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SCREENING OF RICE GERMPLASMS FOR THEIR RESISTANCE AGAINST GALL MIDGE, *ORSEOLIA ORYZAE* WOOD MASON (BIOTYPE-3) IN RANCHI, JHARKHAND

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ABSTRACT

An experiment was conducted to screen out twenty-three rice cultures, varieties and genotypes against rice gall midge (biotype-3) at the research farm of Birsa Agricultural University, RAC (Ranchi Agriculture College) Kanke, Ranchi during kharif season of 2017. Out of 23 genotypes, Kavya, W-1263, Abhaya, Phalguna, Lalat, BG-380-2, RD-202 and Suraksha emerged as resistant and promising against the gall midge (biotype-3), receiving silver shoot incidence below 5% even when they are grown in unprotected condition in the present studies as against the significantly and substantially higher pest incidence (i.e. SS%) recorded in case of TN- 1, IR-64 Sub-1 and IR-64 receiving 32.49%, 20.15% and 19.33%, respectively. Naveen was responsible for realization of the highest grain yield (52.70 q/ha) among all the tested rice varieties.

Key words: Rice, *Orseolia oryzae*, gall midge, screening, kharif, varieties, genotypes, resistant

Rice is the staple food for over half of the world's population. Rice (*Oryza Sativa* L., 2n=24) is one the most important staple food of South-East Asia as well as India including the state of Jharkhand. Rice is grown in the state in around 18 lakh hectares. Out of 29.28 lakh hectares of total cultivated area, rice is grown in 16.72 lakh hectare, which comes to 85% of total cropped area (Anonymous, 2009). About 25-30% area (4.5 to 5.4 lakh hectares) of total rice cultivated area in the state of Jharkhand is endemic to the rice gall midge biotype-3 (*Orseolia oryzae* Wood Mason) over the past 4-5 decades (Shaw et al., 1981) and are responsible for causing loss in yield ranging from 20-35% in general (Prasad and Prasad, 2006). Among these major insect pest species, gall midge (*O. oryzae* WM*)* is one of the most important pest which is capable of causing considerable loss in Jharkhand in general and gall midge endemic areas of the state in particular. The pest could be able to cause loss in yield ranging from 10-25% (Prasad and Prasad, 2006) in the state of Jharkhand under the favourable agro-climatic conditions. Use of host plant resistance is not only eco-friendly but also it is cost effective. Resource poor farmers cannot afford the expenses incurred on the insecticidal inputs to protect their crop. They need pest resistant or tolerant rice varieties to realize better and higher yield of grains. Without minimum or no pesticidal application for sustainable rice production is possible. Use of resistant varieties of rice is highly feasible for eco-friendly management of rice pests. Survey of literature revealed that rice variety had an effect on insect pest incidence. The highest insect pest populations were observed on TN1, while the lowest populations for all pests were recorded on BINA dhan4. BINA dhan4 supported the lowest insect population whereas TN1 supported the highest population of the same pest species (Magunmder et al., 2013). Lingaraj et al. (2008) studied the virulence composition using three standard differentials viz., W1263 (Gm1 gene for resistance), Phalguna (Gm2 gene for resistance) and TN1 (susceptible without any gene). The local gall midge populations in all the test locations expressed their virulence only against the susceptible group consisting of TN1. Prasad and Prasad (2010) reported that 6 entries remained free from the attack of gall midge. These entries were: ARC6605, MR 1523, RP 2068-18-5, Jhitpiti, INRC3021 and Aganni in the agro climatic conditions of Ranchi region of Jharkhand state. Prasad and Prasad (2010) also opined that the transplanted rice crop was infested with three major pests viz. YSB, GM and leaf folder. Two entries *viz*. Suraksha and Ajay remained moderately resistant to all the three pest species as all the three pest species were found to damage below 10% in these two varieties. Prasad and Prasad (2011) reported that five rice varieties viz., Naveen, Lalat, BVD-203, BG 380-2, and IR-36 were found to be moderately resistant to gall midge which in turn generated higher grain yields

to the tune of 43.59, 38.29, 33.58, 34.56 and 32.07 q/ ha, respectively. The susceptible varieties viz. IR-64 and Birsamati registered the highest incidence of silver shoot (23.63 and 39.86% respectively) which resulted in the considerably lowest yield of 16.94 and 18.60 q/ ha respectively. Prasad and Prasad (2011) also revealed that the significantly minimum incidence of gall midge incidence was registered in case of rice varieties viz. Lalat, Suraksha and BG-380-2.

