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Screening of Rice Entries against Asian Rice Gall midge, *Orseolia oryzae* (Wood-Mason) in Telangana, India

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ABSTRACT

Eighteen entries along with 7 varietal/hybrid checks in 2016, twenty three entries along with 9 varietal/hybrid checks in 2017 and twenty one entries along with 7 varietal/hybrid checks in 2018 were screened for resistance against Asian rice gall midge [*Orseolia oryzae* (Wood-Mason)] at Professor Jayashankar Telangana State Agricultural University, Regional Agricultural Research Station, Warangal, Telangana during wet season under delayed planting situation ensuring sufficient pest load. Among the entries screened, only one entry WGL-811 had shown resistant reaction with 5 per cent hill damage and 0.34 per cent silver shoots and 5 entries *viz.*, RDR 1162, WGL 1119, IBT R4, WGL 1150, WGL 1021 shown moderate resistant reaction with less than 5% silver shoot damage. Among these, the entries *viz.*, WGL-811, WGL 1119 and WGL 1150 recorded lower per cent plant damage (5-25%), lower silver shoot damage and were promising against gall midge and can be used in breeding programmes as a source of gall midge resistance or could be released as varieties, if found promising for yield traits and acceptable plant type.

Keywords : *Gall midge, resistance, rice and screening*

Rice (*Oryza sativa* L.) is one of the world's most important crops providing staple food for more than half of the global population (Kulagod, 2011). Rice productivity needs to be increased keeping in view of the over exploding population (Rosegrant and Cline, 2003). The crop encounters many obstacles in the form of stresses both biotic and abiotic (Sabouri *et al.*, 2011) that restricts its ability to reach its complete yield potential. The abiotic stresses can cause yield reduction up to 70% by adversely affecting rice survival, growth and grain filling depending upon the time of occurrence of these abiotic stresses (Akram *et al.*, 2019). Similarly, biotic stresses impart severe yield losses or crop failure during sever infestation (Hasan *et al.*, 2015). Approximately, 52% of global rice production is lost annually owing to the damage caused by biotic stress factors, of which 25% is attributed to the attack by insect pests (Yarasi, *et al.*, 2008). Nearly 300 insect pests attack the rice crop at different stages among which only 28 species cause considerable damage (Pasalu and Katti, 2006). Among these, the Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) is responsible for a world wide damage of more than US$ 700 million annually (Herdt, 1991). In India, it is an important insect pest that causes an annual yield loss of 0.8% of total production, amounting to US $80 million (Krishnaiah, 2004). Siddiq (1991) reported that it causes crop losses ranging from 10 to 100% in India, where gall midge incidence has been reported from both irrigated and rainfed rice, from almost all rice growing states except western Uttar Pradesh, Uttaranchal, Punjab, Haryana and the hilly states of Himachal Pradesh and Jammu and Kashmir (Bentur *et al.*, 2003). In India, regions like northern Telangana, Vidharba (Maharastra), Sambalpur (Orissa) and coastal Karnataka are endemic to gall midge where moderate to severe yield losses occur (Krishnaiah and Varma, 2011). In endemic locations of Telangana like Warangal, Karimnagar it usually occurs in the wet season especially under late transplanted conditions. Gall midge attacks the crop in the initial stages of crop growth. The gall midge and rice share such an intimate relationship that there is a constant battle for survival by either partner (Bentur *et al.*, 2016). The insect takes about 2-3 weeks for completion of its life cycle and the young larvae cause maximum damage. Active first instar maggot feeds on the meristem by lacerating the tissue and sucking the oozing sap. Salivary secretions during feeding induces the leaf sheath primordium to cover the feeding maggot to form a gall like structure. This gall-like structure is a nutritive tissue rich in amino acids and carbohydrates that aid in its growth and development (Rawat *et al.*, 2012). Cells in this region undergo hyperplasia and hypertrophy. Maggots moult twice and cease feeding during the third instar in about ten days. This triggers elongation of the gall chamber into a tubular gall known as 'onion tip' or 'silver shoot'. Affected tillers with silver shoots become sterile without further differentiation and do not bear panicle resulting in considerable yield losses under severe infestation.

