

Competitive Research Grant

Sub-Project Completion Report

on

**Identification of climatic factors responsible for
disease and insect outbreak and their appropriate
management in southern region of Barishal**

Project Duration

May 2016 to September 2018

**Bangladesh Rice Research Institute
Regional Station, Barishal**



Submitted to
Project Implementation Unit-BARC, NATP-2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215



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Citation

Identification of climatic factors responsible for disease and insect outbreak and their appropriate management in southern region of Barishal

Project Implementation Unit

National Agricultural Technology Program-Phase II Project (NATP-2)

Bangladesh Agricultural Research Council (BARC)

New Airport Road, Farmgate, Dhaka – 1215

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Project Implementation Unit

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Acronyms

BARC	: Bangladesh Agricultural Research Council
BRRI	: Bangladesh Rice Research Institute
Co-PI	: Co-Principal Investigator
CRG	: Competitive Research Grant
IPCC	: Intergovernmental Panel on Climate Change
IRRI	: International Rice Research Institute
NATP	: National Agricultural Technology Program
PCR	: Project Completion Report
PI	: Principal Investigator
UNFCCC	: United Nations Framework Convention on Climate Change

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Executive Summary

Disease and insect pest survey, management experiment and demonstration trials were conducted in six districts of Barishal region. There were 24 blocks, each block was of 1 acre of land.

In case of disease infection during T. Aman 2017, BLB was the major disease followed by brown spot, blast and sheath blight. Out of 23 fields visited during Boro 2017-18 season, blast was found in 12 fields. Among the other diseases BLB infection was higher during Boro followed by sheath blight and brown spot. Leaf scald and Bakanae diseases were also recorded in a limited scale.

Irrespective of insect pests average insect infestation was higher in Pirojpur followed by Barishal, Barguna, Patuakhali, and Jhalokathi while lower insect infestation was recorded in Bhola. Irrespective of location higher number of insect was cricket followed by leaf folder and green leaf hopper. Moderate number of insect was rice bug followed by stem borer and grass hopper. Gall midge was the lowest in number.

For brown plant hopper (BPH) insect development, no significant time trends in precipitation and temperature could be demonstrated. The abundance of BPH varied considerably between months within a year which was attributed to seasonal factors, including the availability of suitable host plants. Neck blast disease incidence was (0- 12% DI) during the month of November when maximum average air temperature was 29.8°C and minimum was 19.7°C; rainfall was 22 mm (ranged from 13 to 42 mm). Blast (NB) disease incidence was higher in irrigated (Boro rice) than rainfed (T. Aman rice) ecosystems. Incidence of rice blast disease and the temperature was negatively correlated which indicated that the disease incidence increases with the decrease of temperature. Farmers could correct the time of planting to avoid those disease and insect pest attack.

False smut (FSm) disease was increased with the increasing of N-level. No false smut disease was observed at first seeding time (0). Use of optimum dose or little bit lower dose of Urea of optimum (22 kg Urea/33 decimal land for BRRI dhan49), chemical spray (Azoxystrobin + Propiconazole) at splitted booting stage and seeding at 30 June or 30 July minimizes False smut (FSm) disease of rice at southern region of Barishal. High FSm disease incidence occurred when the average temperature ranged from 22-28°C.

Effect of soil physical properties (missing element) on disease, insect and yield of BRRI dhan58 at Barishal during Boro 2017-18 was observed. Nitrogen was the most limiting nutrient in tidal flooded soil. Urea (nitrogen-fertilizer) has positive effects on stem borer insect performance. Potassium provides high resistance against insect-pests. Phosphorus-fertilizer also decreases the host suitability to stem borer. Secondary-nutrient such as zinc and sulphur also reduce this pest population. Application of N and P might reduce brown spot infection while application of K, S and Zn might reduce BLB and sheath blight development.

Four new chemicals viz. Tebuplus75, Quickout50WP, Dlink 32.5 and Mcvo 75 significantly reduced blast disease and could be used for blast disease management.

BRRI released HYVs of rice viz. BR23, BRRI dhan52, BRRI dhan72, BRRI dhan76, BRRI dhan58, BRRI dhan64, BRRI dhan67, BRRI dhan74 and BRRI Hybrid dhan3 and BRRI Hybrid dhan4 could be used for higher grain yield keeping the disease and insect damage minimum.

Insect pests were lower and natural enemies of insect pests were higher in need based insecticide management (NBIM) treatment than control plots. By using need based insecticide management (NBIM) package farmers can save 2-3 insecticide applications which will reduce hazardous chemical to the environment.

Gall midge was higher in Patuakhali (especially in Dasmina) and Leaf folder was higher at Shanker Pasha, Pirojpur. Farmers of the areas where certain insect infestation is higher especially, Dasmina, Patuakhali and Shanker Pasha, Pirojpur could be alert during their rice cultivation.

Timely release of fund and fund transfer complexity were the major constraints for project running.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:** Identification of climatic factors responsible for disease and insect outbreak and their appropriate management in southern region of Barishal
2. **Implementing organization:** Bangladesh Rice Research Institute, Regional Station, Barishal
3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s):**
PI: Dr. Md. Alamgir Hossain, Chief Scientific Officer, Bangladesh Rice Research Institute, Regional Station, Sagordi, Barishal. Mobile: 01922550400, mahbrri2012@gmail.com
Co-PI: Dr. Mohammad Hossain, Principal Scientific Officer, BRRI, Regional Station, Sagordi, Barishal; Mobile: 01712178657, hossainmbd@yahoo.com
4. **Sub-project budget (Tk):** 1800320/- (Taka Eighteen lakh three hundred twenty only)
5. **Duration of the sub-project:** Start date: 08 May 2017 and end date: 30 September 2018
6. **Justification of undertaking the sub-project:**

Extensive emission of greenhouse gases from massive industrialization causes increasing in the concentration of atmospheric CO₂ which is the key factor for global climate change (UNFCCC, 2013; IPCC, 2014). According to IPCC (Intergovernmental Panel on Climate Change) the predicted changes include more frequent extreme high temperature and less frequent extreme low temperature. Similarly, water vapor, evaporation and precipitation are predicted to increase on average, predictions about increased or decreased precipitation is region specific. In southern and eastern Asia, precipitation is predicted to increase in summer. The IPCC predicted that with the current emission scenario, Global warming is likely to reach 1.5°C between 2030 and 2052 (IPCC 2018). It is very likely that the number of cold days and nights has decreased and the number of warm days and nights has increased on the global scale (IPCC, 2014). Although the IPCC did not find any evidence of any change of tropical and extra tropical storms, more recent analysis concluded that there have been changes in storm patterns in recent years (Emanuel 2005; Webster *et al.* 2005; Kunkel, 2013), which could influence the global movement of pathogens (Brown and Hovmoller 2002; Andjic *et al.*, 2016; Burgess and Wingfield 2017).

In the recent years, frequency of diseases and insect pests occurrence have increased with invasion into new areas in Bangladesh. Outbreaks often occurs in Boro and T. Aman seasons across the rice growing areas perhaps due to changes in production system, expansion of hybrid rice, intensification with mono crop variety, changes of climatic factors, high input use, etc (Ali *et al.*, 2014; Hossain *et al.*, 2017).

Barishal region is an endemic area for disease and insect pest of rice especially, rice disease viz. blast (*Magnaporthe grisea*) and insect pest viz. hispa (*Diuraphis armigera*), leaf folder (*Cnaphalocrocis medinalis*), stem borer and BPH (Hossain *et al.*, 2017; Anonymous, 2014; Islam and Catling, 2012; Islam and Hasan 1999; Miah *et al.*, 1980). Those disease and insects have a long history of outbreak in Barishal region of Bangladesh (Islam and catling, 2012; Shahjahan, *et al.*, 1987). Recently, false smut (*Ustilaginoidea virens*) is becoming a threat for rice production in late transplanted Aman rice. Last few years, those pests appeared as devastating problem for rice production in Barishal region (DAE, 2015).

The incidence and severity of disease along with infestation and population buildup of a pest is greatly affected by weather parameters, and other parameters like crop sequence, alternate host etc. In recent years, many pests and diseases have been reported to be the major limiting factors affecting the production of rice due to intensive cultivation practices and indiscriminate use of nitrogenous fertilizers and pesticides. There is a change in the disease and insect pest scenario in

rice due to changes in climate and agro ecosystem. Besides, the above practices, the use of high-yielding varieties, along with monoculture also influence disease and insect, and minor of these problems have become major ones (Rahmathulla *et.al*, 2012).

In Barishal total crop land is 0.83 million ha of which area under tidal flood is 88%. Under tidal flood area non saline area is 80% and saline area is 20% (DAE, 2015). Salinity along with low temperature is responsible for blast development, water stagnant creates favorable environment for BPH, high temperature favors stem borer in rice. Relationship in between that weather factors and pests development at Barishal region needs to be identified. Besides, appropriate management practices need to be introduced to the farmers as they are not aware about it.

7. **Sub-project goal:** Strengthening the research capacity on climate change and pest-diseases of food crop

8. **Sub-project objectives:**

- i) To identify the physical and climatic factors responsible for disease and insect outbreak
- ii) To develop effective and sustainable management packages for controlling those pests
- iii) To identify breeding location of insects in particular

9. **Implementing location:** Bangladesh Rice Research Institute, Sagardi, Barishal

10. Methodology in brief: The project was implemented at farmers' field of Barishal region and at Regional Station of BRRI, Barishal in three rice crop seasons namely T. Aman 2017, Boro 2017-18 and T. Aman 2018 (Figure 1).

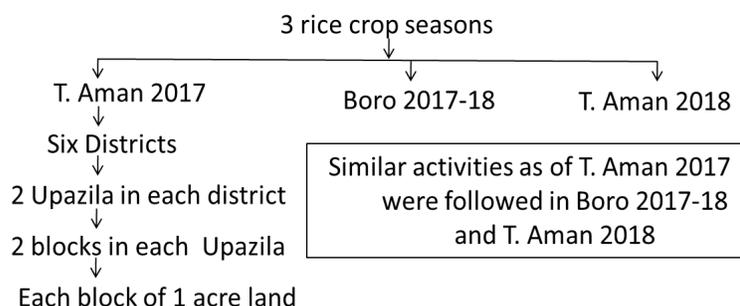


Figure 1: Rice cropping season, location and land selection for the project activities

The work plan of the project was described below:

Activity	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	
Year I													
Site selection; Field selection					—————								
Disease and insect pests survey and collection of sample					—————								
Climatic data collection				—————									
Management experiment and demonstration trial							—————						
Data analysis								—————					
Quarterly report writing									—				
Yearly report writing												—	
Year II													
Disease and insect pests survey and collection of sample	—————												
Climatic data collection	—————												
Management experiment and demonstration trial	—————												
Final data analysis							—————						
Quarterly report writing.				—			—						
Final report writing.									—————				
Publication										—————			

Experiment wise Methodology:

10a: Identification of physical and climatic factors responsible for disease and insect outbreak.

10a(i). Disease and insect pest incidence and severity: Insect pest and disease severity and their damage were assessed visually based on their symptoms (IRRI, 2013, Greer & Webster, 2001). Disease incidence was recorded following formula mentioned below:

$$\text{Disease incidence (\%)} = \frac{\text{Total number of infected panicle in hill}}{\text{Total number of panicle in hill}} \times 100$$

10a(ii). Location, season and time for survey: Two Upzillas from each of Barishal, Jhalokathi, Pirojpur, Potuakjali, Borguna (AEZ 13) and Bhola (AEZ 18) districts were surveyed for disease and insect pests.