MATERIALS AND METHODS

An experiment was conducted to screen out rice germplasm against rice gall midge (Biotype 3) at research farm of Birsa Agricultural University, RAC (Ranchi Agriculture College) Kanke, Ranchi during kharif season of 2017. The experiment was laid out in randomized block design with twenty three treatments *viz*. IR-36, IR-64, IR -64 Sub-1, Lalat, Naveen, BG-380-2, BVS-1, PAC-801, PAC-807, RD-202, Abhishek, MTU-1010, Sahbhagi, CAUR-1, W-1263, Phalguna, Abhaya, ARC-5984, KNM-113, CR-2711-149, Suraksha (resistant check), Kavya (resistant check) and TN-1 (susceptible check).

All the treatments were replicated thrice. Each treatment was grown on a test plot with the size of 5×2.5 m. The sowing was done on 25th July, transplanting on 13th August, and harvesting on 28th December 2017.

The following observations were recorded:

Total number of tillers and total number of silver shoot (SS) were counted on 10 randomly selected plants (hills) per plot for calculating incidence of gall midge in terms of silver shoot (SS%) at 10 days intervals. Experimental data i.e. SS% was converted into angular values (i.e. through arcsin tables) for their statistical analysis. Yield data was recorded as kg/ plot and converted into q/ha for statistical analysis.

RESULTS AND DISCUSSION

Twenty-three rice genotypes were evaluated in the Rice Research Farm of Birsa Agricultural University, Ranchi during kharif season in 2017 for their reaction against rice gall midge. Reaction of 23 rice genotypes against gall midge (*Orseolia oryzae* WM) bio-type-3 is presented in Table 1. It was observed that incidence of silver-shoot (SS%) increased with the advancement of the vegetative growth and age of the rice plants almost up to maximum tillering stage. The observations on the relative incidence of gall midge, in terms of silver shoot (SS%) recorded at 20, 30, 40 and 50 DAT (days after transplanting) and the overall mean incidence of these observations were also recorded as follows:

Observations of incidence of silver shoot (SS%) recorded at 20 DAT

The observations indicated that Abhaya received the minimum incidence of silver shoot (0.56% SS) in turn, which remained at par with that of Kavya (0.60% SS), W-1263 (0.75% SS), CAUR-1 (0.80% SS) and Suraksha (0.80% SS) against the highest incidence of 26.50% silver shoot in case of TN- 1 (SC) followed by IR-64 Sub-1 (11.20% SS), IR-64 (10.40% SS) which were rated as susceptible for gall midge attack in the present studies. The results revealed that Abhaya, Kavya, W-1263, Phalguna and Suraksha emerged as promising against the gall midge, receiving silver shoot incidence below 5% in the present study as against the significantly higher pest incidence recorded in case of TN-1, IR-64 Sub-1 and IR-64. The orders of gall midge incidence i.e. SS(%) were: Abhaya (0.56% SS) >Kavya(0.60% SS) > W-1263 (0.75% SS) > CAUR-1(0.80% SS) >Suraksha (0.80% SS) > IR-36 (1.30% SS) >Lalat (1.50% SS) > Phalguna (1.50% SS) >RD-202 (1.70% SS) >ARC-5984 (1.76% SS) >Naveen (1.80% SS) > CR-2711-149 (2.50% SS) >KNM-113 (2.60% SS) >BG-380-2 (2.70% SS) >BVS-1 (3.60% SS) >Sahbhagi (3.70% SS) >Abhishek (3.90% SS) >MTU-1010 (4.50% SS) >PAC-807 (7.30% SS) >PAC-801 (8.20% SS) >IR-64 (10.40% SS) >IR-64 Sub-1 (11.20% SS) >TN- 1(30.98% SS) in the present study under the field condition (Table 1).

Observations on incidence of SS (%) recorded at 30, 40 and 50 DAT

The incidence of SS (%) recorded at 30, 40 and 50 DAT in almost all the tested rice genotypes were found to follow almost similar trends to those of the incidence obtained at 20 DAT in the respective rice cultures.

