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Identification of Rice Gall Midge Biotype under Field Conditions Prevailing in Y.S.R District, Andhra Pradesh

K. Sunil Kumar[1*], E. Aruna[2] and C. Kiran Kumar Reddy[3]

[1]Scientist (Entomology), Agricultural Research Station, Utukur, Kadapa, Y.S.R District (Andhra Pradesh), India.
[2]Scientist (Agronomy), Agricultural Research Station, Utukur, Kadapa, Y.S.R District (Andhra Pradesh), India.
[3]Scientist (Plant Breeding), Agricultural Research Station, Utukur, Kadapa, Y.S.R District (Andhra Pradesh), India.

(Corresponding author: K. Sunil Kumar)*
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ABSTRACT: A field experiment on detection of rice gall midge biotype under field conditions was carried out in the farm of Agricultural Research Station, Utukur, Kadapa, Y.S.R District during Kharif, 2018, 2019 and 2020 with 17 standard gall midge differentials. Pooled analysis of three years data revealed that, all the entries in Group I exhibited resistance to the biotype of rice gall midge population prevailing in YSR District was following the reaction nearer to the biotype VI with percent similarity index (PSI) of 76.47 per cent.

Keywords: Gall midge biotype, Y.S.R District, Andhra Pradesh.

INTRODUCTION

Rice (*Oryza sativa*. L) is an essential cereal globally and staple diet for half of the population of the world notably in Asian countries. India has 45.1 million ha under cultivation with production of around 121 million tonnes. However, productivity of rice is only 3.54 metric tonnes/ha of milled rice as against the global average productivity of 3.0 tonnes/ha (FAO, 2020). Among the biotic factors, insect pests alone contribute to approximately 10-15 per cent of yield losses, resulting in an estimated overall loss of 21-51 percent in rice production. In India, gall midge pest accounts for an average annual crop loss worth of US $ 80 million (Bentur *et al*., 2003). At present it is considered as major insect pest in India, because of its relative importance.

After the widespread cultivation of high yielding gall midge-resistant rice varieties in farmer fields, different populations or biotypes were observed (Singh, 1996). But the emergence of new virulent biotypes of gall midge in popular rice varieties is capable of overcoming resistance and this is the cause for concern. So far, seven biotypes (GMB1 to GMB6 and GMB4M) of gall midge and 11 gall midge resistance genes (Gm1, Gm2, gm3, Gm4, Gm5, Gm6, Gm7, Gm8, Gm9, Gm10 and Gm11) have been identified (Vijaya Lakshmi *et al*., 2006; Himabindu *et al*., 2010).

Identification of prevailing rice gall midge populations in a particular area is imperative in resistance breeding programmes. In this background, there is an urgent need to generate knowledge on identification of gall midge biotypes that are area specific, inheritance and the mode of action of newly identified resistance sources so that genes can be appropriately utilised in resistant breeding programmes (Singh, 2012).

In Southern zone of Andhra Pradesh, incidence of rice gall midge was not reported by any researcher except in Nellore District. In Y.S.R District of the Southern zone rice gall midge incidence is increasing year by year and causing loss up to 25 to 60 per cent in yield and farmers face difficulty in managing this pest. So, gall midge biotype prevailing in Y.S.R District under field conditions have to be carried out for development of resistance lines to that particular biotype.

Keeping in view of this above perspectives, the following research programme has been planned with specified objective of detection of rice gall midge biotype under field conditions in Y.S.R District at Agricultural Research station, Utukur, Kadapa.

MATERIALS AND METHODS

A field experiment on detection of rice gall midge biotype under field conditions was carried out in the farm of Agricultural Research Station, Utukur, Kadapa, Y.S.R District during Kharif, 2018, 2019 and

2020 with 17 standard gall midge differentials. All the agronomic practices were adopted as per the recommendation of ANGRAU in raising the crop except for management of pests and diseases practices during the experiment period. The field evaluation protocols developed by Kalode and Bentur (1989) was followed.

