Report on

On Farm Adaptive Research of Small Holder Farmers Food Production

Strengthening Adaptive Farming in Bangladesh, India and Nepal

European Union

Caritas Austria

safebin
For Small Farmers Future

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Introduction

Strengthening Agricultural Farming in Bangladesh, India and Nepal is a Collaborative project lead by Caritas Austria, funding by European Commission under the Program: "Building Resilience to Climate Change Through Strengthening Adaptive Small Scale Farming System in Rainfed Areas in Bangladesh, India and Nepal". The overall objective of the project is to promote local food and nutritional security through adaptive small scale farming in rainfed AES in S. Asia in the context of climate change. The project is dealign with dominant food crops like rice, wheat, potato, vegetables and also with high value minor crops, oilseed and pulses in Bangladesh. Predicted changes in temperature and other climate functions will impact agro-ecological conditions and food production. As a result, farmers will need to adjust technologies and practices in order to continue meeting food requirements. However, adapting to new climate scenarios may not be feasible in all situations. A lack of adaptive capacity due to constraints on resources, like access to weather forecasts or better seed varieties, may result in further food insecurity (Rosegrant et. al., 2008; Ewing et al., 2008).

Potential direct effects on agricultural systems will be seasonal changes in rainfall and temperature that could impact agro-climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease populations, etc (Kurukulasuriya et. al., 2003). Evapotranspiration, photosynthesis and biomass production will alter along with land suitability (Parry et. al., 2005). Though increased CO2 levels lead to a positive growth response however, climate change is also likely to have a significant negative impact on agricultural production. Adaptation, including crop choice and timing, has the ability to partially compensate for production declines in all regions. Extreme weather events like SIDOR, AYLA, NARGIS, RESHMI, tidal surge, heat wave, pests, and diseases has jeopardizes agriculture sectors including livestock and fisheries.

Indeed, climate change is likely to strongly affect the wheat crop production that accounts for 21% of the food stock and 200 million hectares of farmland worldwide. Future climate scenarios suggest that global warming may be beneficial for the wheat crop in some regions, but could reduce productivity in zones where optimal temperatures already exist. For example, by 2050, as a result of possible climatic shifts in the Indo-Gangetic Plains, which accounts for 15% of global

wheat production, as much as 51% of the IGP region might be reclassified as a heat-stressed, irrigated, short-season production mega-environment. This shift would represent a significant reduction in wheat yields, threatening the food security of roughly 200 million people, unless appropriate cultivars and crop management practices are available to and adopted by local farmers. In addition, the local seed system must be strengthened to provide farmers with increased access to crop diversity for the selection of better adapted varieties to mitigate climate change risks (Challinor, A. J. and T. R. Wheeler, 2008).

In Bangladesh, among the biotic stress insect and disease infestation has increased with some major crops; in rice, blast (Pyricularia grisea) disease occurrence and severity has increased due to Drought (Haque et. al. 2008; DAE and FAO. 2008; Ali, et. al. 2009). Similarly, extreme weather events like prolong fog in the winter season has threaten potato, wheat, pulse and oil seed production by severe infestation of insect pest and diseases in North -West region of Bangladesh (LACC-II) (Biswas, et. al. 2009; and DAE and FAO. 2008).

Agricultural productivity of the region has threatened mainly by climatic factors like drought, changes rainfall pattern, reduced rainfall, excess extraction of ground water, cold, persistent of prolong foggy weather along with recent challenges of climate change elements that has emerged as major threat of low farm productivity and increased risk of farm activities. Of them water is the scarce resource, agricultural farm activity largely depend on either monsoon water or underground water. Surface water availability of the region is limited in most instances. Moreover, gradual reduction of rainfall and their irregular pattern has further threaten agricultural activities that have impacted the vulnerabilities of the livelihood of the marginal and medium farm families of the region (Personal experience). Sustainable adaptive capacity and food systems that are resilient to progressive climate change through the provision of new technologies, practices and policies.

Intensification of crops with judicious water use following other drought management options and appropriates crop selection (less water required), production packages etc in integrated way is the main focus of this research under SAFBIN. Rice is the staple cereals and food for almost all Bangladeshi people it is also the main source of protein intake. It is the only field crops in monsoon and cultivation of long duration rice variety swarna is the mega rice variety of the project

areas that frequently faces terminal stage (reproductive stage) drought and causes significant yield loss. Since rainfall ceases in mid October therefore very limited residual moisture remain in soil to cultivate second crop therefore, vast areas remain fallow after wet season long duration aman rice cultivation.

Recent release of short duration rice varieties from Bangladesh Rice Research Institute and Bangladesh Institute of Nuclear Agriculture etc of them BRRIdhan56 has drought tolerant and others like BRRIdhan57, BRRIdhan49, BINAdhan7, BRRIdhan33 are mainly drought escaping at the reproductive stage (BRRI, 2011). Due to earliness, opportunity of second crop (non rice like chickpea, linseed, barley and wheat) establishment has been reported by public sector research institute. Mungbean is another drought tolerant crops will also be included in this research plan for reasons i.e. drought tolerant, high value pulse crop and add organic matter to the soil.

Adaptation of the recent release short duration (105-110 days) rice varieties addressing drought impact and opportunity second crop cultivation yet to be verified in farmers field using climate resilient HYV crops and production packages developed by BARI (BARI, 2006). Increasing total farm productivity through adoption and intensification of climate resilience technology in real situation is of great challenges therefore a comprehensive adaptive research farmers conducting primary and secendary review has been conducted following discussion with Professors of RU, Caritas Officials, Scientists of BARI and BRRI, DAE personnel and review article under SAFBIN project of Caritas Bangladesh focusing medium to high land ecosystem rainfed and minor irrigated environment with the following specific objectives:

- To screen and document innovations in traditional food production, distribution and consumptions system of small holder farmers (SHF-FPDCS) with respect to climate change adaptation, mitigation and around nutritional security.
- To collectivize and/or strengthen SHF institution for an organized and sustainable approach.
- To test potential of (SHF-FPDCS) models designed through blending traditional and modern innovations for their abilities to adapt mitigation and ensure nutritional security.
- To develop multi-stakeholder monitoring mechanism for enhancing efficiency of the FPDCS models.
- To influence national research and policy agenda for promotion of collectivized (SHF-FPDCS) to adapt to and mitigate climate change and nutritional security.

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OFAR Report on T. Aman 2012

Problem: Drought causes yield loss on existing long duration (145-150 days) mega variety Swarna and late harvesting delayed next crop establishment in consequent vast area remain fallow after swarna harvest.

Model: Participatory Variety Selection and adaptation performance of the varieties in diverse climatic situation.

Objectives: To identify adaptive rice variety in Rainfed area.

Research Activity-2.1. Participatory Variety Selection of newly developed rice varieties in drought environment, T. Aman, 2012.

Problem: Drought causes yield loss on existing long duration (145-150 days) mega variety Swarna and late harvesting delayed next crop establishment in consequent vast area remain fallow after swarna harvest.

Model: Participatory Variety Selection and adaptation performance of the varieties in diverse climatic situation.

Objectives: To identify adaptive rice variety in Rainfed area.

Materials & Methods

Site: There were 3 sites namely Paba, Boraigram and Potnitola upazilla of greater Rajshahi.

Mother Trial: 3 (one for each upazilla)

Farmers per site: 15

Cultivar: Relatively short duration drought tolerant and drought escaping varieties are selected for this trial. The varieties will be: V_1= BRRIdhan56, V_2= BRRIdhan57, V_3= BINA7, V_4= BRRIdhan49, V_5= Swarna (check)

Replication: 3 (for mother trial) while every three farmers grown same variety and thereby 15 farmers had grown all the five variety and each farmer considered as replication.

Field Size: 10-15 decimal for each farmer

Spacing: 20 cm X 15 cm.

Seedling age: 18-21 days or maximum 25 days for short duration varieties or use 25 days old seedling for all varieties used.

Number of Seedlings per hill: 3-4 seedlings

Fertilizer Mgt: Integrated organic and inorganic fertilizer mgt will be applied. However, if In case of chemical fertilizers are used then following rate will be practiced for mother trial:

Urea: 180 kg/ha applied in 3 equal splits (1st split 10 days after transplanting (DAT) + 2nd split 25 days DAT and 3rd split at the panicle initiation stage.

TSP: 75 kg/ha applied before final land preparation.

MOP: 90 Kg (½ at the basal + ½ with the 2nd top dress of urea)
Gypsum: 60 Kg/ha
For baby trial farmers applied fertilizer according to their own practices.

Pest Mgt: Perching, sweeping, light trap or botanicals' and/or judicious pesticide use. In case of stem borer attack apply Basudin 5G or Carbofuran 10G with 2nd split of urea. If rice bug infestation noticed at the flowering stage then any insecticides belongs to melathion group will be sprayed avoiding pollination time (10 AM-14 PM). Rat infestation may be noticed use bait, watering or put carefully Phostoxin tablet inside hole and block hole with mud.

Data Recording: The following data are to be recorded -

- Name of the cultivar
- Date of seeding (DS)
- Date of transplanting (DT)
- Seedling age
- Date of 50% flowering
- Date of 100% flowering
- Number of productive tiller per hill
- Farmers preference score
- Date of Maturity
- Date of harvest
- Harvest 10 m^2 for each treatment for yield and yield components

Results

Growth duration, fertile tiller, thousand grain weight and yield of BINA-7, BRRIdhan56, BRRIdhan57, BRRIdhan49 and Swarna obtained from baby (Table 1-5) and mother trial (Table 6) are presented in Table 1-6 and Fig.1-2. Drought stress varied not only among the three sites (upazilla) but also from one field to another. Among the upazillas rice crop of Baraigram was severely affected by drought stress (Fig 1). Irrespective of the variety grain yield was the lowest compared to the Paba and Patnitala.

In baby trials, the grain yield, fertile tillers, growth duration varied from one farmers plot to another and drought stress shorten the growth duration of all rice varieties, reduced tiller number which primarily appeared to the cause of yield reduction from one farmers to another. Among the short duration rice varieties, BINA-7 performed the best having slender grain which is at par with BRRIdhan56 but grain is medium bold. In contrast, BRRIdhan57 performed poor in all the parameters investigated particularly drought. Except, BRRIdhan56 (drought tolerant) all other varieties are drought escaping. Medium duration rice varieties BRRIdhan49 and Swarna had more compensation ability in terms of tillering that contributes to higher yield that were at par with BINA-7. Obtaining higher yield from short duration varieties was supported by supplemental irrigation provided by farmers. However, that creates opportunity of seeding winter crops on time.

Table 1. Performance of BINA-7 in baby trials across the 3 upazilla Paba, Potnitola and Boraigram, T. Aman 2012

Location	GD (days)	Fertile Tillers/hill	TGW (g)	Yield (t/ha)
Paba	107	23	20	5.4
	107	21	19.5	5.1
	110	20	20.5	5.2
Patnitola	110	15	20	4.8
	110	12	18	4.54
	105	16	20	5.2
Boraigram	115	17	20	5.11
	110	12	20	4.44
	110	10	18	2.22
Mean				4.66

Table 2. Performance of BRRIdhan56 in baby trials across the 3 upazilla Paba, Potnitola and Boraigram, T. Aman 2012

Location	GD (days)	Fertile Tillers/hill	TGW (g)	Yield (t/ha)
Paba	111	17	20	5
	105	11	19	3.9
	102	9	18	3.33
Patnitala	101	14	18	4.16
	109	18	19	6.5
	107	17	19.5	5.1
Boraigram	109	18	20	5
	110	12	19	2.77
	109	14	19.5	3.9
Mean				4.40

Table 3. Performance of BRRIdhan57 in baby trials across the 3 upazilla Paba, Potnitola and Boraigram, T. Aman 2012

Location	GD (days)	Fertile Tillers/hill	TGW (g)	Yield (t/ha)
Paba	101	19	20	5
	103	16	19.5	3.9
	104	17	20	5
Patnitola	108	12	14	3.16
	108	15	21	5.25
	110	13	21	3.5
Boraigram	108	8	22	2.22
	108	10	22	3.44
	107	9	22	2.22
Mean				3.74

Table 4. Performance of BRRIdhan49 in baby trials across the 3 upazilla Paba, Potnitola and Boraigram, T. Aman 2012.

Location	GD (days)	Fertile Tillers/hill	TGW (g)	Yield (t/ha)
Paba	125	16	21	6
	131	18	21	6
	125	15	20	5
Patnitola	130	13	20	3.9
	125	16	20	4.5
	130	10	20	3.5
Boraigram	130	17	21	4.44
	131	18	20	5
	133	14	20	3.55
Mean				4.65

Table 5. Performance of Swarna in baby trials across the 3 upazilla Paba, Potnitola and Boraigram, T. Aman 2012

Location	GD (days)	Fertile Tillers/hill	TGW (g)	Yield (t/ha)
Paba	137	15	22	5.2
	138	16	22	5.5
	136	18	22	5.8
Patnitola	133	14	22	4.6
	137	15	21.5	4.83
	133	12	21	3.75
Boraigram	139	11	20	3.33
	135	11	22	3.5
	139	16	22	4.5
Mean				4.55

Table 6. Performance of promising rice varieties in mother trial under drought prone environment, T. Aman 2012.

Name of the Upazilla	Variety	Growth duration (Days)	RL(Days)	FT/hill	TGW (g)	Yield(t/ha)
Patnitala	BINA-7	110	59	18	20	5.2
Baraigram	BINA-7	115	59	14	19	3.75
Paba	BINA-7	107	41	19	21	5.5
Mean		**110.7**	**53.0**	**17.0**	**20.0**	**4.8**
Patnitala	BRRIdhan56	108	59	19	22	5.2
Baraigram	BRRIdhan56	103	51	9	20	2.5
Paba	BRRIdhan56	105	41	14	21	4.4
Mean		**105.3**	**50.3**	**14.0**	**21.0**	**4.0**
Patnitala	BRRIdhan57	108	59	17	20	4.18
Baraigram	BRRIdhan57	108	51	12	18	3.69
Paba	BRRIdhan57	107	41	18	19	3.9
Mean		**107.7**	**50.3**	**15.7**	**19.0**	**3.9**
Patnitala	BRRIdhan49	127	76	19	20	5.5
Baraigram	BRRIdhan49	132	67	11	20	2.75
Paba	BRRIdhan49	135	51	17	21	5
Mean		**131.3**	**64.7**	**15.7**	**20.3**	**4.4**
Patnitala	Swarna	140	87	15	20	4
Baraigram	Swarna	139	76	9	22	1.4
Paba	Swarna	137	51	19	22	5.5
Mean		**138.7**	**71.3**	**14.3**	**21.3**	**3.6**

Research Activity-2.2. Integrated rice sheath blight (ShB) disease (caused by Rhizoctonia solani) management.

Problem: Rice sheath blight disease is increasing with increasing temperature and humidity and causes significant yield loss.
Models: Effectiveness of Practiced management options to control Sheath blight disease.

Objective: To identify sustainable management options for sheath blight disease.

Key Management options:
Collection and buried Floating Debris (FD) after final land preparation (FD) consisted of small dead snail, thousands of weed seed, floating sclerotia, live inoculum with previous crop residues, ratoon or volunteer rice and grass weeds, Pupae of different rice insects), top dressing MOP at PI stage (½ MOP of the recommended dose will be applied at basal and ½ at the PI which is generally coincide with last top dress of urea) and Fungicide application (Folicur).
Trial plots: 45 (15 for each Upazila)
Land Size: 10-15 Decimal.
Treatments: There will be five treatments as described below:
T_1: Collection of Floating Debris (F.D)
T_2: Chemical (Folicur)
T_3: ½ Basal Potash
T_4: F.D +Chemical (Folicur)
T_5: Chemicals + ½ of the MOP with 2nd top dress of urea
Replication: 3 (each Treatment will be applied in 3 different farmer's field of each upazilla)
Materials and Methods:
Select field randomly at the before final land preparation stage, check standing water more or less 2"-3" is preferable. Collect FD for T_1 and T_4. Apply ½ of the recommended MOP for T_3 and T_5. Apply recommended doses of fertilizer all TSP and Gypsum at basal before final land preparation. MOP as per treatment. Advise farmers to use optimum age of seedlings (30-35 days for cultivars with growth duration 145-150 days) and spacing 25 x 15 cm with 3-5 seedlings per hill. Spray fungicide folicur at the maximum tillering stage (1st spray and apply second spray 12-15 days after first spray). Insect pest management will be same for all

Fig. 1. Comparative yield (t/ha) performance of different rice varieties from mother trials in 3 upazillas under varying degree of rainfed drought environment, T. Aman 2012.

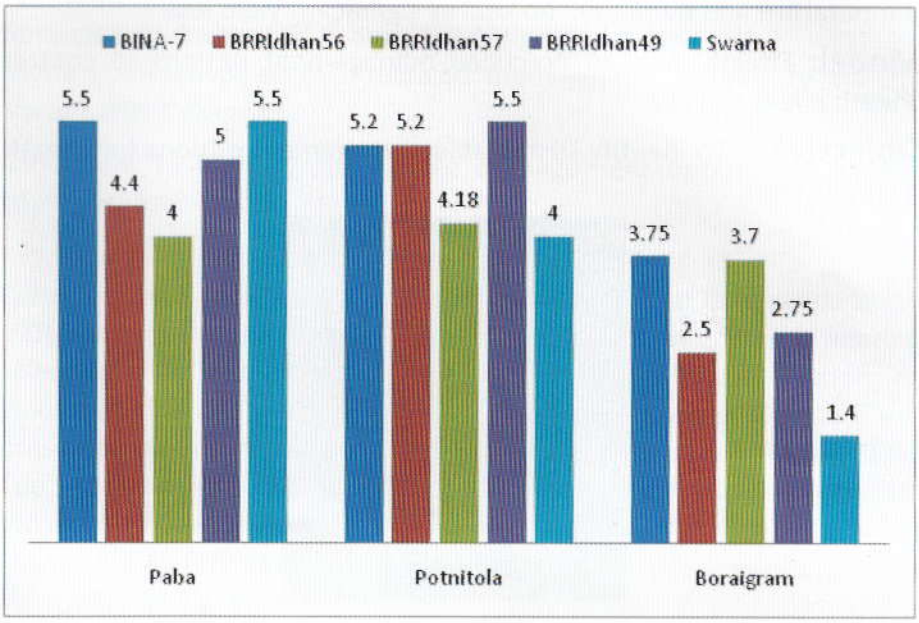
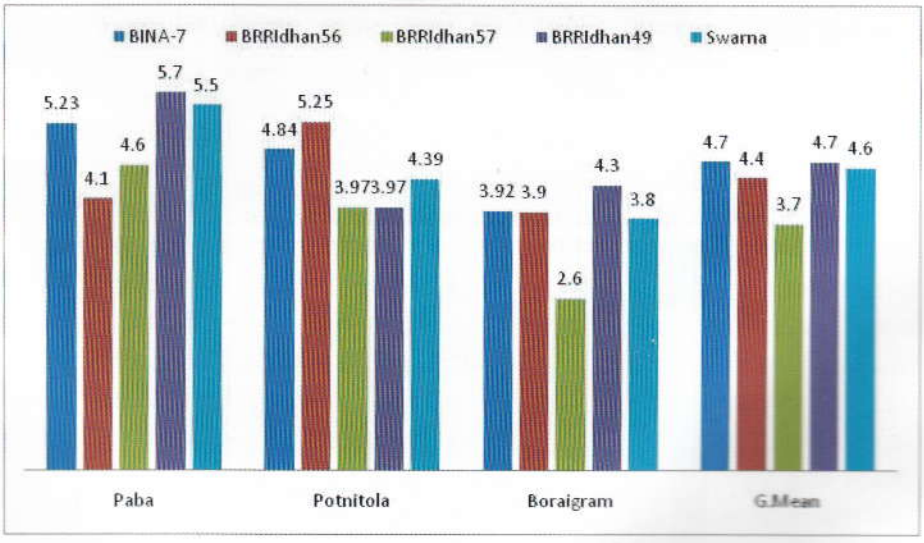


Fig. 2. Comparative yield (t/ha) performance of different rice varieties from baby trials in 3 upazillas under varying degree of rainfed drought environment, T. Aman 2012 (mean of 3 farmers yield).



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Problem: Rice sheath blight disease is increasing with increasing temperature and humidity and causes significant yield loss.

Model: Effectiveness of Practiced management options to control Sheath blight disease.

Objectives: To identify sustainable management options for sheath blight disease.

treatments if necessary. Harvest crops at maturity. Take data of Sheath blight and yield for comparison with treatments of the expt.