As the pest is an early stage pest, monitoring the pest within 30 days after transplanting is the most important task in managing the insect pest under an economic injury level. Farmers often recognize the damage only after galls become conspicuous. Thus, growing of varieties resistant to gall midge provides an efficient, economical means of tackling this pest. Resistant cultivars are ecologically acceptable, safer and also compatible with all other components of Integrated pest management. Moreover, gall midge is known to have different biotypes across the county. Seven distinct gall midge biotypes, differing in their virulence have been reported (Vijaya Lakshmi *et al.*, 2006). So far, 11 resistance genes (designated Gm1 through Gm11) against the pest have been identified from different rice varieties (Himabindu *et al.*, 2010). Using three or four of these sources of resistance, more than 60 gall midge resistant rice varieties have been developed and released for commercial cultivation since 1975 (Bentur *et al.*, 2003). A vast majority of high-yielding rice varieties are prone to gall midge attack (Bentur *et al.*, 2016). Vulnerability of majority of popular varieties to gall midge is due to narrow genetic variability and less diversity among the parents used in breeding. Thus, critical analysis of genetic variability and phenotypic screening for confirmation of recipient parent and finding new sources of resistance are prerequisites for a successful crop improvement programme (Patel *et al.*, 2014). The present study was conducted to screen rice entries to identify resistant sources against gall midge.

MATERIAL AND METHODS

The present study was conducted to evaluate certain rice entries developed in different research stations of Professor Jayashankar Telangana State Agricultural University (PJTSAU) against gall midge during wet season of 2016, 2017 and 2018 at PJTSAU - Regional Agricultural Research Station, Warangal, Telangana, India. The experiment site is located at 18° 0' 49''North latitude and 79° 35' 55''East longitude and an altitude of 265 metres above mean sea level. The test entries selected were under multilocation testing (MLT) in different parts of Telangana and comprised of both early and medium duration entries. Eighteen entries along with 7 varietal/hybrid checks in 2016, twenty three entries along with 9 varietal/hybrid checks in 2017 and twenty one entries along with 7 varietal/hybrid checks in 2018 (Table 1) were screened in natural field conditions under delayed sowing and planting to capture maximum gall midge infestation in the experimental block. Apart from these entries, TN-1 was grown as susceptible check in all the three years and Aganni was grown as resistant check duruing 2018.

Nursery sowing was done during 3rd week of July and transplanted during 3rd week of August in all the three years of study. The fields were mechanically ploughed, puddled and levelled. The entries were transplanted at a spacing of 20 cm between the rows and 15 cm between the plants within the row. One seedling was transplanted per hill. Each test entry had 20 plants transplanted in a single row and for every 9 test entries, infestor row of TN-1 susceptible check was grown. TN-1 was also grown around the experiment block to ensure sufficient pest build up. The crop was grown following all recommended agronomic practices. Manual hand weeding was carried out. Application of Nitrogen, Phosphorus, Potash fertilizers was done at the rate of 120:60:40 Kg/ha, respectively. No plant protection measures were taken throughout the crop period.

Observations on total number of plants, number of damaged plants with galls/silver shoots in each entry, total number of tillers hill^{-1}, number of silver shoots hill^{-1} were recorded twice at 34-41 and 56-59 days after transplanting (DAT). Observations were recorded in all the plants of each entry from which mean values were computed. From the observations, % damaged plants, % silver shoots were calculated using the following formulae:

$$\%\ \text{Damaged plants} = \frac{\text{Number of damaged plants}}{\text{Total number of plants}} \times 100$$

$$\%\ \text{Silver shoots} = \frac{\text{Number of silver shoots hill}^{-1}}{\text{Number of tillers hill}^{-1}} \times 100$$

The entries were then scored against gall midge (Table-2) as per the Standard Evaluation System (SES), International Rice Research Institute (IRRI) for gall midge (IRRI, 2013).