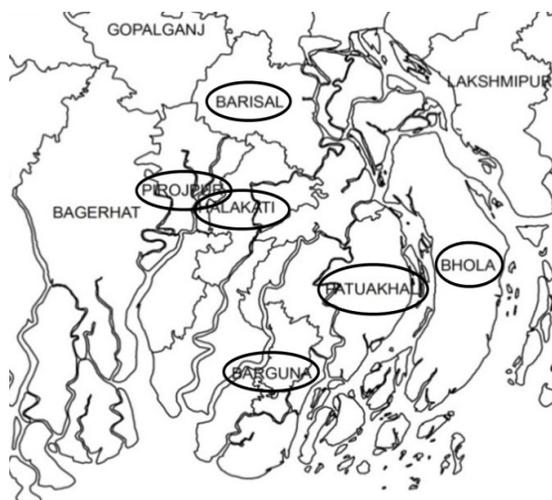


Figure 2: Location for the Project activity (Barishal, Pirojpur, Jhalakati, Patuakhali, Borguna and Bhola)

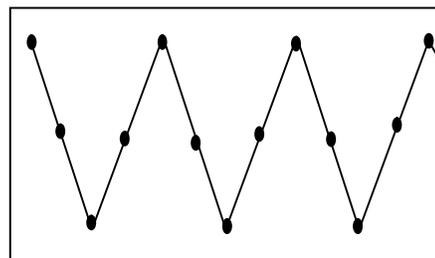


Figure 3: A zigzag sampling pattern used in survey.

Aforesaid AEZs of Bangladesh were surveyed for blast, false smut, hispa and leaf folder. The geographical positions of the selected locations are shown in Figure 2. The survey was conducted during Transplanted Aman 2017 (July to December), Boro 2017-18 (November to May) and Transplanted Aman 2018 (July to December) seasons. In each season, survey was conducted during early-maximum tillering and flowering (for panicle blast) stage of the rice crop.

10a(iii). Field Selection: Soil type, cropping pattern and cropping intensity were taken into consideration in order to select locations. Then fields from each location were randomly selected for investigation. Two Upazilas in each of six districts, two blocks from each of two Upazila and 3 fields from each of two blocks were selected. In total, 72 fields were selected (Figure 1). In selecting and locating the survey area, assistance from Upazilla Agriculture Officer, DAE was taken.

10a(iv). Sampling pattern: For the survey of insect and disease incidence and severity, a zigzag sampling pattern (Figure 3) was followed in this study (Islam and catling, 2012; Savary *et al.*, 1996). At every 50-step interval a single hill (consists of several tillers/plant) was selected and the disease and insect and their damage were recorded.

10a(v). Assessment of cultivar susceptibility: This was expressed as an incidence of damage across all locations (Islam and catling, 2012) of the surveyed areas. Severity was assessed by 0-9

scale as described by Anon. (1996). Cultivar susceptibility was expressed by % incidence of crop damage.

10a(vi). Physical factors (soil physical properties): Effect of soil physical properties on disease-insect development were studied. Soil samples were collected to a depth of 15 cm to observe soil physical properties in terms of nutrient status. Soils were analyzed for pH, total N, organic C, available P, K, S, and Zn by standard analytical methods. Soil physical factors were considered to study their effect on disease and insect development in rice field.

10a(vii). Collection of weather data: Data on maximum and minimum temperature, rainfall, relative humidity, evaporation were collected to correlate with surveyed data.

10a(vii). Statistical analysis: Data on incidence and severity of crop damage, cropping sequence, ecosystem and cultivar adaptability were collected. Percent data and mean data were presented with standard error. Arc sine transformation of data was performed. The influence of weather factors on disease development and population density of insect pests were analyzed by a simple correlation study.

10b: Effective and sustainable management packages for controlling disease and insect:

10b(i). Development of management packages for false smut disease of rice: False smut disease has been historically present in sub-tropical rice environment and used to be considered as a minor disease. However, in the recent past years the disease has emerged as major disease across the sub-tropical environment as well as in Bangladesh. Intensive study on the disease has not been done on the biology, epidemiology and management practices of the disease neither in Bangladesh nor elsewhere. However, there are some reports of cultivar tolerance, sub optimal N use, conservation tillage etc. No reports of very effective fungicide are available. Introduction of BRRIdhan49 and BRRIdhan57 along with perhaps climate change impact the disease has resurged as a threat of rice production in context of yield reduction, quality deterioration and deadly toxin “Ustiloxin” for livestock.

This experiment was conducted with the objectives to find out effective control measure option/s of the disease. The experiment was conducted during T. Aman, 2017. Treatments were as follows-

Fungicides (4):	C1= Nativo - 2 ml for 10 L water C2= Propiconazole - 2 ml for 10 L water C3= AzoxystrobinDifeconazole - 2 ml for 10 L water C4= Control
N-level (3):	N1= Optimum (22 kg/bigha) N2= <1/3rd of optimum N3=>1/3rd of optimum
Seeding time (4):	ST1=15 June ST2=30 June ST3=15 July ST4=30 July

Variety BRRIdhan49 was used. BRRIdhan recommended practices were followed for land preparation and other management. Spray was done at splitting boot stage and 15 days after 1st spray. Split-split plot design was followed with three replications. Spacing was 25 cmX15 cm. Fertilizer rate was 22: 08: 14: 9: 01 kg/bigha for Urea, TSP, MOP, Gypsum and ZnSO₄ respectively. Fertilizers were applied as per treatment. Data were collected on DS and DT, incidence of false smut on panicle, total no. of spore balls, yield and yield components, Weather data was collected from weather station of BRRIdhan Barishal. Data were analyzed by CROPSTAT factorial RCB.

10b(ii). Chemical approach to manage blast disease of rice: The rice blast disease has long been recognized as the most important and potentially damaging rice disease with worldwide distribution. For blast disease management at field level chemical control is mainly practiced and other options particularly water management is another practice. As blast disease progresses rapidly in the rice field farmers mainly want to use chemicals to manage this disease. Every year rice yield loss is occurred in Barishal region due to this disease. Genetic diversity of blast pathogen is very high and pathogens show resistance against chemicals after few years use in the field. Therefore, experiment was conducted to find out effective chemical(s) to manage blast disease of rice.

Fourteen chemicals viz. Success 300 EC, Royal 75WDG, Mzole 32.5Sc, Tebuplus75, Cibazole 32.5, Quickout50WP, Dlink 32.5, Tecobin 75WP, Adistar top, Aiker 20, Bioesony plus, Suntighter, Mcvo 75 and Deconil 500 Sc were used as test chemicals keeping one positive control (Trooper as standard check) and one negative control (plain water). Spray was done twice, first at splitting boot stage and second at 10 days after of 1st spray. Factorial RCB design was followed with three replications. Spacing was 20 cm X 20 cm. BRRI recommended practices were followed for land preparation and other agronomic managements. Chemicals were tested on BRRI dhan34, a susceptible aromatic T. Aman HYV of rice to blast disease.

10b(iii). Need based insecticide management for better yield: During T. Aman 2017 an experiment was conducted at Amtali, Borguna to produce rice by minimizing hazardous insecticide. The following treatments were used for the study:

A. Need Based Management (NBM), such as:

- BRRI recommended fertilizer (22-8-14-9-0 kg Urea-TSP-MoP-Gypsum-Zinc per 33 dec.)
- Row transplanting
- Logo (1 line missing after each 10 lines)
- Perching (1 stand/100 m²)
- Sweeping (need based)
- No insecticide upto 30 days of transplanting
- Need based application of pesticide (not more than 1)

B. Control (Farmer's management: higher dose of urea but lower dose or no use of other fertilizers than BRRI recommended practice; haphazard and miss use of pesticides; no use of other management practices as of NMB)

10b(iv). Use of tolerant variety for disease and insect pest management: Demonstration of BRRI released rice varieties for cultivating in disease and insect prone areas: Experiments and demonstration trials were conducted at the areas where pest's survey was done. In total 24 demonstrations and experiments were conducted in each season. These demonstrations and experiments were distributed to the places where pest severity was found higher during survey. The rice varieties those were observed with less infection of disease and less infestation of insect during survey were demonstrated here for better yield. The RCBD with 3 replications was followed for experiments and demonstration trials.

10c: Identification of breeding location of insects in particular: Based on survey data breeding location of insect pests was identified. During the survey the place or location with higher insect pest severity was observed. Specific area for specific insect was recorded for their breeding location.

Results and discussion

11a: Identification of physical and climatic factors responsible for disease and insect outbreak.

11a(i). Effect of soil physical properties on disease-insect pest severity and yield of BRRIdhan58 at Barishal during Boro 2017-18: Eight soil samples were analysed for pH, total N, organic C, available P, K, S, and Zn by standard analytical methods. Experiment was conducted at BRRIR/S farm, Sagardi, Barishal in Boro season with six treatments, namely NPKSZn, -N (PKSZn), -P (NKSZn), -K (NPSZn), -S (NPKZn) and -Zn (NPKS) in RCB design with four replications. During Boro 2017-18, the fertilizer rate was NPKSZn @ 113-10-20-20-1.5 kg/ha. The test variety was BRRIdhan58. Grain yield was recorded from 10 m² area at 14% moisture content and converted to ton per hectare. Data were subject to statistical analysis and mean separation were done by DMRT using Statistix10 software.

It was observed from the results that the farm soil was neutral in reaction with low organic matter content and low to medium total nitrogen content (Table 1). The status of available P, K and Zn was quite high. However, the farm soil was highly deficient in available S.

From the missing element trial, yield reduction of BRRIdhan58 was observed in Boro2017-18 season (Table 2). The highest grain yield (5.2 tha⁻¹) was found in complete treatment (NPKSZn). Grain yield was significantly lower than the complete treatment due to the omission of N, K, S and Zn. The lowest yield was recorded in (-)N plot followed by (-)K plot. The yield reduced considerably in (-)P plot also. Thus the study reveals that for Boro rice, N is the most limiting nutrient in tidal flooded soil. Higher infection of brown spot disease (severity scale 3-7) was observed in (-)N and (-)P treated plots compared to NPKSZn treated plot. Sheath blight and bacterial leaf blight (BLB) were recorded in (-)K, (-)S and (-)Zn treated plots while those diseases were not observed in (-)N and (-)P treated plots. Higher infestation of stem borer insect was observed in all the treated plots except NPKSZn and (-)N treated plots. Urea (nitrogen-fertilizer) has positive effects on individual insect performance, probably due to deposition-induced improvements in host plant chemistry. Potassium provides high resistance against insect-pests. Increased level of potassium enhances secondary compound metabolism, reduces carbohydrate accumulation and plant damage from insect pests. Phosphorus-fertilizer also decreases the host suitability to various insect-pests. Secondary-nutrient such as zinc and sulphur also reduce the pest populations. Similar results were described by Bela, 2018.

Overall findings suggest that all the nutrients (N, P, K, S, Zn) should be applied for getting the higher yield and obviously, N application must be assured while P, K and Zn should be applied as maintenance dose for optimum rice yield. However, S should be applied every season to obtain optimum crop yield as well as to build up soil S level. Application of N and P might reduce brown spot infection while application of K, S and Zn might reduce BLB and sheath blight development. The findings of present study were in accordance of the study of Sarathi, 2015.

Table 1: Soil physical properties in Sagardi and Charbadna farms, BRRIR/S Barishal

Location	Soil pH	OM (%)	Total N (%)	Avail. P	Avail. S	Avail. Zn	Exch. K (me%)
				(µg g ⁻¹)			
BRRISagordi Farm							
Block A	7.2	2.9	0.15	22	5.6	2.2	0.31
Block B	7.1	2.8	0.14	26	4.1	2.5	0.32
Block C	7.3	2.4	0.12	20	4.0	2.1	0.27
BRRIChar Badna Farm							
West part	7.5	1.7	0.08	26	10.0	3.0	0.27

East part	7.8	0.8	0.04	15	4.1	0.8	0.18
Critical limit (FRG, 2012)			0.12	8	10.0	0.6	0.12

Table 2: Effect of soil physical properties (soil nutrient) on disease development, insect infestation and yield of BRRI dhan58 during Boro 2017-18

Treatment	Grain Yield (tha ⁻¹)	Major disease observed		Major insect pest observed	
		Disease name	Severity Scale	Insect Name	% infection
NPKSZn	5.2	Brown spot	1-3	Stem Borer	1
-N	2.3	Brown spot	5-7	Stem Borer	1
-P	4.37	Brown Spot	3-5	Stem Borer	2
-K	4.1	Sheath blight BLB	1-3 1-3	Stem Borer	2-3
-S	4.5	BLB	3-5	Stem Borer	2
-Zn	4.42	BLB	1-3	Stem Borer	2
CV(%)	12.41	-	-	-	-
LSD	0.364	SE	0.45	-	-

11a(ii). Climatic factors responsible for disease and insect outbreak:

11a(ii)1. Survey of disease and insect pest during T. Aman 2017: During T. Aman 2017 disease and insect pest survey were conducted in six districts of Barishal region. Major insect infestation and disease infection in different varieties at flowering to Maturity stage of rice crop during T. Aman 2017 were presented in Table 3. Rice stem borer was recorded in BR23, BRRI dhan52 and local varieties. Gall midge was observed in all the varieties except BRRI dhan 72 and BRRI dhan77. Local varieties, BRRI dhan76 and BRRI dhan77 having long growth duration, were infested by rice bug (Table 3).

