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Field screening of international genotypes of rice against gall midge (*Orseolia oryzae* Wood-Mason) in direct seeded rice ecosystem

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Abstract
The experiment was conducted at Raj Mohini Devi College of Agriculture and Research Station, Ambikapur, during *Kharif* 2024. The relative occurrence of gall midge on different international rice genotypes was noticed 30 days after sowing (DAS), 45 DAS and 60 DAS. The result revealed that field screening of international rice genotypes against rice gall midge (*Orseolia oryzae*) as percent silver shoot damage recorded with ranged between 2.34-19.94%. Out of 50 international genotypes, no any genotypes of direct seeded rice was exhibited nil or <1% silver shoot (SS) damage during the study period. While 7 genotypes *i.e.* IR22EL1142, R-RF-209, IR22EL1493, IR22EL1570, IRRI 190, IR112995H and Partner high performing lines were recorded as prone to gall midge damage with ranged between 11.08-19.94% SS (scale "7") and categorized as susceptible.

Keywords: Field screening, gall midge, silver shoot, genotypes

Introduction
Rice (*Oryza sativa* L) (2n = 24) belongs to the family Gramineae (Poaceae). The genus Oryza has two accommodate and 22 wild species. Worldwide, India ranks second in area with 47.06 million hectares of land under rice cultivation and after China in production of rice with a production of 125.03 million tonnes that shares 26 percent of world rice production with average productivity of 2850 kg/ha. It contributes to 65 percent of the total population thereby holds the key position to sustain food sufficiency in the country (Keelery, 2023) [3]. In comparison to wheat, rice has less protein. But in terms of amino acid content, rice outperforms other cereals. Rice has a low (2.0-2.5%) fat content. Furthermore, rice is a significant source of zinc and other essential micronutrients for millions across Asia, given its prevalent consumption compared with other cereals (Fukagawa *et al.*, 2019) [2]. In Chhattisgarh, rice is mainly grown under rainfed ecosystem during *Kharif* season and is completely dependent on monsoon. It occupies an area of 3.74 million ha of total 4.14 million rice production with productivity of 1.10 tons. The state contributes 5.58 percent of the total rice production of the country. However, the production and productivity of rice per unit area is very low compared to other states like West Bengal (15.75 million tonnes), Uttar Pradesh (12.50 million tonnes) and Punjab (11.82 million tonnes) (Anonymous 2023). Its cultivation, anticipated to rise steadily from 510 million tons in 2023 to approximately 550 million tons by 2030 and 590 million tons by 2040, is chiefly propelled by population growth and economic expansion in developing Nations (Yuan *et al.*, 2021) [9].

Numerous guilds of insect pests attacked by rice crop in the field, but few causes significant losses. Losses caused by insect pests are the main constraints in achieving a high yield of rice (Rai *et al.*, 2000) [7]. The rice plant is subject to attack by more than 100 species of insects and 20 of them can cause economic damage (Pathak and Khan 1994) [6]. The average yield loss in rice have been accounted for 30% loss in stem borers, while plant hoppers 20%, gall midge 15%, leaf folder 10% and other pests 25%, respectively (Krishnaiah and Varma, 2015) [4]. This study describes possible changes in pest status in direct-seeded rice fields. It is felt that a complex and rich web of general and specific insect-pests of direct seeded rice (DSR) ecosystem was studied. This experiment was performed to test the resistance of 50 international rice genotypes against gall midge.

Materials and Methods

The investigation was conducted at Research-cum-Instructional Farm of Raj Mohini Devi College of Agriculture & Research Station, Ambikapur, Chhattisgarh during *Kharif* 2024. As per above, 50 international genotypes of rice were obtained from the IRRI, through IGKV, Raipur and field trial conducted. The obtained rice genotypes were direct sown on field in Alpha lattice design with 2 replications. Standard agronomical package of practices was adopted for raising rice crops. The observations of gall midge infestation as percent silver shoot was recorded on randomly selected 10 hills in each plot at 30, 45 and 60 days after sowing. The percentage of shoot infestations was calculated in the following way:-

$$\text{Silver Shoot (SS) infestation (\%)} = \frac{\text{Number of silver shoot}}{\text{Total number of tiller}} \times 100$$

Table 1: Standard Evaluation System (SES) for screening resistance to rice gall midge:

