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Preferred rice varieties, seed source, disease incidence and loss assessment in bakanae disease

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Abstract: Rice (*Oryza sativa* L.) is the principal food crops in Bangladesh. Here different rice varieties are grown in 3 rice growing seasons per year *viz.* Aus, Aman and Boro. Eleven rice varieties were grown at randomly sampled 50 farmers' plots in Chandiara village during Boro (November, 2007 – May, 2008), Aus (April – July, 2008) and T. Aman (July – December, 2008) seasons. Among the varieties farmers were preferred BRRI dhan 28 mostly during the Boro and Aus seasons. During the T. Aman season it was BRRI dhan 32. All the farmers' plots were seeded with BRRI released varieties during the T. Aman season though it was 90 and 82% during the Aus and Boro seasons respectively. In these 3 seasons most of the farmers did not procure certified seeds of BADC or non-government agencies. 62 to 88% rice plots per season were seeded with farmer saved seeds in the sampled plots. Bakanae disease incidence was much higher in these plots and comparatively less frequent in the plots seeded with certified seeds of different agencies. All rice varieties grown in the sampled area during this study were found more or less susceptible to the disease. The highest disease incidence (19.1%) was found in the T. Aman followed by the Aus and least frequent in the Boro season. 10.85% grain yield loss due to the disease was estimated by following a modified method and simplified formula during the T. Aman season. Yield loss was observed mainly due to reduction of effective tillers.
Key words: Bakanae, incidence, rice varieties, seed source, yield loss.

Introduction

Rice (*Oryza sativa* L.) is the second most important food crop in the world and one of the principal food crops of tropical and subtropical regions including Bangladesh. In respect of total production, rice ranks the top position in the country. Here, rice is grown in three seasons *viz.* Aus (April to July), Aman (July to December) and Boro (November to May) per annum. Many high yielding rice varieties have been introduced in the country since independence for increase grain production. About 41 million tons of rice was produced in Bangladesh in the year 2006 (Anonymous 2008). This amount is not enough to feed about 140 million people. More over, here, it is affected by thirty one diseases, of which, ten including bakanae are considered as more devastating (Miah *et. al.* 1985 and Latif *et al*. 2006).

In bakanae disease, rice plants become elongate abnormally and remarkably taller than normal plants. The elongated plants die eventually. It appears all the rice growing seasons and causes up to 26.7% yield loss (Latif *et al*. 2006). It is primarily a seed borne disease (Seto 1933). Susceptible rice varieties and seed source may have an important role in bakanae disease incidence. Many researchers from India and Bangladesh reported its incidence and different degrees of yield loss following different methods (Anonymous 1977, Miah *et. al.* 1985, Rathaiah *et al.* 1991 and Latif *et al*. 2006). Among them Rathaiah *et al.* (1991) from India presented an easier and more acceptable method of disease incidence and yield loss calculation for bakanae. This study presents relation among rice varieties, growing seasons & their seed source and a modified method & simplified formula for estimating bakanae disease incidence and yield loss in rice.

Materials and Methods

Several bakanae infected farmers' rice plots were observed in the three successive rice growing seasons *viz.* Boro (November, 2007 – May, 2008), Aus (April – July, 2008) and T. Aman (July – December, 2008) at Chandiara village near Chandina upazilla in Comilla district. In each season, one farmer's plot was selected randomly and then 49 plots were selected around the first plot. All these farmers' plots were contiguous, quadrilateral and varying areas.

Number of hills at each sidelines of every plot was counted. From this count, total number of hills for each plot was calculated by multiplying the average number of hills between two opposite sidelines with the average number of hills between the opposing two sidelines.

