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Effect of Brown Spot on the Yield and Yield Contributing Characters of Different Hybrid Varieties/Lines of Boro Rice

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Abstract: Sixteen hybrid varieties/lines viz. Sonar Bangla-1, Sonar Bangla-5, Sonar Bangla-6, Sonar Bangla-12, 262H, 283H, 284H, 287H, 291H, 305H, 306H, 311H, 312H, 317H, 321H, 352H and check variety BR28 were evaluated under natural epiphytotics against *Bipolaris oryzae* to find out the effect of brown spot on their yield and yield contributing characters. The hybrid line 321H showed highest disease incidence (80%) and severity (77%) followed by 352H, 305H, 291H and Sonar Bangla-5. The lowest incidence (40.50%) and severity (45%) were recorded in case of hybrid line 312H followed by 287H, 284H and 283H. Eventually, 312H performed the highest yield (6.88 t ha^{-1}) and the lowest (3.54 t ha^{-1}) was in case of 321H. Yield contributing character like number of effective tillers/hill, panicle length, number of grains/panicle were significantly higher in 312H while number of spotted grains and unfilled grains/panicle were significantly higher in 321H. Disease incidence and severity were correlated significantly and negatively with the yield.

Key words: Brown spot, rice, hybrid variety/lines, incidence, severity, yield

Introduction

Rice is the staple food constitute 92% of the food grain production in Bangladesh and 72% of the total cropped land is devoted to rice production (Anonymous, 1999). The production of food grain is increasing in the same rate as increasing the population of the country leaving an annual food deficit of 1-2 million tons. With the present yield level and area under rice cultivation it will be rather difficult to produce sufficient production of rice in the near future to fulfil the national demand. Besides, there is a little scope to increase the area under rice cultivation, as the situation rather demands to release some land for other crops.

One of the best options available to the plant breeder is the hybrid rice. For its yield potential, hybrid rice has brought a great hope and aspiration to meet the challenging demand of food deficits of the 21st century (Fakir, 1998). To overcome the present yield ceiling of existing rice varieties, hybrid rice seems to be highly attractive and a viable alternative.

Since, 1998 some private company has been importing hybrid rice seed from India and China. Concerned Research Institutes also exploring some hybrid lines/varieties for its probable utility in the country. But the performances of these varieties/lines were not satisfactory in the farmers' field because of pest susceptibility including brown spot and other diseases.

Among the rice diseases brown spot is an important seed borne disease (Fakir, 1998). It is the cause of historical Bengal famine in 1942-43 and also yet been considered to be one of the major disease of rice in Bangladesh causing 40-60% yield reduction (Mia, 1998). *Bipolaris oryzae* (*Drechlera oryzae*), the pathogen of brown spot causes severe infection during the reproductive phase of the plant that cause both quantitative and qualitative losses (Klomp, 1977). It causes germination failure, disease of emerging seedlings or growing plant resulting spotted, discolored and unfilled grains and ultimately yields reduction. Therefore, before the release of hybrid rice, it is of course, to be considered that those varieties/lines must be resistant/tolerant to field diseases with other desirable agronomic qualities. Thus, screening and selection of disease resistant variety/lines before mass production of seed is vital.

In view of the above facts this experiment has been conducted to estimate the incidence and severity of brown spot disease of different hybrid varieties/lines and to determine the effect of brown spot on the yield and yield contributing characters of rice.

Materials and Methods

The experiment was conducted in the field Laboratory of Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh on boro season in 2001. The hybrid varieties/lines used in the experiment have been given in Table 1.

The soil of the experimental plot was characterized by sandy loam texture with pH around 6.5, organic matter 1.14%, total nitrogen 0.085% and C/N ratio 13.5 (Anonymous, 1979). Seedlings were raised in 15th January 2001 and were transplanted by 15th February' 2001. Urea @180 kg ha^{-1}, TSP @ 100 kg ha^{-1}, MP @ 70 kg ha^{-1}, gypsum @ 60 kg ha^{-1} and cowdung @ 6000 kg ha^{-1} were used. One third of the urea and entire TSP, MP, gypsum and cowdung were applied during the final land preparation. Remaining two-third of the urea was applied in two splits, one at 21st day after transplanting and the other before panicle initiation. Overall crop management was performed as per proper agronomic practices. Randomized complete block design was used as experimental design with (2 x 2.5 m^2) unit plot size.

Assessment of incidence and severity of brown spot: The incidence and severity of brown spot was recorded under natural epiphytotic condition at 50 and 70 days after transplanting. Ten hills were randomly selected from each plot and data were collected on number of tillers/hill, number of diseased tillers/hill and percent leaf area diseased (LAD).