RESULTS AND DISCUSSION

Perusal of the data indicated that gall midge infestation manifested in the form of per cent damaged plants and per cent silver shoots was low during the first observation (34-41 DAT) in all the years of study when compared to second observation (56-59 DAT) and hence damage score assessment was done based on second observation *i.e.*, peak damage of gall midge (Table 3,4, 5). The susceptible check TN-1 had recorded plant damage in the range of 95.0% (2017) to 97.5% (2016, 2018) and silver shoots from 16.85% to 27.27% during 56-59 DAT showing sufficient pest damage making it a valid screening test. The resistant check Aganni recorded 2.5% damaged plants and 0.37 % silver shoots (Table 6).

During 2016, among the test entries including varietal checks, at the time of peak infestation of gall midge, plant damage per cent ranged from 45 (JGL 20779, JGLH 6) to 100 (KNM 1616, WGL 823, JGLH 37, RNR 17462, HR 1-174) (Table 3) while silver shoots percent damage ranged from 8.33% (JGL 20779) to 47.31% (HR 1-174). None of the entries have recorded resistance reaction against gall midge.

During 2017, out of the entries screened, gall midge incidence ranged from 25 (WGL 1150) to 100% (JGL 24497, RNR 23595, IBT R9, WGL 962, IET 26224, RNR 15435) plant damage and 1.02 (IBT R4) to 39.20 % silver shoots (IET 26224). The entries RDR 1162, WGL 1119, IBT R4, WGL 1150, WGL 1021, Pusa 1121 showed moderate

Table 1. Rice entries screened against gall midge at Regional Agricultural Research Station, Warangal

Year	Duration Group	Test entries Number	Test entries List		Varietal/ hybrid checks Number	Varietal/ hybrid checks List	Susceptible Check	Resistant Check
2016	Early	7	KNM 1638	JGL 21820	4	Telangana Sona	TN-1	-
			KNM 2213	JGL 23655		MTU 1010		
			WGL 810	JGL H6		Sheethal		
			WGL 1097			US 312		
	Medium	11	KNM 1616	KPS 2874	3	Somnath		
			JGL 18222	KPS 4329		MTU 1001		
			JGL 20779	RNR 8860		HR-1-174		
			JGLH 37	RNR 17462				
			WGL 823	RNR 19399				
			WGL 914					
2017	Early	15	JGL 24497	IET 26241	4	Telangana Sona	TN-1	-
			JGLH 169	KNM 2305		MTU 1010		
			JGL 20776	KNM 2307		US 314		
			RNR 23595	IBTR 9		Bathukamma		
			RDR 1162	IBTR 4				
			RDR 1188	IBT R 8				
			WGL 1119	KMPS 6251				
			WGL 962					
	Medium	8	JGL 23746	IET 26224	5	Krishna		
			JGL 18629	WGL 1021		Pusa 1121		
			RNR 21225	WGL 1150		Sumathi		
			RNR 17500			MTU 1001		
			RNR 15435			Somnath		
2018	Early	10	JGLH 275	WGRH 18	4	Telangana Sona	TN-1	Aganni
			JGL 25958	RNR 21571		KNM 118		
			JGL 24267	RNR 21278		Bathukamma		
			JGL 30090	WGL 811		PA 6444		
			KPS 6262	WGL 1127				
	Medium	11	KNM 4115	RNR 26098	3	MTU- 1001		
			RNR 25981	JGL 28545		Somnath		
			WGL 848	KNM 4995		Krishna		
			KNM 5021	WGL 825				
			RNR 26121	RNR 15459-6				
			JGL 25960					

