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FIELD SCREENING OF CERTAIN RICE BREEDING LINES AGAINST GALL MIDGE, *ORSEOLIA ORYZAE* (WOOD-MASON) IN WARANGAL, TELANGANA, INDIA

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ABSTRACT

Field screening of 62 rice breeding lines along with six checks was done against Asian rice gall midge [*Orseolia oryzae* (Wood-Mason)] at Regional Agricultural Research Station, Warangal, Professor Jayashankar Telangana Agricultural University, Telangana during wet season of 2016 under delayed planting situation ensuring sufficient pest pressure. Plants were evaluated based on per cent damaged plants (% PD) and silver shoots (% SS). The susceptible check Taichung Native-1 (TN-1) recorded high level of infestation, with 80% PD and 14.2% SS showing susceptible reaction. Among the breeding lines tested, KNM 1625 with 5% PD and 0.4% SS exhibited resistant reaction both on the basis of per cent damaged plants and silver shoots and can be used as a promising gall midge resistant source. JGL 25998, JGL 27020, JGL 27063, JGL 27075, JGL 27143, JGL 27353, JGL 27391, KNM 1722, KNM 1724, KNM 2213, KNM 2275, KNM 2266, KNM 1623, KNM 1638, WGL 505, WGL 667, WGL 938 showed moderate resistance reaction based on silver shoot scoring and showed susceptibility based on plant damage scoring. This limits the probability of selecting these lines as sources of gall midge resistance in resistance breeding programmes. However, resistant/moderate resistant lines can be preferred over susceptible/ highly susceptible lines in gall midge endemic areas, if found promising against yield and other phenotypic characters making timely need based plant protection mandatory.

Key words: Gall midge, Field screening, *Orseolia oryzae*, Resistance, Rice.

Rice is the most important crop providing food for more than one-third of the world's population. It is essentially a crop of warm humid environment conducive for the survival and multiplication of various insect pests. Due to its wide cultivation across several ecosystems, it invites numerous biotic stresses in the form of viruses, bacteria, fungi, parasites, insects, pathogen and weeds. Of these, insect pests alone cause more than 25% yield loss (Dhaliwal *et al*., 2010). Nearly 300 species of insect pests attack the rice crop at different stages, of which, only 23 species cause notable damage (Pasalu and Katti, 2006). Out of these insect pests, five insect pests *i.e.*, yellow stem borer, gall midge, leaf folder, brown plant hopper and white backed plant hopper cause major damage in rice crop production (Katti, 2013). Among these, Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) is an important pest which has been prevalent in almost all the rice growing states in India except Western Uttar Pradesh, Uttaranchal, Punjab, Haryana and Hill states of Himachal Pradesh and Jammu and Kashmir (Bentur *et al*., 1992). The pest is predominantly active during monsoon season, thriving under conditions of high humidity and moderate temperatures, but it may also persist during off-season periods (Kalode and Viswanathan, 1976). Infestation occurs from seedling to the end of tillering stage, leading to significant yield losses. It is regarded as the third most important insect pest of rice in India in terms of distribution and damage severity (Bentur, 2015). Yield loss projections for damage due to 1 per cent gall midge incidence induced silver shoot damage resulted in 3.5 per cent loss (Muralidharan and Pasalu, 2005). The pest is capable of causing yield losses ranging from 10 to 25% (Prasad and Prasad, 2006) and the severity of damage increases under late planting conditions (Chaudhari *et al.,* 2018). Growing resistant varieties remains one of the most reliable and eco-friendly approaches within integrated pest management strategies (Ukwungwu *et al*., 1999). Adoption of gall midge-resistant varieties such as Surekha and Phalguna over large areas in endemic regions of Telangana and north coastal Andhra Pradesh has significantly reduced pest incidence and contributed to yield improvement of about 45% (Krishnaiah *et al.,* 1983). Studies have shown that the Warangal population represents a distinct biotype (GMB4M), exhibiting additional virulence compared to earlier biotypes (Vijayalakshmi *et al*., 2006). The present experiment was conducted to screen certain rice breeding lines against gall midge in Warangal, Telangana, India to identify promising breeding lines with known sources of resistance against gall midge biotype (GMB4M).

