro	Khag	Ram.	Boro	Khag
BARI hybrid maize 2	122.6a	95.8 a	122.1	1.13	1.29 b	1.28ab	162.7	18.40 c	18.62b
BARI hybrid maize 3	111.3ab	84.1 a	116.3	1.20	1.44 b	1.11bc	16.83	21.6 0a	18.48b
BARI hybrid maize 5	102.0b	81.7 a	108.2	1.29	1.93 a	1.30ab	16.88	21.80 a	19.03a
Pacific 11	109.1ab	80.0 b	122.1	1.13	1.96 a	1.34a	16.82	18.10 c	18.87a
Pacific 984	96.1b	76.3 b	111.4	1.06	1.92 a	1.01c	17.57	20.40 b	17.43c
CV%	7.00	8.27	7.38	8.54	6.25	7.78	11.05	5.83	1.15

Varieties	Grain/ cob (no.)			1000-grain wt. (g)			Yield (t/ha)		
	Ram.	Boro.	Khag.	Ram.	Boro.	Khag.	Ram.	Boro.	Khag.
BARI hybrid maize 2	267.9b	412.0 d	538.4b	353.0ab	380.0 ab	400	4.68cd	6.42 c	8.90b
BARI hybrid maize 3	305.1ab	563.8 a	550.0ab	307.3c	375.5 b	440	4.51d	6.80 c	9.37ab
BARI hybrid maize 5	377.4a	559.7 a	563.9a	363.3a	390.8 a	446	6.71a	9.71 a	10.07a
Pacific 11	252.3b	462.2 c	511.5c	336.3b	410.0 a	410	5.91b	7.47 b	8.83b
Pacific 984	322.2ab	501.4 b	530.4b	365.0a	390.2 a	450	5.85b	6.67 bc	7.53c
CV%	6.77	7.87	1.98	6.44	3.91	3.21	9.82	9.82	5.21

AGRO-ECOLOGICAL INFLUENCE ON GROWTH AND YIELD OF CHICKPEA VARIETIES IN THE HILLY AREAS

A.K.M.M. Rahman, M. A. Aziz and Remi Chakma

Abstract

A field trial was conducted at the Hill Agricultural Research Station, Kagrachari during the period from November 2006 to March 2007 to find out the agro-ecological influence on growth, development and yield of BARI released chickpea varieties. Five varieties of chickpea was tested in a RCB design with three replications. The hilly agro-ecology significantly affect the growth, development and yield of chickpea varieties. BARI chola 3 followed by BARI chola 6 showed better growth and development produced highest total dry matter, bear maximum branching and finally contributed highest grain yield under hill agro-ecological environment. Although the experiment was late sown, it should be repeated in the next season for final conclusion.

Introduction

Chickpea is the fifth important pulse crop in Bangladesh in terms of area and production (BBS, 2005). Previously it was the third important pulse crop in Bangladesh in terms of area and production. Its area and production drastically decreasing day by day due to competition with other crops. Botrytis grey mould a major disease of chickpea is also another cause of decreasing chickpea area and production (Bakr, 1991).

The chittagong Hill Tracts has high potential for agricultural development (Brammer, 1997). The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter (Riessen, 2000). The prolonged winter agro-climate might be suitable for the growth, development and yield of winter pulse like chickepea. The predominant cropping patterns followed by the hill farmers is rice based. Among the existing cropping patterns 54% of the farmers follow T.aman rice – fallow- fallow patterns (Aziz *et al*., 2006). It was also observed that about 71% of farmers harvest T.aman rice in the month of October and 29% in November. It indicated that there is enough scope of growing winter pulses like chickpea after harvest of T.aman rice in the hilly areas and as a result the area and production of chickpea will increase. Therefore, the present study was undertaken to find out the influence of hilly environment on growth, development and yield of chickpea.

Materials and Methods

The study was conducted at the Hill Agricultural Research station, Khagrachari after T.aman rice harvest during the period from November 2006 to March 2007. The trial was laid out in a RCB design with three replications. Five BARI released chickpea varieties viz. BARI chola 2, BARI chola 3, BARI chola 4, BARI chola 5 and BARI chola 6 were included in the experiment. Seeds were sown on 30 November 2006 @ 40 kg/ha in solid line with 30 cm row spacing. The unit plot size was 5m x 4m. Fertilizers @ 40-60-20-10-5 kg/ha N, P_2O_5, K_2O, S, Zn and B respectively were applied. All fertilizers were applied as basal before sowing. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when necessary. The data were collected on days to flowering, days to maturity, grain growth period, plant population at harvest, total dry matter production, plant height, branches per plant, pod per plant, seed per

pod, 1000-seed weight and grain yield. Collected data were statistically analyzed following "MSTAT" program. The differences between the means were compared using the least significant difference (LSD) test.

Results and Discussion

Crop growth duration of chickpea varieties as influenced by hilly agro-ecology presented in Table 1. It indicated that there was only 3 days variation in days to flowering among the varieties from 72 days in BARI chola 2 to 75 days in BARI choa 3 and BARI chola 5. The variation in days to maturity was 15 days from 120 days in BARI chola 2 and BARI chola 5 to 135 days in BARI chola 3. Grain growth duration also varied among the varieties (15 days). The highest grain growth duration was observed in BARI chola 3 (60 days) and the lowest in BARI chola 5 (45 days).

Ago-ecological influence on various growth parameter of different chickpea varieties are presented in Fig 1., Fig 2. and Fig.3. The prevailing hill ecological factors significantly affect the total dry matter (TDM) production of chickpea varieties Fig. 1. At 30 days after emergence (DAE) of crop significant variation in TDM production was observed. The highest TDM 1.32 (g/plant) was obtained from BARI chola 3 and the lowest TDM (0.74 g/plant) was obtained from BARI chola 5. From 30 DAE to 50 DAE the increase in TDM production was slow, more or less similar and identical in all the varieties except BARI chola 5. It indicated that the lag phase of chickpea growth existed between 30 to 50 DAE in the hilly agro-ecological zones. After 50 DAE the TDM production was rapid up to 70 DAE which indictated the log phase of chikpea plant. BARI chola 3 and BARI chola 6 produced significantly the highest TDM at 70 DAE followed by BARI chola 2 and BARI chola 4 but BARI chola 5 produced significantly the lowest TDM. After 70 DAE the increase in TDM production was significant and identical between BARI chola 3 and BARI chola 6 up to 90 and 110 DAE. It was found that the TDM production in BARI chola 2, BARI chola 4 and BARI chola 5 was more or less similar and insignificant after 70 DAE. It indicated that the hilly environment is more favorable for growth and dry matter product of BARI chola 3 and BARI chola 6 than the other varieties. BARI chola 3 and BARI chola 6 produced 11.94 and 11.34 g/plant TDM respectively at 110 DAE.

The growth of chickpea plant as plant height (Fig. 2.) significantly influenced by hilly agro-climate. In early growth stage of chickpea plant BARI chola 6 produced the tallest plant (12.00 cm) at 30 DAE followed by BARI chola 3 (10.80 cm). BARI chola 4 produced significantly the shortest plant (9.53 cm). After 30 DAE the increase in plant height was rapid up to 70 DAE and the rate of increase was more or less similar and parallel among the varieties. The rate of increase in plant height beyond 70 DAE and up to 110 DAE was slow and insignificant. The variation in plant height among the varieties was significant. AT 110 DAE significantly the height plant height was recorded from BARI chola 3 (30.33 cm) which was identical with BARI chola 2 (29.97 cm) and BARI chola 5 (29.63 cm). The lowest plant height was recorded from BARI chola 6 (27.67 cm) followed by BARI chola 4 (28.40 cm).

Hilly environment significantly influenced the branching behavior of chickpea varieties (Fig. 3.). At early growth stage of chickpea plant (30 DAE) the highest number of branches per plant was observed in BARI chola 3 (2.33) followed by BARI chola 2 (2.13) and the lowest number of branches per plant was observed in BARI chola 6 (1.73). The rate of increase in branching was maximum between 30 DAE and 50 DAE. AT 50 DAE BARI chola 6 produced significantly the highest number of branches per plant (3.67) which was identical with BARI chola 2 and BARI

chola 3. BARI chola 4 produced the lowest number of branches. After 50 DAE the rate of increase in branching was slow in BARI chola 2 and BARI chola 6 up to 70 DAE but the rate of increase was continuous in BARI chola 3, BARI chola 4 and BARI chola 5. At 70 DAE the highest number of branches was observed in BARI chola 3 (4.57) and lowest in BARI chola 6 (3.73) followed by BARI chola 2 (3.80). Beyond 70 DAE there was no branching in chickpea varieties. The above results revealed that BARI choal 3 produced the highest TDM, tallest plant and maximum branches in the hill valley area of Kagrachari. It indicated that agro-ecological environment of hill valley area is most suitable for the growth and development of BARI chola 3.

The yield and yield components of chickpea varieties as influenced by hill agro-ecology are presented in Table 2. Hilly environment significantly affect the yield and yield components of chickpea varieties except number of seed per pod. BARI chola 3 gave significantly the highest number of pod per plant (21.80) followed by BARI chola 6 (15.57). The lowest number of pod per plant was obtained from BARI chola 4 (9.40) which was identical with BARI chola 2 (10.93) and BARI chola 5 (11.40). The variation in number of seed per pod was insignificant among the chickpea varieties. Significantly the highest 1000-seed weight was found in BARI chola 2 (188.7 g). BARI chola 3 (186.4 g/1000 seed) and BARI chola 6 (186.8 g/1000 seed) gave identical seed weight followed by BARI chola 4 (176.3 g/1000 seed). BARI chola 5 gave significantly the lowest 1000-seed weight (130.1 g). Significantly the highest yield per plant was obtained from BARI chola 3 (4.80 g) followed by BARI chola 6 (3.05 g). BARI chola 4 gave significantly the lowest yield per plant (1.25 g) which was atper with BARI chola 2 (1.83 g). The contribution of all the yield contributing characters finally affect the grain yield. Significantly the highest grain yield was recorded from BARI chola 3 (808 kg/ha) followed by BARI chola 6 (741 kg/ha). The lowest grain yield was obtained from BARI chola 2 (397 kg/ha) which was identical with BARI chola 5 (405 kg/ha). The highest yield obtained in BARI chola 3 possibly due to maximum TDM production, highest number of pod per plant and maximum grain growth duration that contributed to the final grain yield. It might be concluded that the agro-climate of hilly area is most favorable for vegetative growth, total dry matter production and grain yield of BARI chola 3 followed by BARI chola 6. The experiment should be repeated over locations in the hilly areas by coming season for final conclusion.

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Table 1.Days to flowering, Days to maturity and grain growth duration of chickpea varieties as influenced by hill agro-Ecological environment

Varieties	Days to 50% flowering	Days to maturity	Grain growth duration
BARI chola 2	72	120	48
BARI chola 3	75	135	60
BARI chola 4	74	124	50
BARI chola 5	75	120	45
BARI chola 6	73	125	52

Table 2.Yield and yield component of chickpea variety as influenced by hill agro-Ecological environment

Varieties	Pods/plant	Seed/pod	1000 seed weight (g)	Yield/plant	Grain yield (kg/ha)
BARI chola 2	10.93 c	1.04	188.7 a	1.83 cd	397 c
BARI chola 3	21.80 a	1.05	186.4 b	4.80 a	808 a
BARI chola 4	9.400 c	1.07	176.3 c	1.25 d	600 bc
BARI chola 5	11.40 c	1.07	130.1 d	2.67 bc	405 c
BARI chola 6	15.57 b	1.08	186.8 b	3.05 b	741 ab
CV (%)	12.26	3.28	7.24	8.63	11.42

Appendix – I. Agro-climatic data of ARS, Kagrachari from November/06 to April/07

Month	Temperature (^{O}C)		Rainfall (mm)	Humidity (%)
	Maximum	Minimum		
November/06	33.50	20.87	0	82.13
December/06	27.66	14.16	0	78.94
January/07	23.61	12.68	0	79.86
February/07	23.61	12.68	37.6	79.87
March/07	31.69	18.21	14.7	81.60
April/07	34.37	23.21	89.8	81.97

Hill Eco-System

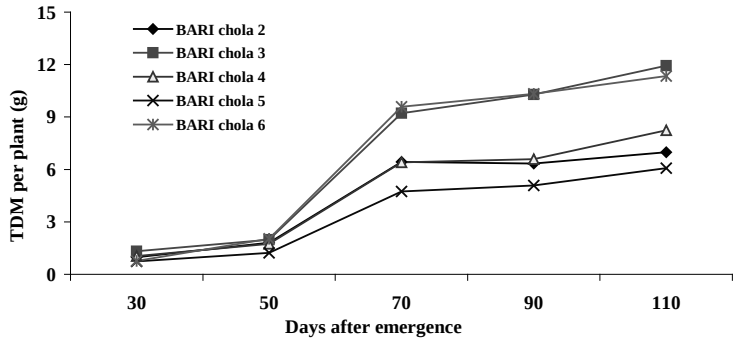

Fig. 1. Influence of hilly environment on total dry matter production of chickpea varieties

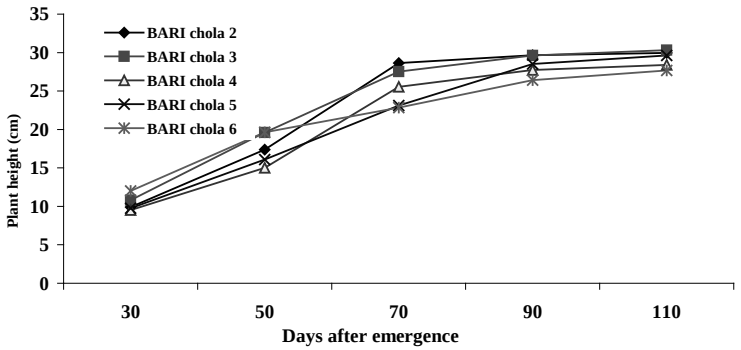

Fig. 2. Influence of hilly environment on plant height of chickpea varieties

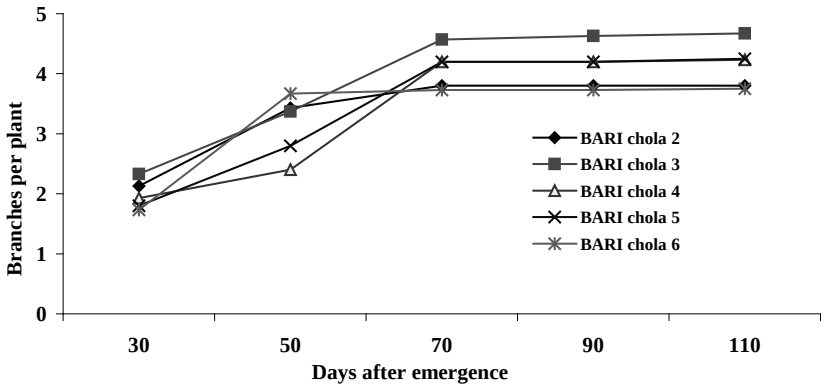

Fig. 3. Influence of hilly environment on branching of chickpea varieties

INFLUENCE OF HILLY ENVIRONMENT ON VEGETATIVE GROWTH AND REPRODUCTIVE DEVELOPMENT IN LENTIL VARIETIES

A.K.M.M. Rahman, M. A. Aziz and Remi Chakma

Abstract

A field trial was conducted at the Hill Agricultural Research Station, Kagrachari during the period from November 2006 to March 2007 to find out the influence of hilly environment on vegetative growth and reproductive development in lentil varieties. Four varieties of lentil were tested in a RCB design with three replications. The hilly environment significantly affects the growth, development and yield of lentil varieties. BARI masur 4 showed better growth and development, produced highest total dry matter, bear maximum branching and finally contributed highest grain yield under hilly environment. Although the experiment was late sown and infested by stem phylum blight disease due to heavy rain during flowering and pod development stage that causes low yield of lentil. Therefore the experiment should be repeated in the next season.

Introduction

Lentil is the second important pulse crop in Bangladesh after lathyrus in terms of area and production (BBS, 2005). Its area and production decreasing day by day due to competition with other crops and severe infestation by some of major diseases like stem phylum blight (Bakr, 1991). The hilly area consists of a series of anti-clinical ridges running parallel to one another and tending to the north-east direction. The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter Riessen, 2000). The prolonged winter climate might be suitable for the growth and development of winter pulses like lentil and chickpea. It was observed that after harvest of T.aman most of the valleys remain fallow. The predominant cropping patterns followed by the hill farmers is rice based. Among the existing cropping patterns 54% of the farmers follow T.aman rice– fallow- fallow patterns (Aziz *et al*., 2006). It was also observed that about 71% of farmers harvest T.aman rice in the month of October and 29% in November. It indicated that there is enough scope of growing winter pulses like lentil after harvest of T.aman rice in the hilly areas and as a result the area and production of lentil will increase. An observation with lentil cultivation at Dighinala of Khagrachari showed that lentil could be grown in the hilly environment. Therefore, the present study was undertaken to find out the influence of hilly environment on growth, flowering and pod setting and yield of lentil.

Materials and Methods

The study was conducted at the Hill Agricultural Research station, Khagrachari after T.aman rice harvest during the period from November 2006 to March 2007. The trial was laid out in a RCB design with three replications. Four BARI released lentil varieties viz. BARI masur 1, BARI masur 2, BARI masur 3 and BARI masur 4 were included in the experiment. Seeds were sown on 30 November 2006 @ 25 kg/ha in solid line with 30 cm row spacing. The unit plot size was 5m x 4m. Fertilizers @ 40-60-20-10-5 kg/ha N, P_2O_5, K_2O, S, Zn and B respectively were applied. All fertilizers were applied as basal before sowing. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when necessary. The data were collected on days to flowering, days to maturity, grain growth period, plant population at harvest, total dry matter production, plant height, branches

per plant, pod per plant, seed per pod, 1000-seed weight and grain yield. Collected data were statistically analyzed following "MSTAT" program. The differences between the means were compared using the least significant difference (LSD) test.

Results and Discussion

The influence of hilly environment influence on various growth parameter of different lentil varieties are presented in Fig. 1. Fig. 2. and Fig.3. The prevailing environmental factors significantly affect the total dry matter (TDM) production of lentil varieties Fig. 1. At 30 days after emergence (DAE) of crop the TDM production in all the lentil varieties was more or less similar with slight exception. The highest TDM 0.34 (g/plant) was obtained from BARI masur 4 and the lowest TDM (0.24 g/plant) was obtained from BARI masur 2. From 30 DAE to 50 DAE the increase in TDM production was rapid and continued up to 70 DAE. It indicated that the lag phase of lentil growth existed within 30 DAE and between 30 to 70 DAE was the log phase in the hilly agro-ecological zones. At 50 DAE the variation in TDM production among the lentil varieties was significant. The highest TDM was produced by BARI masur 2 followed by BARI masur 1 which was identical with BARI masur 4. BARI masur 3 produced the lowest TDM. After 70 DAE the TMD per plant was decreased in all the varieties up to harvest. The decrease in TDM might be due to the severe infestation stem phylum blight. After 70 DAE the variation in TDM production among the varieties was significant up to 90 and 110 DAE. At harvest (110 DAE) BARI masur 4 produced significantly the highest TDM per plant. It indicated that the hilly environment is more favorable for growth and dry matter product of BARI masur 4 than the other lentil varieties.

In early growth stage of lentil plant up to 50 DAE the plant height was insignificant among the varieties (Fig. 2.). The growth of lentil plant as plant height significantly influenced by hilly agro-climate after 50 DAE. Plant height increased rapidly in the varieties up to 70 DAE and then slowly up to 90 DAE. After 90 DAE the plant height decreased in most of the varieties possibly due to severe infestation by stem phylum blight. Branching behavior in lentil varieties was insignificant at the initial growth stage (30 DAE) (Fig.3). Hilly environment significantly influenced the branching behavior of lentil varieties at 50 DAE. The highest number of branches/plant (5.80) was found in BARI mashur 3 which was identical with BARI mashur 4 (5.73). The lowest number of branches/plant observed in BARI mashur 1 (4.93). No branching was observed in all the varieties after 70 DAE.

The yield and yield components of lentil varieties as influenced by hilly environment are presented in Table 1. Hilly environment significantly affect the yield and yield components of lentil varieties except number of seed per pod. BARI mashur 4 gave significantly the highest number of pod per plant (15.33) followed by BARI mashur 3 (10.20). The lowest number of pod per plant was obtained from BARI mashur 2 (6.13). The variation in number of seed per pod was insignificant among the lentil varieties. Significantly the highest 1000-seed weight was found in BARI mashur 3 (21.40 g) followed by BARI mashur 4 (20.55 g). BARI mashur 2 (16.25 g) gave the lowest 1000 seed weight which was identical with BARI mashur 1 (16.65 g/1000 seed). Significantly the highest yield per plant was obtained from BARI mashur 4 (0.254 g). BARI mashur 2 gave significantly the lowest yield per plant (0.143 g) which was at per with BARI mashur 1 (0.157 g) and BARI mashur 3 (0.193 g). The contribution of all the yield contributing characters finally affects the grain yield. Significantly the highest grain yield was recorded from BARI mashur 4 (136 kg/ha). The lowest grain yield was obtained from BARI

mashur 2 (72 kg/ha) which was identical with BARI mashur 1 (89 kg/ha) and BARI mashur 3 (85 kg/ha). It might be concluded that the hilly environment is favorable for vegetative growth, total dry matter production and grain yield of BARI mashur 4. The low yield in masur was due to severe infestation of stem phylum blight caused by excess rain at flowering and pod development stages. The experiment should be repeated over locations in the hilly areas by coming season for final conclusion.

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Table 1. Yield and yield component of lentil varieties as influenced by hilly environment

Treatment	Pods/plant	Seed/pod	1000 seed weight (g)	Yield/plant	Grain yield (kg/ha)
BARI masur-1	8.20 c	1.17	16.65 c	0.157 b	89 b
BARI masur-2	6.13 d	1.07	16.25 c	0.143 b	72 b
BARI masur-3	10.20 b	1.21	21.40 a	0.193 b	85 b
BARI masur-4	15.33 a	1.24	20.55 b	0.254 a	136 a
CV (%)	18.34	4.61	3.29	12.65	10.44

Hill Eco-System

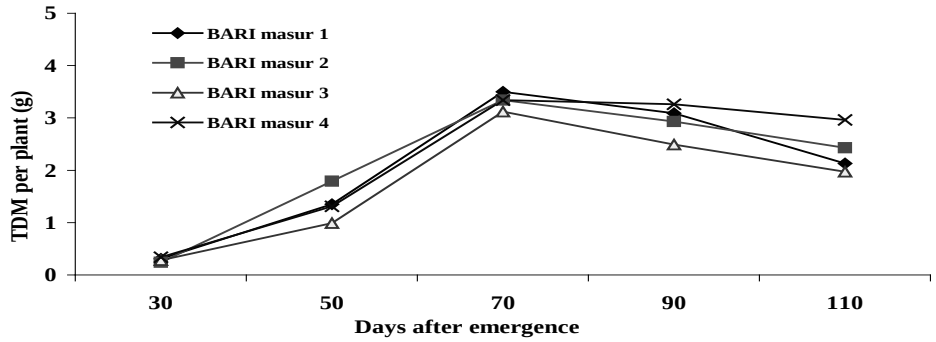

Fig. 1. Influence of hilly environment on total dry matter production of lentil varieties

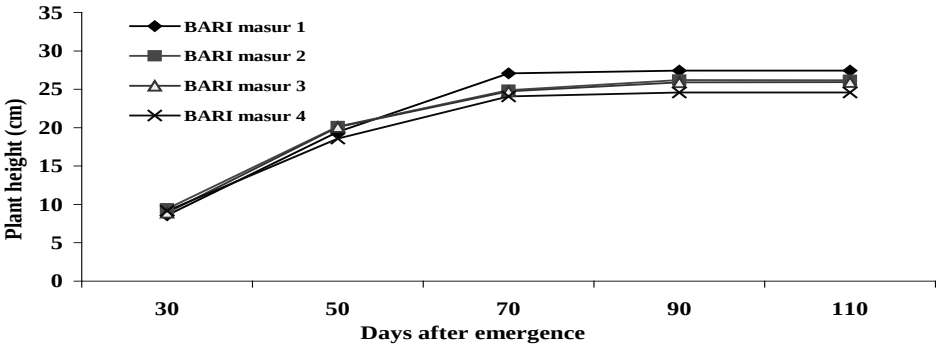

Fig. 2. Influence of hilly environment on plant height of lentil varieties

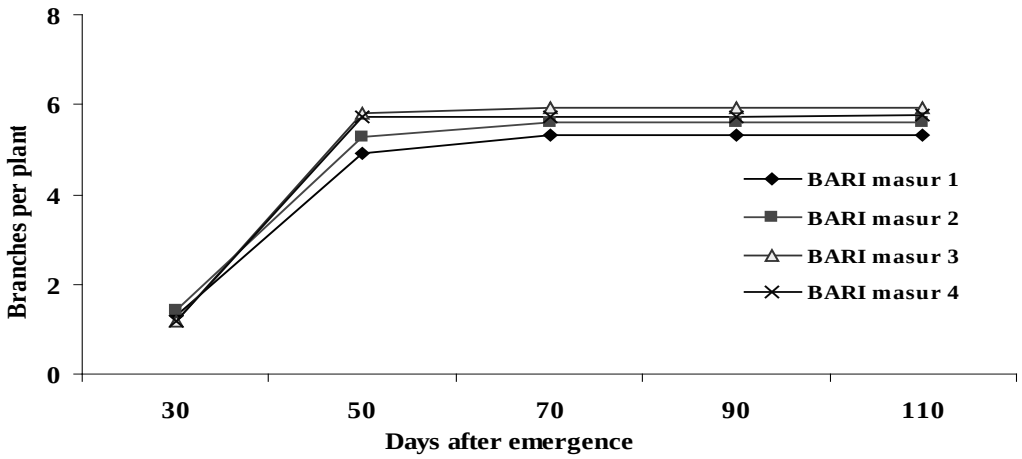

Fig. 3. I nfluence of hilly e nvironment on branching of lentil varieties

PERFORMANCE OF MUSTARD VARIETIES IN THE HILL VALLEY AREAS

M. Abdul Aziz, Remi Chakma, M. Mostaque Ahmed and S.Ahsan

Abstract

A field trial was conducted at the Ramgarh and Raikhali ARS during the period from November 2006 to February 2007 to find out the performance of mustard varieties in the hill valley areas. Five varieties of mustard was tested in a RCB design with three replications. Among the varieties BARI Sarisha-11 showed maximum growth (plant height) performance and took maximum days for grain growth. The same variety gave the highest number of siliqua for plant, higher seed size and the highest yield. It might be concluded that BARI Sarisha 11 may be could be grown in the hill valley areas after harvest of T.aman rice in T.amam-Fallow-Fallow cropping pattern.

Introduction

The total area of the Chittagong Hill Tracts is estimated around 13,237 sq. km, which is about one tenth of the country (Brammer, 1997). The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter. Annual average temperature: maximum 34.6^{0}C, minimum 13.0^{0}C; annual rainfall 3031 mm (BBS, 2004). The hills have mild to steep slopes often breaking or ending in cliffs. Recent alluviums occupy the valley floors. The Chittagong Hill Tract has high potential for agricultural development. Despite hilly terrain high rainfall and prolonged wet season, it remains well drained and offers an attractive scope for year-round agricultural production. The valleys and hilltops in this region are rich in natural resources. The existing cropping pattern in the hill valley is mostly T.aman-fallow-fallow. After harvest of T.aman rice short duration crops like mustard can be grown with residual soil moisture. Some farmers grow local variety of mustard with low yield potential. The present study was therefore, undertaken to select suitable variety of mustard for hilly areas of Bangladesh and to increase cropping intensity of the hilly areas.

Materials and Methods

The study was conducted at the Ramgarh and Raikhali ARS after harvest of T.aman rice during the period from November 2006 to February 2007. The trial was laid out in a RCB design with three replications. Five mustard varieties viz. Tori-7, BARI sarisha-6, BARI sarasha-9, BARI sarisha-11 and local variety were included in the experiment. Seeds were sown on 20-25 November 2006 @ 8 kg/ha in solid line with 30 cm row spacing. The unit plot size was 5m x 4m. Fertilizers @ 120-80-60-40 and 4 kg N, P_2O_5, K_2O, S and Zn respectively were applied. Half of N and all other fertilizers were applied as basal and the remaining half N was applied before flowering at 25 days after sowing. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when necessary. The data were collected on days to flowering, days to maturity, grain growth period, plant population at harvest, plant height, No. of branches per plant, siliqua per plant, seed per siliqua, 1000-seed weight and grain yield. Collected data were statistically analyzed following "MSTAT" program. The differences between the means were compared using the least significant difference (LSD) test.

Results and Discussion

Yield and yield components presented in Table 1. Plant height varied significantly among the varieties in both the locations. The highest plant height of 116.5 cm at Ramgorh and 113.88 cm at Raikhali was obtained from BARI sarisha 11. Significantly the lowest plant height was obtained from local variety. Branches per plant also varied significantly among the varieties. BARI

sharisha 11 produced maximum branches per plant at both the locations. The results showed that the growth duration and physio-morphological growth characters such as plant height and branching habit was maximum in BARI sharisha 11 at both the locations. It indicated that the agro-climate of hilly areas is suitable for the growth of BARI sharisha 11.

Table 1. Yield and yield components of mustard varieties grown in the hill valley area of Ramgorh and Raikhali following T.aman in T.aman-Fallow-Fallow pattern

Variety	Plant heifgt (cm)		Branches/plant		Siliqua/ plant		Seed/ siliqua		1000-seed weight (g)		Yield (kg/ha)	
	Ram	Rai	Ram	Rai	Ram	Rai	Ram	Rai	Ram	Rai	Ram	Rai
Tori-7	109.8	105.81	5.16	4.93	90.54	91.3	17.96	14.68	2.88	2.28	884	926
BARI sharisha-6	109.9	100.39	5.12	4.18	85.63	92.1	12.26	9.45	2.92	2.20	734	879
BARI sharisha-9	114.7	110.60	4.52	3.61	97.24	88.5	12.41	8.43	2.52	2.21	836	761
BARI sharisha-11	116.5	113.88	5.81	5.30	101.01	98.7	17.58	13.53	2.88	2.47	947	1050
Local	106.2	96.33	5.04	4.62	72.89	82.4	10.18	10.82	1.95	1.53	553	570
LSD (0.05)	7.80	NS	0.55	1.03	2.31	4.5	2.60	2.6	0.05	NS	12.49	42.56
CV%	3.72	16.25	5.71	12.48	1.37	3.34	9.82	9.85	1.23	17.35	0.84	3.10

Ram= Ramgorh, Rai= Raikhali

All the yield contributing characters and yield varied significantly among the varieties at both the locations except 100-seed weight at Raikhali (Table 1). The highest number of siliqua per plant (101.1 and 98.7 at Ramgorh and Raikhali) was obtained from BARI sarisha 11. Significantly the lowest number of siliqua was obtained from local variety at both the locations. At Ramgorh, significantly the highest number of seed per siliqua was recorded from Tori 7 (17.96) follpwed by BARI sharisha 11 (17.58). The local variety gave the lowest number of seed per siliqua (10.18). At Raikhali, Tori 7 gave significantly the highest number of seed per siliqua (14.68) followed by BARI sarisha 11 (13.53). BARI sarisha 9 gave the lowest number of seed per siliqua (8.43). Significantly the higher 1000-seed weight was obtained from BARI sarisha 11 followed by Tori 7 (2.88g). The local variety at Ramgorh (1.95 g) and Raikhali (1.53 g) gave the lowest 1000-seed weight. The seed yield also influenced significantly among the varieties at both locations. It was observed that BARI sarisha 11 produced significantly the highest yield at both the locations. BARI sarisha 11 produced 1050 kg/ha at Raikhali and 947 kg/ha at Ramgorh and 1367 kg/ha at Dighinala. Significantly the lowest yield was produced by local variety at Khargrachari (1050 kg/ha). The highest yield in BARI sharisha 11 may be attributed due to its maximum siliqua per plant and 1000-seed weight. Mondal et al. (2003) and Aziz *et al.*, (2006) reported that BARI sarisha 11 was highest yielder in a varietal trial at Joydebpur and hilly areas which was due to maximum siliqua per plant, maximum seed per siliqua and maximum grain weight.

On the basis of growth duration, physio-morphological growth parameters, yield components and their contribution to final yield it might be concluded that BARI sarisha 11 would be suitable for cultivation in the hill valley areas of Bangladesh after harvest of T.aman rice.

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PERFORMANCE OF MUNGBEAN VARIETIES IN THE HILL VALLEY AREAS AFTER HARVEST OF MUSTARD IN T.AMAN-FALLOW-FALLOW CROPPING PATTERN

Md. Abdul Aziz, Remi Chakma and A.F.M.S.Ahsan

Abstract

The experiment was conducted at the Hill Agricultural Research Stations (HARS) of Khagrachari and Raikhali after harvest of mustard in T.aman-Fallow-Fallow croping pattern during Kharif-1 season of 2007. Six mugbean varieties viz. BARI mug 2, BARI mug 3, BARI mug 4, BARI mug 5, BARI mug 6, and BINA mug 5 was adopted in a RCB design with three replications. The trial was sown in last week of March 2007. The results indicated that mugbean could be grown after harvest of mustard in the hill valley areas. BARI mug 4 yielded (983 kg/ha) followed by BARI mug 3 (710 kg/ha) in Khagrachari and BARI mug 6 (1470 kg/ha) following BARI mug 4 (1388 kg/ha) in Raikhali area.

Introduction

The total area of the Chittagong Hill Tracts is estimated around 13,237 sq. km, which is about one tenth of the country (Brammer, 1997). The hills have mild to steep slopes often breaking or ending in cliffs. Recent alluviums occupy the valley floors. The Chittagong Hill Tracts has high potential for agricultural development. Despite hilly terrain high rainfall and prolonged wet season, it ramains well drained and offers an attractive scope for year-round agricultural production. The valleys and hilltops in this region are rich in natural resources. The existing cropping pattern in the hill valley is mostly T.aman-fallow-fallow. After harvest of T.aman rice in the last rabi season mustard could successfully grown with residual soil moisture

Through field visit at the time of mustard harvest it was observed that the existing residual soil moisture retained in the soil could also be enough for growth and production of summer short duration crop in the kharif-1 season. Short duration mungbean could be possible to fit in the existing cropping pattern after harvest of mustard. The present study was therefore, undertaken to find out the performance of mungbean and to select suitable variety of mungbean for hill valley areas of Bangladesh during Kharif-1 season.

Materials and Methods

The study was conducted at the Hill Agricultural Research Stations of Khagrachari and Raikhali after harvest of mustard in T.aman-Fallow-Fallow cropping pattern during the period from March to May 2007. The trial was laid out in a RCB design with three replications. Six mungbean varieties viz. BARI mug 2, BARI mug 3, BARI mug 4, BARI mug 5, BARI mug 6 and BINA mug 5 were included in the experiment. Seeds were sown on 2 March at Khagramchari and 22 March at Ramgorh @ 25 kg/ha in solid line with 30 cm row spacing. The unit plot size was 4m x 3m. Fertilizers @ 40-60-20-20-5 kg N, P_2O_5, K_2O S and Zn respectively were applied. Half of N and all other fertilizers were applied as basal and the remaining half N was applied before flowering at 25 days after sowing following irrigation. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when necessary. The data were collected on days to flowering, plant height, no. of branches per plant, pods per plant, seed per pod, 1000-seed weight and grain yield. Collected data were statistically analyzed following "MSTAT" program. The differences between the means were compared using the least significant difference (LSD) test.

Hill Eco-System

Results and Discussion

The performance of mungbean varieties in the hill valley areas of Khagrachari and Raikhali are presented in Table 1. The number of branches per plant varied significantly among the varieties at khagrachri only. Maximum number of branches per plant (4.53) was obtained from BARI mug 4 (Table 1). BARI mug 2, BARI mug 5 and BINA mug 6 gave identical number of branches per plant. The lowest number of branches per plant (3.13) was obtained from BARI mug 3.

Significant difference in pods per plant among the varieties was observed at all the locations (Tabel). At Khagrachari, the maximum number of pod per plant was found in BARI mug 3 (25.67) which was identical with BARI mug 4 (25.40) and BINA mug 5 (25.27). The lowest pod per plant was found in BARI mug 5 (15.35). At Raikhali, significantly the highest pod was obtained from BARI mug 4 (21.30) which was identical with BINA mug 6 (19.87) followed by BARI mug 3 (17.27). The lowest pod was obtained from BARI mug 2 (15.47) with was identical with BINA mug 5 (15.60). Seed per pod varied significantly among the varieties only at Khagrachari. At Khagrachari, the maximum number of seed per pod was obtained from BINA mug 5 (12.3) but was identical with BARI mug 2 (12.0), BARI mug 6 (11.5), BARI mug 4 (11.3), and BARI mug 3 (10.8). BARI mug 5 gave minimum seed per pod (10.6). At Raikhali, although insignificant the higher number of seed per pod was found in BARI mug 6 (11.6). BARI mug 2 the gave minimum number of seed per pod (9.5). 1000-seed weight also varied significantly among the varieties at both the locations. At Khagrachri, 1000-seed weight was significantly highest in BINA mug 5 (51.0g) but was identical with BARI mug 6 (50.0g). The lowest 1000-seed weight was recorded from BARI mug 3 (27.0g) followed by BARI mug 2 (33.0g). At Raikhali, BARI mug 6 gave maximum 1000-seed weight (46.3g) but was statistically similar with BARI mug 4 (44.7g). BARI mug 2 gave significantly the lowest 1000-seed weight (38.3g). Grain yield, the final contribution of all the yield components influenced significantly among the varieties at all the locations. At Khagrachri, significantly the highest yield was obtained from BARI mug 4 (963 kg/ha) followed by BARI mug 3 (710 kg/ha). BARI mug 6 gave significantly the lowest yield (610 kg/ha) followed by BINA mug 2 (670 kg/ha) and BARI mug 2 (643 kg/ha). At Raikhali, significantly the highest yield was obtained from BARI mug 6 (1470 kg/ha) which was identical with BARI mug 4 (1388 kg/ha). The lowest yield was obtained from BARI mug 5 (1045 kg/ha) followed by BARI mug 2 (1060 kg/ha).

From the study it may be concluded that after harvest of mustard in T.aman-Fellow-Fallow pattern (farmers patter) mungbean could be grown in the hill valley areas of Khagrachari and Raikhali. BARI mug 4 performed better in Khagrachari and BARI mug 6 followed by BARI mug 4 in Raikhali area. But in the last year BARI mug 5 performed better in Khagrachari and Raikhali and BINA mug 2 in Ramgorh area. Therefore the experiment should be repeated in the next season for final conclusion.

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Table 1. Performance of mungbean in the hill valley of Khagrachari and Raikhali after harvest of mustard

Variety	Branches/Plant		Pods/Plant		Seed/pod		1000-seed weight (g)		Yield (kg/ha)	
	Khag	Rai	Khag	Rai	Khag	Rai	Khag	Rai	Khag	Rai
BARI mug 2	3.80ab	4.55	19.80cd	15.47c	12.0ab	9.5	33.0c	38.3c	643c	1060c
BARI mug 3	3.13b	4.57	25.67a	17.27abc	10.8ab	11.3	27.0d	41.8bc	710b	1180b
BARI mug 4	4.53a	4.75	25.40ab	21.30a	11.3ab	11.4	31.0c	44.7ab	963a	1388a
BARI mug 5	2.53b	4.20	15.35d	16.53bc	10.6b	10.4	42.0b	42.0bc	650c	1045c
BINA mug 6	3.73ab	5.31	20.57bc	19.87ab	11.5ab	11.6	50.0a	46.3a	610d	1470a
BINA mug 5	3.80ab	4.03	25.27ab	15.60c	12.3a	10.3	51.0a	40.5bc	670c	1133bc
CV%	12.28	7.34	11.73	6.13	6.74	10.3	5.63	9.64	6.56	10.25

Khag= Khagrachari, Rai= Raikhali

INTERCROPPING POPCORN WITH BUSHBEAN AND PEA AT DIFFERENT PLANTING SYSTEM IN HILL VALLEY AREAS

Remi Chakma, M. A. Aziz, and S.A. Mallick

Abstract

As intercropping experiment was conducted at HARS, Khagrachari during rabi season of 2006 to find out the suitable combination of popcorn and bushbean/pea as intercrop for obtaining maximum return through increasing productivity of the crop. Four intercrop combinations viz. Popcorn normal row + 2 rows bushbean, popcorn paired row +4 rows bushbean, popcorn normal row +2 row Pea, popcorn paired row +4 rows pea were compared with their sole crop. Popcorn normal row + 4 rows pea was found was found as suitable combination in terms of higher maize equivalent yield (6590 kg/ha), gross return (TK. 395400/ha) and benefit cost ratio (4.22).

Introduction

Intercropping is a traditional practice in Bangladesh. Although in the Chittagong Hilltracts, intercropping is very oldest traditional practice. It increases total productivity per unit area through maximum utilization land, labour and growt resources(Craufard, 2000; Quayyam et al., 1999; Marshal and Willey, 1983). Both maize and bushbean are the promising crops at Hilly region. But in the recent year cultivation of hybrid, composite or synthetic maize varieties is decreasing due to proper marketing facilities. Popcorn becomes popular among the tribal people but popcorn is not available in local market. The canopy structure popcorn plant is moderate under which bushbean may be cultivated as intercrop with or without least hampering due to shading effect. It may promote the net return through increasing the productivity of the crops. Besides, as the maize is an exhaustive crop, bushbean may be helpful improve soil fertility through nitrogen fixation from the atmosphere and after harvesting the green pod, plant biomass of bushbean and pea can be incorporated into maize field, which may be increase the soil fertility and also uplift soil organic matter content. With this view, the experiment was undertaken to find out the suitable combination of popcorn and bushbean/pea as intercrop for obtaining maximum net return through increasing the productivity of the crop.

Materials and Methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari during rabi season of 2006. Seven treatments were tested in randomized complete block design with three replications. The treatments were as follows: T_1 = Popcorn normal row +2 rows bushbean, T_2 = Popcorn paired row + 4 rows bushbean, T_3 = Popcorn normal rows+ 2 rows pea, T_4 = Popcorn paired row + 4 rows pea, T_5= Sole popcorn, T_6= Sole bushbean and T_7 = Sole pea The unit plot size was 4.5m x 2m. Seeds of popcorn, bushbean (BARI bushbean -1) and pea (BARI motor 1) were sown on November 14, 2006, popcorn spacing was 75 cm x 25cm for normal rows and 37.5cm x 25cm for paired rows (150cm spacing from one paired to nearest one). Fertilizer were applied at the rate of $N_{116}\,P_{39}\,K_{58}\,S_{21}$, $N_{23}\,P_{31}\,K_{73}$, $N_{23}\,P_{31}\,K_{73}$ and $N_{126}\,P_{36}\,K_{57}\,S_{20}$ kg/ha in the form of Urea, TSP, MP and Gypsum in sole popcorn, bushbean, pea and intercropping systems, respectively. One third of urea, whole amount of TSP, MP and Gypsum were applied as basal. Remaining 2/3 of urea was top dressed at 30 and 50 days after emergence. The yield component data for each crop was collected from 5 randomly selected plants prior to harvest from each plot.

After harvest, the yield data was recorded plot wise. This data were analyzed statistically and mean separation was done by DMRT.

Results and Discussion

Yield and yield components of popcorn were significantly affected be planting system and crop combinations (Table 1). The tallest plant (178.6cm) was observed in sole popcorn.

