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Screening of rice germplasm for resistance and susceptibility against yellow stem borer (*Scirpophaga incertulas walker*) under upland rice ecosystem

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Abstract

Eighteen rice germplasm were evaluated against yellow stem borer (*Scirpophaga incertulas* Walker) infestation, to estimate the reaction under field condition during *Kharif*, 2007 and 2008. The infestation of YSB in all the germplasm was found lower than the check variety, Vandna. However, at late tillering stage, all the germplasm were found to be resistant except Vandna which showed moderately resistant reaction. At maturity stage, only eight germplasm viz., RR 427-100, NDR 1018-1, RR 366-4, NDR 97-12, NDR 1087-10, NDR 97 and RR 270-3 were found resistant against YSB. Seven germplasm viz., RR 270-2, RR 3470-5, NDR 1091-2, Shusk Samrat, RR 270-5, RR 309-5 and Anjali showed moderately resistant reaction, while three germplasm had shown moderately susceptible reaction including the check. It is to fact that yellow stem borer is not act as the major pest borer in upland rice ecosystem, though it preferred aquatic environment.

Keywords: yellow stem borers, rice germplasm, screening, susceptibility & resistance

Introduction

The rice plant is subjected to attack by more than 100 species of insect; 20 of them having economic importance. Among them stem borer species attacking the rice crop, yellow stem borer, *Scirpophaga incertulas* Walker is considered as the serious and specific pest of irrigated and lowland rice that caused heavy yield loss (Singh *et al.*, 2005) [4]. It is a major constraint responsible for low production of rice yield in all most the rice ecosystems, which causing 3-95% yield losses in India (Senapati and Panda, 1999) [3]. Due to limitation in the use of pesticides such as adverse effect on non-target organism, degradation of environment, development of new biotypes and breaking of the plant resistance, the identification and use of resistance/ tolerant varieties is best alternative for the management of the pest.

Materials and Methods

To study the varietal response of eighteen rice germplasm against yellow stem borer, *S. incertulas* under natural field infestation an experiment was conducted rice ecosystems at Crop Research Station CRS Masodha, Faizabad during the two consecutive wet seasons of 2007 and 2008 under rainfed upland rice ecosystem. Thirty days old seedlings of rice germplasm having susceptible check (Vandana) were transplanted in 2nd fortnight of July in 1m x 3m plots size with 15cm x 20cm plant spacing under Randomized Block Design (RBD) and replicated thrice. All the agronomical practices were adopted in raising the crop of good stand. The observation on the total number of tillers coupled with infested tillers (dead hearts; DH) was counted on 10 randomly selected hills from each plot at late tillering stage, however, at the maturity stage of the crop (15 days before harvest), the total number ear bearing tillers as well as white ears (WE) were counted. The mean per cent dead heart and white ears were calculated by using appropriate formulas. Finally the mean significance differences between germplasm were also calculated and compared to each other's. Formulas for calculating per cent dead hearts & white ear

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$$\text{Dead heart (\%)} = \frac{\text{No. of damaged tillers (DH) / 10 hills}}{\text{Total no. of tillers (healty + damage) / 10 hills}} \times 100$$

$$\text{White ears (\%)} = \frac{\text{No. of damaged panicles (WE) / 10 hills}}{\text{Total no. of panicles (healty + damage) / 10 hills}} \times 100$$

Due to low pest pressure in all the rice ecosystems in the area in form of dead hearts (%) and white ears (%), the germplasm were rated under different categories by using Standard Evaluation System (SES) for rice as suggested by IRRI Philippines, 1996 on their 50 per cent level as per scale.

Table1: Scale for germplasm evaluation against rice stem borer.

| Scale | late tillering stage (DH) | maturity stage (WE) | Degree of resistance |
|-------|---------------------------|-------------------------|-----------------------------|
| 0 | No damage | No damage | HR (Highly resistance) |
| 1 | 0.5 – 5.0 per cent | 0.5-2.5 per cent | R (Resistant) |
| 3 | 5.0-10.0 per cent | 2.5-5.0 per cent | MR (Moderately resistant) |
| 5 | 10.0-15.0 per cent | 5.0-7.5 per cent | MS (Moderately susceptible) |
| 7 | 15.0-30.0 per cent | 7.5-12.5 per cent | S (Susceptible) |
| 9 | 30.0 per cent and above | 12.5 per cent and above | HS (Highly Susceptible) |

Result and Discussion

Based on data presented in table 2, At late tillering stage, the dead hearts caused by yellow stem borer were ranged between 0.46 to 4.53 and 0.91 to 6.22 per cent among all the germplasm during *kharif*, 2007 and 2008, respectively. In 2007, the maximum dead hearts (4.53%) was recorded in susceptible check (Vandana), while NDR 118 showed minimum dead heart infestation (0.46% DH). Out of eighteen germplasm, only eight i.e., NDR 118 (0.46%), NDR 97-1 (0.82%), RR 427-100 (0.85%), NDR 1087-10 (0.94%), NDR 97 (1.30%), NDR 1091-9 (2.20%), RR 309-5 (2.33%) and RR 3470-5 (2.41%) showed significantly less dead hearts as compared to check variety. Remaining nine germplasm *viz.*, Anjali, RR 270-5, RR 270-3, Shusk Samrat, RR 418-82, IC