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MATERIAL AND METHODS

The present experiment was conducted at Regional Agricultural Research Station, Warangal, Professor Jayashankar Telangana Agricultural University, Telangana, India during wet season of 2016. Sixty two breeding lines developed from 3 centres, along with 6 checks *viz.,* Kavya, RP 2068-18-3-5, Abhaya, Aganni, W1263 and Taichung Native-1 [TN-1(susceptible check)], were screened against gall midge under natural field conditions. Sowing was delayed by one month for natural build up of gall midge in the experimental block. Nursery of both test lines and checks was sown on 18th July, 2016. Transplanting was done on 20th August, 2016 at a spacing of 20 cm between the rows and 15 cm between the plants within the row. Each line had 20 plants transplanted in a single row. TN-1 was grown as infestor rows (two times in between the test entries) and also as border rows around the block of test entries to facilitate sufficient pest buildup. The crop was grown following all recommended agronomic practices except plant protection measures. First observations on gall midge incidence were recorded on 18-09-2016 (i.e., 29 days after transplanting (DAT)) while second observations were recorded on 13-10-2016 (at 54 DAT). To assess the damage in TN-1, average of both the infestor rows was taken. Number of plants and number of plants with silver shoots were counted and per cent plant damage was arrived at using the formula:

Per cent Plant Damage (% PD)

$$= \frac{\text{Number of plants with silver shoots}}{\text{Total number of plants}} \times 100$$

Similarly, data were recorded on number of tillers and number of silver shoots in all the 20 plants. Mean was calculated and per cent silver shoot damage (tiller damage) was arrived at using the formula:

Per cent Silver Shoots (% SS)

$$= \frac{\text{Mean number of silver shoots per plant}}{\text{Mean number of tillers per plant}} \times 100$$

Then, the test entries were assessed for gall midge damage as per Standard Evaluation System (Table 1) for gall midge (IRRI, 2013).

Table 1. Standard Evaluation System scale for scoring the reaction against gall midge

Per cent 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

RESULTS AND DISCUSSION

The data recorded on differential reaction among the breeding lines against gall midge indicated the existence of genetic variability for resistance against the local Warangal gall midge population. At 29 DAT, gall midge damage ranged from 0-30 per cent plant damage (% PD) and 0-3.8 per cent silver shoots (% SS) among test entries as against 22.5% PD and 1.5% SS in the susceptible check TN-1 (Table 2). Since the damage level was comparatively low during first observation (29 DAT), the breeding lines were assessed as per Standard Evaluation System of IRRI for gall midge based on the damage score recorded during second observation (*i.e.,* at 54 DAT).

At 54 DAT, gall midge incidence in TN-1 recorded 80.00% PD with 14.2% SS, confirming the adequacy of pest pressure and validating the screening conditions. Among the checks, Aganni with 5% PD and 0.3% SS showed resistant reaction. Other checks viz., RP 2068-18-3-5, Kavya, Abhaya and W 1263 recorded plant damage in the range of 30 to 75 per cent and silver shoot damage in the range of 2.4 to 8.3 per cent. Earlier studies by Anusha *et al.* (2022) revealed Aganni as highly resistant to the Warangal gall midge population during 2014 and 2015 screening trials. Similar observations on susceptibility of Kavya against GMB4M at Warangal were reported by Hari *et al.,* 2022.

At the time of peak infestation, none of the test lines, had 'nil' damage by gall midge. Among the breeding lines, 5-95% PD, 0.4 – 21.4% SS was recorded. The entry KNM 1625 with 5% PD and 0.4% SS exhibited resistant reaction on the basis of both plant damage and silver shoot damage. Seventeen breeding lines JGL 25998, JGL 27020, JGL 27063, JGL 27075, JGL 27143, JGL 27353, JGL 27391, KNM 1722, KNM 1724, KNM 2213, KNM 2275, KNM 2266, KNM 1623, KNM 1638, WGL 505, WGL 667, WGL 938 had silver shoots of ≤5 % silver shoots and showed moderate resistance reaction. However, among these, none had recorded less than 10 per cent plant damage. This limits the probability of selecting these lines as sources of gall midge resistance in resistance breeding programmes.

Several workers screened and reported promising rice 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 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. Meher *et al.*, 2009 screened certain genotypes and reported that Ananga, Annada, Kharavela and Shaktiman showed highly resistant reaction. In the present study, nine lines derived from a common parentage of JGL 11470 x BPT 5204 with JGL 11470 being the source of resistance, were screened. Among these lines, KNM 1625 showed resistant reaction against gall midge while KNM 1623, JGL 27063, JGL 27075 showed moderate resistant reaction. Similarly in the five breeding lines derived from the cross JGL 11470 x GP 275, only two lines JGL 27353, JGL 27391 showed moderate reaction.

In the present study, 26 entries JGL 20644, JGL 24344, JGL 24520, JGL 25154, JGL 25925, JGL 25958, JGL 25969, JGL 25975, JGL 26989, JGL 27056, JGL 27058, JGL 27072, JGL 27356, JGL 27371, KNM 1592, KNM 1600, KNM 1616, KNM 1621, KNM 1717, KNM 1728, KNM 1730, KNM 2251,JGL 13595, JGL 3828, WGL 401, WGL 810 showed moderate susceptibility to gall midge.