In case of disease infection, bacterial leaf blight was the major disease followed by brown spot, blast and sheath blight. Blast infestation was found higher in some of the local cultivars especially in Montessormota, Mutha mota, Sakkhor khora and Vushiara while less infestation was found in Sadamota, dudhkalam, BR23 and BRRI dhan72 but absent in, BRRI dhan52, BRRI dhan76, and BRRI dhan77 (Table 3).

Table 3: Major insect infestation and disease infection in different varieties at flowering to Maturity stage of rice crop, T. Aman 2017

Variety	Major Insect Infestation (sweeping)	Major Disease Infection (%DI)
BR 23	GM (0-2%), WM (0-3%), SB (2-5%)	Blast (0-2%), BS (2-25%)
BRRI dhan52	GM (0-10%), LF (0-25%), SB (0-5%)	BS (5-20%), BLB (4-40%)
BRRI dhan72	SB (0-2%)	Blast (0-1%), BS (10-30%)
BRRI dhan76	GM (0-1%), RB (0-10%)	BLB (0-25%), ShB (1-5%)
BRRI dhan77	RB (0-5%)	BS (5-20%), BLB (4-40%)
Local Variety*	GM (0-1%), LF (0-40%); SB (3-7%), RB (0-10%)	Blast (2-10%), BLB (0-60%), BS (10-30%)

GM=Gall midge; LF=Leaf folder; WM=Whorl Maggot; SB=Stem borer; RB=Rice bug
*(Sadamota, Dudhkalam, Montessormota, Mothamota, Vushiara, Lalmota)

Major insect infestation at different Districts of Barishal region during flowering to maturity stage of rice crop (20 hill count) during T. Aman 2017 was presented in Table 4. Identified insect pest were green leafhopper, brown plant hopper, yellow stem borer, short horned grass hopper, long horned grass hopper, long horned cricket and rice bug. Natural enemies of those insect pests were also recorded. Among the natural enemies green mired bug, damsel fly, lady bird beetle, spider beetle, carabid beetle and spider were prevalent.

Table 4: Major insect and their natural enemies at different Districts of Barishal region during Flowering to Maturity stage of rice crop (20 hill count), T. Aman 2017

Location	Insect pest									Natural enemy						
	GLH	BPH	YSB	LF	SHGH	LHGH	LHC	RB	Av	GMB	DF	LBB	SPB	CB	Spi	Av
Barishal	5.0	0.0	4.1	1.8	6.0	3.2	1.2	2.1	2.9	1.6	2.3	2.0	0.3	0.8	7.8	2.5
Jhalokathi	1.3	0.0	3.5	1.8	5.3	2.2	0.8	0.8	2.0	1.2	2.5	0.2	0.0	1.0	6.8	1.9
Pirojpur	0.3	2.0	1.8	1.4	3.4	2.4	0.6	0.9	1.6	1.3	3.0	0.6	0.0	1.3	7.3	2.2
Bhola	0.9	0.0	2.7	0.9	3.8	1.9	0.1	0.0	1.3	0.3	5.5	0.2	0.0	0.2	7.5	2.3
Borguna	0.0	0.3	4.0	2.0	2.3	2.4	0.0	1.5	1.6	0.7	2.2	1.1	1.7	0.5	6.8	2.2
Potuakhali	0.0	0.3	3.8	1.8	2.3	2.3	0.0	1.9	1.5	1.2	2.0	1.6	1.9	0.7	8.2	2.6
Average	1.2	0.4	3.3	1.6	3.9	2.4	0.4	1.2	1.8	1.0	2.9	0.9	0.6	0.7	7.4	2.3

GLH= Green Leafhopper; BPH=Brown plant hopper; YSB=Yellow stem borer; SHGH=short horned grass hopper; LHGH=Long horned grass hopper; LHC= Long horned cricket; RB=Rice bug; GMB=Green mired bug; DF=Damsel fly; LBB=Lady bird beetle; SPB=Spider beetle; CB=Carabid beetle; Spi=Spider; Av=Average.

11a(ii)2. Occurrence and severity of rice diseases in Barishal Region during Boro 2017-18:

In Boro season, survey on rice disease was conducted in farmers' fields of Barishal region of Bangladesh representing Barishal district (Sadar, Ujirpur, Babuganj, Banaripara and Gouronodi) and Pirojpur district (Sadar, Najirpur). Severity and incidence of some major diseases in different rice cultivars of Southern region of Bangladesh were presented in Table 5 and Table 6. Out of 23 fields visited during Boro 2017-18 season, blast was found in 12 fields. Rice blast incidence was comparatively lower in this season compared to 2016-17. Among the other diseases BLB infection was higher during Boro followed by sheath blight and brown spot. Leaf scald and Bakanae diseases were also recorded in a limited scale (Table 5 and 6).

Table 5: Occurrence and severity of rice diseases in Barishal District (Babuganj, Banaripara, Sadar), Boro 2017-18

Varieties/ Lines	Blast		Sheath blight		Leaf scald		BLB		Bakanae		BS	
	DI ^a	DS ^a	DI ²	DS ^a	DI	DS	DI	DS	DI	DS	DI	DS
BR3	0	0	20-25	3-5	0	0	15-20	1-3	0	0	5-10	1-3
BRR1 dhan28	3-5	1	0	0	0	0	15-20	1-3	0	0	0	0
BRR1 dhan47	2-5	1	10-30	1-3	0	0	20-30	1-5	1	1	20-25	1-3
BRR1 dhan58	0	0	10-20	1-3	0	0	10-30	1-3	0	0	15-20	1-2
BRR1 dhan74	2-3	1	0	0	10-15	1-3	30-50	3-5	0	0	0	0
BRR1 dhan67	3-8	1-2	5-8	1	5-10	1-3	10-20	1-3	0	0	10-15	1-2
BRR1 Hybrid dhan3	0	0	5-10	1-3	0	0	0	0	0	0	10-20	1-3
BRR1 Hybrid dhan5	0	0	15-20	1-3	5-10	1-3	5-10	1-2	<1	1	20-25	3-5
Vojon	<1-3	1	0	0	0	0	5-10	1-3	<1	1	10-20	1-3
Sakthorkhara	1-5	1	10	3	0	0	1-10	1	0	0	2	1

DI=% disease incidence, DS=disease severity; '0' = No disease observed

Table 6: Occurrence and severity of rice diseases in Pirojpur ((Najirpur, Sadar), Boro 2017-18

Varieties	Blast		Sheath blight		Leaf scald		BLB		Bakanae		BS	
	DI	DS	DI	DS	DI	DS	DI	DS	DI	DS	DI	DS
BRR1 dhan29	2-3	1	10-20	1-3	0	0	0	0	0	0	5-10	1-2
BRR1 dhan61	7-	5	0	0	0	0	0	0	0	0	10-15	3
BRR1 dhan63	1-2	1	0	0	0	0	10-15	1-3	0	0	3-5	1
BRR1 dhan64	3-5	1	0	0	0	0	1-2	1	0	0	0	0
BRR1 dhan74	1-2	1	10-20	1-3	0	0	0	0	0	0	0	0
BRR1 Hybrid dhan3	0	0	0	0	0	0	5-10	1	0	0	2	1
Hera Hybrid	5-6	1-2	10-15	1-3	2-5	1-3	40-50	3-5	0	0	5-10	1-3
Agro14 Hybrid	3-5	1-2	20-30	1-3	0	0	5-10	1-2	0	0	5-10	1-3
Vojon	0	0	15-20	1-3	0	0	5-20	1-3	<1	1	3-10	1-3

DI=% disease incidence, DS=disease severity; '0' = No disease observed

Occurrence and distribution of rice insect pests and their natural enemies were presented in Figure 4a and 4b. Insect pests and natural enemies were monitored by using light traps during July 2017 to June 2018 at Sagardi farm of BIRRI Barishal. Total population of yellow stem borer (YSB, 14718) was higher followed by green leafhopper (GLH, 3978), long horned cricket (LHC, 3401), mole cricket (MC, 2922), brown plant hopper (BPH, 2822), leaf folder (LF, 2751), rice bug (RB, 1182) and white backed plant hopper (WBPH, 979) (Fig 4a). Other insect pests were present at a limited amount.

Among the natural enemies total population of Staphylinid beetle (SPB, 7395), Green mirid bug (GMB, 2432), Carabid beetle (CRB, 2721) and Pygmy grass hopper (PGH, 1008) were most prevalent. Other natural enemies such as Spider (SPD, 361) Damsel fly (DSF, 216), and Lady Bird beetle (LBB, 13) were also present in a small amount (Fig 4b). The natural enemies of insect pest especially green mirid bug, carabid beetle and pygmy grass hopper were more prominent in the presence of insect pest during the period of October and November when average air temperature was 30.1°C and rainfall was 22.3 mm. The result of Ahmed et al. (2014) supported the present observation.

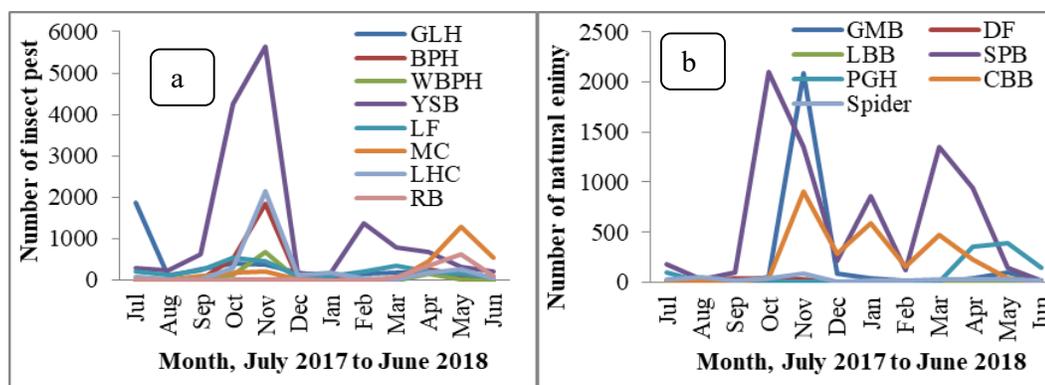


Figure 4: Appearance of (a) major insect pests and (b) natural enemies in light trap at BIRRI Barishal, July'17- June'18

11a(ii)3. Disease and insect pest status at Barishal region during T. Aman 2018

Disease and insect pest survey were conducted during T. Aman 2018. Survey results were presented in Figure 5-7. Irrespective of location and variety incidence of brown spot (BS) disease were the highest followed by bacterial leaf blight (BLB), sheath blight (ShB) and blast while false smut (FSm) incidence was the lowest (Fig 5). Considering locations higher disease was recorded in Babuganj Upazila followed by Barishal Sadar and Ujirpur under Barishal district. Percent disease incidence (%DI) and severity (DS) were the lowest in Patuakhali. Overall, higher rice diseases were found in Barishal district than other districts of this region (Fig 6).

Varietal preference of rice disease was also observed during T. Aman 2018. Irrespective of disease type and location %DI and DS were the highest in HYVs, BIRRI dhan49 which was identically followed by BIRRI dhan52 and local variety Sakkhorkhora (ranged from 9.9 to 10.6% and 1.0-1.4 scale, respectively). Moderate %DI and DS (ranged from 4.1 to 5.5% and 0.5-1.0 scale, respectively) were recorded in HYVs, BR22, BR23, BIRRI dhan78, BIRRI dhan41, BIRRI dhan34, BIRRI dhan76 and BIRRI dhan77 while lower %DI and DS (ranged from 0.4 to 2.7% and 0.3-0.6 scale, respectively) were observed in local varieties except Sakkhorkhora and BR11 (Fig 7).