Disease incidence was calculated by the following formula (Rajput and Bartaria, 1995).

$$\text{Incidence (I)} = \frac{\text{No. of diseased tillers} \times 100}{\text{No. of total tillers}}$$

Disease severity was calculated by the Anonymous (1980) recommended grading scale as follows (Rajput and Bartaria, 1995).

$$\text{Disease severity} = \frac{\text{Sum of total ratting} \times 100}{\text{Total No. of observation} \times \text{maximum grade in the scale}}$$

The crops were harvested at its full maturity and selected 10 tagged hills of each plot were separated and data were recorded on number of effective tillers/hill, panicle length (cm), number of healthy grains/panicle, number of spotted grains/panicle, number of unfilled grains/panicle and yield (t ha^{-1}). Data were analyzed

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using computer MSTAT package program and comparisons of the means were done by Duncan's multiple range test (DMRT) with LSD value.

Results and Discussion

The incidence and severity of brown spot of different hybrid varieties/lines of boro rice differ significantly from one another in comparison to check variety (Table 2). The incidence and severity range from 40.50 to 80 and 45 to 77% respectively among the varieties/lines. The maximum incidence (80%) was observed in 321H followed by 352H, 305H, 291H, Sonar Bangla-5 and 317H. The lowest incidence (40.50%) was observed in 312H followed by 284H, 287H, 283H and Sonar Bangla-6. The check variety - BR28 scored 62.50 % diseases incidence.

Similarly the maximum severity (77%) was noticed in 321H followed by 352H, 305H, 291H and Sonar Bangla-5. The minimum severity (45%) was noticed in 312H followed by 287H/284H, 283H and Sonar Bangla-6. The check variety scored 61.80% diseases severity.

The consequence effect of disease incidence and severity was observed on the yield and yield contributing characters of the hybrid varieties/lines. The number of effective tillers/hill, panicle length, number of healthy grains/panicle, number of spotted grains/panicle and number of unfilled grains/panicle were significantly differ from one another in comparison to check variety (Table 3). The number of effective tillers/hill, panicle length and number of healthy grains/panicle were found significantly the highest in 312 H followed by 284H, 287H and 283H. The number of spotted grains/panicle and the number of unfilled grains/panicle were significantly the highest in 321H followed by 352H, 305H, 291H, Sonar Bangla-5 and Sonar Bangla-1. Ultimately the maximum yield (6.88 t ha^{-1}) was obtained by 312H followed by 284H, 287H, 283H and Sonar Bangla-6 while the minimum yield (3.54 t ha^{-1}) was obtained by 321H followed by 352H, 305H, 291H and Sonar Bangla-5. The check variety BR28 yielded 4.88 t ha^{-1}.

Correlation between % incidence and yield (t ha^{-1}) was Y = 110.23– 9.6448X (r = –0.808) and between % severity and yield

Table 1: Detailed information of the used hybrid materials

Entries	Cross combination	BAU Accession No.	IIR Accession No./China hybrids	Sources
Sonar Bangla-1	-	-	China hybrids	Mollika seed stores, Dhaka
Sonar Bangla-5	-	-	"	"
Sonar Bangla-6	-	-	"	"
Sonar Bangla-12		- -	"	"
262H	25A × 17R	25A	IR58025A	IRRI, Philippines
		17R	IR63870-3-2-3-3R	"
283H	88A × 17R	88A	IR68888A	"
		17R	IR63870-3-2-3-3R	"
284H	88A × 18R	88A	IR68888A	"
		18R	IR63877-43-2-1-3-1R	"
287H	97A × 2R	97A	IR68897A	"
		2R	IR13155-60-3-1-3R	"
291H	97A × 18R	97A	IR68897A	"
		18R	IR63877-43-2-3-1R	"
305H	86A × 1R	86A	IR68886A	"
		1R	Ajaya R	"
306H	86A × 6R	86A	IR68886A	"
		6R	IR58082-126-1-2R	"
311H	86A × 22R	86A	IR68886A	"
		22R	IR68926-61-1R	"
312H	86A × 23R	86A	IR68886A	"
		23R	IR68926-61-2R	"
317H	85 A × 26R	85A	IR68885A	"
		26R	IR21567R	"
321H	84A × 13R	84A	IR67684A	"
		13R	IR62037-12-1-2-2R	"
352H	88A × 10R	88A	IR68888A	"
		10R	IR59682-132-1-1-2R	"
BR28		Check variety		BRRI, Bangladesh