Shorter plant was recorded in popcorn paired row + 2 rows bushbean combination. The shorter plant in the said combination might be attributed due to more intra specific competition for different growth resources. Number of grains/cob was the highest (584) in sole popcorn. On the contrary, minimum number of grains/cob (466.5) was found in popcorn paired row + 4 rows bushbean, and it was similar to that in popcorn paired row +2 rows bushbean. Sole popcorn produced significantly the highest seed yield (6.5t/ha). Popcorn yield decreased due to intercropping with bushbean/pea. But significantly less reduction in yield of popcorn was recorded from popcorn pea intercropping system.

Yield and yield components of bushbean were presented in Table 2. Planting systems significantly influenced bushbean yield, pods/plant and seeds/pod. The highest pods/plant was found insole bushbean (8.50). The lowest pods/plant was found in popcorn normal row + 2 rows bushbean planting system due to more shadding. The highest seeds /pod was recorded from sole bushbean (87.30) and lowest seeds/pod obtain from popcorn normal row + 2 rows bushbean (48.14). Significantly the highest seed yield (14.93t/ha) of bushbean was obtained form sole crop and that of lowest from popcorn normal row + 2 rows bushbean.

Yield and yield components of pea were also presented in Table 2. Planting systems significantly affected the number of pods/plants, seeds/ eight and pod yield of pea. The highest no. of pods/plant (10.4) was recorded in sole pea and the lowest (7.8) from popcorn normal row + 2 rows pea. The lowest no. of pods/plant in this combination was attributed might be due more shading produced by popcorn. Pod yield is a function of yield contribution characters and hence the highest] pod yield (6.5t/ha) was recorded in sole pea.

The highest maize equivalent yield (6590 kg/ha) was recorded from popcorn paired row + 4 rows pea (Table 3). Economic analysis showed that the highest gross margin (TK-395400/ha) was obtained from popcorn paired row + 4 rows pea with benefit cost ratio (4.22 Tk/Tk). The highest benefit cost ratio (4.27) were obtained from sole popcorn.

The results revealed that popcorn normal row + 4 rows pea combination is economically feasible for intercropping system. This experiment will be conducted in the next year for confirmation of the results.

Table 1. Yield and yield component of popcorn in popcorn –bushbean/pea intercropping system

Treatments	Plant height (cm)	Grains/cob (no.)	Grain yield (t/ha)
T_1= Popcorn normal row + 2 rows bushbean	154.1b	479.9b	5.06b
T_2= Popcorn paired row + 4 rows bushbean	159.6b	466.5b	5.28b
T_3= Popcorn normal row + 2 rows pea	161.5b	503.3b	4.27b
T_4= Popcorn paired row +4 rows pea	160.2b	493.5b	4.89b
T_5 = Sole popcorn	178.6a	584.0a	6.50a
CV%	4.22	5.58	6.70

Same letter (s) with in the column do not significantly at 5 % level of probability

Table 2. Yield and yield component of bushbean and pea in popcorn-bushbean/pea intercropping system

Treatments	Pods/Plant (no.)	Seeds/Pod (no.)	Pod yield (t/ha)
Popcorn + bushbean intercropping system			
T_1= Popcorn normal row + 2 rows bushbean	4.90 b	48.14 b	6.83 b
T_2= Popcorn paired row + 4 rows bushbean	5.41 b	54.03b	7.73 b
T_6= Sole bushbean	8.50a	87.30a	14.93a
CV%	13.64	12.20	5.17
Popcorn + Pea intercropping system			
T_3= Popcorn normal row + 2 rows pea	7.8 b	35.6 b	4.50 b
T_4= Popcorn paired row +4 rows pea	8.8 b	42.2 b	5.10 b
T_5 = Sole pea	10.4 a	60.00 a	6.5 a
CV%	7.61	6.24	10.1

Same letter (s) with in the colum do not significantly at 5 % level of probability

Table 3. Economic analysis of popcorn –bushbean/pea intercropping system

Treatments	Yield (kg/ha)			MEY (kg/ha)	Gross return (TK/ha)	Total cost (TK/ha)	Benefic cost ratio
	Popcorn	Bushbean	Pea				
T_1	5060	6833	-	5971	358260	75773	3.73
T_2	5280	7733	-	5971	378660	75773	3.99
T_3	4740	-	4500	6240	374400	75773	3.94
T_4	4890	-	5100	6590	395400	75773	4.22
T_5	6500	-	-	6500	390000	74004	4.27
T_6	-	14930	-	1991	119460	39242	2.04
T_7	-	-	6500	2166	129960	39242	2.31

Note: Popcorn (Market price)= 60Tk/kg, Bushbean (Market price)= 8 Tk/kg, Pea (Market price) = 20 Tk/kg

T_1 = Popcorn normal row +2 rows bushbean, T_2 = Popcorn paired row + 4 rows bushbean, T_3 = Popcorn normal rows+2 rows Pea, T_4 = Popcorn paired row + 4 rows pea, T_5= Sole popcorn**,** T_6= Sole bushbean and T_7 = Sole pea.

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PERFORMANCE OF BARI HYBRID MAIZE VARIETIES IN THE HILLY AREAS OF BANGLADESH

Md. Abdul Aziz, W. Sultana, Uttam Kumar, Remi Chakma and M. Ahmed

Abstract

A field trail was conducted at the hill agricultural research station, Khagrachari and Ramgorh during the rabi season of 2007-2008 to find out the performance of hybrid maize varieties in hilly areas of Bangladesh and to compare the performances of BARI hybrid maize with commercial hybrid maize varieties. Five varieties of hybrid maize were tasted in a RCB design with three replications. Among the varieties BARI hybrid maize 5 produced maximum yield at Khagrachari (10.10 t/ha) and Pacific 984 (7.49 t/ha) at Ramgorh. The lowest yield was obtained from Pacific 984 (7.60 t/ha) at Khagrachari and BARI hybrid of maize 2 (4.55 t/ha) at Ramgorh. BARI hybrid maize 5 followed pacific 984 may be suitable for cultivation in the hilly areas of Bangladesh.

Introduction

Maize stands in third position among cereal crops in Bangladesh after rice and wheat. It can be grown through out the year because it is photo-insensitiveness. Its popularity increasingly day by day in Bangladesh because of its multipurpose uses. The Chittagong Hill Tracts has high potential for agricultural development (Brammer, 1197). The climate of the region is sub–tropical monsoon. Hot and humid rainy season alternates with dry and cool winter (Riessen, 2000). The climate of Bangladesh is most suitable for cultivation of maize including hilly region. In the hilly areas plain land is limited, so, it is essential to make intensive use of land by introducing hybrid varieties in order to get highest yield and more income. On the other hand, the tribal farmers are cultivating hybrid maize in the valley and in Jhum culture in small scale for food purpose and feed for poultry. Therefore, the present study was undertaken to find out the influence of hilly environment on growth, development and yield of hybrid maize and to select suitable variety for hilly region.

Materials and Methods

The study was conducted at the hill agricultural research station, Khagrachari and Ramgorh during the rabi season of 2006-07. The trail was laid out in a RCB design with three replications. Five hybrid maize varieties viz. BARI hybrid maize 2, BARI hybrid maize 3, BARI hybrid maize 5, Pacific 11 and Pacific 984 were included in the experiment. Seeds were sown on 29 November 2006 to 12 December 2007 with a spacing of 75 cm × 25 cm. The unit plot size was 4.5m × 3m. Fertilizers @ 250-60-100-30-5-1 kg/ha N, P, K, S, Zn and B and respectively were applied. $^{1}/_{3}$ of N and all other fertilizers were applied as basal and the remaining N was applied at two splits, at 30 DAE and at 50 DAE. Other intercultural operations such as weeding, thinning, earthing up, irrigation, pesticide application were done as and when necessary. The data were collected on days to taseling, days to silking, cob height, no. of cobs per plant, length of cob, diameter of cob, no. of seed per cob, 1000-seed wt. and grain yield. Collected data were statistically analyzed following MSTAT program. The differences between the means were compared using by DMRT least significant difference test.

Results and Discussion

Khagrachari

The result of various growth parameters of different hybrid maize varieties are presented in Fig.1 and Fig. 2. At the initial growth stage the increasing rate of plant height among the hybrid maize varieties were more or less similar up to 40 DAE (Fig.1.). After 40 DAE the increase in plant height was rapid up to 60 DAE. But significant difference in plant height was observed. After 60 DAE the plant height also increased but slowly up to 100 DAE except BARI hybrid maize 2, the growth of which was more rapid up to 100 DAE than 40 to 60 DAE. At harvest, significantly highest plant height (282.60cm) was obtained from BARI hybrid maize 2. .Significant variations on the number of leaves were also observed among the varieties tested (Fig.2.). At early growth stage (20 DAE), the highest number of leaves per plant was observed in BARI hybrid maize 5 which was statistically identical with BARI hybrid maize 2. The lowest number of leaves per plant was observed in BARI hybrid maize 3 and Pacific 11.The number of leaves per plant increased rapidly up to 60 DAE in all the varieties and then slowly up to 80 DAE. After 80 DAE there was no increase in leaves number per plant, which might be attributed to the reproductive phase of growth of the plant.

The yield and yield components of hybrid maize varieties as influenced by hilly environment are presented in Table 1. The number of cob per plant significantly varied among the varieties. The highest number of cob/plant (1.93) was obtained from pacific 11 which were statistically similar with BARI hybrid maize 5. Pacific 984 gave significantly the lowest number of cob/ plant (1.60). The highest cob length (21.90cm) was recorded from BARI hybrid maize 5 which was statistically similar with BARI hybrid maize 3 (20.37cm).The lowest cob length (19.07cm) was found in pacific 11 which was statistically at par with Pacific 984 and BARI hybrid maize 2. The highest diameter of cob (15.91cm) was recorded from BARI hybrid maize 5. Pacific 11 gave the lowest cob diameter (14.19cm) which was identical with BARI hybrid maize 2 followed by BARI hybrid maize 3. Hilly environment significantly affects the number of grains/cob. The highest number of grains/cob (575.0) was obtained from BARI hybrid maize 5. Significantly the lowest grains/cob (511.1) was obtained from pacific 984.The1000-grain weight varied significantly among the varieties. The highest1000-grain weight was recorded from BARI hybrid maize 5 (362g) followed by Pacific 11 (357.9g). The lowest 1000 grain weight was recorded from BARI hybrid maize 2 which was identical with Pacific 984 and BARI hybrid maize 3. Significantly the highest yield (10.10t/ha) was recorded from BARI hybrid maize 5 followed by BARI hybrid maize 3 (9.73t/ha). BARI hybrid maize 2 gave statistically similar yield (9.10t/ha) with Pacific 11 (8.46t/ha). Significantly the lowest yield (7.60t/ha) was obtained from Pacific 984. The highest grain yield in BARI hybrid maize 5 might be due to maximum cob/ plant grain/cob and individual grain weight

Ramgorh

The yield and yield components of hybrid maize varieties as influenced by hilly environment are presented in Table 2. Significantly the highest plant height was recorded from BARI hybrid maize 2 (123.96cm). The lowest plant height was recorded from Pacific 984 (91.26 cm) which was identical with Pacific 11 (92.06 cm). Cob per plant was insignificant among the varieties. The highest cob length was obtained from Pacific 984 (19.30 cm) which was identical with Pacific 11 (18.57 cm) and BARI hybrid maize 5 (18.36 cm). BARI hybrid maize 3 gave significantly the lowest cob length followed by BARI hybrid maize 2. The cob diameter was insignificant among

the varieties. Significantly the highest number of grain per cob was obtained from Pacific 984 (428.70) which was identical with Pacific 11 (408.56). The lowest number of grain per cob was obtained from BARI hybrid maize 3 (349.43) which was identical with BARI hybrid maize 5 (352.06) and BARI hybrid maize 2 (370.96). The 1000- grain weight varied significantly among the varieties. The highest 1000-seed weight was recorded from Pacific 984 (397.26 g) which was identical with Pacific 11 (376.53 g) followed by BARI hybrid maize 2 (372.76 g). BARI hybrid maize 3 gave significantly the lowest 1000- seed weight (316.96 g). Significantly the highest grain yield was obtained from Pacific 11 (7.49 t/ha) which was identical with Pacific 11 (6.20 t/ha). The lowest yield was obtained from BARI hybrid maize 2(4.55 t/ha). The highest grain yield in Pacific 984 was attributed due to grain per cob and 1000-grain weight.

Conclusion

It was revealed from the study that BARI hybrid maize 5 gave significantly the highest yield at Khagrachari and Pacific 984 at Ramgorh. In the last year (2006-07) BARI hybrid maize 5 perform better at Khagrachari, Boropara and Ramgorh. Therefore, it might be concluded that BARI hybrid maize would be suitable for cultivation in the hilly region of Bangladesh.

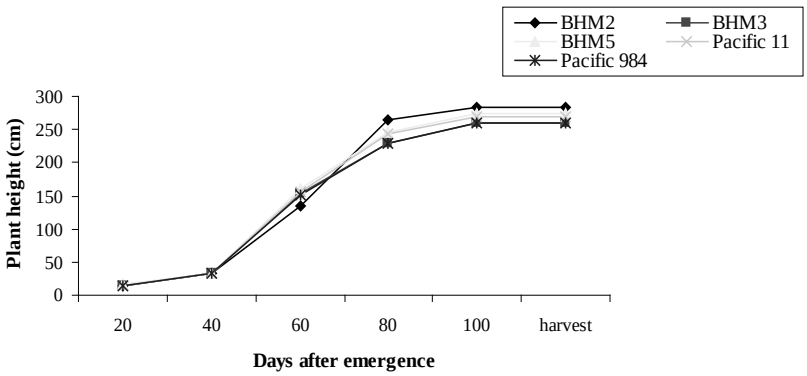

Fig 1. Plant height of hybrid maize varieties as influenced by hilly environment

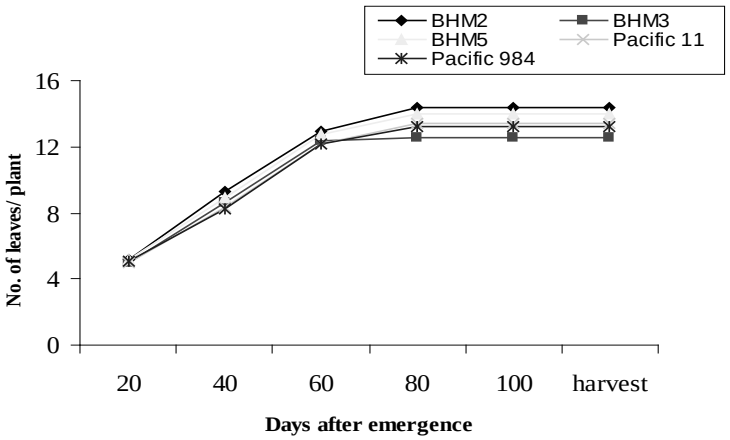

Fig.2 No.of leaves /plant of hybrid maize varieties as influcenced by hilly environment

Table 1. Yield and yield component of hybrid maize varieties as influenced by hill agro- ecological environment at HARS, Khagrachari

Varieties	Cob/ plant (no.)	Cob length (cm)	Cob diameter (cm)	Grain/ Cob (no.)	1000-grain wt. (g)	yield (t/ha)	
						07-08	06-07
BARI hybrid maize-2	1.67c	19.67b	14.53c	541.5bc	314.8b	9.10bc	8.90b
BARI hybrid maize-3	1.73bc	20.37ab	14.64bc	562.7ab	334.9b	9.73ab	9.37ab
BARI hybrid maize-5	1.86ab	21.90a	15.91a	575.0a	362.0a	10.10a	10.07a
Pacific11	1.93a	19.07b	14.19c	528.4c	357.9a	8.46c	8.83b
Pacific 984	1.60c	19.17b	15.23b	511.1c	330.7b	7.60d	7.53c
CV%	5.49	4.38	2.19	2.99	3.29	5.06	5.21

Same latter (s) in a column do not differ significantly at 5% level by DMRT.

Table 2. Yield and yield components of BARI hybrid maize varieties as influenced by hilly environment at HARS, Ramgorh

Variety	Plant height (cm)	Cob / plant (no.)	Cob length (cm)	Cob diameter (cm)	Grain/ cob (no.)	1000 grain weight (g)	Yield (t/ha)	
							07-08	06-07
BARI hybrid maize-2	123.96	1.00	17.46	4.40	370.96	372.76	4.55	4.68
BARI hybrid maize-3	80.63	1.06	16.90	4.30	349.43	316.96	5.06	4.51
BARI hybrid maize-5	76.60	1.13	18.36	4.30	352.06	360.80	5.77	6.71
Pacific-11	92.06	1.13	18.57	4.46	408.56	376.53	6.20	5.91
Pacific-984	91.26	1.00	19.30	4.53	428.70	397.26	7.49	5.85
LSD (0.05)	12.57	0.17	1.51	ns	37.23	23.60	1.72	-
CV (%)	7.18	8.31	4.44	2.80	5.18	3.44	15.72	9.82

PERFORMANCE OF GROWING MUNGBEAN UNDER ZERO TILLAGE CONDITION ON HILL SLOPE

Md. Abdul Aziz, W. Sultana and M. Ahmed

Abstract

The experiment was conducted at the Hill Agricultural Research Station, Ramgorh during the Kharif II season of 2007 to find out the performance of growing mungbean on hill slope following *Jhum* rice under zero tillage condition. Four mungbean varieties viz. BARI mug 2, BARI mug 3, BARI mug 5 and BARI mug 6 were included in the study. BARI mug 6 produced significantly the highest yield (1.14 t/ha). The highest yield in BARI mug 6 was attributed due maximum pods per plant, seeds per pod and individual seed weight. From one year study it might be concluded that BARI mug 6 would be suitable for cultivation on hill slope during Kharif II season. Further investigation may be continued to evaluate the performance of the above-mentioned variety for more locations and confirmation.

Introduction

Jhum cultivation is an age-old traditional system of crop cultivation in hilly areas. This system is completely different from normal cultivation practiced in the plain area. After cultivating crops in one season, farmers generally leave the hill fir rejuvenation of top soils and back to the same hill after 3-10 years for cultivation. Following the initiation of first rain in April, Jhum farmers dibble seeds of different crops with rice as main crop. Farmers keep the land weed free. There is possibility of growing mungbean after harvest of rice because the land is slopy and well drained. The present study was therefore, under taken to find out the performance of growing mungbean on hill slope following *Jhum* rice under zero tillage condition.

Materials and Methods

The experiment was conducted at the Hill Tracts Agricultural Research Station, Ramgorh during the Kharif-II season of 2007. The experiment was laidout in a RCB design with 3 replications. Four mungbean varieties were included in this study. The varieties were BARI mug 2, BARI mug 3, BARI mug 5 and BARI mug 6. The unit plot size was 5m x 4m. Seeds were sown on 21 August 2007 at the rate of 30 kg/ha. Fertilizers were applied at the rate 40-60-20-20-5 kg N,P_2O_5, K_2O,S and Zn respectively. All the nutrients were applied as basal. All other intercultural operations were done as and when necessary. The crop was harvested twice by pod picking on October 22 and October 29, 2007. Data were taken from 10 randomly selected plants from each plot and for yield estimation the whole plot was harvested. The data were statistically analyzed following MSTAT program and means are adjusted by LSD.

Results and Discussion

The performance of mungbean varieties/line at HARS, Ramgorh presented in (Table 1). Although insignificant the maximum plant height was obtained from BARI mug 3 followed by BARI mug 2. BARI mug 5 gave minimum plant height.. Significantly the highest number of branches/plant was obtained from BARI mug 6 (3.24) followed by BARI mug 5. BARI mug 2 gave significantly the lowest number of branches/plant (2.55). The number pods/plant varied insignificantly among the varieties. The maximum number of pod was recorded from BARI mug 6 (18.79) followed by BARI mug 5 (16.36). BARI mug 2 gave the minimum number of pods/plant (14.96). The

seed/pod varied significantly among the varieties. The highest number of seed/pod was recorded from BARI mug 6 (10.07) which was identical with BARI mug 5 (9.83). BARI mug 2 gave significantly the lowest number of seed/pod (8.88).

Although insignificant the maximum individual grain weight was obtained from BARI mug 6 (46.64 g/1000 seed) followed by BARI mug 5 (44.38 g/1000 seed). The lowest grain weight was recorded from BARI mug 3 (38.05 g/1000 seed). Grain yield is the function of pods per plant, seeds per pod and individual seed weight. Significantly the highest grain yield was obtained from BARI mug 6 (1.14 t /ha) followed by BARI mug 5 (0.93 t/.ha). The lowest yield was recorded from BARI mug 3 (0.85 t/ha) which was identical with BARI mug 2 (0.84 t/ha).

Conclusion

From one year study it might be concluded that BARI mug 6 would be suitable for cultivation on hill slope during Kharif II season. Further investigation may be continued to evaluate the performance of the above-mentioned line for more locations and confirmation.

Table 1. Performance of mungbean under zero tillage condition on hill slope at Ramgorh

Variety	Plant population/ m^2	Plant height (cm)	Branches/ plant (no.)	Pods / plant (no.)	Seeds/ pod (no.)	1000 seed weight (g)	Yield (kg/ha)
BARI mug-2	87.67	43.28	2.55	14.96	8.88	42.45	0.84
BARI mug-3	84.00	43.43	2.65	16.25	9.13	38.05	0.85
BARI mug-5	75.67	41.50	2.83	16.36	9.83	44.38	0.93
BARI mug-6	83.00	41.82	3.24	18.79	10.07	46.64	1.14
$LSD_{(0.05)}$	NS	NS	0.35	NS	0.53	NS	0.121
CV (%)	5.57	4.86	6.10	9.47	2.82	9.87	6.43

EFFECT OF POULTRY LITTER WITH BULKING AGENTS ON THE YIELD AND YIELD COMPONENTS OF MUSTARD IN HILL VALLEY

A F M Shamim Ahsan, A K M M Rahman

Abstract

An experiment was conducted as Agricultural research station, Raikhali, Chandraghona, Rangamati hill district during rabi season of 20007-2008 to find out the effect of poultry litter with bulking agents on the yield of mustard and determine the suitable bulking agent for improve the quality of poultry manure. Result showed that, among the treatment combinations the maximum yield (2140 kg/ha) and all the yield contributing parameters of mustard was produced in T_5 (poultry manure with ash and 100% recommend inorganic fertilizer) treatment combination, which was statistically identical with T_7 (poultry manure with sawdust and 100% recommend inorganic fertilizer). Also T_5 and T_7 treatment combination were produced 500% and 460% higher yield over control. However it observed that the ash and sawdust were suitable bulking agents for improving the quality of poultry manure.

Introduction

Mustard (*Brassica spp*.) is the major oilseed crop grown in Bangladesh. It is an important source of cooking oil in Bangladesh. Mustard is mainly cultivated as a winter crop and it is grown almost in all the districts of Bangladesh. Among the oil seed crops, it ranks first in respect of area and production (BBS, 2000). However the average yield of mustard is quite low as compared to our national demand and other mustard producing countries in the world. Poor fertility management is one of the most important constrains for this low yield of mustard in our country, Balanced fertilization is a prerequisite for achieving optimum yield potential of high yielding crops. On the other hand organic manures and fertilizers can play a vital role in sustaining soil fertility and crop production. Most of the soils of Bangladesh are deficient in organic matter. It is generally around 1 percent in most and around 1.5 percent in few soils, whereas to become productive organic matter content in the soils should be maintained around 3-4 percent. But in the hill region, soil organic matter depletion is high due to high soil erosion.

Most of the farmers presently use chemical fertilizer which increases the production cost as well as the soil is degraded and environment is polluted (Higa, 1991). It is true that maintaining the sustainable crop production is difficult by using chemical fertilizer alone and similarly it is not possible to get higher crop yield by using organic manure only. So it is essential to increase organic matter content through combined application of organic manure and inorganic fertilizer to reduce the use of chemical fertilizers.

Poultry manure is an excellent source of promising organic fertilizer, which is cost-effective to the farmers of our country. It has tremendous nutritional value of conserving good soil environment of plant growth (Zang *et al*., 1998; Ishak *et al*., 1999). This manure usually has higher N contents than other animal manures. Application of fresh manure alone can show toxicity consequently damage the crop production. Because application of fresh poultry manure on the soil can lead to NH_3 volatilization losses due in part to a high rate of N mineralization. So the recycling of poultry manure needs to be done in a manner that will not only reduces the losses of nutrient but also increase the soil fertility that is essential for crop production. (Pare *et al*.,2000). It was reported that when organic manure mixed with high carbon materials as a bulking agents (Straw, ash and rice husk etc.) in composting pile the nutrient loss from organic manure to reduced (Paredes *et al*., 2000 and Morisaki *et al.*, 1989). Therefore it is necessary to add bulking agent to improve the quality of poultry manure for higher yield of mustard by

reducing nutrient loss. This also ensures environment from pollution especially bad odor.

Therefore, the present investigation was conducted with the following objectives:

- To select a suitable bulking agent for improving the quality of poultry manure
- To increase the yield of mustard with the use of poultry manure and bulking agent

Materials and Methods

The field experiment of mustard was conducted at ARS, Raikhali, Chandraghona, Rangamati hill district during rabi season of 2007-2008. The experiment was laid out in a Randomized Complete Block (RCB) Design with three replications. The variety BARI Sarisha-11 was grown under 13 different treatments viz. T_1 - Recommended Dose (RD), T_2 - Poultry manure (PM) +100% Recommended Inorganic Fertilizer (RIoF), T_3 - Cowdung @ 10 t/ha, T_3 - PM @ 10 t/ha, T_5 – Poultry litter (PL) + Ash + 100% RIoF, T_6 - PL + rice husk + 100% RIoF, T_7 - PL + sawdust + 100% RIoF, T_8 - PL + rice straw + 100% RIoF, T_9 - PL + Ash + 50% RIoF, T_{10} - PL + rice husk + 50% RIoF, T_{11} - PL + sawdust + 50% RIoF, T_{12} - PL + rice straw + 50% RIoF and T_{13} – control. Seeds were sown in the 4th December @ 8 kg/ha in 4m X 2.4m unit plots. The distance between the row was 30 cm and between plant continuous. The land was fertilize with N-P_2O_5-K_2O-S-Zn-B @ 140or70-80-60-40-1.5-2 kg/ha in the form of urea, TSP, MP, gypsum, zinc sulphate and boric acid respectively. The entire quantity of well-decomposed poultry manure (10 t ha^{-1}) and bulking agent's mixture (5:1 volume basis) were applied in respective plots with one third of urea and full dose of other inorganic fertilizer during final land preparation and thoroughly mixed with soil three days prior to planting. The rest of urea was topdressed in two equal installments at 20 and 40 days after emergence (DAE) after irrigation. Weeding and thinning were done in two weeks after emergence. Marshal was sprayed to control aphids at pod formation stage. Post harvest data on plant height, No. branches per plant, siliqua per plant were recorded for 10 randomly selected plants each plot. For yield estimation, 2m X 2m area from the middle was harvested. The collected data on various parameters under study were statistically analyzed using MSTATC computer package program developed by Russel (1986). The significance of the differences among the treatment means was evaluated by LSD at 5% level of probability (Gomez and Gomez, 1984) for the interpretation of results.

Results and Discussion

The means of observation of the different parameters were presented in Table 1. It was revealed from the data that yield and yield contributing characters of mustard were significantly influenced by the different treatment combinations. The tallest plant (160 cm) was found in T_5 (PL and ash +100% RIF) which were statistically identical with the T_2, T_6, T_7 and T_8. But control treatment produced the shortest plant (84 cm).

Branch number/plant of mustard was significantly influenced by the different treatment combination. The significant highest number of branch/plant (4.27) was obtained with the treatment T_5 (PL and ash +100% RIF) which was statistically identical with the 4.03, 4.13 and 4.07 comes from the treatment combination T_6, T_7 and T_8. Similarly, maximum plant population/m^2 (82), siliqua/plant (150), 1000 seed weight (4.27 g) were recorded in same treatment combination T_5 (PL and ash +100% RIF) as compared to that of other treatments. Among the treatment combinations, the highest seed yield (2140 kg/ha) was observed from the application of PL and ash mixture with 100% RIF, which was 499% higher over control and it was statistically identical with T_7 (PL and sawdust +100% RIF).

The results indicated that among the treatment combinations the maximum yield and yield attributes of mustard was produced by the application of poultry litter with ash or sawdust and

100% recommended inorganic fertilizer. This result suggested that, bulking agents viz. ash and sawdust are needed to improved the quality of poultry manure in the composting pile and application of these manure with 100% recommended inorganic fertilizer produced the highest seed yield of mustard.

Table 1. Yield and yield components of mustard as influenced by different combinations of poultry litter with bulking agents and inorganic fertilizer

Treatment	Plant pop^n/m^2	Plant height (cm)	No. of Branches /plant	No. of siliqua /plant	Seeds /siliqua	1000 seeds wt. (g)	Seed yield (kg/ha)	% increase in yield over control
T_1	80	134.4	3.9	139.1	11.7	4.1	1670	367.7871
T_2	80	152.2	3.93	140.2	11.8	4.13	1825	411.2045
T_3	71	101.67	3.2	76.6	11	2.53	500	40.05602
T_4	74	116.2	3.62	113.47	11.1	2.8	525	47.05882
T_5	82	160.2	4.27	149.87	13.3	4.27	2140	499.4398
T_6	79	145.93	4.03	144	11.9	4.13	1932	441.1765
T_7	80	149.27	4.13	146.5	12.9	4.17	2002	460.7843
T_8	79	146.8	4.07	144.1	12.4	4.13	1946	445.098
T_9	75	143.93	3.9	136.77	11.6	4.1	1540	331.3725
T_{10}	76	123.87	3.63	118.4	11.2	3.77	1412	295.5182
T_{11}	75	137.25	3.88	126.4	11.6	4.03	1520	325.7703
T_{12}	75	131.13	3.67	123.77	11.5	4	1445	304.7619
T_{13}	65	84.78	2.49	52.07	10.6	2.47	357	-
LSD $_{(0.05)}$	4.42	14.8	0.27	16.23	0.78	0.44	185	-
CV%	3.43	6.61	4.28	7.77	3.94	7.03	7.59	-

T_1- RD, T_2- PM @ 10 t/ha + 100% RIoF, T_3- Cowdung @ 10t/ha, T_4- PM@ 10t/ha, T_5- PL + ash+ 100% RIoF, T_6- PL + rice husk + 100% RIoF, T_7- PL + sawdust + 100% RIoF, T_8- PL + rice straw + 100% RIoF, T- PL + ash 50% RIoF, T_{10}- PL + rice husk + 50% RIoF, T_{11}- PL + sawdust + 50% RIoF, T_{12}- PL + rice straw + 50% RIoF and T_{13}- Control

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EFFECT OF DATE OF SOWING ON THE YIELD OF MUSTARD IN THE HILLY AREAS

M. A. Aziz, M. S. Rahman, U. K. Sarker and M. R. Haque

Abstract

A field study was conducted at the Hill Agricultural Research Station, Khagrachari and Raikhali during the rabi season of 2008-2009 to evaluate the effect of date of sowing on the yield and yield attributes of Mustard. The variety BARI Sharisa 11 were tested with five sowing dates viz. 10 November, 15 November, 25 November, 5 December and 15 December in a RCB design with three replications. The sowing dates significantly affect the growth, development and yield of Mustard. Sowing mustard on 10 November produced the maximum seed yield (1996kg/ha) at Khagrachari. At Raikhali 15 November to 25 November gave the maximum yield.

Introduction

Mustard was the major source of edible oil in Bangladesh in few years ago. It is cultivated in our country in the winter season. It is a thermo sensitive as well as photosensitive crop (Ghosh and Chatterjee, 1998). The average yield of mustard in our country is 739 kg/ha whereas the world average yield of mustard is 1575 kg/ha (FAO, 2003). Annual requirement of edible oil is 5 lakh metric tons. The internal production of edible oil can meet up only less than one-third of the annual requirement (Mondal and wahhab, 2001). There is a great scope of increasing yield of mustard by selecting high yielding varieties and improving management practices. Time of sowing is very important for mustard production (Rahman *et al*., 1988; Mondal and Islam, 1993 and Mondal *et al*., 1999). Sowing at proper time allows sufficient growth and development of a crop to obtain a satisfactory yield. The seed yield and maturity of mustard plants are greatly influenced by environmental conditions regardless of genotypes. Different sowing dates provide variable environmental conditions with in the same location for growth and development of crop and yield stability (Pandey *et al*., 1981). Therefore, whenever a new genotype/variety is developed or introduced in a region, an appropriate package of production practices must be developed. A suitable sowing date is very important for good agronomic performance of any crop. Therefore, the present study was undertaken to find out the optimum sowing time for the variety BARI Sarisha 11 for higher yield in the hilly areas.

Materials and Methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari and Raikhali during rabi season of 2008-2009. Five dates of sowing were included in RCB design with three replications. The treatments were as follows: 10 November, 15 November, 25 November, 5 December and 15 December. Seeds were sown as per treatment with row spacing of 30 cm apart. The unit plot size was 3m x 3m. Fertilizers @ 115-34-50-26-2.5-2 kg/ha NPKSZnB, respectively were applied in the form of Urea, Triple super phosphate (TSP), Muriate of potash (MOP), Gypsum, Zinc sulphate and Boric acid. All fertilizers were applied as basal. Intercultural operations such as weeding and thinning were done as and when necessary. The data were collected on days to emergence, days to flowering, days to maturity, plant height, primary branches/plant, siliqua/plant, seeds/siliqua, 1000 seed weight and seed yield.

Results and Discussion

The influence of date of sowing on yield and yield attribute of BARI sarisha-11 at Khagrachari and Raikhali are presented in Tables 1 and 2. All the characters varied significantly due to different dates of sowing except 1000 seed weight at Khagrachari. Plant height decreased linearly with the advance of sowing dates. At Khagrachari, significantly the highest plant height was recorded from 10 November sowing (153.6 cm) followed by 15 November sowing (149.6 cm) (Table 1). The lowest plant height was recorded from 15 December sowing (12.2 cm) which was identical with 5 December sowing (119.2 cm). At Raikhali the highest plant height was recorded from 15 November sowing (147.80 cm) which was identical with 25 November sowing (132.53 cm). 5 December and 25 December sowing gave significantly the lowest plant height. The number of primary branches/plant followed the same trend as plant height both at Khagrachri and Raikhali due to different dates of sowing. At Khagrachari, significantly the highest number of siliqua/plant was obtained from 10 November sowing (192.6) followed by 15 November sowing (152.5). 15 December sowing gave significantly the lowest number of siliqua/plant (75.07) which was identical with 5 December sowing (89.97). At Raikhali the highest number of siliqua/plant was obtained from 15 November sowing (206.87) which was identical with 25 November sowing (197.73). Significantly the lowest number of siliqua/plant was obtained from 15 December sowing (141.13)

Table 1. Plant height, branches /plant and siliqua /plant of BARI Sarisha 11 as influenced by date of sowing at Khagrachari and Raikhali hilly area

Treatments	Plant height(cm)		Primary branches /plant (no.)		Siliqua /plant (no.)	
	Khagrachari	Raikhali	Khagrachari	Raikhali	Khagrachari	Raikhali
10 November	153.6 a	-	3.50 a	-	192.60 a	-
15 November	149.6 ab	147.80 a	3.33 ab	4.33 a	152.50 b	206.87 a
25 November	127.9 bc	132.53 ab	3.26 bc	4.07 a	124.50 c	197.73 ab
5 December	119.2 c	104.73 b	3.16 bc	3.80 ab	89.97 d	173.60 b
15 December	112.2 c	104.00 b	3.06 c	3.33 b	75.07 d	141.13 c
CV (%)	4.64	12.76	3.38	8.23	5.06	4.57

Means followed by same letter(s) do not differ significantly at 5% probability

From Table 2 it was observed that at Khagrachari, significantly the highest number of seeds/siliqua was recorded from 10 November sowing (13.37) which was identical with 15 November, 25 November and 5 December sowing. 15 December sowing gave the lowest number of seed/siliqua (11.07). At Raikhali, the highest number of seeds/siliqua was recorded from 15 November sowing (13.67) which was identical with 25 November and 5 December sowing. 15 December sowing gave significantly the lowest number of seed/siliqua (11.52). The individual seed weight varied insignificantly at Khagrachari due to different dates of sowing. At Raikhali, significantly the highest individual seed weight was recorded from 15 November sowing (4.27 g/1000 seed) which was identical with 25 November and 5 December sowing. 15 December sowing gave the lowest individual seed weight (3.80 g/1000 seed). All the yield contributing character finally contributed to the grain yield. Grain yield decreased linearly with the advancement of sowing dates at both the locations. At Khagrachari, significantly the highest grain yield was obtained from 10 November sowing (2.00 t/ha) followed by 15 November (1.48 t/ha) and 25 November (1.23 t/ha). 15 December sowing gave the lowest grain yield (0.45 t/ha) which

was identical with 5 December sowing (0.49 t/ha). At Raikhali the highest grain yield was recorded from 15 November sowing (2.56 t/ha) which was identical with 25 November sowing (2.29 t/ha). 15 December sowing gave significantly the lowest grain yield (1.43 t/ha) which was identical with 5 December sowing (1.51 t/ha).

Table 2. Seeds/siliqua, 1000 seed weight and Seed yield of BARI Sarisha-11 as influenced by date of sowing at Khagrachari and Raikhali hilly area

Treatments	Seeds/siliqua (no.)		1000 seed weight (g)		Seed yield (t/ha)	
	Khagrachari	Raikhali	Khagrachari	Raikhali	Khagrachari	Raikhali
10 November	13.37 a	-	2.92	-	2.00 a	-
15 November	11.90 ab	13.67 a	2.91	4.27 a	1.48 b	2.56 a
25 November	12.67 ab	12.90 a	2.88	4.17 ab	1.23 b	2.29 a
5 December	12.97 ab	12.65 a	2.88	4.06 ab	0.49 c	1.51 b
15 December	11.07 b	11.52 b	2.88	3.80 b	0.45 c	1.43 b
CV (%)	7.97	2.69	0.43	3.07	13.61	6.96

Means followed by same letter(s) do not differ significantly at 5% probability

Conclusion

From the above findings, it was observe that BARI Sarisha-11 may be sown up to 15 November at Khagrachari and 25 November at Raikhali hilly areas. Sowing after that period drastically reduced the grain yield. For final conclusion the study needed to be repeated in the next season.

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EFFECT OF DATE OF SOWING ON THE YIELD OF CHICKPEA IN THE HILLY AREAS

M. A. Aziz, M. S. Rahman and U. K. Sarker

Abstract

A field trial was conducted at the Hill Agricultural Research Station, Khagrachari during the period from November 2008 to April 2009 to evaluate the effect of date of sowing on the yield and yield attributes of Chickpea. The variety BARI Chola 3 were tested with four sowing time viz. 15 November, 01 December, 15 December and 01 January in a RCB design with three replications. The sowing dates significantly affect the yield attributes and yield of chickpea variety. Sowing chickpea on 15 December produces the maximum seed yield (1419kg/ha) which was found superior to both earlier and later dates of sowing.

Introduction

Chickpea is the fifth important pulse crop in Bangladesh in terms of area and production (BBS, 2005). Previously it was the third important pulse crop in Bangladesh in terms of area and production. The area and production of chickpea is drastically decreasing day by day due to competition with other rabi crops. Botrytis grey mould, a major disease of chickpea is also another cause of decreasing chickpea area and production (Bakr, 1991). The Chittagong Hill Tracts has high potential for agricultural development (Brammer, 1997). The climate of the region is sub-tropical monsoon. Hot and humid rainy season alternates with dry and cool winter (Riessen, 2000). The prolonged winter agro-climate might be suitable for the growth, development and yield of winter pulse like chickpea. Chickpea is highly sensitive to salinity and sodicity in the soil (Chandra, 1980). The predominant cropping patterns followed by the hill farmers is rice based. Among the existing cropping patterns 54% of the farmers follow T.aman - Fallow-Fallow patterns (Aziz *et al*., 2006). It was also observed that about 71% of farmers harvest T.aman rice in the month of October and 29% in November. It indicated that there is enough scope of growing winter pulses like chickpea after harvest of T.aman rice in the hilly areas and as a result the area and production of chickpea may be increased. Therefore, the present study was undertaken to find out the suitable sowing time of chickpea in the hilly region.

Materials and Methods

The study was conducted at the Hill Agricultural Research Station, Khagrachari during the period from November 08 to March 09. The trial was laid out in a RCB design with three replications. Four sowing time viz.15 November, 01 December, 15 December and 01 January were included in the experiment. The variety was used BARI Chola-3. Seeds were sown on as per treatment with 30 cm row spacing. The unit plot size was 3.2m × 3m. Fertilizers @ 20-26-17-10 kg/ha NPKS, respectively were applied. All fertilizers were applied as basal before sowing. Other intercultural operations such as weeding, thinning, irrigation, pesticide application were done as and when necessary. The yield components data for the crop was collected from 10 randomly selected plants prior to harvest. After harvest, the yield data was recorded plot wise. This data were analyzed statistically and mean separations were adjusted by DMRT.

Results and Discussion

The yield and yield components of Chickpea were significantly influenced by sowing dates that were presented in the Table 1. There was a significant difference in plant height among different sowing dates. The highest plant height (50.10cm) was recorded from the plants of first sowing (15 November) which was statistically identical to second sowing (1 December). This might be due to early sowing which contributed to higher vegetative growth. After second sowing, the plant height tends to decrease and lowest plant height

(40.03cm) was obtained from the plants of last sowing (1 January) which might be due to lower growth period. Branching behavior of the plant was significantly influenced by date of sowing in the hilly areas. The highest number of primary branches/plant (5.63) was obtained from the plants of third sowing (15 December) and lowest number of primary branches/plant (3.16) was recorded from the plant of first sowing (15 November).This is because there might be a negative relationships between plant height and branching behaviors due to hormonal movement. The highest number of pods/plant (34.47) was obtained from the plants of third sowing (15 December) which was statistically identical to the plants of last sowing. The lowest number of pods/plant (21.70) was recorded from the plants of first sowing (15 November) which was statistically identical to the plants of second sowing. This is might be due to inverse effect of longer vegetative growth on reproductive growth. Date of sowing had also significant effect on seeds/pod. The highest seeds/pod (1.43) was recorded from the plant of third sowing (15 December) and that of lowest (1.16) from first sowing (15 November). 1000-seed weight in respect of sowing date was non-significant. The seed yield of chickpea under different dates of sowing was significantly influenced by its attributes i.e. primary branches/plant, pods/plant, seeds/pod etc. The maximum seed yield (1419kg/ha) was obtained by sowing chickpea on 15 December, which was found superior to both earlier and later dates of sowing. The reduction in seed yield due to early in sowing can be attributed to longer vegetative growth. The reduction in seed yield also due to delay in sowing can also be attributed to shorter growth period, at the disposal of the late sown crop as the time taken by the crop to mature decreased with delay in sowing. Nanda and Saini (1992) observed that seed yield decreased as sowing date was delayed from late December to January. This result was also supported by Afzal *et al. (*1991).

Conclusion

From the above findings, it was observed that 15 December is the optimum time for sowing of BARI Chola-3 in the hilly areas and yield was reduced both earlier and later sowing. For final recommendation the experiment should be repeated in the next season.

Table 1. Yield and yield components of BARI Chola-3 as influenced by different dates of sowing

Treatments	Plant height(cm)	Primary branches /plant(no.)	Pods/plant (no.)	Seeds /pod (no.)	1000 seed weight (g)	Yield (kg/ha)
15November	50.10 a	3.16 b	21.70 b	1.16 b	132.0	1076 c
01 December	47.50 a	3.96 b	21.27 b	1.23 b	132.2	1145 b
15 December	42.27 b	5.63 a	34.47 a	1.43 a	132.5	1419 a
01 January	40.03 b	4.46 ab	31.47 a	1.20 b	131.9	1349 ab
CV (%)	3.77	11.19	13.96	7.13	0.31	9.54

Same letter (s) in a column does not differ significantly at 5% level by DMRT.

