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PHENOTYPINGOF RICE GENOTYPES AGAINST ASIAN RICE GALL MIDGE, *Orseolia oryzae* (WOOD-MASON) BIOTYPE IV IN ANDHRA PRADESH.

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ABSTRACT

To develop rice cultivars resistant to Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) biotype IV, phenotyping of rice cultivars was conducted during 2016-17 under field conditions at ARS, Ragolu. A total of 105 lines were screened against Asian rice gall midge. Gallmidge incidence as per cent plant damage and per cent silver shoot damage was recorded at 30 and 50 days after transplanting. None of the entries were found highly resistant to Asian gallmidge at Ragolu. However, the entry RGL 7010 was recorded with per cent plant damage of less than 5 per cent, while most of the entries recorded 100 per cent plant damage. These entries could be used as donor in breeding experiments to develop gall midge tolerant varieties.

KEY WORDS: Phenotyping, Rice gall midge, rice genotypes, Cecidomyiidae, *Orseolia oryzae*, *Oryza sativa*.

INTRODUCTION:

Rice is India's predominant crop, and is the staple food of majority of population. India has the world's largest area under rice cultivation and is one of the largest producers of white rice, accounting for 20 per cent of global rice production. In India, rice is cultivated in an area of 42.7 million hectare (mha) with a total production of 161.27 m tonnes (mt) (IRRISTAT, 2017).

Rice crop is attacked by number of insect pests, of which Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) is one of the important pest which causes extensive@ damage. Identification of new sources of resistance to major insect pests is the prime objective of host plant resistance, which includes evaluating the performance of breeding lines, identifying stable source of resistance and transfer them to elite lines. The discovery and use of gall midge resistance genes should be made as efficient as possible because there are some biotypes for which effective resistance genes have not yet been found or for which resistance relies precariously on a single major gene (Bennett *et al.,* 2004).

MATERIALS AND METHODS

A total of 105 cultivars (88 from ARS, Nellore and 17 from ARS, Ragolu) were studied under field conditions at Agricultural Research Station, Ragolu during *kharif*, 2016-17 with Kavya as resistant check and TN 1 as susceptible check. Each entry was transplanted in a single row of 20 hills per cultivar with a spacing of 20 x 15 cm and was replicated twice. Seedlings of 30 days old were transplanted with a single seedling per hill. Normal agronomic practices were followed during the season.

For scoring the damage due to rice gallmidge, total number of hills, no. of infested hills, total no. of tillers and total number of tillers with silver shoot were recorded at 30 DAT (Days after Transplanting), 50 DAT and the percent plant damage and per cent silver shoot infestation was calculated as follows:

$$\% \text{ Plant Damage} = \frac{\text{No. of infested hills}}{\text{Total no. of hills}} \times 100$$

$$\% \text{ Silver shoot damage} = \frac{\text{No. of infested tillers}}{\text{Total no. of tillers}} \times 100$$

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Per cent damaged plants and per cent silver shoot damage per entry were calculated and analysis was done by using ANOVA in SPSS 20.0 software. To check the level of resistance/susceptibility the percent silver shoot in each entry was converted to 0-9 scale by following the IRRI Standard Evaluation System (SES) for rice (IRRI 2002).

Standard Evaluation Systems for evaluating rice for resistance to Rice Gall Midg (IRRI 2002)

Scale	Infected tillers in field Test	Reaction
0	No damage	HR – Highly Resistant
1	Less than 1%	R – Resistant
3	1-5%	MR – Moderately Resistant
5	6-10%	MS – Moderately Susceptibility
7	11-25%	S – Susceptibility
9	More than 25	HS – Highly Susceptibility

RESULT AND DISCUSSION

During 2016-17, the incidence of gall midge was moderate to very high with 100 per cent plant damage. At 30 DAT, per cent silver shoot damage was between 0.00 per cent (RGL 7002, RGL 7003 and RGL 7009) to 16.8 per cent (5757-85-1-1-3). Lowest per cent plant damage was recorded in RGL 7002, RGL 7003 and RGL 7009 (0.00%) and highest in the genotype NLR 5787-24-4-1-1 (95.83%).