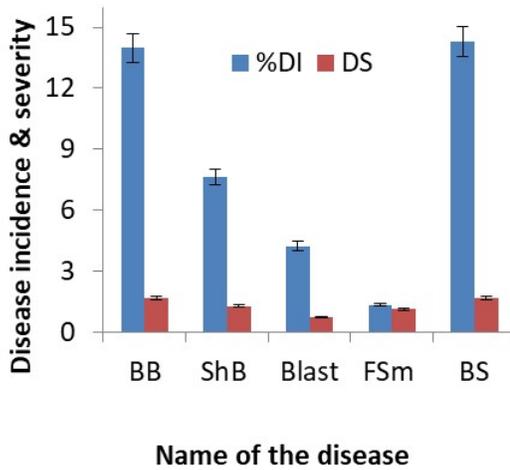


Figure 5: Incidence and severity of different diseases during T. Aman 2018

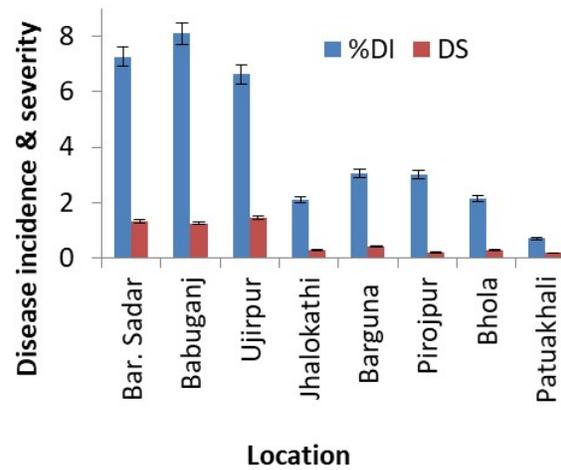


Figure 6: Disease incidence and severity over location during T. Aman 2018

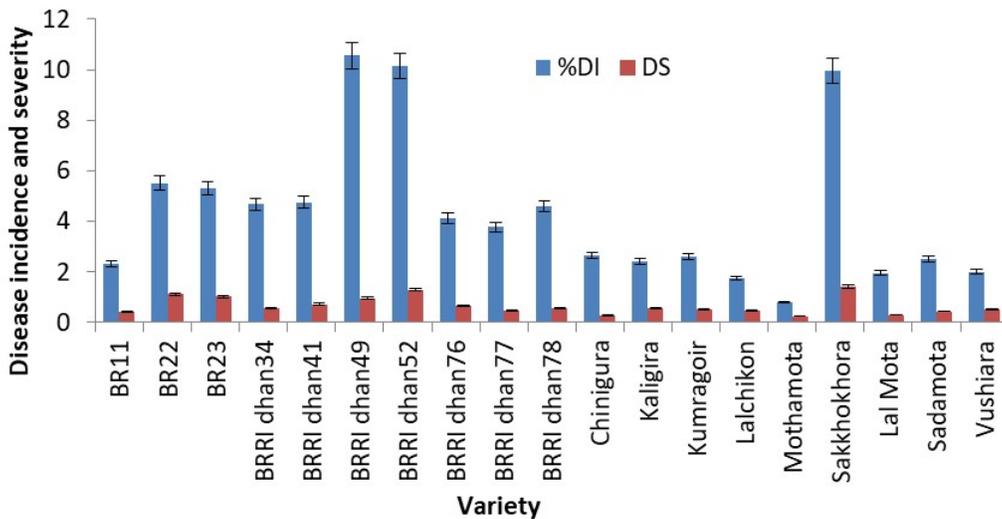


Figure 7: Disease incidence and severity over the Variety during T. Aman 2018

11a(ii)4. Correlation of weather factors on Disease and insect development: Effect of temperature on the appearance of BPH population was presented in the Figure 8. Development of BPH population was affected by temperature. Highest number of BPH insect was recorded during the month of October (from last week) and November when average air temperature was 29.6 °C (ranged from 21.0 to 33.8 °C) and minimum temperature was 19.5 (ranged from 14.6 to 23.2 °C). At that time average rainfall was 22 mm (ranged from 13 to 42 mm) (Figure 9). Ahmed et al. (2014) observed the similar result. Their observation was in accordance with the present study. Haq et al. (2010) reported the similar result which was in accordance with the present study.

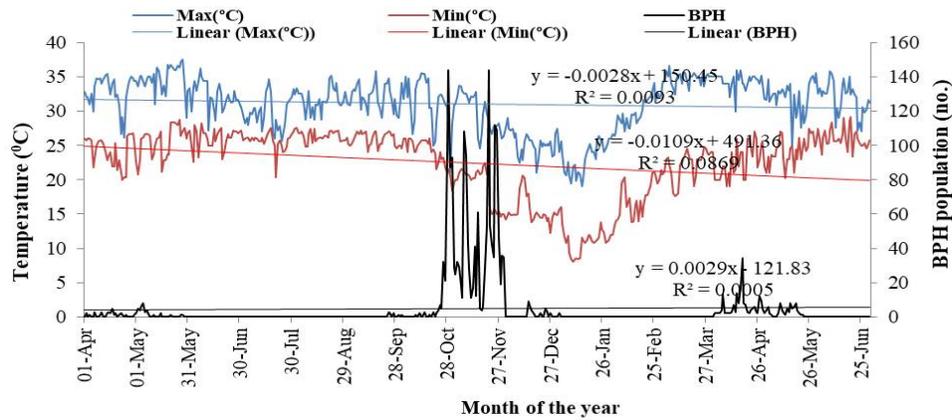


Figure 8: Effect of temperature on the appearance of BPH population.

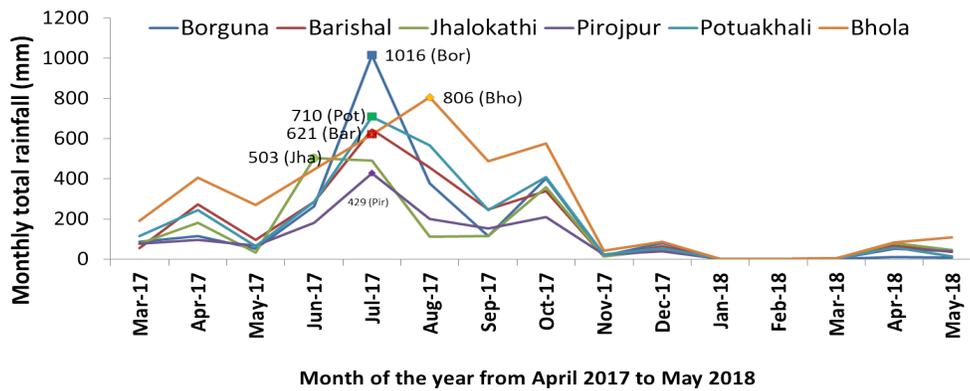


Figure 9: Rainfall pattern at Barishal region from March 2017 to May 2018.

Results of Panna et al., 2014 showed that BPH had become significantly more abundant in April over the 10-year period, but their data did not indicate that this was due to a change in climate, as no significant time trends in temperature and precipitation could be demonstrated. The abundance of BPH varied considerably between months within a year which was attributed to seasonal factors, including the availability of suitable host plants. On the other hand, the variation within months was attributed to fluctuations in monthly temperature and precipitation among years. The effect of increasing temperatures was ambiguous and interacts with the amount of rainfall. Months of the years or areas characterized by a climate that was either cold and dry or hot and wet were likely to experience higher levels of BPH due to climate change, whereas other combinations of temperature and rainfall may reduce the abundance of BPH. Our result indicated that global warming may have contributed to the recent outbreaks of BPH in some rice growing areas of Asia, and that the severity of such outbreaks is likely to increase if climate change exaggerates. Our study highlights the need to consider climate change when designing strategies to manage plant hoppers outbreaks.

During the growing season T. Aman 2017 the experiment was conducted at Barishal. Neck blast (NB) disease incidence was higher in irrigated (Boro rice) than rainfed (T. Aman rice) ecosystems (Figure 10a). Neck blast disease incidence was (0- 12% DI) during the month of November when maximum average air temperature was 29.8°C and minimum was 19.7°C; rainfall was 22 mm (ranged from 13 to 42 mm) (Figure 10b and 11). Leaf blast incidence was lower might be due to lower minimum temperature (16.1°C) and no rainfall. Incidence of neck blast was very less in April 2018 might be due to high degree of maximum (34.5 °C) and minimum (22.9 °C) temperature.

The temperature and incidence of rice blast was negatively correlated which indicated that the disease incidence increases with the decrease of temperature. Humidity is positively correlated with rice blast that indicated increase in disease incidence as humidity increased. Rainfall was also positively correlated with incidence of disease. Shafaullah et al, (2015) observed the similar result which was in accordance with the present study. However, more epidemiological studies are required to characterize the actual and critical factors to predict and forecast rice blast disease. This would help out minimize the yield losses caused by rice blast disease.

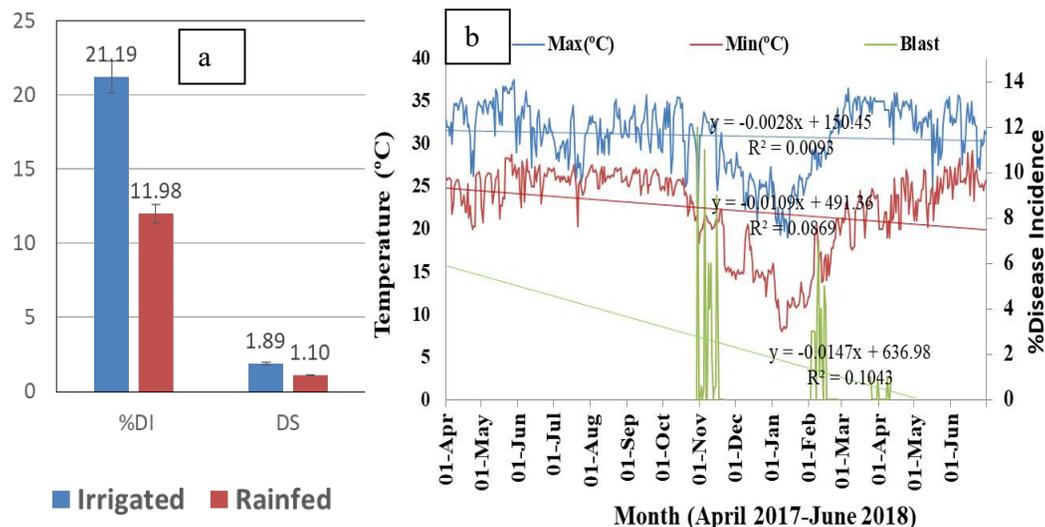


Figure 10: Occurrence of blast disease, (a) blast disease incidence (%DI) and severity (DS) in irrigated and rainfed ecosystem, (b) blast disease incidence in relation to temperature

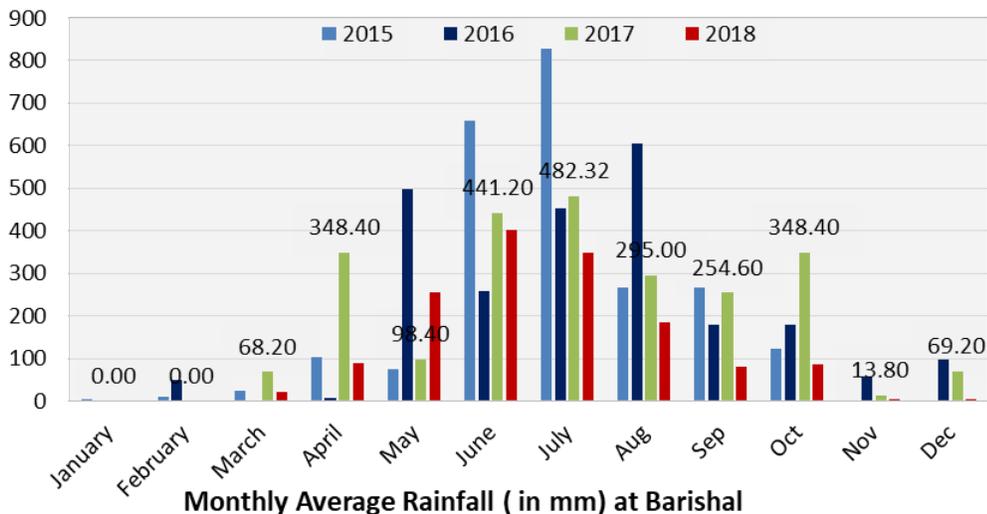


Figure 11: Monthly Average Rainfall (in mm) at Barishal during 2015-2018

11b: Effective and sustainable management packages for controlling disease and insect:

11b(i): Development of management packages for false smut disease of rice: The results on integrated approach of rice false smut disease management during T. Aman 2017 were presented in Figure 12 and Table 7. Higher incidence of rice false smut disease was recorded in third seeding time (7.5) followed by second seeding time (3.2) while lower number of balls on panicle

(1.6) was found in 4th ST (Fig. 12a). False smut disease was increased with the increasing of N-level (Fig. 12b). No false smut disease was observed at first seeding time (0). Lower number of infected panicle and balls on panicle was observed when N2 (1/3rd less than optimum N) and C3 (Azoxystrobin + Propiconazole) was applied at 2nd and 4th ST (Table 7). High FSM disease incidence occurred when the average temperature ranged from 22-28^oC (Fig. 12c). Similar observation was made by Nessa et al. (2015).