For each plot number of hills with bakanae symptom, varietals' names and seed sources were recorded at maximum tillering stage for each rice growing season during the study period. Disease incidence in term of percentage of infected hills for each plot was calculated by the following formula.

$$\text{Disease Incidence (DI)} = \frac{\text{Infected hills/plot}}{\text{Total hills/plot}} \text{ X } 100$$

In total, three hundred bakanae-infected hills were randomly selected from these fifty rice plots during T. Aman season of 2008. Each hill was labelled with number tags. For each infected hill, an adjacent healthy hill was also labelled with an appropriate tag, to obtain a comparable pair of infected and healthy hills (Rathaiah *et al.* 1991). Among the 300 pairs of infected and healthy hills, finally 150 pairs of hills were selected with care so that interference of other disease and pests could be minimized. These 150 pairs of labelled hills were then harvested and brought to the Bangladesh Rice Research Institute (BRRI) laboratory for necessary data collection. Effective tiller number, grain weight and per cent grain moisture for individual hills were recorded. All grain weights were calculated at 14% grain moisture. Per cent grain yield loss per infected hill (% YLIH) was estimated following the formula.

$$\%\text{YLIH} = \frac{\text{GWHH} - \text{GWIH}}{\text{GWHH}} \text{ X } 100$$

Where, GWHH= Grain weight per healthy hills, and GWIH= Grain weight per infected hills.

Average value of grain yield loss in 150 infected hills was used for grain yield loss calculation. Grain yield loss in the sampled plots was estimated using the following formula.

Grain yield loss = %DI x %YLIH x 100%

This formula is the simplification of the formula reported by Rathaiah *et al.* (1991). The simplification was made as: 100% – % infected hills x 33 + % healthy hills x 100/100

(Rathaiah *et al.* 1991). Where, 33, representing 'grain yield per infected hill (% GYIH)' which was calculated by subtracting YLIH (67%) from 100%; %healthy hills was calculated by subtracting %infected hills from 100% and 100/100 representing 100%. Therefore, Grain yield loss=100% – % infected hills x 33 + % healthy hills x 100/100 =[100% –{%infected hills x (100% –% YLIH) +(100% –% infected hills)}]x 100% = [100% –{%infected hills x 100% –%infected hills x %YLIH +100%–%infected- hills}]x100% = [1 – %infected hills + %infected hills x %YLIH– 1 + %infected hills] x 100% (As, 100%=1) = %infected hills x %YLIH x 100% = %DI x %YLIH x 100%.

Results and Discussion

Rice varieties preferred by the farmers at Chandiara village during three successive rice growing seasons is presented in the Table 1. The table shows that 11 rice varieties were grown during Boro (2007-08), Aus (2008) and Transplanted Aman (2008) seasons. Among them BRRI dhan 28 was preferred mostly by the farmers during the Boro and Aus seasons. During the T. Aman season it was BRRI dhan 32. Preference gradient of other rice varieties were BR 20, BR 22 & BRRI dhan 29, BRRI dhan 41, Hybrid, IR 50, BR 26 and BR 16 & BR 23 in the respective growing season.

All the farmers' plots were seeded with BRRI released varieties during the T. Aman season though it was 90 and 82% during the Aus and Boro season respectively. Hybrid variety was seeded only in 18% farmers' plots during the Boro and IR 50 variety was seeded only in 10% farmers' plots during the Aus season. That means, farmers primarily used BRRI released varieties in the sampled rice plots. Variations were found in seed sources in three successive seasons in the 50 sampled plots (Table 2). The table shows that in the Aus season; most of the farmers' plots (88.0 %) were seeded with farmer saved seed. Similar trends were found in the T. Aman and Boro season. Usually after 3 to 6 years they procure certified seeds of BADC or non government agencies and then they save seeds from their own fields. However, hybrid seeds were used in the Boro season only. This was due to natural calamity in previous Boro season resulting in scarcity in farmers' own seeds. To mitigate this problem, Bangladesh government took an initiative to provide hybrid seeds from different non-government seed companies to the farmers.

