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## Phenotyping of rice genotypes against gall midge, *Orseolia oryzae*, (Wood-Mason)

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### Abstract

Two hundred two rice genotypes were phenotyped under the field (Retanga, Khordha) conditions during *kharif*, 2020. Based on the observation of screening, the genotypes were categorised as highly resistant (HR), resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S) and highly susceptible (HS). Results revealed that, among the 202 rice genotypes screened, 50 genotypes recorded a damage score of '0' and rated as highly resistant. Whereas, 20 rice genotypes were noted under resistant category (Score-1). Twenty five genotypes were recorded under moderately resistant category (Score-3). In moderately susceptible category 36 genotypes recorded a damage score of 5. Thirty nine genotypes were recorded under susceptible category (Score-7). While rest 32 rice genotypes including susceptible check TN1 recorded a damage score of 9 and were grouped under highly susceptible category. Highly resistant and resistant rice genotypes can be used as a resistance source for future research work.

**Keywords:** Rice, gall midge biotype-2, phenotyping

### 1. Introduction

Rice crop is cultivated extensively and this crop is attacked by numerous insect pests. Around 300 insect species attack rice crop during its various growth stages out of which 23 are considered as major pest [1]. Rice gall midge is one among these 23 species of insect pest and is regarded as 3<sup>rd</sup> most important pest after borer and hopper pest. Rice gall midge is prevalent in each and every states of India where rice is cultivated extensively leaving some parts of the country like Jammu and Kashmir, western parts of UP, Punjab, Himachal Pradesh and Haryana due to very low temperature prevailing in those areas [2]. According to some reports, gall midge outbreak was occurring occasionally in some parts of the country before 1960s but its nuisance starts with the introduction and cultivation of high yielding variety and dwarf variety. This pest causes a yield loss of around 0.8% of the total production, amounting to US\$ 80 million annually [5]. Gall midge is a pest of *kharif* season and tillering stage of rice crop is the most vulnerable stage to its attack. Fecundity of gall midge is around 180-150 eggs and the oviposition site for gall midge is the tender stem and the lower leaf surface. After hatching, the larvae crawl down with the help of thin water film and enter in to the stem just above the water level. These tiny larvae starts feeding on the growing meristematic parts and while feeding it releases some salivary secretion which contain a chemical, cecidogen that results in elongation of the leaf sheath, forming an elongated silvery white structure known as silver shoot or gall [6]. These galls are responsible for reduction in the yield as the infested plant will remain devoid of the panicles. So the management of this pest is of utmost importance. As gall midge completes all its larval and pupal stages inside the plants and only the egg and adult stage is completed outside the plants, so its management by chemical pesticides and biocontrol agents is very much difficult and costly. So the best option to manage gall midge is by incorporating cultivation of resistant cultivar in the IPM system of rice cultivation [7]. But for this purpose we have to find the resistant cultivars which may possess the resistant genes.

Keeping this in mind, 202 rice genotypes were screened against gall midge biotype- 2, by studying their interaction with the rice cultivars under field conditions. According to the reactions obtained the cultivars were categorized and scored according to the Standard Evaluation System-2013, IRRI [3].

## 2. Materials and Methods

### 2.1 Phenotyping of rice genotypes against gall midge biotype-2

Seeds of 202 rice genotypes were collected from the gene bank of ICAR-NRRI, Cuttack, which includes 84 genotypes from Assam, 86 genotypes from Nagaland, 30 genotypes from Karnataka along with seeds of the susceptible check genotype TN1 and resistant check genotype Abhaya. Rice genotypes were phenotyped against gall midge biotype-2, during *kharif*, 2020 under field condition at farmer's field which is located at Retanga, Khordha (Figure 1). Nursery of different rice genotypes were sown in the month of July and transplanting was done 21 days after seed sowing at a spacing of 15x15cm.



Fig 1: Phenotyping under field condition

#### Observation

Observation on gall midge damage/ silver shoot formation was taken at 30 DAT. Here the per cent of plant damage was calculated with the help of the formula-

$$\text{Per cent Plant Damage} = \frac{\text{Number of plants with silver shoot}}{\text{Total number of plants}} \times 100$$

After the per cent plant damage was calculated with above formula then the rice genotypes were scored according to the Standard Evaluation System for rice, IRRI, 2013 and after scoring, the plant reaction with the gall midge was recorded and their interactions were categorised in to Highly resistant, Moderately resistant, Resistant, Susceptible, Moderately susceptible and Highly susceptible etc (Table1).