Optimum dose or little bit lower dose of Urea of optimum (22 kg Urea/33 decimal land for BRRI dhan49), chemical spray (Azoxystrobin + Propiconazole) at splitted booting stage and seeding at 30 June or 30 July may escape the infection by False smut disease of rice at southern region of Barishal.

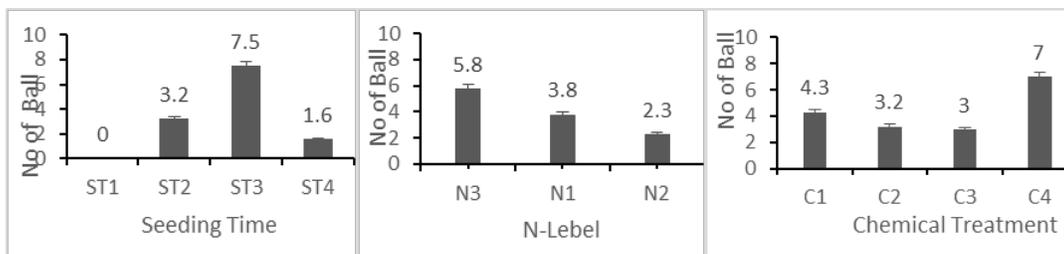


Figure 12: Effect of different, seeding time (a), nitrogen level (b) and chemicals (c) on false smut ball formation on panicle, T. Aman 2017.

Table 7: Interaction effect of planting time, nitrogen and chemical

Treatment interaction	Infectd pan.(no.)	Smut Ball (No.)	Treatment interaction	Infect pan.(no.)	Smut Ball (No.)
ST2 N1 C1	2.0	3.0	ST3 N2 C3	2.0	7.0
ST2 N1 C2	1.0	2.3	ST3 N2 C4	6.0	11.7
ST2 N1 C3	0.7	0.7	ST3 N3 C1	6.0	9.3
ST2 N1 C4	2.3	6.0	ST3 N3 C2	4.7	8.0
ST2 N2 C1	1.0	2.0	ST3 N3 C3	5.7	7.7
ST2 N2 C2	1.0	1.0	ST3 N3 C4	5.7	10.7
ST2 N2 C3	0.0	0.0	ST4 N1 C1	1.3	1.7
ST2 N2 C4	2.0	5.0	ST4 N1 C2	0.7	0.7
ST2 N3 C1	3.3	6.0	ST4 N1 C3	0.3	0.3
ST2 N3 C2	1.7	3.7	ST4 N1 C4	1.7	3.3
ST2 N3 C3	1.3	1.7	ST4 N2 C1	1.0	1.0
ST2 N3 C4	3.3	9.0	ST4 N2 C2	0.3	0.3
ST3 N1 C1	3.0	6.3	ST4 N2 C3	0.0	0.0
ST3 N1 C2	2.7	6.0	ST4 N2 C4	1.3	1.3
ST3 N1 C3	2.7	5.7	ST4 N3 C1	3.0	4.7
ST3 N1 C4	5.0	10.0	ST4 N3 C2	1.0	1.3
ST3 N2 C2	3.7	4.7	ST4 N3 C4	2.3	4.3
			%CV	36.89	42.44
			LSD _{0.05}	0.223	0.989

11b(ii): Chemical approach to manage blast disease of rice: The rice blast disease has long been recognized as the most important and potentially damaging rice disease with worldwide distribution. For blast disease management at field level chemical control is mainly practiced and other options particularly water management is another practice. As blast disease progresses rapidly in the rice field farmers mainly want to use chemicals to manage this disease. Every year rice yield lose is occurred in Barishal region due to this disease. Genetic diversity of blast pathogen is very high and pathogens show resistance against chemicals after few years use in the

field. Therefore, experiment was conducted to find out effective chemical(s) to manage blast disease of rice.

Fourteen chemicals (Table 8a) viz. Success 300 EC, Royal 75WDG, Mzole 32.5Sc, Tebuplus75, Cibazole 32.5, Quickout50WP, Dlink 32.5, Tecobin 75WP, Adistar top, Aiker 20, Bioesoonny plus, Suntighter, Mcvo 75 and Deconil 500 Sc were used as test chemicals keeping one positive control (Trooper as standard check) and one negative control (plain water). Spray was done twice, first at splitting boot stage and second at 10 days after of 1st spray. Factorial RCB design was followed with three replications. Spacing was 20 cm X 20 cm. BRRRI recommended practices were followed for land preparation and other agronomic managements. Chemicals were tested on BRRRI dhan34, a susceptible aromatic T. Aman HYV of rice to blast disease.

Result showed that four chemicals viz. Tebuplus75, Quickout50WP, Dlink 32.5 and Mcvo 75 significantly reduced neck blast (NB) and were similar to standard check chemical Trooper. Reduction of neck blast disease incidence by those chemicals was ranged from 90.0% to 93.7% over untreated control (plain water) (Table 8b). Other chemicals viz. Success 300 EC, Royal 75WDG, Mace, Cibazole 32.5, Quickout50WP, Dlink 32.5, Adistar top, Aiker 20, Suntighter, Mcvo 75 and Deconil 500 Sc also reduced neck blast and this reduction was ranged from 83.1% to 88.7%. Rest of the chemicals was not good in reducing the blast disease (Table 8b). Further test of those effective chemicals was suggested for the next season.

Aforementioned four new chemicals viz. Tebuplus75, Quickout50WP, Dlink 32.5 and Mcvo 75 could be used effectively for blast disease management.

Table 8a: List of fungicides selected for blast screening program

Sl	Name	Dose	Active ingredient (a.i.)	Company
1	Success 300 EC	225 g/ha	Difeno+Propi	Sotota Agro Science
2	Royal 75WDG	300 g/ha	Tebu+Trifloxis	Haychem
3	Mzole 32.5Sc	500 ml/ha	Difeno+Azoxst	Dhanuka Agri Solution
4	Tebuplus75	250 g/ha	Tebu+Trifloxistrobin	Digital Agriculture
5	Cibazole 32.5	500 ml/ha	Azoxst+Difeno	Crop life
6	Quickout50WP	250 g/ha	Iprodine+Carben	Babylon Agri Science
7	Dlink 32.5	500 ml/ha	Azoxst+Difeno	Agrolink BD
8	Tecobin 75WP	300 g/ha	Tebu+Trifloxs	Fasal Agro Ltd
9	Adistar top	200 ml/ha	Azoxst+Difeno	Mahir Agro Care
10	Aiker 20	500 ml/ha	Tebucona+Fenamistrobin	National Agri Care
11	Bioesoonny plus	500-800 g/ha	Azoxst+Difeno	Alpha Agro Care
12	Suntighter	500 ml/ha	Hexacona+Tricyclazole	McDonald Bd Ltd
13	Mcvo 75	250 g/ha	Tebucona+Trifloxstrobin	McDonald Bd Ltd
14	Deconil 500 Sc	2 ml/L	Chlonothalonil 50%	Haychem
15	Trooper 75WP	400 gm/ha	Tricyclazole	Auto Crop Care Ltd

Table 8b: Effect of differents chemicals on the neck blast disease of rice, T. Aman 2017

Treatment	Total Panicle	Infected panicle	% Infected Panicle	% Disease reduction
T1 Success 300 EC	207	18.7	9.0	86.3
T2 Royal 75WDG	177	13.3	7.7	88.2
T3 Mzole 32.5Sc	203	46.7	22.7	65.3
T4 Tebuplus75	193	8.0	4.1	93.7
T5 Cibazole 32.5	198	14.7	7.4	88.7
T6 Quickout50WP	216	13.3	6.4	90.2

T7 Dlink 32.5	227	10.7	5.2	92.0
T8 Tecobin 75WP	190	66.7	34.8	46.9
T9 Adistar top	208	17.3	7.8	88.0
T10 Aiker 20	179	20.0	11.0	83.2
T11 Biosoony plus	167	52.0	34.5	47.4
T12 Suntighter	159	18.7	11.1	83.1
T13 Mevo 75	181	12.0	6.6	90.0
T14 Deconil 500 Sc	163	13.3	8.2	87.4
T15 Trooper 75WP	209	10.7	5.1	92.2
T16 Untreated control	186	118.7	65.5	0.0
CV	39.05	14.02	-	-
LSD	21.9	8.8	-	-

11b(iii): Need based insecticide management (NBIM) for better yield: The results of need based insecticide management during T. Aman 2018 were presented in Table 9 and 10. Insect pests were lower (5.3) but natural enemies of insect pests were higher (3.7) in NBM plots than control plots (6.7 and 2.1, respectively). Growth duration was 138 days and yield was 5.13 t/ha in NBM treatment while growth duration and yield were 136 days and 4.98 t/ha, respectively in control treatment (Table 9). Insect pests and natural enemies were higher in NBM plots than control plots at maximum tillering stage (Table 10). During the experimentation farmer used one insecticide at early stage of crop growth. But no insecticide was used in NBM practice. These might be the reason of having more infestation in NBIM plot at MTS compared to the control. Farmer did not follow the sub treatments of NBIM practices which might increase insect infestation in control plot at later stages. The reports of Haq et al. (2011) and Anonymous (2014) were in agreement with the present study.

Though the yield increase in NBIM package is not significant farmers can save 2-3 insecticide applications which will reduce hazardous chemical to the environment.