Data Recording: The following data are to be recorded -

- Name of the cultivar
- Date of seeding
- Date of transplanting
- Seedling age
- Fertilizer rate per 33 decimal i. e. 1 bigha

* Urea
* TSP
*o MOP
* Gypsum etc

- Sheath blight incidence record

* Count number of hills infested with Sheath Blight disease from randomly selected 20 hills each from experimental plot (from each Treatment) and farmers managed plot (Control)
* Take note of relative lesion height e,g. lesion observed on flag leaf sheath (top leaf), 2nd leaf and sheath, 3rd leaf sheath or below 3rd leaf sheath.

- Date of 50% flowering
- Date of 100% flowering
- Date of Maturity
- Date of harvest
- Harvest 10 m^2 for each treatment for yield and yield components
- Record any other incidence if any example strong wind at flowering, crop faced prolong drought at tillering stage/PI/Flowering stage etc

Results:

This experiment was conducted in 45 farmer's field in 3 upazillas under SAFBIN project. The Mega variety Swarna is grown in the project areas which is highly susceptible to rice sheath blight disease and appeared as major constraint in rice production due to causes of significant yield loss by the disease. The objectives of this research were to minimize yield loss and reduction of primary inoculua, identify efficient and sustainable disease management options.

Key Management options were collection and buried Floating Debris (FD) after final land preparation (FD consisted of small dead snail, thousands of weed seed, floating sclerotia, live inoculum with previous crop residues, ratoon or volunteer rice and grass weeds, Pupae of different rice insects), top dressing MOP at PI stage (½ MOP of the recommended dose will be applied at basal and ½ at the PI which is generally coincide with last top dress of urea) and Fungicide application (Folicur). Which had been laid out to 10-15 decimal land, for each treatment, for each farmer, considered as replication. Each plot was divided into two equal splits, one split was used for imposing treatment another split as disease control. There were 5 treatments as follows:

T_1: Collection of Floating Debris (F.D)

T_2: Chemical (Folicur)

T_3: ½ of Basal Potash

T_4: F.D +Chemical (Folicur)

T_5: Chemicals + ½ of the MOP with 2nd top dress of urea

All other fertilizers especially urea, TSP, Gypsum and $ZnSO_4$ and other management options were equal for each treatment.

Sheath blight disease was controlled successfully almost by all treatments except T_3 where all other fertilizers applied according to recommended dose(RD) except potash only ½ of the RD was applied in this treatment. Disease incidence and yield in T_3 was at per with control (Fig. 1-3). Among the treatments, the least disease incidence was recorded in T_4 followed by T_2 and T_5. In fact, there were no statistically significant differences among them (Fig. 1.). A similar trend also revealed for disease reduction (Fig.2). The grain yield advantage ranged from 0.0-0.5 7 t/ha. The highest

yield advantages 0.57 t/ha was recorded for T_4 where floating debris was collected along with chemical spray applied (Fig.3). Almost equal yield advantages was obtained from T_5 (0.55 t/ha). This followed by T_2 (0.41 t/ha). Statistically these three treatments are similar for obtaining grain yield advantage. In contrast, no yield advantage was noted for T_3 where half of the K was applied along with other fertilizers. Since, pesticidal control measure adds cost of production as well as contribute to environment pollution and our findings clearly indicates that collection of FD + ½ MOP T_5 is equally effective as FD + Chemical T_4 therefore, the T_5 could be a sustainable sheath blight disease management options and could be suggested to farmers after further fine tuning.

Fig. 1. Incidence of sheath blight disease to different management options and respective control treatments

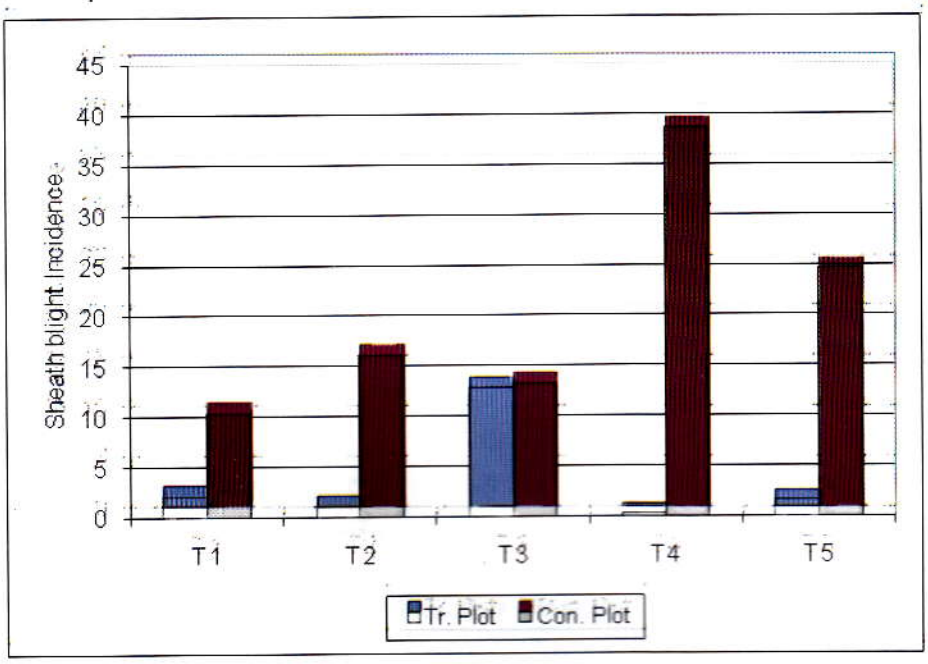


Fig.2. Sheath blight disease reduction (%) over control as shown across treatments

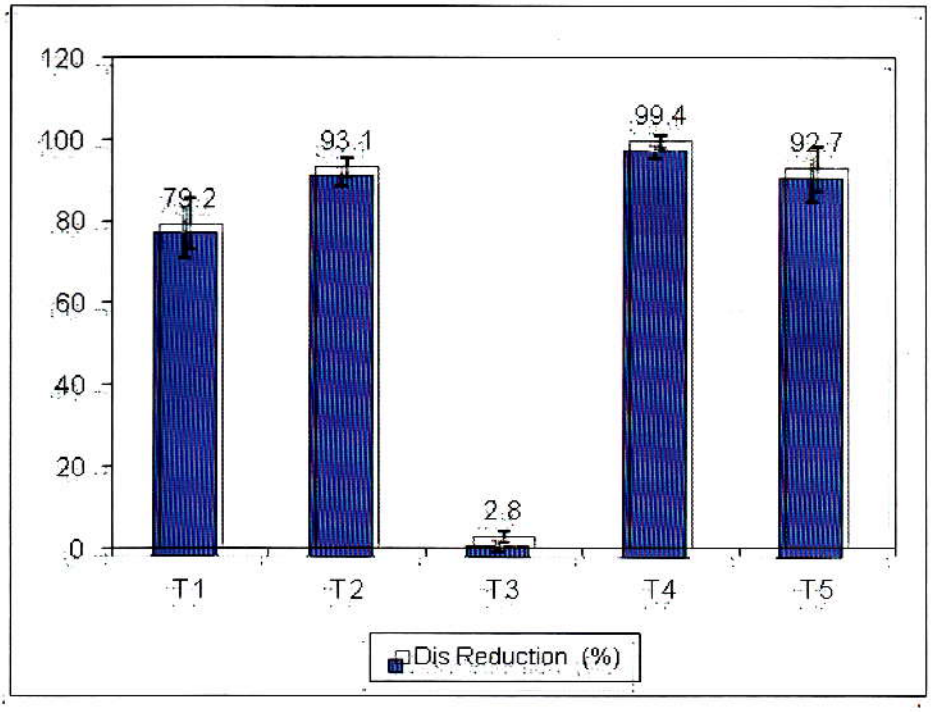
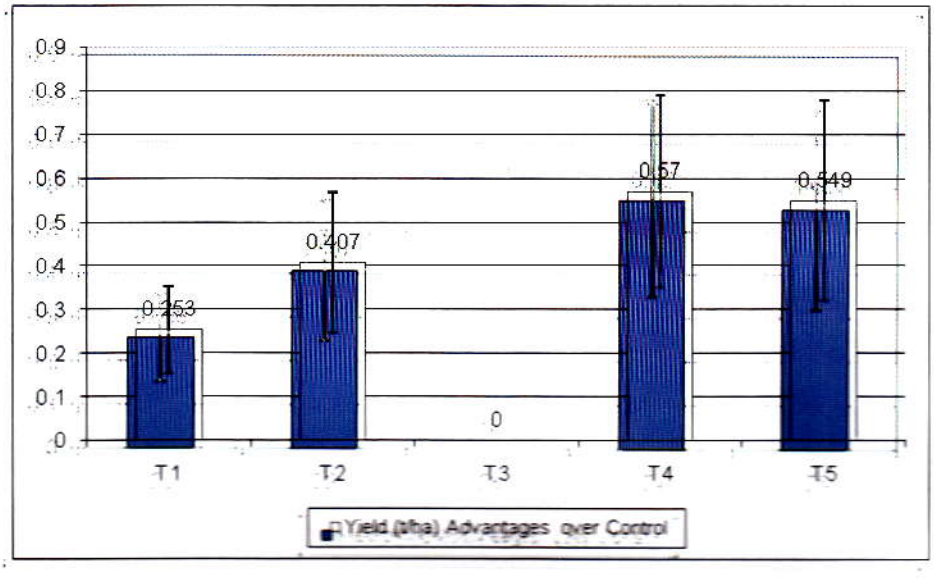


Fig. 3. Comparative yield advantages among the treatments (± bar indicates standard deviation)



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Problem: Less organic matter, less fertility and water holding capacity of soil.

Model: Effect of different sources of organic fertilizer with different combination of N, P and K on yield and yield component of rice in drought prone rainfed ecosystem.

Objectives:

1. To identify best source of organic fertilizer & optimum combination of urea & MOP for achieving of high yield.
2. To improve & sustain soil health and water holding capacity in order to minimize drought effect.

Research Act-2.3: Effect of different sources of organic fertilizer with different combination of N, P and K on yield and yield component of rice in drought prone rainfed ecosystem.

Problem: Less organic matter, less fertility and water holding capacity of soil.

Model: Combination organic and in organic fertilizer.

Objectives

1. To identify best source of organic fertilizer and optimum combination of N (Urea) and K (MOP) for achieving high yield
2. To improve and sustain soil health and water holding capacity in order to minimize drought effect

Materials and Methods:

Experimental design: Randomized Complete Block design will be followed.

Factor 1: Organic manure of two different types:

1. Poultry litter @ 3 t/ha (A)
2. Farm Yard Manure @ 3 t/ha (B)
3. None (check) (C)

Factor 2: Chemical fertilizers with various doses:

1. Nitrogen: ½ of the recommended dose + ½ of MOP +½ TSP =(D)
2. Nitrogen: ½ of the recommended dose + ¼ of MOP +¼ TSP = (E)
3. Full (N) + Full (P) + Full K = (F)
4. None (G)

Replications: 3

Teatment combinations: 3 (Factor 1) x 4 (Factor 2) = 12

Plot size: 3m x 4 m; Cultivar: Guti Swarna Seedling age: 29 days

Spacing: 25 cm x 15 cm

Treatment combinations: There will be 12 treatment combinations as follows:

T_1 = A+D	T_5= B+D	T_9 = C+D
T_2 = A+E	T_6= B+E	T_{10} = C+E
T_3 = A+F	T_7=B+F	T_{11} = C+F
T_4 = A+G	T_8= B+G	T_{12} = C+G

Fertilizer dose: Urea: 180 kg/ha, TSP: 75 kg/ha and MOP: 90 Kg/ha. Land preparation was done using power tiller. Poultry litter (PL) or Farm Yard Manure (FYM) were incorporated 7-10 days before final land preparation that allowed decomposition. Except urea, TSP, MOP and Gypsum were before final land preparation as per treatments. Two to three seedlings were transplanted having spacing 25 cm x 15 cm. Levee was constructed alongside each plot having 20 cm height. Manual weeding (3 times) and stem borer was controlled by virtako. Data such as lodging, flowering, productive tillers, plant height, grains per panicle (10 panicle per plot), thousand grain weight (TGW), date of maturity, straw and grain yield were recorded. In addition, metrological data were also undertaken. Data were analyzed by MSTAT-C.

Results

Two sources of organic fertilizer poultry litter (PL) and Farm Yard Manures (FYM) along with different combination of urea (N), TSP (P) and Muriate of Potash (K) on different yield contributing variables of rice in drought prone rainfed ecosystem are presented in Table 1. Except plant height, statistical analysis of the productive tiller, panicle length, grains per panicle, TGW and yield were done. Mean separation was done by using Least Significant Difference (LSD) value at 0.05% level.

Plant height

Plant was affected by different treatment that ranged from 91 cm in to the highest 132 cm T_2. The highest plant height was noted in T_2 this followed by T_1 (127.5 cm) and T_7 & T_3 (124.0 cm). In contrast, the lowest plant height was recorded in T_9 where only FYM was applied @ 3.0 t/ha and T_{12} (absolute control). Though multiple correlation analysis was not done however, in general optimum plant height is required to obtained high yield that seems to be recorded in the treatments those gave higher yield in this experiment (Table 1).

Fertile tillers/hill

Statistically significant variation was recorded among the treatments. The highest fertile tillers/hill (16) was recorded in the treatments T_7 where FYM + full doses of NPK were applied that was statistically similar with the treatments T_1 (PL+ ½ NPK dose), T_2 (PL+½N+ ¼ P + ¼ K) dose) and T_3 (PL+full NPK). All these treatments are associated with higher yield indicates that high yield can also be achieve by using less inorganic fertilizer as shown T_1, T_2 and T_3 (Table 1).

Panicle length, grains per panicle and TGW

Panicle length, grains per panicle and TGW significantly affected by the treatments as indicated for fertile tillers. Details of the results are shown in Table 1. Highest panicle length was associated in the treatments T_7 followed by T_3 and T_2. On the other hand, the lowest panicle length found in T_8 where only FYM was applied followed by T_{12} (absolute control). In general, similar trend found with grains per panicle. TGW though varied among the treatments statistically however, except T_8 and T_{12} having the least value while others were not significantly different from each other.

Table-1. Summary result of the interaction effect of fertilizer doses and organic matter on productive tiller, plant height, panicle length, thousand grain weight, grains per panicle, straw and grain yield of Swarna, T. Aman 2012

Treatments	Plant height (cm)	Fertile tiller/hill (nos.)	Panicle length (cm)	Grains per panicle (nos.)	Thousand grain weight (g)	Yield (t/ha)
T1	127.5	15.0 a	28.5 a	135.0 a	23.0 a	5.58 a
T2	132.0	13.0 a	26.6 a	133.2 ab	23.0 a	5.0 ab
T3	124.0	14.8 a	28.9 a	134.0 a	23.01 a	5.60 a
T4	117.0	11.2 ab	27.6 a	128.1 b	22.5 a	4.60 bc
T5	125.0	12.0 b	27.0 a	131.5 ab	22.8 a	5.00 ab
T6	122.0	12.0 b	27.5 a	127.3 b	22.3 a	4.50 bc
T7	124.0	16.0 a	29.0 a	136.0 a	23.0 a	5.60 a
T8	100.0	9.0 c	21.8 b	127.3 b	21.6 b	3.37 d
T9	91.0	11.6 ab	26.10 a	128.0 b	22.5 a	4.80 bc
T10	95.0	10.8 abc	24.5 a	128.3 b	22.1	4.20 c
T11	122.0	12.0 b	26.2 a	130.0 ab	22.7 a	4.90 abc
T12	95.0	8.0 c	22.5 b	125.8 b	21. 55 b	3.23 d
LSD (0.05)	NT	3.053	6.504	6.723	0.658	0.7704

Date of seeding: 01 July/12; Date of Transplanting: 29 July/12 and Date of Maturity: 10 Nov/12

Grain yield

ANOVA test of grain yield revealed that among the organic manure, fertilizer dose and their interaction effect are highly significant at .01% level (Table 2). Our results clearly indicates that the best organic source manure and their economic combination with inorganic fertilizer.

Table 2. Analysis of variance for yield

Source	Degree of freedom	Sum of Squares	Mean Square	F-value	Probability
Replication	2	0.108	0.054	1.5066	0.2437
Organic Manure (A)	2	5.107	2.553	71.0348	0.0000**
Fertilizer dose (B)	3	14.208	4.736	131.7552	0.0000**
Interaction (A x B)	6	1.245	0.207	5.7707	0.0010**
Error	22	0.791	0.036	-	-
Total	35	21.459	-	-	-

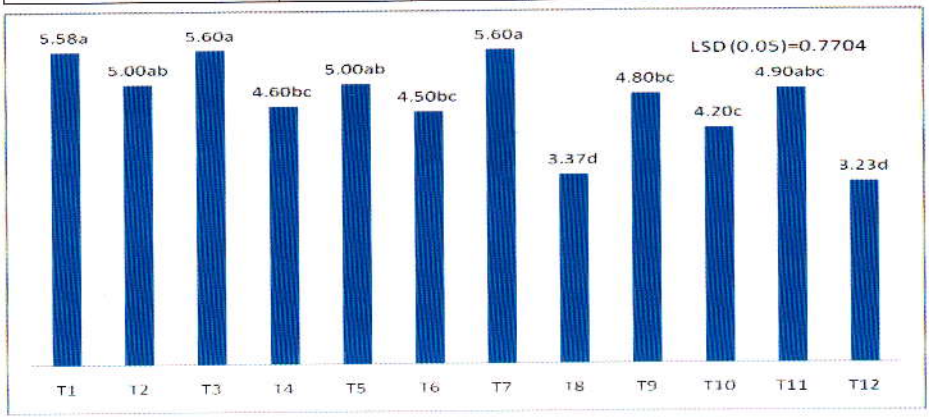
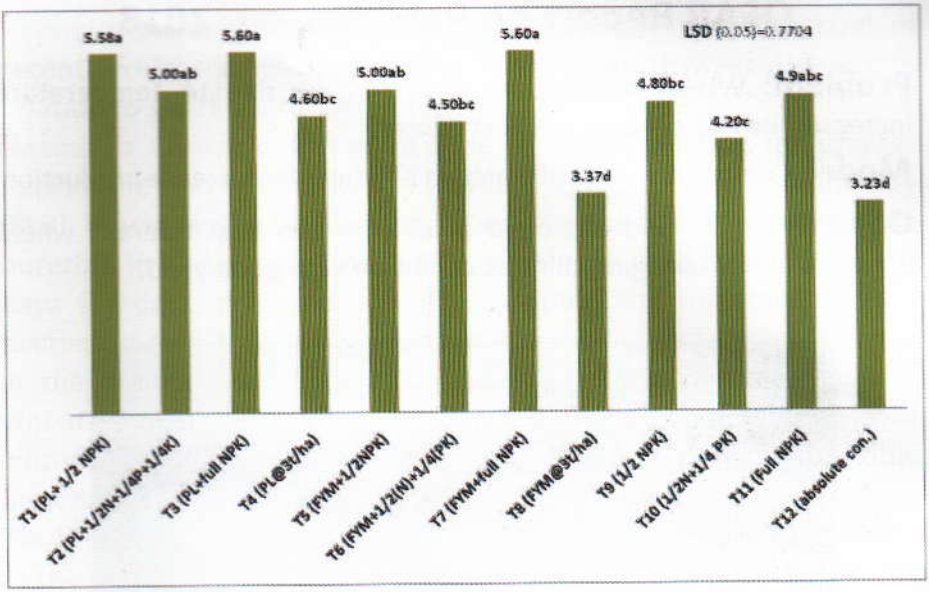


Fig. 1. Interaction effect of fertilizer doses and organic matter on yield of Swarna, T. Aman 2012.

Figure-1 revealed that the highest yield found in T_3 and T_7 (5.6t/ha) where either PL or FYM was applied along with full doses on urea + TSP + MOP. Almost similar yield was also recorded in T_1 where PL + ½ (NPK). This has indicated that ½ of the NPK could be saved in attaining similar level of grain yield if supplemented by PL @ 3 t/ha. T_2 and T_5 (5.0 t/ha) were in the next order of rice yield. Compared to the positive control (T_{11}) where all organic sources of fertilizer applied 0.7 t/ha a yeld advantage was obtained from T_1 where ½ NPK were used with PL. Full NPK + FYM or PL gave similar yield as found in T1. Our results also clearly indicated that Pl is better for supplementing P and K fertilizer compared to the FYM. We could not measure soil water holding capacity data due to unavoidable circumstances of rainfall however, soil organic fraction data and water holding capacity will be taken from on going rabi crops of this expt.