2679-74, RR 270-2, NDR 1018-1 and RR 366-4 had 2.63, 2.85, 2.94, 3.02, 3.23, 3.45, 3.65, 3.74 and 4.46 per cent dead hearts, respectively and were at par with the check variety. However, during *kharif* 2008, maximum per cent dead hearts was noticed in germplasm RR 418-82 (6.12%) as compared to susceptible check Vandana (5.82%), which was at par with RR 270-5 (4.02% DH) and IC 2679-74 (4.34% DH). The germplasm *viz.*, NDR 118 (0.91%) was showed significantly lowest DH than all the germplasm except in NDR 97-12 (1.23%) and RR 427-100 (1.61%) which was at par. Only five germplasm namely, RR 3470-5, RR 309-5, RR 366-4, Vandana and RR 418-82 showed more than 5 per cent DH infestation and at par with each other.

Table 2: Evaluation of rice germplasm against yellow stem borer under upland ecosystem during *Kharif seasons*.

| Sl. No | Germplasm | Per cent dead hearts | | | | Per cent white ears | | | |
|--------|------------------------------|----------------------|--------------|------|--------|---------------------|--------------|------|--------|
| | | 2007 | 2008 | Mean | Rating | 2007 | 2008 | Mean | Rating |
| 1 | RR 427-100 | 0.85 (4.94) | 1.61 (7.08) | 1.23 | 1 | 1.02 (5.72) | 1.23 (6.34) | 1.13 | 1 |
| 2 | NDR 1018-1 | 3.74 (11.12) | 3.24 (10.31) | 3.49 | 1 | 1.13 (6.01) | 2.78 (9.54) | 1.96 | 1 |
| 3 | NDR 118 | 0.46 (3.14) | 0.91 (5.37) | 0.68 | 1 | 0.82 (5.10) | 1.62 (7.29) | 1.22 | 1 |
| 4 | RR 366-4 | 4.46 (11.93) | 5.46 (13.48) | 4.96 | 1 | 2.33 (8.58) | 0.49 (3.29) | 1.30 | 1 |
| 5 | NDR 97-12 | 0.82 (5.16) | 1.23 (6.32) | 1.02 | 1 | 1.27 (6.33) | 3.02 (10.02) | 2.15 | 1 |
| 6 | RR 270-2 | 3.65 (10.89) | 3.26 (10.34) | 3.46 | 1 | 1.76 (7.59) | 5.26 (13.26) | 3.51 | 3 |
| 7 | RR 3470-5 | 2.41 (8.86) | 5.11 (13.00) | 3.75 | 1 | 1.69 (7.42) | 3.54 (10.71) | 2.61 | 3 |
| 8 | NDR 1087-10 | 0.94 (5.51) | 2.64 (9.34) | 1.79 | 1 | 0.73 (4.73) | 2.89 (9.73) | 1.81 | 1 |
| 9 | NDR 1091-9 | 2.20 (8.17) | 2.92 (9.82) | 2.56 | 1 | 2.27 (8.59) | 5.28 (13.28) | 3.77 | 3 |
| 10 | NDR 97 | 1.30 (5.19) | 1.94 (8.01) | 1.62 | 1 | 1.01 (5.69) | 0.67 (4.71) | 0.80 | 1 |
| 11 | RR 270-3 | 2.94 (9.71) | 3.68 (11.02) | 3.31 | 1 | 3.66 (11.02) | 1.02 (5.71) | 2.34 | 1 |
| 12 | Shusk Samrat | 3.02 (9.87) | 3.44 (10.65) | 3.23 | 1 | 2.28 (8.66) | 2.89 (9.76) | 2.59 | 3 |
| 13 | RR 270-5 | 2.85 (9.38) | 4.02 (11.49) | 3.43 | 1 | 1.19 (6.25) | 4.90 (12.78) | 3.05 | 3 |
| 14 | RR 309-5 | 2.33 (8.63) | 5.42 (13.45) | 3.87 | 1 | 2.45 (8.98) | 5.18 (13.16) | 3.81 | 3 |
| 15 | Anjali | 2.63 (9.31) | 3.69 (11.06) | 3.16 | 1 | 3.94 (11.38) | 2.69 (9.44) | 3.32 | 3 |
| 16 | RR 418-82 | 3.23 (10.27) | 6.22 (14.30) | 4.67 | 1 | 5.86 (13.94) | 6.29 (14.52) | 6.08 | 5 |
| 17 | IC 2679-74 | 3.45 (10.61) | 4.34 (11.94) | 3.89 | 1 | 5.31 (13.32) | 5.97 (14.14) | 5.64 | 5 |
| 18 | Vandana (Susceptible check) | 4.53 (12.28) | 5.82 (13.98) | 5.17 | 3 | 6.14 (14.29) | 5.09 (12.93) | 5.62 | 5 |
| | SEm± | 0.86 | 1.11 | | | 0.86 | 0.73 | | |
| | CD at 5 % | 2.37 | 3.08 | | | 2.37 | 2.02 | | |