Table 1. Preferred rice varieties at the sampled 50 farmers' plots during three successive rice growing seasons at Chandiara village near Chandina upazila in Comilla district

Name of rice varieties	Per cent farmers' plots occupied by different rice varieties in three successive seasons**		
	Boro** (2007-08)	Aus** (2008)	T. Aman** (2008)
BR 16*	6.0	---	---
BR 20	---***	38.0	---
BR 22	---	---	34.0
BR 23	---	---	6.0
BR 26	---	8.0	---
BRRI dhan 28*	42.0	44.0	---
BRRI dhan 29	34.0	---	---
BRRI dhan 32	---	---	40.0
BRRI dhan 41	---	---	20.0
Hybrid	18.0	---	---
IR 50*	---	10.0	---

* No. 1 to 26 and 27 to 47 released varieties of Bangladesh Rice Research Institute (BRRI) are designated as BR 1 to BR 26 and BRRI dhan 27 to BRRI dhan 47 respectively. IR represented for Indian rice variety. ** Rice growing season of Boro, Aus and Transplanted Aman are November to May, April to July and July to December respectively in Bangladesh. *** Not found.

Table 2. Variation of seed source during three successive rice growing seasons at 50 sampled plots in Chandiara village

Rice growing seasons	% farmers' plots seeded with seeds procured from different sources in three rice growing seasons		
	Farmer saved seed	Hybrid seeds	BADC* seeds
Boro (2007-2008)	62.0	18.0	20.0
Aus (2008)	88.0	---**	12.0
Aman (2008)	82.0	---	18.0

* Bangladesh agricultural development corporation, the sole agent for marketing BRRI released varieties. ** Not found.

Variations in bakanae disease incidences at the rice plots seeded with different seed sources are presented in the Table 3. It shows that in average, bakanae disease incidence was much higher (8.93 %) in the plots seeded with farmer saved seed and comparatively less frequent (0.05 %) in the plots seeded with BADC or other certified seeds. In accordance with the present study, Islam *et al*. (1994) reported that per cent seed infection in farmers' saved seeds was much higher compared to BADC seeds in Sylhet. Rashid *et al.* (1992) also reported that farmers' saved seeds results more frequent infection with *Bipolaris sorokiniana* compared to BADC seeds. During the study period, it was observed that farmers do not consider bakanae as a disease. In local tongue, the infected plants are called misal/mial, which means off variety. In this investigation, it was found that in every season most of the farmers used seeds collected from infected fields. Seed treatment is not commonly practiced in this area.

The table also shows that bakanae disease incidence was found the highest (19.10%) in the T. Aman season in the plots seeded with farmer saved seeds followed by the Aus 2008 (6.00%) and least frequent (1.70%) in the Boro season. Same trend was observed in the plots seeded with BADC or hybrid seeds. The present findings corroborate with that of Mia and Mathur (1983). According to their findings seed infection with *F. moniliforme*, the causal agent of bakanae disease was much higher in T. Aman season. It might be due to the presence of susceptible host in higher frequency and favorable environment during T. Aman than those of Boro and Aus seasons.

In the present study, average grain weight per healthy hill (GWHH) and infected hill (GWIH) were found 26.85 g and 11.60 g respectively (Table 4). So, per cent yield loss per infected hill (% YLIH) was calculated as 56.80. Rathaiah *et al*. (1991) reported 67.0% yield reduction of an infected hill over healthy hill of a highly susceptible rice variety in India. The difference might be due to the variation in susceptibility of hosts and pathogenicity of the strains and methodology. For yield loss estimation, Rathaiah *et al.* (1991) randomly selected 40 pairs of bakanae-infected hills and adjacent healthy hills from the cropped area and harvested all selected pairs of hills. In the present study, 300 pairs of bakanae-infected hills and adjacent healthy hills were randomly selected from 50 farmers' plots. Because of remarkable presence of other diseases and pests several pairs of hills were discarded time to time. Finally from the 300 pairs 150 pairs of infected and healthy hills were selected for grain harvesting. Due to comparatively larger sampling size and minimization of interference of other diseases and pests, this loss estimation method might be treated as a disease specific method. This method can be tried in the yield loss estimation of other crops.