Table 9: Effect of need based insecticide management (NBIM) on the yield and growth duration of BRR1 dhan49 during T. Aman 2018

Demo treatment	Location	Insect pest (Average no.)	Natural enemy (Average no.)	GD (days)	Yield (t/ha)
Control	Amtali, Borguna	6.7	2.1	136	4.98
Need Based Management (NBIM)	Amtali, Borguna	5.3	3.7	138	5.13
LSD		0.834	0.971	NS	NS

Table 10: Infestation of insect and natural enemies at Maximum Tillering (MTS), Panicle initiation (PIS) and boot Stags (BS) in need based management (NBM) and control plots during T. Aman 2018

Pest/ Enemy	NBM			Control			NBM (Av)	Control (Av)
	MTS	PIS	BS	MTS	PIS	BS		
Pest								
BPH	4	0	2	0	3	4	2.0	2.3
GLH	15	8	20	11	17	27	14.3	18.3
LF	4	4	2	4	11	6	3.3	7.0
LPHH	6	5	5	2	4	11	5.3	5.7
RB	0	1	3	0	3	1	1.3	1.5
SHPH	12	16	4	9	14	13	10.7	12.0
WBPH	1	0	0	0	0	0	0.3	0.0

Pest/ Enemy	NBM			Control			NBM (Av)	Control (Av)
	MTS	PIS	BS	MTS	PIS	BS		
WLH	4	2	2	3	5	4	2.7	4.0
YSB	7	6	9	7	10	8	7.3	8.3
ZLH	4	4	9	5	12	5	5.7	8.0
Natural enemy								
CBB	1	2	4	0	2	2	2.3	1.3
DF	3	4	2	0	2	1	3.0	1.0
GMB	0	1	0	0	0	0	0.3	0.0
LBB	4	6	3	1	4	3	4.3	2.7
Spider	6	11	8	1	9	7	8.3	5.7

BPH=Brown Plant Hopper, GLH=Green Leaf Hopper, LF=Leaf Folder, LPH=Long Horned Plant Hopper, RB=Rice Bug, SHPH=Short Horned Plant Hopper, WBPH=White Backed Plant Hopper, WLH=White Leaf Hopper, YSB=Yellow Stem Borer, ZLH=Zig Zag Leaf Hopper, GMB=Green Mirid Bug, DF=Damsel Fly, LBB=Lady Bird Beetle, CBB=Carabid Beetle.

11b(iv). Use of tolerant variety for disease and insect pest management: Demonstration of BRRI released rice varieties for cultivating in disease and insect prone areas: Demonstration of disease and insect tolerant varieties was conducted, so that farmers could select appropriate varieties for their own use. Grain yield of different rice varieties and farmers description were showed in Table 11a. Increased yield in HYV of rice over local variety during T. Aman 2017 were presented in Table 11b. Higher growth duration was observed in local varieties followed by BRRI dhan76, BRRI dhan77, BR23 and BRRI dhan52 while lower growth duration was found in BRRI dhan72. Local variety yielded 2.82 t ha⁻¹ but HYV rice yielded much more which was 88%, 85%, 82%, 82% and 73% more in BRRI dhan 76, BRRI dhan52, BRRI dhan72, BRRI dhan77 and BR23, respectively than local varieties (Table 11b).

During Transplanting Aman season farmers of the southern region of Barishal could use BR23, BRRI dhan52, BRRI dhan72, BRRI dhan76 and BRRI dhan77 for higher grain yield keeping the disease and insect damage minimum.

Table 11a: Demonstration of BRRI released rice varieties for cultivating in disease and insect prone areas during T. Aman 2017

Sl. No.	Farmers Name	Village/Upazila/District	Variety	Height (cm)	GD	Yield (t/ha)
1.	Shahdat Hossain	Songkorpasa	BR23	122	148	4.86
		Sadar	BRRI dhan52	118	145	5.13
		Pirojpur	BRRI dhan76	142	161	5.16
			Local (Dudkolom)	165	160	2.65
2.	Sultan Howlader	Boroitola	BR23	125	151	4.91
		Sadar	BRRI dhan52	117	143	5.17
		Pirojpur	BRRI dhan76	145	159	5.08
			Local (Sadamota)	151	167	2.85
3.	Imdadul Khan	Moddho Balipara	BR23	124	149	5.10
		Indurkani	BRRI dhan52	116	145	5.05
		Pirojpur	BRRI dhan76	140	160	5.25
			Local (Mothamota)	145	165	2.91
4.	Abu Hanif	Seutibaria	BR23	127	147	4.85
		Indurkani	BRRI dhan52	119	147	4.99
		Pirojpur	BRRI dhan76	138	158	5.14
			Local (Vusiara)	155	163	2.50
5.	Badsha Khan	Rupshia	BR23	123	148	5.09
		Sadar	BRRI dhan52	120	143	5.00

Sl. No.	Farmers Name	Village/Upazila/District	Variety	Height (cm)	GD	Yield (t/ha)
		Jhalokathi	BRR1 dhan72	121	130	5.00
			BRR1 dhan76	141	162	5.24
			Local (Sadamoto)	153	161	2.88
6.	Ripon Howlader	Shachelapur	BR23	121	146	5.07
			BRR1 dhan52	117	143	5.16
		Jhalokathi	BRR1 dhan76	142	157	5.29
			Local(Mothamoto)	148	162	3.08
7.	Delowar Hossain	Malipur	BRR1 dhan72	119	131	5.13
			BRR1 dhan76	140	160	5.20
		Nolcity Jhalokathi	BRR1 dhan77	145	156	5.12
			Local (Vusiara)	152	163	2.40
8.	Nannu Talukder	Khajuria	BR23	126	151	4.77
		Nolcity	BRR1 dhan52	121	145	5.15
		Jhalokathi	Local (Mothamoto)	146	163	2.58
9.	Golam Rosul	Rakudia	BR23	125	152	4.91
		Babugong Barisal	BRR1 dhan52	123	143	5.05
			BRR1 dhan72	120	128	4.81
			BRR1 dhan76	143	164	5.16
		Local (Mothamoto)	149	163	3.05	
10.	Roshid Khan	Rakudia	BR23	124	149	4.72
		Babugong Barisal	BRR1 dhan52	118	142	5.09
			Local (Lalmota)	146	160	3.14
11.	Halim Munshi	Chorkaua	BR23	123	148	4.87
			BRR1 dhan52	119	144	5.11
		Sadar Barisal	BRR1 dhan72	117	132	5.40
			BRR1 dhan76	139	163	5.18
			Local(Sadamota)	144	162	3.19
12.	Abdus Sattar	Kagasura	BR23	122	149	4.69
		Sadar Barisal	BRR1 dhan52	118	141	5.09
			BRR1 dhan76	146	158	5.20
			Local(Lalmoto)	148	160	2.78
13.	Dulal Mia	Amtoli	BR23	123	150	4.81
		Bamna	BRR1 dhan52	116	146	5.12
		Barguna	Local (Lalmota)	145	163	2.75
14.	Mozid Howlader	Douatola	BR23	123	147	4.83
		Bamna Barguna	BRR1 dhan52	121	140	5.25
			BRR1 dhan76	142	156	5.16
			Local (Mothamoto)	146	161	2.76
15.	Md. Mizan	South Amtoli	BR23	121	151	4.98
		Amtoli Barguna	BRR1 dhan52	117	142	5.13
			BRR1 dhan76	140	155	5.31
			Local(Lalmoto)	150	162	2.86
16.	Shahidul Islam	Amtoli	BR23	128	152	4.85
		Amtoli Barguna	BRR1 dhan52	122	145	5.01
			BRR1 dhan76	147	159	5.17
			Local(Lalmota)	151	160	2.79
17.	Hossain Ali	Londa	BR23	118	154	4.81
		Kolapara Patuakhali	BRR1 dhan52	115	142	5.13
			BRR1 dhan76	142	161	5.46
			Local(Mothamoto)	145	165	2.50
18.	Rasel Howlader	Londa	BR23	124	149	4.88
		Kolapara Patuakhali	BRR1 dhan52	116	146	5.09
			BRR1 dhan76	141	160	5.20
			Local(Mothamoto)	146	164	2.45

Sl. No.	Farmers Name	Village/Upazila/District	Variety	Height (cm)	GD	Yield (t/ha)
19.	AB.Mannan	Jamla	BR23	120	148	4.75
		Dumki	BRR1 dhan52	120	143	5.08
		Patuakhali	Local(Vusiara)	148	161	2.68
20.	Mostofa Shorif	Dumki	BR23	123	145	4.98
		Dumki	BRR1 dhan52	123	142	5.47
		Patuakhali	BRR1 dhan72	118	127	5.31
			Local(Mothamota)	149	161	2.61
21.	Abdus Sattar	Chor romesh	BR23	122	142	4.84
		Sadar	BRR1 dhan52	116	147	5.02
		Bhola	BRR1 dhan76	147	158	5.28
			Local(Sadamota)	153	162	3.00
22.	Md. Shohag	Choddogor	BR23	126	145	4.75
		Sadar	BRR1 dhan52	118	140	5.42
		Bhola	BRR1 dhan76	139	156	5.69
			Local(Montessormota)	147	165	3.36
23.	Jomuna Rani	Pokkhia	BR23	128	146	5.45
		Borhanuddin	BRR1 dhan52	117	142	6.80
		Bhola	BRR1 dhan76	141	161	5.93
			Local(Sadamota)	147	167	3.15
24.	Bibi Moriom	East Lokkhipur	BR23	123	148	4.69
		Borhanuddin	BRR1 dhan52	123	141	5.10
		Bhola	BRR1 dhan76	148	158	5.42
			Local(Dudhkalam)	142	159	2.67

Table 11b: Grain yield and yield contributing characters of different rice varieties of HYV increased over local variety, T. Aman 2017

Variety	No. of locations	Pl. ht. (cm)	GD (days)	Yield (tha ⁻¹)	Yield increased over local variety (%)
BR23	23	124	148	4.89 (4.69-5.45)	73
BRR1 dhan52	23	119	143	5.21 (4.99-6.8)	85
BRR1 dhan72	05	119	130	5.13 (4.81-5.4)	82
BRR1 dhan76	19	142	159	5.29 (5.08-5.93)	88
BRR1 dhan77	03	145	156	5.12	82
Local variety*	24	149	162	2.82 (2.4-3.36)	-

*(Average of local varieties viz. Sadamota, Dudhkalam, Mothamota, Vusiara, Lalmota); one local variety was used in each of 24 locations.

During Boro 2017-18 nine rice varieties viz. BRR1 dhan28, BRR1 dhan29, BRR1 dhan47, BRR1 dhan58, BRR1 dhan62, BRR1 dhan64, BRR1 dhan67, BRR1 dhan74 and BRR1 Hybrid dhan3 were tested in 24 locations of Barishal region (Table 12). The highest grain yield (8.6 tha⁻¹) was recorded in BRR1 Hybrid dhan3 while the lowest in local varieties, Sadavojon (4.7 tha⁻¹) and Chaita Boro (3.2 tha⁻¹). Longer growth duration was observed in Sadavojon (157 days) while shorter in Chaita Boro (141 days). Local variety yielded 3.2-4.7 tha⁻¹ but HYV rice yielded much more (average 5.9-8.6 tha⁻¹) (Table 13). Yield of HYVs was higher (26-83% higher) than local variety Sadavojon but 84-169% higher than Chaita Boro (Table 13).

During Boro season farmers of the southern region of Barishal could use BRR1 dhan58, BRR1 dhan64, BRR1 dhan67, BRR1 dhan74 and BRR1 Hybrid dhan3 for higher grain yield keeping the disease and insect damage minimum.