Table 2. Methodology of scoring the reaction

% damage	Score	Reaction
Based on Per cent silver shoots		
0	0	Highly Resistant
<1	1	Resistant
5-Jan	3	Moderately Resistant
10-Jun	5	Moderately Susceptible
25-Nov	7	Susceptible
>25	9	Highly Susceptible
Based on Per cent plant damage		
0-10		Resistant
> 10		Susceptible

Table 3. Screening of rice entries against gall midge during 2016

S. No.	Designation	First Observation (40 DAT)		Second Observation (58 DAT)		Damage score*	Resistance reaction*
		% Damaged plants	% Silver shoots	% Damaged	% Silver shoots		
1	KNM 1638	20.00	1.96	70.00	10.13	5	MS
2	KNM 2213	10.00	0.81	75.00	12.67	7	S
3	JGL 21820	10.00	0.86	55.00	14.53	7	S
4	JGL 23655	10.00	0.81	80.00	18.44	7	S
5	WGL 810	20.00	1.67	80.00	15.48	7	S
6	WGL 1097	30.00	2.45	70.00	11.17	7	S
7	JGLH 6	25.00	1.63	45.00	8.81	5	MS
8	KNM 1616	30.00	2.34	100.00	22.18	7	S
9	JGL 18222	10.00	1.00	84.21	23.83	7	S
10	JGL 20779	20.00	1.49	45.00	8.33	5	MS
11	WGL 823	20.00	2.05	100.00	35.08	9	HS
12	WGL 914	25.00	2.29	80.00	23.32	7	S
13	KPS 2874	30.00	2.34	70.00	14.67	7	S
14	KPS 4329	0.00	0.00	65.00	9.38	5	MS
15	JGLH 37	30.00	2.77	100.00	32.13	9	HS
16	RNR 8860	20.00	1.88	90.00	28.57	9	HS
17	RNR 17462	40.00	2.78	100.00	38.92	9	HS
18	RNR 19399	20.00	2.36	60.00	16.27	7	S
19	Telangana Sona (C)	5.00	0.34	80.00	19.21	7	S
20	US 312 (C)	45.00	4.81	95.00	31.05	9	HS
21	HR 1-174 (C)	10.00	0.93	100.00	47.31	9	HS
22	MTU 1001 (C)	7.50	0.54	70.00	21.10	7	S
23	Sheethal (C)	20.00	1.97	65.00	8.45	5	MS
24	MTU 1010 (C)	36.06	2.81	86.84	25.27	9	HS
25	Somnath (C)	20.00	1.37	80.00	23.61	7	S
26	TN-1(Susc.Check)	45.00	2.85	97.50	27.27	9	HS