Using the simplified formula stated in this report, grain yield loss due to bakanae disease during T. Aman season of 2008 at the study area was estimated as 10.85% (Table 4). Various degrees of yield loss such as 33.75%, 15.0% and 26.7% were reported by Anonymous (1977), Miah *et al.* (1985) and Latif *et al.* (2006). Variation might be due to the difference in study methods, agro climates and biological properties of host and pathogen. The simplified formula gives same result but needs less effort in calculation of yield loss than that of Rathaiah *et al*. (1991).

In the present study, average number of effective tillers per healthy and infected hill was 15.38 and 6.90 respectively (Table 5). Due to bakanae disease, per cent reduction of tillers per infected hill was estimated 55.14% that was very close to % YLIH. It means that yield loss due to bakanae disease was mainly due to reduction of effective tillers. This was in agreement with the finding of Rathaiah *et al*. (1991).

Table 3. Bakanae disease incidence in different seed sources during three successive rice growing seasons at the 50 sampled farmers' plots

Rice growing seasons	Bakanae disease incidence (%) in different seed sources	
	Farmer saved seed	Hybrid/BADC seeds
Boro (2007-2008)	1.7 0	0.03
Aus (2008)	6.00	0.04
T. Aman (2008)	19.10	0.08
Average per season	8.93	0.05

Table 4. Per cent grain yield loss due to bakanae disease at the 50 sampled farmers' plots

Average GWHH*	Average GWIH**	YLIH***	DI**** (Avg.)	Grain yield loss
26.85 g	11.60 g	56.80%	19.1%	10.85%

*Grain weight per healthy hills, **Grain weight per infected hills, *** Average yield loss per infected hill, and **** Disease incidence

Table 5. Relations between percent tiller reduction and yield loss per infected hill in bakanae disease

Avg. number of effective tillers/hill		% tiller reduction /infected hill	% YLIH (Table 4)	Comments
Healthy hills	Infected Hills			
15.38	6.90	55.14 %	56.80 %	Percent tiller reductions and yield loss per infected hill were very closer to each other.

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References

Anonymous. 1977. Annual report for 1974 –75. Mimeographed Paper, BRRI, Joydebpur, Dacca. 64 – 65.

Anonymous. 2008. FAO Rice Market Monitor. Commodity Markets, Policy Analysis and Projections Service, Trade and Markets Division, Food and Agriculture Organization of the United Nations, Rome, Italy. Vol. IX (April), Issue No.1.

Islam, M. R., Ali, A. and Mia, M. A. T. 1994. Survey on seed borne pathogens of rice in fifteen districts of Bangladesh. Bangladesh J, Plant Pathol. 10 (1 & 2): 23–26.

Latif, M. A., Mia, M. A. T. and Hossain, M. A. 2006. Yield loss, integrated management approaches and development of quick screening method of bakanae disease of rice in Bangladesh. Abstract, 2nd international rice congress, October 9 – 13, 2006. New Delhi, India.

Mia, M. A. T. and Mathur, S. B. 1983. Study on seed mycoflora of rice in Bangladesh. Seed Research. 11(2): 254 – 257.

Miah. S. A., Shajahan, A. K. M., Hossain, M. A. and Sharma, N. R. 1985. A survey of rice diseases in Bangladesh. Trop. Pest Manag. 31(3): 208–213.

Rashid, A. Q. M. B., Meah, M. B. and Fakir, G. A. 1992. Importance and distribution of seed borne *Bipolaris sorokiniana* in wheat in Bangladesh. Bangladesh J. Plant Pathol. 8 (1 & 2): 5 – 7.

Rathaiah, Y., Das, G. R. and Sing, K. H. U. 1991. Estimation of yield loss and chemical control of bakanae disease of rice. Oryza. 28: 509 – 512.

Seto, F. 1933. Untersuchungen über die 'Bakanae'– krankheit der Reispflanze. III. Über die Beziehungen Zwischen der Bodenfeuchtigkeit und dem Krankheitsbefall durch Biodeninfektion. Forschungen aus dem Gebiet der Pflanzenkrankheiten. 2:125 –137. (Quoted by Ou, S. H. 1985. Rice Disease. 2nd ed. CAB International Mycological Institute, Kew, Surrey, U.K. pp. XI + 380).