International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 22-07-2025, Accepted: 21-08-2025, Published: 06-09-2025
Volume 10, Issue 9, 2025, Page No. 39-44

Screening of rice genotypes against gall midge, *Orseolia Oryzae* (Wood-Mason)

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Abstract
In the experiment, total 94 rice entries were screened against rice gall midge incidence at 35, 50 and 65 DAT by standard evaluation system. Out of these entries 2 lines were found to be highly resistant *viz*., IBT WGL 31* and Aganni recorded under "0" scale *i.e.,* they were free from infestation. The maximum infestation was recorded 57.39 per cent silver shoots in RP6503-3*. Among them nil entries were found to be resistant, 25 entries were moderately resistance, 24 entries were moderately susceptible, 29 entries were susceptible, and 14 entries were found to be highly susceptible. During the field experimentation the silver shoot per cent was ranged between 0 to 57.93 per cent.

Keywords: Gall midge, *Oryza sativa*, rice entries, screening, silver shoots

Introduction

Rice (*Oryza sativa* L.) is one of the world's most important food crop which is a primary source of carbohydrate for more than half of the world's population. In Asian countries, rice is the main staple crop covering about ninety per cent of rice grown in the world, with two countries, China and India, growing more than half of the total crop. In India, 65 per cent of the population depends on rice as their staple food and the country is a huge contributor to the global rice production (Anonymous, 2024a) [1]. Chhattisgarh is known as "rice bowl of India" and about 82% population of the state is dependent on agriculture for their livelihood. The total rice grown area is 3.89 million hectares with the production of 10.03 million tonnes and productivity of 2576 kg ha^{-1} during 2023-24 (Anonymous, 2024b) [2].

Main reasons for the low productivity of rice are insect-pests, diseases and weeds. Many species have been reported to attack rice crop but 20 species have been found to be major including yellow stem borer, leaf folder, gall midge, and some other insect pests. It was estimated that more than hundred species of insects feed on rice and cause severe damage (Muralidharan and Pasalu, 2006) [10].

One of the main pests of rice in Chhattisgarh is the rice gall midge, *Orseolia oryzae* (Diptera: Cecidomyiidae). It is referred to as "gangai" in Chhattisgarhi locally in the Bastar region (Darro *et al.,* 2023) [4]. The most disturbing pest to rice is the gall midge, leaf folder and brown plant hopper (Netam and Gupta, 2015) [11]. Wood- Mason subsequently identified the pest as *Cecidomyia oryzae* (Cotes, 1889) [3]. *Pachydiplosis oryzae* was the new name given to the insect by Felt (1921) [5], and *Orseolia oryzae* by Gagne (1973) [6]. In 1881 the American naturalist provided the first reliable record of this insect in India. From the nursery to the very end of the tillering stage, rice is attacked by gall midges. The formation of a silvery-white, tubular leaf sheath gall known as a "silver shoot" or "onion shoot" is the outward sign of damage produced by gall midge (Seni and Naik, 2017) [15]. Gall midge incidence was higher in crops that were sown later (Kulkarni *et al.,* 1989) [8].

The key functional components in India's rice production system is the management of insects. Controlling pest species can be managed by chemical control, cultural practice alteration, or the use of resistant varieties, focusing minimize crop losses both domestically and internationally, efforts should be undertaken to incorporate a variety of pest control techniques (Prasad & Prasad, 2013) [13].

HPR is an important tool of IPM, because pest can be easily managed by raising pest resistant or tolerant variety for sustainable crop production. HPR is not only environment 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 genotype to realize better and higher yields of grains without use of pesticide application for sustainable rice production (Yadav *et al.,* 2020) [17]. Looking into the above facts, the present study aimed to identify rice germplasm resistant to gall midge infestation.