Table 12: Demonstration of BRR1 released rice varieties for cultivating in disease and insect prone areas during Boro 2017-18

Sl. No.	Locations	Varieties	Tiller No.	Panicle No.	GD (days)	Yield (tha ⁻¹)
1	Barishal Sadar	BRRi dhan29	14	13	155	7.35
		BRRi dhan47	13	12	149	6.10
		BRRi dhan67	16	15	147	7.09
2	Barishal Sadar	BRRi dhan28	14	13	143	6.15
		BRRi dhan29	15	14	157	7.16
		BRRi dhan74	16	14	144	7.17
3	Babugonj, Barishal	BRRi dhan47	14	13	142	6.21
		BRRi dhan62	15	14	146	6.07
		BRRi dhan67	16	15	152	7.20
4	Babugonj, Barishal	BRRi dhan47	14	13	148	6.12
		BRRi dhan58	16	15	152	7.20
		BRRi dhan67	16	15	143	6.67
5	Jhalokathi Sadar	BRRi dhan28	15	13	144	6.18
		BRRi dhan47	13	12	148	6.23
		BRRi dhan58	14	13	142	6.21
6	Jhalokathi Sadar	BRRi dhan28	15	14	141	6.14
		BRRi dhan47	14	13	145	5.98
		BRRi dhan67	16	15	141	6.72
7	Nolchity, Jhalokathi	BRRi dhan47	15	14	142	6.10
		BRRi dhan58	17	15	148	7.15
		BRRi dhan67	16	14	146	6.78
8	Nolchity, Jhalokathi	BRRi dhan47	13	12	148	6.17
		BRRi dhan58	16	14	147	7.23
		BRRi dhan64	15	14	150	6.66
9	Nazirpur, Pirojpur	BRRi Hybrid dhan3	13	12	144	8.87
		BRRi dhan47	13	12	141	6.05
		BRRi dhan58	13	12	145	7.17
10	Nazirpur, Pirojpur	BRRi Hybrid dhan3	12	11	148	8.67
		BRRi dhan67	17	15	146	7.18
		BRRi dhan74	14	13	142	7.20
11	Pirojpur Sadar	BRRi dhan28	15	14	142	6.44
		BRRi dhan58	14	12	151	7.29
		BRRi dhan67	16	15	143	6.69
12	Pirojpur Sadar	BRRi dhan29	14	13	154	7.47
		BRRi dhan62	16	15	145	6.05
		BRRi dhan67	15	14	144	6.75
13	Barguna Sadar	BRRi dhan28	14	13	144	5.99
		BRRi dhan47	16	14	146	6.10
		BRRi dhan67	15	14	148	6.29
14	Barguna Sadar	BRRi dhan28	17	15	140	5.68
		BRRi dhan47	16	14	145	5.90
		BRRi dhan67	18	16	142	6.11
15	Amtali, Barguna	BRRi dhan28	16	13	141	5.93
		BRRi dhan47	15	13	142	6.16
		BRRi dhan58	18	15	152	6.51
16	Amtali, Barguna	BRRi dhan28	15	14	143	5.88
		BRRi dhan47	14	13	147	5.90
		BRRi Hybrid dhan3	13	12	149	8.55
17	Kalapara, Patuakhali	BRRi dhan47	17	15	141	6.20
		BRRi dhan67	19	17	147	6.25
		BRRi dhan62	16	15	144	5.91
18	Kalapara, Patuakhali	BRRi dhan74	16	14	145	6.85
		BRRi dhan47	15	14	146	5.95
		BRRi dhan67	17	16	141	6.33

Sl. No.	Locations	Varieties	Tiller No.	Panicle No.	GD (days)	Yield (tha ⁻¹)
		BRRRI Hybrid dhan3	13	12	150	8.11
19	Dumki, Patuakhali	BRRRI dhan28	14	13	144	5.80
		BRRRI dhan47	15	14	147	5.71
		BRRRI dhan62	16	14	144	5.87
20	Dumki, Patuakhali	BRRRI dhan28	15	13	141	5.78
		BRRRI dhan47	14	13	142	5.96
		BRRRI dhan62	17	15	143	5.66
21	Bhola Sadar	BRRRI dhan28	15	14	144	6.10
		BRRRI dhan47	14	12	141	5.80
		BRRRI dhan58	16	14	152	6.68
22	Bhola Sadar	BRRRI dhan28	16	15	137	5.81
		BRRRI dhan47	15	14	140	5.90
		BRRRI dhan58	17	15	147	6.53
23	Borhanuddin, Bhola	BRRRI dhan28	15	13	143	5.78
		BRRRI dhan47	16	15	141	5.71
		BRRRI dhan58	18	16	148	6.42
24	Borhanuddin, Bhola	BRRRI dhan28	13	12	142	5.85
		BRRRI dhan47	15	14	140	5.89
		BRRRI dhan58	16	14	145	6.67

Table 13: Yield and yield contributing characters of HYV and Local cultivars during Boro 2017-2018

Variety	No. of location	Tiller no.	Panicle no.	GD (day)	Yield (t/ha) (range)	% yield increase over Sadavojon	% yield increase over Chaita Boro
HYV of rice							
BRRRI dhan28	14	14.9	13.5	142	6.0 (5.7-6.4)	28	88
BRRRI dhan29	03	14.3	13.3	155	7.3 (7.2-7.5)	55	128
BRRRI dhan47	20	14.6	13.3	144	6.0 (5.7-6.3)	28	88
BRRRI dhan58	11	15.9	14.1	148	6.8 (6.2-7.3)	45	113
BRRRI dhan62	05	16.0	14.6	144	5.9 (5.8-6.1)	26	84
BRRRI dhan64	01	15.0	14.0	150	6.7	43	109
BRRRI dhan67	13	16.3	15.0	145	6.7 (6.3-7.2)	43	109
BRRRI dhan74	03	15.3	13.7	144	7.1 (6.8-7.2)	51	122
BRRRI Hybrid dhan3	04	12.8	11.8	148	8.6 (8.1-8.9)	83	169
Local variety							
Sadavojon	12	-	-	157	4.7 (4.3-5.1)	-	-
Chaita Boro	12	-	-	141	3.2 2.9-3.5	-	-

A total of 14 demonstrations were conducted during T. Aman 2018. Eight HYV of rice viz. BR23, BRRRI dhan41, BRRRI dhan49, BRRRI dhan52, BRRRI dhan76, BRRRI dhan77, BRRRI dhan87 and BRRRI Hybrid dhan4 were tested in nine locations of Barishal, Jhalokathi, Pirojpur and Patuakhali districts of Barishal region. Table 14 represented growth duration, grain yield and increased yield in HYV of rice over local variety during T. Aman 2018. Higher and similar growth duration was observed in local variety and BRRRI dhan76 (161 days) followed by BRRRI dhan77, BR23, BRRRI dhan52, BRRRI dhan41, BRRRI dhan49 while lower growth duration was found in BRRRI Hybrid dhan4 (120 days). Average yield of local variety was 3.1 tha⁻¹ but HYV rice yielded much more which was ranged from 45 to 90%.

Table 14: Demonstration of BRRRI released rice varieties for cultivating in disease and insect prone areas during T. Aman varieties in 2018

Variety	GD	Av. Yield	Range of Yield	Yield increased over local
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	(days)	(t/ha)	(t/ha)	variety (%)
BR23	146	5.3	4.5-5.9	71.0
BRRi dhan41	144	4.5	4.1-4.9	45.2
BRRi dhan49	136	4.9	4.2-5.5	58.1
BRRi dhan52	147	5.5	4.7-6.0	77.4
BRRi dhan76	161	5.1	4.3-5.6	64.5
BRRi dhan77	148	4.8	4.1-5.6	54.8
BRRi dhan87	129	5.7	4.9-6.3	83.9
BRRi Hybrid dhan4	120	5.9	5.3-6.6	90.3
Local variety*	161	3.1	2.5-3.6	0.0

*(Average of local varieties viz. Sadamota, Dudhkalom, Mothamota, Vusiara, Lalmota); one local variety was used in each of 14 demos.

11c: Identification of breeding location of insects in particular:

Breeding location of insect pests was identified based on survey data. Survey of insect pests was conducted in six districts of southern region of Barishal. Gall midge was higher in Patuakhali especially at Dasmina and leaf folder along with stem borer and rice bug were higher in Pirojpur especially at Shanker Pasha (Table 15). Irrespective of insect pests average insect infestation was higher in Pirojpur followed by Barishal, Barguna, Patuakhali, and Jhalokathi while lower insect infestation was recorded in Bhola. Irrespective of location higher number of insect was cricket followed by leaf folder and green leaf hopper. Moderate number of insect was rice bug followed by stem borer and grass hopper.

Farmers of the areas where certain insect infestation is higher especially, Dasmina, Patuakhali and Shanker Pasha, Pirojpur could be alert during their rice cultivation.

Table 15: Major insect infestation at different Districts of Barishal region during Flowering to Maturity stage of rice crop (20 hill count), T. Aman 2017

District	GM	LF	SB	RB	GLH	GH	Cri	WM	Av
Pirojpur	0.9	2.9	2.5	2.6	2.1	2.3	2.6	2.2	2.2
Jhalokathi	0.3	1.9	1.2	2.1	1.6	1.6	2.3	1.5	1.5
Barishal	1.0	2.1	2.4	2.1	2.1	1.6	2.4	2.7	2.1
Barguna	0.9	2.5	1.9	1.9	1.5	1.7	2.3	1.3	1.7
Patuakhali	1.1	1.8	1.3	1.1	2.9	1.5	2.0	1.6	1.6
Bhola	0.1	1.4	1.1	1.3	1.7	1.3	1.7	1.1	1.2
Av	0.6	2.0	1.7	1.9	2.0	1.7	2.2	1.7	1.7

GM=Gall midge; LF=Leaf folder; WM=Whorl Maggot; Cri= Cricket; SB=Stem borer; GH=Grass hopper; GLH= Green Leafhopper; RB=Rice bug

Appendices

Appendix 1: Pictorial view of the project activities



Site selection for T. Aman 2017 at Nolchity, Jhalakathi



Seed distribution at Pirojpur during T. Aman 2017



Transplanting of BRRI HYV at Barisal Sadar during T. Aman 2017



Survey of disease at farmers' field during T. Aman 2017



Survey of rice gall midge infected field at Dosmina, Potuakhali during T. Aman 2017



Survey and collection of insect at Amtali, Borguna during T. Aman 2017



Survey of rice leaf folder infected field at Dumki, Potuakhali during T. Aman 2017



Survey of rice gall midge and sheath blight infected field at Amtali, Borguna during T. Aman 2017



Demonstration of BRRI HYV rice at Borhanuddin, Vhola during T. Aman 2017



Demonstration plot at Kolapara, Potuakhali during T. Aman 2017



Demonstration of management practices of disease and insect pest through farmer practice (FP) and research practice (RP)



Crop cut at Babujanj, Barisal during T. Aman 2017



Farmers' Field day at Jhalakathi Sadar, Jhalakathi during T. Aman 2017



Farmers' Field day at Gabkhan, Jhalakathi during T. Aman 2017



Boro 17-18 field selection



Boro seed distribution 2017-18



BARC Team visited experimental field at Nolchity, Jhalakathi on 18.02.2018



Effect of physical properties (soil nutrient), Boro 2017-18



Variety demonstration during Aus
2018

Variety demonstration during T. Aman
2018

Appendix 2: Farmers' list and other information, T. Aman- 2017

Sl. No.	Farmers Name	Village	Upazila	District	Variety	Area (dec.)
01.	Shahdat Hossain	Songkorpasa	Sadar	Pirojpur	BR23, BRRIdhan52, BRRIdhan76	100
02.	Sultan Howlader	Boroitola	Sadar	Pirojpur	BR23, BRRIdhan52, BRRIdhan76	100
03.	Imdadul Khan	Moddho Balipara	Indurkani	Pirojpur	BR23, BRRIdhan52, BRRIdhan76	100
04.	Abu Hanif	Seutibaria	Indurkani	Pirojpur	BR23, BRRIdhan52, BRRIdhan76	100
05.	Badsha Khan	Rupshia	Sadar	Jhalokathi	BR23, BRRIdhan52, BRRIdhan76	100
06.	Ripon Howlader	Shatinapur	Sadar	Jhalokathi	BR23, BRRIdhan52, BRRIdhan76	100
07.	Delowar Hossain	Malipur	Nolchity	Jhalokathi	BRRIdhan72, BRRIdhan77	100
08.	Nannu Talukder	Khajuria	Nolchity	Jhalokathi	BRRIdhan52, BRRIdhan77	100
09.	Golam Rosul	Rakudia	Babugong	Barisal	BR23, BRRIdhan52, BRRIdhan72, BRRIdhan76	100
10.	Gofur Molla	Rakudia	Babugong	Barisal	BR23, BRRIdhan52	100
11.	Halim Munshi	Chorkaua	Sadar	Barisal	BR23, BRRIdhan52, BRRIdhan72, BRRIdhan76	100
12.	Abdus Sattar	Kagasura	Sadar	Barisal	BR23, BRRIdhan52, BRRIdhan72, BRRIdhan76	-
13.	Dulal Mia	Amtoli	Bamna	Barguna	BR23, BRRIdhan52, BRRIdhan77	100
14.	Mozid Howlader	Douatola	Bamna	Barguna	BRRIdhan52, BRRIdhan72,	100