Values with in parentheses are arc sine transformation, $\text{Sin}^{-1} \sqrt{x/100}$

At maturity stage, the damage occurred in form of white ears was ranged from 0.73 to 5.86 per cent and 0.49 to 6.29 per cent during 2007 and 2008, respectively. In *kharif* 2007, the maximum white ear (6.14%) was observed in check variety Vandana which was significantly higher than all the germplasm except RR 418-82 (5.86%) and IC 2679-74 (5.31%), which found at par; while significantly lowest WE (0.73%) was recorded in NDR 1087-10. Eight germplasms namely, NDR 118, NDR 97, RR 427-100, NDR 1018-1, RR

270-3, NDR 97-12, RR 3470-5 and RR 270-2 showed less than 2 per cent WE infestations *i.e.*, 0.82, 1.01, 1.02, 1.13, 1.19, 1.27, 1.69 and 1.76, respectively. However in 2008, the minimum white ear was recorded in RR 366-4 (0.49 %), which was significantly lowest among the germplasm except NDR 97 (0.67%) while, the germplasm RR 418-82 showed maximum WEs and differed significantly among others except RR 270-5 (5.18%), RR 270-2 (5.26%), NDR 1091-4 (5.28%) and IC 2679-74 (5.97%), which were at par with each

other. Variety Vandana (5.09% WE) had showed less damage than RR 418-82 (6.08% Wes).

Table3: Categorization of rice germplasm under upland rice ecosystem

| Sl. No. | Category (Score) | Late tillering Stage | | Maturity Stage | |
|---------|------------------|----------------------|---------------------------------------|----------------|--|
| | | Dead hearts (%) | Name of germplasm | White Ear (%) | Name of germplasm |
| 1 | HR (0) | No damage | Nil | No damage | Nil |
| 2 | R (1) | 0.01 -5.00 | All the germplasm except Vandana (17) | 0.01-2.5 | RR 427-100, NDR 1018-1, NDR 118, RR 366-4, NDR 97-12, NDR 1087-10, NDR 97 and RR 270-3 (8) |
| 3 | MR (3) | 5.0-10.0 | Vandana | 2.5-5.0 | RR 270-2, NDR 1091-9, RR 270-5, RR 3470-5, RR 309-5, Anjali and Shusk Samrat (7) |
| 4 | MS (5) | 10.0-15.0 | Nil | 5.0 -7.5 | RR 418-82, IC 2679-74 and Vandana (3) |
| 5 | S (7) | 15.0-30 | Nil | 7.5-12.5 | Nil |
| 6 | HS (9) | 30.0 and above | Nil | 12.5 and above | Nil |

Among the eighteen germplasms evaluated against yellow stem borer at late tillering, the minimum incidence was observed in NDR 118 during both the years. The varieties Vandana and RR 418-82 showed maximum infestation during *Kharif*, 2007 and 2008, respectively. At maturity stage of the crop, minimum infestation was observed in NDR 1087-10 and RR 366-4 and maximum in Vandana and RR 418-82 varieties, respectively during 2007 and 2008. Pooled data revealed that, at late tillering stage, the varieties NDR 118 (0.68%) and Vandana (5.17%) showed minimum and maximum infestation (dead hearts), respectively whereas at maturity, the minimum incidence (0.80% WE) was observed in NDR 97 and maximum (6.08% WE) in RR 418-82 variety. The check variety 'Vandana' found moderately resistant at late tillering and moderately susceptible at maturity stages in the present studies. Besides, other germplasm were found less susceptible at late tillering as compared to Vandana. However, at maturity stage seven germplasm namely, RR 270-2, RR 3470-5, NDR 1091-9, Shusk Samrat, RR 270-5, RR 309-5 and Anjali were found moderately resistant, while three germplasm viz., RR 418-82, IC 2679-74 and Vandana showed moderately susceptible reaction and the remaining eight were found resistant. None of the germplasm fell comes under susceptible or highly susceptible categories (table 3). It may be due to low pest pressure due to delayed and erratic rainfall during the crop seasons. The findings are in accordance with the observations of Senapati and Panda (1999) [3], Singh *et al.* (2005) [4], Prakash *et al.* (2007) [1] and Subudhi *et al.* (2007) [5], who have reported that the yellow stem borer was not a major pest in upland ecosystem, though it preferred aquatic conditions.

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