Materials And Methods

The experiment was conducted during *Kharif* 2023 at the Research cum Instructional Farm, Shaheed Gundadhur College of Agriculture and Research Station, Kumhrawand, Jagdalpur. Ninety-four rice genotypes were evaluated for gall midge resistance at a spacing of 20 × 15 cm. Seeds were sown on 8 July 2023, and seedlings were transplanted to the main field after one month under standard agronomic practices. Gall midge incidence, expressed as the percentage of silver shoots, was recorded at 35, 50, and 65 days after transplanting. Observations included the total number of plants, tillers, and silver shoots. Per cent infestation of gall midge calculated by given formula:

$$\% \text{ silver shoot} = \frac{\text{Number of silver shoots}}{\text{Total number of } tillers} \times 100$$

Then, the pest intensity was scored as per standard evaluation system, International Rice Research Institute (IRRI) for gall midge.

Table 1: Standard evaluation system for rice gall midge

Scale	Damage (%)	Reaction
0	0% (No damage)	HR
1	<1%	R
3	1-5%	MR
5	6-10%	MS
7	11-25%	S
9	>25%	HS

HR = highly resistant, R = resistant, MR = moderately resistant, MS = moderately susceptible, S = susceptible, HS = highly susceptible.

The observation of data showed that healthy tillers and damaged tillers/hills were recorded for the per cent infestation of gall midge. Ten randomly selected hills from each of 94 transplanted cultures were assessed at the maximum tillering stage. Resistance status was determined based on the percentage of silver shoot infestation, enabling the identification of promising genotypes for gall midge resistance.

Results And Discussion

From the table 2 and 3 it is observed that among 94 rice entries screened against gall midge, the 2 entries *viz.,* IBT WGL 31* and Aganni were ranked with "0" scale and found highly resistant. Nil entry was found under "1" scale.

Total 25 entries *viz.,* Akshayadhan (*Gm*4+*Gm*8)*, APKS 82-75*, GP 91*, IBTWGL 21*, JGL 38071*, JGL 41652, Kavya, Karma Mahsun*, KNM 11575*, KNM 14282*, KNM 14283*, KNM 14319, KNM 14382*, KNM 15135, W1263, RP 5923*, RP 6290-20-6*, RP 6290-22-41 (RMS-22-7)*, RP 6290-22-60 (RMS-22-17)*, RP6505-30*, WGL 1825, WGL 1909, RMS (ISM 10), RMS(ISM-B-4), and AGANNI were recorded under scale "3" MR (moderately resistant) to gall midge incidence.

The 24 entries *viz.,* IBTWGL 3*, KNM 11579*, KNM 12392*, KNM 13449, KNM 15236, PTB 20, RP 6290-22-4 (RMS-2-24)*, RP 6290-22-53 (RMS-22-10)*, RP 6290-22-72 (RMS -22-23)*, RP6505-31*, IBTWGL 2*, RP 6505-89*, WGL 1792*, WGL 1822, WGL 1837, WGL 1859, WGL 1861, RP 2068-18-3-5, RMS (ISM 18), RMS (ISM 19), RMS (ISM 24), Sel. from RGL 1746, Sel. from RGL-11414, and RGL-7005 were "5" scale and found to be MS (moderately susceptible) to gall midge.

The 29 entries *viz.,* KNM 15222, KNM 16034, KNM 16035, MO4(Bhadra), NLR 3836(5894-11-1-1-3-1-1), RNR 31451, RNR 41585, RP 6290-22-11 (RMS-22-26)*, RP6505-32*, WGL 1119*, WGL 1246*, WGL 1782*, WGL 1789*, WGL 1790*, WGL 1791*, Abhaya, WGL 1843, WGL 1860, WGL 1877, WGL 1930, WGL 1941, WGL 1942, RP 5927, RMS (ISM 11), RMS (ISM 12), RMS (ISM 26), RMS (ISM 27), RGL-7002, RGL-7004 were "7" scale and found to be S (susceptible) to gall midge.

The 14 entries *viz.,* TN1, KNM 15148, NLR 3817(5892-25-1-5-3-2-1), NLR 3821(5891-28-2-2-1-1-1), NLR 3880(5895-44-2-2-1-1-1), RNR 41712, TN1, RP6503-3*, WGL 1846, WGL 1878, RP 5876, RP 5921, TN1, and TN1 were recorded under scale "9" and found to be HS (highly susceptible) to gall midge.