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INTERCROPPING POPCORN WITH COWPEA AT DIFFERENT PLANTING SYSTEM IN THE HILL VALLEY AREAS

R. Chakma, U. K. Sarker, M. A. Aziz, M. S. Rahman, and M. M. Ullah

Abstract

An intercropping experiment was carried out at the Hill Agricultural Research Station, Khagrachari during two consecutive rabi seasons of 2007-08 and 2008-09 to find out the suitable combination of popcorn and cowpea for increasing productivity of the land. Six treatments were Popcorn normal row+ 2 rows cowpea, Popcorn paired row + 4 rows cowpea, Popcorn normal row + broadcast cowpea, Popcorn paired row + broadcast cowpea, Sole popcorn and Sole cowpea. The highest gross return (Tk.300800/ha) and benefit cost ratio (2.98) were obtained from Popcorn paired row + 4 rows cowpea due to the highest maize equivalent yield (6016 kg/ha).

Introduction

Intercropping is an ancient and traditional practice in the Chittagong Hill Tracts. It increases total productivity per unit area through maximum utilization of land, labour and growth resources (Marshal and Willey, 1983; Quayum *et al*., 1999; Crauford, 2000). Both maize and cowpea are the promising crops at hilly region. Popcorn is very much popular among indigenous people because they can easily process it as food. Moreover, the canopy structure of popcorn is moderate under which cowpea may be cultivated as intercrop with or without least hampering due to shading effect. It may promote net return through increasing the productivity of the crops. As maize is an exhaustive crop, it uplift huge amount of nutrients from soil and cowpea may play a vital role to recover it by fixing nitrogen from atmosphere. On the other hand, cowpea may increase soil fertility and organic matter content when incorporated into soil after harvesting. Keeping this view in mind, this experiment was undertaken to find out the suitable combination of popcorn and cowpea as intercrop for obtaining maximum net return through increasing the productivity of the crop.

Materials and Methods

The experiment was conducted at Hill Agricultural Research station, Khagrachari from November to April of 2007-08 and 2008-09. Six treatments were as follows T_1- Popcorn normal row + 2 rows cowpea, T_2- Popcorn paired row + 4 rows cowpea, T_3- Popcorn normal row + broadcast cowpea, T_4- Popcorn paired row + broadcast cowpea, T_5- Sole popcorn and T_6-Sole cowpea. The unit plot size was 4.5m X 4m. Seeds of popcorn and cowpea (BARI Felon-1) were sown on 26th November 2008, maintaining popcorn spacing of 60 cm × 25 cm for normal rows and 30 cm × 25 cm for paired rows (120cm spacing from one paired to nearest one). Fertilizer were applied at the rate of $N_{116}P_{39}K_{58}S_{21,}$ $N_{10}P_{10}K_{13}$ and $N_{126}P_{36}K_{57}S_{26}$ Kg/ha in the form of Urea TSP, MOP and Gypsum for sole Popcorn, Cowpea and intercropping systems, respectively. In case of sole maize and intercropping, one third urea, total TSP, MOP and Gypsum were applied as basal. Remaining 2/3 urea was top dressed at 30 and 50 days after emergence. In case of sole cowpea, entire amount of fertilizers were applied as basal. The yield components data for the crop was collected from 10 randomly selected plants prior to harvest. After harvest, the yield data was recorded plot wise. This data were analyzed statistically and mean separations were adjusted by DMRT.

Results and Discussion

Yield and yield components of Popcorn were significantly affected by planting system and crop combination (Table 1). The highest number of pods/ plant (1.60) was observed in two different treatments including sole popcorn and popcorn paired row + 4 rows cowpea and the lowest (1.00) was recorded from popcorn normal row + 2 rows cowpea. Number of grains/ cob was highest (538.3) in sole popcorn which was statistically similar with popcorn normal row + 2 rows cowpea. On the other hand, minimum number of grains/ cob (480.8) was obtained from popcorn paired row + broadcast cowpea. This minimum number of grains/cob might be attributed to more intra specific competition for different growth resources. Sole popcorn produced significantly the highest yield (5.89 t/ha) and lowest yield (4.72 t/ha) was recorded in popcorn normal row + 2 rows cowpea.

Yield and yield components of cowpea are presented in Table 2. Planting system significantly influenced pods/ plant and seed yield. The highest pods/ plant were found in sole cowpea (50.46) and lowest number of pods/ plant (32.06) was observed in popcorn paired row + broadcast cowpea. This is also might be due to intra-specific competition for growth resources. The variation in number of seeds/ pod was insignificant among different planting systems. The highest seed yield (2453kg/ha) was obtained from sole cowpea and lowest (1179 kg/ha) was recorded from popcorn normal row + 2 rows cowpea which was statistically at par with popcorn paired row + 4 rows cowpea, popcorn normal row + broadcast cowpea and popcorn paired row + broadcast cowpea. This result clearly indicated that intra specific competition for growth resources have direct effect on yield.

Economic analysis presented in Table 3 during second year showed that the highest gross return (TK 300800/ha) and benefit cost ratio (2.98) were obtained from popcorn paired row + 4 rows cowpea due to highest maize equivalent yield (6016 kg/ha). Similar result trend was also observed during first year.

Conclusion

It might be concluded that popcorn paired row + 4 rows cowpea combination is economically feasible for intercropping system in the hilly areas of Bangladesh.

Table1. Yield and yield components of popcorn in popcorn –cowpea intercropping system

Treatments	Cobs/plant (no.)	Grains/cob (no.)	Grain yield (t/ha) 07-08	Grain yield (t/ha) 08-09
T_1- Popcorn normal row + 2 rows cowpea	1.00 b	509.5 ab	4.67 b	4.72 b
T_2- Popcorn paired row + 4 rows cowpea	1.60 a	503.2 b	5.51a	5.36 b
T_3- Popcorn normal row + broadcast cowpea	1.06 b	490.4 b	4.51b	4.82 b
T_4- Popcorn paired row + broadcast cowpea	1.26 ab	480.8 b	5.18 ab	4.95 b
T_5-Sole popcorn	1.60 a	538.3 a	5.72a	5.89 a
CV %	13.69	3.37	8.08	9.76

Same letter (s) within the column does not differ significantly at 5 % level by DMRT

Hill Eco-System

Table 2. Yield and yield components of cowpea in popcorn –cowpea intercropping System

Treatments	Pods/Plant (no.)	Seeds /pod (no.)	Seed yield (kg/ha) 07-08	Seed yield (kg/ha) 08-09
T_1- Popcorn normal row + 2 rows cowpea	30.73 b	16.73	610 b	1179 b
T_2-Popcorn paired row + 4 rows cowpea	38.80 b	16.86	830 b	1312 b
T_3- Popcorn normal row + broadcast cowpea	36.20 b	15.73	640 b	1261 b
T_4-Popcorn paired row + broadcast cowpea	32.06 b	16.26	760 b	1255 b
T_6-Sole cowpea	50.46 a	17.26	2133 a	2453 a
CV %	12.90	8.06	12.93	17.66

Same letter (s) within the column does not differ significantly at 5 % level by DMRT

Table 3. Economics of popcorn –Cowpea intercropping system

Treatments	Yield (kg/ha)		MEY (kg/ha)	Gross return (Tk/ha)	Total cost (Tk/ha)	Net return (Tk/ha)	Benefit Cost Ratio
	Popcorn	Cowpea					
T_1	4720	1179	5309	265450	75510	189940	2.51
T_2	5360	1312	6016	300800	75510	225290	2.98
T_3	4820	1261	5450	272500	75510	196990	2.60
T_4	4950	1255	5577	278850	75510	203340	2.69
T_5	5890	-	5890	294500	74990	221110	2.94
T_6	-	2453	1226	61300	34350	26950	0.78

T_1- Popcorn normal row + 2 rows cowpea, T_2- Popcorn paired row + 4 rows cowpea
T_3- Popcorn normal row + broadcast cowpea T_4-Popcorn paired row + broadcast cowpea
T_5- Sole popcorn T_6- Sole cowpea

Note: Market price of Popcorn = Tk. 50/kg, Market price of Cowpea = Tk. 25/kg
Labour cost = Tk. 120/day Irrigation = Tk 70 /hr
Urea = Tk 12/kg TSP = Tk 40/kg
MOP = Tk 35 /kg Zypsum = Tk 8/kg
Cowdung = Tk 1/Kg

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EFFECT OF IRRIGATION ON GROWTH AND YIELD OF MAIZE IN THE HILLY AREAS

U. K. Sarker, M. A. Aziz, M. S. Rahman and M. M. Ullah

Abstract

A field study was conducted at the Hill Agricultural Research Station, Khagrachari during two consecutive rabi seasons of 2007-08 and 2008-09 to evaluate the optimum level of irrigation on the growth and yield of BARI hybrid maize 5. The treatments consisted of 5 levels of irrigation viz. 2 irrigation at knee height stage+60 DAE, 3 irrigation at knee height, 60 DAE+85-90 DAE, 3 irrigation at knee height, 60 DAE+115-120 DAE, 4 irrigation at knee height, 60 DAE, 85-90 DAE+115-120 DAE and control. The highest yield (8.94 t/ha) was obtained from 3 irrigation at knee height, 60 DAE +85-90 DAE. 2 irrigation at knee height stage +60 DAE, 3 irrigation at knee height, 60 DAE + 115-120 DAE and 4 irrigations at knee height, 60 DAE, 90 DAE+115-120 DAE gave statistically identical yield. Control treatment gave lowest yield (5.63 t/ha).

Introduction

Water plays a vital role for the production of Maize as it is generally grown in winter season in Bangladesh when rainfall is scanty. Moreover, there is a direct correlation between water supply and utilization of fertilizer elements. The irrigation and fertilizer research results of Nagy (1995) have indicated that irrigation improves the use efficiency of fertilizer. In irrigated treatments- which mean a higher yield level- economic fertilizer doses are greater due to the positive correlation between irrigation and fertilizer. We can ensure constant water supply and physiological operations in plant with irrigation. Results of experiments prove that irrigation in general, especially in a case of drought, highly increase yield (Szoke Molnar, 1977). Therefore, the present study was undertaken to evaluate different levels of irrigation on the growth and yield of maize in the hilly region.

Materials and Methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari during two consecutive rabi seasons of 2007-08 and 2008-09. Five treatments were included in RCB design with three replications. The treatments were as follows: T_1-2 irrigation at knee height stage+60 DAE, T_2-3 irrigation at knee height, 60 DAE+85-90 DAE, T_3-3 irrigation at knee height, 60 DAE+115-120 DAE, T_4-4 irrigation at knee height, 60 DAE, 85-90 DAE + 115-120 DAE and T_5-control. Seeds were sown on 23 November 2008 with a spacing of 75 cm X 25 cm. The unit plot size was 4mX4m. Fertilizers @ 250-60-100-30-5-1 kg/ha NPKSZnB, respectively were applied in the form of Urea, Triple super phosphate (TSP), Muriate of potash (MOP), Gypsum, Zinc Sulphate and Boric acid. One third urea and all other fertilizers were applied as basal. The rest of the urea was applied in two equal splits at 30 DAE and 60 DAE. Intercultural operations such as weeding, thinning and earthing up were done as and when necessary. The data to be collected on plant height, number of leaves/plant, cobs/plant, cob length, cob diameter, number of grains/cobs, 1000- grain weight and grain yield etc.

Results and Discussion

The effect of irrigation on plant height and no. of leaves/plant were presented in Fig 1. and Fig 2. At early stage of growth the increasing rate of plant height was more or less similar up to 40 DAE. After 40 DAE, it rises gradually and a tremendous change in plant height was observed at

80 DAE. No changes occur in plant height after 80 DAE except where irrigations were given at 115-120 DAE. This is might be due to availability of moisture in the soil. At initial growth stage, the highest no. of leaves/plant was observed where irrigation in given four times and lowest in control treatment. Number of leaves/plant increases up to 80 DAE and no changes occurred in case of number of leaves after 80 DAE.

The yield and yield components of BARI hybrid maize 5 were significantly influenced by different irrigation levels. The number of cobs/plant was significantly affected by irrigation. The highest number of cobs/plant (1.46) was recorded from 3 irrigation at knee height, 60 DAE + 85-90 DAE and lowest (1.00) was obtained from control treatment i.e. no irrigation. This indicates importance of irrigation in case of producing cobs/plant. In terms of cob length, the highest (19.53cm) was obtained from three irrigation at knee-height, 60 DAE + 85-90 DAE which is statistically similar to all other treatments except control and lowest (17.20cm) was recorded from control treatment. This result stated that, irrigation has direct influence on cob length. 3 irrigation at knee-height, 60 DAE + 85-90 DAE produced the highest cob diameter (15.28cm) and no irrigation i.e. control treatment produced the lowest cob diameter (13.80cm). The number of grains/cob was significantly influenced by irrigation. The highest number of grains/cob (560.4) was recorded from 3 irrigation at knee-height, 60 DAE + 85-90 DAE and lowest (402.6) was recorded from control treatment. This result indicated that, 3 irrigations at knee-height, 60 DAE + 85-90 DAE as compared to other treatments is suitable for enhancement of yield contributing characters. 1000-seed weight was non-significant for all of the irrigation levels. This is might be due to genetical character of crop. The contribution of yield contributing character finally affected yield. Yield of BARI hybrid maize 5 varied significantly due to different irrigation levels. During second year, the highest yield (8.94 t/ha) was obtained from 3 irrigation at knee-height, 60 DAE + 85-90 DAE. 3 irrigation at Knee height, 60 DAE +115-120 DAE and 4 irrigation at knee-height, 60 DAE, 85-90 DAE+115-120 DAE gave lower yield 6.74 t/ha and 6.91 t/ha respectively. This is might be due to enhancement of vegetative growth when irrigation given at 120 DAE. The lowest yield (5.63 t/ha) was recorded from control treatment. Similar results trend was also observed during first year.

Conclusion

The results revealed that three irrigations at knee-height, 60 DAE+85-90DAE showed better performance in respect of yield of BARI hybrid maize 5 during both years. So, this variety with above irrigation level can be recommended for hilly regions.

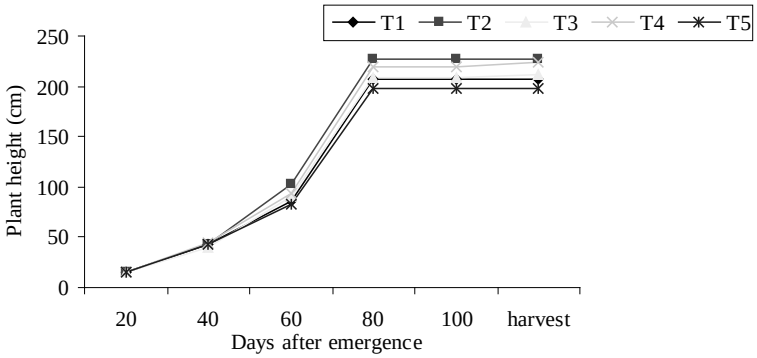

Fig.1 Effect of soil moisture on plant height of BARI hybrid maize 5

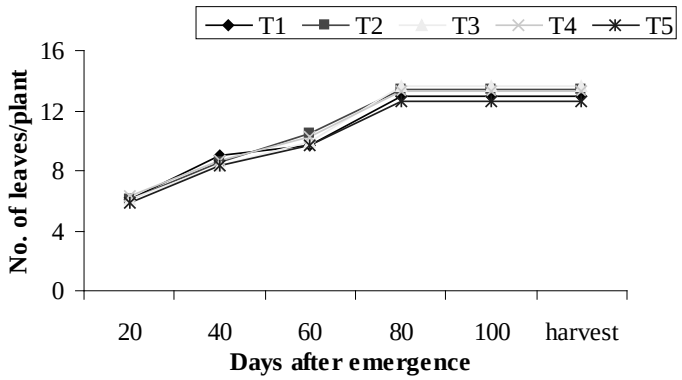

Fig.2 Effect of soil moisture on the leaves/ plant of BARI hybrid maize 5

Here,

T_1-2 irrigation at knee height stage + 60 DAE, T_2- 3 irrigation at knee height, 60 DAE + 85-90 DAE, T_3- 3 irrigation at knee height, 60 DAE +115-120 DAE, T_4- 4 irrigation at knee height, 60 DAE, 85-90 DAE +115-120 DAE and T_5-control

Table1. Yield and yield components of BARI hybrid maize-5 as influenced by different irrigation level

Treatment	Cobs/plant (no.)	Cob length (cm)	Cob diameter (cm)	Grains/cob (no.)	1000 seed weight (g)	Yield (t/ha) 07-08	Yield (t/ha) 08-09
T_1	1.06 cd	18.53 ab	14.41 bc	475.5 ab	344.53	6.32 c	6.59 b
T_2	1.46 a	19.53 a	15.28 a	560.4 a	345.73	8.22 a	8.94 a
T_3	1.20 c	18.20 ab	14.66 ab	480.5 ab	344.90	7.09 b	6.74 b
T_4	1.26 b	18.80 a	14.64 ab	486.9 ab	345.00	7.25 b	6.91 b
T_5	1.00 d	17.20 b	13.80 c	402.6 b	343.23	6.05 c	5.63 c
CV (%)	5.27	2.56	1.84	6.83	1.16	9.36	10.00

Same letter (s) in a column does not differ significantly at 5% level by DMRT.

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EFFECT OF FERTILIZER ON THE GROWTH AND YIELD OF JHUM MORICH

R. Chakma, U. K. Sarker, M. A. Aziz, M. S. Rahman and M. M. Ullah

Abstract

A field trial was conducted at the Hill Agricultural Research Station, Khagrachari during two consecutive Kharif seasons of 2007-08 and 2008-09 to determine the optimum level of fertilizer for better production of Jhum morich. The treatment consisted of three levels of fertilizers (recommended dose, 50% reduction of recommended dose and no fertilizer). The highest yield (5.57 t/ha) was obtained from application of recommended dose which was statistically similar with 50% reduction of recommended dose. The lowest yield (4.44t/ha) was recorded from control treatment.

Introduction

Jhum Morich is very popular spices among indigenous people of Chittagong Hill Tracts. It is cultivated mostly in Kharif season at *Jhum* field and can also be cultivated in rabi season if moisture is available. The yield of *Jhum* morich is very low because farmers never use any kind of fertilizer. Hotness of *Jhum* morich very high but it dose not create any problems in the bowels. Because of its hotness its market price is high. Yield can be increased by using fertilizers. Considering the facts as stated the present investigation has been undertaken to determine the optimum level of fertilizer for better production of *Jhum* morich.

Materials and Methods

The study was carried out at the Hill Agricultural Research Station, Khagrachari during two consecutive Kharif seasons of 2007-08 and 2008-09. Three levels of fertilizer dose were used in this experiment viz. Recommended dose for chili ($N_{100}P_{60}K_{80}S_{20}$ kg/ha), 50% reduction of recommended dose and No fertilizer (control). The trial was laid out in RCB design with four replications. Seeds were directly dibbled on 25 May 2008 maintaining spacing of 50cm ×50 cm. The unit plot size was 4m× 4m. Except nitrogenous fertilizer all the fertilizers were applied at final land preparation. N fertilizer was applied at 25 DAE, 50 DAE and 70 DAE. Intercultural operations such as weeding, thinning and pesticide application were done as and when necessary. The data were collected on plant height, branches/plant, fruits/plant and yield. Collected data were statistically analyzed following MSTAT program. The differences between the means were compared using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Yield and yield components of *Jhum* morich were significantly influenced by fertilizer levels. The highest plant height (65.66cm) was obtained from the plant of recommended dose and lowest plant height (53.25cm) was recorded from control treatment which statistically at par with the plant of 50% reduction of recommended dose. This is might be due to that optimum application of fertilizer enhanced plant growth. In case of branches/plant, highest number of branches (10.57) was obtained from the plant of recommended dose and lowest (8.19) was recorded from control treatment which was statistically similar with the plant of 50% reduction of recommended dose. Recommended dose gave the highest fruits/plant (223.4) and control treatment contributed the lowest fruits/plant (162.4).

This is caused because optimum fertilizer application might help to enhance reproductive development of *Jhum* morich. Yield/plant was significantly affected by fertilizer dose. The highest yield/plant (259.8gm) was recorded from the plant of recommended dose and lowest (122.4gm) from control. All the parameter discussed above finally contributed yield. The highest green chili yield (5.57 t/ha) was obtained form recommended dose which was statistically similar with 50% reduction of recommended dose and lowest (4.44 t/ha) was recorded from control treatment during second year. A similar result trend was observed during first year. The highest yield with recommended dose is might be due to higher number of fruits/plant and higher yield/plant etc.

Conclusion

From this result it might be concluded that after application of fertilizer yield was increased and % yield increase over control was 25.45 and 17.34 with recommended dose and 50% reduction of recommended dose respectively. Even by using 50% reduction of recommended dose farmer will be benefited.

Table1. Yield and yield components of *Jhum* morich as influenced by different fertilizer levels

Treatments	Plant height (cm)	Branches/plant (no.)	Fruits/ plant (no.)	Yield/ plant (g)	Yield (t/ha) 2007-08	Yield (t/ha) 2008-09	% yield increase over control
Recommended dose for chili	65.66 a	10.57a	223.4 a	259.8 a	5.39 a	5.57 a	25.45
50% reduction of recommended dose	56.63 b	9.47 ab	204.8 ab	226.8 b	5.10 a	5.21 ab	17.34
No fertilizer (control)	53.25 b	8.19 b	162.4 b	122.4 c	4.23 b	4.44 b	-
CV (%)	3.19	6.13	9.21	2.18	8.20	9.72	-

Same letter (s) in a column does not differ significantly at 5% level by DMRT

Interaction effect

The interaction effect of irrigation and phosphorus was found significant on the seed yield only during 2008-09 growing season (Table 2). Two years results revealed that irrigation at 15 and 30 DAE with applying 90 kg P/ha produced the maximum seed yield of sesame and the lowest yield found by applying 30 kg P/ha with no irrigation.

Conclusion

From this study it is revealed that irrigation at 15 and 30 DAE with 90 kg P/ha is optimum for higher yield of sesame at Ishurdi region.

Table 1. Effect of yield and yield contributing characters of sesame as affected by irrigation and phosphorus during early kharif season of 2007 and 2008

Treatment	Capsules/plant (no.)		Seeds/capsule (no.)		1000 seed weight (g)		Seed yield (t/ha)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
Effect of irrigation								
No irrigation	51.65c	61.77c	70.56c	73.18	2.94c	3.01b	0.79c	1.23c
Irrigation at 15 DAE	64.18b	69.83b	74.47b	72.22	3.03bc	3.15b	1.09b	1.37b
Irrigation at 30 DAE	64.66b	68.85b	74.30b	69.93	3.07b	3.08b	1.06b	1.36b
Irrigation at 15 and 30 DAE	73.75a	81.40a	75.91a	73.06	3.25a	3.22a	1.26a	1.51a
CV(%)	-	4.71	-	7.22	-	3.01	-	126

Effect of phosphorus								
P_{30}	62.0b	67.05b	73.22b	73.18	3.01b	2.97b	0.97b	1.14c
P_{60}	63.28ab	74.13a	73.68ab	72.22	3.05b	3.13a	1.04b	1.36b
P_{90}	65.15a	73.32a	74.70a	69.93	3.15a	3.17a	1.18a	1.65a
P_{120}	63.80ab	73.36a	73.64ab	73.06	3.08b	3.10a	1.02b	1.66a
CV(%)	3.99	3.95	1.67	6.74	2.76	2.97	14.85	5.21

Means followed by same letter(s) do not differ significantly at 5% probability

Table 2. Effect of interaction of irrigation and phosphorus on the yield of sesame

Phosphorus (P)	Irrigation (I)							
	I_0		I_{15}		I_{30}		I_{15+30}	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
P_{30}	0.70a	1.05f	1.00a	1.20e	0.98a	1.20e	1.26a	1.31d
P_{60}	0.77a	1.23e	1.08a	1.40cd	1.02a	1.36cd	1.30a	1.45c
P_{90}	0.92a	1.30e	1.22a	1.46c	1.24a	1.42cd	1.36a	1.61a
P_{120}	0.79a	1.31d	1.09a	1.50b	1.02a	1.43d	1.21a	1.62a

Means followed by same letter(s) do not differ significantly at 5% probability

EFFECT OF DATE OF SOWING ON THE YIELD OF MUSTARD IN THE HILLY AREAS

M. Abdul Aziz, R. Chakma and C. K. Dash

Abstract

A field study was conducted at the Hill Agricultural Research Station, Khagrachari during the rabi season of 2009-10 to evaluate the effect of date of sowing on the yield and yield attributes of mustard. The variety BARI sharisa-11 was tested with four sowing time viz. 15 November, 25 November, 5 December and 15 December in a RCB design with three replications. The sowing dates significantly affected the growth, development and yield of mustard. Sowing mustard on 15 November produced the maximum seed yield (2.75 t/ha), sowing after that period the yield reduced drastically.

Introduction

Mustard was the major source of edible oil in Bangladesh in few years ago. It is cultivated in our country in the winter season. It is a thermo sensitive as well as photosensitive crop (Ghosh and Chatterjee, 1998). The average yield of mustard in our country is 739 kg/ha whereas the world average yield of mustard is 1575 kg/ha (FAO, 2003). Annual requirement of edible oil is 5 lakh metric tons. The internal production of edible oil can meet up only less than one-third of the annual requirement (Mondal and wahhab, 2001). There is a great scope of increasing yield of mustard by selecting high yielding varieties and improving management practices. Time of sowing is very important for mustard production (Rahman *et al*., 1988; Mondal and Islam, 1993 and Mondal *et al*., 1999). Sowing at proper time allows sufficient growth and development of a crop to obtain a satisfactory yield. The seed yield and maturity of mustard plants are greatly influenced by environmental conditions regardless of genotypes. Different sowing dates provide variable environmental conditions with in the same location for growth and development of crop and yield stability (Pandey *et al*., 1981). Therefore, whenever a new genotype/variety is developed or introduced in a region, an appropriate package of production practices must be developed. A suitable sowing date is very important for good agronomic performance of any crop. Therefore, the present study was undertaken to find out the optimum sowing time for the variety BARI Sarisha 11 for higher yield in the hilly areas.

Materials and Methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari during rabi season of 2009-10. Four treatments were included in RCB design with three replications. The treatments were as follows: S_1-15 November, S_2-25 November, S_3-5 December and S_4-15 December. Seeds were sown on as per treatment with row spacing of 20 cm apart. The unit plot size was 4m x 3m. Fertilizers @ 115-34-50-26-2.5-2 kg/ha NPKSZnB, respectively were applied in the form of Urea, Triple super phosphate (TSP), Muriate of potash (MOP), Gypsum, Zinc sulphate and Boric acid. All fertilizers were applied as basal. Intercultural operations such as weeding and thinning were done as and when necessary. The data to be collected on days to emergence, days to flowering, days to maturity, plant height, primary branches/plant, siliqua/plant, seeds/siliqua, 1000 seed weight and seed yield.

Results and Discussion

Effect of date of sowing on plant characteristics, yield attributes and yield are presented in Table l and Table 2. Days to emergence of the variety for different sowing dates were more or less similar. The plants of 15 November sowing took the highest number of days (35 days) to first flowerings. December 15 sowing plants took the lowest number of days (29) to give first flower. The first sowing (15 November) needed the highest number of days to 50% flowering (40 days). Plants of last sowing (15 December) needed 29 days to give 50% plants to flower. The longest period to mature (95 days) was required by the plants of 15 November sowing and it was followed by the second (25 November) and third sowings (5 December). The shortest period (88 days) to mature was required by the fourth sowings (15 December). Early sowings required longer period to mature and delayed sowing reduces the time to mature.

The highest plant height, 162.0 cm was recorded from the plant of first sowing (15 November) and lowest (124.1 cm) was obtained from the plants of last sowing (15 December). Mondal and Islam (1993) supported the above result and reported that sowing in the early November gave the highest plant height than in December. Shahidullah *et al*. (1997) also reported similar findings. Among the five sowing dates, the highest number of primary branches/ plant (4.53) was found from the plants of first sowing (15 November) and the lowest number of primary branches/ plant was recorded from the plants of last sowing (15 December). The highest number of siliqua/ plant (253.9) was obtained from the plants of first sowing (15 November) and it was significantly different from the all other sowing dates. This finding was in conformity with the findings of Mondal *et al*. (1999) who stated that the plants sowing on 15 November produced the highest number of siliqua/plant and reduced in the late sowings. The highest number of seeds/siliqua (13.40) was produced in the plants of 15 November sowing, and statistically similar seeds/siliqua was obtained from 25 November, 5 December and December 15 sowing (11.87, 11.07 and 10.97 respectively). The lowest seeds/siliqua were found in the plant of 15 December sowing (10.97). This result is in agreement with the results of Mondal *et al*. (1999) and Shahidullah *et al*. (1997). 1000- seed weight was non-significant for all of the sowing dates. However, numerically highest 1000-seed weight (3.87gm) was recorded from first sowing (15 November).The highest seed yield (2.52 t/ha) was produced on 15 November sowing which might be attributed to early planting, higher number of siliqua in individual plants, number of seeds/siliqua etc. Sowing on 25 November yielded the second highest yield (1.67 t/ha). The lowest seed yield (0.92 t/ha) was obtained from 15 December sowing. The findings in the present study about seed yield were supported by Brar *et al*. (1998) and Mondal *et al*. (1999). In the last year 5 November sowing gave the highest yield (2.00 t/ha).

Table 1. Plant characteristics of BARI Sarisha 11 as influenced by different dates of sowing

Treatments	Days to emergence	Days to first flowering	Days to Flowering (50%)	Days to maturity
15 November	4	35	40	95
25 November	4	33	38	93
5 December	4	32	32	90
15 December	4	29	29	88

Table 2. Yield and yield components of BARI Sarisha 11 as influenced by different dates of sowing

Treatments	Plant height(cm)	Primary branches /plant (no.)	Siliqua /plant (no.)	Seeds/ siliqua (no.)	1000 seed weight (g)	Seed yield (ton/ha)	
						2009-10	2008-09
05 November	-	-	-	-	-	-	2.00 a
15 November	162.0 a	4.53 a	253.9 a	13.40 a	3.87	2.52 a	1.48 b
25 November	143.7 b	3.36 b	200.3 b	11.87 b	3.83	1.67 b	1.23 b
5 December	138.0 bc	3.23 b	195.0 b	11.07 b	3.82	1.25 bc	0.49 c
15 December	124.1 c	2.23 c	144.9 c	10.97 b	3.79	0.92 c	0.45 c
Level of significance	**	**	**	**	NS	**	
CV (%)	4.47	7.12	6.77	4.15	0.71	8.86	

Same letter (s) in a column does not differ significantly at 1% level by DMRT

Conclusion

From two years result it might be concluded that upto 15 November would be the optimum date of sowing for BARI sarisha-11 in the hilly areas of Bangladesh and sowing after that period drastically reduced in yield.

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SOWING TIME AND VARIETAL PREFERENCE OF WHEAT AT HIGHER ELEVATION IN HILLY ENVIRONMENT AT KHAGRACHARI

M. A. Rahman, M.A.Aziz, C. K. Dash, U. K. Sarker, and M. M. Ullah

Introduction

Due to competition with other high-value and commercial crops the areas under wheat is gradually decreasing for the last couple of years which is a great threat under the food deficit condition in Bangladesh. Thus attention is necessary to expand wheat production in the non-traditional areas where cropping intensity is low and there is the scope of introduction and expansion of wheat. A huge arable valley land in the hilly region remains fallow in the winter due to limited irrigation water for Boro rice cultivation. Water requirement of wheat is minimum compared to rice thus more areas can be brought under wheat cultivation with the limited water resource available in these areas. The physical and environmental conditions of the hill regions are different from that traditional wheat growing plain land. Much works have done on agronomic management of wheat under the plain but not for the hill. The sowing date of wheat is considered as the most important factors to expose the crop to longer cool period to maximize grain yield. The pattern of winter at the hill is different and therefore sowing time of wheat may need to adjust to get the environmental benefit. Also there may have varietal difference in response to change in elevation and physio-environmental condition at the hill. Therefore the experiment was conducted to investigate whether there are varietal differences in response to sowing time at the higher elevation and to identify the wheat variety suitable for hilly areas.

Methods and materials

The field experiment was conducted at hill research station, Bangladesh Agricultural Research Institute, Khagrachuri for the last two consecutive years of 2008-09 and 2009-10. The experimental design was split-plot where three dates of sowing were assigned in the main plots and five wheat varieties were tested in the sub plots. The size of each subplot was 5m × 2m. Three sowing dates of S_1, S_2 and S_3 were November 20, November 30 and December 10 for 2008-09 and November 24, December 5 and December 15 for 2009-10 respectively. Five wheat varieties were Shatabdi (V_1), Sufi (V_2) Sourav (V_3), Bijoy (V_4) and Prodip (V_5). Fertilizers at the rates of 100 kg N, 38 kg P, 35 kg K and 20 kg S ha^{-1} were applied as urea, triple super phosphate, muriate of potash, and gypsum, respectively. All fertilizers including two-third urea were uniformly applied in the field during final land preparation. The rest of urea was top dressed at the crown root initiation (CRI) stage at 21 days after sowing (DAS). The crop was irrigated trice to bring the soil moisture near to field capacity during CRI, booting and grain-filling stages. Weeds were controlled once at 35 DAS manually by hand weeding. During maturity crops were harvested duly and sun-dried to measured biomass. Then the dried crop was threshed and after threshing, the grains were dried in the atmosphere and then moisture content of each sample was measured grain yields were converted to t ha^{-1} at 10% moisture to compare the treatment effects. All the data were statistically analyzed and the mean value was tested by the least significant difference (LSD) at 5% level of significance.

Results and Discussion

a) Effect of sowing time

Plant height, spikes/m^2, spikelet/spike and grains/spike of wheat were statistically similar for different sowing date in for both the years. Generally late sowing caused the reduction in thousand grain weight which was not significant in first year (Table 1). Also in second year the sowing date of S_1 and S_2 resulted in statistically similar thousand grain weight (Table 2). Wheat yield was declined from 3.37 in S_1 to 2.91 t/ha in S_3 and from 3.83 in S_1 to 3.17 t/ha to in S_3 for 2008-09 and 2009-10, respectively. However, this yield variation was not statistical significant for first year and also the yields under S_1 and S_2 was statistically similar for both the years. Generally wheat yield drastically declines due to late sowing as the plant expose to terminal heat stress under the late sowing condition in Bangladesh. In present study, the grain yield performance of wheat at different sowing dates indicated that late sowing of wheat until 10th December in first year and late sowing untill 5th December in second year did not affect wheat yield. Thus wheat can be sown until the first week of December with out loosing yield under the experimental soil and environmental conditions at Khagrachari.

b) Effect of variety

All the varieties used in this experiment were semi dwarf type and their height was varied from 89.1 to 94.6 cm and from 99.8 to 103.2 cm for the years of 2008-09 and 2009-10 respectively which were statistically non-significant. However, there were significant variations among the genotypes for several traits like initial plant population, spikes/m^2, grains/spike, thousand grain weight and grain yield for both the years (Table 1and 2). The wheat variety Prodip produced the least number of spikes/m^2 whereas other four varieties produced similar number of spikes/m^2 for both the years. The minimum initial plant population at 20 DAS (Table 1) indicated that germination and stand establishment was seriously affected in Prodip resulted comparatively less number of spikes/m^2 which finally contributed to poor grain yield of Prodip compared to other varieties. Number of grains/spike was the highest Sufi which was similar to that Saurav and Prodip in first year. The same variety Sufi produced the significantly higher grains/spike than all other variety in second year. However this genotypic advantage of higher grains/spike could not contribute to expected higher yield of Sufi due to its very low thousand grain weight. Thousand grain weight was the maximum in Shatabdi (54.7g) which was statistically similar to Prodip in first year. Also in second year, the variety Shatabdi produced maximum thousand grain weight that was statistically similar to all other varieties but higher than Sufi.

c) Interaction effect of sowing time and variety

The grain yield of wheat was significantly influenced by the interaction of sowing time and variety (Table 3). The variety Shatabdi gave the highest yield of 4.25 t/ha under the first sowing date its yield was declined at higher rate as compared to other varieties due to late sowing of second and third dates. The yield reduction due to late sowing was the highest in Shatabdi followed by Prodip and Sufi. On the contrary, Sourav and Bijoy performed higher yield statistically similar to Shatabdi and the yield reduction due to late sowing were minimum in these two varieties compared to other three varieties. The result indicating that both Bijoy and Sourav have good stability for different sowing dates. The variety Shatabdi is good only for early sowing conditions. The wheat variety Sourav and Bijoy have the potentials of producing satisfactory yields through out the sowing period even until up to 15th December.

Hill Eco-System

Conclusion

The national average yield of wheat varied from 2.20 to 2.34 for last couple of years. On farm demonstrations of newly develop wheat varieties produced an average yield of 3.0 t/ha in optimum sowing with the full package of production technologies as recommended by wheat research centre under the close supervision of DAE personals and ORFD scientist. Under such a condition, the yield performance of experimental wheat varieties in non-traditional hilly region of Khagrachuri found very encouraging. The variety Shatabdi could be recommended for early sowing conditions whereas variety Sourav and Bijoy could be grown through out the sowing period even until up to 15th December. Thus due attention is needed to expand wheat cultivation in the hill regions of Bangladesh.

Table 1: Yield component and agronomic characters of wheat as influenced by dates of sowing and variety in 2008-09

Treatment	Plant ht. (cm)	Spikes m^{-2}	Spikelet/Spike	Grains $spike^{-1}$	1000 grain wt. (g)	Grain yield($t\ ha^{-1}$)
A. Sowing date						
S_1	93.7	329.9	17.5	41.2	48.2	3.37
S_2	93.6	329.9	17.6	39.8	46.9	3.25
S_3	92.0	348.7	17.5	38.5	46.2	2.92
$LSD_{(0.05)}$	Ns	Ns	Ns	Ns	Ns	Ns
B. Variety						
Shatabdi	94.3	358 a	17.9	37.0 b	54.7 a	3.71 a
Sufi	93.0	350 a	17.4	43.9 a	36.5 d	2.85 b
Sourav	94.6	337 a	18.0	41.4 a	47.2 b	3.25 ab
Bijoy	94.5	362 a	16.9	34.5 b	43.9 c	2.92 b
Prodip	89.1	274 b	17.6	42.3 a	53.3 a	3.17 b
$LSD_{(0.05)}$	Ns	38.4	Ns	4.1	4.7	0.50
CV (%)	4.5	11.8	5.8	10.6	5.8	15.1

Table 2. Yield component and agronomic characters of wheat as influenced by dates of sowing and variety in the year of 2009-10

Treatment	IPP at 20 DAS	Plant ht. (cm)	Spikes m^{-2}	Grains $spike^{-1}$	1000 grain wt. (g)	Grain yield ($t\ ha^{-1}$)
A. Sowing date						
S_1	190.8	103.0	337.8	45.4	48.6 a	3.83 a
S_2	181.9	100.7	319.8	43.1	47.8 a	3.57 a
S_3	187.5	100.3	311.4	42.1	42.7 b	3.17 b
$LSD_{(0.05)}$	Ns	Ns	Ns	Ns	3.9	0.35
B. Variety						
Shatabdi	193.4 b	102.0 ab	330.6	41.6 b	49.3 a	3.71 a
Sufi	216.3 a	105.2 a	327.1	48.9 a	39.4 b	3.18 b
Sourav	185.7 b	98.8 b	321.3	44.0 b	46.6 a	3.65 a
Bijoy	182.7 b	101.2 ab	324.3	41.8 b	48.7 a	3.71 a
Prodip	156.0 c	99.4 ab	311.7	41.4 b	47.9 a	3.36 b
$LSD_{(0.05)}$	16.1	7.1	Ns	3.9	4.2	0.24
CV (%)	8.9	6.2	7.4	9.1	6.1	7.6

Table 3: Interaction effect of sowing time and variety on grain yield (t/ha) of wheat in 2009-10

Sowing date	Variety					
	Shatabdi	Sufi	Saurav	Bijoy	Prodip	Mean
S_1	4.25 a	3.40 gi	3.90 b	3.88 bd	3.73 be	3.83
S_2	3.68 bf	3.35 fg	3.62 bg	3.80 bc	3.40 eh	3.57
S_3	3.20 hi	2.79 j	3.44 ch	3.44 dh	2.96 ij	3.17
Mean	3.71	3.18	3.65	3.71	3.36	3.52

EFFECT OF IRRIGATION ON THE YIELD AND YIELD ATTRIBUTES OF WHEAT

C. K. Dash, M.A. Aziz, U. K. Sarker, M. A. Rouf, M. N. Akter and M. M. Ullah

Abstract

A field study was conducted at the Hill Agricultural Research Station, Khagrachari during 2009-10 to evaluate the optimum level of irrigation on the growth and yield of wheat. The treatments consisted of 4 levels of irrigation viz. 2 irrigation at 10 DAS + CRI stage, 2 irrigation at CRI stage + 60 DAS, 3 irrigation at 10 DAS + CRI stage + 60 DAS, 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS and control where no irrigation were given. The highest yield (2.5 t/ha) was obtained from 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS. Control treatment gave lowest yield (1.62 t/ha).

Introduction

Water plays a vital role for the production of wheat as it is generally grown in winter season in Bangladesh when rainfall is scanty. Moreover, there is a direct correlation between water supply and utilization of fertilizer elements. The irrigation and fertilizer research results of Nagy (1995) have indicated that irrigation improves the use efficiency of fertilizer. In irrigated treatments- which mean a higher yield level- economic fertilizer doses are greater due to the positive correlation between irrigation and fertilizer. We can ensure constant water supply and physiological operations in plant with irrigation. Results of experiments prove that irrigation in general, especially in a case of drought, highly increase yield (Szoke Molnar, 1977). Due to competition with other high-value and commercial crops the areas under wheat is gradually decreasing for the last couple of years which is a great threat under the food deficit condition in Bangladesh. So it is necessary to expand wheat production in the non-traditional hilly areas to increase wheat production. Experimental results revealed that until 10th December did not affect plant growth of wheat in the hilly areas of Khagrachari. Irrigation is a pre-requisite to successful wheat production. Moreover hilly areas have scarcity in irrigation water during winter. Hence the study has been undertaken to optimize the irrigation level for wheat production in the hilly areas.

Materials and Methods

The Experiment was conducted at Hill Agricultural Research Station, Khagrachari during rabi season of 2009-10. Wheat variety Shatabdi was used in the experiment. The treatments consisted of 4 levels of irrigation viz. 2 irrigation at 10 DAS + CRI stage, 2 irrigation at CRI stage + 60 DAS, 3 irrigation at 10 DAS + CRI stage + 60 DAS, 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS and control where no irrigation were given. Seeds were sown on 24th November row spacing of 20 cm apart. The unit plot size was 4m X 4m. Fertilizers @ 100-26-50-20-5-1kg/ha NPKSZnB, respectively were applied in the form of Urea, Triple super phosphate (TSP), Muriate of Potash (MOP), Gypsum, Zinc Sulphate and Boric acid. Two third urea and all other fertilizers were applied as basal. The rest to the urea was applied at 22 DAE. Intercultural operations such as weeding, irrigation and thinning were done as and when necessary. Data were taken on on plant height, effective tillers/m^2, spikes/spikelet, grains/spike, 1000- grain weight and grain yield etc.

Results and Discussion

The effect of different level of irrigation levels presented in Table 1 revealed that plant height, effective tillers/m^2, spikes/spikelet, grains/spike and yield were influenced by irrigation level. The highest plant height, 106.90 cm was recorded from 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS. The lowest plant height, 75.90 cm was recorded from control.