At 50 DAT, highest per cent plant damage of 100 was observed in 39 entries and genotypes with < 10 per cent were RGL 11414, RGL 7002, RGL 7003, RGL 7005, RGL 7006, RGL 7009, RGL 7010 and NLR 4003. The entries NLR 4003, RGL 7005 and RGL 7006 were not selected for genotyping because the damage in these entries was above 10.00 per cent (NLR 4003 (16.67%), RGL 7005 (20.83%) and RGL 7006 (16.67%) at 30 DAT (Table 1).

Overall grouping of the entries phenotyped against rice gall midge based on the reaction pattern observed at 50 DAT was presented in Table 2. The per cent silver shoot damage at 50 DAT ranged from 0.29 (NLR 4003) with per cent plant damage of < 5.0 was recorded in the entry, RGL 7010 i.e., 3.00 per cent and with per cent silver shoot damage of 1.78. The per cent silver shoot damage and per cent plant damage at 50 DAT in the susceptible check, TN 1 was 23.01 per cent and 96.67 per cent, respectively. The frequency of test entries under different levels of gall midge damage, as a reflection of pest pressure and performance of entries, at ARS, Ragolu was given in fig. 1.

None of the entries were found to be highly resistant at ARS, Ragolu. Similar results were presented by Rabindra Prasad (2011) who reported the susceptibility of 28 hybrids to biotype III at Jharkand. Even the Resistant rice variety Lalat had 11.41 per cent plant damage. Anusha *et al*. (2017) reported that, of the 38 pre-breeding lines tested, 12 entries were found resistant to biotype I at IIRR, Hyderabad, 6 lines were resistant to biotype III at Jagtial and none of the entries were resistant to biotype IV M at Warangal.

The entry selected, RGL 7010 could be exploited in resistant breeding programme for the development of genotypes resistant against rice gall midge after the identification of gene conferring resistance through molecular studies.

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Table: 1. Reaction of rice cultures to Gall midge at Ragolu during 2016-17

S. No.	Test Entries	Mean Damage 30 DAT		Mean Damage 50 DAT		Reaction
		Silver shoot SS (%)	Plant Damage DP (%)	Silver shoot SS (%)	Plant Damage DP (%)	
1	AL-2	4.60 (2.34)	33.33 (35.26)	20.50 (4.62)	90.18 (71.90)	HS
2	AL-4	4.33 (2.31)	33.33 (35.10)	17.55 (4.28)	76.47 (63.02)	HS
3	AL-5	9.34 (3.13)	54.55 (47.80)	24.27 (5.01)	93.73 (75.50)	HS
4	AL-7	10.09 (3.22)	62.50 (53.05)	28.63 (5.44)	92.50 (78.61)	HS
5	NLR 3461	9.61 (3.26)	66.67 (54.90)	30.87 (5.62)	96.43 (82.25)	HS
6	NLR 3467	6.75 (2.77)	66.67 (54.90)	31.71 (5.71)	100.00 (90.00)	HS
7	NLR 3472	2.58 (1.89)	23.08 (28.71)	23.26 (4.91)	96.15 (81.95)	HS
8	NLR 3473	3.45 (2.11)	37.50 (37.50)	33.02 (5.76)	100.00 (90.00)	HS
9	NLR 3474	8.09 (3.00)	50.00 (45.00)	21.15 (4.56)	88.33 (70.07)	HS
10	NLR 3475	3.34 (2.00)	25.00 (28.49)	31.15 (5.67)	12.18 (20.10)	S
11	NLR 3476	3.66 (2.13)	29.17 (32.15)	18.62 (4.36)	87.05 (69.42)	HS
12	NLR 3477	1.98 (1.72)	16.67 (24.09)	19.87 (4.50)	85.00 (67.50)	HS
13	NLR 3479	2.28 (1.68)	16.67 (17.63)	22.94 (4.89)	91.67 (77.95)	HS
14	NLR 3480	4.56 (2.36)	50.00 (45.00)	34.40 (5.95)	95.83 (81.61)	HS
15	NLR 3481	7.15 (2.84)	25.00 (28.49)	27.00 (5.25)	94.12 (79.97)	HS
16	JGL-17004	2.80 (1.89)	33.33 (35.26)	21.27 (4.72)	83.73 (66.48)	HS
17	JGL-3844	5.19 (2.49)	20.83 (26.02)	17.14 (4.26)	66.67 (57.13)	HS
18	JGL-1798	0.64 (1.28)	8.33 (16.78)	3.23 (1.95)	20.95 (26.86)	S
19	WGL-32100	0.58 (1.23)	8.33 (12.05)	4.83 (2.28)	38.97 (38.34)	HS
20	WGL-48684	5.42 (2.50)	33.33 (35.10)	9.16 (3.18)	62.38 (52.30)	HS
21	NLR 3465	3.68 (2.13)	29.17 (32.15)	25.11 (5.02)	90.00 (76.72)	HS