LSD (0.05)=0.7704
5.58a
5.00ab
5.60a
4.60bc
5.00ab
4.50bc
5.60a
3.37d
4.80bc
4.20c
4.9abc
3.23d
T1 (PL+ 1/2 NPK)
T2 (PL+1/2N+1/4P+1/4K)
T3 (PL+full NPK)
T4 (PL@3t/ha)
T5 (FYM+1/2NPK)
T6 (FYM+1/2(N)+1/4(PK)
T7 (FYM+full NPK)
T8 (FYM@3t/ha)
T9 (1/2 NPK)
T10 (1/2N+1/4 PK)
T11 (Full NPK)
T12 (absolute con.)

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Problem: Wheat production is decreasing due to temperature increased or late seeding or short winter.

Model: Comparative test of varieties of wheat for increase production.

Objectives: To find out most adaptable and heat tolerant wheat variety/s under changing climatic condition with good yield.

Experiment-1. Mother and on farm adaptive research trial of recently released wheat varieties in three north-west districts in relation to short winter on yield.

Research Concept: Optimum time of wheat seeding for greater Rajshahi region is 15 Nov. to 1st week of Dec. as recommended by BARI. However, the seeding time goes late due to cultivation of long duration in T. Aman season & rice remains in field for further 7-10 days for drying. In consequence, residual soil moisture further decreased resulting in poor germination and crop faces heat stress at the grain filling stage that causes huge reduction of yield of wheat. Since, very less water is required compared to rice cultivation therefore expansion of wheat in larger area is possible instead of rice cultivation using same amount of water.

Problem: Wheat production is low due to high temperature stress at the reproductive stage , less water use efficiency or late seeding or short winter.

Model: Comparative test of wheat varieties for increasing production.

Objective: To find out most adaptable and heat tolerant wheat variety/s under changing climatic condition with good yield

General Materials & Methods

The trial was conducted in three districts namely Rajshahi, Natore and Noagaon in each districts one upazilla was selected. The selected upazillas were Paba, Barigram and Patnitala respectively. Three wheat varieties, Prodip, Satabti and BARIwheat27 were used in this adaptive trial. A total of 54 trials (18 for each upazilla) were implemented. The plot size was 10-15 decimal. Seed rate was 120 kg/ha and seeding method was either line or broadcasting. Fertilizers were applied as recommended by BARI viz. Urea: 200kg/ha, TSP: 160 kg/ha, MOP: 40 kg/ha and Gypsum: 120kg/ha. Some farmers used compost in addition of fertilizer. In most instances 2-3 irrigation were applied. In case of partial irrigated condition: Except $^{1}/_{3}$ urea all fertilizers were applied before last ploughing and remaining $^{1}/_{3}$ ureas apply before 1st irrigation (21 days after seeding at crown root initiation stage). Data were analyzed by MSTAT-C & CROPSTAT.

The following data were recorded namely i. Date of seeding, ii. Amount of rainfall & number of rainy days iii. Drought period, iv. Foggy period, v. Number of irrigation, vi. Date of maturity, vii. Yield and yield components etc.

RESULTS & DISCUSSION

Mother Trials

Three mother trials were conducted in three upazillas Paba, Baraigram and Patnitala in rabi season 2012-2013. The experiment was laid out in RCB design with three replications. Details materials & methods, data collection and production practices are described in general materials and methods. Yield reduction was calculated following formula as described below:

Yield Reduction (YR) = (Grain yield in November seeding-Grain yield in December seeding)/Grain yield in November seeding*100

The objectives of these trials were to find out comparative yield performance at a glance in relation to climate change and to select the widely adaptable variety in context of farmer's preferences.

ANOVA analysis showed that location, variety and their interaction effect significantly varied at 5% level. Details of the results are presented in Table-1. The seeding time for Patnitala, Baraigram and Paba were 15, 19 and 26 November 2012.

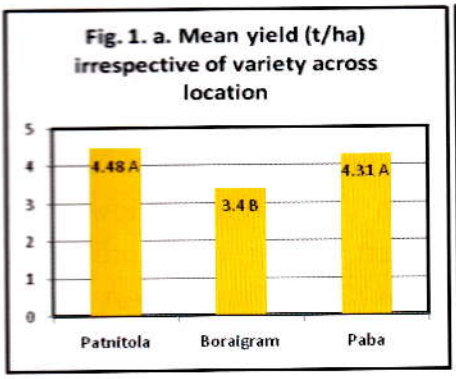
Table 1. ANOVA for grain yield of 3 wheat varieties using data from Mother Trials of 3 locations

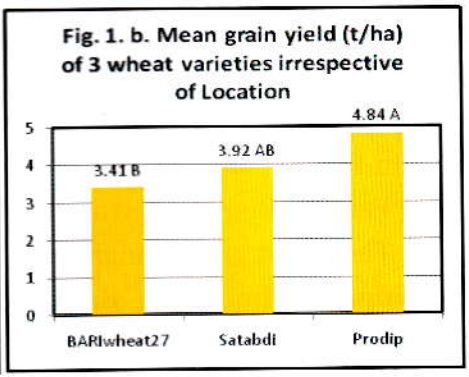
Sources of variation	Degree of freedom	Sums of squares	Mean Squares	F-Ratio	Prob.
Variety (V)	2	12.6943	6.34715	172.60	0.000
Location (L)	2	8.24521	4.12260	112.11	0.000
Replication	3	0.28475	0.94916	0.26	0.856
V x L	4	4 9.4084	2.35211	63.96	0.000
Residual	24	.882551	.367730	-	-
Total	35	31.2590	.893113	-	-

Growth duration of all three varieties were almost similar i. e. 113 days. However, growth duration varied among the locations that found lowest in Patnitala 108 days in contrast with the highest 118 days in Paba. A similar trend was recorded for number of rainless days. Fertile tillers/hill was highest in Baraigram and lowest in Paba. Thousand grain weight was highest (48.7 g) in Patnitola that was almost similar in Baraigram (47.3 g) but lowest Paba. Interaction effect between location and variety are presented in Table-2 and Fig-1. Among the varieties, Prodip gave the highest yield (4.84 t/ha) irrespective of location. This was followed by Satabdi (3.92 t/ha). Irrespective of varieties, highest yield was recorded in Patnitala (4.48 t/ha) subsequently found in Paba (4.31 t/ha) though there was no statistically difference.

Table 2. Yield and other ancillary performance of promising wheat varieties across location in mother trial, Rabi season, 2012-13.

Name of the Upazilla	Variety	Date of seeding	Growth duration (Days)	Rain Less (Days)	Fertile Tiller/hill	Thousand Grain Weight (g)	Yield (t/ha)
Patnitola	BARIGom-27	15.11.12	108	107	5	48	4.28 a
	Satabdi	15.11.12	108	107	5	46	3.80 ab
	Prodip	15.11.12	108	107	4	52	5.36 a
Mean			**108.0**	**107.0**	**4.7**	**48.7**	**4.5**
Baraigram	BARIGom-27	19.11.12	113	110	10	47	1.80 c
	Satabdi	19.11.12	115	112	10	46	3.80 ab
	Prodip	19.11.12	118	117	4	49	4.58 a
Mean			**115.3**	**113.0**	**8.0**	**47.3**	**3.4**
Paba	BARIGom-27	26.11.12	118	117	3	40	4.16 a
	Satabdi	26.11.13	118	117	4	46	4.16 a
	Prodip	26.11.14	118	117	4	49	4.58 a
Mean			**118.0**	**117.0**	**3.7**	**45.0**	**4.3**





Interaction of Genotype (Variety) X Environment (Location) was highly significant and summarized in Table-3. Irrespective of location, BARIwheat27 gave significantly higher yield in Patnitola and Paba, Satabdi performed best in Paba but considerably good yield also found in other two locations. Variety Prodip performed the best in all three location. In general, all three upazilla are suitable for wheat cultivation however appropriate varietal selection is required as BARIwheat27 is not suitable for Baraigram

Table-3. G X E interaction effect on mean yield (t/ha)

Location/Variety	BARIwheat27	Satabdi	Prodip	Mean
Patnitola	4.28 bc	3.8 d	5.36 a	4.48
Baraigram	1.80 e	3.8 d	4.58 b	3.40
Paba	4.16 bc	4.18 bc	4.60 b	4.31
Mean	3.41	3.92	4.84	4.10
LSD (0.05) = 0.28 & SE = 0.96				

Adaptive Research Trials

Fifty four adaptive research trials 18 for each upazilla were implemented under this field activity. Three wheat varieties Prodip, Satabdi and BARwheat27 were included in all those

upazillas. In Each upazilla 18 farmers were selected and seeds of each variety were cultivated by six farmers. The results of the adaptive research trials are presented variety wise in Table 3-5. Our results indicates that BARIwheat27, growth duration, fertile tillers, thousand grain weight and yield varied from one farmers field to another in most instances (Table-3). Growth duration ranged from the highest 118 days to lowest 107 days. This range agreed with the recommendation of BARI, 2011. Two main reasons been recorded for shortening growth duration by the field staff of Caritas i. e. moisture stress due to prolong drought or reduced number of irrigation applied. High temperature stresses perhaps another reason for shortened growth duration (GD). Among the upazilla highest GD (113 days) was recorded in Paba and the lowest in Patnitala (108 days). Rainless days was the lowest in Patnitala followed by Baraigram. Mean fertile tillers were same in Paba and Patnitala however higher (4.6/hill) in Baraigram. Thousand grain weight ranged from 41 to 31 g with grand mean 46.3 g and varied across the location. The highest mean grain yield was recorded in Paba (3.85 t/ha). This was followed by Patnitala (3.5 t/ha) and the least in Baraigram (3.37 t/ha). Correlation coefficient between fertile tillers/hill and thousand grain weight on yield was weak r=0.35 and 0.15 respectively.

Table-4. ANOVA for grain yield of wheat varieties across locations

Sources of variation	Degree of freedom	Sums of squares	Mean Squares	F-Ratio	Prob.
Variety (V)	2	0.8772	0.4386	1.04	o.366
Location (L)	2	3.6026	1.8013	4.25	0.021
Replication	5	3.8974	0.7794	1.84	0.126
V x L	4	4.5312	1.1328	2.67	0.045
Residual	40	16.950	0.4237	-	-
Total	53	29.858	0.5633	-	-

Growth duration (GD), rainless days and yield & yield contributing characters of satabdi are presented in Table-4. GD ranged from 109 to 116 days. Overall performance was better in Patnitala followed by Paba. In contrast, the variety poorly performed in Baraigram. The grain yield ranged from 1.5 t/ha to 5.0 t/ha across 18 farmers field. The mean grain was the highest in Patnitala (3.82 t/ha) followed by Paba and the lowest in Baraigram (2.74 t/ha). Linear positive correlation was found with tillers/hill and thousand grain weight on yield at R^2 = 0.855 and 0.833 respectively. The variety is highly sensitive to local environment and adaphic factors and overall performance was similar with BARIwheat27. This investigation indicated that BARIwheat27 and Satabdi are suitable for Patnitala and Paba not in Baraigram.

Fig. 4. Correlation of thousand grain weight and fertile tillers on yield of BARIwheat27

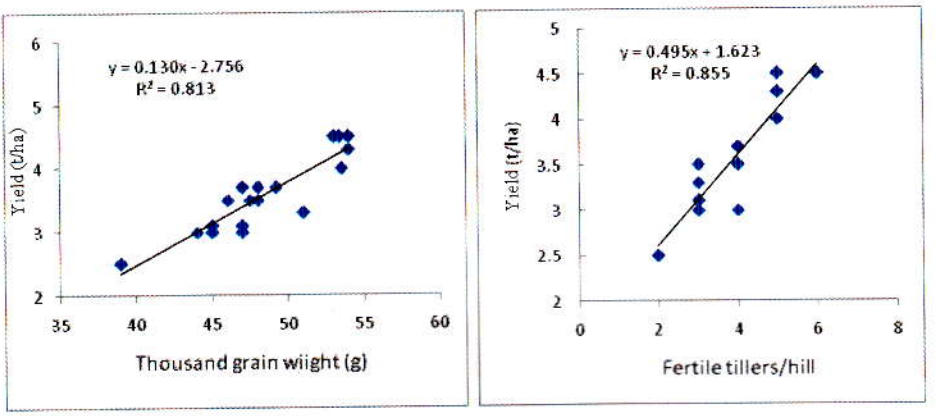
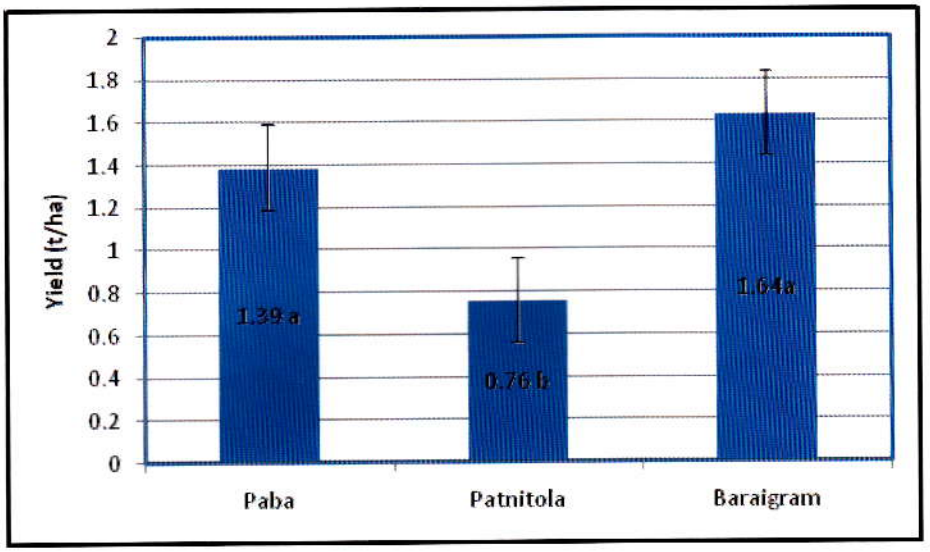


Fig. 12. Khesari yield in three locations, Rabi season 2012-13 (SE bar)



Experiment-4. Comparative on farm adaptation of different oil seed crops in different
ecosystem of North-west region of Bangladesh under changing climate situation.

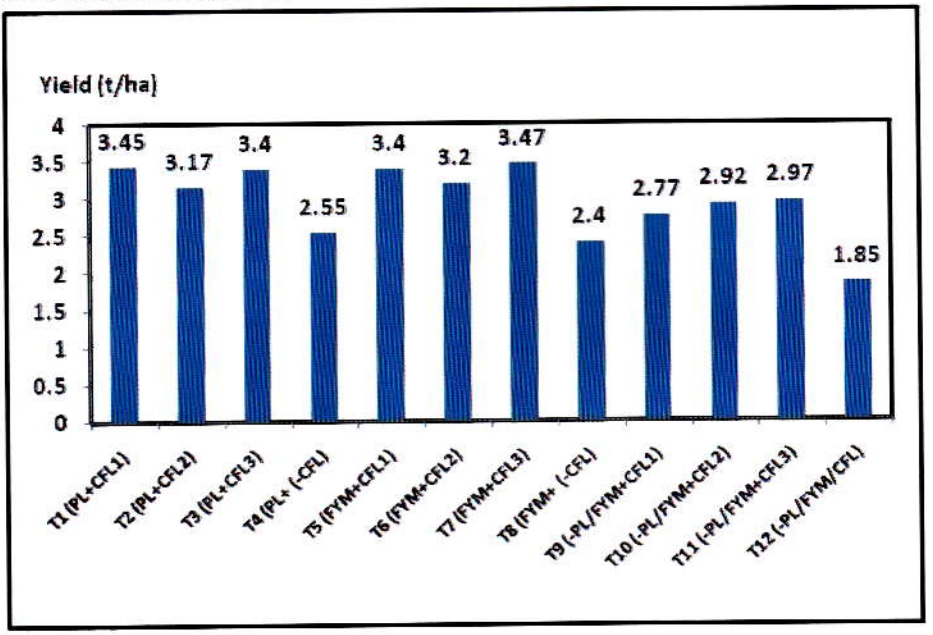
Problem: Vast area remain fallow after wet season aman rice harvest, limitation of water resources and all soil are not suitable for pulses and oil seed cultivation

Model: Increase productivity and profitability through introduction oil seed in T. Aman -Fallow cropping pattern

Objectives: To identify most suitable oil seed crop/s with specific soil types and ecosystem in rainfed condition (crop intensification).

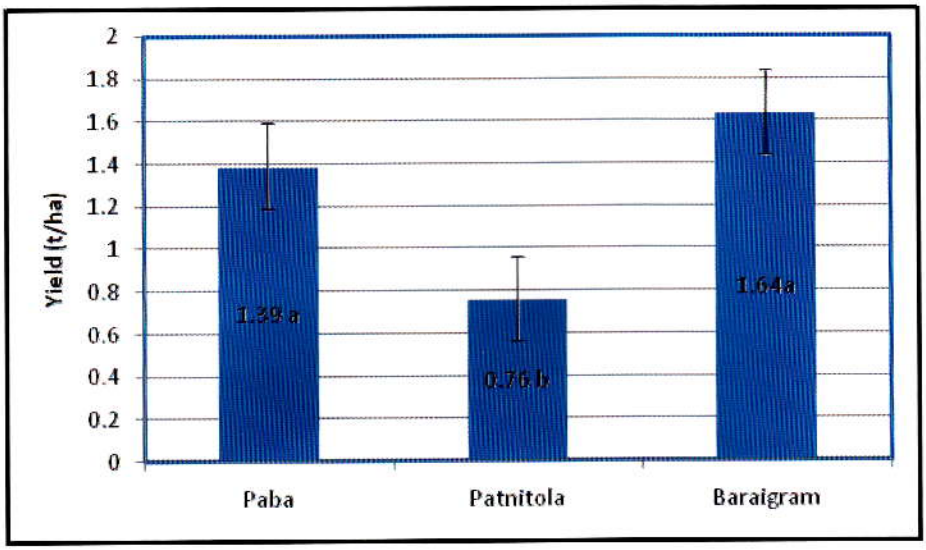
Materials & Methods: Two oil seed crops mustard and Lin seed were tested on farm in the project sites. The plot size was 400 sqm. BARISarisha14 and 15 were used in this trial. BARISarisha14 was cultivated in Patnitola in 9 farmers field while BARISarisha15 was tested in Paba and Baraigram upazilla (5 trial plots in each upazilla). In case of lin seed cv. Nila was used in all the trials. Lin seed was tested in 11 farmer's field, 5 fields in each of Paba and Baraigram and one trial in Patnitala. Seeds were sown through broadcasting. Seed rate of linseed was 7.0 kg/ha and mustard 8kg/ha. Seeds of linseed were sown 27 Nov-3 Dec. And mustard were sown 15-28 Nov. Fertilizers Urea: 75 kg/ha; TSP: 110kg/ha and MOP: 40 kg/ha were applied for

Fig. 3. Effect of organic and inorganic fertilizer on the yield of BARIwheat26, 2012-13



In conclusion, application of both poultry litter and farm yard manure @ 3.0 t/ha can save ½ of the recommended chemical fertilizers and may be recommended for scale up in the upcoming wheat growing season 2013. ¼th of p and K application along with ½ of the recommended doses of N required to validate further as nutrient composition of FYM in particular is composed as equal as PL. We could not monitor soil moisture using tensiometer however, it is generally believed that FYM improves soil organic matter contents better than PL and thereby increase water holding capacity to minimize drought stress.

Fig. 12. Khesari yield in three locations, Rabi season 2012-13 (SE bar)



Experiment-4. Comparative on farm adaptation of different oil seed crops in different
ecosystem of North-west region of Bangladesh under changing climate situation.

Problem: Vast area remain fallow after wet season aman rice harvest, limitation of water resources and all soil are not suitable for pulses and oil seed cultivation

Model: Increase productivity and profitability through introduction oil seed in T. Aman -Fallow cropping pattern

Objectives: To identify most suitable oil seed crop/s with specific soil types and ecosystem in rainfed condition (crop intensification).

Materials & Methods: Two oil seed crops mustard and Lin seed were tested on farm in the project sites. The plot size was 400 sqm. BARISarisha14 and 15 were used in this trial. BARISarisha14 was cultivated in Patnitola in 9 farmers field while BARISarisha15 was tested in Paba and Baraigram upazilla (5 trial plots in each upazilla). In case of lin seed cv. Nila was used in all the trials. Lin seed was tested in 11 farmer's field, 5 fields in each of Paba and Baraigram and one trial in Patnitala. Seeds were sown through broadcasting. Seed rate of linseed was 7.0 kg/ha and mustard 8kg/ha. Seeds of linseed were sown 27 Nov-3 Dec. And mustard were sown 15-28 Nov. Fertilizers Urea: 75 kg/ha; TSP: 110kg/ha and MOP: 40 kg/ha were applied for

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Problem: Vast area remain fallow after T-Aman rice harvest because of less soil moisture and all soil are not suitable for pulses and oil seed cultivation.