The yield and yield components of shatabdi were significantly influenced by different irrigation levels. Number of effective tillers/m^2 ranges from 54.93 to 84.93. The highest effective tillers/m^2 (84.93) were recorded from 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS which was statistically similar with 3 irrigation at 10 DAS + CRI stage + 60 DAS (72.13). The lowest effective tillers/m^2 (54.93) was recorded from control. No. of Spikes/spikelet were significantly varied with the irrigation levels. 4 irrigations at 10 DAS + CRI stage + 60 DAS + 75 DAS gave the highest number of Spikes/spikelet (185.7). 2 irrigations at 10 DAS + CRI stage, 2 irrigations at CRI stage + 60 DAS and 3 irrigations at 10 DAS + CRI stage + 60 DAS gave statistically similar no. of Spikes/spikelet (149.3, 155.3 and 166.7). The lowest Spikes/spikelet (141.0) was recorded from control plot. Grains/spike was highest for 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS (41.97) which was statistically similar with 3 irrigation at 10 DAS + CRI stage + 60 DAS (39.00), lowest grains/spike (29.80) was recorded from control treatment. Thousand seed weight was non-significant for all of the irrigation levels. This is might be due to genetical character of crop. The contribution of yield contributing character finally affected yield. Yield of BARI wheat variety shatabdi varied significantly due to different irrigation levels. The highest yield (2.53 t/ha) was obtained from 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS The lowest yield (1.62 t/ha) was recorded from control treatment.

Table 1. Yield and yield components of BARI wheat variety Shatabdi as influenced by different irrigation level

Treatment	Plant height (cm)	Effective tillers/m^2	Spikes/spikelet (no.)	Grains/spike (no.)	1000-grain weight (g)	Yield (t/ha)
T_1	88.84 b	65.4 bc	149.3 bc	34.10 c	49.21	1.87 c
T_2	92.28 b	70.07 b	155.3 bc	36.70 bc	49.13	2.08 b
T_3	92.98 b	72.13 ab	166.7 b	39.00 ab	50.48	2.22 b
T_4	106.90 a	84.93 a	185.7 a	41.97 a	50.25	2.53 a
T_5	75.90 c	54.93 c	141.0 c	29.80 d	49.51	1.62 d
Level of significance	**	**	**	**	NS	**
CV (%)	7.38	9.1	6.07	6.91	1.06	7.48

Same letter (s) in a column does not differ significantly at 1% level by DMRT.

Here,

T_1: 2 irrigation at 10 DAS + CRI stage, T_2: 2 irrigation at CRI stage + 60 DAS, T_3: 3 irrigation at 10 DAS + CRI stage + 60 DAS, T_4: 4 irrigation at 10 DAS + CRI stage + 60 DAS + 75 DAS, T_5: Control (No irrigation)

Conclusion

From the result it may be concluded that 4 irrigation may result satisfactory yield of wheat. However this is a first year experiment and the experiment will be repeated second time for conformation.

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GREEN COB AND FODDER YIELD OF SWEET CORN AS INFLUENCED BY SOWING TIME IN THE HILLY REGION

R. R. Saha, Bulbul Ahmed, J. Rahman and M. A. Hossain

Abstract

A field experiment was conducted at the farm of Hill Agricultural Research Station, Ramgorh, Khagrachari during rabi season of 2010-11 to determine the optimum sowing time for better marketable yield of green cob as well as fodder of sweet corn (var. BARI Sweet corn-1) in the hilly region. Five sowing dates (November 20, November 30, December 10, December 20 and December 30) were included in the study. Sowing dates showed significant influence on cob diameter, weight of individual cob, green cob yield /ha and TSS content (%). The highest green cob yield (14.13 t/ha) was obtained from 20 December sowing followed by 30 December sowing (13.28 t/ha). The maximum green fodder yield (40.61 t/ha) obtained from 10 December sowing and it was not significantly different from other sowing dates. Maximum TSS (Total soluble sugar/ solid) value was obtained from 30 November sowing (14.46%) followed by 10 December sowing (13.91%).

Introduction

Sweet corn is mainly produced for human consumption either as a fresh cob or processed product. The kernel of sweet corn is translucent as fresh condition. The green cob is suitable for fresh consumption due to its sweet and delicious taste. Tribal people of hilly areas normally take any type of corn as boiled or roasted condition. Generally the people of this area cultivate the corn as jhum along with other crops. Sweet corn may be a good option for them. BARI already released a sweet corn variety (BARI Sweet corn- 1). As sweet corn is harvested early i. e. 20-24 days after silking then the plant and husk could be used as fodder. Therefore, the present study was conducted to determine optimum sowing time for better marketable yield of green cob as well as fodder of sweet corn in the hilly areas.

Materials and Methods

The experiment was conducted at Hill Agricultural Research Station, Ramgorh, Khagrachari during rabi season of 2010-2011. The soil of this hill area belongs to AEZ 29 and the soil bears acidity. Total rainfall 158 mm was received during the crop growth period. The mean maximum and minimum temperature were 27.83^{0}C and 18.61^{0}C respectively during the crop growth season (Fig 1). Five different sowing dates (November 20, November30, December 10, December 20 and December 30) were included in the experiment as treatment variables. The trial was laid out in a randomized complete block design with three replications. The unit plot size was 4.5m ×3.5m. Seeds of sweet corn (var. BARI Sweet corn-1) were sown according to treatment with the spacing of 45cm x25cm. The experiment plot was prepared and labeled properly. Lime was also applied due to minimize the acidity effect in hilly areas. Fertilizers at the rate of 150-60-90-20 kg/ha of NPK and S were applied in the form of urea, triple super phosphate (TSP), muriate of potash (MoP) and gypsum, respectively. The full amount of TSP, MoP, Gypsum and 1/3 urea were applied as basal during final land preparation. The remaining 2/3 of urea were side dressed at 30 and 55 days after emergence. Weeding, irrigation and insecticides spraying were done as and when required to maintain an optimum growth condition for the crop. The green cob was harvested at 20-24 days after silking of when the corn silks were turned to dry as brown color. The collected data were analyzed statistically and means were separated using LSD test at 5% level of significance.

Hill Eco-System

Results and Discussion

Sowing date significantly influenced the cob diameter, individual cob weight, green cob yield /ha and TSS value of BARI Sweet corn-1. No significant variation was observed in plant height, cob length and green fodder yield /ha due to sowing dates (Table1). Longest cob (16.66 cm) was recorded at 10 December sowing and the shortest from 20 November sowing (15.84 cm). The highest cob diameter and individual cob weight were obtained from 20 December sowing. The highest green cob yield (14.13 t/ha) was obtained from 20 December sowing and it was statistically identical with 30 December sowing (13.28 t/ha). The reason for higher green cob yield/ha of sweet corn might be due to increased cob diameter and weight. The maximum green fodder yield (40.61 t/ha) was found from 10 December sowing which was identical with that of other sowing time. Sweetness of the green cob i.e., TSS value varied significantly due to different sowing dates and the highest TSS value (14.46%) was recorded at 30 November sowing which was at par with that of 10 December sowing (13.91%).

Conclusion

Results of the experiment revealed that 20 to 30 December sowing could be suitable for sweet corn cultivation in hilly region in respect of green cob yield. The experiment should be conducted next year for final conclusion.

Table1. Effect of sowing time on the green cob and fodder yield and yield contributing characters of BARI Sweet corn 1

Sowing dates	Plant height (cm)	Cob length (cm)	Cob diameter (cm)	Weight of individual cob (gm)	Yield of green cob (t/ha)	Green fodder yield (t/ha)	% TSS
Nov 20	240	15.84	4.09	107.4	9.48	38.76	12.96
Nov 30	261	16.03	4.21	143.2	12.6	38.32	14.46
Dec 10	268	16.66	4.18	139.43	12.3	40.61	13.91
Dec 20	279	15.87	4.44	169.23	14.13	38.22	13.31
Dec 30	281	17.37	4.18	149.4	13.28	37.47	13.62
$LSD_{(0.05)}$	NS	NS	0.16	6.3	1.35	NS	0.59
CV%	6.37	6.37	1.93	9.55	5.78	9.05	2.52

NS= Not significant

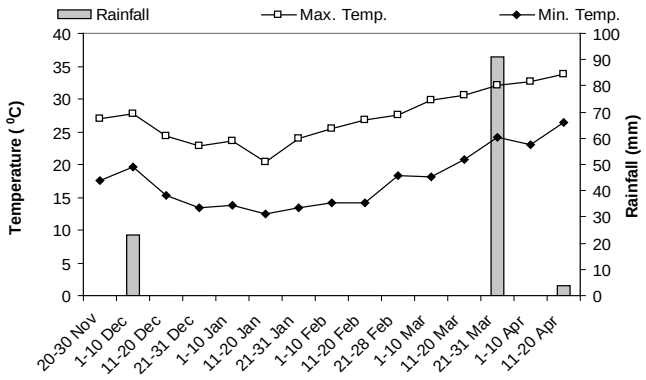

Fig. 1. Mean of daca-day maximum and minimum air temperature and rainfall during sweet corn growing period

HYBRID MAIZE + SWEET POTATO INTERCROPPING UNDER DIFFERENT PLANTING SYSTEMS IN THE HILLY AREAS

M. N. Islam, M. A. Hossain and M. Mohabbotullah

Abstract

An intercropping experiment was conducted at the Hill Agricultural Research Station, Khagrachari during rabi season of 2010-11 to find out the suitable planting system of hybrid maize-sweet potato intercropping. Three intercropping combinations viz., maize paired row + 2 rows sweet potato (100% HM: 40% SP), maize normal row +1 row sweet potato (100% HM: 60% SP) and sweet potato normal row + 1 row maize after 2 rows sweet potato (100% SP: 50%HM) were evaluated against their sole crops. Cob yield of hybrid maize and tuber yield of sweet potato was the highest in respective sole crops. The highest cob equivalent yield (25.43 t/ha) was found in maize normal row +1 row sweet potato (100% HM: 60% SP) i.e T_4. The highest gross return (Tk 127150 /ha), gross margin (Tk.87130/ha) and benefit cost ratio (3.18) were recorded in the same combination. The results revealed that maize normal row +1 row sweet potato (100% HM: 60% SP) combination might be suitable and profitable for the hill valley of Khagrachari.

Introduction

Hybrid maize-sweet potato intercropping system becomes popular in Bangladesh for their high yield potential and diversified uses. Production and area may be increased by several folds by growing these two crops in association as they possess different photosynthetic pathways, different growth habit and requirement of different growth resources (Ogunlela *et al.*, 1988). Intercropping have many advantages, but there are difficulty in sowing or harvesting and in quantifying and applying fertilizers for getting maximum profit from the component crops of intercropping systems. However, hill farmers grow hybrid maize and sweet potato in hill valley as sole crops. In that region, productivity and profitability may be increased through intercropping of maize and sweet potato. Hence, the experiment was conducted to find out the suitable planting system of hybrid maize-sweet potato intercropping.

Materials and Methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari during rabi season of 2010-11. Four treatment combinations were as follows: T_1 = Sole hybrid maize (75 × 25 cm), T_2 = Sole sweet potato (60 cm × 30 cm), T_3 = Hybrid maize paired rows (37.5/150/37.5 × 25 cm) + 2 rows sweet potato (100% HM: 40% SP), T_4 = Hybrid maize normal row +1 row sweet potato (100% HM: 60% SP), T_5 = Sweet potato normal row + 1 row maize after 2 rows sweet potato (100% SP: 50% HM)

The experiment was laid out in a randomized complete block design with five replications. The unit plot size was 4.5 m × 4.5 m. The hybrid maize (var. BARI hybrid maize 5) and sweet potato (BARI Mishtialu-7) were used in this intercropping experiment. Seeds of maize and vines of sweet potato were sown/ planted on December 07, 2010 according to treatments. Sole hybrid maize and intercropping treatments were fertilized with 260-55-110-40-4-1 kg/ha NPKSZnB while sole sweet potato was grown with 100-40-100-10-1 kg/ha NPKSZn. The full amount of P K S Zn B and $^1/_3$ N were applied as basal in the form of triple super phosphate, muriate of potash, gypsum, zinc sulphate, boric acid and urea, respectively. The remaining N was top dressed in two

equal splits at 30 and 60 days after sowing (DAS). Irrigation was given after sowing/planting for proper establishment of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAS. Two hand weeding were done at 20 and 40 DAS to keep the crops reasonably weed free. Data of maize and sweet potato were taken from randomly selected 10 plants from each plot. Cob of maize was harvested at 145 DAS (May 02, 2011) and sweet potato at 146 DAS (May 03, 2011). Data of both the crops were analyzed statistically and the means were adjudged using LSD. Cob equivalent yield and benefit cost analysis were also done.

Results and Discussion

Effect on maize

Number of cobs/m^2, weight single cob with husk and yield of cob with husk of hybrid maize were influenced significantly due to intercropping with sweet potato under different planting systems (Table 1). The highest number of cobs/m^2 (5.32) was recorded in sole maize, which was identical with those where cent-percent population of hybrid maize was used. The minimum number of cobs/m^2 was found in T_5 (2.64). The difference in cobs/m^2 among different combinations was attributed due to planting systems. Weight of single cob (400 g) was maximum in sole maize and it was at par with T_4 (365 g) and T_5 (384 g). On the other hand, weight of single cob (351 g) was minimum in T_3. The highest cob yield (21.28 t/ha) was found in sole maize which was statistically similar with T_3 (18.60 t/ha) and T_4 (19.27 t/ha). The lowest cob yield (10.14 t/ha) was recorded in T_5 due to mainly for minimum number of cobs/m^2.

Effect on sweet potato

Yield and yield components of sweet potato were affected significantly in maize/sweet potato intercropping unsystems (Table 2). The significant variation in plants/m^2 (2.93-5.15) was attributed mainly due to planting system. The higher and identical number of tubers/plant was recorded in T_2 (3.6), T_3 (3.9) and T_5 (4.0) but the lowest in T_4 (3.2). Tuber weight/plant followed the trend of tubers/plant. Single tuber weight (180.56g) was the highest in sole sweet potato (T_2). Single tuber weight was reduced under intercrop situation. Single tuber weight (140.63 g) was the lowest in T_4 where total plant population was the highest. Tuber weight/plant and single tuber weight in intercropping systems was significantly lower than those in sole sweet potato. The lower values of those parameters might be contributed to the shading effect of tall stature maize plants as well as inter specific competition. The highest tuber yield (9.30 t/ha) of sweet potato was recorded in sole crop (T_2). In intercrop situation, tuber yield of sweet potato was lower and the lowest yield (4.43 t/ha) was recorded in T_3 combination. Tuber yield in different intercrop combinations was attributed to the cumulative effect of yield components.

Intercrop efficiency

Cob equivalent yields and economic study of hybrid maize-sweet potato intercropping system are presented in Table 3. Total yield in terms of cob equivalent yields (19.20 – 25.43 t/ha) was higher than sole maize or sole sweet potato. Among intercropping systems, higher cob equivalent yield was obtained from T_4 due to higher cob yield (19.27 t/ha). Similarly, gross return (Tk 127150 /ha), gross margin (Tk 87130/ha) and benefit cost ratio (3.18) were also higher in that combination.

Conclusion

The results revealed that maize normal row + 1 row sweet potato (100% HM: 60% SP) combination might be suitable and profitable for the hill valley of Khagrachari.

Table 1.Yield and yield components of hybrid maize in maize-sweet potato intercropping under different planting systems

Treatment	Cobs/m^2 (no.)	Weight of single cob with husk (g)	Yield of cob with husk (t/ha)
T_1	5.32	400	21.28
T_2	-	-	-
T_3	5.30	351	18.60
T_4	5.28	365	19.27
T_5	2.64	384	10.14
LSD $_{(0.05)}$	0.91	34	4.66
CV (%)	9.81	4.8	13.12

Table 2.Yield and yield components of sweet potato in maize-sweet potato intercropping under different planting systems

Treatment	Plants/m^2 (no.)	Tubers/plant (no.)	Tuber wt./plant (g)	Single tuber wt. (g)	Tuber yield (t/ha)
T_1	-	-	-	-	-
T_2	5.15	3.6	650	180.56	9.30
T_3	2.93	3.9	590	151.28	4.43
T_4	3.65	3.2	550	140.63	5.13
T_5	5.12	4.0	600	147.37	7.55
LSD $_{(0.05)}$	0.85	0.42	76.4	18.27	1.71
CV (%)	10.1	5.7	6.4	5.9	13

Table 3. Cob equivalent yield and benefit cost analysis of maize-sweet potato intercropping under different planting systems

Treatment	Cob yield (t/ha)	Tuber yield (t/ha)	Cob equi. yield (t/ha)	Gross return (Tk/ha)	Cost of production (Tk/ha)	Gross margin (Tk/ha)	BCR
T_1	21.28	-	21.28	106400	38000	68400	2.80
T_2	-	9.30	11.16	55800	28500	27300	1.96
T_3	18.60	4.43	23.92	119600	40000	79580	2.99
T_4	19.27	5.13	25.43	127150	40000	87130	3.18
T_5	10.14	7.55	19.20	96000	40000	56000	2.40

Local market price (Tk/kg): Maize cob: 5/-, Sweet potato: 6/-

GREEN COB AND FODDER YIELD OF SWEET CORN AS INFLUENCED BY SOWING TIME AT RAMGHOR

M. Shaheenuzzamn, B. Ahmed, J. Rahman and R. R. Saha

Abstract

A field experiment was conducted at the farm of Hill Tract Agricultural Research Station, Ramgorh, Khagrachari during rabi season of 2011-12 to determine the optimum sowing time for better marketable yield of green cob as well as fodder of sweet corn (var. BARI Sweet corn 1). Five sowing dates (November 20, November 30, December 10, December 20 and December 30) were included in the study. The result showed that significantly highest green cob yield (8.60 t/ha) was obtained from 20 November sowing followed by 30 November (8.03 t/ha), 10 December (7.67 t/ha) and 20 December (8.11 ton/ha) sowings The maximum green fodder yield (39.99 t/ha) was obtained from 30 November sowing and it was statistically at par with that of 20 November sowing. Maximum TSS (Total soluble sugar) value was obtained from 20 November sowing followed by 30 November, 10 December and 20 December sowings similar trend was also found in 2010-2011. The results revealed that 20 November sowing might be optimum sowing time for sweet corn production in the hilly areas in terms of green cob and fodder yield.

Introduction

Sweet corn is mainly produced for human consumption either as a fresh cob or processed product. The kernel of sweet corn is translucent as fresh condition. The green cob is suitable for fresh consumption due to its sweet and delicious taste. Tribal people of hilly areas normally take any type of corn as boiled or roasted condition. Generally the people of this area cultivate the corn as jhum along with other crops. Sweet corn may be a good option for them. BARI already released a sweet corn variety (BARI Sweet corn 1). As sweet corn is harvested early i. e. 20-24 days after silking then the plant and husk could be used as fodder. Therefore, the present study was conducted to determine optimum sowing time for better marketable yield of green cob as well as fodder of sweet corn in the hilly areas.

Materials and Methods

The experiment was conducted at Hill Tract Agricultural Research Station, Ramgorh, Khagrachari during rabi season of 2011-12. The soil of this hill area belongs to AEZ 29 and the soil bears acidity. Five dates of sowing (November 20, November 30, December 10, December 20 and December 30) were included in the experiment. Weather data was presented in Table 2. The trial was laid out in a randomized complete block design with three replications. The unit plot size was 4.5m×3.5m. Seeds of sweet corn (var. BARI Sweet corn 1) were sown according to treatment with the spacing of 45cm×25cm. The experiment plot was prepared and labeled properly. Lime @1.5 t/ha was also applied due to minimize the acidity effect in hilly areas. Fertilizers at the rate of 150-60-90-20 kg/ha of NPK and S were applied in the form of Urea, Triple Super Phosphate (TSP), Muriate of Potash (MoP) and Sulfur, respectively. The full amount of TSP, MoP, Gypsum and 1/3 Urea were applied as basal during final land preparation. The remaining 2/3 of urea were side dressed at 30 and 55 days after emergence. Weeding, irrigation and insecticides spraying were done as and when required to maintain an optimum growth condition for the crop. The green cob was harvested at 20-24 days after silking when the corn silks were turned to dry as brown

color. The collected data were analyzed statistically and means were separated using LSD test at 5% level of significance.

Results and Discussion

Days to emergence showed slight variation among the sowing time (Fig. 1). This might be due to varioation of prevailing temperature. Days to tasseling of sweet corn was also markedly differed by sowing time (Fig.2). This result was in agreement with the findings of Khan *et al* (2011). They reported that days to tasseling were significantly affected by date of sowing. Days to tasseling decreased with delaying of sowing time. This might be due to differences in photoperiod and temperature among sowing times. Photoperiod and temperature can influence the timing of development events in maize (Aitken, 1977; Allison and Daynard, 1979) and influence days to tasseling in maize with appreciable genetic differences in relative sensitivity to these factors (Ellis *et al.,* 1992). These results are also supported by Khan *et al.* (2009); Khan *et al.* (2004), Shaw (1988), and Daughtry *et al.* (1984) who reported dependence of tasseling duration on temperature and variety. Days to silking was influenced by sowing time (Fig.3). The minimum days to silking were recorded from 30 November (74 days) sowing and the maximum days to silking were recorded from 20 December (78 days) sowing. Significant effects of sowing date on days to silking in corn was reported by Khan *et al. (*2009) and Shafi *et al. (*2006). Sowing time significantly influenced the cob length, cob diameter, weight of individual cob and yield green cob and fodder as well as TSS value of BARI Sweet corn-1 but no significant variation was observed in plant height (Table 1).

The longest cob (18.07 cm) was recorded at 30 December sowing and the shortest cob from 30 November and 10 December sowings. Maximum cob diameter (4.82 cm) was recorded at 20 November and 20 December (4.5 cm) sowings whereas minimum cob diameter was recorded at 30 November sowing. The highest individual cob weight was obtained from 30 December sowing and the lowest from 30 November sowing. During study period, temperature was lower at late sown condition (Table.2) due to that individual cob weight was found higher. Sencar *et al.* (1997) also stated that weight of individual cob increased with delayed sowing time.The highest green cob yield (8.60 t/ha) was recorded from 20 November sowing followed by 30 November, 10 December and 20 December and the lowest (Table 1). This might be due to differences of environmental condition during growing period of different sowing time. Environmental conditions may have reduced photoassimilate production during the lag phase of late sown maize, because both temperature and incident solar radiation were low at that time which affecting biomass production and perhaps sink activity (Ou-Lee and Setter, 1985). Some researchers also stated that delaying the sowing date resulted in decreased yields (Ishimura *et al.*, (1984), Tomorga *et al.,* (1985), Imholte and Carter (1987) whereas Herbek *et al.* (1986) reported that yields increased with a delayed sowing date. The maximum green fodder yield (40.00 t/ha) was found from 30 November and the minimum (33.94 t/ha) from 30 December sowing. The highest TSS value (13.78 %) was recorded at 20 November sowing which was identical with that of other sowing. Similar trend was found in 2010-2011.

Conclusion

Two years study revealed that 20 November sowing might be optimum sowing time for sweet corn cultivation in hilly region in terms of green cob and fodder yield.

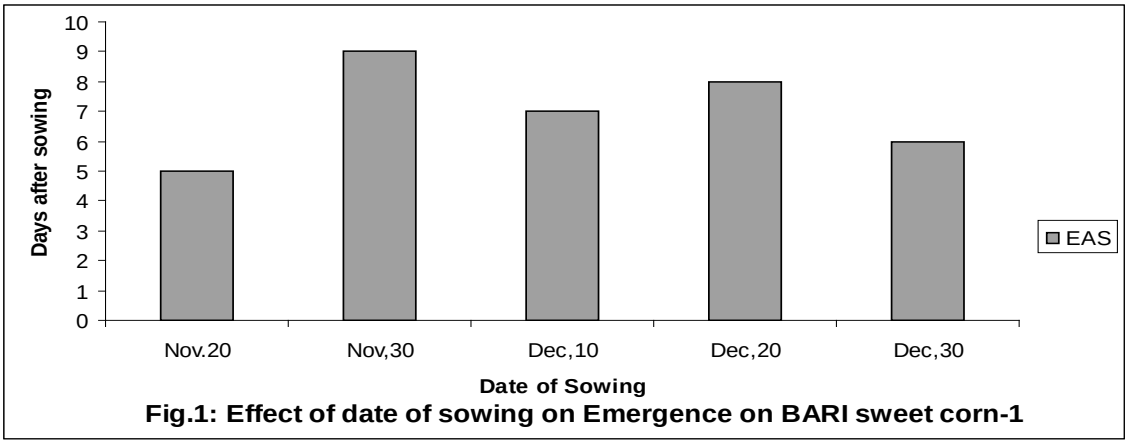

Fig.1: Effect of date of sowing on Emergence on BARI sweet corn-1

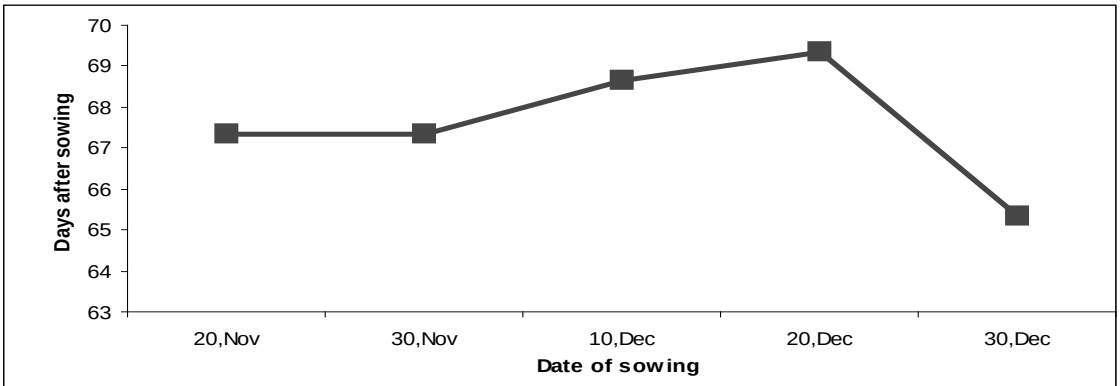

Fig.2: Effect on date of sowing on Days to Tasseling in BARI sweet corn-1.

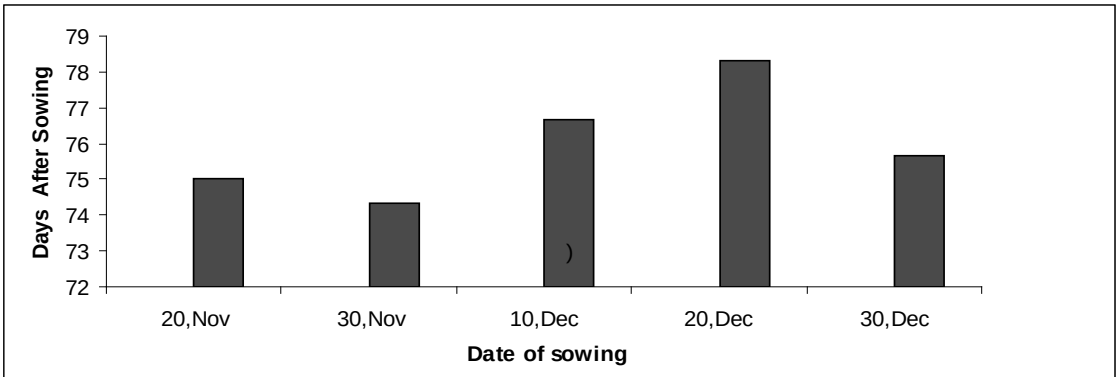

Fig.3: Effect of date of sowing on days to Silking in BARI sweet corn-1.

Table 1. Effect of sowing time on the green cob, fodder yield and yield contributing characters of BARI Sweet corn 1

Sowing dates	Plant height (cm	Cob length (cm)	Cob diameter (cm)	Weight of individual cob (gm)	Yield of green cob (t/ha)		Green fodder yield (ton/ha)		% TSS
					2011-12	2010-11	2011-12	2010-11	2011-12
Nov 20	2.46	17.46 b	4.82 a	156.77 b	8.60 a	8.43	38.94 ab	38.76	13.78 a
Nov 30	2.63	16.80 c	3.82 b	131.50 c	8.03 a	7.81	39.99 a	38.32	13.57 ab
Dec 10	2.57	17.00 c	4.44 ab	159.43 b	7.67 a	5.59	34.39 bc	40.61	13.00 ab
Dec 20	2.52	17.87 ab	4.5 a	192.37 a	8.11 a	5.00	37. 08 abc	38.22	13.27 ab
Dec 30	2.70	18.07 a	4.5 ab	196.00 a	6.15 b	6.46	33.94 c	37.47	12.54 b
$LSD_{(0.05)}$	NS	0.4281	0.352	8.861	2.267	1.35	7.361	NS	1.103
CV (%)	5.76	4.12	4.28	2.81	9.91	5.78	6.73	9.05	4.42

Table 2. Monthly climatic data during 2011-2012

Name of Month	Temperature (^{0}C)			Humidity (%)	Rainfall (cm)
	Maximum	Minimum	Mean		
November,11	25.33	19.73	22.53	77.99	0
December,11	21.96	17.58	19.77	82.23	0
January,12	20.16	15.54	17.85	79.04	0
February,12	25.96	15.65	20.81	70.32	0
March,12	29.58	22.80	26.19	71.93	0
April,12	29.56	25.16	27.36	68.58	19.52
May,12	28.60	26.33	27.47	72.83	5.20

Source: Annual research report, HARS, Khagrachari, 2011-12

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GREEN COB AND FODDER YIELD OF SWEET CORN AS INFLUENCED BY SOWING TIME AT KHAGRACHARI

Bulbul Ahmed, M. Salim and M.M. Ullah

Abstract

A field experiment was conducted at the farm of Hill Agricultural Research Station, Khagrachari Hill District during rabi season of 2011-12 to determine the optimum sowing time for better marketable yield of green cob as well as fodder of sweet corn (var. BARI Sweet corn-1) in the hilly region. Five sowing dates (November 20, November 30, December 10, December 20 and December 30) were included in the study. The highest green cob yield was obtained from December 20 sowing (13.99t/ha) followed by December 10 (13.16 t/ha) and December 30 sowing (13.41 t/ha). The highest green fodder yield was obtained from December 20 sowing (39.52 t/ha). Maximum TSS value was recorded in November 30 sowing (13.57). The results revealed that 10 to 30 December sowing could be suitable for sweet corn cultivation in hilly region in respect of green cob yield as well as green fodder yield.

Introduction

Sweet corn is mainly produced for human consumption either as a fresh cob or processed product. The kernel of sweet corn is translucent as fresh condition. The green cob is suitable for fresh consumption due to its sweet and delicious taste. Tribal people of hilly areas normally take any type of corn as boiled or roasted condition. Generally, the people of this area cultivate the corn as jhum along with other crops. Sweet corn may be a good option for them. BARI already released a sweet corn variety i.e. BARI sweet corn 1. As sweet corn is harvested early i. e. 20-25 days after silking then the plant and husk could be used as fodder. Therefore, the present study was conducted to determine the optimum sowing time for better marketable yield of green cob as well as fodder of sweet corn in the hilly areas.

Materials and Methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari Hill District during rabi season of 2011-2012. The soil of this hill area belongs to AEZ 29 and it is acidic in nature. Five different sowing dates (November 20, November 30, December 10, December 20 and December 30) were included in this study. The trial was laid out in a randomized complete block design with three replications. The unit plot size was 4.5m × 4m. Seeds of sweet corn (var. BARI sweet corn-1) were sown according to treatment with the spacing of 45cm × 25 cm. Fertilizers @ 150-60-90-20 kg/ha of NPKS were applied in the form of urea, triple super phosphate, muriate of potash and gypsum, respectively. One third of urea and full amount of other fertilizers were applied as basal during final land preparation. The remaining 2/3 of urea were side dressed at 30 and 55 days after emergence. Weeding, irrigation and insecticide spraying were done when required. The green cob was harvested at 25 days after silking when the silks turned in to brown color. The collected data were analyzed statistically and means were separated using LSD test at 5% level of significance.

Results and Discussion

Sowing date significantly influenced plant height, cob length, cob diameter, individual cob weight and green cob yield (Table-1). Plant height increased towards late sowing and the tallest plant was

recorded in December 30 sowing (282.25 cm). The longest cob was recorded in December 30 sowing (17.45 cm) and the shortest in November 20 sowing 15.37 cm). The highest cob diameter and individual cob weight were obtained from December 20 sowing. The highest green cob yield was obtained from December 20 sowing (13.99 t/ha) and it was statistically identical with December 10 sowing (13.16 t/ha) and December 30 sowing (13.41t/ha). The reason for higher green cob yield of sweet corn might be due to increased cob diameter and individual cob weight. The maximum green fodder yield was found from December 20 sowing (39.52 t/ha). Sweetness of the green cob i.e., TSS (% brix) value was not varied significantly due to different sowing dates. The highest TSS value was recorded at November 30 sowing.

Table 1. Yield and yield components of sweet corn under different sowing dates

Sowing date	Plant height (cm)	Cob length (cm)	Cob Diameter (cm)	Weight of individual cob (g)	Yield of green cob (t/ha)	Green fodder yield (t/ha)	% TSS (brix)
Nov. 20	241.33	15.37	4.15	110.13	9.51	38.25	13.00
Nov.30	258.67	16.57	4.41	146.06	11.71	39.45	13.57
Dec.10	277.67	16.57	5.35	139.16	13.16	39.34	13.12
Dec 20	276.33	15.46	5.56	168.07	13.99	39.52	13.22
Dec 30	282.25	17.45	4.32	156.46	13.41	39.42	13.00
$LSD_{(0.05)}$	16.08	0.83	1.20	7.64	1.58	NS	NS
CV (%)	3.19	2.63	13.39	2.82	6.80	2.61	4.25

Conclusion

The results revealed that 10 to 30 December sowing could be suitable for sweet corn cultivation in hilly region in respect of green cob yield as well as green fodder yield.

INTERCROPPING HYBRID MAIZE WITH SWEET POTATO UNDER DIFFERENT PLANTING SYSTEMS IN THE HILLY AREAS

M.N. Islam, M. Salim and M.M. Ullah

Abstract

An intercropping experiment was conducted at the Hill Agricultural Research Station, Khagrachari during rabi season of 2011-12 to find out the suitable planting system of hybrid maize-sweet potato intercropping. Three intercropping combinations viz., T_3=maize paired row + 2 rows sweet potato (100% HM: 40% SP), T_4=maize normal row +1 row sweet potato (100% HM: 60% SP) and T_5=sweet potato normal row + 1 row maize after 2 rows sweet potato (100% SP: 50%HM) were evaluated against their sole crops. Cob yield of hybrid maize and tuber yield of sweet potato was the highest in respective sole crops. Among intercropping treatments, the highest cob yield (18.64 t/ha) was recorded in T_4 and tuber yield (8.01 t/ha) in T_5. On the contrary, higher fodder yield was obtained from T_3 (38.45 t/ha) and T_4 (38.00 t/ha) combination. The highest gross return (TK 1,44,840 /ha), gross margin (Tk.1,03,840 /ha) and benefit cost ratio (3.53) were also recorded in T_4 combination. The results revealed that maize normal row +1 row sweet potato (100% HM: 60% SP) combination might be suitable and profitable for the hill valley of Khagrachari.

Introduction

Hybrid maize-sweet potato intercropping system becomes popular in Bangladesh for their high yield potential and diversified uses. Production and area may be increased by several folds by growing these two crops in association as they possess different photosynthetic pathways, different growth habit and requirement of different growth resources (Ogunlela *et al.,* 1988). Intercropping have many advantages, but there are difficulty in sowing or harvesting and in quantifying and applying fertilizers for getting maximum profit from the component crops of intercropping systems. However, hill farmers grow hybrid maize and sweet potato in hill valley as sole crops. In that region, productivity and profitability may be increased through intercropping of maize and sweet potato. Hence, the experiment was conducted to find out the suitable planting system of hybrid maize-sweet potato intercropping.

Materials and Methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari during rabi season of 2011-12. Five treatment combinations were as follows: T_1 = Sole hybrid maize (75 x 25 cm) , T_2 = Sole sweet potato (60 cm x 30 cm), T_3 = Hybrid maize paired rows (37.5/150/37.5 x 25 cm) + 2 rows sweet potato (60 cm x 30 cm) in between two maize paired row (100% HM: 40% SP), T_4 = Hybrid maize normal row (75 cm x 25 cm) +1 row sweet potato in between two maize rows (100% HM: 60% SP) and T_5 = Sweet potato normal row + 1 row maize after 2 rows sweet potato (100% SP: 50% HM)

The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4.5 m x 4.5 m. BARI hybrid maize-7 variety of maize and BARI Mishtialu-7 variety of sweet potato were used in this intercropping experiment. Seeds of maize and vines of sweet potato were sown/ planted on December 07, 2011 according to treatments. Sole hybrid maize and intercropping treatments were fertilized with 250-60-130-30-4-1 kg/ha NPKSZnB while sole sweet potato was grown with 125-50-125-18-2-1 kg/ha NPKSZnB. For sole maize and intercrop, the full amount of P K S Zn B and $^1/_2$ N were applied as basal in the form of triple super

phosphate, muriate of potash, gypsum, zinc sulphate, boric acid and urea, respectively. The remaining N was top dressed in two equal splits at 35 and 65 days after sowing (DAS). For sweet potato ½ N and all other fertilizers were applied as basal. The rest amount of N was top dressed at 35 DAS followed by earthing up and irrigation. Irrigation was given after sowing/planting for proper establishment of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAS. Two hand weeding were done at 20 and 40 DAS to keep the crops reasonably weed free. Data of maize and sweet potato were taken from randomly selected 10 plants from each plot. Cob of maize was harvested at 138 DAS (April 25, 2012) and sweet potato at 150 DAS (May 07, 2012). Data of both the crops were analyzed statistically and the means were adjudged using LSD test. Benefit cost analysis were also done.

Results and Discussion

Effect on maize

Number of cobs/m^2, weight single cob with husk and yield of cob with husk of hybrid maize were influenced significantly due to intercropping with sweet potato under different planting systems (Table 1). The highest number of cobs/m^2 (5.89) was recorded in sole maize, which was identical with those where cent-percent population of hybrid maize was used. The minimum number of cobs/m^2 was found in T_5 (2.72). The difference in cobs/m^2 among different combinations was attributed due to planting systems. Weight of single cob was more in sole maize (438.33 g). Among intercrop treatments, maximum single cob weight was recorded in T_5 (391.33 g) which was at par with T_4 (373.33 g) and T_3 (370.33 g). The highest cob yield was found in sole maize (21.66 t/ha). Among intercrop treatments, the highest cob yield was obtained from T_4 (18.64 t/ha) which was at par with T_3 (18.33 t/ha). The lowest cob yield was recorded in T_5 (10.69 t/ha) due to mainly for minimum number of cobs/m^2. Similar to cob yield, the highest green fodder yield was recorded in sole maize (40.25 t/ha). In intercrop situation, higher green fodder yield was obtained from T_3 (38.45 t/ha) and T_4 (38.00 t/ha) combination due to higher maize population.

Table 1. Yield and yield components of hybrid maize in maize-sweet potato intercropping under different planting systems.

Treatment	Cobs/m^2	Single cob weight with husk (g)	Yield of cob with husk (t/ha)	Green fodder yield (t/ha)
T_1	5.89	438.33	21.66	40.25
T_2	-	-	-	-
T_3	5.50	370.33	18.33	38.45
T_4	5.50	373.33	18.64	38.00
T_5	2.72	391.33	10.69	19.95
$LSD_{(0.05)}$	0.72	49.34	1.66	0.83
CV (%)	7.37	6.28%	4.80	2.61

T_1= Sole hybrid maize (75cm × 25 cm), T_2= Sole sweet potato (60 cm × 30 cm), T_3= Maize paired row + 2 row sweet potato, T_4= Maize normal row + 1 row sweet potato, T_5= Sweet potato normal row (60 cm × 30 cm) + 1 row maize after 2 row sweet potato

Effect on sweet potato

Yield and yield components of sweet potato were affected significantly in maize/sweet potato intercropping systems (Table 2). The significant variation in plants/m^2 (3.29-5.50) was attributed mainly due to planting system. The number of tubers/plant was statistically similar in all the treatments. Tuber weight/plant was the highest in sole sweet potato (696.67 g) which was identical with T_3 (610.0 g) and T_5 (655.0 g) but the lowest in T_4 (556.0 g). Single tuber weight was also the highest in sole sweet potato (185.38 g) i.e. T_2. Single tuber weight was reduced under intercrop situation. In intercropping systems, single tuber weight was maximum in T_3 (151.19 g)

which was at par with T_4 (143.54 g) and T_5 (148.26 g). The lower values of those parameters might be contributed to the shading effect of tall stature maize plants as well as inter specific competition. The highest tuber yield of sweet potato was recorded in sole crop (9.43 t/ha). In intercrop situation, tuber yield of sweet potato was lower and the lowest yield was recorded in T_3 (4.61 t/ha) combination, while the higher in T_5 (8.01 t/ha). Tuber yield in different treatments was attributed to the cumulative effect of yield components.

Table 2. Yield and yield components of sweet potato in maize-sweet potato intercropping under different planting systems

Treatment	Plants/m^2 (no.)	Tubers/plant (no.)	Tuber wt./ plant (g)	Single tuber wt.(g)	Tuber yield (t/ha)
T_1	-	-	-	-	-
T_2	5.34	3.63	696.67	185.38	9.43
T_3	3.29	4.36	610.00	151.19	4.61
T_4	4.08	3.76	556.00	143.54	5.44
T_5	5.50	4.33	655.00	148.26	8.01
$LSD_{(0.05)}$	0.30	0.97	120.78	15.64	0.89
CV (%)	3.34	12.09	9.60	4.98	6.54

T_1= Sole hybrid maize (75cm × 25 cm), T_2= Sole sweet potato (60 cm × 30 cm), T_3= Maize paired row + 2 row sweet potato, T_4= Maize normal row + 1 row sweet potato, T_5= Sweet potato normal row (60 cm × 30 cm) + 1 row maize after 2 row sweet potato

Intercrop efficiency

Cob yield, fodder yield, tuber yield and economic study of hybrid maize-sweet potato intercropping systems are presented in Table 3. Gross return is derived by adding the values of cob with husk, green fodder and sweet potato tuber per hectare. The highest gross return (Tk 1,44,840 /ha), gross margin (Tk 1,03,840/ha) and benefit cost ratio (3.53) were higher in T_4 i.e. maize normal row + 1 row sweet potato combination.

The results revealed that maize normal row +1 row sweet potato (100% HM: 60% SP) combination might be suitable and profitable for the hill valley of Khagrachari.

Table- 3. Benefit-cost analysis of maize-sweet potato intercropping under different planting systems.

Treat.	Cob yield (t/ha)	Fodder yield (t/ha)	Tuber yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	21.66	40.25	-	1,28,425	38,000	90,425	3.37
T_2	-	-	9.43	56,580	29,500	27,080	1.91
T_3	18.33	38.45	4.61	1,38,535	41,000	97,535	3.37
T_4	18.64	38.00	5.44	1,44,840	41,000	1,03,840	3.53
T_5	10.69	19.95	8.01	1,11,485	41,000	70,485	2.71

Market price (TK/kg.): Single maize cob 5/-, Sweet potato: 6/- and green fodder 0.5/-

T_1= Sole hybrid maize (75cm × 25 cm), T_2= Sole sweet potato (60 cm × 30 cm), T_3= Maize paired row + 2 row sweet potato, T_4= Maize normal row + 1 row sweet potato, T_5= Sweet potato normal row (60 cm × 30 cm) + 1 row maize after 2 row sweet potato

Weather data on Hill Agricultural Research Station, Khagrachari Hill District during rabi 2011-12.