Table 2. Field screening of rice entries against gall midge at Warangal during 2016

Entry No.	Designation	Cross	29 DAT		54 DAT		DS #	R #
			Per cent Plant damage	Per cent Silver shoots	Per cent Plant damage	Per cent Silver shoots		
1	JGL 20644	MTU 1010 x JGL-11118	10.0	0.6	75.0	10.0	5	MS
2	JGL 21789	MTU 1010 x JGL-11118	10.0	0.6	80.0	10.9	7	S
3	JGL 21831	JGL 13595 x JGL-11470	20.0	3.8	60.0	12.3	7	S
4	JGL 24344	HPR 2143 x JGL 3855	5.0	0.4	55.0	8.9	5	MS
5	JGL 24520	JGL-11118 x VD 82	10.0	0.8	50.0	5.5	5	MS
6	JGL 25154	JGL 17653 x RP 2421	20.0	1.7	60.0	7.4	5	MS
7	JGL 25925	JGL 11470 x VD 62	0.0	0.0	44.4	9.8	5	MS
8	JGL 25947	MTU 1001 x JGL 3844	20.0	1.8	75.0	14.8	7	S
9	JGL 25958	MTU 1010 x NLR 34449	20.0	1.5	75.0	8.4	5	MS
10	**Kavya**	WGL 27120/WGL 17672// Mahsuri/Surekha	**20.0**	**1.7**	**75.0**	**8.3**	**5**	**MS**
11	JGL 25960	MTU 1010 x NLR 34449	20.0	1.7	95.0	21.4	7	S
12	JGL 25964	MTU 1010 x NLR 34449	20.0	1.1	90.0	16.0	7	S
13	JGL 25969	MTU 1010 x NLR 34449	10.0	0.9	60.0	6.5	5	MS
14	JGL 25975	HPR 2143 x JGL 13595	10.0	0.8	83.3	8.5	5	MS
15	JGL 25998	JGL 17004 x NLR 3042	5.0	0.4	25.0	4.4	3	MR
16	JGL 26772	BPT 5204 x (JGL 18047 x Bhadrakali)	20.0	1.7	70.0	12.3	7	S
17	JGL 26960	JGL 18047 x Bhadrakali	20.0	1.1	80.0	14.7	7	S
18	JGL 26989	JGL 18071 x Bhadrakali	10.0	0.9	40.0	6.7	5	MS

Entry No.	Designation	Cross	29 DAT		54 DAT		DS #	R #
			Per cent Plant damage	Per cent Silver shoots	Per cent Plant damage	Per cent Silver shoots		
19	JGL 27015	JGL 11727 x JGL 17004	10.0	0.8	75.0	15.3	7	S
20	**RP 2068-18-3-5**	**Swarnadhan / Velluthacheera**	**5.0**	**0.4**	**35.0**	**6.1**	**5**	**MS**
21	JGL 27020	JGL 11727 x JGL 17004	15.0	1.8	25.0	2.5	3	MR
22	JGL 27056	JGL 11470 x BPT 5204	5.0	0.8	50.0	6.6	5	MS
23	JGL 27058	JGL 11470 x BPT 5204	10.0	0.8	40.0	5.2	5	MS
24	JGL 27063	JGL 11470 x BPT 5204	5.0	0.4	20.0	1.9	3	MR
25	JGL 27072	JGL 11470 x BPT 5204	10.0	0.8	65.0	7.3	5	MS
26	JGL 27075	JGL 11470 x BPT 5204	15.0	1.0	30.0	3.0	3	MR
27	JGL 27143	JGL 15185 x HPR 2143	5.0	0.3	40.0	4.3	3	MR
28	JGL 27353	JGL 11470 x GP 275	10.0	0.7	55.0	5.0	3	MR
29	JGL 27356	JGL 11470 x GP 275	15.0	1.3	42.1	8.1	5	MS
30	JGL 27361	JGL 11470 x GP 275	10.0	0.7	70.0	11.8	7	S
31	JGL 27371	JGL 11470 x GP 275	5.0	0.4	50.0	7.8	5	MS
32	JGL 27391	JGL 11470 x GP 275	15.0	0.9	50.0	4.8	3	MR
33	KNM 1592	JGL 3844 x BPT 5204	5.0	0.4	40.0	7.7	5	MS
34	KNM1598	JGL 3844 x BPT 5204	30.0	3.0	75.0	11.3	7	S
35	KNM 1600	JGL 3844 x BPT 5204	20.0	1.8	70.0	9.7	5	MS
36	KNM 1610	JGL 3844 x BPT 5204	15.0	1.2	65.0	10.8	7	S
37	KNM 1616	JGL 11470 x BPT 5204	20.0	2.0	60.0	7.7	5	MS
38	**Abhaya**	**CR 157-392/CR 57-21**	**0.0**	**0.0**	**35.0**	**4.9**	**3**	**MR**
39	KNM 1621	JGL 11470 x BPT 5204	5.0	0.4	55.0	8.5	5	MS
40	KNM 1625	JGL 11470 x BPT 5204	5.0	0.3	5.0	0.4	1	R
41	KNM 1632	JGL 11470 x BPT 5204	15.0	1.0	65.0	10.9	7	S
42	KNM 1717	JGL 18065 x VD 82	15.0	1.0	65.0	8.7	5	MS
43	KNM 1722	JGL 15185 x HPR 2443	0.0	0.0	15.0	1.6	3	MR
44	KNM 1724	JGL 15185 x HPR 2443	10.0	0.9	20.0	2.6	3	MR
45	KNM 1728	JGL 15185 x HPR 2443	10.0	0.7	40.0	6.4	5	MS
46	KNM 1730	JGL 15185 x HPR 2443	10.0	1.0	45.0	7.2	5	MS
47	KNM 2213	MTU 1001 x JGL 11470	10.0	0.9	30.0	4.5	3	MR
48	**Aganni**	**Donor**	**0.0**	**0.0**	**5.0**	**0.3**	**1**	**R**
49	KNM 2251	JGL 3855 x JGL 11470	15.0	1.2	40.0	8.0	5	MS
50	KNM 2275	JGL 3828 x JGL 13595	5.0	0.8	20.0	2.1	3	MR
51	KNM 2266	JGL 3828 x JGL 13595	15.0	1.4	55.0	4.7	3	MR
52	JGL 13595	-	5.0	0.5	35.0	5.5	5	MS
53	JGL 3828	BPT 5204/ Aganni	5.3	1.2	52.6	7.5	5	MS
54	KNM 1623	JGL 11470/BPT 5204	0.0	0.0	25.0	1.9	3	MR
55	KNM 1638	JGL 11727/JGL 17004	0.0	0.0	20.0	1.9	3	MR
56	WGL 401	BPT 5204/Bhadrakali	0.0	0.0	60.0	9.4	5	MS
57	WGL 505	BPT 5204/RYP-1	5.0	0.7	45.0	5.0	3	MR
58	**W 1263**	**Eswarakorra/MTU 15 (check)**	**5.0**	**0.6**	**30.0**	**2.4**	**3**	**MR**
59	WGL 667	MTU 1001/NDLR 8	10.0	0.7	35.0	3.7	3	MR