The observations on the incidence of rice gall midge (*O. oryzae*) in the terms of silver shoot were recorded at 20, 30, 40 and 50 DAT. A perusal of overall mean results of all the four observational dates revealed that the incidence of silver shoot, caused by rice gall midge, was found in ascending order from 20 to 50 DAT in general with the advance of age of rice plants. Mean observations of silver shoot (SS%) recorded at 20, 30, 40 and 50 DAT were calculated in order to find out the response of the rice genotypes against gall midge pertaining to intensity of incidence of silver shoot. The overall perusal of the results (Table 1) based on mean of four observations indicated that Kavya received the

Table 1. Evaluation of rice genotypes for the reaction against gall midge, *Orseolia oryzae* (Biotype-3)

Rice genotype	Silver shoot (SS%) caused by gall midge, recorded at				
	20 DAT	30 DAT	40 DAT	50 DAT	Overall Mean
IR-36	1.30 (6.53)	2.60 (9.13)	3.40 (10.57)	5.60 (13.65)	3.23 (9.97)
IR-64	10.40 (18.79)	15.70 (23.33)	20.60 (26.99)	30.60 (33.58)	19.33 (25.67)
IR-64 Sub-1	11.20 (19.54)	16.80 (24.19)	19.80 (26.42)	32.80 (34.93)	20.15 (26.27)
Lalat	1.50 (6.94)	2.70 (9.37)	3.60 (10.93)	4.80 (12.60)	3.15 (9.96)
Naveen	1.80 (7.64)	2.23 (8.39)	2.76 (9.48)	5.60 (13.55)	3.10 (9.76)
BG-380-2	2.70 (9.35)	3.80 (11.14)	3.08 (10.03)	4.70 (12.48)	3.57 (10.75)
BVS-1	3.60 (10.92)	5.70 (13.76)	6.70 (14.93)	14.70 (22.52)	7.68 (15.54)
PAC-801	8.20 (16.59)	7.80 (16.20)	10.70 (19.09)	18.70 (25.62)	11.35 (19.37)
PAC-807	7.30 (15.64)	6.60 (14.86)	11.86 (20.13)	16.50 (23.96)	10.56 (18.65)
RD-202	1.70 (7.31)	2.40 (8.80)	2.80 (9.45)	3.86 (11.27)	2.69 (9.21)
Abhishek	3.90 (11.31)	4.70 (12.42)	8.70 (17.12)	12.70 (20.87)	7.50 (15.43)
MTU-1010	4.50 (12.17)	8.70 (17.14)	9.70 (18.14)	10.70 (19.07)	8.40 (16.63)
Sahbhagi	3.70 (11.05)	7.80 (16.19)	8.60 (17.05)	17.80 (24.95)	9.48 (17.31)
CAUR-1	0.80 (5.02)	2.50 (8.88)	3.16 (10.21)	5.80 (13.84)	3.07 (9.49)
W-1263	0.75 (4.87)	1.50 (6.97)	1.87 (7.71)	2.70 (9.29)	1.71 (7.21)
Phalguna	1.50 (6.99)	1.80 (7.69)	2.08 (8.26)	2.26 (8.54)	1.91 (7.87)
Abhaya	0.56 (4.20)	1.76 (7.55)	1.86 (7.75)	2.76 (9.53)	1.74 (7.26)
ARC-5984	1.76 (7.60)	3.40 (10.59)	4.70 (12.51)	8.60 (17.04)	4.62 (11.94)
KNM-113	2.60 (9.22)	3.40 (10.58)	4.30 (11.97)	5.76 (13.86)	4.02 (11.41)
CR-2711-149	2.50 (9.01)	3.20 (10.20)	4.36 (12.05)	6.26 (14.47)	4.08 (11.43)
Suraksha (RC)	0.80 (5.10)	1.30 (6.55)	1.88 (7.87)	4.37 (11.99)	2.09 (7.88)
Kavya (RC)	0.60 (4.43)	0.86 (5.32)	1.26 (6.43)	1.86 (7.64)	1.15 (5.95)
TN-1 (SC)	26.50 (30.98)	30.40 (33.46)	34.56 (36.00)	38.50 (38.35)	32.49 (34.70)
SEm (±)	(0.72)	(0.85)	(0.67)	(0.86)	(0.78)
CD (p=0.05)	(2.05)	(2.43)	(1.92)	(2.45)	(2.21)
CV (%)	(11.88)	(11.60)	(8.09)	(8.27)	(9.96)