Name of Month (Days)	Temperature (^{0}C)		Humidity (%		Rainfall (cm)
	Maximum	Minimum	Maximum	Minimum	
November	25.33	19.73	86.23	69.76	
December	21.96	17.58	87.77	76.70	
January	20.16	15.54	79.41	68.67	
February	25.96	15.65	83.06	57.58	
March	29.58	22.80	86.70	57.16	
April	29.56	25.16	81.76	55.40	2.44
May	28.60	26.33	84.06	61.60	1.73

SUITABILITY STUDY OF DIFFERENT LOCAL FRENCH BEAN VARIETIES INTERCROPPED WITH HYBRID MAIZE UNDER DIFFERENT PLANTING SYSTEM IN KHAGRACHARI

M.N. Islam, M. Salim and M.M. Ullah

Abstract

An intercropping experiment was conducted at Hill Agricultural Research Station, Khagrachari during rabi season of 2012-13 to find out local French bean varieties and their planting system suitable for intercropping with hybrid maize in hilly areas. Six intercropping combinations viz., maize single row (75cm × 25cm) + 2 rows French bean (white seed), maize single row (75cm × 25cm) + 2 rows French bean (pink seed), maize single row (100cm × 25cm) + 3 rows French bean (white seed), maize single row (100cm × 25cm) + 3 rows French bean (pink seed), maize single row with 2 plants/hill (100cm × 50cm) + 3 rows French bean (white seed) and maize single row with 2 plants/hill (100cm × 50cm) + 3 rows French bean (pink seed) were evaluated against their sole crops. Green bob yield of hybrid maize and seed yield of French bean was the highest in respective sole crops. Among intercrop combinations, the highest yield of green cob (19.00 t/ha) and fodder (27.10 t/ha) was recorded in maize single row + 3 rows French bean (pink seed). The highest seed yield (2.78 t/ha) of French bean was also found from the same combination. The highest gross return (Tk 1,99,075/ha), gross margin (Tk1,53,075/ha) and benefit cost ratio (3.32) were obtained from maize single row + 3 rows French bean (pink seed). The results revealed that maize single row + 3 rows French bean (pink seed) might be suitable and profitable intercrop combination for the hill valley of Khagrachari.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit area through maximum utilization of land, labour and growth resources (Islam *et al,* 2004). The important determinants in intercropping systems are the judicious choice of compatible crops with minimum inter-specific competition. Hybrid maize as well as local French bean are popular to hill people. They consume immature/green cob of maize but mature seeds of French bean. As a short duration and short stature legume crop, French bean may be intercropped with hybrid maize. Moreover, by changing planting geometry of hybrid maize, incident light on French bean may be increased. Intercropping have many advantages, but there are some difficulties in sowing or harvesting as well as in quantifying and applying fertilizers for getting maximum yield from component crops in intercropping systems. However, hill farmers grow hybrid maize and French bean in hill valley as sole crops. In that region, productivity and profitability may be increased through intercropping of maize and French bean. Hence, the experiment was conducted to find out local French bean varieties and their planting system suitable for intercropping with hybrid maize in hilly areas.

Materials and Methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari during rabi season of 2012-13. Eight treatment combinations were as follows: T_1=Maize single row (75cm × 25cm) + 2 rows French bean (white seed), T_2=Maize single row (75cm × 25cm) + 2 rows French bean (pink seed), T_3=Maize single row (100cm × 25cm) + 3 rows French bean (white seed), T_4=Maize single row (100cm × 25cm) + 3 rows French bean (pink seed),

T_5=Maize single row with 2 plants/ hill (100cm × 50cm) 3 rows French bean (white seed), T_6=Maize single row with 2 plants/ hill (100cm × 50cm) + 3 rows French bean (pink seed), T_7=Sole maize and T_8=Sole French bean

The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m x 3 m. BARI Hybrid Maize-9 variety of hybrid maize and two local French bean (white and pink coloured seed) were used in this intercropping experiment. Seeds of maize and French bean were sown on November 29, 2012 according to treatments. Sole hybrid maize and intercropping treatments were fertilized with 250-55-110-40-4-2 kg/ha NPKSZnB while sole French bean was grown with 120-40-60-12-3 kg/ha NPKSZnB. In sole maize and intercrop, $^1/_2$ N and full amount of other fertilizers were applied as basal in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate, and boric acid, respectively. The remaining N was top dressed at 30 days after sowing (DAS). In sole French bean, ½ N and all other fertilizers were applied as basal. The rest amount of N was top dressed at 30 DAS followed by irrigation. Irrigation was given after sowing for proper emergence of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAS. Two hand weeding were done at 20 and 40 DAS to keep the crops reasonably weed free. Data of maize and French bean were taken from randomly selected 10 plants from each plot. Green cob of maize was harvested on 8 and 15 April, 2013 (135 and 142 DAS) and French bean on March 15, 2013 (110 DAS). Collected data of both the crops were analyzed statistically and the means were adjudged by LSD. Benefit cost analysis was also done.

Results and Discussion

Effect on maize

Number of plants/m^2, yield of green cob with husk and fodder yield of hybrid maize were influenced significantly due to intercropping with French bean under different planting systems (Table 1). The highest number of plants/m^2 (4.8) was recorded in sole maize and it was lowered in intercrop combinations due to planting systems. The highest green cob yield (22.30 t/ha) was found in sole maize which was statistically similar with T_2 (21.30 t/ha) and T_1 (20.75 t/ha). The lowest green cob yield (17.20 t/ha) was recorded in T_3. The variation in green cob yields in different treatments were attributed to the combined effect of number of plants/m^2 and cob/plant. Similar to green cob yield, the highest green fodder yield (44.06 t/ha) was found from sole maize and it was statistically at par with T_2 (42.00 t/ha) and T_1 (41.30 t/ha). The minimum green fodder yield (24.00 t/ha) was observed in T_5. Green fodder yields in different treatments varied mainly due to variation in plants/m^2.

Table 1. Yield and yield components of hybrid maize in maize-French bean intercropping under different planting systems

Treatment	Plants/m^2 (no.)	Cobs/plant (no.)	Yield of green cob with husk (t/ha)	Green fodder yield (t/ha)
T_1	3.8	1.2	20.75	41.30
T_2	4.0	1.1	21.30	42.00
T_3	2.3	1.5	17.20	25.00
T_4	2.3	1.6	19.00	25.10
T_5	2.2	1.7	20.00	24.00
T_6	2.4	1.7	19.68	25.20
T_7	4.8	1.1	22.30	44.06
$LSD_{(0.05)}$	0.4	NS	2.25	2.60
CV (%)	7.37	6.52	7.02	3.36

T_1=Maize single row (75cm × 25cm)+2 rows French bean (white seed), T_2=Maize single row (75cm × 25cm)+2 rows French bean (Pink seed), T_3=Maize single row (100cm × 25cm)+3 rows French bean (white seed), T_4=Maize single row (100cm × 25cm)+3 rows French bean (Pink seed), T_5=Maize single row with 2 plants/ hill (100cm × 50cm)+3 rows French bean (white seed), T_6=Maize single row with 2 plants/ hill (100cm × 50cm)+3 rows French bean (Pink seed), T_7=Sole maize and T_8=Sole French bean

Effect on French bean

Yield and yield components of French bean were affected significantly in maize French bean intercropping systems (Table 2). The significant variation in number of plants/m^2 (9.94-13.75) was attributed mainly due to planting system. The highest number of plants/m^2 (13.75) was recorded in sole French bean but in intercrop combinations the number of plants/m^2 was identical (9.94-10.53). The highest seed weight/m^2 (395g) was also recorded in sole French bean which was statistically identical with T_4 (278g) and T_3 (255g) due to higher population. Seed yields of French bean were corresponding to seed weight/m^2. Sole French bean produced the highest seed yield (3.95 t/ha). Among intercrop combinations the higher seed yield of French bean (2.78 t/ha) was observed in T_4 which was statistically similar to T_3 combinations (2.60 t/ha) and the lowest yield (2.10 t/ha) was recorded in T_2 combination.

Table 2. Yield and yield components of French bean in maize- French bean intercropping under different planting systems

Treatment	Plant/ m^2 (no.)	Weight of seeds (g/m^2)	Seeds yield (t/ha)
T_1	10.06	213	2.14
T_2	10.22	211	2.10
T_3	10.45	255	2.60
T_4	10.53	278	2.78
T_5	9.94	232	2.31
T_6	10.33	242	2.41
T_8	13.75	395	3.95
$LSD_{(0.05)}$	2.30	150	1.51
CV (%)	3.40	9.06	7.13

Intercrop efficiency

Benefit cost analyses of hybrid maize- French bean intercropping under different planting systems are presented in Table 3. The highest gross return (Tk 1,99,075/ha) was recorded in T_4, which was close to T_2 (Tk 190750/ha) and T_6 (Tk 190000/ha). The highest gross margin (Tk 1,53,075/ha) was also recorded in T_4 and it was close to T_6 (Tk 144000/ha)and T_5 (Tk 140850/ha). The highest benefit cost ratio (3.32) was also found from T_4 combination.

Table 3. Benefit cost analysis of maize- French bean intercropping under different planting systems

Treatment	Green cob yield (t/ha)	Fodder yield (t/ha)	Seed yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	20.75	41.30	2.14	188975	50000	138975	2.77
T_2	21.30	43.00	2.10	190750	50000	140750	2.81
T_3	17.20	25.00	2.60	183250	46000	137250	2.98

Treatment	Green cob yield (t/ha)	Fodder yield (t/ha)	Seed yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Gross margin (Tk./ha)	BCR
T_4	19.00	27.10	2.78	199075	46000	153075	3.32
T_5	20.00	24.00	2.31	186850	46000	140850	3.06
T_6	19.68	29.00	2.41	190000	46000	144000	3.13
T_7	22.30	44.06	-	122515	45000	77515	1.72
T_8	-	-	3.95	138250	45000	93250	2.07

Market price (Tk/kg.): Maize cob: 5/-, French bean seed: 35/- and maize fodder: 0.25/-

T_1=Maize single row (75cm × 25cm)+2 rows French bean (white seed), T_2=Maize single row (75cm × 25cm)+2 rows French bean (Pink seed), T_3=Maize single row (100cm × 25cm)+3 rows French bean (white seed), T_4=Maize single row (100cm × 25cm)+3 rows French bean (Pink seed), T_5=Maize single row with 2 plants/ hill (100cm × 50cm)+3 rows French bean (white seed), T_6=Maize single row with 2 plants/ hill (100cm × 50cm)+3 rows French bean (Pink seed), T_7=Sole maize and T_8=Sole French bean

Conclusion

The results revealed that maize single row (100cm × 25cm) + 3 rows French bean (Pink seed) combination might be suitable and economically profitable for the hill valley of Khagrachari.

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SUITABILITY STUDY OF DIFFERENT LOCAL FRENCH BEAN VARIETIES INTERCROPPED WITH HYBRID MAIZE UNDER DIFFERENT PLANTING SYSTEM IN RAMGRAH

M. N. Islam and A.Biswas

Abstract

An intercropping experiment was conducted at the Hill Tract Agricultural Research Station, Ramgrah, Khagrachari during rabi season of 2012-13 to find out local French bean varieties and their planting system suitable for intercropping with hybrid maize in hilly areas. Six intercropping combinations viz., maize single row + 2 rows French bean (White seed), maize single row + 2 rows French bean (Pink seed), maize single row + 3 rows French bean (White seed), maize single row + 3 rows French bean (Pink seed), maize single row with 2 plants/hill + 3 rows French bean (White seed) and maize single row with 2 plants/hill + 3 rows French bean (Pink seed) were evaluated against sole maize. Sole maize produced the highest grain yield (4.75 t/ha). But among intercrop combinations, maize single row (100 cm × 25 cm) + 3 rows French bean (Pink seed) i.e. T_4 gave the highest maize equivalent yield (18.99 t/ha), gross return (Tk 229390/ha), gross margin (Tk164390/ha) and benefit cost ratio (3.53) which were very close to T_6 and T_3. The result revealed that maize single row (100 cm × 25 cm) + 3 rows French bean (Pink seed) or maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (Pink seed) i.e. T_6 or maize single row (100 cm × 25 cm) + 3 rows French bean (White seed) i.e. T_3 might be suitable and economically profitable inter crop combination for hill valley of Ramgarh.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit of area through maximum utilization of land, labor and growth resources (Willey, 1979). The important determinants in intercropping system are the judicious choice of compatible crops with minimum inter-specific competition. Hybrid maize and local French bean are popular to hill people. They use immature cob of maize but mature seeds of French bean. As a short duration and short stature legume crop, it may be intercropped with hybrid maize. Moreover, by changing planting geometry of hybrid maize, incident light on French bean may be increased. Intercropping have many advantages, but there are difficulty in sowing or harvesting as well as in quantifying and applying fertilizers for getting maximum profit from the component crops of intercropping systems (Islam *et.al.* 2004). The hill farmers grow hybrid maize and French bean in hill valley as sole crops. However, this experiment was conducted to find out local French bean varieties and their planting system suitable for intercropping with hybrid maize in hilly areas.

Materials and Methods

The experiment was conducted at the Hill Tract Agricultural Research Station, Ramgarh, Khagrachari during rabi season of 2012-13. Seven treatments as follows:

T_1 = Maize single row (75 cm × 25 cm) + 2 rows French bean (White seed), T_2 = Maize single row (75 cm × 25 cm) + 2 rows French bean (Pink seed), T_3 = Maize single row (100 cm × 25 cm) + 3 rows French bean (White seed), T_4 = Maize single row (100 cm × 25 cm) + 3 rows French bean (Pink seed), T_5 =Maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (White seed), T_6 = Maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (Pink seed), T_7 = Sole maize (60 cm × 20 cm)

The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 3 m × 3 m. The hybrid maize (var. BARI Hybrid Maize-7) and French bean (local) were used in this intercropping experiment. Seeds of maize and French bean were sown on

24 November, 2012 according to treatments. Sole hybrid maize was grown with 250-55-110-40-4-2 kg/ha NPKSZnB. The intercropping treatments were fertilized with 250-55-110-40-4-2 kg/ha NPKSZnB and the sole French bean was fertilized with 120-40-60-12-3 kg/ha NPKSZnB. In sole maize, ½ N and all other fertilizers were applied as basal and rest N was top dressed at 30 DAS. In intercropping treatments, ½ N and all other fertilizers were applied as basal and rest N was top dressed at 30 DAS. In sole French bean, ½ N and all other fertilizers were applied as basal and rest N was top dressed at 30 DAS. Weeding, irrigation and other intercultural operations were done as and when necessary. Data of maize and chili were taken from randomly selected 5 plants from each plot. Mature cob of maize was harvested on 13 April, 2013 (140 DAS). Green chili was harvested several times according to eating quality. Data of both the crops were analyzed statistically and the means were adjusted using LSD. Benefit cost analysis was also done.

Results and Discussion

Effect on maize

Plant population/m^2, number of grains/ cob, 100-grain weight and grain yield of hybrid maize were influenced significantly due to intercropping with French bean under different planting systems (Table 1). The plant population/m^2 in different treatments (4.0 - 5.33) differed significantly due to planting systems. The highest number of grains/cob (503.40) was recorded in sole maize i.e. T_7 and the lowest (363.87) in T_2 combination. The lower number of grains/cob in intercrop combinations might be attributed due to more intra and inter specific competition. The highest 100-grain weight (45.67g) was found from T_3 which was identical to those where maize was planted with 100 cm spacing (T_4, T_5 and T_6). The bolder grains in those treatments might be attributed to less mutual shading. The lowest 100-grain weight (35.67g) was recorded in sole maize. The highest grain yield (4.75 t/ha) was obtained from the sole maize. Among the intercrop treatments, the highest grain yield (4.32 t/ha) was obtained from T_4 combination and the lowest (3.14 t/ha) from T_5 combination.

Table 1. Yield and yield components of hybrid maize in maize-French bean intercropping under different planting systems.

Treatment	Plants/m^2 (no.)	Cobs/plant (no.)	Grains/cob (no.)	100-grain wt. (g)	Grain yield (t/ha)
T_1	5.33	1.00	395.59	37.33	4.13
T_2	5.33	1.00	363.87	36.33	3.72
T_3	4.00	1.00	384.63	45.67	3.40
T_4	4.00	1.00	407.80	39.00	4.32
T_5	4.00	1.00	408.00	40.33	3.14
T_6	4.00	1.00	418.61	38.33	3.20
T_7	5.33	1.00	503.40	35.67	4.75
$LSD_{(0.05)}$	0.69	-	77.28	8.54	0.99
CV (%)	8.5	-	10.55	12.32	14.6

T_1 = Maize single row (75 cm × 25 cm) + 2 rows French bean (White seed),T_2 = Maize single row (75 cm × 25 cm) + 2 rows French bean (Pink seed),T_3 = Maize single row (100 cm × 25 cm) + 3 rows French bean (White seed),T_4 = Maize single row (100 cm × 25 cm) + 3 rows French bean (Pink seed),T_5 = Maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (White seed),T_6 = Maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (Pink seed) and T_7 = Sole maize (60 cm × 20 cm)

Effect on French bean

Number of pods/plant and seeds/pod of French bean were affected significantly in maize-French bean intercropping systems (Table 2). The highest number of pods/plant (9.60) was recorded in T_3 combination which was at par with all other treatments except T_1. Maximum number of seeds/pod (4.33) was also observed in T_3 and it was statistically identical with all other combinations except

T_2 and T_6. Plant population/m2, 100-seed weight, green seed yield/ha and fodder yield/ha of French did not differ significantly among the treatments in maize-French bean intercropping.

Table 2. Yield and yield components of French bean in maize-French bean intercropping under different planting systems.

Treatment	Plant/m^2 (no.)	Pods/ plant (no.)	Seeds /pod (no.)	100 seed weight (g)	Green seed yield (t/ha)	Fodder yield (t/ha)
T_1	26.22	6.87	4.13	96.06	3.27	6.67
T_2	21.93	7.67	3.40	103.68	2.71	5.85
T_3	26.22	9.60	4.33	96.76	3.65	6.67
T_4	25.19	9.13	3.87	101.34	3.52	6.20
T_5	25.19	8.60	4.13	98.97	3.45	6.20
T_6	23.11	8.73	3.40	100.36	3.72	5.89
$LSD_{(0.05)}$	NS	2.66	0.74	NS	NS	NS
CV (%)	9.79	17.30	10.47	10.42	23.66	15

Intercrop efficiency

Maize equivalent yield and benefit cost analysis of maize-French bean intercropping under different planting systems is presented in Table 3. The highest maize equivalent yield (18.99 t/ha) was obtained from T_4 treatment which was very close to T_6 (18.70 t/ha) and T_3 (18.61 t/ha) combinations. The highest gross return (Tk 229390/ha) was also recorded in T_4 and it was very close to T_6 (Tk 225872/ha) and T_3 (Tk 224967/ha) combinations due to higher maize equivalent yield. The highest gross margin (Tk.164390/ha) and benefit cost ratio (3.53) were obtained from T_4 which was closely followed by T_6 (3.47) and T_3 (3.46).

Table 3. Maize equivalent yield and benefit cost analyses of maize-French bean intercropping under different planting systems.

Treatment	Maize equivalent yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Gross margin (Tk./ha)	Benefit cost ratio
T_1	17.76	214727	65000	149727	3.30
T_2	15.01	181602	65000	116602	2.79
T_3	18.61	224967	65000	159967	3.46
T_4	18.99	229390	65000	164390	3.53
T_5	17.52	211730	65000	146730	3.26
T_6	18.70	225872	65000	160872	3.47
T_7	4.75	57000	50000	7000	1.14

Market price (Tk/kg): Maize grain: 12/-, Green seed of French bean: 50/- and Fodder: 0.25/-

T_1 = Maize single row (75 cm × 25 cm) + 2 rows French bean (White seed),T_2 = Maize single row (75 cm × 25 cm) + 2 rows French bean (Pink seed),T_3 = Maize single row (100 cm × 25 cm) + 3 rows French bean (White seed),T_4 = Maize single row (100 cm × 25 cm) + 3 rows French bean (Pink seed),T_5 = Maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (White seed),T_6 = Maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (Pink seed) and T_7 = Sole maize (60 cm × 20 cm)

Conclusion

The result revealed that maize single row (100 cm × 25 cm) + 3 rows French bean (Pink seed) or maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows French bean (Pink seed) or maize single row (100 cm × 25 cm) + 3 rows French bean (White seed) might be suitable and economically profitable inter crop combination for hill valley of Ramgarh.

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HYBRID MAIZE AND CHILLI INTERCROPPING UNDER DIFFERENT PLANTING SYSTEMS

M.N. Islam, M. Salim and M.M. Ullah

Abstract

An intercropping experiment was conducted at Hill Agricultural Research Station, Khagrachari during rabi season of 2012-13 to find out suitable planting system of hybrid maize and chili intercropping for hilly areas. Four intercropping combinations viz., maize single row (100cm × 25cm) + 2 rows chili (50cm × 40cm), maize single row with 2 plants/ hill (100cm ×25cm) + 2 rows chili (50cm × 40cm), maize single row (150cm × 25cm) + 3 rows chili (50cm × 40cm) and maize single row with 2 plants/ hill (150cm × 50cm) + 3 rows chili (50cm × 40cm) were evaluated against their sole crops. Cob yield of hybrid maize and green yield of Chilli was the highest in respective sole crops. The higher green cob yield (17.65 t/ha) and green chili yield (2.50 t/ha) were found in maize single row (150cm × 25cm) +3 rows chili (50cm × 40cm) combination i.e T_3. The highest gross return (TK 1,69,765 /ha), gross margin (Tk.1,23,765/ha) and benefit cost ratio (2.69) were recorded in the same combination. The highest fodder yield (26.06 t/ha) was obtained from same combination (T_3) combination. The results revealed that maize single row (150cm × 25cm) + 3 rows chili (50cm × 40cm) combination might be suitable and economically profitable for the hill valley of Khagrachari.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit area through maximum utilization of land, labour and growth resources (Islam *et al*, 2004). The important determinants in intercropping systems are the judicious choice of compatible crops with minimum inter-specific competition. Maize based intercropping is found profitable and suitable in many countries like Bangladesh. Maize is a C4 crop; its roots enter more than one meter in to the soil. Hybrid maize is an unbranched and erect cereal crop grown with wide spacing. Short duration and short stature crop like chili may be grown in association with hybrid maize. Incident light may be increased on below storey crop by changing planting geometry of hybrid maize. This experiment was conducted to find out suitable planting systems of hybrid maize and chili intercropping for the hill valley of Khagrachari.

Materials and Methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachori during rabi season of 2012-13. Six treatments were as follows: T_1= Maize single row (100cm × 25cm) + 2 rows chili (50cm × 40cm), T_2= Maize single row with 2 plants/ hill (100cm × 25cm) + 2 rows chili (50cm × 40cm), T_3= Maize single row (150cm × 25cm) + 3 rows chili (50cm × 40cm), T_4= Maize single row with 2 plants/ hill (150cm × 50cm) + 3 rows chili (50cm × 40cm), T_5= Sole maize (60cm × 20cm) and T_6= Sole chili (50cm × 40cm)

The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m x 3 m. The hybrid maize (var. BARI Hybrid Maize-9) and chili (var. local ufta morich) were used in this intercropping experiment. Seeds of maize and seedlings of chili were sown/ planted on November 30, 2012 according to treatments. Sole hybrid maize was fertilized with 250-55-110-40-4-2 kg/ha NPKSZnB, while sole chili was grown with 120-80-120-20-4 kg/ha NPKSZn and inter crop was grown with 370-55-110-40-4-2 kg/ha NPKSZnB,

respectively. In sole maize, $^1/_2$ N and full amount of PKSZnB were applied as basal in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid, respectively. The remaining N was top dressed at 30 days after sowing (DAS). In chili, ½ N and all other fertilizers were applied as basal. The rest amount of N was top dressed in three splits at 25, 50 and 70 DAT. On the other hand in case of intercrop, 1/2 N and all other fertilizers were applied as basal. The rest amount of N was top dressed in three splits at 25, 50 and 70 DAT. Irrigation was given after sowing/planting for proper establishment of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAE. Two hand weeding were done at 20 and 40 DAE to keep the crops reasonably weed free. Data of maize and chili were taken from randomly selected 10 plants from each plot. Green cob of maize was harvested on 8 and 15 April, 2013 (135 and 142 DAS) and chili was harvested at 118 DAT, 133 DAT and 153 DAT. Data of both the crops were analyzed statistically and the means were adjudged using LSD. Benefit cost analysis was also done.

Results and Discussion

Effect on maize

Number of plants/m^2, cobs/plant, yield of green cob with husk and fodder yield of hybrid maize are presented in Table 1. Number of plants/m^2 in different treatments deferred significantly due to planting systems. The highest number of plants/m^2 (6.67) was recorded in sole maize and it decreased in different treatments depending on planting configurations. The number of cobs/plant did not differ significantly in different treatments. Significantly the highest green cob yield (23.00 t/ha) was found in sole maize which was statistically similar with T_1 (20.90 t/ha). The lowest green cob yield (17.09 t/ha) was recorded in T_4 due to the cumulative effect of plants/m^2 and cobs/plant. The highest green fodder yield (43.60 t/ha) was observed in sole maize. Among intercrop treatments, the higher green fodder yield (38.00 t/ha) was recorded in T_1 combination.

Table1. Yield and yield components of hybrid maize in maize- chili intercropping under different planting systems.

Treatment	Plants/m^2 (no.)	Cobs/plant (no.)	Yield of green cob with husk (t/ha)	Green fodder yield (t/ha)
T_1	4.00	1.40	20.90	38.00
T_2	4.25	1.20	20.50	37.20
T_3	2.58	1.68	17.65	26.06
T_4	2.67	1.47	17.09	25.10
T_5	6.67	1.13	23.00	43.60
LSD $_{(0.05)}$	1.23	NS	2.95	0.74
CV (%)	7.37	5.24	6.00	4.02

T_1= Maize single row (100cm × 25cm) + 2 rows chili (50cm × 40cm), T2= Maize single row with 2 plants/ hill (100cm × 25cm) + 2 rows chili (50cm × 40cm), T_3= Maize single row (150cm × 25cm) + 3 rows chili (50cm × 40cm), T_4= Maize single row with 2 plants/ hill (150cm × 50cm) +3 rows chili (50cm × 40cm),T_5= Sole maize (60cm × 20cm) and T_6= Sole chili (50cm × 40cm)

Effect on Chili

Yield and yield components of chili were affected significantly in maize/ chili intercropping systems (Table 2). The significant variation in plants/m^2 (2.4-4.3) was attributed mainly due to planting system. The highest weight of green chili/plant (100g) was recorded in T_3 where maize was sown with wider spacing (150 cm) and the lowest (39.4g) in T_1. The highest green chili yield (3.72 t/ha) was recorded in sole crop (T_6). In intercrop situation, green chili yields were lower and

the lowest yield (1.25 t/ha) was recorded in T_4 combination. Lower green chili yield in different intercrop combinations was attributed to the lower number of plants/m^2 as well as shading effect.

Table 2. Yield and yield components of chili in maize- chili intercropping under different planting systems

Treatment	Plant/m^2 (no.)	Weight of green chili (g/plant)	Green chili yield (t/ha)
T_1	3.3	39.4	1.29
T_2	3.2	42.1	1.34
T_3	2.5	100.0	2.50
T_4	2.4	52.9	1.25
T_6	4.3	86.5	3.72
$LSD_{(0.05)}$	0.40	20.3	98.12
CV (%)	4.02	11.23	9.60

Intercrop efficiency

The highest gross return (Tk 1,69,765/ha), gross margin (Tk 1,23,765/ha) were recorded in T_3 combination while the lowest in sole chili (T_6) and benefit cost ratio (2.69) were also higher in that combination. Similarly, the highest benefit cost ratio was observed in T_3.

Table 3. Benefit cost analysis of maize- chili intercropping under different planting systems.

Treatment	Green cob yield (t/ha)	Fodder yield (t/ha)	Green chili yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Gross margin (Tk./ha)	BCR
T_1	20.90	38.00	1.29	152700	50000	102700	2.05
T_2	20.50	37.20	1.34	152000	50000	102000	2.04
T_3	17.65	26.06	2.50	169765	46000	123765	2.69
T_4	17.09	25.10	1.25	129225	46000	83225	1.80
T_5	23.00	43.60	-	125900	46000	79900	1.73
T_6	-	-	3.72	111600	45000	66600	1.48

Market price (Tk/kg.): Maize cob: 5/-, Chili: 30 /- and Maize fodder: 0.25/-

T_1= Maize single row (100cm × 25cm) + 2 rows chili (50cm × 40cm), T2= Maize single row with 2 plants/ hill (100cm × 25cm) + 2 rows chili (50cm × 40cm), T_3= Maize single row (150cm × 25cm) + 3 rows chili (50cm × 40cm), T_4= Maize single row with 2 plants/ hill (150cm × 50cm) +3 rows chili (50cm × 40cm),T_5= Sole maize (60cm × 20cm) and T_6= Sole chili (50cm × 40cm)

Conclusion

The results revealed that maize single row (150cm × 25cm) + 3 rows chili (50cm × 40cm) i.e T_3 combination might be suitable and economically profitable for the hill valley of Khagrachari.

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PERFORMANCE OF SWEET POTATO VARIETIES IN HILLY AREAS

Bulbul Ahmed, A. Biswas, M. Shaheenuzzamn, R. R. Saha, and Z. A. Firoz

Abstract

The experiment was conducted at research field of Hill Tract Agricultural Research Station. Ramgarh, Khagrachari during rabi season of 2012-13. Five different sweet potato varieties (BARI Sp-6, BARI Sp-7, BARI Sp-8, BARI Sp-9 and local cultivar) were included in the experiment. The highest yield of tuber (14.07 t/ha) was recorded from BARI Sp-7 followed by BARI Sp-6 (13.56 t/ ha). The highest yield increase over local cultivar was recorded from BARI Sp-7 (53.02 %) and the lowest yield increase over local cultivar was recorded from BARI Sp-9 (43.89 %).

Introduction

Sweet potato (*Ipomea batatas* (L.) has a long history to stave off famine-especially as a cheap source of calories (Adam, 2005). Sweet potatoes are usually consumed without special processing. The fresh tuber is boiled, roasted, baked, or fried as chips, which may be sold as snacks or salted and eaten as potato crisps in most parts of world. Orange flesh sweet potatoes are rich in β-carotene (precursor for vitamin A). Sweet potatoes are grown on about 8.2 million hectares worldwide, yielding about 102 million tons; with an average yield of about 12.1 ton/ha (FAOSTAT, 2010). They are mainly grown in developing countries, which account for over 95% of world production. Sweet potato is low input requirements, ease of production and ability to produce under adverse weather and soil conditions. It was introduced into Bangladesh during the second half of the nineteenth century, but its production was limited by lack of modern technology. The average yield is still only 10.75 t/ha. Plant characters and yield of sweet potato varied widely among the varieties (Yadav *et al*., 1996 and Anonymous, 1992). The Bangladesh Agricultural Research Institute (BARI) has recently developed several new varieties of sweet potato with yield potential of 25-30 t/ha, but these varieties are not yet available for farmers of the Chattagong Hill Tracts. The total area of Chattagong Hill Tracts is estimated around 13,237 m^2 which is about 10% of total land area of the country. The climatic condition of this area is sub-tropical monsoon. Although this area has high potentiality for agricultural development but maximum land remain fallow after T.aman due to proper initiative and introducing high yielding different crop and crop variety. After harvest of T.aman there is wide scope to grow high yielding sweet potato varieties because farmers of this area cultivate local cultivars of sweet potato which is poor yielder. Recent years, BARI has developed some varieties which are high yielder along with yellow flesh (rich in vitamin A). Thus, high yielding sweet potato can supplement as a good source of food mainly marginal farmer of hilly region. With this view, the present study was done for the increasing productivity of sweet potato through introducing HYV in the hilly region.

Materials and Methods

The experiment was conducted at research field of Hill Tract Agricultural Research Station. Ramgarh, Khagrachari during rabi season of 2012-13. The soil of this hill area belongs to AEZ 29 and the soil bears acidity. Five different sweet potato varieties (BARI Sp-6, BARI Sp-7, BARI Sp-8, BARI Sp-9 and local cultivar) were included in the experiment. The trial was laid out in a randomized complete block design with four (dispersed) replications. The unit plot size was 4.2m×3m. Vine of sweet potatoes (BARI Sp-6, BARI Sp-7, BARI Sp-8, BARI Sp-9 and local

cultivar) were planted at 16th November, 2012 according to treatment with the spacing of 60 cm × 30 cm. Vine of sweet potatoes (BARI Sp-6, BARI Sp-7, BARI Sp -8, BARI Sp -9) were collected from Agricultural Research Station (ARS), BARI, Pahartoli , Chittagong with help of TCRC, Gazipur and local cultivar was collected from the farmer's of Ramgarh. The experimental plot was prepared and labeled properly. Lime was also applied due to minimize the acidity effect in hilly areas. Fertilizers at the rate of 70-25-95 kg/ha of N P K in the form of urea, triple super phosphate (TSP) and muriate of potash (MoP), respectively along with 10 ton cowdung. The full amount of cowdung and TSP and 1/4 MoP, and ¼ Urea were applied as basal during final land preparation.The remaining of urea and MoP were side dressed at 60 days after planting. Weeding, irrigation and insecticides spraying were done as when required to maintain an optimum growth condition for the crop. It was harvested after 150 DAS when the vines were turned to dry as brown color. Number of tuber/plant, individual tuber weight, and yield of tuber/hectare was recorded. The collected data were analyzed statistically and means were separated using LSD test at 5% level of significance.

Results and Discussion

Yield and yield contributing characters of sweet potato varieties (BARI Sp-6, BARI Sp-7, BARI Sp-8, BARI Sp-9 and local cultivar) were presented in the Table-1. The sweet potato varieties under study exhibited variation in respect of number of tuber/ plant, individual tuber weight, and yield of tuber per hectare. The effect of the sweet potato varieties was found significant on Number of plant/m^2 varied significantly among the varieties. Significantly higher numbers of plants/ m^2 were recorded from BARI Sp-6 (4.52), BARI Sp-8 (4.44) and BARI Sp-7 (4.38) and the lowest was local cultivar (3.95).

The effect of the sweet potato varieties was found significant variation on number of tuber/plant. The highest number of tuber/plant (4.40) was recorded from BARI Sp-9 and the lowest number of tuber/plant (2.80) was recorded from Local cultivar. Farooque and Husain (1973) reported that the number of tubers per plant varied from 4.70 to 11.76. Siddique (1985) also found the number of tubers per plant varied from 1.73 to 6.03. So results of the present experiment showed similar trend and agreement with that of the previous results.

The effect of sweet potato varieties showed insignificant variation on individual tuber weight and yield of tuber. The highest individual weight of tuber (268.35 g) was recorded from BARI Sp-8 and the lowest individual weight of tuber (135.50 g) was recorded from local cultivar which might be due to genetic variations of the varieties. The results of the present study were in agreement with the report of Vasconcellos *et al*. (1986) where they found that the average weight of tubers was from 82.30 to 311.70g. It was supported by our result.

Among the sweet potato varieties, BARI Sp-7 performed better in tuber yield (14.07 t/ha) followed by BARI Sp-6 (13.56 t/ha) and local cultivar was the lowest yielder (6.61 t/ha). Although the potential yield of BARI released varieties is 40-45 t/ha but in the hilly region, all the varieties were produced lower tuber yield. It might be due to prevailing lower temperature during mid-November and mid-March when maximum temperature was below 30^oC and the minimum temperature below 20^oC. Sweet potato grows the best where average temperature are 24^0C, the thermal optimum is reported to be about 24^0C (Kay, 1973). Prior to mid November and after mid March the maximum and minimum temperature was above and below these thresholds. Beside this, lack of irrigation of water in CHT region which caused drought condition is another limitation. Higher temperatures and drought also can divert photosynthates to lignifications

(Amthore, 2003) as it drastically reduces starch yield. Thus, high temperatures (>30^{o}C) and drought can significantly reduce the tuber yield and starch content sweet potato tubers. For this reason, the average yield of sweet potato varieties was might be reduced.

The highest yield increase over local cultivar was recorded from BARI Sp-7 (53.02 %) and the lowest yield increase over local cultivar was recorded from BARI Sp-9 (43.88 %).

Table 1. Effect of Sweet potato varieties on tuber yield and yield contributing characters in hilly region of Ramgorh, Khagrachari

Treatment	No. of plant /m^2	No. of tuber/plant	Individual tuber weight (g)	Yield of tuber (t/ha)	Yield increase over local (%)
BARI Sp-6	4.52	4.30	212.85	13.56	51.25
BARI Sp-7	4.38	3.65	208.50	14.07	53.02
BARI Sp-8	4.44	3.70	248.95	12.78	48.28
BARI Sp-9	4.27	4.40	268.35	11.78	43.88
Local Cultivar	3.95	2.80	135.50	6.61	-
$LSD_{(0.05)}$	0.485	1.002	71.45	1.994	-
CV (%)	7.28	17.26	21.59	11.01	-

Conclusion

Results of the present study indicated that BARI Sp- 7 and BARI Sp-6 are suitable sweet potato varieties for cultivation in hill region of Bangladesh. The experiment could be repeated in the next year for the confirmation of the results.

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CHILLI AND HYBRID MAIZE INTERCROPPING UNDER DIFFERENT PLANTING SYSTEMS

N.Chakma,S Hossain, M.Salim, M.S.Noman and M.M. Ullah

Abstract

An experiment was conducted at Hill Agricultural Research Station, Khagrachari during the Rabi season of 2013-14 to find out suitable intercropping systems of hybrid maize and chilli for increasing total productivity and economic return. Four intercropping combinations viz., maize single row (100cm × 25cm)+2 rows (50 cm × 40 cm), maize single row with 2 plants/ hill (100 cm ×25 cm) +2 rows (50 cm × 40 cm), maize single row (150 cm × 25 cm) +3 rows (50cm × 40cm) and maize single row with 2 plants/ hill (150cm × 50cm) +3 rows (50 cm × 40 cm) were evaluated against their sole crops. Cob yield of hybrid maize and yield of green chilli was the highest in respective sole crops. Maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm) combination might be suitable and economically profitable for the hill valley of Khagrachari. The cob yield (20.90 t/ha), fodder yield (32.61 t/ha) and green chilli yield (2.04 t/ha) were found in this intercrop combination. The highest gross return (Tk.2,98,753 /ha), gross margin (Tk.2,43,753/ha) and benefit cost ratio (5.43) were also recorded in the same combination.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit area through maximum utilization of land, labour and growth resources (Islam *et al.,* 2004). The important determines in intercropping system are the judicious choice of compatible crops with minimum inter-specific competition. Maize based intercropping is found profitable and suitable in many countries like Bangladesh. Maize is a C_4 crop; its roots enter more than one meter in to the soil. Hybrid maize is an un branched and erect cereal crop grown with wide space. Several short duration and short stature crop like chilli may be grown in association with hybrid maize. Incident light may be increased on below storeyed crop by changing planting geometry of hybrid maize. This experiment was done to find out suitable planting systems of hybrid maize and chilli intercropping system for higher productivity and economic return.

Materials and Methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari during the *Rabi* season of 2013-14. Six treatment combinations were used as follows: T_1= Maize single row (100cm × 25cm)+2 rows chilli (50cm × 40cm), T_2= Maize single row with 2 plants/ hill (100 cm × 25 cm) +2 rows chilli (50 cm × 40 cm), T_3= Maize single row (150 cm × 25 cm) +3 rows chili (50 cm × 40cm), T_4= Maize single row with 2 plants/ hill (150 cm × 50 cm) +3 rows chilli (50 cm × 40 cm), T_5= Sole maize (60cm × 20cm) and T_6= Sole chilli (50 cm × 40 cm). The experiment was laid out in a randomized complete block design with three replications. The unit plot size was 4 m × 3 m. The hybrid maize (var. BARI hybrid maize 7) and chilli local (ulta morich) were used in this experiment. Seeds of maize and chilli were sown on 02 December 2013 according to treatments. Sole hybrid maize was fertilized with 250-55-110-40-4-2 kg/ha of N P K S Zn B, while sole chilli was grown with 120-80-120-20-4 kg/ha of N P K S Zn and intercrop was grown with 370-55-110-40-4-2 kg/ha of N P K S Zn B. For sole maize the full amount of P K S Zn B and $^1/_2$ N were applied as basal in the form of triple super phosphate, muriate of potash, gypsum, zinc sulphate, boric acid and urea, respectively. The remaining N was top dressed at 30 days after sowing (DAS). Incase of chilli ½ N and all other fertilizers were applied as basal. The rest amount of N was top dressed in three splits at 25, 50 and 70 days after transplanting (DAT). On the other hand, incase of intercrop 1/3 N and all other fertilizers were applied as basal. The rest amount of

N was top dressed in three splits at 25, 50 and 70 days after emergence (DAE). Irrigation was given after sowing/planting for proper establishment of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAE. Two hand weeding were done at 20 and 40 DAE to keep the crops reasonably weed free. Data of maize and chilli were taken from randomly selected 05 plants from each plot. Green cob of maize was harvested at 135 and 142 DAS and chilli was harvested at 118, 133 and 153 DAT. Data of both the crops were analyzed statistically and the means were adjudged using LSD. Benefit cost analysis was also done.

Results and Discussion

Effect on maize

Plant height, plant population/m^2, number of green cob/plant, individual cob wt. with husk, green cob yield (t/ha), fodder yield (t/ha) of hybrid maize were influenced significantly due to intercropping with chilli under different planting systems (Table 1). The highest plant height was recorded in sole maize (301.20 cm) and the lowest (291.57 cm) in maize single row with 2 plants/ hill (150 cm × 50 cm) + 3 rows chilli (50 cm × 40 cm) but there was no significant difference between all the data for plant height. The highest number of plant population/m^2 was recorded in sole maize (10.67) and lowest (4.67) in maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm). The highest number of cobs/plant (1.73) was recorded in maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm) and the lowest in sole maize (1.20). The difference in cobs/plant among different combinations was attributed due to planting systems. The highest individual cob wt. (458.00 g) was recorded in maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm) and the lowest (344.00 g) was recorded in maize single row (100 cm × 25 cm) + 2 rows chilli (50 cm × 40 cm) and sole maize. The highest cob yield was recorded in sole maize (25.47 t/ha) and the lowest (17.18 t/ha) was recorded in maize single row with 2 plants/ hill (150 cm × 50 cm) + 3 rows chilli (50 cm × 40 cm). The highest fodder yield (38.39 t/ha) was recorded in sole maize and the lowest (30.22 t/ha) in maize single row with 2 plants/ hill (150 cm × 50 cm) + 3 rows chilli (50 cm × 40 cm).

Table 1. Yield and yield components of maize in maize chilli intercropping under different planting systems in 2013- 2014

Treatment	Plants height (cm)	Plant population/m^2(No.)	No. of cobs/plant	Individual cob wt. with husk (g)	Cob yield (t/ha)	Fodder yield (t/ha)
T_1	295.20	5.00	1.53	344.00	22.45	35.36
T_2	301.13	6.00	1.43	401.33	22.54	34.44
T_3	298.93	4.67	1.73	458.00	20.90	32.61
T_4	291.57	5.33	1.67	426.67	17.18	30.22
T_5	301.20	10.67	1.20	344.00	25.47	38.39
T_6	-	-	-	-	-	-
$LSD_{(0.05)}$	25.10^{ns}	1.49	0.39	92.11	4.17	5.57
CV (%)	7.46	10.27	11.42	12.39	10.29	10.37

Effect on chilli

Yield and yield components of chilli were significantly affected in maize chilli intercropping systems (Table 2). The significant variation in plants height (72.53- 97.67 cm) was attributed mainly due to planting system. The highest number of fruits/plant was recorded in sole chilli (42.53) and the lowest (18.53) in maize single row with 2 plants/ hill (100 cm × 25 cm) +2 rows chilli (50 cm × 40 cm). The highest 100 fruit wt. (144.65 g) was recorded in sole chilli and the lowest (126.03 g) in maize single row with 2 plants/ hill (100 cm × 25 cm) +2 rows chilli (50 cm × 40 cm). The highest yield was recorded in sole chilli (4.14 t/ha) and the lowest (0.93 t/ha) in

maize single row with 2 plants/ hill (100 cm × 25 cm) + 2 rows chilli (50 cm × 40 cm). Incase of intercrop situation the highest yield (2.04 t/ha) was recorded in maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm). All these variations were attributed due to planting system.