22	NLR 3480	3.38 (2.05)	20.83 (27.05)	20.99 (4.51)	92.86 (78.90)	HS
23	NLR 3479	3.39 (2.04)	20.83 (27.05)	23.35 (4.85)	89.29 (76.21)	HS
24	NLR 3482	6.71 (2.77)	45.83 (42.53)	25.14 (5.07)	96.88 (82.76)	HS
25	NLR 3483	4.10 (2.26)	45.83 (41.34)	29.37 (5.49)	97.06 (82.98)	HS
26	NLR 3474	1.60 (1.59)	54.17 (47.47)	22.79 (4.86)	100.00 (90.00)	HS
27	NLR 3484	7.63 (2.70)	20.83 (27.05)	25.06 (5.06)	90.00 (76.72)	HS
28	NLR 3478	7.13 (2.85	41.67 (40.20)	31.85 (5.70)	100.00 (90.00)	HS
29	NLR 3475	9.95 (3.31)	54.17 (47.95)	32.95 (5.79)	100.00 (90.00)	HS
30	NLR 3481	8.19 (2.97)	54.17 (47.47)	26.99 (5.25)	100.00 (90.00)	HS
31	NLR 3463	6.32 (2.65)	58.33 (50.58)	28.87 (5.37)	100.00 (90.00)	HS
32	NLR 3467	7.88 (2.94)	62.50 (52.27)	24.83 (5.08)	100.00 (90.00)	HS
33	NLR 3464	9.65 (3.26)	57.50 (49.62)	33.33 (5.72)	97.06 (82.98)	HS
34	NLR 3468	4.37 (2.21)	45.83 (42.37)	20.62 (4.23)	94.12 (79.97)	HS
35	NLR 3469	5.78 (2.56)	50.00 (45.00)	26.36 (5.15)	97.06 (82.98)	HS
36	NLR 3466	6.17 (2.65)	50.00 (45.00)	28.99 (5.46	55.26 (54.47)	HS
37	NLR 3470	4.26 (2.24)	33.33 (34.55)	25.03 (5.03)	88.54 (70.71)	HS
38	NLR 3471	4.68 (2.38)	45.83 (42.60)	30.35 (5.49)	90.63 (72.41)	HS
39	NLR 3472	8.63 (3.07)	70.83 (65.10)	31.85 (5.72)	100.00 (90.00)	HS
40	NLR 3473	6.57 (2.72)	58.33 (50.10)	28.20 (5.40)	100.00 (90.00)	HS
41	NLR 3490	7.51 (2.88)	58.33 (49.80)	21.46 (4.68)	96.88 (82.76)	HS
42	NLR 3460	10.25 (3.30)	70.83 (59.11)	22.06 (4.69)	90.63 (77.17)	HS
43	5825-1-1-1-1	8.59 (3.02)	54.17 (47.95)	22.25 (4.74)	92.82 (74.47)	HS
44	5825-1-1-2-1	6.35 (2.70)	58.33 (50.10)	24.64 (5.06)	100.00 (90.00)	HS
45	5812-7-2-1-1	6.70 (2.77)	50.00 (45.00)	24.73 (5.07)	100.00 (90.00)	HS