Previous researcher, Prasad and Prasad (2010) [12] stated that six entries remained unaffected by the gall midge attack, these entries were ARC6605, MR 1523, RP 2068-18-5, Jhitpiti, INRC3021, and Aganni. Sumathi and Manickam (2013) [16] tested 17 entries that were examined in GMBT, ARC 6605 and INRC 3021 were resistant to gall midge and to have no gall midge damage.

Seni and Naik (2019) [15] observed that among 137 rice entries screened against gall midge, the entries viz., WGL 1164, WGL 1127, RP 5925, RP 1, INRC 3021, IBT R4, IBT GM (1, 2, 3, 4, 7, 9, 11, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 46) were found highly resistant.

Kumar *et al.,* (2022) [9] screened 83 rice genotypes, among them 4 entries *viz.*, WGL-1789, WGL-1790, WGL-1798 and WGL-1800 were found highly resistant.

Darro *et al.,* (2023) [4] were evaluated 115 rice genotypes against gall midge resistance. Total 28 entries *viz.*, JGL 35161, JGL 36175, JGL38168, KNM 12368, KNM 12424, Aganni, KNM12450, SKL 11-3-838-220-10-150, WGL 1614, WGL1623, FBL 19064, FBL 19101, FBL 19102, FBL19112, Karma Mashuri, mahamaya, GM 4(IBT), GM 40(IBT), WGL1 (IBT), WGL2 (IBT), WGL3(IBT), WGL 31 (IBT), RP 5923 (IBT), APKS 83-24, APKS 83-40, ENT GP 2018-178*, RP 6290- 20-36 are ranked with "0" scale (0% SS) found to be highly resistance to gall midge.

Table 2: Screening of rice genotypes against gall midge

No. of entries	Designation	Silver shoots %			Damage score	Reaction
		35 (DAT)	50 (DAT)	65 (DAT)		
1	TN1	11.54	25.93	15.00	9	HS
2	Akshayadhan (*Gm*4+*Gm*8) *	1.49	1.59	1.32	3	MR
3	APKS 82-75*	0.00	1.35	0.00	3	MR
4	GP 91*	0.00	3.57	0.00	3	MR
5	IBT WGL 31*	0.00	0.00	0.00	0	HR
6	IBTWGL 21*	0.00	0.00	5.17	3	MR
7	IBTWGL 3*	0.00	0.00	8.82	5	MS
8	JGL 38071*	0.00	0.00	2.63	3	MR
9	JGL 41652	0.00	0.00	3.61	3	MR

10	Kavya	0.00	0.00	1.27	3	MR
11	Karma Mahsun*	0.00	0.00	1.15	3	MR
12	KNM 11575*	0.00	0.00	5.26	3	MR
13	KNM 11579*	0.00	0.00	5.81	5	MS
14	KNM 12392*	1.39	0.00	6.49	5	MS
15	KNM 13449	0.00	0.00	5.63	5	MS
16	KNM 14282*	0.00	0.00	3.66	3	MR
17	KNM 14283*	0.00	0.00	2.02	3	MR
18	KNM 14319	0.00	0.00	2.74	3	MR
19	KNM 14382*	0.00	0.00	2.70	3	MR
20	Aganni	0.00	0.00	0.00	0	HR
21	KNM 15135	0.00	1.47	5.48	3	MR
22	KNM 15148	18.18	33.13	15.38	9	HS
23	KNM 15222	0.00	1.25	13.16	7	S
24	KNM 15236	0.00	0.00	5.80	5	MS
25	KNM 16034	12.12	17.95	14.81	7	S
26	KNM 16035	20.90	24.62	17.39	7	S
27	MO4(Bhadra)	3.57	22.89	13.16	7	S
28	NLR 3817(5892-25-1-5-3-2-1)	16.67	46.91	26.76	9	HS
29	NLR 3821(5891-28-2-2-1-1-1)	14.88	38.82	36.36	9	HS
30	W1263	0.00	0.00	1.03	3	MR
31	NLR 3836(5894-11-1-1-3-1-1)	14.13	22.22	23.53	7	S
32	NLR 3880(5895-44-2-2-1-1-1)	23.88	37.31	17.31	9	HS
33	PTB 20	5.10	2.25	7.92	5	MS
34	RNR 31451	14.71	0.00	20.97	7	S
35	RNR 41585	4.35	16.44	17.81	7	S
36	RNR 41712	11.74	26.39	5.00	9	HS
37	RP 5923*	0.00	0.00	6.49	3	MR
38	RP 6290-20-6*	0.00	0.00	4.76	3	MR
39	RP 6290-22-11 (RMS-22-26) *	2.63	2.35	18.99	7	S
40	TN1	13.64	30.49	13.33	9	HS
41	RP 6290-22-4 (RMS-2-24) *	0.00	1.59	5.63	5	MS
42	RP 6290-22-41 (RMS-22-7) *	1.30	0.00	3.95	3	MR
43	RP 6290-22-53 (RMS-22-10) *	0.00	0.00	7.69	5	MS
44	RP 6290-22-60 (RMS-22-17) *	0.00	0.00	3.39	3	MR
45	RP 6290-22-72 (RMS -22-23) *	1.35	8.06	4.35	5	MS
46	RP6503-3*	20.00	57.39	8.33	9	HS
47	RP6505-30*	0.00	1.22	2.56	3	MR
48	RP6505-31*	0.00	5.56	6.85	5	MS

