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Screening of Certain Rice cultures against Asian Rice Gall midge

Keywords: *Gall midge, Resistance, Rice and Screening*

Rice, the staple food for more than three billion people worldwide, is attacked by nearly 300 insect pests at different stages among which only 28 species cause considerable damage (Pasalu and Katti, 2006). Among these, the Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) is responsible for a worldwide damage of more than US$ 700 million annually (Herdt, 1991). In India, it is an important insect pest which causes an annual yield loss of 0.8% of total production, amounting to US $80 million (Krishnaiah, 2004) and has been reported from both irrigated and rainfed rice, from almost all rice growing states except western Uttar Pradesh, Uttaranchal, Punjab, Haryana, Himachal Pradesh and Jammu and Kashmir (Bentur *et al*., 2003). In Telangana, it is endemic to certain locations like Warangal, Karimnagar where it usually occurs in the initial stages of crop growth during wet (*Kharif*) season especially under late transplanted conditions.

Gall midge causes maximum damage in maggot stage. Active first instar maggot feeds on the meristem by lacerating the tissue and sucking the oozing sap. Salivary secretions during feeding induces the leaf sheath primordium to cover the feeding maggot to form a gall chamber, which later elongates in the form of a tubular gall known as 'onion tip' or 'silver shoot'. Affected tillers with silver shoots become sterile; do not bear panicle resulting in considerable yield losses under severe infestation. Farmers often recognize the damage only after galls become conspicuous. Hence, growing of varieties resistant to gall midge provides an efficient, economical means of tackling this pest. So far, 11 resistance genes (designated Gm1 through Gm11) have been identified from different rice varieties (Himabindu *et al.*, 2010). Using three or four of these sources of resistance, more than 60 gall midge resistant rice varieties have been developed and released for commercial cultivation since 1975 (Bentur *et al*., 2003). Improved rice varieties carrying Gm1 or Gm2 genes, however, have lost their resistance against gall midge in most of the rice growing areas. Gall midge is known to have different biotypes across the country. Seven distinct gall midge biotypes, differing in their virulence have been reported (Vijaya Lakshmi *et al*., 2006). A vast majority of high-yielding rice varieties are prone to gall midge attack (Bentur et al., 2016). Though growing gall midge resistant varieties is the most successful strategy to combat the pest, durability of the resistance is to be addressed. Varietal resistance against the existing local biotype is effective in reducing the losses caused by the pest in a region.

The present study was conducted to screen certain rice cultures developed in Professor Jayashankar Telangana State Agricultural University (PJTSAU) - Regional Sugarcane and Rice Research Station, Rudrur against gall midge during wet season of 2016 and 2017 at PJTSAU - Regional Agricultural Research Station, Warangal, Telangana, India.

Thirty seven entries in 2016, twenty six entries in 2017 along with TN-1 as susceptible check (Table 2) were screened in natural field conditions under

delayed sowing and planting to capture maximum gall midge infestation in the experimental block. The entries *viz.*, RDR 1158, RDR 1162, RDR 1286 and RDR 1308 were screened during second year also. Nursery sowing was done on 23rd July in 2016, 22nd July in 2017 and transplanted on 20th August in 2016, 23rd August in 2017. The entries were transplanted at a spacing of 20 cm between the rows and 15 cm between the plants within the row. One seedling was transplanted per hill. Each test entry had 20 plants transplanted in a single row and for every 9 test entries, infestor row of TN-1 susceptible check was grown. TN-1 was also grown around the experiment block to ensure sufficient pest build up. The crop was grown following all recommended agronomic practices. However, no plant protection measures were taken throughout the crop period. Application of Nitrogen, Phosphorus, Potash fertilizers was done at the rate of 120:60:40 Kg/ha, respectively.

Observations on total number of plants, number of damaged plants with galls/silver shoots, number of tillers per hill, number of silver shoots per hill were recorded twice at 31-37 and 55 days after transplanting (DAT). Observations were recorded in all the plants of each entry from which mean values were computed. From the observations, % damaged plants, % silver shoots were calculated using the following formulae:

$$\% \text{ Damaged plants} = \frac{\text{Number of damaged plants}}{\text{Total number of plants}} \times 100$$

$$\% \text{ Silver shoots} = \frac{\text{Number of silver shoots hill}^{-1}}{\text{Number of tillers hill}^{-1}} \times 100$$

The entries were then scored against gall midge (Table-1) as per the Standard Evaluation System (SES), International Rice Research Institute (IRRI) for gall midge (IRRI, 2013).