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46	5812-7-3-2-1	9.44 (3.18)	70.83 (59.11)	28.93 (5.46)	100.00 (90.00)	HS
47	5813-7-1-1-1	8.32 (2.88)	58.33 (51.61)	26.18 (5.20)	100.00 (90.00)	HS
48	5814-3-1-1-2	8.48 (3.05)	50.00 (45.00)	25.68 (5.15)	100.00 (90.00)	HS
49	5814-8-2-1-1	13.34 (3.72)	70.83 (57.85)	12.75 (3.43)	93.75 (79.65)	HS
50	5814-14-3-1-1	9.72 (3.22)	83.33 (65.91)	21.34 (4.59)	92.86 (78.90)	HS
51	5814-17-1-3-1	7.38 (2.82)	45.83 (42.53)	13.79 (3.56)	46.19 (41.38)	HS
52	5815-10-1-1-1	11.40 (3.32)	63.54 (55.39)	24.55 (5.04)	100.00 (90.00)	HS
53	5815-11-1-1-1	13.07 (3.61)	84.62 (73.15)	29.17 (5.49)	100.00 (90.00)	HS
54	5813-2-2-1-1	13.64 (3.82)	79.17 (62.95)	27.50 (5.32)	96.88 (82.76)	HS
55	5813-15-3-1-2	11.98 (3.48)	75.00 (61.51)	25.03 (5.08)	90.63 (77.17)	HS
56	5796-10-4-2-1	8.07 (2.98)	70.83 (57.85)	23.32 (4.89)	100.00 (90.00)	HS
57	5785-12-2-1-2	13.93 (3.79)	87.50 (75.00)	32.13 (5.75)	92.86 (78.90)	HS
58	5788-34-3-2-1	8.21 (3.03)	60.26 (50.97)	30.32 (5.57)	96.88 (82.76)	HS
59	5788-37-2-1-3	12.82 (3.71)	83.33 (65.91)	28.16 (5.39)	93.75 (75.52)	HS
60	5787-21-1-2-2	14.54 (3.92)	87.50 (75.00)	29.96 (5.55)	100.00 (90.00)	HS
61	5787-24-4-1-1	12.81 (3.72)	95.83 (81.61)	29.46 (5.52)	100.00 (90.00)	HS
62	5782-1-1-1-2	13.56 (3.82)	83.33 (65.91)	36.70 (6.14)	100.00 (90.00)	HS
63	5802-13-2-3-1	3.04 (1.96)	33.33 (34.55)	9.36 (3.11)	53.13 (46.80)	HS
64	5757-85-1-1-3	16.80 (4.17)	87.50 (69.56)	29.62 (5.51)	100.00 (90.00)	HS
65	5710-27-2-1-1	16.44 (4.14)	83.33 (65.91)	33.81 (5.86)	100.00 (90.00)	HS
66	5710-41-2-1-3	13.32 (3.75)	70.83 (57.37)	39.00 (6.32)	100.00 (90.00)	HS
67	5710-75-1-1-3	9.53 (3.24)	79.17 (63.98)	30.37 (5.59)	100.00 (90.00)	HS
68	5705-20-1-1-1	13.46 (3.78)	83.33 (65.91)	28.00 (5.36)	100.00 (90.00)	HS
69	5705-97-3-1-1	12.61 (3.68)	83.33 (65.91)	26.87 (5.27)	100.00 (90.00)	HS