Table 2. Yield and yield components of chilli in maize chilli intercropping under different planting systems in 2013- 2014

Treatment	Plant height (cm)	Plant population/m^2 (No.)	No. of fruits/plant	100 fruit wt. (g)	Fruit yield (t/ha)
T_1	97.40	7.00	30.93	131.73	1.46
T_2	97.67	6.00	18.53	126.03	0.93
T_3	91.80	8.00	38.87	142.63	2.04
T_4	93.40	7.00	24.27	128.46	1.52
T_5	-	-	-	-	-
T_6	72.53	8.00	42.53	144.65	4.14
LSD ($_{0.05}$)	11.09	13.01^{ns}	4.92	6.61	1.23
CV (%)	11.02	10.18	11.21	9.78	10.40

Intercrop efficiency

Green cob yield, fodder yield, green chilli yield and economic study of hybrid maize chilli intercropping system are presented in Table 3. Total yield in terms of cob yield (20.90 t/ha), fodder yield (32.61 t/ha), and green chilli yield (2.04 t/ha) were higher than sole maize or sole chilli which was found in maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm). Among intercropping systems, the highest cob yield (22.54 t/ha) was obtained from maize single row with 2 plants/ hill (100 cm × 25 cm) + 2 rows chilli (50 cm × 40 cm) and the highest fodder yield (35.36 t/ha) was obtained from maize single row (100 cm × 25 cm) + 2 rows chilli (50 cm × 40 cm) but in these treatments, green chilli yield was lower (0.93 and 1.46 t/ha, respectively) than all other intercrops. So, maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm) combination was more suitable than others due to highest BCR. Similarly, gross return (Tk 2,98,753 /ha), gross margin (Tk 2,43,753/ha) and benefit cost ratio (5.43) were also higher in that combination.

Table 3. Benefit cost ratio analysis of chilli maize intercropping under different planting systems in 2013-2014

Treatment	Green cob yield (t/ha)	Fodder yield (t/ha)	Green chilli yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Gross margine (Tk./ha)	BCR
T_1	22.45	35.36	1.46	291740	55000	236740	5.30
T_2	22.54	34.44	0.93	271210	55000	216210	4.93
T_3	20.90	32.61	2.04	298753	55000	243753	5.43
T_4	17.18	30.24	1.52	240155	55000	185155	4.37
T_5	25.47	38.39	-	264298	50000	214298	5.28
T_6	-	-	4.14	165600	60000	105600	2.76

* Local market price (Tk./kg) Maize cob: 10/-, Chilli: 40/- and fodder: 0.25/-

T_1 =Maize single row (100 cm × 25 cm)+2 rows chilli (50 cm × 40 cm), T_2 =Maize single row with 2 plants/ hill (100 cm × 25 cm) +2 rows chilli (50 cm × 40 cm) , T_3 =Maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm) , T_4 =Maize single row with 2 plants/ hill (150 cm × 50 cm) + 3 rows chilli (50 cm × 40 cm) and T_5 =Sole maize (60cm × 20cm), T_6 =Sole chilli (50cm × 40cm)

Conclusion

The results revealed that maize single row (150 cm × 25 cm) + 3 rows chilli (50 cm × 40 cm) combination might be suitable and economically profitable for the hill valley of Khagrachari.

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SUITABILITY STUDY OF DIFFERENT LOCAL FRENCH BEAN VARIETIES INTERCROPPED WITH HYBRID MAIZE UNDER DIFFERENT PLANTING SYSTEM IN HILLY AREAS

N.Chakma, S Hossain, M.Salim, M.S.Noman & M.M. Ullah

Abstract

An experiment was conducted at Hill Agricultural Research Station, Khagrachari during the Rabi season of 2013-14 to find out suitable local french bean varieties intercropped with hybrid maize under different planting system in hilly areas higher productivity and economic return. Six intercropping combinations viz., maize single row (75 cm × 25 cm) +2 rows french bean (black seed), maize single row (75 cm × 25 cm) + 2 rows french bean (pink seed), maize single row (100cm × 25 cm) + 3 rows french bean (black seed), maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed) , maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (black seed) and maize single row with 2 plants/hill (100 cm × 50 cm) + 3 rows french bean (pink seed) were evaluated against their sole crops. Maize single row + 3 row French bean (pink seed) intercrop combination might be suitable for higher productivity and economic return for the hill valley of Khagrachari. The medium cob yield (12.05 t/ha) and fodder yield (22.77 t/ha) and the highest seed yield (6.84 t/ha) were found in this combination. The highest gross return (Tk.3,99,793/ha), net return (Tk.3,34,793/ha) and benefit cost ratio (6.15) were recorded in the same combination.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit area through maximum utilization of land, labour and growth resources (Islam *et al.,* 2004). The important determines in intercropping system are the judicious choice of compatible crops with minimum inter-specific competition. Both hybrid maize and local french bean are popular to hill people. They use immature/green cob of maize but mature seeds of French bean. As a short duration and short stature legume crop, it may be intercropped with hybrid maize. Moreover, by changing planting geometry of hybrid maize, incident light on French bean may be increased. Intercropping have many advantages, but there are difficulty in sowing or harvesting and in quantifying and applying fertilizers for getting maximum profit from the component crops of intercropping systems. However, hill farmers grow hybrid maize and French bean in hill valley as sole crops. In that region, productivity and profitability may be increased through intercropping of maize and French bean. Hence, the experiment was conducted to find out suitable local French bean varieties intercropping with hybrid maize under different planting system in hilly areas and to increase total productivity and economic return through suitable combination.

Materials and Methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari during the *Rabi* season of 2013-14. Seven treatment combinations were as follows: T_1=Maize single row (75 cm × 25 cm) + 2 rows french bean (black seed), T_2=Maize single row (75 cm × 25 cm) + 2 rows french bean (Pink seed), T_3=Maize single row (100 cm × 25 cm) + 3 rows french bean (black seed), T_4=Maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed), T_5=Maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (black seed), T_6=Maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (pink seed), T_7=Sole maize. The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4 m × 4 m. The

hybrid maize (var. BARI hybrid maize 7) and French bean local black and pink colour were used in this experiment. Seeds of maize and French bean were sown on 02 December 2013 according to treatments. Sole hybrid maize and intercropping treatments were fertilized with 250-55-110-40-4-2 kg/ha of N P K S Zn B. For sole maize and intercrop the full amount of P K S Zn B and $^1/_2$ N were applied as basal in the form of triple super phosphate, muriate of potash, gypsum, zinc sulphate, boric acid and urea, respectively. The remaining N was top dressed at 30 days after sowing (DAS). Irrigation was given after sowing/planting for proper establishment of crops. Subsequently three irrigations were applied at 30, 60 and 90 DAS. Two hand weeding were done at 20 and 40 DAS to keep the crops reasonably weed free. Data of maize and French bean were taken from randomly selected 5 plants from each plot for yield contributing characters. Green cob of maize was harvested at 135 and 142 DAS and French bean at 110 DAS. Data of both the crops were analyzed statistically and the means were adjusted using LSD. Benefit cost analysis was also calculated.

Results and Discussion

Effect on maize

Plant height, plant population/m^2, green cob yield/plot, cob yield (t/ha), fodder yield (t/ha) of maize were influenced significantly due to intercropping with French bean under different planting system (Table 1). The highest plant height (295.47 cm) was recorded in maize single row (75 cm × 25 cm) + 2 rows french bean (black seed) and the lowest (214.33 cm) was in maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (pink seed). The highest number of plant population was recorded in sole maize (9.33) and the lowest was recorded in maize single row (100 cm × 25 cm) + 3 rows french bean (black seed) and maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (black seed). Difference in plant population /m^2 among different combinations was attributed due to planting system. The highest green cob yield/plot was in sole maize (30.12 kg) and the lowest (14.3 kg) was found in maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows French bean (black seed). The highest cob yield was recorded in sole maize (18.82 t/ha) and the lowest (8.94 t/ha) in maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (black seed) due to lowest number of cob. The highest fodder yield was recorded in sole maize (33.13 t/ha) and the lowest (19.57 t/ha) was recorded in maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (black seed). This was attributed due the lowest number of plant population.

Table 1. Yield and yield components of hybrid maize in maize french bean intercropping under different planting systems in 2013-2014

Treatment	Plant height (cm)	No. of leaf	Plant population /m^2 (no.)	No. of cobs/plant	Green cob yield/plot (kg)	Cob yield (t/ha)	Fodder yield (t/ha)
T_1	295.47	15.07	6.67	1.07	25.27	15.79	31.77
T_2	272.13	15.20	8.67	1.00	20.70	12.94	26.90
T_3	269.20	15.73	5.33	1.20	16.73	10.46	20.88
T_4	270.67	15.04	7.00	1.20	19.28	12.05	22.77
T_5	252.73	15.20	5.33	1.13	14.30	8.94	19.57
T_6	214.33	15.07	6.00	1.13	16.00	10.00	21.31
T_7	280.60	15.07	9.33	1.07	30.12	18.82	33.13
$LSD_{(0.05)}$	52.21	-	3.11	-	4.52	2.85	4.65
CV%	11.07	0.00	10.12	0.00	12.51	12.52	10.38

Here, T_1=Maize single row (75 cm × 25 cm) + 2 rows french bean (black seed), T_2=Maize single row (75 cm × 25 cm) + 2 rows french bean (pink seed), T_3=Maize single row (100 cm × 25 cm) + 3 rows french bean (black seed), T_4=Maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed), T_5=Maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (black seed), T_6=Maize single row with 2 plants/ hill (100 cm × 50 cm) + 3 rows french bean (pink seed), T_7=Sole maize

Effect on French bean

Yield and yield components of French bean were significantly affected in maize French bean intercropping systems (Table 2). The significant variation in plant height (44.87-55.27 cm), plant population/m^2 (16.00-28.00 cm), 100 seed wt. (42.83-94.96 g), pod yield (7.36-13.59 t/ha.) and seed yield (3.69-6.84 t/ha) were mainly attributed due to planting systems. The highest green pod yield (13.59 t/ha) and green seed yield (6.84 t/ha) were recorded in maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed) and the lowest green pod yield (7.36 t/ha) and green seed yield (3.69 t/ha) was recorded in maize single row (75 cm × 25 cm) + 2 rows french bean (black seed). Pod and seed yield in different intercrop combinations were attributed to the cumulative effect of yield components.

Table 2. Yield and yield components of French bean in maize French bean intercropping under different planting systems in 2013-2014

Treatment	Plant height (cm)	Plant population/m^2 (cm)	100 green seed wt. (g)	Green pod yield (t/ha)	Green seed yield (t/ha)
T_1	49.27	16.33	42.83	7.36	3.69
T_2	45.53	16.00	44.10	7.73	4.39
T_3	51.33	26.00	88.66	12.71	6.02
T_4	55.27	28.00	94.96	13.59	6.84
T_5	44.87	18.00	44.21	7.94	4.43
T_6	46.80	19.00	87.06	12.52	5.71
T_7	-	-	-	-	-
LSD $_{(0.05)}$	7.28	9.71	13.01	3.87	1.2
CV (%)	8.17	10.12	10.72	11.07	10.82

Intercrop efficiency

Cob yield, fodder yield, green seed yield and economic performance of hybrid maize French bean intercropping system are presented in Table 3. Total yield in terms of cob yield (12.05 t/ha), fodder yield (22.77 t/ha) and seed yield (6.84 t/ha) were higher than sole maize or sole french bean which was found in maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed) . Among intercropping systems, the highest cob yield and fodder yield were obtained from maize single row (75 cm × 25 cm) + 2 rows french bean (black seed) but in this treatment, green seed yield was the lowest (3.69 t/ha). On the other hand, the highest seed yield (6.84 t/ha) was observed in maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed). So, maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed) combination was more suitable than others due to highest BCR. Similarly, gross return (Tk.3,99,793/ha), net return (Tk 3,34,793t/ha) and benefit cost ratio (6.15) were also higher in that combination.

Table 3. Benefit cost ratio analysis of maize French bean intercropping under different planting systems in 2013-2014

Treatment	Green cob yield (t/ha)	Fodder yield (t/ha)	Green seed yield (t/ha)	Gross return (Tk./ha)	Cost of production (Tk./ha)	Net return (Tk./ha)	BCR
T_1	15.79	31.77	3.69	313443	62000	251443	5.06
T_2	12.94	26.90	4.39	311725	62000	249725	5.03
T_3	10.46	20.88	6.02	350620	65000	285620	5.39
T_4	12.05	22.77	6.84	399793	65000	334793	6.15
T_5	8.94	19.57	4.43	271493	65000	206493	4.18
T_6	10.00	21.31	5.71	333728	65000	268728	5.13
T_7	18.82	33.13	-	196483	50000	146483	3.93

* Local market price (Tk/kg.) Maize cob: 10/-, french bean: 40/- and fodder = 0.25/-

Conclusion

The results revealed that maize single row (100 cm × 25 cm) + 3 rows french bean (pink seed) combination might be suitable for increasing total productivity and economic return for the hill valley of Khagrachari.

References

Islam, M.N.; M.M. Haque and A. Hamid (2004). Productivity and competitive interference in maize and French bean intercropping system in different sowing dates. Bangladesh J. Agril.Res. 29 (2):193- 202.

INTERCROPPING LALSHAK WITH CHILLI UNDER DIFFERENT PLANTING SYSTEM

N. Chakma, M.N. Islam, A.A. Begum and M.A. Aziz

Abstract

An intercropping experiment was conducted at Hill Agricultural Research Station, Khagrachari during *rabi* season of 2014-15 to find out suitable planting system of chilli & red amaranthas intercrop in hilly areas, to increase total productivity and economic return through suitable combination. Six intercropping combinations viz., T_1=100%Chilli (50 cm×40 cm) + 100% lalshak (broadcast), T_2= 100% Chilli (50 cm × 40 cm) + 75% lalshak (broadcast), T_3=100% Chilli (50 cm × 40 cm) + 50% lalshak (broadcast), T_4=100% Chilli (50 cm × 40 cm) + 25% lalshak (broadcast), T_5=Sole Chilli (50 cm × 40 cm)), T_6= Sole lalshak (broadcast) were evaluated. The medium chilliyield (3.96 t/ha) and highest red amaranthyield (4.96/ha) were found in 100% Chilli (50 cm×40 cm) + 100% lalshak (broadcast) i.e T_1. The highest gross income (TK 218000 /ha), net income (Tk.158000/ha) and benefit cost ratio (2.63) were recorded in the same combination. The results revealed that 100% Chilli (50 cm × 40 cm) + 100% lalshak (broadcast) combination might be suitable, increase total productivity of inter crop and profitable for the hill valley of Khagrachari.

Introduction

Intercropping is a traditional practice in Bangladesh. It increases total productivity per unit area through maximum utilization of land, labour and growth resources (Islam *et al,* 2004). Intercropping is one of the cropping strategies that have been recognized to improve the food security situation and incomes for the farmers. Intercropping also helps toreduce weed populations, insect pests infestation & risk of complete crop failure. Intercropping system becomes more productive & profitable when it is done properly by selecting compatible crops, spatial arrangements & population density of component crops as well as judicious application of chemical fertilizers. Lalshak is a short duration and short stature vegetable. On the other hand, chilli is comparatively tall and long duration spice. Lalshak and chilli intercropping is practiced in some parts of the country. But different farmers use different lalshak population in lalshak & chilli intercropping system. Hence, this experiment was conducted to standardize lalshak population (plant spacing) suitable for intercropping with chilli.

Materials and methods

The experiment was conducted at the Hill Agricultural Research Station, Khagrachari during *rabi* season of 2014-15. Local chilli & BARI Lalshak -1 were used as materials in this intercropping experiment. Six treatment combinations were used viz., T_1=100% Chilli (50 cm × 40 cm) + 100% lalshak (broadcast), T_2=100% Chilli (50 cm × 40 cm) + 75% lalshak (broadcast), T_3= 100% Chilli (50 cm × 40 cm) + 50% lalshak (broadcast), T_4= 100% Chilli (50 cm × 40 cm) + 25% lalshak (broadcast), T_5= Sole Chilli (50 cm × 40 cm), T_6= Sole lalshak (broadcast). The experiment was laid out in randomized complete block design with three replications. The unit plot size was 4m × 4m. Seedlings of chili were sown on 20 November & red amaranth on 27 November. In case of sole red amaranth the other sowing dates were 27 November, 7 January & 15 February. Sole chilli and intercropping treatments were fertilized with 120-80-120-20-4 kg/ha N P K S Zn B & for sole red amaranth with 40-10-30 kg/ha NPK. For sole chilli and intercrop the full amount of P K S Zn B and $^1/_2$ N were applied as basal in the form of triple super phosphate, muriate of potash, gypsum, zinc

sulphate, boric acid and urea, respectively. The remaining N was top dressed at 25, 50 & 70 days after planting (DAP). For sole red amaranth $^1/_2$ N & all other fertilizers were applied as basal. Rest N was applied at 25 DAE. Irrigation was given after planting for proper establishment of crops. Irrigations were applied at 15 days interval. Three hand weeding were done at 20, 40 and 60 DAP to keep the crops reasonably weed free for chilli. Data of chilli were taken from randomly selected 5 plants from each plot. Data of red amaranth were taken from randomly selected two 50 cm^2 area from each plot. Green chilli was harvested at 110, 122, 150 & 160 DAP and red amaranth at 35 DAS in case of intercropping but sole red amaranth was harvested 3 times as it was sown 3 times each time at 35 DAS. Data of both the crops were analyzed statistically and the means were adjusted using LSD. Benefit cost analysis and (CV %) were also calculated.

Result & Discussion

Effect on Chilli

No significant variation among different treatments were found in case of plant population & plant height. Number of primary branch per plant was recorded highest in T_5 (2.27) which was statistically similar with T_4 (2.20), T_3 (2.13) & T_2 (2.00). Lowest number of primary branch was recorded in T_1 (1.80) which was statistically similar with T_2 (2.00). Highest number of fruit per plant was observed in T_5 (230.93) and lowest was observed in T_1 (174.27). Weight of fruit/plant was also recorded highest in T_5 (270.03gm) and lowest was recorded in T_1 (206.41 gm). In case of yield (t/ha) highest data was recorded in T_5 (6.45) and lowest in T_1 (3.96) which was statistically similar with T_2 (4.43).

Table 1. Yield and yield components of local chilli in chilli-red amaranth intercropping under different planting systems

Treatment	Plant population	Plant height (cm)	Primary branch /plant	No. of fruit/plant	Wt. of fruit/plant (gm)	Yield t/ha
T_1	5.67	61.13	1.80	174.27	206.41	3.96
T_2	5.67	64.67	2.00	183.33	234.58	4.43
T_3	5.67	57.93	2.13	200.47	248.84	5.68
T_4	6.00	59.40	2.20	219.20	253.77	5.71
T_5	6.00	63.00	2.27	230.93	270.03	6.45
$LSD_{(0.05)}$	NS	NS	0.30	8.44	3.72	0.70
CV(%)	8.62	7.81	7.55	2.22	0.81	5.11

Effect on Red amaranth

Plant population per 50 cm^2 was recorded highest in T_6 (55.33) & lowest was recorded in T_4 (30.50). In case of plant height highest data was recorded in T_4 (20.23 cm) which was statistically similar with T_6 (19.17 cm) & T_3 (18.80cm). Lowest plant height was recorded in T_1 (14.37 cm). Individual wt. of red amaranth was observed highest in T_6 (0.25 gm) which was statistically similar with T_4 (0.22gm), T_3 (0.22 gm) & T_2 (0.21 gm). Lowest individual wt. was recorded in T_1 (0.10 gm). Yield of red amaranth (t/ha) was found highest in T_6 (8.09 t/ha) & lowest was in T_4 (0.87 t/ha) which was statistically similar with T_3 (1.61 t/ha).

Table 2. Yield and yield components of Red amaranth in chilli-red amaranth intercropping under different planting systems

Treatment	Plant population/50 cm^2	Plant height (cm)	Individual wt. (gm)	Yield (t/ha)
T_1	51.67	14.37	0.10	4.96
T_2	45.17	17.57	0.21	3.38
T_3	36.67	18.80	0.22	1.61

Treatment	Plant population/50 cm^2	Plant height (cm)	Individual wt. (gm)	Yield (t/ha)
T_4	30.50	20.23	0.22	0.87
T_6	55.33	19.17	0.25	8.09
$LSD_{(0.05)}$	1.93	2.11	0.06	1.50
CV(%)	2.34	6.23	12.06	12.14

T_1=100% Chilli (50 cm × 40 cm) + 100% lalshak (broadcast), T_2=100% Chilli (50 cm × 40 cm) + 75% lalshak (broadcast), T_3= 100% Chilli (50 cm × 40 cm) + 50% lalshak (broadcast), T_4= 100% Chilli (50 cm × 40 cm) + 25% lalshak (broadcast), T_5= Sole Chilli (50 cm × 40 cm), T_6= Sole lalshak (broadcast).

Intercrop efficiency

Green chilli yield, red amaranth yield and economic study of Chilli-red amaranth intercropping system are presented in Table 3. Total yield in terms of green chilli yield (6.45 t/ha) & red amaranth yield (8.09 t/ha) were higher in sole Chilli or sole red amaranth. Among intercropping systems, higher chili yield, was obtained from T_4 (5.71 t/ha) but in case of red amaranth yield (0.87 t/ha) which is lower than other intercrops. So among intercropping systems T_1 combination is more suitable than others due to highest BCR. On the other hand, red amaranth yield (4.96 t/ha) which was found inT_3 is highest among the intercropping treatments. Similarly, gross income (Tk 218000 /ha), net income (Tk 158000/ha) and benefit cost ratio (2.63) were also higher in that combination.

Table 3. Benefit Cost Ratio (BCR) analysis of chilli red amaranth intercropping under different planting systems

Treatment	green Chilli yield (t/ha)	Red amaranth (t/ha)	Gross income (Tk./ha)	Cost of production (Tk./ha)	Net income (Tk./ha)	BCR
T_1	3.96	4.96	218000	60000	158000	2.63
T_2	4.43	3.38	200500	58000	142500	2.46
T_3	5.68	1.61	202600	57000	145600	2.55
T_4	5.71	0.87	188700	56000	132700	2.37
T_5	6.45	-	193500	55000	138500	2.52
T_6	-	8.09	161800	53000	108800	2.05

Considering price (Tk/Kg) : Green chilli = 30, Red amaranth =20

Conclusion

The results revealed that 100% Chilli (50 cm × 40 cm) + 100% lalshak (broadcast) i.e T_1 combination might be suitable and economically profitable for the hill valley of Khagrachari. For final recommendation the experiment should be continued for the next year.

References

Islam, M.N.; M.M. Haque and A.Hamid (2004). Productivity and competitive interference in maize and chilli intercropping system in different sowing dates. Bangladesh J. Agril. Res.

EFFECT OF FERTILIZER PACKAGE ON YIELD AND YIELD CONTRIBUTING CHARACTERS OF MAIZE VARIETIES IN HILLY AREA

N. Chakma, S. Hossain, M.A. Rouf, A. Barman and M.M. Ullah

Abstract

An experiment was conducted at HARS, Khagrachari during *rabi* during 2014-15 to find out suitable fertilizer packages of maize in hilly area. Four fertilizer packages viz. T_1 : CD = 5 t/ha, N_0, P_0, K_0, S_0, Zn_0, B_0 T_2 : CD= 5t/ha, N_{150}, P_{30}, K_{75}, S_{20}, Zn_2, $B_{0.5}$ T_3 : CD= 5t/ha, N_{200}, P_{60}, K_{100}, S_{40}, Zn_3, B_1 (FRG 2012) T_4 : CD= 5 t/ha, N_{250}, P_{90}, K_{125}, S_{60}, Zn_4, $B_{1.5}$ and 2 varieties (BARI Hybrid maize-7, BARI Hybrid maize-9)were used in this experiment. Among the fertilizer packages T_4 was recorded higher in case of on plant height (cm), plant population/m^2, No. of leaves during green con harvest, Number of cob/plant, Individual cob wt. with husk, cob height (cm),green cob yield (t/ha), fodder yield. In case of interaction V_1T_4 (BARI Hybrid maize-7 +100% higher fertilizer than recommended) gives highest and statistically similar result with V_2T_4 (BARI Hybrid maize-7 +100% higher fertilizer than recommended). The results revealed that BARI Hybrid maize-7 with 100% higher fertilizer than recommended i.e. T_4: CD= 5 t/ha, N_{250}, P_{90}, K_{125}, S_{60}, Zn_4, $B_{1.5}$ would be suitable for maize cultivation in the hill valley areas. For final recommendation the experiment should be continued for the next year.

Introduction

Maize (Zea mays) belongs to the family poaceae. It is also known as corn in some English speaking countries and domesticated by indigenous peoples of meso America in prehistoric times. In Bangladesh maize production is increasing day by day as it is used as feed for poultry and livestock. Maize acreage and production have an increasing tendency with the introduction of hybrid since 1993. Area, production, and yield of maize have increased by 17%, 33%, and 16%, respectively, which reflect the effect of adopting improved technology (Mohiuddin, 2003). Its position is 1st among the cereals in terms of yield, but in terms of area and production, it ranks 3rd just after rice and wheat (BBS, 2003, 2006).In CHT green cobs are used for human consumption as boiled or roasted. So, in CHT there is huge demand of maize. BARI has developed several hybrid varieties of maize but there is no recommended fertilizer package of maize in hill valleys. People are using fertilizer dose of maize recommended for plain land. Therefore this experiment has been undertaken to find out the suitable fertilizer package of maize in hill valleys.

Materials and methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari hill district during *rabi* season during 2014-15. BARI hybrid Maize-7, BARI hybrid Maize-9 were used as variety in this experiment. The treatments used in this experiment were: T_1 : CD = 5 t/ha, N_0, P_0, K_0, S_0, Zn_0, B_0 T_2 : CD= 5 t/ha, N_{150}, P_{30}, K_{75}, S_{20}, Zn_2, $B_{0.5}$ T_3 : CD= 5t/ha, N_{200}, P_{60}, K_{100}, S_{40}, Zn_3, B_1 (FRG 2012) T_4 : CD= 5 t/ha, N_{250}, P_{90}, K_{125}, S_{60}, Zn_4, $B_{1.5}$ The experiment was conducted in split plot Design (SPD) with three replications. Unit plot size was 3m × 4m. Soil of the experimental field was low in P^H (5.2), N (0.08%), P (31%), K (0.13%), S (11%). One third of nitrogen and all of P, K, S, Mg, Zn, B were applied during sowing. Remaining N was applied in two equal splits as side dressing in maize rows at(8-10 leaf stage) 30-35 DAS and 90 DAS & mixed thoroughly with the soil as soon as possible. Seeds were sown in the experimental plot at 24 November 2014 following 60cm × 20 cm spacing. Intensive care was taken during the growing period to ensure adequate growth and development of the crop. The data on plant height (cm),

plant population/m^2, no. of leaves during green cob harvest , number of cob/plant, individual cob wt. with husk, individual cob weight without husk, cob height (cm), green cob yield (t/ha), fodder yield were recorded. The data were analyzed statistically by using MSTAT-C software.

Result and Discussion

Effect of variety

The two varieties did not show any significant affect on the yield & yield contributing characters of maize.

Table 1. Effect of varieties on yield and yield contributing characters of maize

Treatment	Plant height (cm)	No. of leaves	Cob wt. with husk (gm)	Cob wt. without husk (gm)	Cob height cm)	Cob yield/plot (kg)	Cob yield t/ha	Fodder yield/ plot(kg)
V_1	225.55	14.75	254.93	186.05	17.29	29.06	24.21	57.98
V_2	254.63	14.83	254.28	185.88	19.37	29.07	24.23	57.88
LSD	NS	NS	NS	NS	NS	NS	NS	NS
CV%	9.32	2.98	0.66	0.99	9.31	4.39	4.39	2.49

Here, V_1: BARI Hybrid maize -7 and V_2: BARI Hybrid maize -9

Effect of fertilizer

Plant height of maize was recorded highest in T_4 (269.37cm) which was statistically similar with T_2(253.17 cm) & T_3 (258.53cm). Lowest plant height was recorded in T_1 (179.30 cm). No significant variation was recorded in case of number of leaves per plant. Highest cob wt. with husk was recorded in T_4 (320.20 gm) & lowest was recorded in T_1 (139.80gm). Cob weight without husk was observed highest in T_4 (235.70 gm) & lowest was observed in T_1 (93.60 gm). Highest cob height was recorded in T_4 (20.60 cm) which was statistically similar with T_1 (14.17 cm). Lowest cob height was recorded in T_1 (14.17cm). Cob yield per plot was also recorded highest in T_4 (37.88 kg) & lowest in T_1 (18.07 kg). Similar result was also observed in yield (t/ha) of maize. Highest fodder yield/plot was also recorded in T4 (73.92 kg) & lowest was recorded in T_1 (36.21 kg).

Table 2. Effect of different fertilizer packages on yield and yield contributing characters of maize

Treatment	Plant height (cm)	No. of leaves	Cob wt. with husk (gm)	Cob wt. without husk (gm)	Cob height (cm)	Cob yield/plot (kg)	Cob yield t/ha	Fodder yield/plot (kg)
T_1	179.30	14.67	139.80	93.60	14.17	18.07	15.06	36.21
T_2	253.17	14.83	251.23	185.90	18.52	29.38	24.49	58.68
T_3	258.53	14.67	307.20	228.67	20.02	30.93	25.78	62.92
T_4	269.37	15.00	320.20	235.70	20.60	37.88	31.57	73.92
LSD	41.10	ns	3.10	3.38	3.13	2.34	1.95	2.66
CV%	9.32	2.98	0.66	0.99	9.31	4.39	4.39	2.49

Here, T_1: CD = 5 t/ha, N_0, P_0, K_0, S_0, Zn_0, B_0, T_2 : CD= 5t/ha, N_{150}, P_{30}, K_{75}, S_{20}, Zn_2, $B_{0.5}$, T_3 : CD= 5t/ha, N_{200}, P_{60}, K_{100}, S_{40}, Zn_3, B_1 (FRG 2012), T_4 : CD= 5t/ha, N_{250}, P_{90}, K_{125}, S_{60}, Zn_4, $B_{1.5}$

Interaction Effect

In case of interaction highest plant height was recorded in V_2T_4 (284.93 cm) which was statistically similar withV_2T_3 (279.73cm), V_2T_2 (263.53 cm) & V_1T_4 (253.80 cm). Lowest was recorded in V_1T_1 (168.27 cm) which was also statistically similar with V_2T_1 (190.33 cm).No. of

leaves per plant were not significant. Cob wt. with husk was observed highest in V_1T_4 (321.33) which was statistically similar with V_2T_4 (319.07 gm) & lowest was observed in V_1T_1 (139.47 gm) which was also statistically similar with V_2T_1 (140.13 gm). Cob wt. without husk was also recorded highest in V_1T_4 (236.33 gm) which was statistically similar with V_2T_4 (235.07 gm) & lowest was recorded in V_1T_1 (93.33 gm) which was statistically similar with V_2T_1 (93.87 gm). Highest cob height was observed in V_2T_4 (22.43 cm) which was statistically similar with V_2T_3 (21.00 cm) & V_2T_2 (19.80 cm). Lowest cob height was recorded in V_1T_1 (14.10cm) which was statistically similar with V_2T_1 (14.23 cm). Cob yield per plot was recorded highest V_1T_4 (38.40 kg) which was statistically similar with V_2T_4 (37.37 kg) & lowest was recorded in V_1T_1 (17.67 kg) which was also statistically similar with V_2T_1 (18.46 kg).Similar result was recorded in yield (t/ha). In case of fodder yield highest result was observed in V_2T_4 (74.17 kg) which was statistically similar with V_1T_4 (73.67 kg) & lowest was observed in V_2T_1 (35.82 kg) which was also statistically similar with V_1T_1 (36.60 kg).

Table 3. Interaction effect of different varieties & fertilizer packages on yield and yield contributing characters of maize

Treatment	Plant height (cm)	No. of leaves	Cob wt. with husk (gm)	Cob wt. without husk (gm)	Cob height (cm)	Cob yield/plot (kg)	Cob yield t/ha	Fodder yield/plot (kg)
V_1T_1	168.27	14.87	139.47	93.33	14.10	17.67	14.72	36.60
V_1T_2	242.80	14.87	252.00	185.67	17.23	29.83	24.86	59.00
V_1T_3	237.33	14.47	306.93	228.87	19.05	30.33	25.28	62.67
V_1T_4	253.80	14.80	321.33	236.33	18.77	38.40	32.00	73.67
V_2T_1	190.33	14.47	140.133	93.87	14.23	18.46	15.39	35.82
V_2T_2	263.53	14.80	250.46	186.13	19.80	28.93	24.11	58.37
V_2T_3	279.73	14.87	307.47	228.47	21.00	31.53	26.28	63.17
V_2T_4	284.93	15.20	319.07	235.07	22.43	37.37	31.14	74.17
LSD	39.79	ns	3.01	3.27	3.03	2.26	1.89	2.57
CV%	9.32	2.98	0.66	0.99	9.31	4.39	4.39	2.49

Here, V_1T_1: BARI Hybrid maize -7 +control, V_1T_2: BARI Hybrid maize-7+ less fertilizer than recommended dose, V_1T_3: BARI Hybrid maize-7 +recommended dose, V_1T_4: BARI Hybrid maize-7 +higher fertilizer than recommended, V_2T_1: BARI Hybrid maize-9 +control, V_2T_2 : BARI Hybrid maize -9+ 50% less fertilizer than recommended dose, V_2T_3: BARI Hybrid maize-9 +recommended dose, V_2T_4: BARI Hybrid maize-7 +100% higher fertilizer than recommended

Conclusion

The results revealed that BARI Hybrid maize-7 with 100% higher fertilizer than recommended i.e. T_4 : CD= 5t/ha, N_{250}, P_{90}, K_{125}, S_{60}, Zn_4, $B_{1.5}$ would be suitable for maize cultivation in the hill valley areas.. For recommendation this experiment should be continued for the next year.

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EFFECT OF FERTILIZER PACKAGES ON YIELD AND YIELD CONTRIBUTING CHARACTERS OF ONION IN HILL VALLEY

N.Chakma, S. Hossain, M.A. Rouf, A. Barman & M.M. Ullah

Abstract

An experiment was conducted at HARS, Khagrachari during *rabi* during 2014-15 to find out suitable fertilizer packages of onion in hilly area. Four fertilizer packages viz. T_1 : CD = 5 t/ha, N_{60}, P_{12}, K_{40}, S_{10}, T_2 : CD= 5 t/ha, N_{120}, P_{24}, K_{80}, S_{20},. (FRG 2012) T_3 : CD= 5t/ha, N_{240}, P_{48}, K_{160}, S_{40}, T_4 : CD= 0 t/ha, N_0, P_0, K_0, S_0, were used in this experiment.T_3 was recorded higher in case of plant height, plant population/m^2 but length of bulb, diameter of bulb, individual weight (g) and yield (t/ha) were highest in T_2. The result revealed that recommended rtilizer dose for plain land i.e. T_2 : CD= 5t/ha, N_{120}, P_{24}, K_{80}, S_{20},. (FRG 2012) would be economically profitable for onion cultivation in the hilly areas. For precise conclusion the experiment should be continued for the next year.

Introduction

Onion (*Allium cepa* L.) is one of the most important winter spice crops grown in Bangladesh. It ranks first in terms of area of cultivation and production amongst the bulb crops produced in the world (FAO 2002). Among the spice crops grown in Bangladesh, it ranks second in respect of production and area (BBS 2002). Onion is an integral part of our daily diet and its use is very common in almost all food preparations (Hossain and Islam 1994). It is also used as preservative and medicine (Vohra et al. 1994). In Bangladesh, the demands for onion are augmenting day by day, where the area under onion cultivation is not increasing rather it is reducing. As a result, Bangladesh has to import onion from other countries to meet its demand (Hossain and Islam 1994). The average yield of onion in Bangladesh is only 3.45 t/ha (FAO 2002). This is a very poor yield compared to other leading onion growing countries of the world. Lack of use of modern genotypes and optimum fertilizer dose may be a major constraint of maximum harvest (Shamima and Hossain 2000). BARI has developed several onion varieties but there is no recommended fertilizer packages especially for CHTs. Farmers are using the fertilizer package recommended for plain lands. The present experiment was undertaken to find out the suitable fertilizer package of onion in hilly area.

Materials and methods

The experiment was conducted at Hill Agricultural Research Station, Khagrachari hill district during *rab*i season during 2014-15. BARI Peyaj -5 was used as variety in this experiment. The treatments used in this experiment were: T_1 : CD = 5 t/ha, N_{60}, P_{12}, K_{40}, S_{10}, T_2 : CD= 5 t/ha, N_{120}, P_{24}, K_{80}, S_{20},. (FRG 2012), T_3 : CD= 5t/ha, N_{240}, P_{48}, K_{160}, S_{40}, T_4 : CD= 0t/ha, N_0, P_0, K_0, S_0.The experiment was conducted in Randomized complete block Design (RCBD) with three replications. Plot size was 3m×3m. Soil of the experimental field was low in P^H (5.2), N (0.08%), P (31%), K (0.13%), S (11%). All the amount of CD, TSP, Gypsum, half of Urea and MoP were applied as basal dose during final land preparation and mixed adequately with the soil. The rest urea and MoP were applied in two split one at 25 days and the other was 50 days after transplanting. 35 days old seedlings were transplanted in the experimental plot at 28 December 2014 following 20cm × 10 cm spacing. Intensive care was taken during the growing period to

ensure adequate growth and development of the crop. The data on plant height, plant population/m^2, length of bulb, individual wteight, yield (t/ha) were recorded. The data were analyzed statistically by using MSTAT-c software.

Result and discussion

At 70 DAT highest plant height was recorded in T_3 (73.40cm) and lowest in T_4 (50.93cm) but in case of plant height at harvest highest was recorded at T_2 (51.27cm) & lowest was at T_4 (41.93cm). Plant population/m2 & number of leaf /plant were statistically similar in all treatments.Highest length of bulb was recorded in T_2 (6.23cm) & lowest was recorded in T_4 (5.80cm). Incase of diameter highest was recorded in T_2 (5.25 cm) which was statistically similar with T_3 (4.89 cm) & lowest was in T_4 (4.73 cm). Highest individual wt. was recorded in T_2 (77.00 gm) which was statistically similar with T_3 (68.07 gm) & lowest was in T_4 (43.13 gm) which was also statistically similar with T_1 (52.60 gm). Yield /plot was highest in T_2 (31.48 kg) which was statistically similar with T_3 (29.74 kg) & lowest was in T_4 (24.74 kg) which was also statistically similar with T_1 (25.76 kg). Similar trend was recorded incase of yield t/ha. In almost all cases highest result was recorded at T_2 & statistically similar result at T_3. Similarly lowest were recorded in T_4 which was also statistically simillar with T_1.

Table 1. Yield and yield component of onion under different treatment combination

Treatment	Plant height at 70 DAT (cm)	plant height at harvest (cm)	Plant population /m^2	No. of leaf	Length of bulb (cm)	Diameter of bulb (cm)	Individual bulb weight (gm)	Yield / plot (kg)	Yield t/ha
T_1	58.53	50.13	43.00	9.73	5.85	4.76	52.60	25.76	28.60
T_2	63.60	51.27	43.00	9.13	6.23	5.25	77.00	31.48	35.00
T_3	73.40	47.40	46.67	9.53	6.00	4.89	68.07	29.78	33.09
T_4	50.93	41.93	44.33	8.27	5.80	4.73	43.13	24.74	27.48
Lsd(0.05)	12.50	3.41	8.84	2.30	1.03	0.36	10.52	2.26	2.51
CV%	10.16	3.87	9.99	12.53	8.64	3.65	8.75	4.06	4.05

Here,

T_1 : CD = 5 t/ha, N_{60}, P_{12}, K_{40}, S_{10}, T_2 : CD= 5 t/ha, N_{120}, P_{24}, K_{80}, S_{20},. (FRG 2012), T_3 : CD= 5 t/ha, N_{240}, P_{48}, K_{160}, S_{40}, T_4 : CD= 0t/ha, N_0, P_0, K_0, S_0,

Conclusion

The result revealed that recommended fertilizer dose for plain land i.e. T_2: CD= 5t/ha, N_{120}, P_{24}, K_{80}, S_{20},. (FRG 2012) would be economically profitable for onion cultivation in the hilly areas. For precise conclusion the experiment should be continued for the next year.

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Haor Eco-system

A DIAGNOSTIC SURVEY ON CROPS AND CROPPING IN HAOR AREAS OF BANGLADESH

K. Roy, M.A.M.Mian, Bulbul Ahmed, M.A. Aziz and M.A. Hossain

Abstract

The study was conducted in three haor upazillas namely Dirai, Khaliazuri and Itna under Sunamgonj, Netrokona and Kisorgonj districts of Bangladesh respectively to assess socio economic status, land utilization pattern, delineate the productivity and profitability of growing major crops, find out the existing cropping patterns and assess the prospect of possible cropping patterns. Both primary and secondary data were used in the study. Thirty seven percent of respondent involved in sole agriculture. And rest of them engaged in boating, fishing, ducks rearing besides agriculture. About 40% of sample farmers were involved in NGO for getting loan. There are about 0.58 million hectares of cultivated lands in selected three haor districts, of which 73% falls under haor areas. Though boro rice is the major crop of haor areas but some field crops such as maize, wheat, groundnut, sweet potato, cucumber and some winter vegetables like, cauliflower, corolla ete are also grown in Rabi season. About 80% respondents of those three haor districts follow Boro rice -Fallow-Fallow cropping pattern. Rest of them follows some other cropping pattern such as groundnut/ sweet potato-Fallow-Fallow, Maize -Fallow- fallow and winter vegetables- Fallow- Fallow. The cost of Hybrid rice production in farmers field was found 66,536/- per hector whereas 59,067/- for MV. The yield of hybrid boro was double (10 ton/ha) than that of MV boro (5 ton/ha). BCR of hybrid rice was 2.75 whereas 1.62 for MV rice. According to the farmers' assessment, natural hazard specially flash flood, higher price of inputs, and transportation problem were the major hindrance to crop production. Considering the scope of annual income and infrastructural situation, poor standard of living of the farmers was found in haor areas. Short durational Rabi crops (mustard) – Boro rice- Fellow- Fellow and intercropping with maize-Fallow-Fallow may become potential pattern beside Boro rice- Fallow - Fallow-Fallow pattern. Selection of short durational and water lodging tolerant varieties along with improved management practices should be potentials for further researchable issues.

Introduction

There are many haors (basin like structure) where water remains either stagnant or in flash flooding condition during the months of June to November and mainly boro rice is grown in the Rabi season using irrigation. Geographically, most of the haors are situated in seven districts of the North-East Bangladesh. The districts are: Sunamganj, Kishoreganj, Netrokona, Sylhet, Habiganj, Maulavibazar and Braman Baria. There are as many as 423 small or large haors in Bangladesh. The Hakaloki haor, Sumir haor, Dakhar haor, Tanguyar haor, Gungiajuri haor, Mukhar haor, Kaowadighir haor etc are the prominent haors in Bangladesh. The maximum number of haors is lying in Sunamgonj, Netrokona and Kishoregonj district. In terms of ecosystem, crop production practices, and economic activities and overall livelihoods of the farmers of haor areas are quite different from those of the other parts of the country. The cropping practices in Boro season mainly depends on nature. Early flood, hailstorm and drought are the main constraints to grow crops.