49	RP6505-32*	10.13	2.47	12.82	7	S
50	IBTWGL 2*	0.00	0.00	8.82	5	MS
51	RP 6505-89*	0.00	0.00	8.82	5	MS
52	WGL 1119*	0.00	0.00	14.86	7	S
53	WGL 1246*	1.32	2.82	11.59	7	S
54	WGL 1782*	0.00	7.35	17.33	7	S
55	WGL 1789*	0.00	3.03	12.33	7	S
56	WGL 1790*	0.00	0.00	15.19	7	S
57	WGL 1791*	0.00	0.00	11.25	7	S
58	WGL 1792*	0.00	0.00	6.49	5	MS
59	WGL 1822	0.00	0.00	8.62	5	MS
60	Abhaya	1.18	2.82	15.12	7	S
61	WGL 1825	0.00	0.00	5.19	3	MR
62	WGL 1837	0.00	0.00	8.70	5	MS
63	WGL 1843	0.00	0.00	11.39	7	S
64	WGL 1846	15.25	33.33	21.21	9	HS
65	WGL 1859	0.00	0.00	10.00	5	MS
66	WGL 1860	0.00	7.27	19.74	7	S
67	WGL 1861	0.00	0.00	8.22	5	MS
68	WGL 1877	13.85	18.06	14.29	7	S
69	WGL 1878	13.04	26.09	18.67	9	HS
70	RP 2068-18-3-5	2.94	3.03	6.25	5	MS
71	WGL 1909	0.00	0.00	4.55	3	MR
72	WGL 1930	0.00	0.00	14.06	7	S
73	WGL 1941	4.48	23.53	23.08	7	S
74	WGL 1942	0.00	1.22	16.92	7	S
75	RP 5876	21.79	37.35	31.43	9	HS
76	RP 5921	11.84	32.00	29.58	9	HS
77	RP 5927	2.63	3.90	13.98	7	S
78	RMS (ISM 10)	0.00	0.00	4.55	3	MR
79	RMS (ISM 11)	0.00	0.00	13.70	7	S
80	TN1	5.26	25.56	24.39	9	HS
81	RMS (ISM 12)	13.64	15.52	12.86	7	S
82	RMS (ISM 18)	0.00	0.00	10.00	5	MS
83	RMS (ISM 19)	6.17	9.09	9.38	5	MS
84	RMS (ISM 24)	1.35	0.00	7.58	5	MS
85	RMS (ISM 26)	0.00	0.00	13.92	7	S
86	RMS (ISM 27)	16.39	20.63	10.53	7	S
87	RMS(ISM-B-4)	0.00	1.27	2.78	3	MR