Model: Increase productivity and profitability through introduction Pulses and oil seed in T. Aman –Fallow cropping pattern and stability of them

Objectives: To identify most suitable pulse crop/s and oil seed crop with specific soil types and ecosystem in rainfed condition and increase crop intensification.

Fig. 2. Mean grain yield of wheat varieties (mean of six on farm adaptive trial data) irrespective of location (SE bar)

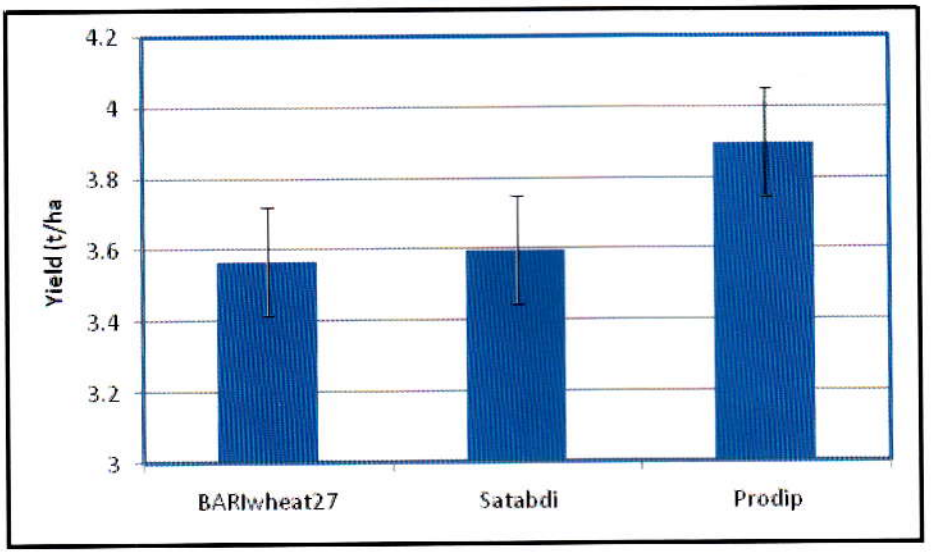


Fig. 3. Mean grain yield of wheat varieties (mean of six on farm adaptive trial data) irrespective of variety (SE bar)

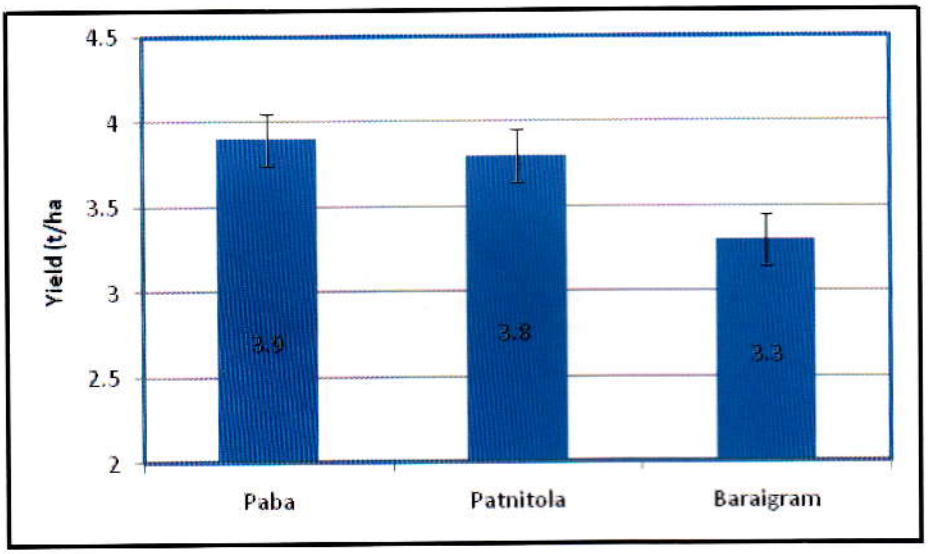


Table 5. Interaction effect between Location x variety on mean grain yield (t/ha) using data from on farm adaptive trials

Location/Variety	BARIwheat27	Satabdi	Prodip	Mean
Potnitola	3.51	4.2	3.65	3.79
Boraigram	3.36	2.74	3.83	3.31
Paba	3.85	3.81	4.1	3.92
Mean	3.57	3.58	3.86	3.67
LSD (0.05) = 0.76 & SE = 0.27				

Table 6. Relative adaptive performance of BARI-27 in Paba, Patnitola and Baraigram, Rabi season, 2012-13.

Location	Date of seeding	Growth Duration (days)	Rain Less (Days)	Fertile Tillers/hill	Thousand Grain Weight (g)	Yield (t/ha)
Paba	22.11.2012	118	117	4	47	3.0
	23.11.2012	113	112	5	53	4.5
	27.11.2012	112	111	5	54	4.3
	28.11.2012	111	110	6	53.4	4.5
	21.11.2012	114	113	3	51	3.3
	04.12.2012	112	111	3	48	3.5
Mean		**113**	**112**	3.7	46.3	3.4
Patnitala	28.11.2012	107	106	4	47	3.7
	24.11.2012	109	108	5	53.5	4.0
	24.11.2012	108	107	4	49.2	3.7
	20.11.2012	109	108	4	46	3.5
	26.11.2012	107	106	3	47	3.1
	14.11.2012	109	108	3	45	3.1
Mean		**108**	**107**	3.8	48.0	3.5
Baraigram	20.11.2012	111	108	4	47.5	3.5
	19.11.2012	114	111	4	48	3.7
	17.11.2012	115	112	6	54	4.5
	20.11.2012	111	108	3	44	3.0
	01.12.2012	111	108	3	45	3.0
	06.12.2012	110	107	2	39	2.5
Mean		**112**	**109**	3.7	46.3	3.4
Standard deviation						**0.50**
G. Mean		**111**	**110**	**4.0**	**46.3**	**3.57**

Table. 6. Relative adaptive performance of wheat variety Satabdi in Paba, Patnitola and Baraigram, Rabi season, 2012-13.

Location	Date of seeding	Growth Duration (days)	Rain Less (Days)	Fertile Tillers/hill	Thousand Grain Weight (g)	Yield (t/ha)
Paba	03.12.2012	115	114	4	46	3.2
	20.11.2012	119	118	4	47	3.5
	28.11.2012	112	111	6	50	4.5
	22.11.2012	114	113	3	47	3.2
	27.11.2012	118	117	7	49.5	5.0
	18.11.2012	108	107	4	41	3.5
Mean		**114**	**113**	4.67	46.75	3.82
Patnitala	27.11.2012	108	107	6	50	4.5
	24.11.2012	111	110	4	45	3.5
	24.11.2012	108	107	6	50	5.0
	18.11.2012	108	107	4	48	4.0
	26.11.2012	112	111	5	49	4.2
	24.11.2012	111	110	5	48	4.0
Mean		**109**	**108**	5.00	48.33	4.20
Baraigram	18.11.2012	118	115	3	44	2.5
	15.11.2012	117	114	6	50	4.35
	20.11.2012	115	112	4	47	3.5
	04.12.2012	117	114	3	38	1.85
	01.12.2012	116	113	2	28	1.5
	01.12.2012	115	112	4	45	2.75
Mean		**116**	**113**	3.67	42.00	2.74
Standard deviation						**0.94**
G. Mean		**113**	**111**	**4.17**	**45.33**	**3.58**

Across the location growth duration of Prodip ranged from 109-114 days. Details of the results are shown in Table-5. Rainless days were almost similar in all the location. Fertile tillers was the highest in Baraigram (5.5/hill) and lowest in Patnitola (3.7/hill). Thousand grain weight was highest in Paba (51.33), Baraigram was in the next order. Grain yield was highest Paba (4.07 t/ha) followed by Baraigram (3.83 t/ha). In contrast, the lowest yield was noted in Patnitala (3.65 t/ha). Linear correlation was recorded between fertile tillers/hill and grain yield R^2= 0.847while exponential relationship was associated between thousand grain weight and grain yield R^2 = 0.829 (Fig-3). Considering the adaptability of the varieties tested Prodip was identified as wider adaptable varieties in all three locations so was BARIwheat27while Satabdi performed poorly in Baraigram.

Fig. 5. Correlation of thousand grain weight and fertile tillers on yield of Satabdi

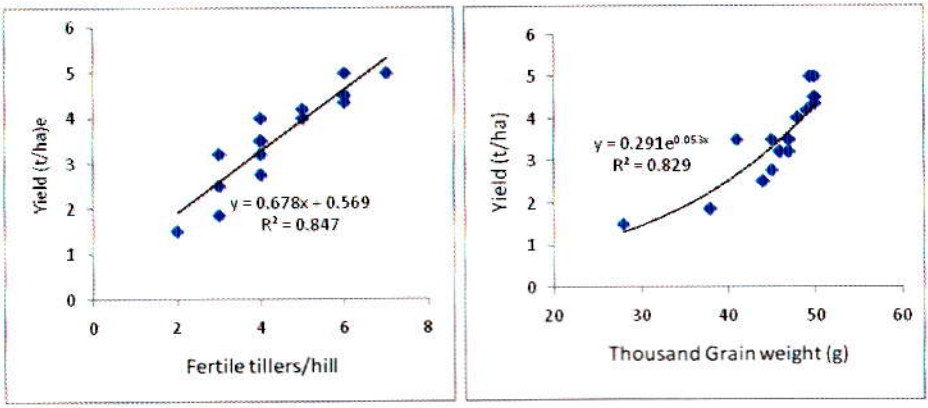
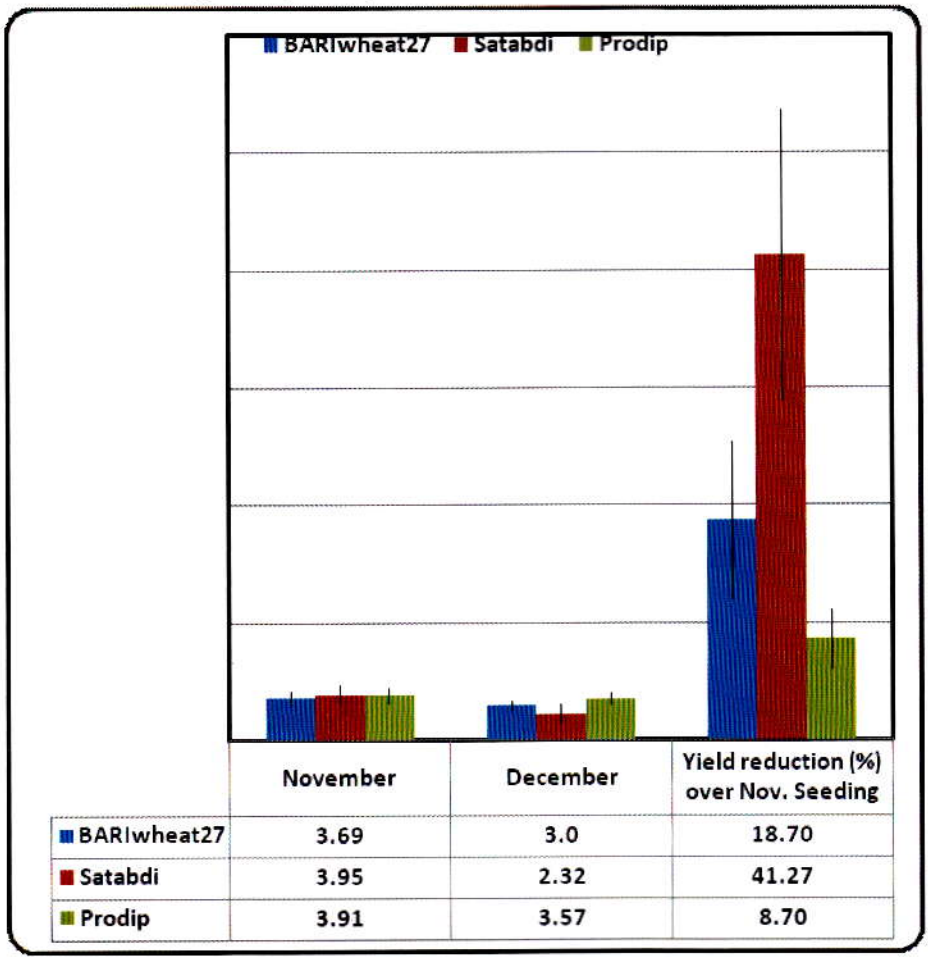


Table 7. Relative adaptive performance of wheat variety Prodip in Paba, Patnitala and Baraigram, Rabi season, 2012-13

Location	Date of seeding	Growth Duration (days)	Rain Less (Days)	Fertile Tillers/hill	Thousand Grain Weight (g)	Yield (t/ha)
Paba	01.12.2012	113	112	4	48	3.70
	22.11.2012	111	110	3	49	3.50
	19.11.2012	116	115	6	52	4.80
	21.11.2012	109	108	4	52	4.30
	30.11.2012	110	109	5	54	4.14
	04.12.2012	109	108	4	54	4.00
Mean		**111**	**110**	**4.3**	**51.33**	**4.07**
Patnitala	26.11.2012	111	110	4	48	3.50
	26.11.2012	108	107	3	47	3.00
	21.11.2012	109	108	4	48	4.00
	26.11.2012	105	104	5	49	4.50
	26.11.2012	111	110	3	48	3.70
	24.11.2012	107	106	4	47	3.20
Mean		**109**	**108**	**3.7**	**47.83**	**3.65**
Baraigram	17.11.2012	111	108	4	43	3.00
	14.11.2012	118	115	5	55	4.00
	05.12.2012	115	112	4	45	3.00
	18.11.2012	113	110	7	56	5.00
	15.11.2012	116	113	5	55	4.50
	19.11.2012	113	110	4	43	3.50
Mean		**114**	**111**	**5.5**	**49.5**	**3.83**
Standard deviation						**0.60**
G. Mean		**111.39**	**109.72**	**4.44**	**50.33**	**3.85**

From these adaptive trials it was noted that seeding time was a major factor for yield. Farmers those seeded within November got higher yield compared to December seeding (Fig-2). Individual wheat varieties responded in a different way (Fig-2). The highest yield reduction was recorded in Satabdi (41.27%) and Lowest with Prodip (8.7%). This result revealed that seeding time of Prodip had wider flexibility than Satabdi and BARIwheat27 in order to get optimum yield. Therefore, late cultivation of wheat Prodip would be a wise selection for the farmers. BARIwheat27 were not suitable for Baraigram. Among the location Patnitala and Paba were more suitable for wheat cultivation compared to Baraigram. Wheat cultivation using 2-3 supplemental irrigation instead of boro rice cultivation would save 3/4th amount of water. Consequently, depletion of ground water table could be maintained in a sustainable manner from further depletion in dry season.

Fig. 6. Effect of seeding time wheat on grain yield (t/ha), yield reduction and cultivar response (Sd bar).



	November	December	Yield reduction (%) over Nov. Seeding
BARIwheat27	3.69	3.0	18.70
Satabdi	3.95	2.32	41.27
Prodip	3.91	3.57	8.70

OFAR Report on Rabi Season 2013

Problem: Less organic matter, less fertility and water holding capacity of soil.

Model: Effectiveness of different organic and inorganic combination on soil fertility and water holding capacity.

Objectives:

1. To identify best source of organic fertilizer and optimum combination of N (Urea) P (MOP) and K for achieving high yield.
2. To improve and sustain soil health and water holding capacity in order to minimize drought effect.

Experiment -2: Effect of different sources of organic fertilizer with different combination of N, P and K on yield and yield component of wheat in drought prone rainfed ecosystem.

Problem: Less organic matter, less fertility and water holding capacity of soil.

Model: Combination organic and in organic fertilizer.

Objectives:

1. To identify best source of organic fertilizer and optimum combination of N (Urea) P (MOP) and K for achieving high yield.
2. To improve and sustain soil health and water holding capacity in order to minimize drought effect.
3. The best and most economic treatment/s will identified and be scale up through SAFBIN project.

Materials & Methods:

The experiment was conducted in Patnitola of Noagaon district. The experimental design was Factorial RCB with three replications. Land preparation was done properly using power tiller. Individual Plot size was 3m x 4 m. Cultivar was BARIwheat-26 and seeded in 30 November in line having spacing 25 cm x 15 cm. PL or FYM were applied 7-10 days before final land preparation. Inorganic (Chemical) fertilizers (IF) were applied during final land preparation. Fertilizer dose: Urea: 300 kg/ha, TSP: 125 kg/ha and MOP: 240 Kg/ha. Irrigation was applied twice at 21 days after seeding (CRI stage) and grain filling stage from pond water. Half of the urea and all other fertilizers were applied during final land preparation. The remaining urea was applied at CRI before 1st irrigation.

Two different sources of OM were used along with control that considered as Factor 1 and 3-levels of chemical fertilizers + control was considered as Factor 2 in this experiment.

Factor-1: Organic manure of two different types:

1. Poultry litter @ 3 t/ha (PL)
2. Farm Yard Manure @ 3 t/ha (FYM)
3. PL or FYM (Control)

Factor-2: Chemical fertilizers with various doses:

1. Nitrogen: ½ of the recommended dose + ½ of MOP +1/2 TSP =(CFL1)
2. Nitrogen: ½ of the recommended dose + ¼ of MOP +1/4 TSP = (CFL2)
3. Full (N) + Full (P) + Full K = (CFL3)
4. - CFL (Control)

Treatment combinations: There will be 12 treatment combinations as follows:

T_1 = PL+CFL1	T_5= FYM+CFL1	T_9 = -PL/FYM+CFL1
T_2 = PL+CFL2	T_6= FYM+CFL2	T_{10} = -PL/FYM+CFL2
T_3 = PL+CFL3	T_7= FYM+CFL3	T_{11} = -PL/FYM+CFL3
T_4 = PL+ (-CFL)	T_8= FYM+ (-CFL)	T_{12} = -PL/FYM/CFL

Data such as date of seeding, harvesting, fertile tiller, productive tiller, labor, straw yield, weather parameters, yield and yield components were recorded.

Results

Grain yield of wheat was influenced mainly by different chemical fertilizer level with organic fertilizers PL (Poultry Litter) or FYM (Farm Yard manure). ANOVA indicated that individual effect OM (Organic matter), IF (Inorganic fertilizer) & their interaction varied significantly for grain yield of wheat (Table-1). The main effect of organic manure varied statistically with control only. Both PL and FYM performed statistically similar for grain yield indicating either PL or FYM are equally effective irrespective of chemical fertilizer level (Fig.-1).

Table 1 . ANOVA for yield of wheat in integrated organic and inorganic fertilizer trial

Source of variation	Degree of freedom	Sums of squares	Mean squares	F-ratio	Probability
Organic Manure (OM)	2	2.033	1.016	15.80	0.0
Inorganic fertilizer (IF)	3	5.980	1.993	30.97	0.0
OM x IF	6	0.243	0.406	0.63	0.705
Residual	24	1.544	0.643		
Total	35	9.802			

Irrespective of organic manure, among the chemical fertilizer level CFL3 performed the best with mean grain yield 3.33 t/ha followed by statistically similar with CFL1 (3.20 t/ha) where ½ of the recommended chemical fertilizer applied with either PL or FYM. CFL2 were in the next order where ½ of the N and ¼th P and ¼th K were applied. In contrast, the lowest yield was recorded with absolute control where neither PL/FYM nor chemical fertilizers were applied (Table-2 and Fig-2). Our findings revealed that organic manure @3.0 t/ha along with ½ of the recommended chemical fertilizer might be sufficient to obtain optimum yield of wheat.