Table 4. Screening of rice entries against gall midge during 2017

S. No.	Designation	First Observation (34 DAT)		Second Observation (56		Damage score*	Resistance reaction*
		% Damaged plants	% Silver shoots	% Damaged plants	% Silver shoots		
1	JGL 24497	35.00	2.43	100.00	10.07	5	MS
2	RDR 1162	40.00	3.38	50.00	5.16	3	MR
3	JGLH 169	80.00	7.05	95.00	13.10	7	S
4	RNR 23595	70.00	7.14	100.00	16.92	7	S
5	RDR 1188	50.00	4.64	75.00	7.10	5	MS
6	IBT R9	65.00	5.56	100.00	18.20	7	S
7	JGL 20776	75.00	8.89	85.00	11.45	7	S
8	WGL 1119	25.00	1.63	25.00	1.85	3	MR
9	IET 26241	35.00	4.89	90.00	12.17	7	S
10	KNM 2305	50.00	5.71	70.00	8.11	5	MS
11	IBT R4	5.00	0.20	80.00	1.02	3	MR
12	WGL 962	70.00	7.10	100.00	17.57	7	S
13	KMPS 6251	55.00	5.56	85.00	10.09	5	MS
14	KNM 2307	75.00	6.37	80.00	9.52	5	MS
15	IBT R8	90.00	11.28	95.00	24.00	7	S
16	JGL 23746	60.00	8.75	77.78	18.30	7	S
17	WGL 1150	15.00	0.83	25.00	1.36	3	MR
18	RNR 21225	75.00	9.94	90.00	19.22	7	S
19	IET 26224	95.00	17.01	100.00	39.20	9	HS
20	RNR 17500	85.00	11.20	50.00	8.45	5	MS
21	WGL 1021	50.00	4.51	50.00	5.03	3	MR
22	RNR 15435	40.00	5.09	100.00	20.92	7	S
23	JGL 18629	65.00	10.10	94.74	22.35	7	S
24	Bathukamma (C)	75.00	7.65	90.00	23.94	7	S
25	Somnath (C)	80.00	12.18	85.00	13.51	7	S
26	Telangana Sona (C)	30.00	2.86	84.21	11.99	7	S
27	MTU 1010 (C)	60.00	6.74	95.00	28.94	9	HS
28	Krishna (C)	70.00	12.33	95.00	18.68	7	S
29	Pusa 1121 (C)	30.00	4.35	33.33	4.36	3	MR
30	Sumathi (C)	80.00	8.70	66.67	9.49	5	MS
31	MTU 1001 (C)	65.00	6.48	65.00	6.33	5	MS
32	US 314 (C)	50.00	11.54	50.00	7.41	5	MS
33	TN-1 (Susc.Check)	81.67	7.88	95.00	16.85	7	S

*Damage score and Resistance reaction based on silver shoot damage at 56 DAT

HR- Highly Resistant; R- Resistant; MR- Moderately Resistant ; MS- Moderately Susceptible; S- Susceptible; HS- Highly Susceptible

Table 5. Screening of rice entries against gall midge during 2018

S. No.	Designation	First Observation (32 DAT)		Second Observation (52 DAT)		Damage score*	Resistance reaction*
		% Damaged plants	% Silver shoots	% Damaged plants	% Silver shoots		
1	WGRH 18	25.00	1.59	100.00	38.14	9	HS
2	JGLH 275	7.14	0.68	100.00	31.08	9	HS
3	WGL 1127	20.00	1.79	95.00	23.33	7	S
4	KPS 6262	25.00	2.11	95.00	17.65	7	S
5	JGL 25958	10.00	0.78	100.00	15.03	7	S
6	RNR 21571	5.00	0.40	100.00	23.91	7	S
7	JGL 24267	7.14	1.39	71.43	25.00	7	S
8	RNR 21278	5.00	0.34	100.00	21.98	7	S
9	WGL 811	0.00	0.00	5.00	0.34	1	R
10	JGL 30090	0.00	0.00	85.00	23.08	7	S
11	KNM 4115	15.00	1.46	95.00	17.36	7	S
12	RNR 25981	0.00	0.00	100.00	13.37	7	S
13	WGL 848	0.00	0.00	50.00	16.22	7	S
14	KNM 5021	10.00	0.67	100.00	14.89	7	S
15	RNR 26121	0.00	0.00	95.00	16.87	7	S
16	JGL 25960	25.00	1.98	100.00	17.53	7	S
17	RNR 26098	0.00	0.00	91.67	22.22	7	S
18	JGL 28545	45.00	2.76	100.00	24.62	7	S
19	KNM 4995	10.00	0.67	60.00	6.35	5	MS
20	WGL 825	12.50	1.67	100.00	20.12	7	S
21	RNR 15459-6	5.00	0.40	85.00	15.06	7	S
22	PA 6444 (C)	0.00	0.00	100.00	32.00	9	HS
23	Telangana Sona (C)	40.00	4.37	100.00	31.93	9	HS
24	KNM 118 (C)	15.00	1.75	80.00	20.28	7	S
25	Bathukamma (C)	0.00	0.00	100.00	23.13	7	S
26	Krishna (C)	5.00	0.83	80.00	14.72	7	S
27	MTU 1001 (C)	0.00	0.00	40.00	11.11	7	S
28	Somnath (C)	25.00	1.84	97.50	20.73	7	S
29	TN-1(Susc. Check)	23.50	1.83	97.50	24.16	7	S
30	Aganni (Res. Check)	0.00	0.00	2.50	0.37	1	R