Entry No.	Designation	Cross	29 DAT		54 DAT		DS #	R #
			Per cent Plant damage	Per cent Silver shoots	Per cent Plant damage	Per cent Silver shoots		
60	WGL 705	Kavya/Rasi	10.0	0.6	85.0	14.8	7	S
61	WGL 767	BPT 5204/Kavya	15.0	1.8	60.0	13.0	7	S
62	WGL 810	NLR 34445/BPT 5204	10.0	0.7	75.0	9.7	5	MS
63	WGL 819	BPT 5204/Kavya	15.0	1.7	75.0	14.3	7	S
64	WGL 825	Kavya/MTU 1001	25.0	1.7	70.0	13.3	7	S
65	WGL 938	IRBBN-39/R 68352-14-1-1-1	15.0	1.3	25.0	2.5	3	MR
66	WGL 1062	Gedonzipetan/Kavya	15.0	1.5	75.0	11.1	7	S
67	JGL 11118	IET 8585/JGL 1792	10.0	0.9	95.0	16.4	7	S
68	**TN-1 (Susceptible Check)@**		**22.5**	**1.5**	**80.0**	**14.2**	**7**	**S**

@ Mean incidence of 2 infestor rows
DS- Damage Score; R - Reaction
Based on per cent silver shoots at second observation
HR-Highly Resistant, R-Resistant, MR-Moderately Resistant, MS-Moderately Susceptible, S-Susceptible, HS-Highly Susceptible

CONCLUSION

Among the rice breeding lines screened, KNM 1625 showed resistant reaction and is a promising gall midge resistant source. JGL 25998, JGL 27020, JGL 27063, JGL 27075, JGL 27143, JGL 27353, JGL 27391, KNM 1722, KNM 1724, KNM 2213, KNM 2275, KNM 2266, KNM 1623, KNM 1638, WGL 505, WGL 667, WGL 938 showed moderate resistance reaction based on silver shoot damage and showed susceptibility based on plant damage scoring system. This limits the probability of selecting these lines as sources of gall midge resistance in resistance breeding programmes. It is interesting to note that within the same cross there is variation in the damage suggesting segregation for resistance to gall midge among the breeding lines. Nevertheless, resistant/moderate resistant varieties can be preferred over susceptible/ highly susceptible varieties in gall midge endemic areas, if found promising against yield and other phenotypic characters and a prophylactic spray can be advocated to further mitigate the damage.

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