Figures in the parentheses are angular transformed values; DAT- Days after transplanting; RC-Resistant Check; SC-Susceptible Check

minimum incidence of silver shoot (1.15% SS), which remained at par with that of W-1263 (1.71% SS), Abhaya (1.74% SS), Phalguna (1.91% SS) and Suraksha (2.09% SS) against the highest incidence of 32.49% silver shoot in case of TN-1 (SC) followed by IR-64 Sub-1 (20.15% SS), IR-64 (19.33% SS) which were rated as susceptible for gall midge attack in the present study. The results revealed that Kavya, W-1263, Abhaya, Phalguna , Suraksha emerged as promising against the gall midge, receiving silver shoot incidence below 5% in the present study as against the significantly higher pest incidence recorded in case of TN-1, IR-64 Sub-1 and IR-64 . The orders of gall midge incidence i.e. SS (%) were: Kavya (1.14% SS) >W-1263 (1.71% SS) >Abhaya (1.74% SS) > Phalguna (1.91% SS) >Suraksha (2.09% SS) >RD-202 (2.69% SS) >CAUR-1(3.07% SS) >Naveen (3.10% SS) >Lalat (3.15% SS) >IR-36 (3.23% SS) >BG-380-2 (3.57% SS) >KNM-113 (4.02% SS)> CR-2711-149 (4.08% SS) >ARC-5984 (4.62% SS) >Abhishek (7.50% SS) >BVS-1 (7.68% SS) >MTU-1010 (8.40% SS) >Sahbhagi (9.48% SS) >PAC-807 (10.56% SS) >PAC-801 (11.35% SS) >IR-64 (19.33% SS) >IR-64 Sub-1(20.15% SS) >TN- 1(32.49% SS) in the present study under field conditions.

These findings were almost in agreement with that of earlier findings of Lingaraj et al. (2008) who studied the virulence composition using three standard differentials viz., W1263 (Gm1 gene for resistance), Phalguna (Gm2 gene for resistance) and TN1 (susceptible without

any gene). The local gall midge populations in all the test locations expressed their virulence only against susceptible group consisting of TN1. Prasad and Prasad (2011) opined that the transplanted rice crop was infested with three major pests viz. YSB, GM and leaf folder. Two entries viz. Suraksha and Ajay remained moderately resistant to all the three pest species as all the three pest species were found to damage below 10% in these two varieties. Prasad and Prasad (2011) observed that the significantly minimum incidence of gall midge incidence was registered in the rice varieties Lalat, Suraksha and BG-380-2 in the agro-climatic condition of Jharkhand.

Effect of HPR on grain yield of rice

A perusal of results (Fig. 1) revealed the highest grains yield of rice (52.70 q/ha) was obtained in case of Naveen and it remained at par with CAUR-1 (52.60 q/ha), CR-2711-149 (49.30 q/ha), while the minimum yield was obtained from susceptible check i.e. TN-1 (26.70 q/ha). Yield of different genotypes of rice was found in decreasing order of: Naveen (52.70 q/ha) >CAUR-1 (52 .60 q/ ha) >CR-2711-149 (49.30 q/ ha) >Sahbhagi (46.7 q/ ha) >PAC-801 (44.30 q/ ha) >IR-36 (44.30 q/ ha) >BG-380-2 (43.60 q/ ha) >Abhishek (41.30 q/ ha) >IR-64 Sub-1 (40.70 q/ ha) >ARC-5984 (39.70 q/ ha) >W-1263 (39.60 q/ ha) >Abhaya (37.60 q/ ha) >Suraksha (37.5 q/ ha) >KNM-113 (36.70 q/ ha) >Phalguna (36.70 q/ ha) >Kavya (34.80 q/ ha) >TN-1 (26.70 q/ ha) in the present investigations conducted in the field conditions (Fig. 1).

These findings were in corroboration with the results of Prasad and Prasad (2011) who conducted field experiment during wet season of 2009 and 2010 in the farmers field in the gall midge endemic areas of Simdega district of Jharkhand to screen out certain popular rice varieties against gall midge. They reported that five rice varieties viz., Naveen, Lalat, BVD-203, BG 380-2, and IR-36 were moderately resistant to gall midge which produced higher grain yields to the tune of 43.59, 38.29, 33.58, 34.56 and 32.07 q/ ha.

The experiment revealed that Kavya, W-1263, Abhaya, Phalguna, Lalat, BG-380-2, RD-202 and Suraksha can be considered as resistant and promising against the gall midge (biotype-3), receiving silver shoot incidence below 5% even when they were grown in unprotected condition, as against the significantly and substantially higher pest incidence (i.e. SS%) recorded in case of TN-1, IR-64 Sub-1 and IR-64 receiving 32.49%, 20.15% and 19.33%, respectively. Naveen could be responsible for realization of the highest grain yield (52.70 q/ ha) among all the tested rice varieties in the present study.