*Damage score and Resistance reaction based on silver shoot damage at 56 DAT

HR- Highly Resistant; R- Resistant; MR- Moderately Resistant ; MS- Moderately Susceptible; S- Susceptible; HS- Highly Susceptible

Table 6. Distribution of entries to different classes of Rice gall midge reaction at peak infestation level

Year	Entry type	Number of entries	Resistance Reaction					
			HR	R	MR	MS	S	HS
2016	Test entries	18	0	0	0	4	10	4
	Varietal/ Hybrid Checks	7	0	0	0	1	3	3
	Susceptible check (TN-1)	1	-	-	-	-	-	1
2017	Test entries	23	0	0	5	6	11	1
	Varietal/ Hybrid Checks	9	0	0	1	3	4	1
	Susceptible check (TN-1)	1	-	-	-	-	1	
2018	Test entries	21	0	1	0	1	17	2
	Varietal/ Hybrid Checks	7	0	0	0	0	5	2
	Susceptible check (TN-1)	1	0	0	0	0	1	-
	Resistant check (Aganni)	1	-	1	-	-	-	-

HR- Highly Resistant; R- Resistant; MR- Moderately Resistant ; MS- Moderately Susceptible; S- Susceptible; HS- Highly Susceptible

resistance with less than 5% silver shoots. However, hill damage in these entries ranged from 25 to 80%.

During 2018, at the time of peak infestation of gall midge in TN1, gall midge incidence among test entries ranged from 5 (WGL 811) to 100 % hill damage (WGRH 18, JGLH 275, JGL 25958, RNR 21571, RNR 21278, RNR 25981, KNM 5021, JGL 25960, JGL 28545, WGL 825, PA 6444, Bathukamma, Telangana Sona) and 0.34 (WGL 811) to 38.14 (WGRH 18) % silver shoots. Only one entry WGL-811 had shown resistant reaction with 5 per cent hill damage and 0.34 per cent silver shoots against local cheek gall midge population.

The susceptible check TN-1 had shown susceptible to highly susceptible reaction (Table 6) with damage score ranging from 7-9 during the experimental period. The resistant check Aganni had recorded less than 1 per cent silver shoot damage. Aganni possesses Gm8 gene, conferring hypersensitive independent (HR– type) resistance to gall midge biotypes GMB1, GMB2, GMB3, GMB4 and GMB4M (Sama *et al.*, 2012). Among the varietal/hybrid checks tested, none had shown any highly resistant or resistant reaction except Pusa 1121 with moderate resistant (MR) reaction. However, hill damage in Pusa 1121 is above 33.33%. Other varietal/hybrid checks had shown moderately susceptible to highly susceptible reaction. Among the MLT entries, none of the entries were immune to gall midge with 'nil' incidence. Warangal derived gall midge population were characterized as a distinct new gall midge biotype and designated tentatively as GMB4M, as it is similar to biotype 4 but with added virulence against CR-MR1523 differential (Vijaya Lakshmi *et al.*, 2006). Most of the entries screened in the present study at Warangal were found susceptible to the existing gall midge biotype 4M of Warangal. Only one entry WGL 811 had shown resistant reaction with 5 % plant damage and 0.34 % silver shoots (Table 5) and 5 entries viz., RDR 1162, WGL 1119, IBT R4, WGL 1150, WGL 1021 showed MR reaction with less than 5% silver shoot damage. Plant damage in these entries ranged from 25% (WGL 1119, WGL 1150) to 80%. Moderately resistant entries based on silver shoot damage having resistant reaction based on plant or hill damage are better than those with higher plant damage and susceptible reaction. In the present study, out of the 5 MR entries, only WGL 1119 and WGL 1150 recorded lower plant damage with resistant reaction (Table 4). Several workers screened rice genotypes and reported promising entries against gall midge in the respective locations. Sumathi and Manickam, 2013 tested 17 different rice entries at Rice Research Station, Tirur, Tamil Nadu during 2009 and found that the entries *viz.,* 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 aginst gall midge. Srinivas et al, 2016 reported that the genotypes JGL 19607, JGL 21820, JGL 3844 and JGL 23745 exhibited low gall midge incidence and could be utilized as parents in developing gall midge resistance genotypes. Painkra *et al.,* 2017 reported that the genotype R 1674-50-1-1-1 25 showed highly resistant reaction and the genotype R 2048-189-1-132-1 showed resistant reaction against gall midge damage under late planting situations in Chattisgarh, India. Prasad et al, 2018 reported that four varieties *viz.,* Kavya, Lalat, IR-36 and RD 202 recorded less than 5% silver shoots and could be recommended in the gall midge endemic areas like Simdega, Gumla, Khunti and Lohardagga districts of Jharkhand. The present findings are in conformity with Seni and Naik, 2017 who reported moderately resistant reaction of WGL 1119 at Chiplima, Odisha. In this study, the genotypes W 1263, INRC 3021, Sudu Hondarawala, PTB 26, RP4686-48-1-937, RMSG-11, WGL 1147, WGL 1127, WGL 1121, WGL 1131, WGL 1141, JGL 27058 exhibited resistance reaction against gall midge.