Table 1: Standard Evaluation System (SES) for Rice Gall Midge under field conditions

Damage (Plants with silver shoot) per cent in net house	Score	Reaction
No damage	0	Highly Resistant
<1%	1	Resistant
1-5%	3	Moderately Resistant
6-10%	5	Moderately Susceptible
11-25%	7	Susceptible
>25%	9	Highly Susceptible

### 3. Results and Discussion

Rice gall midge is the most prevalent pest in India. Seven biotypes of rice gall midges are there out of which two

biotypes like biotype -1 and biotype -2 are present in Odisha<sup>[4]</sup>. Gall midge biotype -2 is found in Cuttack and Khordha districts. In this present experiment, seeds of 202 rice genotypes were collected from the germplasm of ICAR-NRRI, Cuttack to check their reaction against rice gall midge under condition and their response were presented in table 2.

#### 3.1 Phenotyping of rice genotypes

Out of the 202 rice genotypes tested, fifty genotypes *viz.*, AC-44862, AC-44871, AC-44883, AC-44884, AC-44887, AC-44894, AC-44897, AC-44903, AC-44914, AC-44917, AC-44919, AC-44920, AC-44924, AC-44929, AC-44935, AC-44590, AC-44602, AC-44621, AC-44494, AC-44500, AC-44504, AC-44507, AC-44508, AC-44513, AC-44514, AC-44515, AC-44518, AC-44519, AC-44524, AC-44525, AC-44528, AC-44530, AC-44534, AC-44535, AC-44540, AC-44542, AC-44546, AC-44547, AC-44550, AC-44552, AC-44553, AC-44554, AC-44558, AC-44563, AC-44564, AC-44568, AC-44572, AC-44574, AC-44579 and Abhaya were recorded to have highly resistant reaction without having any silver shoot formation. Twenty rice genotypes *viz.*, AC-44869, AC-44873, AC-44879, AC-44880, AC-44885, AC-44893, AC-44904, AC-44915, AC-44916, AC-44927, AC-44501, AC-44502, AC-44509, AC-44529, AC-44533, AC-44539, AC-44555, AC-44562, AC-44567 and AC-44575 were recorded resistant reaction to the gall midge pest. Twenty five genotypes *viz.*, AC-44875, AC-44878, AC-44881, AC-44886, AC-44891, AC-44908, AC-44909, AC-44922, AC-44934, AC-44607, AC-44497, AC-44503, AC-44511, AC-44512, AC-44538, AC-44541, AC-44549, AC-44551, AC-44556, AC-44557, AC-44559, AC-44565, AC-44566, AC-44569 and AC-44570 were recorded in moderately resistant category. In moderately susceptible category thirty six genotypes *viz.*, AC-44858, AC-44864, AC-44868, AC-44872, AC-44888, AC-44889, AC-44890, AC-44895, AC-44896, AC-44905, AC-44907, AC-44911, AC-44912, AC-44918, AC-44921, AC-44923, AC-44926, AC-44928, AC-44943, AC-44594, AC-44600, AC-44603, AC-44609, AC-44505, AC-44506, AC-44516, AC-44517, AC-44527, AC-44536, AC-44537, AC-44545, AC-44548, AC-44561, AC-44576, AC-44582 and AC-44584 were categorized. Thirty nine genotypes *viz.*, AC-44857, AC-44859, AC-44860, AC-44870, AC-44877, AC-44892, AC-44898, AC-44900, AC-44901, AC-44906, AC-44913, AC-44925, AC-44930, AC-44932, AC-44936, AC-44937, AC-44942, AC-44586, AC-44587, AC-44588, AC-44589, AC-44591, AC-44593, AC-44598, AC-44601, AC-44606, AC-44608, AC-44614, AC-44615, AC-44616, AC-44498, AC-44520, AC-44526, AC-44532, AC-44543, AC-44544, AC-44573, AC-44577 and AC-44581 were recorded under susceptible category. Rest Thirty two rice genotypes *viz.*, AC-44863, AC-44865, AC-44866, AC-44867, AC-44874, AC-44876, AC-44882, AC-44899, AC-44902, AC-44910, AC-44931, AC-44933, AC-44938, AC-44939, AC-44940, AC-44941, AC-44585, AC-44592, AC-44595, AC-44597, AC-44604, AC-44605, AC-44613, AC-44618, AC-44619, AC-44495, AC-44496, AC-44531, AC-44560, AC-44580, AC-44583 and TN1 were recorded under highly susceptible category.