PA- 6444 appeared to be tolerant to gall midge, as it produced higher yield of 41.41 q/ha, despite of suffering from relatively higher incidence of silver shoot, SS (18.11%) and hill (plant) infestation (HI) with the pest to the tone of 54.06%. The susceptible varieties viz. IR-64 and Birsamati registered highest pest incidence of SS (%) to the extent of 23.63 and 39.86%, which resulted to the considerably lowest yield of 16.94 and 18.60 q/ ha respectively in the gall midge endemic areas of Simdega in the farmers' fields of Jharkhand.

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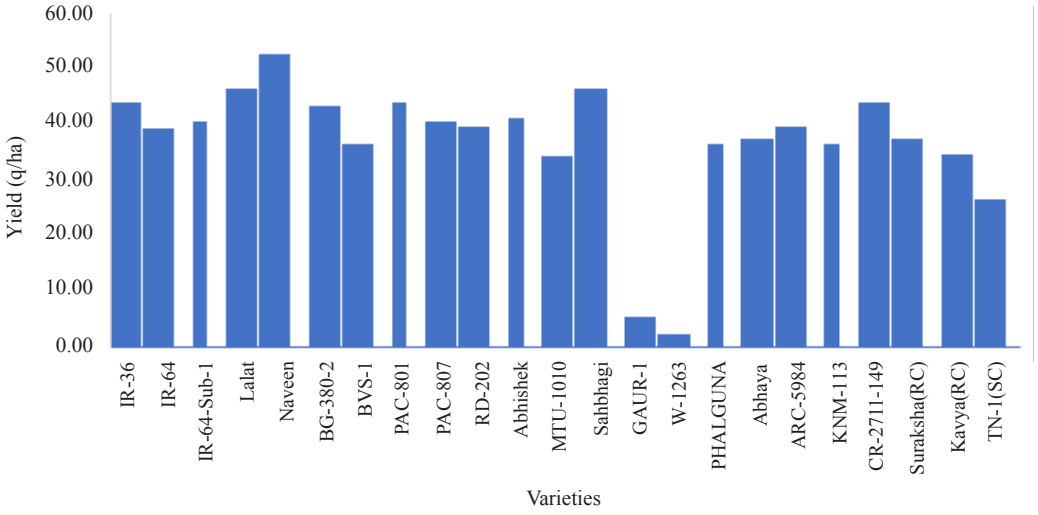

Fig. 1. Effect of Host Plant Resistance (HPR) on yield

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REFERENCES

Anonymous. 2009. Annual Report of State Agricultural Management Extension and Training Institute (SAMETI), Jharkhand, Ranchi, pp-211.

Lingaraj V K, Chakravarthy A K, Eregowda T N. 2008. Detection of Asian rice gall midge (*Orseolia oryzae*) biotype 1 in the new locations of Karnataka, South India. Bulletin of Insectology 61 (2): 277-281.

Magunmder S K G, Ali M P, Choudhury T R, Rahin S A. 2013. Effect of variety and transplanting date on the incidence of insect pests and their natural enemies. World Journal of Agricultural Sciences 1 (5): 158-167.

Prasad R, Prasad D. 2006. Account of insect pest problem in rice ecosystem in Ranchi. Indian Journal of Entomology 68 (3): 240-246.

Prasad R, Prasad D. 2010. Use of host plant resistance (HPR) for the management of rice gall midge (*Orseolia oryzae* WM) in Jharkhand. In: *Extended Abstract of Research Papers, National symposium on emerging trends in pest management Strategies under changing climatic scenario*, held on 20-21, Dec. 2010 at Orissa University of Agriculture and Technology (OUAT), Bhubneshwar, pp 28-29.

Prasad R. 2011. Status of the rice gall midge (*Orseolia oryzae* Wood Mason). Journal of Rice Research 4 (1&2): 19-20.

Prasad R, Prasad D. 2011. Incidence of gall midge (*Orseolia oryzae* Wood Mason) in some promising rice varieties. Journal of Plant Protection and Environment 8 (1): 57-62.

Prasad R, Prasad D. 2011. Management of major insect pests of rice through host plant resistance and need based judicious application of insecticides. Journal of Applied Zoological Researches 22 (1): 41-44.

Shaw S P, Chand P, Prasad S C. 1981. A different biotype of gall midge (*Orseolia oryzae* WM) at Ranchi. Oryza 18: 168-169.

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