70	5711-22-1-2-1	14.76 (3.94)	70.83 (57.37)	25.61 (5.16)	100.00 (90.00)	HS
71	5763-36-1-1	11.34 (3.51)	58.33 (49.80)	23.04 (4.90)	90.63 (77.17)	HS
72	5812-63-2-2	12.66 (3.64)	83.33 (72.37)	27.46 (5.32)	100.00 (90.00)	HS
73	NLR 3437	15.16 (4.02)	83.33 (66.61)	27.40 (5.33)	100.00 (90.00)	HS
74	NLR 3439	14.71 (3.96)	83.33 (72.37)	27.37 (5.32)	100.00 (90.00)	HS
75	NLR 3440	9.21 (3.15)	79.17 (69.90)	21.71 (4.74)	100.00 (90.00)	HS
76	NLR 3443	9.64 (3.22)	70.83 (59.11)	16.85 (4.22)	97.06 (82.98)	HS
77	NLR 3444	12.59 (3.67)	75.00 (61.51)	23.46 (4.94)	100.00 (90.00)	HS
78	NLR 3445	10.19 (3.30)	62.50 (52.27)	26.25 (5.22)	96.88 (82.76)	HS
79	NLR 3447	13.61 (3.75)	70.83 (57.85)	27.79 (5.36)	100.00 (90.00)	HS
80	NLR 4000	10.93 (3.40)	75.00 (60.00)	21.92 (4.77)	100.00 (90.00)	HS
81	NLR 4003	3.09 (1.84)	16.67 (17.63)	0.29 (1.13)	2.63 (6.63)	S
82	NLR 4005	8.14 (2.96)	62.50 (52.50)	20.47 (4.62)	86.67 (69.24)	HS
83	NLR 4007	7.86 (2.97)	66.67 (54.90)	20.33 (4.61)	93.33 (79.29)	HS
84	NLR 4008	9.98 (3.28)	62.50 (52.50)	20.60 (4.62)	90.00 (71.81)	HS
85	NLR 4009	7.71 (2.91)	66.67 (55.45)	19.99 (4.57)	96.67 (82.52)	HS
86	NLR 4002	10.53 (3.39)	83.33 (66.61)	24.51 (5.05)	93.73 (75.50)	HS
87	NLR 4001	15.03 (4.00)	87.50 (69.56)	29.91 (5.56)	100.00 (90.00)	HS
88	NLR 3513	16.06 (4.12)	87.50 (69.56)	28.45 (5.41)	100.00 (90.00)	HS
89	RGL-1	0.51 (1.21)	4.17 (8.39)	6.24 (2.66)	63.33 (52.91)	HS
90	RGL-52	12.18 (3.57)	62.50 (53.05)	18.76 (4.43)	90.81 (72.63)	HS
91	RGL-1750	7.87 (2.92)	50.00 (45.00)	23.74 (4.97)	100.00 (90.00)	HS
92	RGL-11226	6.80 (2.78)	54.17 (47.40)	24.20 (5.01)	96.88 (82.76)	HS
93	RGL-2332	8.78 (3.12)	54.17 (47.63)	27.40 (5.32)	83.10 (66.70	HS

94	RGL-11414	2.30 (1.80)	7.50 (15.68)	1.12 (1.45)	6.67 (14.96)	MS
95	RGL-2537	13.00 (3.71)	50.00 (45.00)	9.15 (3.16)	63.42 (52.87)	HS
96	RGL-2538	9.16 (3.15)	62.50 (52.50)	22.79 (4.86)	100.00 (90.00)	HS
97	RGL-7001	1.98 (1.61)	25.00 (22.50)	1.91 (1.65)	9.58 (17.83)	S
98	RGL-7002	0.68 (1.27)	8.33 (12.05)	1.10 (1.39)	3.13 (7.24)	MS
99	RGL-7003	0.64 (1.28)	8.33 (16.78)	0.00 (1.00)	0.00 (0.00)	MS
100	RGL-7004	5.38 (2.52)	45.83 (42.60)	19.63 (4.53)	81.25 (64.34)	HS
101	RGL-7005	1.64 (1.62)	20.83 (27.05)	0.65 (1.26)	3.13 (7.24)	S
102	RGL-7006	1.72 (1.64)	16.67 (23.39)	1.74 (1.65)	9.58 (17.83)	S
103	RGL-7007	4.18 (2.24)	37.50 (37.50)	13.85 (3.85)	69.49 (56.61)	HS
104	RGL-7008	3.49 (2.09)	29.17 (32.63)	11.67 (3.52)	70.42 (58.10)	HS
105	RGL-7009	0.00 (1.00)	0.00 (0.00)	1.77 (1.66)	5.83 (13.9)	MS
106	RGL-7010	0.87 (1.33)	4.5 (8.7)	1.78 (1.57)	3.00 (7.08)	MR
107	TN 1(Sus check)	12.63 (3.69)	50.00 (45.00)	23.01 (4.89)	96.67 (82.52)	HS
	Grand Mean	7.84	52.47	22.22	82.95	
	F-Value	2.80	2.991	4.46	9.55	
	P-Value	0.00	0.00	0.00	0.00	