Damage score (%SS)	Scale	Status
0	0	Highly Resistant (HR)
<1	1	Resistant (R)
1-5	3	Medium Resistant (MR)
6-10	5	Medium Susceptible (MS)
11-25	7	Susceptible (S)
>25	9	Highly Susceptible (HS)

Results and Discussion

According to the result (Table 2) revealed that the incidence of gall midge as percent silver shoot (%SS) ranged between 0.0 to 12.27%SS at 30 DAS. Among all 50 genotypes of rice, only one genotype *i.e.* IR22EL1382 was found to be nil damage of gall midge (scale "0"). While five genotypes of rice i.e. IR22EL1485, IR22EL1380, IR22EL1073, IR22EL1226 and Local check were observed as <1% SS damage of gall midge (scale "1") and in similar manner 31 genotypes were recorded 1.01-5.90% SS damage (scale "3") and 10 genotypes *i.e.* IR22EL1483, IR112995H, IR22EL1488, IR22EL1089, DRR Dhan 42, IR22EL1421, IR22EL1142, IR22EL1570, IRRI 190 and Partner high performing 25 lines were recorded 6.09-10.31% SS damage of gall midge (scale "5"). Rest of 3 genotypes *i.e.* IR22EL1493, US 314 (local check) and Partner high performing lines were recorded 11.60-12.27% SS damage of gall midge (scale "7").

At 45 DAS, the extent of damaged shoot caused by gall midge was gradually increased with ranged between 2.53-32.06% SS in the genotypes. Among 50 genotypes, no genotype was recorded with nil or less than one percent damage. 20 genotypes of rice *i.e.* IR22EL1044, Arize 6453 ST (local check), Partner high performing line, IR22EL1571, R-RF-215, IR22EL1073, GSR 8, IR22EL1034, IR22EL1076, IR138840H, IR22EL1156, Katihan 2, NSIC RC 222, IR22EL1382, IR22EL1550, IR22EL1226, IR22EL1421, IR22EL1146 and 2 Local checks were found to be 2.53-5.53% SS damage (scale "3") and in a similar manner 18 genotypes were recorded to be 6.52-9.79% SS damage (scale "5") and 11 genotypes were recorded to be 11.87-22.32% SS damage (scale "7"). Only one genotype *i.e.* Partner high performing lines was recorded highest damage with 32.06% SS (scale "9").

At 60 DAS, the gall midge infestation as silver shoot was fluctuated and the damage ranged was recorded between 0.91-20.06% SS. Among all genotypes, only one genotype *i.e.* R-RF-215 was found to be <1% SS damage of gall midge (scale "1"). While 18 genotypes found to be moderately damage with 2.15-5.51% SS (scale "3") and in a similar manner 21 genotypes were recorded to be 6.26-10.79% SS damage (scale "5"). Rest 10 genotypes *i.e.* IR22EL1156, IR22EL1383, IR22EL1571, DRR Dhan 42, IR22EL1421, IR22EL1415, IR22EL1294, IR112995H, R-RF-209 and 1 Partner high performing lines were recorded maximum damage with 11.20-20.06% SS (scale "9").

The overall mean results (Table 2 & 3) revealed that the gall midge infestation as silver shoot recorded with ranged between 2.34-19.94%. Out of 50 international genotypes, no any international genotypes of direct seeded rice was exhibited nil damage or less than one percent damage during the study period. However, 7 genotypes *i.e.* IR22EL1142, R-RF-209, IR22EL1493, IR22EL1570, IRRI 190, IR112995H and Partner high performing lines were recorded as prone to gall midge damage with ranged between 11.08-19.94% SS (scale "7") and categorized as susceptible. 27 international rice genotypes *i.e.* Arize 6453 ST, Katihan 2, IR22EL1044, IR22EL1226, R-RF-215, IR138840H, IR22EL1073, IR22EL1382, NSIC RC 222, IR22EL1034, IR22EL1250, IR22EL1146, IR22EL1076, GSR 8, IR22EL1485, IR22EL1086, IR22EL1268, IR22EL1147, IR22EL1079, IR22EL1380, IR22EL1156, IR22EL1571, Sahbhagi Dhan Partner high performing line and 2 Local check were found to be moderately resistant with 2.34-5.81% SS damage (scale "3") and in a similar manner rest of the 16 genotypes were recorded to be moderately susceptible with 6.00-10.64% SS damage (scale "5"). The current findings more or less supported with the work of Painkra *et al.* (2017) who screened among 52 rice genotypes against rice gall midge and found that the one genotype viz., R 1674-50-1-1-1 25 has no gall midge damage and showed highly resistant, and one another genotype viz., R 2048-189-1-132-1 showed resistance with up to 1% gall midge damage scored at 45 and 65 DAT. While, check entry TN 1 highest percentage of damage as silver shoot (ranged ranged between 9.01 and 15.57%) and categorized as susceptible at 45 and 65 DAT, respectively. Similarly, Seni and Naik (2017) reported that the highest incidence of silver shoot caused by gall midge was in TN-1 (36.71% SS after 50 DAT) whereas 12 entries viz., W 1263, INRC 3021, Sudu Hondarawala, PTB 26, RP 4686-48-1-937, RMSG-11, WGL 1147, WGL 1127, WGL 1121, WGL 1131, WGL 1141, JGL 27058 were found resistant.