Table 2. Interaction effect of OM x CFL on mean yield (t/ha)

OM/CFL	CFL1	CFL2	CFL3	-CFL	Mean
PL	3.45	3.17	3.40	2.55	3.14
FYM	3.40	3.20	3.47	2.40	3.12
-PL/FYM	2.77	2.92	2.97	1.85	2.62
Mean	3.20	3.09	3.33	2.27	2.97

LSD 0.05 = 0.42

Fig. 1. Main mean effect of different sources of organic manure

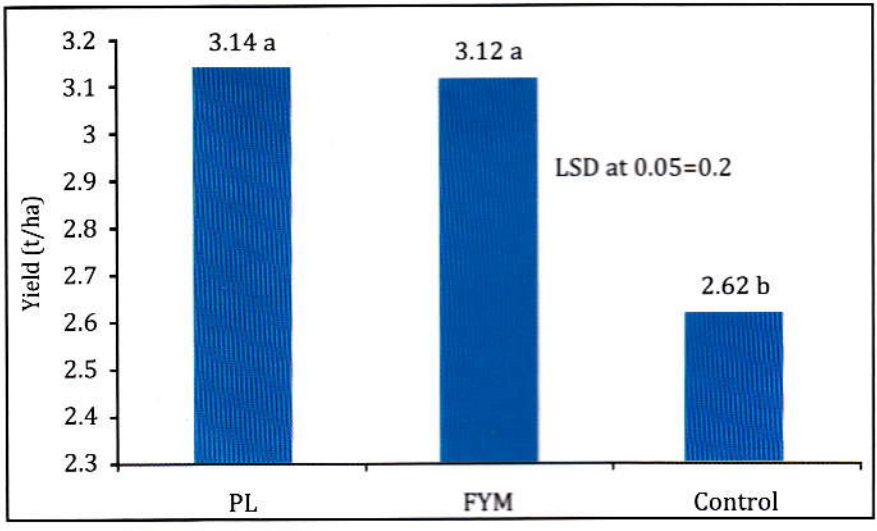
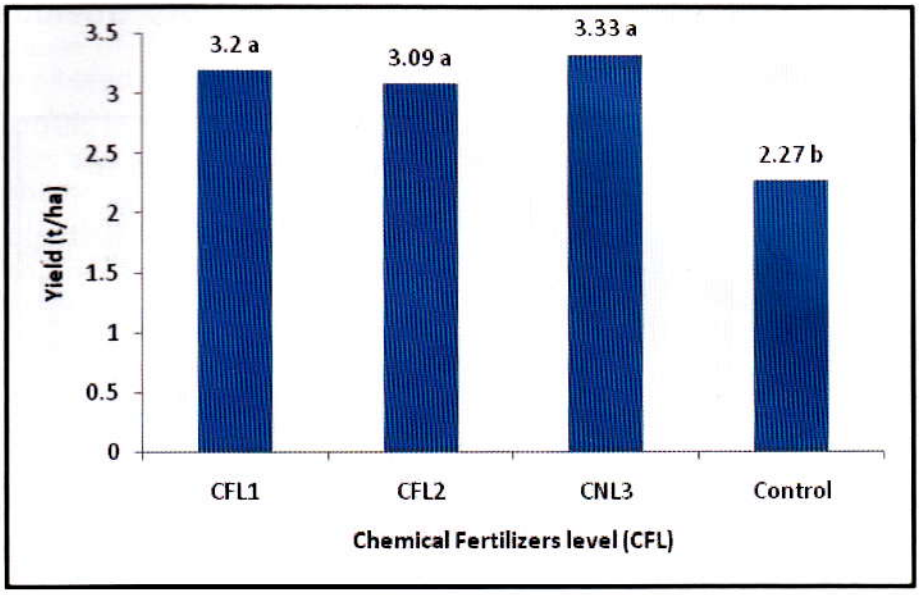


Fig. 2. Main mean effect of different doses of chemical fertilizers and control



Considering the overall combinations of OM & CFL, Fig-1 illustrated that the highest yield was noted in T_7 (3.47 t/ha) where recommended fertilizers along with FYM applied however, in T_3 where similar fertilizer applied and PL was used instead of FYM produced slightly lower yield (3.4 t/ha). It was observed that wheat plants in T_3 were lodged partially due to excess nutrient supply from PL and chemical fertilizer. Treatments T_1 and T_5, where ½ of the recommended fertilizers applied, slightly higher yield 0.05 t/ha advantage was obtained with PL (T_1). The crop suffers from 15 days foggy environment and receives 15 mm rain.

Experiment-3. Comparative adaptive performance different pulse crops in different
ecosystem under climate change situation.

Problem: Vast area remain fallow after wet season aman rice, scarce water resource and all soil are not suitable for pulses cultivation

Model: Increase productivity and profitability through introduction Pulses in T. Aman -Fallow cropping pattern

Objectives: To identify most suitable pulse crop/s with specific soil types and ecosystem in rainfed condition (crop intensification).

Materials and Methods

Three pulse crops; Lentil, Chickpea and Khesari were grown in farmers' field in the project sites (three upazilla). Each trial plot sizes were 400 sqm for all pulse crops. For lentil, a total of 16 adaptive trials were set in farmers' field under SAFBIN project. Of them 10 trials were in Baraigram, 5 in Paba and 1 in Patnitola. For chickpea and Khesari each of 13 trials were demonstrated with 5 trials for each crop and that was 3 trials in Patnitala. Land preparation and other crop husbandry activities were done as per recommendation described in research plan. Seeds were sown by broadcasting. The lentil variety was BARI-6, chickpea BARI-5 and BARI-6 and; Khesari BARIkhesari-3. Seed rate of lentil, chickpea and khesari respectively were 35, 60 and 60 kg/ha. Crop wise fertilizer rate were as follows:

Chickpea: Urea: 40kg/ha, TSP: 80kg/ha and MOP: 30 kg/ha

Lentil: Urea: 40kg/ha, TSP: 80kg/ha and MOP: 40 kg/ha .

Khesari Urea: 40kg/ha, TSP: 80kg/ha and MOP: 30kg/ha

Insect and disease were controlled by Simbush or Ripcord, Rovral-50 WP & Bavistin by many farmers as soon as infestation noticed. Data of growth duration, rainless days, seeding date, pod/pant, thousand grain weight and yield were recorded. Data were analyzed by statistical package of Excel and CROPSTAT for yield and yield contributing variables.

Results & Discussion:

Lentil

Growth duration, rain less days, pod per plant, thousand grain weight and yield were varied across the locations. Detail results are shown in Table-11. Strong correlation was found with pod/plant (R^2=0.818) but not with thousand grain weight (Fig.9). Irrespective of location the highest grain yield (2.3 t/ha) was found in 2 farmers field of Baraigram that seeded in 15 & 16 November. In contrast the least grain yield (0.7 t/ha) recorded in Patnitala seeded in the same date. Indicates that lentil is not adaptable in agro-climatic situation of Patnitala. Among the location, the mean yield also varied, the highest yield found in Baraigram (1.84 t/ha) followed by Paba (1.66 t/ha) and no significant variation was found among them (Fig-8). Seeding date showed great influence on grain yield (Fig-3). Farmers those seeded in 15-20 November got 22.3% higher yield compared to those seeded in 21-30 Nov (Fig-10).

Table 11. Performance of Lentil in adaptive trials across the 3 upazilla Paba, Patnitala and Baraigram, rabi season, 2012-13

Location	Date of Seeding	Growth Duration (days)	Rain Less (Days)	Pods/plant	Thousand Grain Weight (g)	Yield (t/ha)
Paba	20/11/12	112	111	75	22	1.60
	27/11/12	117	116	73	23	1.85
	13/11/12	112	111	75	24	1.90
	20/11/12	121	120	70	23.5	1.75
	04/12/12	102	101	58	24	1.20
Mean		**112.80**	**111.80**	**70.2**	**23.30**	**1.66**
Patnitala	15/11/12	130	129	25	22	0.70
Mean		**130**	**129**	**50**	**22**	**0.7**
Baraigram	28/11/12	105	102	49	18	1.30
	15/11/12	117	114	78	21	2.00
	16/11/12	111	108	40	18	1.50
	21/11/12	111	110	40	17	1.40
	18/11/12	107	104	80	20	2.00
	23/11/12	109	106	45	18	1.50
	19/11/12	116	113	78	20	2.00
	15/11/12	117	114	88	22	2.30
	19/11/12	113	110	80	20	2.10
	16/11/12	118	115	85	20	2.30
Mean		**112.40**	**109.60**	**66.3**	**19.40**	**1.84**
Sd						0.432

Fig. 8. Mean yield of lentil across location (bar indicates Sd = 0.432)

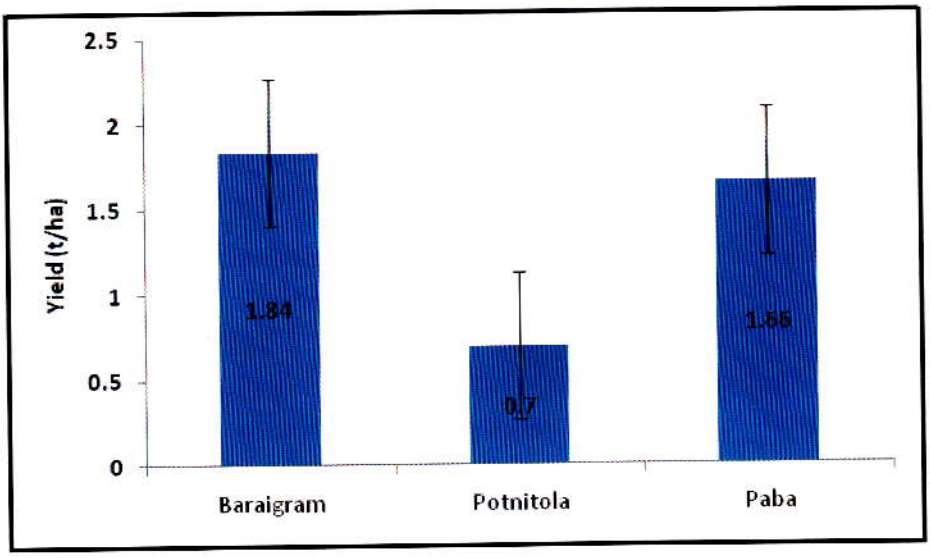
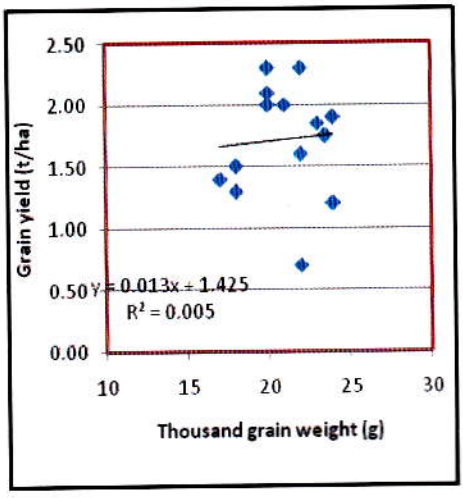


Fig. 9. Correlation of pod per plant and thousand grain weight on the yield of Lentil (data used from adaptive trials)



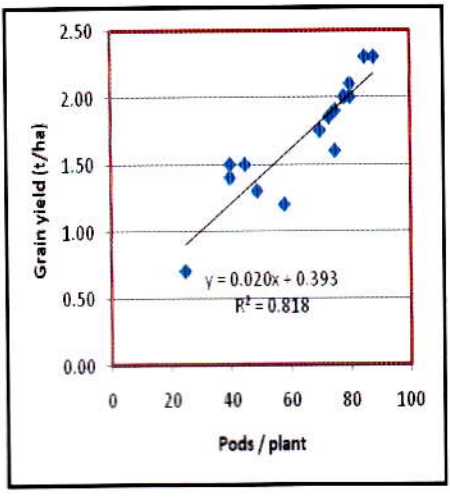
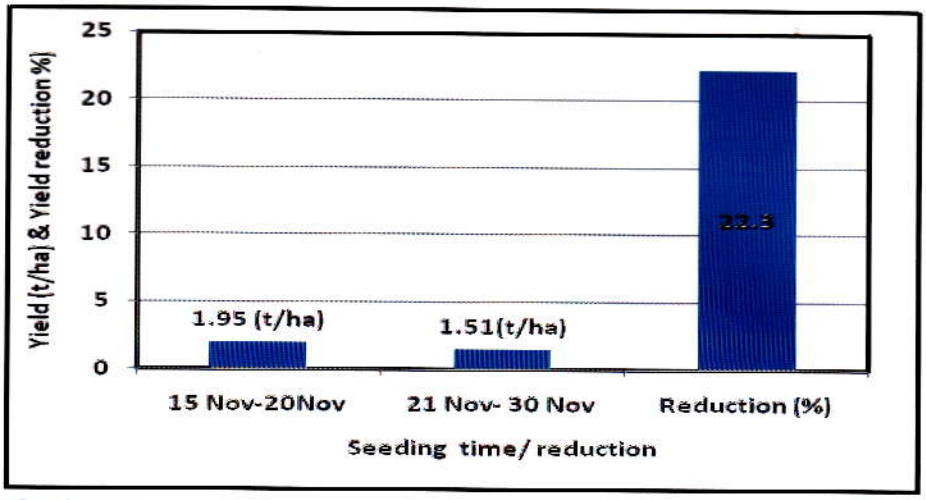


Fig. 10. Lentil yield influenced by seeding time irrespective of location and yield reduction



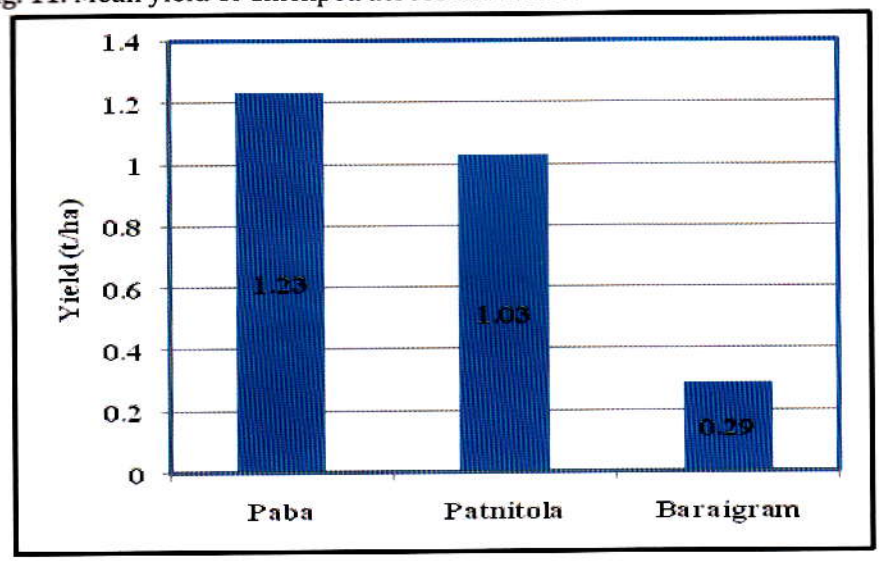
Chickpea

Yield and other ancillary characters are presented in details in Table-12. Irrespective of location and trials the highest yield (1.75 t/ha) recorded in Paba this was followed by 1.3 t/ha in the same location in two trials. Chickpea yield ranged from 1.75 -0.2 t/ha. The lowest yield noted in Baraigram. The location mean yield was highest in Paba (1.23 t/ha). In contrast, The lowest yield was found in Baraigram (0.3 t/ha). No significant variation was found of mean chickpea grain yield between Paba and Patnitola (Fig-11)

Table 12. Performance of Chickpea in baby trials across the 3 upazilla Paba, Patnitala and Baraigram, Rabi season, 2012-13.

Location	Growth Duration (days)	Rain Less (Days)	Pods/plant	Thousand Grain Weight (g)	Yield (t/ha)
Paba	127	126	44	95	1.30
	136	135	44.5	118	1.75
	138	137	55.5	110	1.30
	130	129	47	104	0.50
	129	128	44	80	1.30
Patnitala	122	121	57	118	1.10
	115	114	56	118	1.00
	121	120	50	116	0.98
Baraigram	128	125	30	80	0.325
	137	134	30	102	0.62
	122	119	16	85	0.125
	122	119	17	90	0.175
	96	93	7	95	0.20
Sd			16.69	14.47	0.53

Fig. 11. Mean yield of Chickpea across the locations



Khesari

According to Table 13 variation of Khesari yield significantly varied with probability 0.04 across the location. Results of the field performance of Khesari are presented in details in Table 14. Irrespective of location and trials the yield ranged from 0.65 -2.5 t/ha. Mean grain yield was highest in Baraigram (1.64 t/ha) followed by 1.39 t/ha in Paba. In contrast, the lowest yield was obtained in Potnitola 0.76 t/ha (Fig 12). This results indicates that soil as well as climatic condition of Baraigram and Paba are favorable for Khesari production compared to Potnitola. Out of 13 trials no irrigation was applied in 12 trials. Relay broadcasting of Khesari may be the another promising option where supplemental irrigation facilities are absent. However, the economic profitability is very less compared to lentil and chickpea.

Table 13. ANOVA for grain yield of Khesari across the location

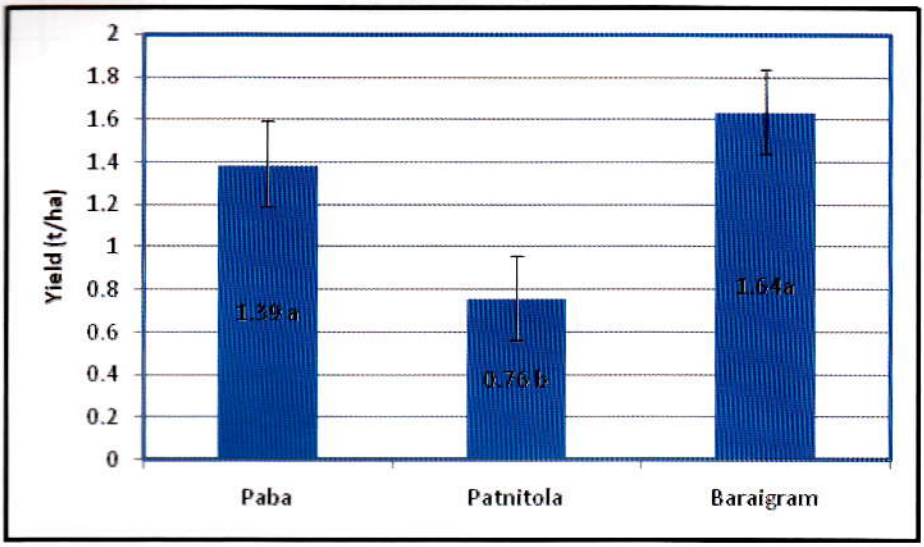
Source of variation	Degree of freedom	Sums of square	Mean square	F-ratio	Prob.
Location	2	2.05633	1.02817	4.70	0.04
Replication	4	0.90726	0.22681	1.04	0.446
Error	8	1.75053	0.21881		
Total	14	4.71413	0.33672		

LSD (0.05) = 0.682

Table 14. Performance of Khesari in baby trials across the 3 upazilla Paba, Patnitala and Baraigram, Rabi season, 2012

Location	Growth Duration (days)	Rain Less (Days)	Pods/plant	Thousand Grain Weight (g)	Yield (t/ha)
Paba	118	117	28	52	1.40
	130	129	25	51	1.37
	134	133	31	48	1.18
	124	123	26	51	1.50
	125	124	27	50	1.50
Mean	**126.20**	**125.2**	**27.4**	**50.4**	**1.39**
Patnitala	123	122	43	42	0.65
	122	121	45	41	0.7
	134	133	50	45	0.9
	125	124.5	46	42.7	0.75
	126	125	47	42	0.8
Mean	**126.00**	**125.10**	**46.20**	**42.54**	**0.76**
Baraigram	125	122	25	55	2.50
	129	126	28	49	1.40
	121	118	20	45	0.50
	123	120	35	55	2.30
	129	126	30	50	1.50
Mean	**125.40**	**122.40**	**27.60**	**50.80**	**1.64**

Fig. 12. Khesari yield in three locations, Rabi season 2012-13 (SE bar)



Experiment-4. Comparative on farm adaptation of different oil seed crops in different
ecosystem of North-west region of Bangladesh under changing climate situation.

Problem: Vast area remain fallow after wet season aman rice harvest, limitation of water resources and all soil are not suitable for pulses and oil seed cultivation

Model: Increase productivity and profitability through introduction oil seed in T. Aman -Fallow cropping pattern

Objectives: To identify most suitable oil seed crop/s with specific soil types and ecosystem in rainfed condition (crop intensification).