**Table 2:** Evaluation of rice genotypes against gall midge biotype-2 under field conditions

Sl. No.	Accession Number	Per cent plant damage	SES Score	Reaction
1	AC- 44857	18.00	7	S
2	AC- 44858	8.25	5	MS
3	AC- 44859	24.33	7	S
4	AC- 44860	22.00	7	S
5	AC- 44862	0	0	HR
6	AC- 44863	60.94	9	HS
7	AC- 44864	6.08	5	MS
8	AC- 44865	30.11	9	HS
9	AC- 44866	53.33	9	HS
10	AC- 44867	48.55	9	HS
11	AC- 44868	7.40	5	MS
12	AC- 44869	0.25	1	R
13	AC- 44870	12.75	7	S
14	AC- 44871	0	0	HR
15	AC- 44872	7.69	5	MS
16	AC- 44873	0.88	1	R
17	AC- 44874	36.66	9	HS
18	AC- 44875	4.00	3	MR
19	AC- 44876	42.86	9	HS
20	AC- 44877	18.18	7	S
21	AC- 44878	2.60	3	MR
22	AC- 44879	0.45	1	R
23	AC- 44880	0.24	1	R
24	AC- 44881	4.67	3	MR
25	AC- 44882	32.08	9	HS
26	AC- 44883	0	0	HR
27	AC- 44884	0	0	HR
28	AC- 44885	0.22	1	R
29	AC- 44886	2.35	3	MR
30	AC- 44887	0	0	HR
31	AC- 44888	5.66	5	MS
32	AC- 44889	9.09	5	MS
33	AC- 44890	8.23	5	MS
34	AC- 44891	3.18	3	MR
35	AC- 44892	12.88	7	S
36	AC- 44893	0.89	1	R
37	AC- 44894	0	0	HR
38	AC- 44895	7.28	5	MS
39	AC- 44896	8.76	5	MS
40	AC- 44897	0	0	HR
41	AC- 44898	6.33	5	MS
42	AC- 44899	27.77	9	HS
43	AC- 44900	12.88	7	S
44	AC- 44901	17.85	7	S
45	AC- 44902	38.27	9	HS
46	AC- 44903	0	0	HR
47	AC- 44904	0.24	1	R
48	AC- 44905	7.66	5	MS
49	AC- 44906	23.56	7	S
50	AC- 44907	8.33	5	MS
51	AC- 44908	2.52	3	MR
52	AC- 44909	3.66	3	MR
53	AC- 44910	51.00	9	HS
54	AC- 44911	9.66	5	MS
55	AC- 44912	8.25	5	MS
56	AC- 44913	23.00	7	S
57	AC- 44914	0	0	HR
58	AC- 44915	0.65	1	R
59	AC- 44916	0.33	1	R
60	AC- 44917	0	0	HR
61	AC- 44918	6.00	5	MS
62	AC- 44919	0	0	HR
63	AC-44920	0	0	HR
64	AC- 44921	10.00	5	MS

65	AC- 44922	4.22	3	MR
66	AC- 44923	7.28	5	MS
67	AC- 44924	0	0	HR
68	AC- 44925	24.50	7	S
69	AC- 44926	8.39	5	MS
70	AC- 44927	0.22	1	R
71	AC- 44928	7.33	5	MS
72	AC- 44929	0	0	HR
73	AC- 44930	22.11	7	S
74	AC- 44931	48.00	9	HS
75	AC- 44932	23.80	7	S
76	AC- 44933	39.76	9	HS
77	AC- 44934	4.80	3	MR
78	AC- 44935	0	0	HR
79	AC- 44936	18.28	7	S
80	AC- 44937	14.28	7	S
81	AC- 44938	31.00	9	HS
82	AC- 44939	38.20	9	HS
83	AC- 44940	54.66	9	HS
84	AC- 44941	28.33	9	HS
85	AC- 44942	21.03	7	S
86	AC- 44943	8.22	5	MS
87	AC- 44585	39.50	9	HS
88	AC- 44586	19.80	7	S
89	AC- 44587	17.50	7	S
90	AC- 44588	15.22	7	S
91	AC- 44589	18.25	7	S
92	AC- 44590	0	0	HR
93	AC- 44591	9.11	5	MS
94	AC- 44592	37.27	9	HS
95	AC- 44593	22.00	7	S
96	AC- 44594	8.25	5	MS
97	AC- 44595	36.66	9	HS
98	AC- 44597	55.26	9	HS
99	AC- 44598	13.22	7	S
100	AC- 44600	7.34	5	MS
101	AC- 44601	23.33	7	S
102	AC- 44602	0	0	HR
103	AC- 44603	8.11	5	MS
104	AC- 44604	41.43	9	HS
105	AC- 44605	53.33	9	HS
106	AC- 44606	25.00	7	S
107	AC- 44607	2.20	3	MR
108	AC- 44608	21.27	7	S
109	AC- 44609	7.2	5	MS
110	AC- 44613	37.14	9	HS
111	AC- 44614	12.11	7	S
112	AC- 44615	21.25	7	S
113	AC- 44616	24.00	7	S
114	AC- 44618	29.40	9	HS
115	AC- 44619	52.00	9	HS
116	AC- 44621	0	0	HR
117	AC- 44494	0	0	HR
118	AC- 44495	31.46	9	HS
119	AC- 44496	61.50	9	HS
120	AC- 44497	2.20	3	MR
121	AC- 44498	18.66	7	S
122	AC- 44500	0	0	HR
123	AC- 44501	0.50	1	R
124	AC- 44502	0.30	1	R
125	AC- 44503	2.88	3	MR
126	AC- 44504	0	0	HR
127	AC- 44505	8.50	5	MS
128	AC- 44506	7.44	5	MS
129	AC- 44507	0	0	HR
130	AC- 44508	0	0	HR
131	AC- 44509	0.33	1	R