Table 2: Field screening of international rice genotypes against rice gall midge (as%SS) infestation during *Kharif* 2024

S. No.	Genotypes	Gall midge infestation (% SS)					
		30 DAS	45 DAS	60 DAS	Mean	Scale	Status
1	IR22EL1380	0.85	6.65	8.96	5.49	3	(MR)
2	IR112995H	6.20	22.32	18.40	15.64	7	(S)
3	IR22EL1570	8.33	20.40	5.85	11.52	7	(S)
4	IR22EL1079	2.47	7.17	6.49	5.38	3	(MR)
5	IR22EL1493	11.60	13.57	9.10	11.42	7	(S)
6	IR22EL1073	0.95	3.48	7.15	3.86	3	(MR)
7	IR22EL1089	7.03	15.28	9.61	10.64	5	(MS)
8	IR22EL1415	1.02	8.43	14.40	7.95	5	(MS)
9	IR22EL1571	2.25	2.99	12.16	5.80	3	(MR)
10	IR22EL1142	7.76	15.78	9.68	11.08	7	(S)
11	IR22EL1156	2.02	3.99	11.20	5.73	3	(MR)
12	IR22EL1483	6.09	7.16	6.61	6.62	5	(MS)
13	IR22EL1382	0.00	4.44	7.41	3.95	3	(MR)
14	IR22EL1485	0.77	7.53	6.33	4.87	3	(MR)
15	IR22EL1101	5.50	8.50	5.68	6.56	5	(MS)
16	IR22EL1421	7.70	4.92	13.19	8.60	5	(MS)
17	IRRI 190	10.31	14.29	10.72	11.77	7	(S)
18	IR22EL1146	2.13	5.53	6.26	4.64	3	(MR)
19	IR138840H	4.71	3.85	2.22	3.59	3	(MR)
20	IR22EL1488	7.02	7.87	9.82	8.23	5	(MS)
21	IR22EL1268	1.90	7.01	6.79	5.23	3	(MR)
22	IR22EL1226	0.95	4.51	3.57	3.02	3	(MR)
23	IR22EL1076	5.48	3.76	4.90	4.71	3	(MR)
24	IR22EL1383	4.59	8.34	11.23	8.05	5	(MS)
25	IR22EL1250	1.38	7.52	5.00	4.64	3	(MR)
26	IR22EL1034	2.57	3.57	6.54	4.23	3	(MR)
27	IR22EL1550	5.30	4.50	8.21	6.00	5	(MS)
28	IR22EL1294	5.27	11.87	14.70	10.61	5	(MS)
29	IR22EL1238	3.39	11.98	2.62	6.00	5	(MS)
30	IR22EL1086	4.11	8.82	2.50	5.15	3	(MR)
31	IR22EL1044	3.90	2.53	2.50	2.97	3	(MR)
32	IR22EL1542	4.29	9.57	7.89	7.25	5	(MS)
33	IR22EL1147	3.42	7.47	5.18	5.36	3	(MR)
34	R-RF-209	5.90	8.17	20.06	11.38	7	(S)
35	R-RF-215	5.72	3.24	0.91	3.29	3	(MR)
36	Partner high performing lines	3.13	16.01	9.05	9.40	5	(MS)
37	Partner high performing lines	8.07	9.79	10.79	9.55	5	(MS)
38	Partner high performing lines	12.27	32.06	15.48	19.94	7	(S)
39	Partner high performing lines	3.76	12.98	5.91	7.55	5	(MS)
40	Partner high performing lines	3.97	2.71	8.88	5.19	3	(MR)
41	DRR Dhan 42	7.40	7.18	12.50	9.02	5	(MS)
42	Katihan 2	1.01	4.03	2.71	2.58	3	(MR)
43	NSIC RC 222	2.89	4.19	5.54	4.20	3	(MR)
44	Sahbhagi Dhan	2.35	12.64	2.43	5.81	3	(MR)
45	GSR 8	5.63	3.50	5.22	4.78	3	(MR)
46	Arize 6453 ST (Local check)	2.28	2.59	2.15	2.34	3	(MR)
47	US 314 (Local check)	12.21	9.58	7.34	9.71	5	(MS)
48	Local check	1.85	3.40	9.64	4.97	3	(MR)
49	Local check	5.67	6.52	3.28	5.16	3	(MR)
50	Local check	0.56	4.52	4.20	3.09	3	(MR)