A = Cytoplasmic male sterile line (Female), R = Restorer line (Male)

Table 2: Incidence and severity of brown spot caused by *Bipolaris oryzae* in different hybrid varieties/lines of boro rice

Entries	No. of diseased tillers/hill	Incidence (%)	No. of diseased leaves/hill	% severity
Sonar Bangla-1	5.96a-d	65.50f	42.25d-f	64.50e
Sonar Bangla-5	6.23ab	69.25de	44.25b-d	65.00e
Sonar Bangla-6	4.82hi	50.75kl	29.00j	51.25k
Sonar Bangla-12	5.13e-h	55.75l	34.25l	56.25 l
262H	4.94f-l	53.75j	32.50l	55.75i
283H	4.88hi	49.50l	28.25j	50.50kl
284H	4.46i	43.75o	22.25l	46.50m
287H	4.39i	45.25n	24.75k	47.25m
291H	5.95a-d	70.00d	45.00a-c	68.75c
305H	5.92a-d	72.25c	46.00ab	71.25b
306H	5.49d-f	59.00h	38.85gh	60.25g
311H	5.54c-f	60.25h	39.25gh	61.25fg
312H	4.78hi	40.50p	20.25l	45.00n
317H	6.14a-c	68.25e	43.25c-e	66.42d
321H	6.48a	80.00a	47.25a	77.00a
352H	5.99a-d	74.85b	39.58gh	72.50b
BR28	5.69b-e	62.50g	40.50fg	61.80f
LSD (P=0.01)	0.5464	1.366	2.318	1.293

Table 3: Effect of brown spot caused by *Bipolaris oryzae* on the yield and yield contributing characters of different hybrid varieties/lines of boro rice

Entries	Number of effective tillers/hill	Panicle length (cm)	No. healthy grains/panicle	No. spotted grains/panicle	No. unfilled grains/panicle	Yield ha^{-1} (ton)
Sonar Bangla-1	9.10cd	22.40f-h	94.97j	9.73d	35.37de	4.78e
Sonar Bangla-5	9.00c-e	21.93hi	92.93j	10.17d	39.47bc	4.38fg
Sonar Bangla-6	9.50bc	24.37c-e	122.3d	6.20f-l	23.57g	5.89c
Sonar Bangla-12	9.20cd	24.17c-e	107.6g	6.60e-h	27.17f	5.38d
262H	9.25cd	24.30c-e	115.4f	6.27e-l	25.90fg	5.46d
283H	9.25cd	24.80cd	121.8d	5.87f-l	19.37h	6.02c
284H	10.25ab	26.67ab	134.1b	5.10ij	13.67j	6.72b
287H	9.75bc	26.67ab	128.3c	5.17h-j	17.17hi	6.48b
291H	8.50d-f	21.37hi	92.13j	12.83c	41.17b	4.18gh
305H	8.25ef	20.87ij	83.07k	13.00c	42.13b	3.94h
306H	9.30cd	23.80d-f	102.20h	7.33ef	32.33e	4.94e
311H	9.25cd	23.47d-g	98.90l	7.70e	32.73e	4.92e
312H	11.80a	27.10a	138.50a	4.30j	15.70ij	6.88a
317H	9.00c-e	22.00g-l	94.80j	10.00d	37.60cd	4.48f
321H	8.15f	18.57k	73.50m	20.47a	56.33a	3.54i
352H	8.00f	19.80jk	78.53l	17.23b	41.40b	3.94h
BR28	9.15cd	22.87e-h	95.20j	9.33d	33.37e	4.88e
LSD ($P \leq 0.01$)	0.7081	1.398	3.027	1.315	2.938	0.2739

(t ha^{-1}) was $Y = 108.2 - 9.501X$ ($r = -0.984$). The correlation indicates that the entries of hybrid varieties/lines were effective in increasing the yield by suppressing the fungal activities as evident with lower incidence and severity.

Experimental findings revealed that some hybrid lines to be attributed tolerance character against *Bipolaris oryzae* in comparison to check variety. Similar trend of results were reported by Rajput and Bartaria, (1995), Shukla *et al*. (1995), Prabhu *et al*. (1996), Prasad *et al*. (1998), Jha *et al*. (1999), Chuahan *et al*. (2000) and Payasi and Singh (2001). Payasi and Singh (2001) found resistant character in accession lines JR75, RWR92-3 and RWR54 against brown spot of rice. Chuahan *et al*. (2000) screened the accession line Lohana 1, Kalamkata and Rangi as highly resistant against brown spot. Jha *et al*. (1999) found six highly resistant and three resistant among fifty rice accession lines in India.

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