Each differential was grown in a separate nursery bed in a raised nursery bed method and labelled with tag. The experiment was laid out in a randomised block design (RBD) with 17 differentials which are replicated twice. Manual transplantation was done after approximately 28-30 days of sowing. While transplanting, single seedling per hill was transplanted in a single row of 20 hills with a spacing of 20 cm between the rows and 15 cm within the rows.

During the period of study, the incidence of rice gall midge in term of per cent silver shoot and plant damage in different rice differentials were recorded at 30 and 50 DAT.

When a particular biotype is not following any specific reaction pattern of an identified biotype, percent similarity index (PSI) aids in comparing the similarity of either resistant (R) or susceptible (S) reaction of an existing biotype at a location to the reaction pattern of the identified biotypes. The reaction pattern shown by a biotype of a location similar to the identified biotype can be known with this value.

The Per cent Similarity Index (PSI) was calculated by using the formula

$$PSI=\frac{\text{Total no. of differentials - Total no. of dissimilar reactions}}{\text{Total no. of differentials}}\times 100$$

RESULTS AND DISCUSSION

The pooled analysis of field experiments conducted during Kharif, 2018, 2019 and 2020 revealed that, among the differentials at 30 DAT, the per cent mean silver shoot damage varied from 0.00 to 20.78, while at 50 DAT, it ranged from 0.00 to 35.82 per cent. The recorded per cent of plant damage at 30 DAT and 50 DAT ranged from 0.00 to 82.50 and 0.00 to 100.00 respectively. In the case of the susceptible check variety TN 1, the per cent of silver shoot damage at 30 DAT and 50 DAT was 20.78 and 35.82 per cent respectively. Regarding plant damage, TN 1 exhibited 82.50 and 100.00 per cent at 30 DAT and 50 DAT respectively (Table 1).

In Group I, all entries showed resistance (R), with a no occurrence of gall midge incidence. In Group II, ARC 5984 was the only entry that demonstrated resistance (R), with no gall midge incidence at both 30 and 50 DAT. All other entries in this group were susceptible (S) to the pest. Group III had MR 1523 as the notable entry, showing susceptibility (S) to the gall midge. In Group IV, both INRC 3021 and AGANNI displayed resistance (R), with no gall midge incidence. As for group V, TN 1, which served as the susceptible check, exhibited the expected susceptibility (S) to the pest.

Table 1: Pooled data for reaction of differentials to the existing biotype at ARS, Utukur during *kharif*, 2018, 2019 & 2020.

Group	Entry No.	Differential	Silver shoot damage (%)		Plant damage (%)		Reaction observed
			30 DAT	50 DAT	30 DAT	50 DAT	
I	1	KAVYA	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (23.18)	R
	2	W 1263	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	R
	3	ARC 6605	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	R
II	4	PHALGUNA	11.43 (19.75)	29.63 (32.98)	55.00 (47.87)	100.00 (90.00)	S
	5	ARC 5984	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	R
	6	DUKONG - 1	10.91 (19.28)	15.43 (23.12)	30.00 (33.21)	82.50 (65.27)	S
	7	RP-2333-156-8	11.87 (20.14)	24.38 (29.59)	77.50 (61.68)	97.50 (80.90)	S
	8	MADHURI L 9	10.98 (19.28)	21.96 (27.94)	25.00 (30.00)	67.50 (55.25)	S
	9	BG-380-2	14.15 (22.10)	20.28(26.75)	52.50 (46.43)	80.00 (63.43)	S
III	10	MR 1523	12.96 (21.10)	27.36(31.54)	42.50 (40.69)	82.50 (65.27)	S
IV	11	RP 2068-18-3-5	10.90 (19.28)	24.43 (29.61)	35.00 (36.27)	77.50 (61.68)	S
	12	ABHAYA	15.81 (23.42)	24.15 (29.43)	52.50 (46.43)	82.50 (65.32)	S
	13	INRC 3021	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	R
	14	AGANNI	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	R
	15	INRC 15888	4.49 (12.23)	9.09 (17.54)	22.50 (28.32)	82.50 (46.43)	S
	16	B 95-1	14.66 (22.51)	18.53 (25.49)	32.50 (34.76)	65.00 (53.78)	S
V	17	TN 1	20.78 (27.12)	35.82 (36.76)	82.50 (65.27)	100.00 (90.00)	S
		Grand Mean	8.17	15.04	29.85	53.12	
		P Value (0.05)	0.00	0.00	0.00	0.00	
		Sig	S	S	S	S	