The available statistics indicate that, the total cultivated area in those haor districts is about 1.26 million hectares of which 0.68 million ha (nearly 66%) is under haor. Almost 80% of this area

(i.e. 0.68 million ha) is covered by Boro rice, while about 10% area is covered by T. Aman production (Huda, 2004). Hybrid rice cultivation is also gradually increasing in different locations of haor districts (Husain *et al*., 2001). There are some suitable lands namely "kanda", generally high land which become suitable for cultivation in early December. Now-day-some progressive farmers are showing interest to grow winter crops such as wheat, maize, mustard, groundnut, pulses, oilseeds, sweet potato and chili rather than rice etc in those areas. In farmers view, in rice cropping has a 100% yield loss risk due to early flash water coming from Meghaloyan as where another crop cultivation could escape 100% yield loss risk from flooding. So, there is a great possibility of growing winter seasonal crops along with rice since the cropped land area is being continuously shrinking day by day leading to in sufficiency in food security of Bangladesh. That is why it has indeed become imperative to exploit the crop production potentiality of the large haor areas; it is because those areas usually remain under-utilized with quite low cropping intensity (Jabber and Alam, 1996). However, very limited study has been conducted with regards to delineating the issues of crop production practices in the haor areas. Therefore, an attempt was made to study the over all land utilization pattern; crops and cropping pattern; and constraints to crop production in major three districts of haor areas in Bangladesh. The specific objectives of the study were as follows:

i) To find out the socio economic profile of the farmers, their land utilization pattern, crops grown and cropping practices exist in the haor areas of Bangladesh,
ii) To delineate the productivity and profitability of major crops in the haor areas.
iii) To evaluate the existing cropping patterns and assess the prospect of possible improved patterns and
iv) To explores the constraints to crop cultivation in the haor areas.

Methodology

A-multi-stages sampling technique was followed to select district upozila, village and households for this study. In first stage of sampling, three haor district namely Sunamgonj, Netrokona and Kishoregonj were purposively selected due to major portion of those is under haor than any other districts.. Secondly three upazilla (Dirai, Khaliazuri and Itna) taking one upazilla from each districts were also purposively selected. Then two villages under each upazilla were selected randomly for collecting primary data and information. Finally, from a comprehensive list of farm households in the village, a total of ninety households taking fifteen households from each village were selected randomly for data collection. Data were collected using pre tested interview schedule during Boro season of 2010-11. Necessary secondary data were collected from different published reports of Bangladesh Bureau of Statistics (BBS) and Department of Agriculture Extension. Descriptive statistics were mostly used in this study to analyze the collected data.

Results and Discussion

Socio-economic Profile of the Respondent

Farmers' age: Age of the sample farmers varied from 20 to more than 60 years. Fifty six percent of the sample farmers in all areas were belonged to the age group raged from 31-45 years followed by 46-60 years. A few numbers of farmers who were less than 30 years or more than 60 years old were found in the study areas. The Table 1 revealed that majority (89%) of the effective farmers was belonged to the age group of 31-60 years.

Education: It is noted that only 8% farmers of all areas were illiterate whereas national literacy rate is 51% (BBS, 2008). Maximum numbers (43%) of the sample farmer were found literate up to primary level followed by secondary level (32%). It also surprising that 6% of the sample farmers from all areas was literate up to more than higher secondary level and it is another cause of doing service along with agriculture (Table1). Most of them were primary school teacher, post master, family planning worker etc.

Occupation: It was found from the survey findings, that the earning members of the sample households were engaged in six different occupations. The major occupation (37%) of the sample farmers of all areas was agriculture. Business along with agriculture was another important occupation in Netrokona (40%) as well as in Sunamgonj (23%) districts whereas fishing along with agriculture was found to be the predominant occupation in Kishoregonj district (Table 1). Boating was plying an imperative means of earning like service for the livelihood of the haor people. Fewer people also found engaged in duck raring, cattle raring and stone or pit collecting.

Table 1. Socio-economic profiles of farmers in haor areas of Bangladesh

Characteristics	Categories	Sunamgonj	Netrokona	Kishoregonj	All areas
Farmers age	20-30 years	1 (3)	1(3)	-	1 (2)
	31-45 years	19 (63)	15 (50)	17 (56)	17 (56)
	46-60 years	10 (34)	8 (27)	11 (37)	10 (33)
	>60 years	-	6 (20)	2 (7)	2 (9)
Education level	Illiterate	2 (7)	2 (7)	3 (10)	2 (8)
	Primary	16 (53)	10 (33)	13 (43)	13 (43)
	Secondary	9 (30)	11 (37)	9 (30)	10 (32)
	Higher Secondary	2 (7)	5 (17)	3 (10)	3 (11)
	>Higher Secondary	1 (3)	2 (6)	2 (7)	2 (6)
Occupation	Only agriculture	12 (40)	10 (34)	11 (36)	11 (37)
	Agriculture+Business	7 (23)	12 (40)	3 (10)	7 (24)
	Agriculture+Fishing	5 (17)	1(3)	9 (30)	5 (16)
	Agriculture+Boating	2 (7)	1 (3)	2 (7)	2 (6)
	Agriculture+Service	1 (3)	2 (7)	2 (7)	2 (6)
	Others	3 (10)	4 (13)	3 (10)	3 (11)

Note: Figures in the parentheses indicate percentages of total respondents

Family size: The composition of family members in the study areas are shown in Table 2. The average numbers of persons comprising the family size of respondents were 7 in both Sunamgonj and Netrokona district and 8 in Kishoregonj whereas the national average was 4.9 people per household (BBS, 2007). Its may be due to combined family in nature. Among the family members of the household, 37% were belonged to adult male, 31% adult female and 32% children of the family in all areas.

Table 2: Information regarding family size (No.farm) of the study areas

Categories	Sunamgonj	Netrokona	Kishoregonj	All areas
Adult male	3 (43)	2 (29)	3 (38)	3 (37)
Adult female	2 (29)	2 (28)	3 (37)	2 (31)
Children	2 (28)	3 (43)	2 (25)	2 (32)
Total	7 (100)	7 (100)	8 (100)	7 (100)

Figure in the parentheses indicates percentage of total family members

Land holdings: In all areas of three haor districts 88% farmers possessed own cultivated land and 95% farmers had their homestead area whereas 78% of sample farmers grow crops in their own land only in Rabi season due to water lodging from June to November. Nine percent farmers of the study areas remain their land fallow after harvesting Aman. The farmer of haor area also practiced in ranted in or out, mortgaged in or out tradition in a little scale (Table 3).

Table 3. Land ownership pattern in three selected haor districts (Figures in ha)

Land ownership pattern	Sunamgonj	Netrokona	Kishoregonj	All areas
Own cultivated	27 (90)	28 (93)	24 (80)	26 (88)
Ranted in	10 (33)	6 (20)	9 (30)	8 (28)
Ranted out	3 (10)	3 (10)	2 (7)	3 (9)
Mortgaged in	2 (7)	3 (10)	4 (13)	3 (10)
Mortgaged out	-	-	2 (7)	1 (2)
Homestead	30 (100)	29 (97)	26 (87)	28 (95)
Garden	23 (77)	23 (77)	24 (80)	23 (78)
Fallow	5 (17)	3 (10)	-	3 (9)

Figure in the parentheses indicate percentage of total

About 30% of the sample farmers having land holding raged from 0.41-0.60 ha. Similar result was also found in the case of all areas. Only 8% sample farmers in all areas owned more than 0.80 ha of land whereas 18% had ess than 0.20 ha of land (Table 4).

Table 4. Distribution of sample farmers according to farm size

Farm size (hectare)	Sunamgonj	Netrokona	Kishoregonj	All areas
<0.20	5 (17)	6 (20)	5 (17)	5 (18)
0.21-0.40	2 (7)	4 (13)	7 (23)	4 (14)
0.41-0.60	10 (33)	8 (27)	9 (30)	9 (30)
0.61-0.80	10 (33)	9 (30)	8 (27)	9 (30)
>0.80	3 (10)	3 (10)	1 (3)	2 (8)

Figure in the parentheses indicate percentage of total respondents

Involvement in social organization: in all areas about 70% of all areas of the haor farmers left behind the social organizations. The rest 30% were engaged in different social activities through various social organizations. Table 5 reveals that only 3% farmers were associated with BRDB and most of them (37%) were associated with different NGOs such as BRAC, ASA, Proshika etc.

Table 5. Involvement of sample farmers in different social organizations

Organization	Sunamgonj	Netrokona	Kishoregonj	All areas
BRDB	2 (7)	1 (3)	1 (5)	1 (3)
NGO	13 (43)	10 (33)	17 (57)	13 (43)
Others	5 (17)	15 (50)	3 (14)	8 (27)
No involvement	10 (33)	4 (14)	9 (30)	8 (27)

Figures in the parentheses indicate percentage of the total respondents

Source of fund: The sample farmers of haor areas opined that received loan from different sources such as bank, NGOs, money lenders and relatives. Seventeen percent of the farmers were found to be capable to cultivate crops with their own fund, whereas 37% had to depend on different NGOs for fund to grow crops followed by money lenders (33%). It was also found that the farmers of Sunamgonj district had some opportunity to get money from their relatives. The

reason of receiving monetary help from relatives is that one or two member of the most families are working in abroad.

Table 6. Sources of fund for the sample farmers in the study areas

Source	Sunamgonj	Netrokona	Kishoregonj	All areas
Own	5 (17)	7 (23)	4 (13)	5 (17)
Bank	1(3)	5 (17)	1 (3)	3 (10)
NGO	9 (30)	8 (27)	17(57)	11 (37)
Money lender	13 (43)	10 (33)	8 (27)	10 (33)
Relatives	2 (7)	-	-	1 (3)

Figures in the parentheses indicate percentage of the total respondents

Cropping Patterns in the Study Areas:

The cropping patterns practiced by the sample farmers in different basin haor areas are presented in Table 7. Boro rice based cropping pattern is predominant in the haor areas under Sunamgonj, Netrokona and Kishorgonj district. About 80% of respondent farmers practiced Boro rice-Fallow-Fallow cropping pattern. But comparatively higher land (local name is kanda) of those areas used to cultivate various field crops likes maize, wheat, groundnut, sweet potato and cucumber. Without rice based cropping pattern there are some field crop based cropping pattern was found. In Sunamgonj district 9% of the respondent follow Cucumber/Sweet potato/ Wheat - Fallow-Fallow pattern followed by Winter vegetables –Fallow – Fallow (7%). Maize is a new crop in the haor areas under Netrokona district. Maize cultivation is keep growing popular year by year. As a result, 8% of the respondents are following maize based cropping pattern (Maize – Fallow - Fallow). Same parcentage also fallow groundnut/ Sweet potato – Fallow – Fallow pattern. On the other hand, ground nut and sweet potato is till now a popular crop in haor areas under Kishorgonj district. Though, land under those crops is getting replaced by irrigated boro rice cultivation, 22% of the respondent farmers follow groundnut / Sweet potato - Fallow-Fallow pattern yet. Beside these, some other cropping patterns practiced in three districts which are not under basin haor areas are Fallow- B. Aman – Fallow (Sunamgonj), Boro- Fallow- T. Aman (Netrokona) and Boro-Jute-T. Aman (Kishoregonj).

Table 7. Major Cropping patterns practiced in different haor areas

District	Pattern-1	Pattern-2	Pattern-3
Sunamgonj	Boro-Fallow-Fallow (82)	Cucumber / Sweet potato / Wheat - Fallow- Fallow (9)	Winter vegetables – Fallow - Fallow (7)
Netrokona	Boro-Fallow-Fallow (84)	Maize-Fallow-Fallow (8)	Ground nut / Sweet potato / Fallow- Fallow (8)
Kishoregonj	Boro-Fallow-Fallow (78)	Ground nut / Sweet potato / Fallow- Fallow (22)	-

Figure in the parentheses indicate percentage of total respondent following the pattern
Vegetables-Tomato, Cabbage, Cauliflower, Chili, carrot etc.

Distribution of land

There are seven districts namely Sunamgonj. Kishoregonj, Netrokona, Sylet, Hobigonj, Moulvi Bazar and B.Baria where there are as many as 423 haors. The highest numbers of haors (133) fall in Sunamganj district followed by Kishoregonj (122). According to the number of haor, Netrokona occupying the third position (80). The total cultivated land in those three districts is 0.58 million hectares of which 73% area is covered by the haors (Table 8). In Kishoregonj, Sunamgonj and Netrokona districts 80, 78, and 61% of the haor areas are under crop cultivation, respectively.

Table 8. Distribution of cultivated land under three haor districts of Bangladesh, 2008

Districts	No of haor**	Total cultivated land (million ha)	Land area under haor (million ha)	Cultivated land under haor	
				million ha	% of haor areas
Sunamgonj	133	0.20	0.18	0.14	78
Kishoregonj	122	0.17	0.15	0.12	80
Netrokona	80	0.21	0.14	0.14	61
Total	335	0.58	0.47	0.40	73

The Jugantar, 18 April 2008 (Huda, 2004)

Cropping intensity

Among all the haor districts, the proportion of single cropped area is the highest (44%) in Sunamgonj and due to that the cropping intensity in that district stands at the lowest (143%) (Table 9). On the contrary, the proportion of triple cropped area is the highest (with lowest single cropped area) in Kishoreganj that led to have highest cropping intensity (215%), which is higher than the national average cropping intensity of 178% (Das, 2004). The cropping intensity in the haor area could be increased if attempts taken in improving the cropping practices for the single and double cropped areas.

Table 9. Land use pattern and cropping intensity in the haor districts

District	Total cropped area (000 ha)	% of cropped area under			Cropping intensity (%)
		Single cropping	Double cropping	Triple cropping	
Sunamgonj	397	44	23	3	143
Netrokona	424	15	29	8	186
Kishoregonj	232	14	25	12	215

DAE, 2008-2009

Crop management

Major crops in the study areas were identified as Boro rice. Hybrid rice belonging to different names such as Heri, ACI-1, Sonar Bangla, Sokti, Sompod etc from different companies is going to be popular (43%) followed by BR-29 and BR- 28 (57%). BR-28 is mostly cultivated rice in char areas. Production technology of different rice in three haor district is more or less same. But they apply more fertilizer in hybrid rice field than MV rice and follow line sowing with one seedling per hill. Most of the farmers ploughed and ladder their land 2 times (65% and 88% respectively). Sixty percent farmers transplanted boro rice in January followed by February (35%), whereas only 5% farmer transplant in December due to remaining water in low land. During monitoring period to the farmers' field, it was observed that the farmers, who transplanted hybrid rice, perform in line sowing. Out of them (55%) were interested in traditional transplanting system due to shortage of both labor and time. Among the respondents only 40% applied urea, TSP and MOP fertilizer as basal. Majority of the farmers top dressed urea two times whereas 77% of respondent farmers weeded two times. Sixty seven percent of the sample farmers irrigated their rice field for 5 times. Among the respondents 72% did not apply any pesticide for crop cultivation. The duration of harvesting time was from May to June whereas maximum number of farmers (88%) harvested their crops in May.

Table 10. Agronomic profiles of Boro rice in haor areas

Agronomic profiles		Boro rice	
		No.	%
Variety	MV	34	57
	Hybrid	26	43
No. of ploughing	1	12	20
	2	39	65
	3	9	15
No of laddering	2	53	88
	3	7	12
Time of transplanting	December	3	5
	January	36	60
	February	21	35
Method of trans planting	Line	27	45
	Traditional	33	55
Basal fertilizer application	Urea, TSP, MOP	24	40
	Urea,TSP	18	30
	No	18	30
No. of top dress	3 times	3	5
	2 times	50	83
	1 times	7	12
No. of weeding	3 times	6	10
	2 times	46	77
	1 times	5	8
	No	3	5
No. of irrigation	6 time	12	20
	5 time	40	67
	4 times	7	12
	3 times	1	1
No. of pesticides spray	2 times	17	28
	No	43	72
Month of harvest	May	53	88
	Jun	6	10
	July	1	2

*no of respondents was 60

Input use scenario in rice field

Farmers in the deep haor area grew rice varieties in the Boro season and applied fewer amounts of inputs. It might be due to lack of getting information about production technologies. There was a substantial difference in labour use between MV and Hybrid boro production. The use of human labor for Hybrid rice production was higher than that of MV Boro (Table 11). It might be the cause of farmer's interest in line transplanting method. It is noted that, the sample farmers having small farm size was interested to grow Hybrid rice. The amount of seed used for MV was more than double compared to Hybrid.

In the case of fertilizer application, farmers used more amount of urea for Hybrid rice. Any other input used for rice cultivation was more or less same between MV and Hybrid. It was noted that information regarding to pesticide was not available or reliable.

Table 11. Comparative input use scenario for MV and Hybrid Boro rice cultivation in haor areas.

Input used	MV	Hybrid	Rate
Pre-harvest labor (MDs/ha)	43	50	250 Tk/day at pre harvest

Input used	MV	Hybrid	Rate
Harvest &Post-harvest labor (MDs/ha)	45	45	400 Tk/day at post harvest
Power tiller (hr/ha)	12	14	250 Tk/hr
Seeds (kg/ha)	30	13	35 Tk./kg (MV), 250 Tk./kg (Hybrid)
Irrigation (hr/ha)	32	37	80 Tk/hr
Fertilizer			
Urea	250	355	14 Tk./kg
TSP	115	150	28 Tk./kg
MoP	88	88	24 Tk./kg

Cost and return from rice crop cultivation

The cost of seed for Hybrid Boro rice production was Tk 3267/ha which was almost three times higher than that of MV Boro production (1058/ha). Cost of all items for Hybrid rice cultivation was also higher than MV of rice production except interest on operation cost and land rent (Table 12). It was found that maximum percentage of total cost was used for harvest and post harvest labor cost followed by land rent cost and pre harvest labor cost in both cases. On an average, the gross return of Hybrid Boro rice was Tk. 183238/ha which was almost two times higher than that of MV Boro rice (Table 13). Benefit cost ratio of Hybrid rice (2.75) was also almost double than MV rice (1.62).

Table 12. Cost of Boro rice cultivation in the haor areas

Cost items	MV of rice		Hybrid rice	
	Cost (Tk./ha)	% of total cost	cost (Tk./ha)	% of total cost
Land preparation	3000	5	3500	5
Seeds/seedlings	1050	2	3250	5
pre-harvest labor	10,750	18	12,500	19
Harvest and post harvest labor	18,000	30	18,000	27
Fertilizer	8832	15	11282	17
Irrigation	2560	4	2960	4
Interest on operation capital (@12%)	875	1	1044	2
Land rent	14000	24	14000	21
Total	59067	100	66536	100

Table 13. Profitability (Tk./ha) of Boro rice cultivation in the haor areas

Cost and returns items	MV of rice	Hybrid rice
Yield (kg/ha)	5167	9904
Gross returns (Tk/ha)	95597	183238
Production cost (Tk/ha)	59067	66536
Net returns (Tk/ha)	36530	116702
BCR	1.62	2.75

Constraints to crop production

The farm level constraints as observed and opined by the sample respondents are presented in Table 14. The most vital constraints in the haor areas was natural hazard like flash flood and hill storm and this was opined by 92% of the sample farmers. Other major problems to grow crops in the haor areas were high price of inputs except fertilizer such as labor, seed, credit and machinery which were reported by 47%, 87%, 70% and 57% of the farmers respectively. The shortage of hired labor at plantation period was predominant obstacle to grow hybrid rice in line transplanting method. Transportation of the output after harvesting also appeared to be a problem since in most areas the roads are non metal “katcha” roads and 82% farmers reported about this constraints (Table 14). Lack of short duration modern varieties as a constraint was mention by most of the sample farmers. In case of credit 70% of the sample farmer reported as a problem for higher interest rate.

Table 14. Constraints to crop cultivation in the haor areas

Particulars	Type of Constraints	% farmer opined
Water supply	Not available timely	30
	Higher water charge	60
	Irrigation facility not available	10
Credit	Cumbersome procedure	30
	High interest rate	70
Land	Shortage of suitable land	47
	Higher rate	53
Labor	Shortage of hired labor	53
	High wage rate	47
Fertilizers	Not available timely	60
	High price	40
Seed	Quality seeds not available	23
	High price	87
Field machinery	Not available	43
	High price	57
Marketing	Transportation problem	66
	Low price	44
Natural hazard	Flash flood, hill storm	92

Conclusions and Recommendation

The haor areas under three selected districts of Bangladesh covered almost 0.47 million hectares of land of which 73% area is devoted to crop cultivation. In these three districts about 80% of the total cropped areas are covered by Boro-Fallow-Fallow cropping pattern. Farmers in the haor areas apply lower amounts of fertilizers than the recommended rate, possibly because of better soil fertility. In the farmer's field the cost of production for MV and Hybrid rice is 59,067/- and 66,536/- per hectare, respectively. The return from Hybrid boro is about 20% higher than that of MV boro. Short durational Rabi crops (mustard) – Boro rice- Fallow- Fallow and intercropping with maize-Fallow-Fallow may become potential pattern beside Boro rice- Fallow - Fallow-pattern. Natural hazard, higher price of inputs, and transportation problem were the major constraints to crop production in the haor areas.

Development of physical infrastructure, cropping pattern, short duration crop varieties as well as adaptation trial of new technologies could be immensely useful for horizontal expansion of cropped area in the haor areas of Bangladesh which would eventually increase the level of food productivity in the country.

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SCREENING OF MUNGBEAN VARIETIES FOR FALLOW LAND OF SYLHET

M.A. Aziz, M I Nazrul, M R Shaheb and M A Hossain

Abstract

A screening program was conducted at the farmer's field at MLT site; Zakigonj during rabi season of 2010-2011 to popularize and disseminate BARI developed Mungbean varieties. Five varieties of Mungbean viz. BARI Mung-2, BARI Mung -3, BARI Mung -4, BARI Mung -5, and BARI Mung-6 were used in this screening trail. In terms of yield, BARI Mung-6 (942kg ha^{-1}) performed better than other varieties at farmer's field at Zakigonj.

Introduction

Mungbean (V*igna radiata L.*) is one of the most important pulse crops in Bangladesh. It is a rich source of protein and several essential micronutrients. It contains 24% protein and 59% carbohydrate. lt also contains 75 mg calcium, 8.5 mg iron and 49 mg B-carotene per 100g of split dual (Bakar *et al*., 2004). Legumes in rotation with crops also increase organic matter content of soil. In Bangladesh, Mungbean is cultivated in 22,400 ha land and produces 16,900 metric ton with an average yield of 750 kg ha^{-1} (BBS 2006). The yield is quite low in the world context. The farmers usually grow local variety of Mungbean which is low yielder. Recently, Pulses Research Centre, BARI has developed high yielding Mungbean varieties, especially BARI Mung-6 that has significant yield advantage over local. Considering the above facts the program was undertaken to popularize BARI Mungbean varieties among the farmers as well as ensure higher yield of Mungbean with higher economic return to the farmers.

Materials and Methods

This screening program was conducted in the farmer's field at Zakigonj during Kharif season of 2010-11. A whole day visit was done for convincing cooperator farmers to cultivate high yielding Mungbean varieties. Five cooperator farmers were selected for the study. The unit plot size was 5m x 6m. The study was set up in a randomized block design with 3 replicatons (dispersed) All the fertilizers (FRG/2005) were applied during the final land preparation. The seeds were sown on 25 March 2011 with a spacing of 30 cm between lines. Plant protection measures were taken as required. Other intercultural operations were done as and when required. The mungbean was harvested on 22-26 May 2011 by three picking of pods. At maturity, different data were collected and analyzed statistically.

Results and Discussion

Results pertaining to the yield and yield contributing characters were presented in Table 1. Tallest plant was recorded with BARI Mung-4 (65.20cm) followed by BARI Mung-3 (60.22cm) and BARI Mung-6 (59.33cm) and shortest plant in BARI Mung-5. Pod $plant^{-1}$ was higher (15.75) in BARI Mung-6 and lower (12.75) in BARI Mung-2. Seed pod^{-1} and 1000 seed weight (g) were higher in BARI Mung-6 than others. BARI Mung-6 gave the higher seed yield (942kgha^{-1}) that was statistically similar to that of BARI Mung-4 and BARI Mung-5. Comperatively lower seed yield was produced by the varieties BARI Mung-2 and BARI Mung-3, which were 735 kg/ha and 785 kg/ha, respectively.

Table-1. Yield and yield contributing characters of screened Mung bean varieties in fallow land at MLT site, Zakigonj, 2011

Varieties	Plant height (cm)	Population /m^2 (no.)	Pod length (cm)	Pods/ plant (no.)	Seeds/ pod (no.)	1000 seed weight (gm)	Yield (t/ha)
BARI Mung- 2	57.70b	30.25	7.70b	12.75	11.00b	32.75c	735b
BARI Mung -3	60.22b	28.00	8.00b	13.50	12.75a	36.50b	785 b
BARI Mung -4	65.20a	27.00	8.47b	13.75	12.25ab	32.50c	855ab
BARI Mung- 5	57.20b	29.75	9.85a	15.50	12.25ab	40.25a	940a
BARI Mung- 6	59.33b	28.75	10.38a	15.75	12.25ab	40.75a	942a
$LsD_{(0.05)}$	2.846	3.33	1.32	3.083	1.488	3.436	123.3
CV (%)	3.08	7.52	9.67	14.05	7.98	6.10	9.40

Means having same or without letter do not differ significantly at 5% level of probability

Conclusion

Among the five mungbean varieties, BARI Mung-6 performed well in comparison to others. It may be introduced in the cropping pattern and increase the growing area under mungbean by cultivation of BARI mung-6.

Farmers Reaction

Farmers showed their interest to cultivate the Mungbean for utilization of fallow land in Sylhet areas.

SCREENING OF PULSE AND OILSEED VARIETIES IN THE HAOR AREAS OF SYLHET

K. Roy, M I Nazrul, M R Shaheb and M. A. Hossain

Abstract

Observation trials were carried out at MLT site, Sunamgonj during rabi season of 2010-2011 to select suitable variety of pulse and oilseed crops for haor area of Bangladesh and to increase pulse and oil seed production as well as income of farmers. BARI Sharisha 13, 14, 15, SAU Sharisha3 and local one (Lengra) were used for screening of suitable mustard crops. BARI Mosur 3, 4, 5 and 6 were also used for screening of suitable lentil crop for haor areas in this observational trial. The results revealed that BARI Sharisha 16 (1.50t/ha) performed better than that of the others, followed by SAU Sharisha-3(1.33t/ha) and BARI Sharisha 14(1.00 t/ha) while among the four lentil varieties tested in the Sunamgonj haor area BARI Mosur-6 showed higher yield (1.0 t/ha) followed by BARI Mosur- 4 (0.83tha^{-1}) and BARI Mosur-5 (0.80tha^{-1}).

Introduction

Haor is a wetland ecosystem in the north eastern part of Bangladesh. The haor basin is an internationally important wetland ecosystem, which is situated in Sunamganj, Habiganj, Moulvibazar, Sylhet Sadar Upazila, as well as Kishorganj and Netrokona districts. It constitutes around 17% of the country's land area. The total number of haor is about 414. This is a naturally depressed area covering 24265 sq km (Alam *et al.,* 2010). During July to November due to overflow of rivers and heavy rainfall the areas go under 4 to 5 m depth of water and look like as a sea. During dry season (December to April) the water is completely drained out from the area by gravity and turns to very fertile land for crop production. Though this is mainly rice based cropping area, but farmers can also adopted to grow some vegetables, pulse and oilseed crops in comparatively high land areas. As a depressed as well as remote area, farmers are deprived of getting new technology for crop cultivation. Most of the cases they use some local variety of pulse and oilseed crop. Therefore, the present study was undertaken to select suitable variety of pulse and oilseed crops for haor areas, specifically in Sylhet region of Bangladesh and to increase crop production as well as income of farmers.

Materials and Methods

Observation trials were carried out at MLT site, Sunamgonj during rabi season of 2010-11. BARI released Mustard varieties viz. BARI Sarisha 14, BARI Sarisha 15, BARI Sarisha 16, SAU Sarisha 3 and 1 (One) Local variety named Lengra and Lentil varieties viz. BARI Mosur 3, BARI Mosur 4, BARI Mosur 5 and BARI Mosur 6 were used in these observational trial. It was non replicated trials so the seeds of those selected crops distributed to the farmers to cultivate as per plot size 6m x 5m in line sowing system. Both the mustard and lentil were sown on 27 November, 2010. The yield and yield contributing characters were recorded and averages of those were presented in tabular form (Table-1).

Results and Discussion

Mustard

Among the mustard varieties tested in the haor areas (Sunamgonj), BARI Sharisha16 (1.50t/ha) performed better than that of the others, followed by SAU Sharisha-3 and BARI Sharisha14. The

local variety produced lowest grain yield (0.75 t/ha). Before harvesting it rained heavily causing partially damaged by shattering loss of mustard.

Table-1. Comparative yield and yield contributing characters of screened mustard varieties at Sunamganj haor area, 2010-2011

Varieties	Plant height (cm)	Pods/plant (no.)	Yield/plot (kg)	Yield (t/ha)
BARI Sharisha-14	72.00	57.00	3.00	1.00
BARI Sharisha- 15	67.00	55.00	2.50	0.83
BARI Sharisha -16	65.00	76.00	4.50	1.50
SAU Sharisha -3	97.00	80.00	3.99	1.33
Lengra (Local variety)	52.00	92.00	2.25	0.75

Lentil

Among the four lentil varieties tested in the Sunamgonj haor area, BARI Mosur-6 showed higher yield (1.0 t/ha) followed by BARI Mosur-4 and BARI Mosur-5. BARI mosur- 3 gave lower (0.67 t/ha) yield (Table-2). As this was new crop for that area farmer can't provide the local Mosur to use as control.

Table-2. Comparative yield and yield contributing characters of screened lentil varieties at Sunamganj haor area, 2010-2011

Varieties	Pods/plant (no.)	Yield/plot (kg)	Yield (t/ha)
BARI Mosur-3	24.00	2.00	0.67
BARI Mosur-4	29.00	2.50	0.83
BARI Mosur-5	26.00	2.40	0.80
BARI Mosur-6	35.00	3.00	1.00

Conclusion

From the findings of the study, it might be concluded that BARI Sharisha 16 performed better than that of the others, followed by SAU Sharisha 3 and BARI Sharisha 14. BARI Mosur 6 could be the best for that area in respect of yield.

Farmers reaction

i) Farmers are highly pleased to see the yield of pulse and oil seeds crops

ii) They stored seeds of those as to use for the next year cultivation.

SCREENING OF MUSTARD, LENTIL AND CHICKPEA VARIETIES IN THE HAOR AREAS AT SYLHET REGION

R. Roy, M. I. Nazrul, M.R. Shahab and M. A. Hossain

Abstract

Three separate observation trials were carried out at MLT site, Sunamgonj during rabi season of 2011-2012 to select suitable variety of mustard, lentil and chickpea for haor area of Sylhet region. In first trial BARI Sarisha-11, BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-16 and Lengra (local) of mustard; in 2nd trail BARI Mosur-3, BARI Mosur-4, BARI Mosur-5 and BARI Mosur-6 of lentil and in 3rd trial BARI Chhola-3, BARI Chhola-4, BARI Chhola-5, BARI Chhola-6, BARI Chhola-7, and BARI Chhola-8 of Chickpea were used as treatment variables. BARI Sarisha-16 (0.90 t/ha) performed better followed by BARI Sarisha-11 (0.85 t/ha) and BARI Sarisha-15 (0.84 t/ha). Among lentil varieties BARI Mosur-6 showed higher yield (0.83 t/ha) followed by BARI Mosur-5 (0.78t/ha). Among chickpea varieties, BARI Chhola-5 produced maximum yield (1.11 t/ha) followed by BARI Chhola 8 (1.08 t/ha). The results revealed that BARI Sarisha-16 and BARI Sarisha-15 from mustard, BARI Mosur-6 and BARI Mosur-5 from lentil and BARI Chhola-5 and BARI Chhola-8 from chickpea may be selected for future study.

Introduction

Haor is a wetland ecosystem in the north eastern part of Bangladesh. The haor basin is an internationally important wetland ecosystem, which is situated in Sunamganj, Habiganj, Moulvibazar, Sylhet Sadar Upazila, as well as Kishorganj and Netrokona districts (The Daily Jugantar, 18 April 2008). It constitutes around 17% of the country's land area (Alam *et al*. 2010). The total number of haor is about 414. This is a naturally depressed area covering 24265 sq km (Alam *et al*. 2010). During July to November due to overflow of rivers and heavy rainfall the areas go under 4 to 5 m depth of water and look like as a sea. During dry season (December to April) the water is completely drained out from the area by gravity and turns to very fertile land for crop production. Ecosystem, crop production practices, economic capability and the overall livelihoods of the farmers of haor areas are quite different from those of the other parts of the country. (Kazal *et al*. 2010). Rice is the main crop in haor area, but farmers are interested to grow some vegetables, pulse and oilseed crops in comparatively high land areas. As a depressed as well as remote area, farmers are deprived of getting new technology for crop cultivation. Most of the cases they use some local variety of pulse and oilseed crop. Therefore, the present study was undertaken to select suitable variety of mustard, lentil and chickpea for haor areas, specifically in Sylhet region.

Materials and Methods

Three separate observation trial were carried out at MLT site, Sunamgonj during rabi season of 2011-2012. The treatment variables for the first trial was BARI Sarisha-11, BARI Sarisha-14, BARI Sarisha-15, BARI Sarisha-16 and Lengra (local); for 2nd trial BARI Mosur-3, BARI Mosur-4, BARI Mosur-5, BARI Mosur-6 and for 3rd trial BARI Chhola-3, BARI Chhola-4, BARI Chhola-5, BARI Chhola-6, BARI Chhola-7, and BARI Chhola-8. The unit plot size was 6m x 5m. It was a non replicated trials and crops were sown in line as per recommended spacing. The mustard and lentil was sown on 28 November, 2011 and harvested on 23-28 February 2012. Chickpea was sown on 30 November 2011 and Harvested on 28 March 2012. Data on yield and yield contributing characters were recorded.

Results and Discussion

Mustard

Among the mustard varieties tested BARI Sarisha-16 (0.90 t/ha) performed better followed by BARI Sarisha-11 (0.85 t/ha) and BARI Sarisha-15 (0.84 t/ha). The local variety produced the lowest seed yield (0.74 t/ha). Before harvesting, shattering loss was occurred due to heavy rain causing partial damage of the trial.

Table 1. Yield and yield contributing characters mustard varieties at Sunamganj, 2011-2012

Varieties	Plant height (cm)	Plant popul./m^2 (no.)	Days to maturity	1000 grain wt. (g)	Yield (t/ha)	Straw yield (t/ha)
BARI Sarisha- 11	95	58	92	2.50	0.85	1.60
BARI Sarisha -14	48	54	79	2.50	0.76	1.45
BARI Sarisha -15	61	54	79	2.50	0.84	1.55
BARI Sarisha -16	102	57	92	3.00	0.90	1.68
Lengra (Local)	84	50	79	2.50	0.74	1.35

Lentil

Among lentil varieties BARI Mosur-6 showed higher yield (0.83 t/ha) followed by BARI Mosur-5 (0.78 t/ha). BARI Mosur-4 gave lower (0.65 t/ha) yield (Table-2). Lentil is a new crop in haor area, so no local variety is available there.

Table 2: Yield and yield contributing characters of lentil varieties at Sunamganj, 2011-2012

Varieties	Days to maturity	Plant population/ m^2 (no.)	Pod/ plant (no.)	1000 grain weight (g)	Yield (t/ha)
BARI Mosur- 3	91.5	56.5	36.0	20	0.68
BARI Mosur- 4	91.5	59.0	33.5	20	0.65
BARI Mosur -5	91.5	62.5	33.5	22	0.78
BARI Mosur- 6	91.5	66.5	33.5	25	0.83

Chickpea

BARI Chickpea-5 produced maximum yield (1.11 t/ha) followed by BARI Chickpea-8 (1.08 t/ha). BARI Chickpea-6 produced the lowest yield (0.75 t/ha) (Table 3).

Table-3: Yield and yield contributing characters of Chickpea varieties at Sunamganj, 2011-2012

Varieties	Plant Population/m^2 (no.)	Days to maturity	1000 grain weight (g)	Yield (t/ha)
BARI Chola- 3	27	111	125	0.87
BARI Chola -4	29	110	120	1.00
BARI Chola -5	29	110	125	1.11
BARI Chola -6	27	112	100	0.75
BARI Chola -7	29	109	125	1.02
BARI Chola -8	27	113	250	1.08

Farmer's opinion

i) Farmers are highly pleased to see the yield of pulse and oil seeds crops
ii) They are interested to store seeds of those crops for the next year cultivation.

Conclusion

The results revealed that BARI Sarisha-16 and BARI Sarisha-15 from mustard, BARI Mosur-6 and BARI Mosur-5 from lentil and BARI Chhola-5 and BARI Chhola-8 from chickpea may be selected for future study.

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PERFORMANCE OF MUNGBEAN VARIETIES IN SYLHET REGION

K.Roy, M. I. Nazrul, M. R. Shaheb and M. A. Hossain

Abstract

A screening program was conducted at the farmer's field at FSRD site, Jalalpur, Sylhet during rabi season of 2011-12 to select suitable varieties and to popularize and disseminate BARI developed Mungbean varieties. Five varieties of Mungbean viz. BARI Mung-2, BARI Mung-3, BARI Mung-4, BARI Mung-5 and BARI Mung-6 were used in this screening trail. Results showed the tallest plant (42.67cm) was obtained from BARI Mung-5 and the lowest (33.33 cm) from BARI Mung-5. Pod plant^{-1} was higher (17.67) in BARI Mung-3 and the lowest (13.50) in BARI Mung-4. Seed pod^{-1} was higher in BARI Mung-6 than the others. BARI Mung-6 produced the highest yield (0.87tha^{-1}) and it was statistically identical with BARI Mung-5 and BARI Mung-2. The lowest seed yield (0.59tha^{-1}) was recorded from BARI Mung-4 and BARI Mung-3.

Introduction

Mungbean (V*igna radiate L.*) is one of the most important pulse crops in Bangladesh. It is a rich source of protein and several essential micronutrients. It contains 24% protein and 59% carbohydrate. lt also contains 75 mg calcium, 8.5 mg iron and 49 mg B-carotene per 100g of split dual (Bakar *et al*., 2004). Legumes in rotation with crops also increase organic matter content of soil. In Bangladesh, Mungbean is cultivated in 22,400 ha land and produces 16,900 metric ton with an average yield of 750 kg ha^{-1} (BBS 2006). The yield is quite low in the world context. The farmers usually grow local variety of Mungbean which is low yielder. Recently, Pulses Research Centre, BARI has developed high yielding Mungbean varieties, especially BARI Mung-6 that has significant yield advantage over local. Considering the above facts the program was undertaken to select suitable variety and to popularize BARI Mungbean varieties among the farmers as well as ensure higher yield of Mungbean with higher economic return to the farmers.

Materials and Methods

This screening program was conducted in the farmer's field at FSRD site, Jalalpur, Sylhet during Kharif season of 2012. A whole day visit was done for convincing cooperator farmers to cultivate high yielding Mungbean varieties. Five varieties of Mungbean viz. BARI Mung-2, BARI Mung-3, BARI Mung-4, BARI Mung-5 and BARI Mung-6 were used in this screening trail. Four cooperator farmers were selected for the study. The trial was set up in randomized complete block design with four disperse replications. The unit plot size was 20 m^2 with plant spacing of 30 cm x 10 cm. Fertilizers @ N_{20} P_{26} K_{17} S_{10} kg/ha were applied during final and preparation. All the fertilizers were applied as basal. The seeds were sown on 15-18 March 2011. Plant protection measures were taken as required. Other intercultural operations were done as and when required. The Mung bean was harvested on 22-26 May 2011 by three picking of pods. Data on yield and yield contributing characters of crops were recorded and analyzed following MSTAT C software and means were adjudged by LSD test (Gomez and Gomez, 1984).

Results and Discussion

Results of yield and yield components of Mungbean are presented in Table 1. The tallest plant (42.67cm) was obtained from BARI Mung-5 and the lowest (33.33 cm) in BARI Mung-5. Pod plant^{-1} was higher (17.67) in BARI Mung-3 and the lowest (13.50) was obtained in BARI Mung-

4. Seed pod^{-1} was higher in BARI Mung-6 than others. Result indicated that BARI Mung-6 produced the highest yield (0.87tha^{-1}) and it was statistically identical with BARI Mung-5 (0.74 t/ha) and BARI Mung-2 (0.69 t/ha). The lowest seed yield (0.59tha^{-1}) was recorded in BARI Mung-3 followed by BARI Mung-4 (0.59 t/ah).

Table 1. Yield and yield components of Mungbean varieties in Sylhet during kharif season

Variety	Plant height (cm)	Pod plant^{-1} (no.)	Pod length (cm)	Seed Pod^{-1} (no.)	Plant population m^{-2} (no.)	Yield (tha^{-1})
BARI Mung-2	42.333	15.33	6.500	9.50	58.67	0.69
BARI Mung-3	42.333	17.67	6.500	8.00	55.67	0.65
BARI Mung-4	34.333	13.50	6.533	9.23	47.67	0.59
BARI Mung-5	42.667	14.33	7.900	8.47	44.67	0.74
BARI Mung-6	33.333	14.00	7.633	8.67	57.33	0.87
CV(%)	15.80	27.76	10.99	8.28	19.54	11.82
LSD $_{(0.05)}$	13.97	3.16	1.75	1.65	23.39	0.19

Farmers Reaction

Farmers showed their interest to cultivate the Mungbean for utilization of fallow land in Sylhet areas.

Conclusion

Among the five screened Mung bean varieties, BARI Mung-6 performed well in comparison to yield. It may be introduced in the cropping pattern and increase the growing area under Mungbean by cultivation of BARI Mung-6.

PERFORMANCE OF HYBRID MAIZE VARIETIES IN THE HAOR AREAS OF BANGLADESH

K. Roy, Bulbul Ahmed and M.S. Islam

Abstract

A field study was conducted at Shingpur haor, Nikli upazilla under MLT site, Kishoreganj during rabi season of 2011-2012 to find out the suitable variety and to popularize the BARI Hybrid maize varieties among the farmers of haor areas of Bangladesh. Seven varieties i.e., NK-40 (Check), Laltir (555), C-6485, Pacific-11, C-1921 BARI Hybrid maize-9 and BARI Hybrid maize-7 were used in this study. Among the varieties, BARI Hybrid maize- 9 gave higher yield (12.13 t/ha) and the lowest (7.80 t/ha) yield was found from Pacific-11. The highest gross return (Tk.218340/ha) and BCR (4.25) were found from BARI Hybrid maize 9. The lowest BCR, 2.47 found in Pacific-11.

Introduction

Haor is a wetland ecosystem covering 17% of the country's land area (Alam *et a*l. 2010). About 800 acres of land occupying by maize cultivation in Nikli upazilla, Kishoreganj. Boro -Fallow-Fallow is the main cropping pattern in those areas (K. Roy *et al*, 2011) but the farmers of the concern area also follow Maize-fallow-fallow cropping patern. Himalyan flash flood is the main obstacle to grow rabi crops in haor areas. Most of the years it comes at panicle initiation or maturity stage of rice (April) and remain stagnant up to the month of November and causing total yield loss. To reduce total yield loss, farmers are showing interest in maize cultivation. Because of taller plant height, maize can remain standing over flash water at ripening stage. So, farmers can harvest maize cob easily. In this way, they can minimize the risk of total yield loss. But farmers of haor areas are not aware of suitable hybrid maize variety and they have to buy maize seeds by at least Tk. 200 per kg from the private sectors. On the other hand, BARI developed seed is very cheap (Tk.85/kg) than others. Therefore, the present study was undertaken to select suitable hybrid maize variety and to popularize BARI released hybrid maize varieties for haor area of Bangladesh.