Materials & Methods: Two oil seed crops mustard and Lin seed were tested on farm in the project sites. The plot size was 400 sqm. BARISarisha14 and 15 were used in this trial. BARISarisha14 was cultivated in Patnitola in 9 farmers field while BARISarisha15 was tested in Paba and Baraigram upazilla (5 trial plots in each upazilla). In case of lin seed cv. Nila was used in all the trials. Lin seed was tested in 11 farmer's field, 5 fields in each of Paba and Baraigram and one trial in Patnitala. Seeds were sown through broadcasting. Seed rate of linseed was 7.0 kg/ha and mustard 8kg/ha. Seeds of linseed were sown 27 Nov-3 Dec. And mustard were sown 15-28 Nov. Fertilizers Urea: 75 kg/ha; TSP: 110kg/ha and MOP: 40 kg/ha were applied for

linseed while in mustard Urea: 125 kg/ha, TSP: 170 kg/ha, MOP: 90 kg/ha, Gypsum: 150 kg/ha $ZnSo_4$: 5 kg/ha and Boric acid 10 kg/ha. Melathion and Dithane-M45 were applied for aphid & alternaria disease control during foggy days by many farmers. Most farmers applied 1 irrigation for linseed while in mustard 1-2 irrigation was applied for mustard. Descriptive statistical analysis was done by Excel-2007.

Results & Discussion:

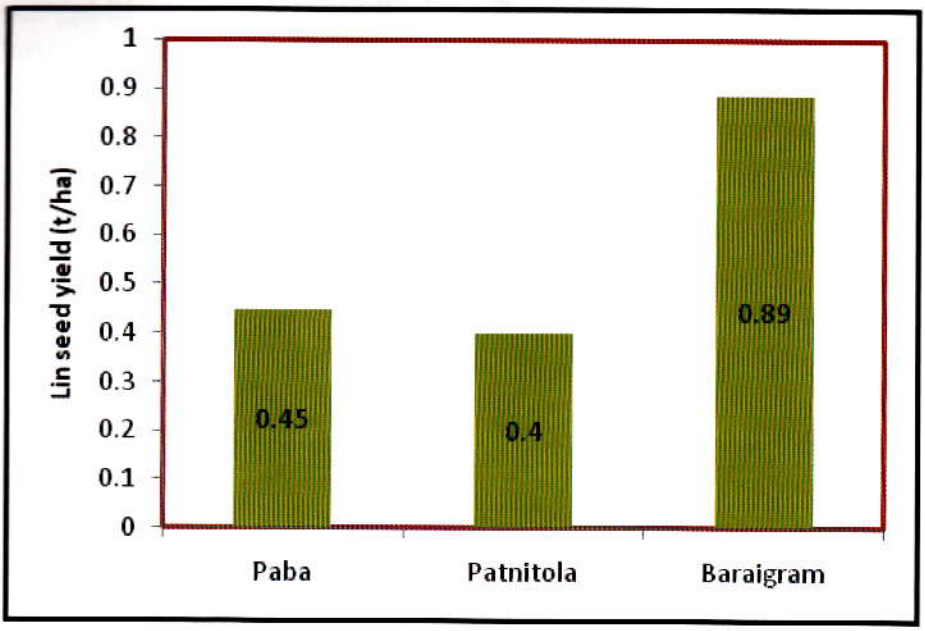
Linseed

Details of the result are shown in Table 15. Growth duration varied from one field to another within the location. Similar observation was recorded across the location. The mean growth duration was 117 days that ranged from 105-130 days. The crop faced 115 (mean) rainless days. The average pod/plant was 43.0 having minimum 16 and maximum 90. Mean thousand grain weight was 3.25 g. The highest linseed yield (1.25 t/ha) was recorded in Baraigram and lowest (0.04 t/ha) in Paba (Table-15).

Table 15. Detail performance of Linseed in adaptive trials across the 3 upazilla Paba, Patnitala and Baraigram, Rabi season, 2012-13

Location	Growth Duration (days)	Rain Less (Days)	Pods/plant	Thousand Grain Weight (g)	Yield (t/ha)
Paba	117	116	25	3.00	0.9
	105	104	15	2.90	0.04
	120	119	30	3.50	0.37
	113	112	55	3.80	0.86
	105	104	24	3.00	0.10
Patnitala	123	122	16	3	0.4
Baraigram	130	127	42	3	0.60
	117	114	42	3	0.61
	117	114	67	3.5	1.00
	120	117	68	3.5	1.00
	116	113	90	3.5	1.25

Fig. 13. Linseed yield across location in rabi season 2012-13



Significant variation of linseed yield was noted among the locations (Fig. 13). The highest mean grain yield was recorded in Baraigram (0.89 t/ha) that significantly differed with other two locations. There was no significant different of linseed yield of Paba and Patnitola. Linseed yield was mainly affected by moisture stress and date of seeding. Those farmers seeded within November and was applied at least one irrigation they got considerably good yield compared to complete rainfed and late seeding.

Mustard

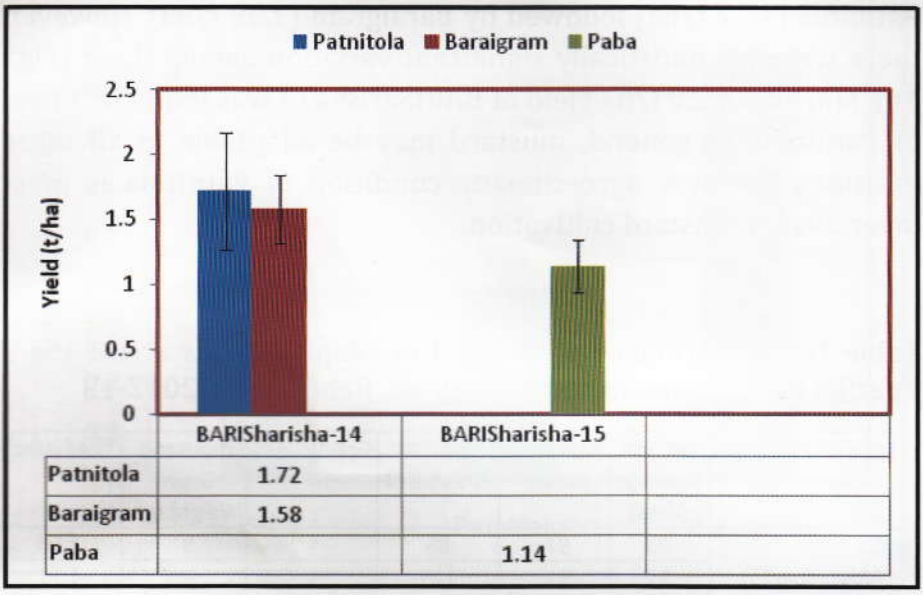
Results are shown in Table-16 and Fig-14. Ancillary characters, rainless days and yield contributing data are presented in Table-16. BARISarisha15 was grown in Paba upazilla only therefore relative performance particularly GXE interaction on yield could not be illustrated. However, the yield varied from one farmers field to another that ranged from 0.99 to 1.48 t/ha

having mean yield 1.14 t/ha. BARISarisha14 was demonstrated in Baraigram and Patnitola. And mean yield was the highest in Patnitola (1.72 t/ha) followed by Baraigram (1.58 t/ha). However, there were no statistically significant variation among them (Fig.-14). More than 2.0 t/ha yield of BARISarisha14 was found in 3 field of Patnitola. In general, mustard may be adaptable in all three locations however agro-climatic condition of Patnitola is most favorable for mustard cultivation.

Table 16. Performance of Mustard in adaptive trials across the 3 upazilla Paba, Patnitala and Baraigram, Rabi season, 2012-13

Location/Variety	Growth Duration (days)	Rain Less (Days)	No. of Pods/plant	Grains/ Pod	Thousand Grain Weight (g)	Yield (t/ha)
Paba (BARIsarisha-15)	98	97	85	-	5	1.00
	92	91	115	-	3	1.11
	103	102	95	-	3.1	0.99
	98	97	96	-	4.5	1.11
	97	96	75	-	4.85	1.48
Mean	97.6	96.6	93.2	-	4.09	**1.14±0.20**
Patnitala (BARIsarisha-14)	94	94	76	-	3	1.2
	95	94	77	-	3	1.2
	91	90	90	-	3	1.80
	97	96	116	-	4	2.10
	100	99	117	-	4	2.40
	91	90	85	-	3	1.50
	91	90	86	-	3	1.50
	95	94	117	-	4	2.30
	92	92	88	-	3.5	1.50
Mean	94	93.11	94.67	-	3.39	**1.72±0.45**
Baraigram (BARIsarisha-14)	94	91	75	25	4	1.30
	92	89	90	25	4	1.80
	103	100	85	20	4	1.50
	92	89	95	26	5	1.90
	91	88	80	26	3	1.40
Mean	**94**	**91**	**85**	**24**	**4**	**1.58±0.26**

Fig.14. Relative yield performance of mustard varieties and their yield potential and adaptive performance among the location



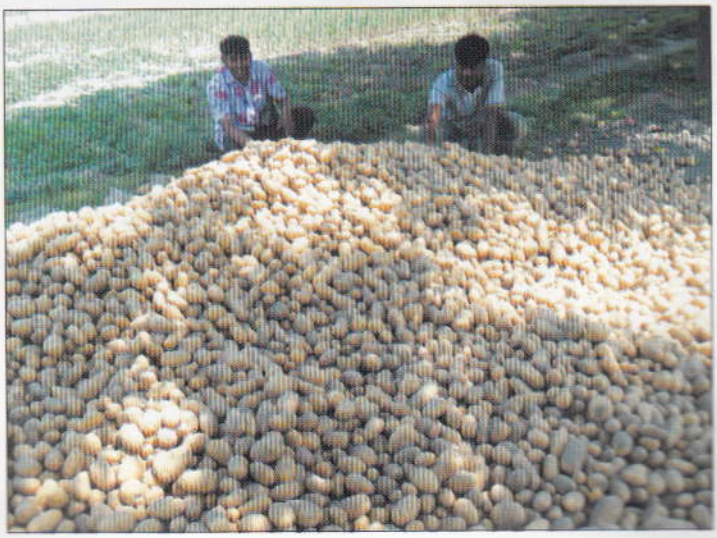
	BARISharisha-14	BARISharisha-15	
Patnitola	1.72		
Baraigram	1.58		
Paba		1.14	

OFAR Report on Rabi Season 2013

Problem: High incidence of late blight disease of potato due to increase of misty weather

Model: Performance assessment of IPM on late blight disease of potato.

Objectives: Increase yield by controlling late blight disease hence increase profitability.



Experiment-5. Integrated Management of late blight Disease of Potato

Problem: High incidence of late blight disease of potato caused by Phytophthorainfestans.

Model: IPM

Management options: Use Quality seed (Foundation seed), Chemical use, application of Ash and liquid soap

Objectives: Increase yield by controlling late blight disease hence increase profitability

Materials & Methods

This experiment was conducted in Paba site only. Potato cultivar Diamont was used in this trial. The soil was prepared properly as per recommendation. The experiment was laid in RCB design with three replications. Individual plot size was 12 sq. meter. Seed rate was 1.5 t/ha with spacing 45 cm x 25 cm following ridge and furrow method.Fertilizer doses were as follows:

Urea: 240 kg/ha
TSP: 135 kg/ha
MOP: 240kg/ha
Gypsum: 120 kg/ha
Boron: 10 kg/ha
Poultry litter (PL) (decomposed): 3t/ha

There were six treatments as follows:

T_1 = Quality Seed of potato (QSP) (Control)
T_2 =QSP + Fungicides
T_3 =QSP + Ash + Fungicides
T_4 =QSP + Spray liquid soap
T_5 =QSP + Ash + Spray liquid soap
T_6 = QSP+ Ash + Spray liquid soap +Fungicide

Fungicide: Ridomol (0.2%) and Dithen M-45 (0.2%) were sprayed alternatively.

Fertilizer application: ½ Urea and all other fertilizers were applied before final land preparation. While PL were applied 10 days before final land preparation and applied at 1stploughing followed by laddering.

Irrigation: Four irrigation were applied, 1st irrigation 10-15 days after seeding (DAS); 2nd irrigation 25-35 (DAS), 3rd irrigation 40-50 DAS and 4th irrigation 55-60 DAS.

Data recording: The following data were recorded from this experiment:

1.Growth duration, rainless days, plant heightnd tubers/plant
2. Number of late blight infected/dead plants
3. Yield data from whole plot 12 sqm area.

Results: The field was infested with aphid and late blight disease. Details of the ancillary characters are shown in Table 8. Growth duration and rainless days were similar irrespective of treatments. While plant height narrowly varied among the treatment. Similar observation was also found for tuber per plant. Tuber /pant varied from 9-14. ANOVA of tuber yield revealed that significant variation among the treatment at probability label (0.000) with LSD (0.05) = 4.17 (Table-9). Among the treatments the highest potato tuber yield was recorded in T6 (52.0 t/ha) where integrated all control measure variables. This was followed by treatments T_3 and T_5. Both these treatment were statistically identical with almost similar yield. These findings indicated that liquid soap might have some fungicidal effect as T_5 is comparable with T_3 where fungicide Ridomil and Dithane M-45 were applied. In contrast the lowest yield (32 t/ha) was recorded in control (T_1)

Application of fungicide along with quality seed were in the next order of effectiveness. Yield difference between T_1 and T_2 clearly indicated that ash had contributed to yield increase 8.0 t/ha. Ash is a good source of K, enhances soil moisture conservation and kept soil loose which in consequence perhaps enhanced to increase potato yield in T_2. Ash has also disease suppression effect. Comparison between T_1 and T_4, liquid soap influenced on yield increase by 4.2 t/ha (Table-8).

Potato late blight pathogen (Phytophthorainfestans) spore spread quickly to neighbor potato field in foggy warm condition through wind (air borne) and irrigation water. Therefore use of quality seed potato for late blight disease control may not be very effective to combat disease. And the disease is polycyclic therefore prophylactic control measure is necessary in advanced

growth period particularly from the initiation of tuber formation. Compared to the treatment T_5 and T_6, addition of fungicide application contributed yield 8 t/ha. Correlation of tuber/plant and blighted plant number on yield are shown in Fig-7. Yield was correlated having R^2 = 0.845 and 0.788 with tubers per plant and late blighted plants respectively (Fig- 7).

Table 8. Effect of different combination of potato late blight disease control methods on tuber yield

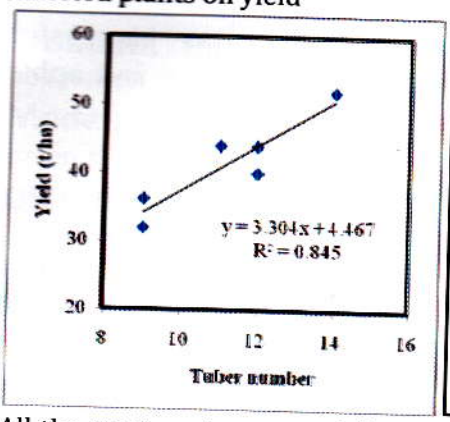
Treatment	Growth duration (days)	Rainless Days	Plant Height (cm)	Tubers/ Plant	Infected /dead plants (No.)/plot	Yield (t/ha)
T_1 = Quality Seed (QSP) (Control)	91	90	35.75	9	120	32.0 d
T_2 = QSP + Fungicides (F)	91	90	35.75	12	32	40 bc
T_3 = QSP + Ash + F	91	90	31.75	12	22	44.5 b
T_4 = QSP + liquid soap	91	90	33.00	9	68	36.2 c
T_5 = QSP + Ash + liquid soap	91	90	33.00	11	45	44 b
T_6 = QSP+ Ash + liquid soap +F	91	90	30.75	14	12	52.0 a
LSD (0.05)						4.17

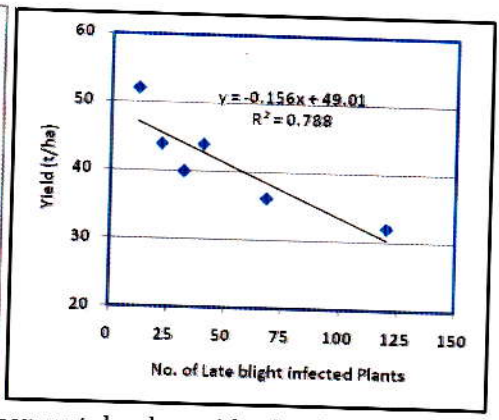
Table.9.ANOVA for potato tuber yield (t/ha)

Sources of variation	Degrees of Freedom	Mean Squares	Sum of Square	F Value	Prob
Treatment	5	730.76	146.147	27.8523	0.000
Replication	2	17.194	8.597	1.6384	0.2424
Error	10	52.472	5.247		
Total	17	800.403			

CV = 5.54 %

Fig. 7. Correlation of Tuber number/plant and number of late blight infected plants on yield





All the treatments were validated separately alongside the farmer's field of Paba. Each treatment was demonstrated in two farmer's field. In general, ancillary characters varied narrowly with mother trial. Greater variation of disease infested plant; yield and yield contributing characters was seen. However, the yield trend followed similar with mother trial across the treatment (Table 10).

Table 10. Performance of different control measures methods for controlling late blight disease of potato in farmers field and their impact on ancillary character and yield.

Treatment	Growth Duration (days)	Rainless Days (Days)	Plant Height (cm)	Tubers/Plant	Infected /dead plants (No.)/plot	Yield (t/ha)
T1	85	84	23.00	6	180	21.50
T1	105	104	33.83	5	185	19.00
Mean	**95**	**94**	**28.42**	**5.5**	182.5	**20.25**
T2	82	81	27.80	8	160	23.50
T2	91	90	29.36	5	163	25.00
Mean	**86.50**	**85.50**	**28.58**	**6.5**	161.5	**24.27**
T3	87	86	32.25	10	123	32.50
T3	94	93	22.16	8	129	29.00
Mean	**90.50**	**89.50**	**27.205**	**9.0**	126.0	**30.75**
T4	92	91	19.80	5	121	28.00
T4	85	84	23.00	7	154	25.00
Mean	**88.5**	**87.5**	**21.4**	**6.0**	137.5	**26.05**
T5	88	87	23.60	8	120	30.40
T5	88	87	23.83	9	119	31.00
Mean	**88**	**87**	**23.72**	**8.50**	119.5	**30.70**
T6	86	85	40.13	9	115	32.00
T6	83	82	26.20	11	98	36.00
Mean	**84.50**	**83.50**	**33.17**	**10**	106.5	**34.00**

This investigation though clearly showed that any of the individual options was not sufficient to control late blight disease of potato but integration of some of those options was successful. Application of liquid soap against late blight disease and aphid control needs further investigation.

OFAR Report on Rabi Season 2013

Problem: Onion seed setting hampered due to insufficient pollination hence low seed yield.

Model: Performance assessment of honey bee on pollination of onion flower.

Objectives: To familiarize farmer about beneficial effect of honey bee and capacity building in rearing them & also to increase seed production of onion and fruit setting in other cucurbitaceous crops hence increase income and improve their livelihood.

Experiment-6. Enhancing onion seed production through introduction of Honey bee box.

Problem: Onion seed setting hampered due to insufficient pollination hence low seed yield

Research concept: Onion seed is a high value agricultural input in Bangladesh. Seed production is largely hampered by lack of pollination due to insufficient presence of pollination vectors. Support of honey bee box (by Caritas) from commercial honey collector/farm may further increase the profitability of farm income to marginal and small farmers scale farmers.

Objective: To familiarize farmer about beneficial effect of honey bee and capacity building in rearing & also to increase seed production of onion and fruit setting in other cucurbitaceous crops hence increase income and improve their livelihood.

Model: Pollination of onion flower with honey bee for increased seed settings

Materials & Methods: The experiment was conducted in all three upazillas. The experiment was laid out in 4 clustered field in each upazilla and one of them was control without honey bee box. Local improved onion variety Taherpuri was used in all farmers field. Seed (bulb) rate was 1.2 t/ha. Planting time were 27 Nov to 01 dec, 2012. Spacing was 30 cm (line-line) and bulb to bulb 15 cm. Land prepared to attain fine tilth condition. Fertilizer doses were Urea: 240-250 kg/ha; TSP: 200Kg/ha; MOP: 175 Kg/ha and three farmers used compost. Compost + ½ urea + full TSP + ½ MOP were used before final land preparation and remaining ½ urea + ½ MOP applied 25 DAS and 50 DAS. Two to three irrigations were applied. Data of Seeding, weeding, irrigation, rainfall, rainy days, disease infestation were taken. Seed and bulb yield were recorded from 10 m^2 area.

Results: Onion seed production was hampered by purple blotch and stemphylum diseases hence both seed and bulb production were very low (Table-18). The results of Patnitola were not compiled in figure in order to avoid ambugity. The highest seed production 0.44 t/ha in Paba with honey bee pollination. This followed by 0.35 t/ha in control treatment in the same upazilla. In contrast, seed production in Baraigram was very poor (0.04-0.03 t/ha).