132	AC- 44511	2.11	3	MR
133	AC- 44512	4.22	3	MR
134	AC- 44513	0	0	HR
135	AC- 44514	0	0	HR
136	AC- 44515	0	0	HR
137	AC- 44516	7.50	5	MS
138	AC- 44517	6.30	5	MS
139	AC- 44518	0	0	HR
140	AC- 44519	0	0	HR
141	AC- 44520	19.00	7	S
142	AC- 44524	0	0	HR
143	AC- 44525	0	0	HR
144	AC- 44526	23.50	7	S
145	AC- 44527	8.29	5	MS
146	AC- 44528	0	0	HR
147	AC- 44529	0.52	1	R
148	AC- 44530	0	0	HR
149	AC- 44531	55.00	9	HS
150	AC- 44532	21.25	7	S
151	AC- 44533	0.36	1	R
152	AC- 44534	0	0	HR
153	AC- 44535	0	0	HR
154	AC- 44536	8.50	5	MS
155	AC- 44537	9.00	5	MS
156	AC- 44538	2.33	3	MR
157	AC- 44539	0.66	1	R
158	AC- 44540	0	0	HR
159	AC- 44541	3.52	3	MR
160	AC- 44542	0	0	HR
161	AC- 44543	21.44	7	S
162	AC- 44544	18.00	7	S
163	AC- 44545	7.55	5	MS
164	AC- 44546	0	0	HR
165	AC- 44547	0	0	HR
166	AC- 44548	8.28	5	MS
167	AC- 44549	4.50	3	MR
168	AC- 44550	0	0	HR
169	AC- 44551	2.33	3	MR
170	AC- 44552	0	0	HR
171	AC- 44553	0	0	HR
172	AC- 44554	0	0	HR
173	AC- 44555	0	0	R
174	AC- 44556	2.22	3	MR
175	AC- 44557	3.69	3	MR
176	AC- 44558	0	0	HR
177	AC- 44559	1.00	3	MR
178	AC- 44560	36.66	9	HS
179	AC- 44561	9.0	5	MS
180	AC- 44562	0.48	1	R
181	AC- 44563	0	0	HR
182	AC- 44564	0	0	HR
183	AC- 44565	2.50	3	MR
184	AC- 44566	3.60	3	MR
185	AC- 44567	0.33	1	R
186	AC- 44568	0	0	HR
187	AC- 44569	4.22	3	MR
188	AC- 44570	2.35	3	MR
189	AC- 44572	0	0	HR
190	AC- 44573	23.50	7	S
191	AC- 44574	0	0	HR
192	AC- 44575	0.85	1	R
193	AC- 44576	7.45	5	MS
194	AC- 44577	17.27	7	S
195	AC- 44579	0	0	HR
196	AC- 44580	35.00	9	HS
197	AC- 44581	17.64	7	S
198	AC- 44582	7.50	5	MS

199	AC- 44583	37.25	9	HS
200	AC-44584	6.33.	5	MS
201	TN1	52	9	HS
202	Abhaya	0	0	HR

HR-Highly resistant, R-Resistant, MR-Moderately resistant, MS-Moderately susceptible, S-Susceptible, HS-Highly susceptible

#### 4. Conclusion

It can be concluded that, the rice genotypes coming under highly resistant and resistant category were carrying some resistant genes against the rice gall midge. Hence, these rice genotypes can be used as a donor for developing resistant varieties against gall midge through marker assisted breeding programme.

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