Table 1. Methodology of scoring the reaction

% damage	Score	Reaction
Based on per cent silver shoots		
0	0	Highly Resistant
<1	1	Resistant
1-5	3	Moderately Resistant
6-10	5	Moderately Susceptible
11-25	7	Susceptible
>25	9	Highly Susceptible
Based on per cent plant damage		
0-10		Resistant
> 10		Susceptible

Perusal of the data indicated that gall midge infestation manifested in the form of per cent damaged plants and per cent silver shoots was low during the first observation (31- 37 DAT) in both the years when compared to second observation (55 DAT) and hence damage score assessment was done based on second observation *i.e.*, peak damage of gall midge (Table 2, 3). The susceptible check TN-1 had recorded 97.5% plant damage and 23.57% silver shoot damage in 2016 and 90 % plant damage and 8.91 % silver shoot damage in 2017. During 2016**,** gall midge incidence in test entries ranged from 15.79 to 100 % plant damage; 1.37 to 31.16 % silver shoot damage. During *Kharif*, 2017, gall midge incidence in test entries ranged from 30 to 100 % plant damage; 3.98 to 32.64 % silver shoot damage. None of the test entries recorded 'nil' damage by gall midge during both the years. All entries recorded > 10 % plant damage/ hill damage and were susceptible as per resistance scoring based on plant damage. Among the test entries, only 2 entries in 2016 *viz.*, RDR 1162 (1.37 % silver shoots) and RDR-1164 (2.47 % silver shoots) and only 3 entries in 2017 *viz.*, RDR 1188 (3.98 % silver shoots), RDR-1336 (4.82 % silver

Table 2. Screening of certain rice cultures against gall midge during *Kharif*, 2016

Designation	Assessment based on plant damage		Assessment based on tiller damage		
	% galls	Reaction	% galls	DS	Reaction
RDR 1245	70	Susceptible	14.04	7	Susceptible
RDR 1246	65	Susceptible	7.56	5	Moderately Susceptible
RDR 1247	85	Susceptible	13.82	7	Susceptible
RDR 1248	90	Susceptible	16.52	7	Susceptible
RDR 1249	95	Susceptible	15.89	7	Susceptible
RDR 1254	95	Susceptible	16.18	7	Susceptible
RDR 1257	100	Susceptible	22.31	7	Susceptible
RDR 1259	100	Susceptible	23.84	7	Susceptible
RDR 1260	90	Susceptible	22.32	7	Susceptible
RDR 1261	85	Susceptible	13.85	7	Susceptible
RDR 1262	100	Susceptible	22.08	7	Susceptible
RDR 1281	100	Susceptible	25.62	9	Highly Susceptible
RDR 1282	90	Susceptible	15.38	7	Susceptible
RDR 1286	95	Susceptible	21.72	7	Susceptible
RDR 1290	90	Susceptible	15.63	7	Susceptible
RDR 1292	100	Susceptible	27.38	9	Highly Susceptible
RDR 1294	90	Susceptible	15.9	7	Susceptible
RDR 1297	95	Susceptible	25.63	9	Highly Susceptible
RDR 1298	90	Susceptible	24.24	7	Susceptible
RDR 1299	90	Susceptible	24.38	7	Susceptible
RDR 1300	90	Susceptible	17.9	7	Susceptible
RDR 1301	95	Susceptible	18.27	7	Susceptible
RDR 1306	100	Susceptible	24.89	7	Susceptible
RDR 1308	65	Susceptible	6.44	5	Moderately Susceptible
RDR 1311	75	Susceptible	15.79	7	Susceptible
RDR 1313	95	Susceptible	20.49	7	Susceptible
RDR 1316	85	Susceptible	19.75	7	Susceptible
RDR 1317	100	Susceptible	18.45	7	Susceptible
RDR 1325	100	Susceptible	19.92	7	Susceptible
RDR 1140	100	Susceptible	21.76	7	Susceptible
RDR 1158	100	Susceptible	31.16	9	Highly Susceptible
RDR 1151	100	Susceptible	25.17	7	Susceptible
RDR 1162	15.79	Susceptible	1.37	3	Moderately Resistant
RDR 1164	35	Susceptible	2.47	3	Moderately Resistant
RDR 1180	78.95	Susceptible	11.85	7	Susceptible
RDR 1188	60	Susceptible	7.6	5	Moderately Susceptible
RDR 1144	95	Susceptible	26.12	9	Highly Susceptible
TN 1 (S.	97.5	Susceptible	23.57	7	Susceptible