Materials and Methods

A field study was conducted at Shingpur haor, Nikli upazilla under MLT site Kishoreganj during rabi season of 2011-2012. The experiment was laid out in a randomized complete block design with six dispersed replications. Seven varieties i.e., NK-40 (Check), Laltir (555), C-6485, Pacific-11, C-1921, BARI Hybrid maize -9 and BARI Hybrid maize -7 were used in this study. The unit plot size was 6 m x 5 m. The seeds were sown with 75 cm X 25 cm spacing on 10 December, 2011. The crop was fertilized @ 140-50-90-30-4-1 kg/ha of N-P-K-S-Zn-B in the form of urea, triples super phosphate, muriate of potash, gypsum, zinc oxide and boric acid, respectively. All fertilizers were applied as basal during final land preparation. Irrigations were provided at 25, 40, 65 and 75 DAS. Weeding and earthling were done as and when required. The crop was harvested on 7 April 2012. The seed yield and yield components of different maize varieties were recorded and analyzed statistically.

Results and Discussion

Yield and yield attributes of different maize varieties were significantly differed in the haor area (Table1). The tallest plant (215 cm.) was obtained from local variety followed by BARI Hybrid maize-9 and the shortest plant (184 cm) from C-6485. Maximum number of cob/plant (1.60) was

obtained from BARI Hybrid maize-9. Maximum cob length (20.76 cm) was found from C-6485 which was statistically identical to BARI Hybrid maize-9. Maximum cob breath was obtained from BARI Hybrid maize-6 (14.79 cm). The minimum cob length (16.44cm) was found from C-1921 which was identical to Pacific-11. The highest number of grain per cob (527) was recorded from BARI Hybrid maize-9 which was statistically identical to others variety except NK-40. The highest yield (12.13 t/ha) was found from BARI Hybrid maize-9 and the lowest (7.80 t/ha) from Pacific-11. The highest gross return (Tk.218340/ha) and BCR (4.25) were found from BARI Hybrid maize -9. The lowest BCR (2.47) was found in Pacific-11(Table 2).

Farmers' reaction

Farmers are very much excited to see the performance of BARI Hybrid maize -9. They sought seed for future production even they also requested to ensure seed availability in local market. The results revealed that BARI Hybrid maize-9 is suitable for haor areas of Sylhet in respect of grain yield and price of seed.

Conclusion

Different varieties performed differently at different locations. Among the varieties BARI Hybrid maize- 9 showed better performance and produced higher yield in most of the locations. Similarly, Laltir (555) and C-6485 gave satisfactory yield. Therefore, considering seed price and yield it would be benefited for the haor farmers.

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Table 1. Yield and Yield Contributing character of different maize varieties in haur area during the season of 2011-2012

Variety	Plant height (cm)	Cob/ plant (no.)	Cob length (cm)	Cob Breath (cm)	Grain/ cob (no.)	100 grain weight (g)	Grain yield (t ha^{-1})
NK-40(Check)	196	1.0	19.97a	16.87abc	432b	43.67a	9.18cd
Laltir (555)	200	1.0	19.07a	16.50bc	521ab	38.67c	10.43bc
C-6485	184	1.3	20.76a	16.96ab	503ab	43.00ab	11.02b
Pacific-11	190	1.0	16.50b	16.03c	448ab	38.00c	7.80d
C-1921	203	1.5	16.44b	17.38ab	476ab	38.67bc	9.49c
BHM -9	215	1.6	20.67a	17.59a	527a	43.33a	12.13a
BHM -7	206	1.0	19.40a	16.93abc	520a	36.33c	9.37c
CV (%)	-	-	5.99	2.78	9.42	5.90	7.89

Means having same or without letter (s) do not differ significantly at 5% level of probability

Table 2. Cost and return analysis from Maize at Kishoreganj during rabi 2011-12

Treatment	Gross return (TK/ha)	TVC (TK/ha)	Gross margin (Tk/ha)	BCR
NK-40 (Check)	165240	56940	108300	2.90
Laltir (555)	187740	56940	130800	3.30
C-6485	198360	56940	141420	3.48
Pacific-11	140400	56940	83460	2.47
C-1921	169200	56940	112260	2.97
BHM -9	218340	51340	167000	4.25
BHM -7	167400	51340	116060	3.20

*TVC includes Labour, Land preparation, Seed, fertilizers, Insecticides

Price of Maize = Tk. 18/kg

FERTILIZER MANAGEMENT OF MUSTARD IN HAOR AREA OF BANGLADESH

K. Roy and S. K. Paul

Abstract

The experiment was conducted at the haor area of Samarchor village under Sallah upozila of Sunamgonj District during rabi season of 2012-13 to find out suitable fertilizer doses for higher yield of BARI Sarisha-16. Five fertilizer doses viz., T_1: 115-33-43-27-2-2 kg/ha NPKSZnB (Recommended dose), T_2: 54-15-38-10-0.5-0.5 kg/ha NPKSZnB (based on AEZ-22, Sunamgonj), T_3: 85-13-49-5-1-0.5 NPKSZnB (Soil test based), T_4: 40-11-28 NPK (Farmers' practice) and T_5: control were tested in this experiment. The experiment was laid out in a randomized complete block design with three replications. BARI Sarisha-16 produced the highest yield (2.72 t/ha) with recommended fertilizer dose followed by soil test based fertilizer dose (2.32 t/ha). The results revealed that recommended dose may lead toward an increase in the yield of BARI Sarisha-16 under the agro climatic condition of haor areas of Bangladesh.

Introduction

Mustard is one of the major oilseed crops that play a vital role in the domestic supply of edible oil in Bangladesh. Mustard occupies 68% of the area and contributes nearly 32% of the total oilseed production in Bangladesh (BBS, 2010). With the increase of population pressure, the demand for edible oil is increasing day by day. But the area and production of mustard is declining year by year. It may be due to introduction of high valuable crops as well as improper management practices. Farmers cultivate it with their innovative ideas on variety, fertilizer dose and agronomic practices.

One the other hand haor basin is a remote and difficult area that is flooded every year during monsoon. It is situated in grater Sylhet, Kishoreganj and Netrokona districts. The climate and ecosystem of the area is different of other places. And there has a vast area remain always fallow. In the year of 2008-2009 current fallow of Bangladesh is 474 thousand hactor of which 278 thousand acre in grater Sylhet (BBS 2010). It could bring this land under oilseed cultivation easily during rabi season.

Some farmers in those areas cultivate local variety of mustard with poor management. Newly introduced variety may excel the out dated local variety in terms of increased yield per unit area. Similarly, fertilizers play an important role in the environmental influences on crop production. Research workers have reported differential responses of different genotypes to fertilizer application (Rashid and Khan, 2008). Several factors responsible for low yield are poor soil, out dated varieties and lack of modern technologies used for cropping. The application of suitable fertilizers in appropriate doses is considered as one of the most important factors for increasing crop yield per unit area. Therefore the experiment was conducted to find out suitable fertilizer doses for maximum yield of mustard in haor areas.

Materials and Methods

Field experiment was conducted during the winter season of 2012-13 at farmer's field of Samarchor village under Sunamgonj District. The soil to the experiment field was clay loam in texture. Soil sample of experiment field was collected and analyzed with the help of Soil Science Division, BARI. The physical and chemical properties of soil are presented in Table 1. Seeds were collected form Oilseed Research Centre, BARI, Gazipur. Seeds were sown on 25 November 2012. Five fertilizer treatments were applied in that experiment such as T_1: 115-33-43-27-2-2 kg/ha NPKSZnB (Recommended dose), T_2: 54-15-38-10-0.5-0.5 kg/ha NPKSZnB (based on AEZ-22, Sunamgonj), T_3: 85-13-49-5-1-0.5 kg/ha NPKSZnB (Soil test based), T_4: 40-11-28 kg/ha

NPK (Farmers' practice) and T_5: control (Native fertilizer). Intercultural operations were done as and when necessary. Plant samples were collected at harvest. Ten plants were uprooted randomly from each plot under different treatments to determine the plant height, no of branches per plant, and yield attributes. The seed yield of per m^2 was recorded than converted to ton per hector. Similarly, the total weight of harvested plants after sun-drying and threshing was recorded in order to obtain the biomass yields. The experiment was conducted in randomized block design with three replications. Individual plot size was of 3 m X 3 m. All the replicated data were analyzed statistically and mean separation was done by LSD test.

Table 1. Physical and chemical properties of soil of experimental field (Sunamgonj haor)

Physical Properties	Location: Sunamgonj Haor				AEZ:22			
Chemical Properties	pH	OM %	Total N	P (µg/ml)	K (meq/100ml)	S (µg/ml)	B (µg/ml)	Zn (µg/ml)
	7.0	1.05	0.055	18	0.14	22	0.36	1.05
Critical Level	-	-	-	10	0.12	10	0.2	0.6

Results and Discussion

Total number of plants per meter square was calculated at the harvesting stage. There was statistically significant variation of plant numbers per meter square among the fertilizer treatments. Statistically identical number of plant per square areas was observed in T_1, T_2 and T_3 treatment. Though, the highest number of plant (122) was observed in T_1 treatment and lowest number (59.33) in T_5 treatment (Table 2). It may be due to lower fertility level did not support the plants to stay alive at final or harvesting stage.

Plant height was significantly influenced by different fertilizer doses. Fertilizer dose T_3 showed the greatest plant height and was significantly higher compared to that of the other fertilizer doses except T_1 whereas the lowest plant height (184 cm) was recorded in T_5 (Table 2).

Table 2. Yield components of BARI Sarisha-16 under different fertilizer doses in haor area of Bangladesh

Treatments	Plants/m^2	Plant height (cm)	Branches/plant	Siliqua/plant	Seed/siliqua
T_1	122	205	7.0	187.0	12.13
T_2	119	193	5.5	128.3	12.03
T_3	108	207	6.5	181.5	12.23
T_4	67.67	191	5.6	134.6	11.33
T_5	59.33	184	5.6	116.5	10.33
LSD	18.59	0.06	0.60	41.38	1.1
CV (%)	10.37	1.53	5.30	14.70	5.02

T_1. 115-33-43-27-2-2 kg/ha NPKSZnB (Recommended dose), T_2. 54-15-38-10-0.5-0.5 kg/ha NPKSZnB (based on AEZ-22, Sunamgonj), T_3. 85-13-49-5-1-0.5 NPKSZnB (Soil test based) T_4. 40-11-28 NPK (Farmers' practice), T_5. Control

The number of branches per plant varied significantly due to different fertilizer doses of mustard. The highest and lowest number of branches were recorded by T_1 (7.0), and T_2 (5.5), respectively (Table 2). The lowest number of branches of T_2 per plant was significantly identical with that of other varieties except T_3 (Table 2). The variation in the number of branches per plant reflected the differential rate of vegetative growth among the five fertilizer doses.

Out of the five fertilizer treatments undertaken for the trial, the lowest siliquae per plant was observed in T_5 (116.5) which were statistically similar with treatment T_2 and T_4. The highest no of siliqua per plant was found in T_1 (187.0) which was statistically similar with T_3 treatment (Table 2). The number of siliquae had a close relationship with grain yield in rapeseed, determined by the number of branches, buds, and flowers, as well as by the capacity of source, and the supply of nutrients and water (Allen and Morgan, 1975; Tayo and Morgan, 1975; Diepenbrock, 2000). In

some earlier studies, Ali *et al*.(2003) observed a significant correlation between siliquae number and yield in rapeseed; Thurling, (1974b) reported that, in B. *campestris*, there was a significant correlation between yield and siliquae number and Ozer *et al*. (1999) suggested that the siliquae number could be a good selection criterion for increasing grain yield in rapeseed.

The number of seeds per siliquae was also significantly affected by the different fertilizer doses of mustard. All treatments except T_5 showed statistically similar performance in case of number of seeds per siliquae. The maximum and minimum number of seeds per siliquae was reported in T_1 (12.13) and T_5 (10.33), respectively (Table 2).

Fertilizer T_1 (3.37 gm) recorded the highest 1000- seed weight, while the lowest 1000- seed weight was recorded in treatment T_5 (3.03 gm), indicating no significant difference between different fertilizer treatment (Table 3). Evans (1993) mentioned the seed size depended on environmental conditions, genotype, and the potential of the genotype in producing seed number.

Table 3. Yield components and yield of BARI Sarisha-16 under different fertilizer doses in haor area of Bangladesh

Treatments	1000 seed wt (g)	Seed yield (t/ha)	Straw yield (t/ha)
T_1	3.37	2.72	3.97
T_2	3.33	2.11	3.67
T_3	3.13	2.32	3.47
T_4	3.07	1.58	3.03
T_5	3.03	1.42	2.80
LSD	NS	0.31	0.24
CV (%)	6.74	8.01	3.75

T_1. 115-33-43-27-2-2 kg/ha NPKSZnB (Recommended dose), T_2. 54-15-38-10-0.5-0.5 kg/ha NPKSZnB (based on AEZ-22, Sunamgonj), T_3. 85-13-49-5-1-0.5 NPKSZnB (Soil test based) T_4. 40-11-28 NPK (Farmers' practice), T_5. Control

The seed yields (t/ha) obtained from different fertilizer doses were computed which revealed statistically significant responses in all treatments. The highest seed yield was obtained in T_1 (2.72 t/ha) followed by T_3 (2.32 t/ha) (Table 3). The lowest yield was observed in T_5 (1.42 t/ha). The increased seed yield inT_1 might be due to maximum population/m^2, siliqua per plant and 1000-seed weight. The highest and lowest straw yield was recorded in T_1 (3.97 t/ha) and T_5 (2.80 t/ha) (Table 3) respectively.

Conclusion

The results revealed that recommended dose may lead toward an increase in the yield of BARI Sarisha-16 under the agro climatic condition of haor areas of Bangladesh.

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PERFORMANCE OF HYBRID MAIZE VARIETIES IN THE HAOR AREAS OF BANGLADESH

K. Roy and M.S. Islam

Abstract

A field study was conducted at Shingpur haor, Nikli upazilla with the collaboration of Agronomy Division, BARI, Gazipur and OFRD, BARI, Kishoreganj during the rabi seasons of 2011-2012 to 2012-13 to find out the suitable variety and to popularize the BARI hybrid maize varieties among the farmers. The experiment was laid out in a randomized complete block design with six dispersed replications. There were six varieties ie, NK-40 (Check), C-6485, C-1921, Pacific-11, BARI Hybrid maize -7 and BARI Hybrid maize -9 used in this study. Among the varieties, BARI Hybrid maize - 9 gave higher yield (12.13 t/ha) but the lowest (7.80 t/ha) yield was found from Pacific-11 in 2011-12 growing season. In 2012-13 seasons, BARI Hybrid maize - 9 (7.93 t ha^{-1}) and Pacific 11 (8.03 t ha^{-1}) performed better performance and the lowest yield (5.42 t ha^{-1}) was found from C-6485. The highest net return (Tk.75540) and BCR (2.47) were found from BARI Hybrid maize - 9 which was similar to Pacific-11 variety. Two years results revealed that BARI Hybrid maize -9 would be suitable for cultivation in haor areas of Bangladesh.

Introduction

Haor is a wetland ecosystem covering 17% of the country's land area. About 800 acres of land under maize cultivation remains in Nikli upazilla, Kishoreganj. Boro -Fallow-Fallow is the main cropping pattern in those areas but the farmers of the concern area following Maize-fallow-fallow cropping pattern to some extent. Himalyan flash flood is the main obstacle to grow rabi crops in haor areas. Most of the years, it comes at panicle initiation or maturity stage of rice (April) and remain stagnant up to the month of November and causing total yield loss. To reduce total yield loss, some farmers are showing interest in maize cultivation. Because of taller plant height, maize can remain standing over flash water at ripening stage. So, farmers could harvest maize cob easily. They could minimize the risk of total yield loss. Farmers of haor areas are not aware of suitable hybrid maize variety and paying at least Tk. 200 per kg seed from the private sectors but BARI developed seed is very cheap (Tk.85/kg) than others. Therefore, the present study was undertaken to select suitable hybrid maize variety for haor area of Bangladesh.

Materials and Methods

A field study was conducted at Shingpur haor, Nikli upazilla under OFRD, BARI, Kishoreganj during the rabi season of 2012-2013 to find out the suitable variety and to popularize the BARI hybrid maize varieties among the farmers of haor areas. The experiment was laid out in a randomized complete block design with six dispersed replications. There were six varieties ie, NK-40 (Check), C-6485, C-1921, Pacific-11, BARI Hybrid maize-7 and BARI Hybrid maize-9 used in this study. The unit plot size was 6 m x 5 m. The seeds were sown with 75 cm × 25 cm spacing on 27 November, 2012. The lands were fertilized as BARI recommendation dose i.e., 140-50-90-30-4-1, N-P-K-S-Zn-B kg ha^{-1} in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc oxide and boric acid, respectively. All fertilizers were applied as basal during final land preparation. Irrigations were done at three times at 35, 65 and 75 DAS. Weeding and earthing up were done as and when required. Disease and pest management were done but infestation of cutworm and cob borer were 4% and 10-15% respectively. The crop was harvested

on 16 April 2013. The seed yield and yield components of different maize varieties were recorded and analyzed statistically.

Results and Discussion

Yield and yield attributes of different maize varieties were significantly differed in the haor area (Table1a, 1b). The tallest plant (2.30 m.) obtained from BARI Hybrid maize-9. The shortest plant (1.75 m) was obtained from C-1921 which was statistically identical to C-6485. The number of cob plant^{-1} and cob breath was insignificant. The highest cob length (18.60 cm) was found from BARI Hybrid maize-9 which was statistically identical to C-6485 and lowest was found from C-1921. The highest number of grain per cob (560) recorded from BARI Hybrid maize-9 and the lowest number (337) in C-1921.

Table 1a.Yield Contributing characters of different maize varieties in haor areas during the rabi season of 2012-2013

Varieties	Plant height (m)	No of cob plant^{-1}	Cob length (cm)	Cob breath (cm)	No of grain cob^{-1}	100 grain weight (g)
NK-40 (Check)	1.97	1.33	17.40	16.87	422	31.83
C-6485	1.78	1.07	18.60	16.96	462	27.90
C-1921	1.75	1.07	16.40	17.38	337	30.00
Pacific-11	2.00	1.06	18.41	16.03	446	30.76
BARI Hybrid maize -7	2.05	1.20	17.80	17.59	400	28.40
Hybrid maize -9	2.30	1.04	18.60	16.93	560	24.90
LSD $_{(0.05)}$	0.13	NS	0.46	NS	36.80	1.63
CV (%)	3.58	9.39	4.40	7.05	4.61	3.10

Among the varieties, NK-40 gave maximum 100 grain weight (31.83 g) and the minimum weight (27.90 g) in C-6485 variety. Ear height is an important character to consider a good maize variety. The highest ear height 150 cm was obtained from BARI Hybrid maize-9. The lowest 104 cm in C-1921 which was statistically identical to NK-40 (106 cm). Due to long ear height BARI Hybrid maize -9, showed logging behavior than other varieties in the first sowring (17 April) which might be affected the yield. The highest yield 12.13 t/ha was found from BARI Hybrid maize -9 and the lowest yield 7.80 t/ha found in Pacific-11 during 2011-12 season. But in 2012-13, BARI Hybrid maize-9 (7.93 t ha^{-1}) and Pacific 11 (8.03 t ha^{-1}) showed better result.

Table 1b. Ear height and yield of different maize varieties in haor area during the seasons of 2011-2012 to 2012-13

Varieties	Ear height (cm)	Grain yield (t ha^{-1})	Grain yield (t ha^{-1})	Mean
		2011-12	2012-13	
NK-40 (Check)	106	9.18cd	7.31 b	8.25
C-6485	97	11.02b	5.42 d	8.22
C-1921	104	9.49c	6.64 c	8.07
Pacific-11	124	7.80d	8.03 a	7.92
BARI Hybrid maize-7	115	9.37c	6.88 c	8.13
BARI Hybrid maize-9	150	12.13a	7.93 a	10.03
LSD $_{(0.05)}$	0.18	1.40	0.29	-
CV (%)	6.90	7.89	4.38	-

The yield performance was better in previous year. It might be due to heavy cool weather in the month of December which delayed the crop growth. On the other hands, after formation of cob, it

was appear that the infestation (10-15%) of cob borer which hampered the yield. It might be due to long term maize cultivation in certain areas. Considering the economic analysis (Table 2) reveled that, BARI Hybrid maize-9 was profitable in both the years.

Table 2. Cost and return analysis from maize at Kishoreganj during the rabi seasons of 2011-12 and 2012-13

Varieties	Gross return (TK/ha)		TVC (TK/ha)	Gross margin (Tk/ha)		BCR
	2011-12	2012-13		2011-12	2012-13	2012-13
NK-40 (Check)	146880	116960	56940	89940	60020	2.05
C-6485	176320	86720	56940	119380	29780	1.52
C-1921	151840	106240	56940	94900	49300	1.86
Pacific-11	124800	128480	56940	67860	71540	2.25
BARI Hybrid maize -7	149920	110080	51340	92980	58740	2.14
BARI Hybrid maize -9	194080	126880	51340	142740	75540	2.47

*TVC includes Labor, Land preparation, Seed, fertilizers, Insecticides
Price of Maize = Tk. 16/kg

Farmers' opinions

Farmers are very much happy to see the performance of BARI Hybrid maize -9 as our native product. They bought seed for future production even they also requested to ensure seed availability in local market.

Conclusion

From the two years results, it can be concluded that BARI Hybrid maize-9 could be grown in the haor area of Bangladesh with maximum yield and economic benefit. There is no risk to be loser the farmers in terms of impurity or degeneration seed as well as, considering seed price and yield.

FERTILIZER MANAGEMENT OF HYBRID MAIZE IN HAOR AREAS

K. Roy, M. A. Aziz and M.S. Islam

Abstract

A field study was conducted at Shingpur haor, Nikli upazilla with the collaboration of Agronomy Division, BARI, Gazipur and OFRD, BARI, Kishoreganj during the rabi seasons of 2013-14 to find out suitable fertilizer doses for higher yield and to popularize BARI Hybrid maize -9 among the farmers. Five fertilizer doses viz., Recommended dose: N_{255} P_{50} K_{105} S_{23} Zn_4 $B_{1.5}$ kg/ha, Based on AEZ-22: N_{54} P_{15} K_{38} S_{10} $Zn_{0.5}$ $B_{0.5}$ kg/ha, Soil test based: N_{195} P_{43} K_{92} S_{18} Zn_2 $B_{1.38}$, Farmers' practice: N_{60} P_{30} K_{60} S_{25} kg/ha, and Control (Native) were tested in this experiment. The experiment was laid out in a randomized complete block design with six dispersed replications. BARI Hybrid maize -9 produced the highest yield (7.55 t/ha) with recommended fertilizer dose followed by soil test based fertilizer dose (6.80 t/ha). The highest BCR (1.84) were found from recommended dose followed by Based on AEZ-22. The results revealed that recommended dose may lead toward an increase in the yield of BARI Hybrid maize -9 under the agro climatic condition of haor areas of Bangladesh.

Introduction

Haor is a wetland ecosystem covering 17% of the country's land area. About 800 acres of land under maize cultivation remains in Nikli upazilla, Kishoreganj. Boro -Fallow-Fallow is the main cropping pattern in those areas but the farmers of the concern area following Maize-fallow-fallow cropping pattern to some extent. Himalyan flash flood is the main obstacle to grow rabi crops in haor areas. Most of the years, it comes at panicle initiation or maturity stage of rice (April) and remain stagnant up to the month of November and causing total yield loss. To reduce total yield loss, some farmers are showing interest in maize cultivation. Because of taller plant height, maize can remain standing over flash water at ripening stage. So, farmers could harvest maize cob easily. They could minimize the risk of total yield loss. Farmers of haor areas are not aware of suitable hybrid maize variety. They are generally using the traditional varieties along with poor management practices which results in lower yield. Farmers in the haor areas apply lower amounts of fertilizers than the recommended rate (Roy *et al*. 2012). In our previous study, BARI Hybrid maize-9 showed better performance at those areas regarding to net return as well as BCR. Therefore, the experiment was conducted to find out optimum fertilizer dose of BARI Hybrid maize -9 under haor land situation.

Materials and Methods

A field study was conducted at Shingpur haor, Nikli upazilla under MLT site Kishoreganj during rabi season of 2013-2014. The experiment was laid out in a randomized complete block design with six dispersed replications. Five fertilizer doses viz., Recommended dose: N_{255} P_{50} K_{105} S_{23} Zn_4 $B_{1.5}$ kg/ha, Based on AEZ-22: N_{54} P_{15} K_{38} S_{10} $Zn_{0.5}$ $B_{0.5}$ kg/ha, Soil test based: N_{195} P_{43} K_{92} S_{18} Zn_2 $B_{1.38}$, Farmers' practice: N_{60} P_{30} K_{60} S_{25} kg/ha, and Control were studied in this experiment. The unit plot size was 6 m x 5 m. The seeds were sown with 75 cm × 25 cm spacing on 20 November, 2013. One third of nitrogen and full quantity of other fertilizers were applied at the time of final land preparation in the form of urea, triple super phosphate, muriate of potash, gypsum, zinc sulphate and boric acid, respectively. Rest of nitrogen was applied in two equal proportions as top dressing at 25-30 and 40-50 days after seeding). Irrigations were provided at 25, 40, 65 and 75 DAS. Weeding and earthling were done as and when required. The crop was

harvested on 26 April 2014. The seed yield and yield components of different fertilizer doses were recorded and analyzed statistically.

Table 1. Physical and chemical properties of soil of experimental field (Kishoregonj haor)

SL. No.	P^H	OC (%)	Total N (%)	Ca meq/100g	Mg meq/100g	K meq/100g	P	S	Zn
1.	5.3	1.10	0.10	2.5	1.2	0.34	5	17	1.15
Critical limit	-	C:N=10:1	0.12	2	0.8	0. 2	14	14	2

Results and Discussion

Yield and yield attributes of BARI Hybrid maize-9 were significantly differed under different fertilizer doses in the haor area (Table 2). The tallest plant (2.74 m.) was obtained from Recommended dose followed by Soil test based dose and the shortest plant (2.04 m) from control treatment. The ear height followed the same trend as plant height. Maximum number of cob/plant (1.13) was obtained from recommended dose. Maximum cob length (18.01 cm) was found from recommended dose which was statistically identical to soil test based treatment. Maximum cob breath (16.52 cm) was obtained from recommended dose. The minimum cob breath (9.67) was found from control treatment. The highest number of grain per cob (576.7) was recorded from recommended dose $_{\text{which}}$ was statistically identical to other fertilizer treatments except based on AEZ-22 and control treatment. The highest yield (7.55 t/ha) was found from recommended dose and the lowest (3.41 t/ha) from control.

Cost and benefit analysis is presented in Table 3. The highest gross return and gross margin was recorded in recommended dose (gross return: Tk. 120800/ha and gross margin: Tk. 55157/ha) followed by based on AEZ-22 (gross return: Tk. 87520/ ha and gross margin: Tk. 39298/ ha). The maximum BCR was obtained from recommended dose (1.84).The lowest gross return (Tk. 54560/ha), gross margin (Tk. 12860/ha) and BCR (1.31) were found from control.

Table 2. Yield and yield components of BARI Hybrid maize -9 under different fertilizer managements in Kishoregonj haor

Treatments	Plant height (m)	Ear height (m)	Cob/plant (no.)	Cob length (cm)	Cob breath (cm)
Recommended dose	2.74a	1.35 a	1.13 a	18.01 a	16.52 a
Based on AEZ-22	2.33d	1.28 b	1.00	14.75 b	13.82 c
Soil test based	2.49b	1.31 ab	1.00	16.65 a	15.32 b
Farmers' practice	2.41c	1.27 b	1.00	14.72 b	12.16 d
Control	2.04 e	1.05 c	1.00	8.63 c	9.67 e
LSD $_{(0.05)}$	0.06	0.06	0.06	1.54	0.54
CV (%)	1.61	1.89	3.14	6.03	2.27

Recommended dose: N_{255} P_{50} K_{105} S_{23} Zn_4 $B_{1.5}$ kg/ha, T_2. Based on AEZ-22: N_{54} P_{15} K_{38} S_{10} $Zn_{0.5}$ $B_{0.5}$ kg/ha, Soil test based: N_{195} P_{43} K_{92} S_{18} Zn_2 $B_{1.38}$, Farmers' practice: N_{60} P_{30} K_{60} S_{25} kg/ha and Control

Table 2. Continued.

Treatments	Grain/cob (no.)	1000- seed wt. (g)	Seed yield (kg/ha)
Recommended dose	576.7	26.13	7.55
Based on AEZ-22	272.6	22.48	5.47
Soil test based	331.9	23.44	6.80
Farmers' practice	401.7	22.08	5.42
Control	281.0	18.20	3.41
LSD $_{(0.05)}$	251.5	0.23	0.42
CV(%)	38.52	0.60	4.16

Table 3. Cost and return analysis of BARI Hybrid maize -9 under different fertilizer managements in Kishoregonj haor

Treatments	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
Recommended dose	120800	65643	55157	1.84
Based on AEZ-22	87520	48222	39298	1.81
Soil test based	108800	60335	48465	1.80
Farmers' practice	86720	50250	36470	1.73
Control	54560	41700	12860	1.31

Input: land preparation, fertilizer, seed, intercultural operations, irrigation, insecticide cost etc included this analysis.
Output: Maize price/kg – Tk. 16/-

Farmers' opinion

Farmers opined that they would grow BARI Hybrid maize-9 along with N_{255} P_{50} K_{105} S_{23} Zn_4 $B_{1.5}$ kg/ha (Recommended dose) in the next year for getting highest yield as well as BCR.

Conclusion

From the results, it may be concluded that N_{255} P_{50} K_{105} S_{23} Zn_4 $B_{1.5}$ kg/ha (Recommended dose) would be the optimum fertilizer dose of BARI Hybrid maize -9 for getting highest BCR in the Kishoregonj haor (AEZ- 22).

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IMPROVEMENT OF EXISTING CROPPING PATTERN FALLOW–BORO–FALLOW RICE WITH MUSTARD–BORO –T. AUS, RADISH LEAF-WHEAT-DAINCHA, RADISH-PUMPKIN-DAINCHA, POTATO-PUMPKIN-T. AUS AND GARLIC-MUNGBEAN IN HAOR AREAS

M.A. Aziz, A. Hossain and M.A. Razzaque

Abstract

The experiments were executed at the Habibpur Union, Sulla, Sunamgonj initiated in *kharif* season 2014-2015 to develop economically profitable and viable cropping pattern for replacing the existing Fallow-Boro-Fallow cropping pattern. The alternate cropping patterns Mustard– Boro-T. Aus, Radish leaf-Wheat-Daincha, Radish-Pumpkin-Daincha, Potato-Pumpkin-T Aus, Garlic-Mungbean were grown during November 2014 to June 2015. The yield of BARI Sarisha-15 was 1.0 and BARI Sarisha-14 was 0.98, Wheat was 1.83, radish was 60, pumpkin was 35, potato (cardinal) 18 and garlic was 10 t/ha, respectively. T.Aus Parija and Mungbean failed due to late sowing and affected by sudden flash.

Introduction

The vast wet land situated in the Northern Part of Bangladesh is known as Haor. This area created opportunity of fish production during wet season and allowed rice production during dry season. The available statistics indicate that, almost 80% of this area is under Boro rice (Huda, 2004). In sulla upazilla Fallow-Boro-Fallow cropping pattern is followed. Boro rice is the only crop for the farmers. Due to the climate change in the recent year rainfall in the Meghalaya have been increased during monsoon that causing flash floods on the other hand during dry season rainfall has decreased in alarming rate that affecting rice production in the Haor areas. The flood timing and pattern is affecting the changing local ecosystem and the livelihood of the local people. Haor area has indeed become imperative to exploit the crop production potentiality of those areas usually remain under-utilized with quite low cropping intensity (Jabber and Alam, 1996). There are many lands which rise earlier (by October) and remains fallow all the year round local people call it 'Kanda' land. There is also some land which is used for Boro rice cultivation that usually starts from December. There are scope to grow short duration crop successfully during Rabi season using these two type of land in the Haor basin and could be harvested much earlier. Keeping this fact in mind, to explore the adaptive crop and technologies to increase the cropping intensity and crop diversification the trial basis study was conducted under the full management of the farmers. This study was conducted in the Sulla Union of Sunamgonj District from October 2104 to June 2015. It is anticipated that findings of this study would benefit the people as well as the country as a whole through increased crop production and reduced vulnerability of the people.

Objective(s)

1. To develop economically profitable and climate adaptive viable cropping pattern against existing Fallow – Boro-Fallow cropping pattern in the Sulla Upazilla under Sunamgonj District.
2. To introduce the new crops and varieties and to popularize the crops in this area.
3. To increase the cropping intensity by using fallow land of this area during winter season.

Materials and Method

The experiments were conducted in farmer's field at Habibpur and Suskai Union under Sulla Upazilla in Sunamgonj with collaboration of Islamic Relief, Bangladesh; an INGO. These trials

were conducted year round of 2014 to 2015 to develop economically profitable and climate adaptive viable cropping pattern for existing Fallow - Boro - Fallow cropping pattern and to increase the cropping intensity by using fallow land of this area during winter season. 1) Mustard – Boro-T. Aus, 2) Raidsh leaf-Wheat-Daincha, 3) Radish-Pumpkin-Daincha, 4) Potato-Pumpkin-T Aus, 5) Garlic-Mungbean. Fertilizer application and intercultural operation was done properly. The yields of the crops were recorded and averages of those were presented in tabular form.

Methodology

Area selection

Medium Low kandas of Anandopur and Suskai village under Hobibpur union of Sulla Upazilla of Sunamgonj were purposively selected which are usually kept fallow before Boro cultivation. These kinds of lands are considered suitable for mustard, wheat, radish, pumpkin and potato cultivation.

Farmer Selection

Farmers were selected based on the following criteria:

- Must be an advanced farmer;
- Able to understand new technology easily;
- Long experience in crop production;
- Able to understand adverse effect of climate change on crop production;
- Inventive.

Land Selection

Comparative high (kanda,) land was selected. The plot size ranges from 7 to 20 decimals.

The criteria followed in land selection are:

- Alleviation of the land
- Water availability of the land
- Distance from road.
- Previous usage of the land.
- Texture of the land

Crop Selection

Criteria followed for selection of the crops are:

- Following the BARI recommendation;
- Sharing experience of crop production with other related organizations, who are working in the haor areas;

Data Collection Method

Following methods were adopted for data collection

- Survey (survey tools, land and farmer selection, crop selection)
- FGD (finalizing the farming modalities, crop selection in a group discussion)
- Recall method (previous data)
- Monitoring (monitoring format, observation)

Data analysis

Only yield data, production cost and income data were collected and were processed and presented in the report.

Results and Discussion

1. Cropping pattern (Mustard-Boro-T.Aus)

Production of Mustard of the study plots were less than the maximum yield of varietal standard weight BARI standard (BARI, 2011). On the other hand, yield from experimental plots of mustard was higher than national average yield (BBS 2005).

Table 1. Yield Analysis

Plot No.	Variety	Date of sowing	Date of harvesting	Crop life span	Yield t/ha	Expected highest yield t/ha	National average yield
1	BARI Sarisha-15	5.11.2014	22.1.15	78	1	1.5	0.79 t/ha
2	BARI Sarisha-15	3.11.2014	7.1.15	65	0.86	1.5	0.79t/ha
3	BARI Sarisha-14	4.11.2014	27.1.15	83	0.92	1.4	0.79t/ha
4	T. Aus (Parija)	7.5.2015	Failed				

Source: Field Study 2014

Transplantation of T. Aus being dependent on rainfall it was delayed of sowing the seeds. Seeds were sown during early monsoon (early May). The delayed transplantation of T. Aus faces flash flood results destroying the crops.

Table 2. Socio Economic Benefit Analysis

plot No	Land Area (decimal)	Total production (kg)	Total Production Cost (tk)	Total Income			Total Net profit	Net profit /ha	Profit
				Crop (@40tk/kg)	Straw/Fuel (@40tk/ Decimal)	Total (tk)			
1	7	30	1063	1200	280	1480	417	14714	Profitable
2	10	35	1317	1400	400	1800	483	11930	Profitable
3	20	75	1945	3000	800	3800	1855	22909	Profitable

Note: in the cost benefit analysis rent of land was not considered Source: Field Study 2014

It was found that profitability of mustard production was high as well as it creates 46 man-days/ha job opportunity in land preparation, harvesting and intercultural operation. Oil cake might help the cattle health nourishing. Following mustard cultivation Apiculture could be introduced that might create another job opportunity in the Haor community. The bi-product of the mustard is supplying fuel for the household cooking which is a crying need for this area.

Pest and disease infestation

Usually Aphid attacks mustard crops at flowering and fruiting stage and Cercospora leaf spot during vegetative stage. Fortunately in the trial plots no insect and disease infestation was noticed.

Lesson learned:

- Seed sowing could be started from mid to late October that may create opportunity to grow Boro rice earlier.
- In the Haor basin no pest and disease occurred in the mustard that is additional advantage to grow this crop.

- No bees were found in the crop field for pollination.
- Huge land could be utilized for Mustard production.
- From the piloting, maximum involved farmers realized that this type of crop is needed and it was appreciated by all farmers and they accepted the research result with trust. From the next year, they want to cultivate mustard using their lesson learned with more caring.

2. Cropping pattern (Radish leaf-Wheat- Daincha)

Table 03. Yield Analysis

Plot No.	Variety	Date of sowing	Date of harvesting	Crop life span	Yield t/ha	Expected highest yield t/ha	National average yield
1	Radish (Leaf vegetable) (Tasakisan)	2.10.2014	12.11. 2014	35 days	60.00		
2	Wheat (BARI GOM-26)	15.11.2014	17.2.2015	94 days	1.83	3.5 (BARI, 2011)	1.87 t/ha (Mondol,2011)
3	Daincha	25.3.2014					

Radish for leaf as vegetable was sown in October and Harvested gradually from 25 days to 40 days of age of the plant then wheat was sown. It was found that under the management of farmer the production of wheat got 1.83 t/ha from the trial plot which is behind from national average yields 1.87 metric tons per hectare (Mondol, 2011). Among the various factors responsible for low yield farmer's knowledge, sowing time, management, and crop protection from cattle and rat was major. The life span of the selected variety is normally 105-108 days but it was harvested within 94 days as there was no crops surrounding the plots man and other animals were destroying the crops. The farmer had no previous experience on wheat cultivation and had no training on it that might hamper production process results low yield. As only yield data was collected and any other yield factors were not calculated so other factors may be associated in low yield factor which could not be explained here.

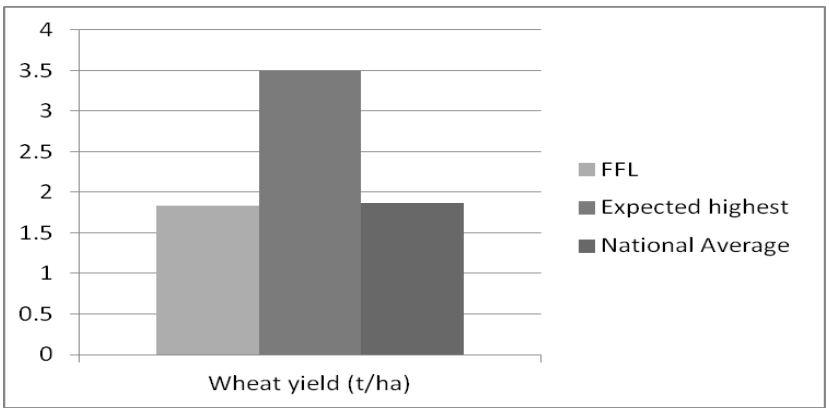

Fig. Yield of Wheat

Table 04: Socio Economic Benefit Analysis of wheat

plot No	Land Area (decimal)	Total production (kg)	Total Production Cost (tk)	Total Income			Total profit	Net profit /ha	Profit
				Crop (@25tk/kg)	Straw/Fuel (@50tk/Decimal)	Total (tk)			
1	14	80	1829	2000	700	2700	871	15376	Profitable

Note: in the cost benefit analysis rent of land was not considered Source: Field Study 2014

It was found that the cost benefit ratio was 1.69 in wheat production as well as it creates 46 man-days/ha job opportunity for men and women in land preparation, intercultural operation, harvesting, carrying, threshing, and post harvest processing.

Pest and disease infestation

No disease was noticed during the cultivation period but animal, people and rodent pest was found as major problem.

Lesson learned:

- Seed sowing could be started from mid to late November to get optimum climatic condition that may increase the wheat yield and during early October to November radish for leaf as vegetable could be grown easily before wheat sowing.
- Huge land could be utilized for wheat production.
- From the piloting, maximum involved farmers realized that this type of crop is needed and it was appreciated by all farmers and they accepted the research result with trust. From the next year, they want to cultivate wheat using their lesson learned with more caring.

3. Cropping pattern (Radish -Pumpkin-T Aus)

Radish was sown on 28 October and it was harvested from 25 days of age continued up to 14 December, 2014. The pumpkin seeds were sown as relay crop on 25.10.2014 and harvesting was started on 18 February 2015.

Crop	Date of sowing	Date of harvesting	Life span	Yield (t/ha)	Expected highest yield (t/ha)	National average yield
Radish	28.10.2014	14.12. 2014	45-50 days	60	70 (BARI, 2008)	31 (BAU 2012)
Pumpkin	25.10.2014	18.2.2015	160-190 days	65	60	-

Table 4. Socio Economic Benefit Analysis of pumpkin

plot No	Land Area (decimal)	Total production (kg)	Total Production Cost (Tk)	Total Income Crop (@10 Tk/kg)	Total profit (Tk)	Profit
1	28	7000kg	18000tk	70000	52000	Profitable

4. Cropping pattern (Potato -Pumpkin-T Aus)

Seed was sown on 11 November 2014 of Cardinal variety and was harvested on 28 January 2015. T Aus was delayed to sow and was affected by flash flood and destroyed.

Crop	Date of sowing	Date of harvesting	Life span	Yield (t/ha)
Potato (cardinal)	15.11.2014	28.1. 2015	73 days	18
Pumpkin	20.11.2014	30.2.2015	160-190 days	65

5. Cropping pattern (Garlic –Mungbean)

Table 5. Garlic production

Date of sowing	Date of harvesting	Life span	Yield (t/ha)	Expected highest yield (t/ha)	National average yield (t/ha)
3.11.2014	7.3. 2015	96 days	10	12 (BARI, 2008)	2-3 (BAU 2012)

Mungbean was destroyed following heavy rain and flash flood.

Conclusion and Recommendation

Many of the crops under the trial cropping pattern were new crops to the farmer of this area. Duration of the study was only one year. Usually, agriculture research needs at least 3 years of time to pilot same thing in 3 consecutive years to have a real picture that can lead to a conclusion of the findings. The results so far came out from the study is need to be further study in wider scale by the mandated expert for scale up the learning from this study. According to the researchers the yield could be increased through proper land preparation, irrigation and intercultural operations. In the Haor area bees are rare which plays important role for pollination to increase the production of mustard. Sowing season and variety of wheat could be adjusted for better yield. Being rain fed Aus cultivation it was delayed to sowing that faces flash flood. Farmers were found less interested in Aus rice cultivation due to the question of crop protection from cattle during Aus season. Culturally in the Haor area after harvesting of Boro cattle are being freed in the field.

However, the research identified Mustered, Wheat, Pumpkin, Potato, Daincha were technically and economically suitable for sulla Haor area. But there are many other issues that need to be considered for wider dissemination of the findings. These issues include technology transfer, market, availability of seeds, protection of crops in the kanda lands from cattle and wild animal, mills of extracting oil etc. Kanda lands and medium low land are found very suitable crop diversification and intensification.

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Agronomy Division

Bangladesh Agricultural Research Institute

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