Table 1. Effect of honey bee pollination on seed and bulb yield of onion, rabi season, 2012-13

	Location	Seed	Bulb
Honey Bee	Paba	0.44	1.05
	Baraigram	0.04	1.72
	Patnitala	0.02	1.5
Control	Paba	0.35	0.86
	Baraigram	0.03	1.85
	Patnitala	0.10	2.00

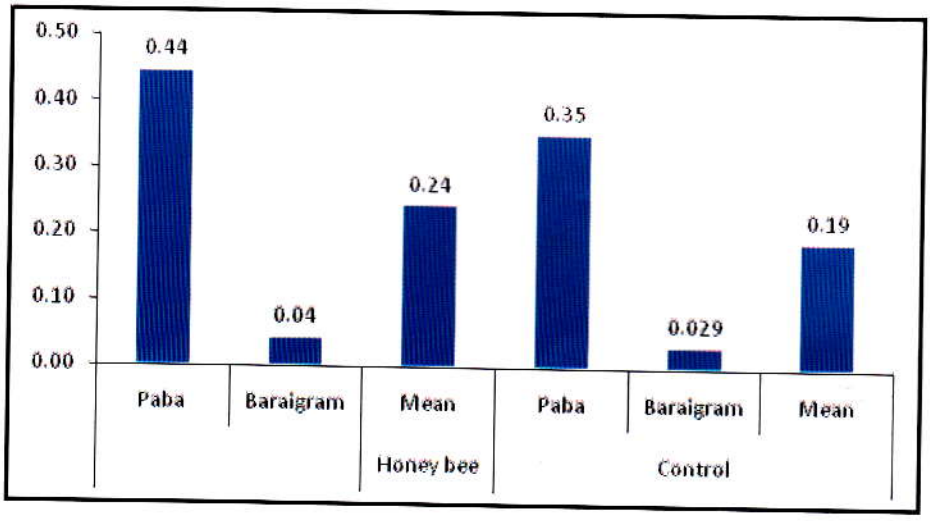


Fig. 1. Onion seed yield (t/ha) with and without honey bee pollination

Enhancing pollination by honey bee in seed setting though the mean value is higher compared to control but not satisfactory in terms of seed yield (Fig 17). This means the trial required validation with precise disease control steps. Our results indicate that soil and ecosystem of Baraigram and Patnitala may not suitable for onion seed production. Impact of honey bee pollination in seed setting, are not clear hence need further investigation. Dissemination of spores of purple blotch and stemphylum by honey bee also need detail careful investigation.

OFAR Report on Rabi Season 2013

Problem: All varieties of Mungbean do not perform well due to diverse micro climatic .

Model: Varietal Trial of Mungbean.

Objectives: Varietal Trial of Mungbean.

Executive summary

Mungbean is a high value drought tolerant pulse crop with less cost of production. Newly developed varieties (by BINA and BARI) are high yielding than traditional mungbean. Location specific adaptive performance had not been thoroughly investigated yet in rainfed environment with these new varieties. A comprehensive study was under taken under SAFBIN project of CARITAS Rajshahi. Under this research there were three research activities in three upazillas Paba, Patnitola and Baraigram of the districts Rajshahi, Noagaon and Natore during Khar if- 1 season, 2013. Problem statement, research model, objectives and materials & methods, are stated separately for each experiment.

The key findings are stated below

- Yield and yield component of mungbean was influenced by sources of nutrient (FYM, PL and Chemical fertilizer & combinations with FYM & PL). FYM found the best than PL.
- Farm yard manure (FYM) + combinations of chemical fertilizer was best compared to either sole chemical fertilizer or PL+ combinations of chemical fertilizers.
- The highest mungbean yield (1.15 t/ha) was found in treatments where FYM were applied @ 3.0 ton dry matter/ha in combination with ½ N + ¼ PK
- FYM @ 3.0 ton dry matter/ha produced mungbean yield 1.13 t/ha
- FYM + ½ NPK (T5) or sole chemical fertilizer ½ NPK gave slightly higher than 1.0 t/ha yield.
- In PVS/mother trials variety, location and their interaction were significantly affected mungbean yield.
- BINAmung-5 and BARImung-6 had remarkable effect on location. BINAmung-5 gave the highest yield (1.88 t/ha) among the varieties in Baraigram but not in Patnitola (0.93 t/ha). Therefore, BINAmung-5 should be recommended for cultivation in Baraigram.
- BARImung-6 was also performed better in Baraigram had an yield 1.3 t/ha may be recommended for maintaining varietal diversity.
- In Patnitola BINAmung-8 would be best so was BARImung-6. In terms of adaptability BINAmung-8 was wider adaptable in a range of microclimatic environment.
- In baby trial, seeding time remarkably affected mungbean yield. Seeding within 28 March-5 April the yield was 1.45 t/ha which gradually decreases 1.26 t/ha (06 -10 April), 1.01 t/ha (11-15 April) and 0.86 t/ha 16 April onward.
- Location had tremendous effect on yield of mungbean however, in this trial variety did not show any difference that conflicts the result of mother trial.
- It is recommended that Mungbean seeding should be within 15 March to 10 April to get good yield.

From the above trials, it may be concluded that mungbean is a high value crop with less cost of cultivation. Overall productivity had increased and soil health will improve. Location specific mungbean variety is suggested. However, BINAmung-8 had wider adoption ability and may also suggest for cultivation. Agroclimatic condition of Baraigram, Natore is most suitable for mungbean cultivation.

Research Act.-1: Effect of different sources of organic fertilizer with different combination of N, P and K on yield and yield component of mungbean in drought prone rainfed ecosystem of Patnitala.

Mungbean is a high value drought tolerant crop that increase farm profitability as well as plant residue incorporation improves soil health and water holding capacity. Therefore, this experiment was conducted in Patnitola, Noagaon during Kharif-1 season, 2013.

The problem stated in rain-fed ecosystem, model followed experimental design, objectives, land preparation, seeding, agronomic management and data recording are stated below:

Problem: Less organic matter, less fertility and water holding capacity of soil.

Model: Combination organic and in organic fertilizer.

Objectives:

1. To identify best source of organic fertilizer and optimum combination of N (Urea) P (TSP) and K (MOP) for achieving high yield
2. To improve and sustain soil health and water holding capacity in order to minimize drought effect

Experimental design: Factorial RCB design was followed.

Factor 1: Organic manure of two different types:

1. Poultry litter @ 3 t/ha (A)
2. Farm Yard Manure @ 3 t/ha (B)
3. None (check) (C)

Factor 2: Chemical fertilizers with various dose combinations:

1. Nitrogen: ½ of the recommended dose + ½ of MOP + ½ TSP =(D)
2. Nitrogen: ½ of the recommended dose + ¼ of MOP + ¼ TSP = (E)
3. Full (N) + Full (P) + Full K = (F)
4. None (G)

Replications: 3

Treatment combinations: 3 (Factor 1) x 4 (Factor 2) x 3 (Replications) = 36

Plot size: 3 m x 4 m

Cultivar: BINAmug-5

Seeding method: Broadcast

Seed rate: 40 kg/ha

Treatment combinations: There will be 12 treatment

T_1 = A+D	T_5= B+D	T_9 = C+D
T_2 = A+E	T_6= B+E	T_{10} = C+E
T_3 = A+F	T_7=B+F	T_{11} = C+F
T_4 = A+G	T_8= B+G	T_{12} = C+G

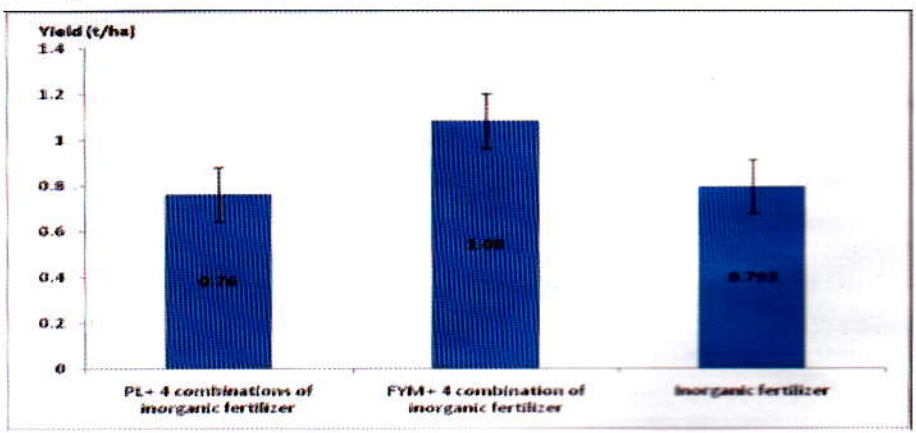
Fertilizer dose: Urea: 40 kg/ha, TSP: 80 kg/ha and MOP: 30 Kg/ha. All fertilizers were applied before last ploughing. While organic manure PL/FYM was applied before 1st ploughing. Final land preparation was done 7 days after 1st ploughing for decomposition.

Data Recording: Date of seeding, date of pod harvest, number of harvest, pods per plant, seeds per pod, plant height, thousand grain weight, and yield were taken from whole plot harvest.
Data analysis: Data were analyzed by CROPSTAT.

Result & Discussion

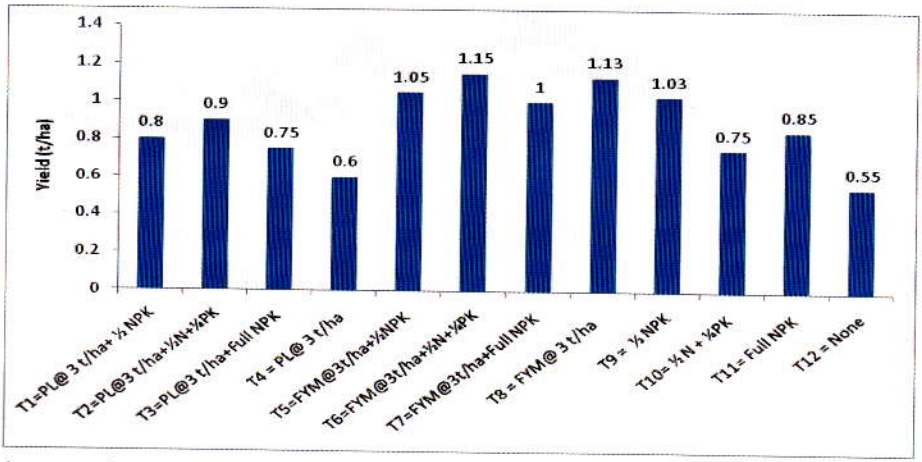
Analysis of variance of yield, pod/plant, seed/pod, thousands seed weight and plant height are presented in Table 1-5. Main effect and interaction effect of pod yield are presented in Figure-1 and Table - 6. Summary of mean data are cited in Table-7. Treatment combination data are shown in Figure 2. Correlation analysis of pod yield with number of pod/plant, seeds/pos, thousand grain weight and plant height are given in Fig. 3. Highly significant effect of organic manure source, chemical fertilizer level and their interaction was found on the yield of mungbean (Table 1-). Similar observation was revealed for pod/plant, seeds/pod and plant height (Table 2, 3 & 5). In contrast, thousand seed weight was significantly affected only by organic manure sources (Table- 4).

Fig. 1. Main effect of PL, FYM and Inorganic fertilizer on yield of mungbean.



Correlation analysis showed that pod/plant (R2 = 0.798) and seed/pod (R2=0.845) had positively related with yield indicating higher number of pod/plant and seeds per pod significantly increase yield while, thousand grain weight had narrow positive relationship (R2=0.265) with yield. Negative relationship was noted between plant height and yield (R2=0.01) i. e. higher the plant height lower the yield (Fig. 3).

Fig. 2. Mean yield of mungbean as affected by different source and level of application



Among the treatments mean yield was highest where FYM (1.08 t/ha) applied followed by sole chemical fertilizer (0.793 t/ha) with grand mean 0.88. Treatments combined with PL, mean grain yield was the least (0.76 t/ha) (Fig. 1). The poor performance of mungbean BINA-5 was perhaps due to vigorous growth of the plant as recorded the highest plant height (89.3 cm) (Table 7). Flowering and Pod formation reduced in mungbean under high fertility condition as decomposed PL is a very good source of nutrient compared to FYM. Optimum plant growth attained in FYM treatment combinations (69.3 cm) so was slightly shorter plants were recorded in sole chemical treatments (66.25 cm) (Table 7).

Table 6. Interaction of fertilizer source (S) x Level (L) on yield (t/ha).

Fertilizer source/level	L1= 1/2NPK	L2= 1/2N+1/4PK	L3= Full NPK	L4 = - NPK	Mean
PL	0.80	0.90	0.75	0.60	0.76
FYM	1.05	1.15	1.00	1.13	1.08
Chemical fertilizer	1.00	0.75	0.85	0.55	0.79
Mean	0.95	0.93	0.87	0.76	0.88

LSD (0.05) = 0.36

Table 7. Effect different sources and level of nutrient on mean yield and yield contributing characters of mungbean, Potnitola, 2013.

Treatments	Yield (t/ha)	Pod/plant	Grains/pod	TGWT(G)	PH (cm)
T_1=PL@ 3 t/ha+ ½ NPK	0.80	8.67	9.33	40.00	90.33
T_2=PL@3 t/ha+½N+¼PK	0.90	11.67	10.67	39.33	87.00
T_3=PL@3 t/ha+Full NPK	0.75	9.33	8.33	39.33	95.00
T_4 = PL@ 3 t/ha	0.60	6.67	6.33	38.33	84.67
T_5=FYM@3t/ha+½NPK	1.05	17.33	12.67	39.33	75.00
T_6=FYM@3t/ha+½N+¼PK	1.15	21.67	13.00	41.00	68.67
T_7=FYM@3t/ha+Full NPK	1.0	17.7	11.3	40.0	68.7
T_8 = FYM@ 3 t/ha	1.13	21.00	14.00	41.33	65.00
T_9 = ½ NPK	1.03	14.33	12.00	36.33	66.67
T_{10}= ½ N + ¼PK	0.75	9.00	8.33	37.67	78.67
T_{11}= Full NPK	0.85	9.33	10.33	39.33	75.33
T_{12} = None	0.55	9.33	6.67	35.00	44.33
LSD 0.05	0.36	9.5	0.96	1.64	2.20

Among the treatments, yield ranged from 0.55 to 1.15 t/ha respectively in the treatments T_{12} and T_6 (Fig-2 & Table-7) with grand mean 0.88 t/ha. The highest seed yield (1.15 t/ha) was recorded in the treatments T_6 where FYM+ ½ N+1/4thof PK applied. This was followed by T_8 (1.13 t/ha) and there was no significant difference between T_6 & T_8. Mungbean yield in T_5 was 1.05 t/ha so was T_9 (1.03). In contrast, the lowest yield was found control treatment T_{12} (0.55 t/ha) where neither organic nor inorganic fertilizer applied followed by T_4 (0.60 t/ha). It was noted that rainfall was unexpectedly high that affected the overall per formation of the mungbean growth and development at the flowering and pod formation. Many seeds in pod were rotted due to high frequency of rainfall at the pod maturity stage. Heavy rainfall during pod development and maturation stage caused seed rot that affected reflected on overall low yield of mungbean. In this study, it was also observed that plant height increased further from optimum (60±5 days) had negatively affected on yield (Fig.-3). However, our result indicates that FYM alone or FYM based combination with ½ N and ¼ PK was better than any other treatments that will increase profit and sustain mungbean cultivation in Patnitala. This experiment required repetition for conclusion.

Table 1. ANOVA of yield of mungbea

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Organic source (S)	2	0.74	0.37	202.50	0.00
Fertilizer level (L)	3	0.22	0.72	39.30	0.00
Replications	2	0.18	0.59	3.20	0.06
S x L	6	0.33	0.55	30.30	0.00
Residual	22	0.40	0.18	-	-
Total	35	1.34	0.38	-	-

Table 2. ANOVA of Pod/plant of mungbean

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Fertilizer sources (S)	2	753.16	376.58	295.88	0.00
Fertilizer level (L)	3	24.0	8.0	6.29	0.003
Replications	2	2.67	1.33	1.05	0.37
S x L	6	118.2	19.7	15.47	0.00
Residual	22	28.0	1.27	-	-
Total	35	926.0	26.45	-	-

Table 3. ANOVA of seed/pod of mungbean

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Fertilizer sources (S)	2	115.17	57.58	43.94	0.00
Fertilizer level (L)	3	26.75	8.91	6.80	0.002
Replications	2	1.17	0.58	0.45	0.651
S x L	6	62.83	10.47	7.99	0.00
Residual	22	28.83	1.31	-	-
Total	35	234.75	6.71	-	-

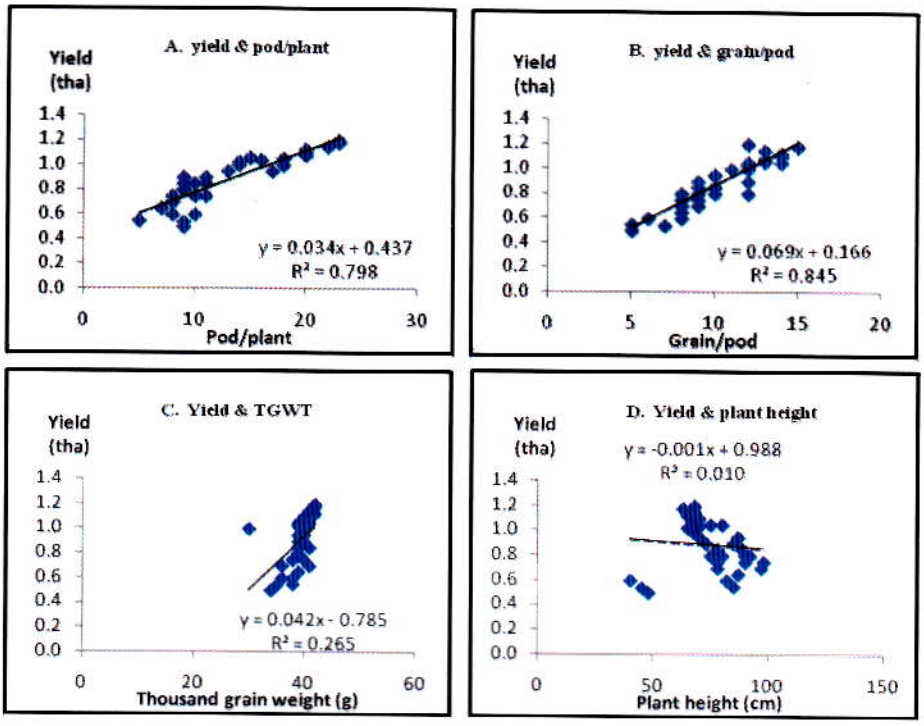
Table 4. ANOVA of thousand grain weight of mungbean

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Fertilizer sources (S)	2	68.66	34.33	9.08	0.00
Fertilizer level (L)	3	10.75	3.58	0.95	0.95
Replications	2	0.16	0.83	0.02	0.02
S x L	6	32.00	5.33	1.41	1.41
Residual	22	83.17	3.78	-	-
Total	35			-	-

Table 5. ANOVA of Plant height of mungbean

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Fertilizer sources (S)	2	3740.72	1870.4	275.65	0.00
Fertilizer level (L)	3	1293.0	431.0	63.52	0.00
Replications	2	32.05	16.02	2.36	0.11
S x L	6	1194.83	199.13	29.35	0.00
Residual	22	149.30	6.78	-	-
Total	35			-	-

Fig. 3. Correlation of different yield contributing variables with yield



Research Act.-2: Participatory variety selection of mungbean varieties released by BARI and BINA, in drought prone environment.

Problem: All varieties of mungbean do not perform well due to diverse micro climatic condition.

Model: Drought causes yield loss on existing long duration (145-150 days) mega variety Swarna and late harvesting delayed next crop establishment in consequent vast area remain fallow after swarna harvest.

Objective: To identify of mungbean variety and to select location specific best variety preferred by farmers.

Materials & Methods:

The experiment was conducted in three locations Paba, Baraigram and Patnitala of Rajshahi, Natore and Noagaon districts. Three mungbean varieties were used. Land preparation was done properly by power

tiller and all fertilizers were applied before final ploughing. Seeds were sown by broadcasting. Weeding was done once 30 DAS. Pods were picked up 3 times. Data such as seeding date, harvesting date, rainfall and number of rainy days; and yield and yield components were recorded. Preference analysis was done through voting by the farmers. Data anasis were done using CROPSTAT. Other variables are stated below:

Variety: BINAmug-5, BINAmug-8 and BARImug-6
Location: 3 (1 location damaged)
Design: Factorial RCB with 3 reps.
Seed rate: 40 kg/ha
Plot size: 3 x 4 m
Fertilizers: Urea: 40, TSP: 80 and MOP: 30 Kg/ha.