DS - Damage Score

Table 3. Screening of rice cultures against gall midge during *Kharif*, 2017

Designation	Assessment based on hill damage		Assessment based on tiller damage		
	% galls	Reaction	% galls	DS	Reaction
RDR 1152	55	Susceptible	8.97	5	Moderately Susceptible
RDR 1147	95	Susceptible	11.17	7	Susceptible
RDR 1188	47.37	Susceptible	3.98	3	Moderately Resistant
RDR 1158	75	Susceptible	6.29	5	Moderately Susceptible
RDR 1162	70	Susceptible	7.59	5	Moderately Susceptible
RDR 1193	90	Susceptible	15.15	7	Susceptible
RDR 1195	90	Susceptible	16.67	7	Susceptible
RDR 1200	80	Susceptible	10.82	7	Susceptible
RDR 1196	95	Susceptible	12.42	7	Susceptible
RDR 1199	85	Susceptible	10.68	7	Susceptible
RDR 1212	94.74	Susceptible	12.92	7	Susceptible
RDR 1221	100	Susceptible	19.08	7	Susceptible
RDR 1210	95	Susceptible	23.16	7	Susceptible
RDR 1208	100	Susceptible	18.21	7	Susceptible
RDR 1216	85	Susceptible	11.64	7	Susceptible
RDR 1214	95	Susceptible	17.01	7	Susceptible
RDR 1225	100	Susceptible	27.41	9	Highly Susceptible
RDR 1236	90	Susceptible	14.47	7	Susceptible
RDR 1232	73.68	Susceptible	12.93	7	Susceptible
RDR 1280	70	Susceptible	9.87	5	Moderately Susceptible
RDR 1286	90	Susceptible	32.64	9	Highly Susceptible
RDR 1295	80	Susceptible	11.65	7	Susceptible
RDR 1265	84.21	Susceptible	8.46	5	Moderately Susceptible
RDR 1308	38.89	Susceptible	5.06	3	Moderately Resistant
RDR 1336	50	Susceptible	4.82	3	Moderately Resistant
RDR 1362	30	Susceptible	7.50	5	Moderately Susceptible
TN 1 (S. check)	90	Susceptible	8.91	5	Moderately Susceptible

DS - Damage Score *Entries under retesting

shoots) and RDR 1308 (5.06 % silver shoots) showed moderately resistant reaction (MR) based on tiller basis. RDR 1162 which showed moderate resistant reaction during 2016 did not show consistent resistant reaction during 2017. Most of the entries screened in the present study were found susceptible to the existing gall midge biotype 4M of Warangal. In the present study, all the 5 MR entries had more than 10 per cent hill damage. Endemic areas have high population pressure which could be the possible reason for this. Moderately resistant entries based on silver shoot damage having resistant reaction based on plant or hill damage are better than those with higher plant damage having susceptible reaction. Moderately resistant varieties are a better option compared to a susceptible variety, when resistant varieties with 'nil' incidence are not available, in gall midge endemic areas like Warangal where a distinct gall midge biotype designated tentatively as GMB4M, similar to biotype 4 but with added virulence against CR-MR1523 differential (Vijaya Lakshmi et al., 2006) is reported.