Sl. No.	Farmers Name	Village	Upazila	District	Variety	Area (dec.)
					BRR1 dhan76	
15.	Md. Mizan	South Amtoli	Amtoli	Barguna	BR23, BRR1 dhan52, BRR1 dhan76	100
16.	Shahidul Islam	Amtoli	Amtoli	Barguna	BR23, BRR1 dhan52, BRR1 dhan76	100
17.	Hossain Ali	Londa	Kolapara	Patuakhali	BR23, BRR1 dhan52, BRR1 dhan76	100
18.	Rasel Howlader	Londa	Kolapara	Patuakhali	BR23, BRR1 dhan52, BRR1 dhan76	100
19.	Kabir Alom	North Moradia	Dumki	Patuakhali	BR23, BRR1 dhan52	100
20.	Mostofa Shorif	Dumki	Dumki	Patuakhali	BR23, BRR1 dhan52, BRR1 dhan76	100
21.	Abdus Sattar	Chor romesh	Sadar	Bhola	BR23, BRR1 dhan52, BRR1 dhan76	100
22.	Md. Shohag	Choddogor	Sadar	Bhola	BR23, BRR1 dhan52, BRR1 dhan76	100
23.	Jomuna Rani	Pokkhia	Borhanuddin	Bhola	BR23, BRR1 dhan52, BRR1 dhan76	100
24.	Bibi Moriom	East Lokkipur	Borhanuddin	Bhola	BR23, BRR1 dhan52, BRR1 dhan76	100

Appendix 3: Farmers' list and other information, Boro 2017-18

Sl. No.	Farmers Name	Village	Upazila	District	Variety	Area (dec.)
01.	Abdus Sattar	Kagasura	Sadar	Barisal	BRR1 dhan29, BRR1 dhan47, BRR1 dhan67	100
02.	Abu Hanif	Kagasura	Sadar	Barisal	BRR1 dhan28, BRR1 dhan29, BRR1 dhan74	100
03.	Golam Rosul	Rakudia	Babugong	Barisal	BRR1 dhan47, BRR1 dhan62, BRR1 dhan67	100
04.	Ajijul Haq	Rakudia	Babugong	Barisal	BRR1 dhan47, BRR1 dhan58, BRR1 dhan67	100
05.	Feroj Howlader	Shatinapur	Sadar	Jhalokathi	BRR1 dhan28, BRR1 dhan47, BRR1 dhan58	100
06.	Ismail Talukder	Chamta	Sadar	Jhalokathi	BRR1 dhan28, BRR1 dhan47, BRR1 dhan67	100
07.	Badul Howlader	Serampur	Nolchity	Jhalokathi	BRR1 dhan47, BRR1 dhan58, BRR1 dhan67	100
08.	Harish Howlader	Raipasha	Nolchity	Jhalokathi	BRR1 dhan47, BRR1 dhan58, BRR1 dhan64	100
09.	Mojebur	Vaijora	Nazirpur	Pirojpur	BRR1 Hybrid dhan3,	100

	Rahaman				BRRi dhan47, BRRi dhan58	
10.	Haidar Ali	Chalitabari	Nazirpur	Pirojpur	BRRi Hybrid dhan3, BRRi dhan67, BRRi dhan74	100
11.	Siddique Rahaman	Kodomtola	Sadar	Pirojpur	BRRi dhan28, BRRi dhan58, BRRi dhan67	100
12.	Kalipodo	North Kodomtola	Sadar	Pirojpur	BRRi dhan29, BRRi dhan62, BRRi dhan67	100
13.	Jalal Sikdar	Gorjonbunia	Sadar	Barguna	BRRi dhan28, BRRi dhan47, BRRi dhan67	100
14.	Sahalom Gazi	Noltona	Sadar	Barguna	BRRi dhan28, BRRi dhan47, BRRi dhan67	100
15.	MD.Chan Mia Matbor	Chola Vanga	Amtoli	Barguna	BRRi dhan28, BRRi dhan47, BRRi dhan58	100
16.	MD.Nur Alom	Amragacia	Amtoli	Barguna	BRRi dhan28, BRRi dhan47, BRRi Hybrid dhan3	100
17.	MD.Shelim Duari	Lothip Pur	Kolapara	Patuakhali	BRRi dhan47, BRRi dhan67, BRRi dhan62	100
18.	MD.Shajahan	Old Mohipur	Kolapara	Patuakhali	BRRi dhan74, BRRi dhan47, BRRi dhan67, BRRi Hybrid dhan3	100
19.	MD.Kashem Sardar	Atharo Gacia	Dumki	Patuakhali	BRRi dhan28, BRRi dhan47, BRRi dhan62	100
20.	MD.Mannan Hawladar	Atharo Gacia	Dumki	Patuakhali	BRRi dhan28, BRRi dhan47, BRRi dhan62	100
21.	Raton Manazar	Oest Chor Kali	Sadar	Bhola	BRRi dhan28, BRRi dhan47, BRRi dhan58	100
22.	MD.Shek Forid	Chor Vedurea	Sadar	Bhola	BRRi dhan28, BRRi dhan47, BRRi dhan58	100
23.	Ripon Chonro Das	Togbi	Borhanuddin	Bhola	BRRi dhan28, BRRi dhan47, BRRi dhan58	100
24.	MD.Akbar Hossin	Pokkhia	Borhanuddin	Bhola	BRRi dhan28, BRRi dhan47, BRRi dhan58	100

11. Research highlight/findings:

- For brown plant hopper (BPH) insect development, no significant time trends in precipitation and temperature could be demonstrated. The abundance of BPH varied considerably between months within a year which was attributed to seasonal factors, including the availability of suitable host plants.
- Incidence of rice blast disease and the temperature was negatively correlated which indicated that the disease incidence increases with the decrease of temperature. Farmers could correct the time of planting to avoid those disease and insect pest attack.

- Use of optimum dose or little bit lower dose of Urea of optimum (22 kg Urea/33 decimal land for BRRI dhan49), chemical spray (Azoxystrobin + Propiconazole) at splitted booting stage and seeding at 30 June or 30 July minimizes False smut (FSm) disease of rice at southern region of Barishal. High FSm disease incidence occurred when the average temperature ranged from 22-28^oC.
- Four new chemicals viz. Tebuplus75, Quickout50WP, Dlink 32.5 and Mcvo 75 significantly could be used for blast disease management.
- By using need based insecticide management (NBIM) package farmers can save 2-3 insecticide applications which will reduce hazardous chemical to the environment.
- BRRI released HYVs of rice viz. BR23, BRRI dhan52, BRRI dhan72, BRRI dhan76, BRRI dhan58, BRRI dhan64, BRRI dhan67, BRRI dhan74 and BRRI Hybrid dhan3 and BRRI Hybrid dhan4 could be used for higher grain yield keeping the disease and insect damage minimum.
- Gall midge was higher in Patuakhali (especially in Dasmina) and Leaf folder was higher at Shanker Pasha, Pirojpur. Farmers of the areas where certain insect infestation is higher especially, Dasmina, Patuakhali and Shanker Pasha, Pirojpur could be alert during their rice cultivation.
- In case of disease infection, BLB was the major disease followed by brown spot, blast and sheath blight. Blast disease was less in BRRI dhan67 but high in BRRI dhan61.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	-	-	-	-	
(b) Lab &field equipment	01	200000	01	200000	
(c) Other capital items	-	-	-	-	

2. Establishment/renovation facilities: Not applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participant			Duration (Day)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop					
(c) Field Day	349	251	600	01	3 field-day was conducted

C. Financial and physical progress

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	269527	269127	269127	0	100	
B. Field research/lab expenses and supplies	768200	794398	794398	0	100	
C. Operating expenses	143292	99038	96287	2751	98	Bank bound

						balance
D. Vehicle hire and fuel, oil & maintenance	199000	170610	170610	0	100	
E. Training/workshop/seminar etc.	67500	65700	65700	0	100	
F. Publications and printing	95000	12000	12000	0	100	
G. Miscellaneous	57801	0	0	0	100	
H. Capital expenses	200000	200000	200000	0	100	
	1800320	1610873	1608122	2751		

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
To identify the physical and climatic factors responsible for disease and insect outbreak	<ul style="list-style-type: none"> • Site selection and Field selection Disease and insect pests survey • Climatic data collection • Soil properties examination 	<p>-Rice false smut disease was increased with the increased N-level</p> <p>- Nitrogen was the most limiting nutrient in tidal flooded soil. Urea (nitrogen-fertilizer) has positive effects on stem borer insect performance. Potassium provides high resistance against insect-pests. Phosphorus-fertilizer also decreases the host suitability to stem borer. Secondary-nutrient such as zinc and sulphur also reduce this pest population. Application of N and P might reduce brown spot infection while application of K, S and Zn might reduce BLB and sheath blight development.</p> <p>-BPH was recorded when average air maximum temperature was 29.6°C, minimum temperature was 19.5°C and average rainfall was 22 mm. Neck blast disease incidence was recorded when maximum average air temperature was 29.8°C and minimum was 19.7°C; rainfall was 22 mm.</p>	Better management option
To develop effective and sustainable management packages for controlling those pests	<ul style="list-style-type: none"> • Management experiment and demonstration trial • Farmers' Field Day 	<p>-Development of management packages for false smut disease of rice: Management package is 'Optimum dose or little bit lower dose of Urea of optimum (22 kg Urea/33 decimal land for BRRRI dhan49), chemical spray (Azoxystrobin + Propiconazole) at splitted booting stage and seeding at 30 June or 30 July minimizes the infection by False smut disease of rice at southern region of Barishal.'</p> <p>-Four chemicals viz. Tebuplus75, Quickout50WP, Dlink 32.5 and Mcvo 75 significantly reduced neck blast (NB) and were similar to recently used standard chemical Trooper. Newly identified those chemicals could be used for blast disease management.</p> <p>-Though the yield increase in NBIM package is not significant farmers can save 2-3 insecticide applications which will reduce hazardous chemical to the environment.</p> <p>-Some varieties such as BR23, BRRRI dhan52, BRRRI dhan72, BRRRI dhan76, BRRRI dhan58, BRRRI dhan64, BRRRI dhan67, BRRRI dhan74</p>	Better management option

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome(short term effect of the research)
		and BRR Hybrid dhan3 were less affected by disease and insect during the survey. Those varieties yielded 46-169% more over the locally cultivated varieties.	
To identify breeding location of insects in particular	Disease and insect pests survey	Gall midge was higher in Patuakhali (especially in Dasmina) and Leaf folder was higher at Shanker Pasha, Pirojpur. Farmers of the areas where certain insect infestation is higher especially, Dasmina, Patuakhali and Shanker Pasha, Pirojpur could be alert during their rice cultivation.	Better management option

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	-	1	বৃহত্তম বরিশাল অঞ্চলে বোরো ধান চাষে করণীয়
Journal publication	-	-	-
Information development	-	-	-
Other publications, if any	-	-	-

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

Need based management practices of pesticides

ii. Generation of new knowledge that help in developing more technology in future

Climate factors for disease and insect pest development identified

iii. Technology transferred that help increased agricultural productivity and farmers' income

Farmers agreed to cultivate HYV of rice and to adopt the management options

iv. Policy Support

Pest management based on forecasting system

G. Information regarding Desk and Field Monitoring

i) **Desk Monitoring** [description & output of consultation meeting, monitoring workshops/seminars etc.):
-none

ii) **Field Monitoring** (time& No. of visit, Team visit and output):

Monitoring team	Date(s) of visit	Total visit till date (No.)	Remarks
Technical Division/ Unit, BARC	None		
PIU-BARC, NATP-2	18/02/2018	01	
Internal Monitoring (DG and D-R)	02/12/2017	01	
Others Visitors (if any)	None		

H. Lesson Learned/Challenges (if any)

- i) Huge work of the project was a major challenge to perform within the short period of time.
- ii) Unavailability of fund in time was another constrain. We were lucky that other projects were running that time and we shared fund to this project for execution of project work.
- iii) Insect pests have the particular breeding location
- iii) Need based pesticide management practices would reduce the hazardous effect on environment.

I. Challenges (if any)

Timely release of fund and fund transfer complexity were the major challenge for project management.

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Signature of the Principal Investigator

Date

Seal

Counter signature of the Head of the organization/authorized representative

Date

Seal