Result & Discussion

Mungbean yield was influenced by variety, location and interaction between them (Table-1). Details of the results are presented in Table 3-4. Among the variety, BINAmung-5 and BARImung-6 showed remarkable yield difference between location Patnitola and Barigram. This two variety performed best in Baraigram compared to Patnitola while BINAmung-8 gave statistically similar yield in both the locations. Our results indicated that BINAmung-5 and BARImung-6 showed location specific adaptation and both of them performed the best adaptability with the microclimatic condition and soil properties of Baraigram compared to the Patnitola (Table 2). The soils of Barigram is light textured sandy loam to loam which enhances drain out of excess rain water while patnitola soil was silty clay and heavy textured and relatively high rainfall area that might have affected mungbean growth and development. In consequent, overall yield performance of mungbean was poor in Patnitola. BINAmung-8 showed relatively wider adaptively in both the location. Our results, clearly indicates that, BINAmung-5 was best followed by BARImung-6 considering yield. In contrast, BINAmung-8 was best for patnitala followed by BARImung-6 (Table-2).

Table 1. ANOVA of mungbean yield from PVS

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Mungbean Variety (V)	2	0.203	0.101	15.84	0.001
Location (L)	1	0.623	0.623	97.61	0.00
Replications	2	0.463	0.231	0.36	0.02
V x L	2	0.804	0.402	62.68	0.005
Residual	10	0.641	0.064	-	-
Total	17	1.70	0.10	-	-

CV = 6.4%

Table 2. Genotype x Environment interaction table of mean mungbean yield (t/ha)

Genotype/Environment	BINAmung-5	BINAmung-8	BARImung-6	Mean
Patnitola	0.93 cd	1.20 b	1.08 c	1.07 B
Baraigram	1.88 a	1.16 b	1.3o b	1.44 A
Mean	1.4 A	1.18 B	1.19 B	1.258

LSD 0.05= 0.145

Table 3. Growth duration, rainy days and ancillary characters of Mungbean in mother trial of Patnitola.

Variety	GD	Rainy days	No. of Pods/Plant	No. of grains/Pod	TGWT (g)	Yield (t/ha)
BINA-5	62	11	21	13	35	0.93
BINA-8	64	11	21	13	33	1.20
BARI-6	61	11	18	11	31	1.08
Mean	62.3	11.0	20.0	12.3	33.0	1.1
Sd	1.5	0.0	1.7	1.2	2.0	0.1

DS: 6.4.2013

Table 4. Growth duration, rainy days and ancillary characters of Mungbean in mother trial of Baraigram.

Variety	GD (Days)	No. of Rainy days	No. of Pods/Plant	No. of grains/Pod	TGWT (g)	Yield (t/ha)
BINA-5	71	18	28	12	38	1.88
BINA-8	62	18	25	12	35	1.15
BARI-6	61	18	20	10	40	1.30
Mean	64.7	18.0	24.3	11.3	37.7	1.4
Sd	5.5	0.0	4.0	1.2	2.5	0.4

DS: 4.4.2013

Experiment-3. Baby trials of mungbean varieties in Paba, Patnitola and Baraigram, 2013.

Problem: Farmers are less aware with mungbean different varieties and adaptability in their context of rainfed ecosystem and micro climatic condition.

Objective: The objectives of the baby trials were to assess the performance of varieties on a large number of farms and to help disseminate new varieties.

Model: Varietal Trial of Mungbean.

Materials & Methods:

Three mungbean varieties BINAmung-5, BINAmung-8 and BARImung-6 were tested in Baby trials. These varieties were recommended and found better in the trials of BARI and BINA in those locations. Seeds of these varieties as kit were provided to farmers 30 farmers of each Paba, Patnitola and Baraigram during Kharif1, 2013. Farmers planted, fertilized, crop management, harvesting, threshing were done by themselves. SAFBIN staff took records of seeding time, crop management practices done, harvesting time, crop cut for yield and yield components data. Farmer's prefer the varieties compared by their own. Farmers plant these varieties on their own farms.

Each variety were tested on 10 farms and considered as replication or block. Seeds were sown by broadcasting. Land sizes was 10 -15 decimal. Damaged plot data were estimated following standard statistical procedure. Farmers group discussion (FGD) on the performance of the varieties were organized for each of 3 location. Farmers were asked to talk about the good and bad features of the varieties. The statistical analysis of quantitative data from baby trials gathered from each farm. Variety means over trials were calculated and presented. The LSD for differences among cultivars were calculated from a standard 2-way ANOVA, with cultivars and location as factors.

Result and Discussion:

Wide range of variation of yield of mungbean was observed from one farmers field to another even within same variety and location. For example, in Paba, yield ranged from 0.25 - 1.8 t/ha (BINA-5), 0.3-2.0 t/ha (BINA-8) and 0.4-1.8 t/ha (BARI-6). Similar observation was recorded for Patnitola and Baraigram. Wide range of variation on yield from one farmers to another perhaps due to variation in seeding time, fertilizer application, plant population, soil elevation, fertility, agronomic management, farmers knowledge etc. ANOVA analysis of the mean yield data revealed that locations had remarkable significant effect on yield (Table 1 & Fig. 1).

Table 1. ANOVA of mungbean yield

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Mungbean Variety (V)	2	0.48	0.24	0.96	0.39
Location (L)	2	3.94	1.97	7.95	0.001
Replications	9	0.76	0.84	0.34	0.96
V x L	4	1.00	0.26	1.06	0.30
Residual	72	17.87	0.25	-	-
Total	89	24.10	0.27	-	-

Factorial effect of varieties revealed that yield as well as rainy days, pod/plant, grains per pod and thousand grain weight were not significantly differed except growth duration. In case of location, yield, thousand grain weight and rainy days varied across the

Table 6. Factorial effect of varieties

Variety	Yield (t/ha	Growth duration (Days	Rainy days	Pod/plant	Grains/pod	TGWT (G)
BINAmung-5	1.11	69.3	17.2	16.7	11.6	37.8
BINAmung-8	1.27	66.7	14.7	16.6	12.4	37.1
BARImung-6	1.12	61.9	16.8	14.9	11.9	37.9
LSD 0.05	0.25	2.80	2.40	1.90	0.51	1.20

Table 7. Factorial effect of location

Variety	Yield (t/ha	Growth duration (Days	Rainy days	Pod/plant	Grains/pod	TGWT (G)
Paba	0.89	66.8	19.3	12.2	11.7	40.1
Patnitola	1.24	66.5	11.3	16.5	12.7	35.1
Baraigram	1.40	64.5	18.1	19.5	11.6	36.7
LSD 0.05	0.25	2.79	2.40	1.89	0.51	1.20

Interaction effect of variety x location validated the results that location had an impact of mungbean cultivation in order to obtain optimum yield. While, varietal effect on yield were statistically similar (Table-8).

Table 8. Variety x location interaction effect of yield (t/ha)

Variety	Paba	Patnitola	Baraigram	Mean
BINAmung-5	0.70	1.20	1.46	1.11 A
BINAmung-8	1.10	1.45	1.30	1.27 A
BARImung-6	0.90	1.06	1.40	1.12 A
Mean	0.89 B	1.24 B	1.40 A	-

LDS 0.05 = 0.44

Growth duration varies significantly among the varieties. Similar observation was recorded for location (Table 2). ANOVA of pod/plant, seed/pod and thousand grain weight are presented in Table 3-5. Factorial effect of yield and yield components parameters are presented in Table 6-7. Among the location, the highest mean yield was recorded in Baraigram (1.4 t/ha) followed by Patnitola (1.24 t/ha). In contrast, the lowest yield was recorded in Paba (0.89 t/ha). Though the varietal effect on yield had no significant difference however, mean highest yield was found in BARImung-8 (1.27 t/ha). BINAmung-5 and BARImung-6 gave almost similar yield (1.12 t/ha) irrespective of location. Among the location Barigram is most suitable for mungbean cultivation followed by Patnitola. None of the variety attain optimum yield in Paba. In general, BINAmung -8 showed wider adaptibility in all three locations compared to BINAmung-5 and BARImung-6. BARImung-5 and BARImung 6 performed best in Baraigram (Fig 1). In contrast, BINAmung-8 performed best in Patnitola.

It was recorded that mungbean trials seriously suffered by series of rainfall, 3 plots were completely damaged. Farmers opined that seeds in pod were rotted due to frequent shower and affected on yield. They also mentioned that farmers whom seeded early (28 March to 10 April) they got good yield (Fig. 2). Plots in the lower elevation where run-off water accumulated plats got yellowish and finally got dead.

Our result indicates that cultivation of location specific mungbean variety is necessary particularly Patnitola and Paba. Enhancing awareness of this issue is utmost required. Delayed seeding onward 10 April should possibly be avoided so that flowering and pod formation stage could escape heavy shower.

Fig. 1. Effect of location on the yield of three mungbean varieties

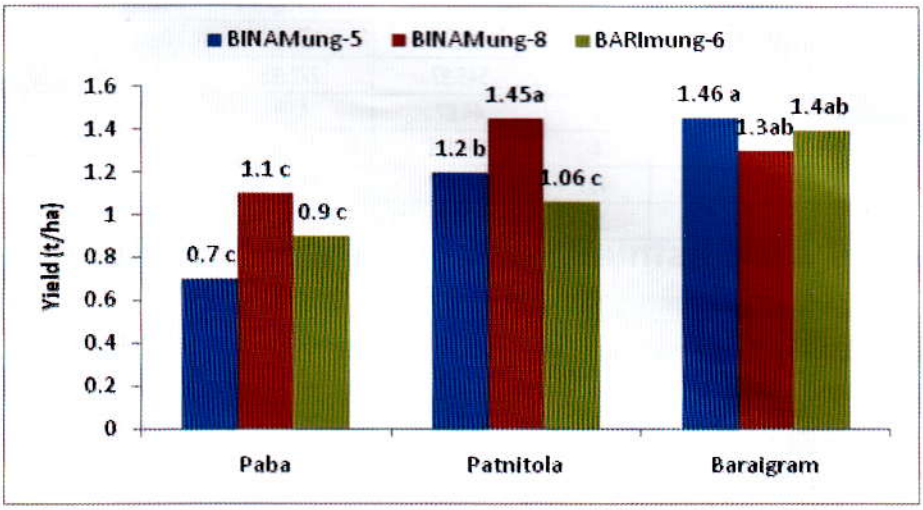


Table 2. ANOVA of growth duration

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Mungbean Variety (V)	2	102.15	51.07	2.35	0.10
Location (L)	2	1113.1	556.54	25.58	0.00
Replications	9	187.55	20.83	0.96	0.48
V x L	4	134.11	33.52	1.54	0.199
Residual	72	1566.64	21.75	-	-
Total	89	3103.56	34.87	-	-

Table 3. ANOVA of Pod/plant

Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Mungbean Variety (V)	2	65.05	32.53	2.39	0.09
Location (L)	2	807.8	403.9	29.66	0.00
Replications	9	49.15	5.46	0.40	0.93
V x L	4	129.13	32.28	2.37	0.06
Residual	72	980.44	13.16	-	-
Total	89	2031.6	22.82	-	-

Table 4. ANOVA of Grains/pod

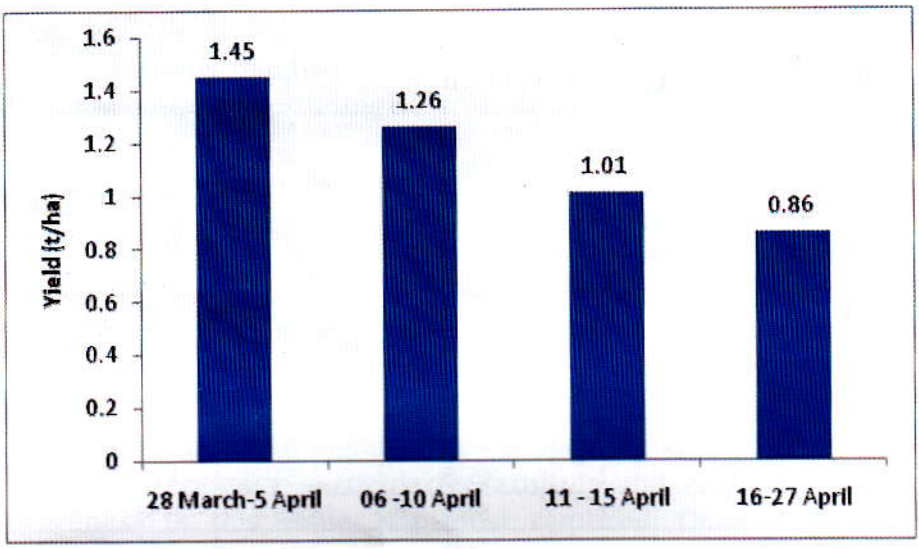
Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Mungbean Variety (V)	2	9.53	4.77	4.76	0.09
Location (L)	2	21.51	10.76	10.74	0.00
Replications	9	13.03	1.45	1.45	0.185
V x L	4	1.39	0.35	0.35	0.85
Residual	72	72.12	1.00	-	-
Total	89				

Table 5. ANOVA of thousand grain weight

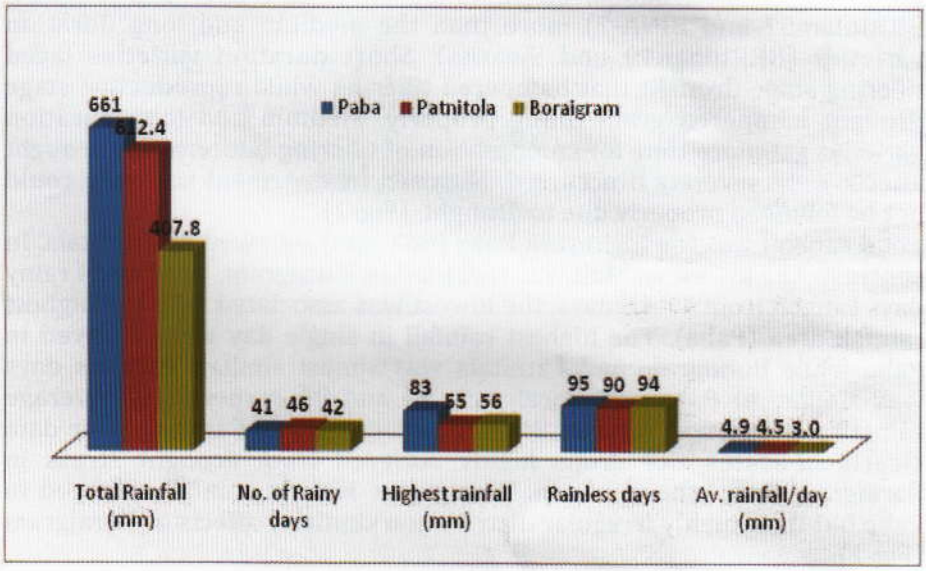
Sources of variation	Df	Sum of squares	Mean Square	F-Ratio	Prob
Mungbean Variety (V)	2	10.12	5.10	0.93	0.40
Location (L)	2	545.97	272.98	49.5	0.00
Replications	9	44.87	4.98	0.90	0.527
V x L	4	108.08	27.02	4.90	0.002
Residual	72	397.09	5.51	-	-
Total	89	1106.25	12.42	-	-

LSD 0.05 = 0.44

Fig. 2. Effect of seeding dates on the mean yield of Mungbean. (3 varieties x 3 locations x 10 field).



Report of Metrological Rainfall Data 2012



Report of Metrological Rainfall Data
Duration: 01 July to 15 November, 2012

Rainfall distribution pattern of the Paba, patnitala and Baraigram upazilla of SAFBIN project

Details of the rainfall data from 01 July to 15 November are presented in Fig. 2. Five drought spell were observed during the crop growth period of them 1st spelll was observed at the beginning of the crop establishment. therefore most of the trials conducted under SAFBIN initial crop establishment was done using supplemental irrigation. Second drought spell hampered tillering, weeding and N-fertilization on time. Third and 4th drought spell hampered short duration varieties (BRRIdhan56, BRRIdhan57 and BINA-7) more than the medium and long duration varieties (BRRIdhan49 and Swarna). Short duration varieties faced tillering stage drought that hampered tillering while reproductive stage drought hampered grain filling properly. Medium and long duration varieties get more time for compesation of tillering but terminal drought affects yield severely if occurred. Nitrozen management schedule could not be followed properly due to drought (Fig-2).

Total rainfall was the highest in Paba (661 mm) followed by Patnitala. In contrast , the lowest rainfall was recorded in Baraigram. Number of rainy days ranged from 41-46 days, the lowest was associated with the highest rainfall area (Paba). The highest rainfall in single day was observed in Paba while Baraigram and Patnitala was almost similar. Rainless days was similar to Paba and Baraigram 95 and 94 respectively. Average rainfall per day was least in Baraigram followed by Patnitala. Our data clearly indicates rice crops highly suffered from drought stress in Baraigram than other location. Though the highest rainfall occurred in Paba but their highly irregular distribution similarly affects as Baraigram (Fig-1).

Fig. 1. Total rainfall, number of rainy days, highest rainfall, rainless days and average rainfall in Paba, Patnitala and Baraigram during wet season aman rice growth period, 2012.

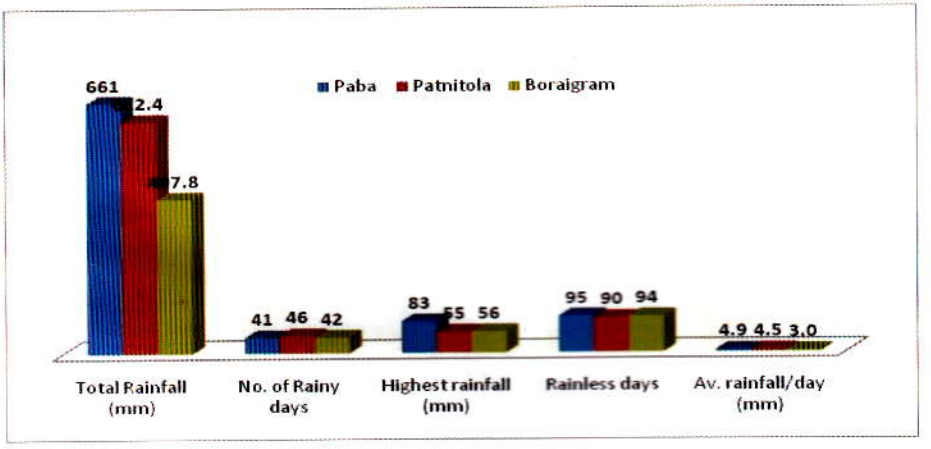
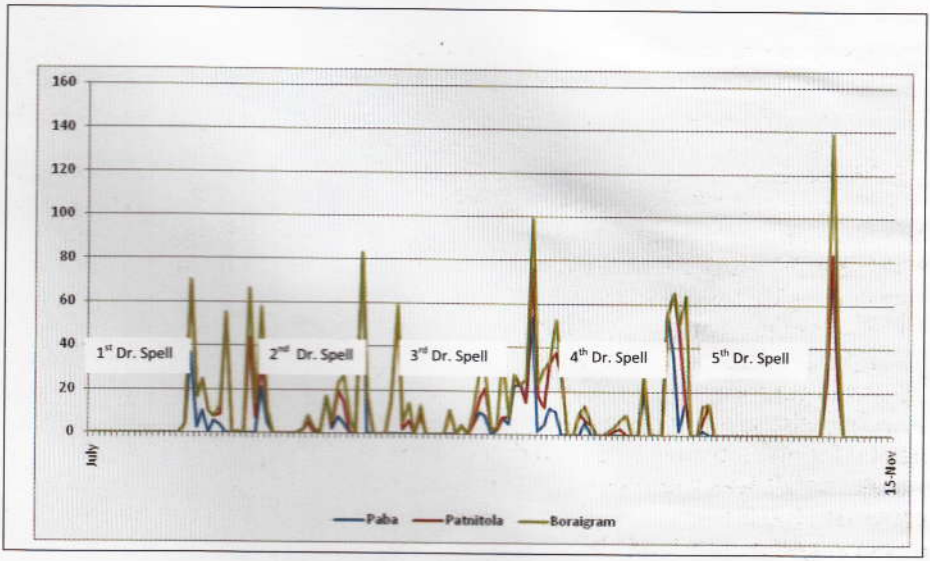


Fig. 2. Rainfall distribution pattern of Paba, Patnitola and Borigram metrological station of CARITAS during aman rice growth period (01 July to 15 Nov, 2012)



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