Values in paranthesis are angular transformed values

Table: 2 Overall grouping of the entries phenotyped against rice gall midge based on the reaction pattern observed at 50 DAT

No. of entries	Per cent plant damage	Score	Reaction
Nil	No damage	0	HR - Highly Resistant
Nil	Less than 1%	1	R - Resistant
1	1-5%	3	MR – Moderately Resistant
4	6-10%	5	MS – Moderately Susceptibility
6	11-25%	7	S - Susceptibility
94	More than 25	9	HS – Highly Susceptibility

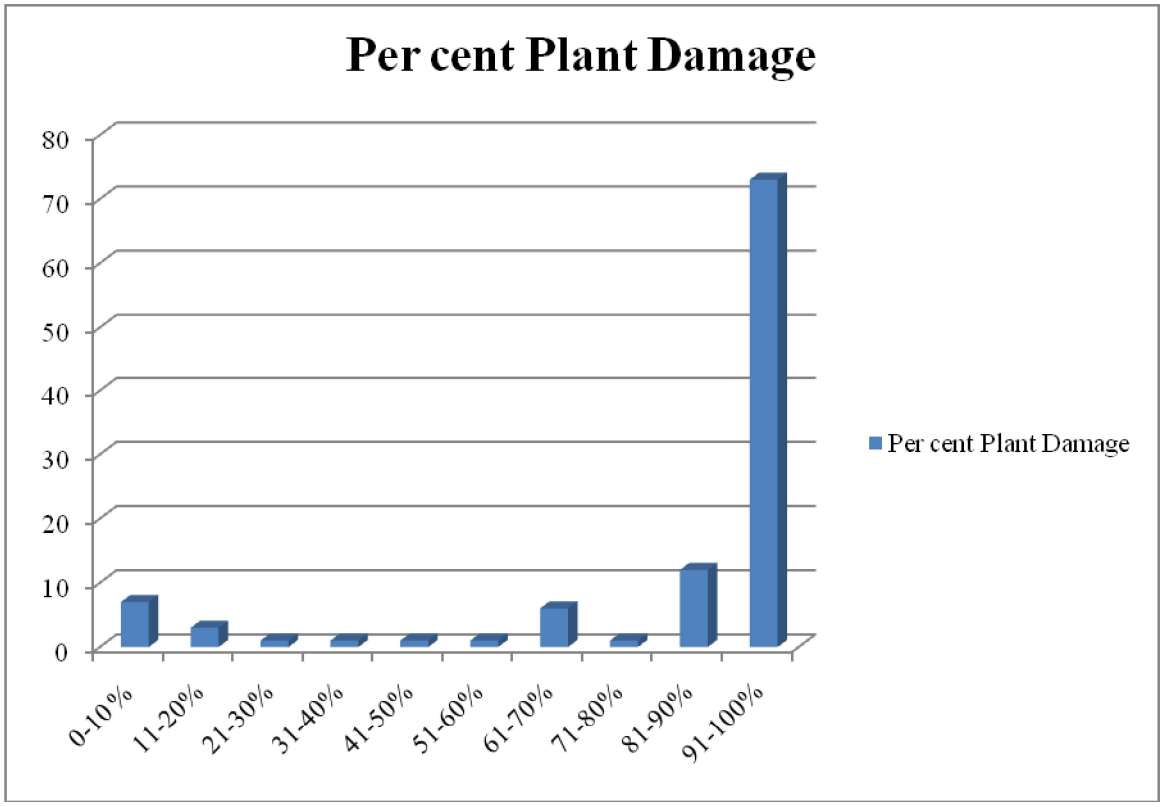

Fig. 1. Frequency distribution of reaction of rice germplasm against rice gall midge existing at ARS, Ragolu at 50 DAT (*kharif 2016-17*)