Note: HR: Highly Resistance, R: Resistance, MR: Medium Resistance, MS: Medium Susceptible, Susceptible (S), Highly Susceptible (HS)

Table 3: List of identified international rice genotypes against gall midge damage during *Kharif* 2024

Reaction	Damage (%SS)	No. of Genotypes	Genotypes details
Highly Resistance (HR)	0	0	
Resistance (R)	<1	0	
Moderately Resistance (MR)	1-5	27	Arize 6453 ST, Katihan 2, IR22EL1044, IR22EL1226, R-RF-215, IR138840H, IR22EL1073, IR22EL1382, NSIC RC 222, IR22EL1034, IR22EL1250, IR22EL1146, IR22EL1076, GSR 8, IR22EL1485, IR22EL1086, IR22EL1268, IR22EL1147, IR22EL1079, IR22EL1380, IR22EL1156, IR22EL1571, Sahbhagi Dhan, Partner high performing line and 2 Local check
Moderately Susceptible (MS)	6-10	16	IR22EL1238, IR22EL1550, IR22EL1101, IR22EL1483, IR22EL1542, IR22EL1415, IR22EL1383, IR22EL1488, IR22EL1421, DRR Dhan 42, US 314, IR22EL1294, IR22EL1089, 3 Partner high performing line and 1 Local check
Susceptible (S)	11-25	7	IR22EL1142, R-RF-209, IR22EL1493, IR22EL1570, IRRI 190, IR112995 Hand Partner high performing lines
Highly Susceptible (HS)	>25	0	

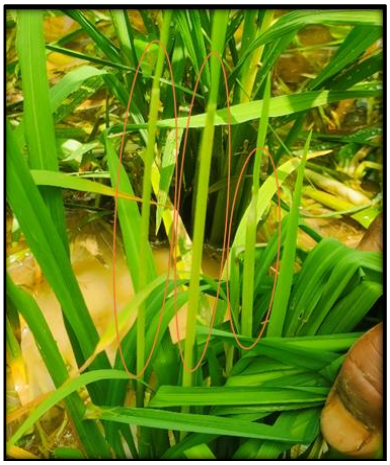

Fig 1: Infested tillers by gall midge

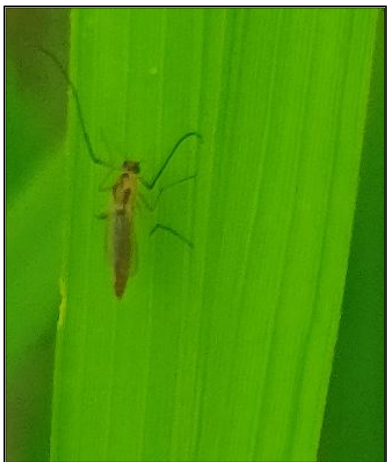

Fig 2: Adult of gall midge

Fig 3: View of experimental field

Conclusion

The current finding of field screening on international rice genotypes against rice gall midge revealed that among 50 genotypes, no genotypes of direct seeded rice was exhibited nil or <1% SS damage during the study period. While 7 genotypes recorded as prone to gall midge damage with ranged between 11-25% SS (scale "7") and categorized as susceptible.

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