Though growing gall midge reistant varieties is the most successful strategy to combat the pest, cultivation of varieties containing single resistance gene has resulted in frequent breakdown of resistance due to emergence of virulent biotypes of the insect which is a cause for concern (Lingaraj *et al.,* 2008). Improved rice varieties carrying Gm1 or Gm2 genes have lost their resistance against gall midge in most of the rice growing areas. Recent advances in molecular biology and availability of biotechnological tools have brought in a paradigm shift in our approach to explore and deploy plant resistance against insect pests towards more rational ways to achieve multiple and durable resistance (Bentur *et al.,* 2013). Development and use of molecular markers has played an increasing role in rice breeding and genetics during last few decades. The molecular markers that are tightly linked to the gene of interest have improved the efficiency of conventional plant breeding (Fraiture *et al.,* 2016). Cohen *et al.,* 2004 suggested gene pyramiding of two or more resistance genes in the same plant are likely to delay the selection of virulence. WGL 1119 and WGL 1150 were products of marker assisted back cross breeding developed through the targeted transfer of Gm4 and *Xa21* and *xa13* into the genetic background of Warangal Sannalu (WGL-32100) and Tellahamsa, respectively (Hari *et al.,* 2017). Sreedhar (2020) recorded a very low incidence of galls (0.9%) with high yield (4869.7 kgha^{-1}), early duration (84.7 days), short stature (9.7 cm) and less 1000 grain weight (14.8 g) in WGL 1119 and pointed out that it could be used in the breeding programme to develop gall midge resistant, high yielding, early duration, non lodging medium slender grain genotype. Cultivation of gall midge resistant varieties such as Surekha and Phalguna on 70% of the rice areas in gall midge-endemic districts in Telangana and north coastal districts in Andhra Pradesh, reduced pest incidence considerably, resulting almost 45% increase in yield

(Krishnaiah *et al.*, 1983). This reiterates the importance of growing gall midge resistant varieties in endemic areas. Thus, a thorough and continuous screening of various available rice germplasm is necessary to get new sources of resistance, especially to face the challenge of evolving biotypes.

CONCLUSION

From the present study, the entry WGL 811 with resistant reaction, WGL 1119 and WGL 1150 with moderately resistant reaction were promising against gall midge and could be released as gall midge resistant varieties if found promising against yield and other phenotypic traits or could be used in resistance breeding programme.

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