88	Sel. from RGL 1746	1.28	0.00	7.79	5	MS
89	Sel. from RGL-11414	0.00	9.72	7.79	5	MS
90	AGANNI	0.00	0.00	3.23	3	MR
91	RGL-7002	0.00	0.00	12.50	7	S
92	RGL-7004	1.47	1.41	11.54	7	S
93	RGL-7005	2.94	4.76	8.75	5	MS
94	TN1	18.42	43.66	23.08	9	HS

Score = 0 = Highly resistant (0% SS), 1 = Resistant (<1% SS), 3 = Moderately resistant (1-5% SS), 5 = Moderately susceptible (6 - 10% SS), 7 = Susceptible (11 - 25% SS), 9 = Highly susceptible (25% SS)

Table 3: Screening of rice genotypes against gall midge

Per cent Damage	Score	Reaction	No. of Entries	Name of Entries
0 %	**0**	**HR**	**2**	**IBT WGL 31*, Aganni.**
<1 %	**1**	**R**	**0**	**Nil**
1-5 %	3	MR	25	Akshayadhan (*Gm*4+*Gm*8)*, APKS 82-75*, GP 91*, IBTWGL 21*, JGL 38071*, JGL 41652, Kavya, Karma Mahsun*, KNM 11575*, KNM 14282*, KNM 14283*, KNM 14319, KNM 14382*, KNM 15135, W1263, RP 5923*, RP 6290-20-6*, RP 6290-22-41 (RMS-22-7)*, RP 6290-22-60 (RMS-22-17)*, RP6505-30*, WGL 1825, WGL 1909, RMS (ISM 10), RMS(ISM-B-4), AGANNI.
6-10 %	5	MS	24	IBTWGL 3*, KNM 11579*, KNM 12392*, KNM 13449, KNM 15236, PTB 20, RP 6290-22-4 (RMS-2-24)*, RP 6290-22-53 (RMS-22-10)*, RP 6290-22-72 (RMS -22-23)*, RP6505-31*, IBTWGL 2*, RP 6505-89*, WGL 1792*, WGL 1822, WGL 1837, WGL 1859, WGL 1861, RP 2068-18-3-5, RMS (ISM 18), RMS (ISM 19), RMS (ISM 24), Sel. from RGL 1746, Sel. from RGL-11414, RGL-7005.
11-25 %	7	S	29	KNM 15222, KNM 16034, KNM 16035, MO4(Bhadra), NLR 3836(5894-11-1-1-3-1-1), RNR 31451, RNR 41585, RP 6290-22-11 (RMS-22-26)*, RP6505-32*, WGL 1119*, WGL 1246*, WGL 1782*, WGL 1789*, WGL 1790*, WGL 1791*, Abhaya, WGL 1843, WGL 1860, WGL 1877, WGL 1930, WGL 1941, WGL 1942, RP 5927, RMS (ISM 11), RMS (ISM 12), RMS (ISM 26), RMS (ISM 27), RGL-7002, RGL-7004.
>25 %	9	HS	14	TN1, KNM 15148, NLR 3817(5892-25-1-5-3-2-1), NLR 3821(5891-28-2-2-1-1-1), NLR 3880(5895-44-2-2-1-1-1), RNR 41712, TN1, RP6503-3*, WGL 1846, WGL 1878, RP 5876, RP 5921, TN1, TN1.

HR - highly resistant, R - resistant, MR - moderately resistant, MS - moderately susceptible, S - susceptible, HS - highly susceptible.

Conclusion

The rice genotypes IBT WGL 31* and Aganni exhibited high resistance to gall midge, indicating their potential as donor parents in breeding programs for developing gall midge–resistant varieties, or as direct cultivars if they demonstrate satisfactory yield performance.

Acknowledgments

The first author expresses profound gratitude to the Head, Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India, for valuable guidance and support. The authors sincerely thank the Director and Project Coordinator, All India Coordinated Rice Improvement Project, ICAR–Indian Institute of Rice Research, Rajendranagar, Hyderabad; the Director of Research Services, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh; and the Dean, Shaheed Gundadhur College of Agriculture and Research Station (IGKV), Jagdalpur, Chhattisgarh, for providing essential research facilities. Their unwavering support, insightful suggestions, and constant encouragement significantly contributed to the successful completion of this investigation.

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