Note: Values in the parenthesis are Angular transformed; DAT: Days After Transplanting

Table 2: Per cent Similarity index of existing biotype at Kadapa in comparison with all the existing biotypes in India.

Group	Entry No.	Differential	Resistant gene	Reaction at Kadapa	Gall midge Biotype (Prescribed Reaction pattern)						
					1	2	3	4	4M	5	6
I	1	KAVYA	Gm1	S	R	S	R	S	S	R	R
	2	W 1263	Gm2	R	R	S	R	S	S	R	R
	3	ARC 6605		R	R	S	R	S	S	R	R
II	4	PHALGUNA	Gm2	S	R	R	S	S	S	R	S
	5	ARC 5984	Gm5	R	R	R	S	S	S	R	S
	6	DUKONG - 1	Gm6	S	R	R	S	S	S	R	S
	7	RP-2333-156-8	Gm7	S	R	R	S	S	S	R	S
	8	MADHURI L 9	Gm9	S	R	R	S	S	S	R	S
	9	BG-380-2	Gm10	S	R	R	S	S	S	R	S
III	10	MR 1523	Gm11	S	R	R	R	R	S	R	S
IV	11	RP 2068-18-3-5	Gm3	S	R	R	R	R	S	S	S
	12	ABHAYA	Gm4	S	R	R	R	R	R	S	S
	13	INRC 3021		R	R	R	R	R	R	S	S
	14	AGANNI	Gm8	R	R	R	R	R	R	S	S
	15	INRC 15888		S	R	R	R	R	R	S	S
	16	B 95-1		S	R	R	R	R	R	S	S
V	17	TN 1	None	S	S	S	S	S	S	S	S
Per cent Similarity Index					35.29	29.41	58.82	52.94	64.70	47.05	76.47

From the data it is clear that all the entries in Group I exhibited resistance to the unknown biotype of rice gall midge population present in Utukur, Kadapa and the biotype existing in Y.S.R District was following the reaction nearer to the biotype VI with percent similarity index (PSI) of 76.47 per cent (Table 2).

In a study conducted by Harathi (2019) at Nellore, a different reaction pattern was observed. To determine the biotype, present at Nellore, they employed the Per cent Similarity Index (PSI) and found that it exhibited a 70.6% similarity with biotype VI. This finding suggests that the biotype observed at Nellore shares a significant similarity with biotype VI, as determined by the PSI calculation.

In contrast, Lingaraj *et al.* (2008) reported a different finding in Madikeri and Ponnampet, Kodagu, Mysore, and Hassan districts of Karnataka. In his study, he observed a perfect reaction pattern with the presence of biotype I, which showed an R-R-R-S reaction pattern when tested against 14 rice differentials. These findings demonstrate regional variations in the gall midge biotype distribution and the associated reaction patterns.

Indeed, continuous biotype monitoring studies are crucial in various aspects of rice gall midge management. These studies provide valuable insights into the biotype dynamics and aid in identifying resistant donors for the development of resistant cultivars. By monitoring the biotype over time, researchers can track any changes or shifts in the population, allowing for proactive measures to be taken.

Nurseries raised at Agricultural research Station, Utukur during Kharif, 2019.

Experimental view of gall midge biotype trial at Agricultural research Station, Utukur during Kharif, 2019.

CONCLUSIONS

The Present research study revealed that the biotype existing in Y.S.R District was following the reaction nearer to the biotype VI with percent similarity index (PSI) of 76.47 per cent and further it has to be confirmed with Molecular identification by using SSR's primers.

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