Several workers screened rice genotypes and reported promising entries against gall midge in the respective locations. Sumathi and Manickam, 2013 tested different rice entries at Rice Research Station, Tirur, Tamil Nadu during 2009 and found that the entries *viz.*, RP 4683-29-2-645, RP 4683-30-1-648, RP 4686-49-1- 943, RP 4687-52-2-1197, RP 4688-53-2-1258, RP 4688-53-2-1259, JGL 17025, JGL 17183, JGL 17187, JGL 17189, Kavya, JGL 17190, JGL 17196, JGL 17198, JGL 17211 and JGL 17221 recorded 'nil' gall midge in field and were promising against gall midge. Seni and Naik, 2017 reported that the genotypes W 1263, INRC 3021, Sudu Hondarawala, PTB 26, RP4686-48-1-937, RMSG-11, WGL 1147, WGL 1127, WGL 1121, WGL 1131, WGL 1141, JGL 27058 exhibited resistance reaction against gall midge at Chiplima, Odisha. Shravan Kumar *et al.,* 2020 reported that the entries *viz.*, IBT MRR 18, IBT MRR 23 and IBT MRR 24 were found highly resistant and six entries *viz.,* IBT MRR 17, IBT MRR 19, IBT MRR 20, IBT MRR 21, IBT MRR 22 and IBT MRR 28 had shown resistant reaction at Warangal, Telangana. These entries were developed through marker assisted backcross breeding.

From the present study of gall midge screening, it can be concluded that, the entries RDR 1162, RDR-1164, RDR 1188, RDR-1336 and RDR 1308 though showed moderately resistant reaction based on tiller damage had higher hill damage. However, they can be preferred over susceptible/ highly susceptible varieties in gall midge endemic areas, if found promising against yield and other phenotypic traits.

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LITERATURE CITED

Bentur J S, Pasalu I C, Sharma N P, Prasada Rao U and Mishra B 2003 Gall midge resistance in rice. *Technical bulletin no. 01/ 2003*, 20pp. Directorate of Rice Research, Hyderabad, India

Bentur J S, Rawat N, Divya D, Sinha D K, Agarrwal R, Atray I and Nair S 2016 Rice-gall midge interactions: Battle for survival. Journal of Insect Physiology, 84: 40–49

Herdt R W 1991 Research priorities for rice biotechnology. In: *Rice biotechnology*. [Khush, G. S. and Toenniessen, G.H. (eds.)]. CABI and International Rice Research Institute, Manila, Philippines, 19–54

Himabindu K, Suneetha K, Sama V S A K and Bentur J S 2010 A new rice gall midge resistance gene in the breeding line CR57-MR1523, mapping with flanking markers and development of NILs. *Euphytica*, 174: 179–187

IRRI 2013 Standard Evaluation System for Rice. 5th Edition. IRRI, Los Banos, Philippines, 55

Krishnaiah K 2004 Rice gall midge, *Orseolia oryzae* - an overview. In: *New approaches to gall midge resistance in rice*. [Bennett, J., Bentur, J.S., Pasalu,I.C. and Krishnaiah, K. (eds.)]. Proceedings of the International Workshop, 22-24 November 1998, Hyderabad, India, Los Banos (Philippines): International Rice Research Institute and Indian Council of Agricultural Research,195 p.

Pasalu I C and Katti G 2006 Advances in eco-friendly approaches in rice IPM. *Journal of Rice Research,* 1(1):83–90

Seni A and Naik B S 2017 Screening of different rice entries against rice gall midge, *Orseolia oryzae* (Wood-Mason). *International Journal of Environment Agriculture and Biotechnology*, 5(2):2427-2432

Shravan Kumar, R., Malathi, S and Rao, P J M. 2020. Screening of certain rice entries against Asian rice gall midge, Orseolia oryzae (Wood-Mason) in Warangal, Telangana, Journal of Entomology and Zoology studies, Vol. 8(5):1888-1893

Sumathi E and Manickam G 2013 Field screening of rice accessions against rice gall midge (*Orseolia oryzae* Wood-Mason). *Crop Research*, 45:54–58

Vijaya Lakshmi P, Amudhan S, HimaBindu K, Cheralu C and Bentur J S 2006 A new biotype of the Asian rice gall midge *Orseolia oryzae* (Diptera: Cecidomyiidae) characterized from the Warangal population in Andhra Pradesh, India. *International Journal of Tropical Insect Science*, 26: 207–211

PJSTAU– Krishi Vigyan Kendra, Malyal,
Mahabubabad, Telangana.

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