Plant Archives Vol. 25, Supplement 2, 2025 pp. 2406-2409 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.305

RICE GALL MIDGE *ORSEOLIA ORYZAE* (WOOD-MASON) BIOTYPE IDENTIFICATION IN TBP COMMAND AREA, KARNATAKA INDIA

Sujay Hurali[1*], Netra Hubballi[1], Padmakumari[2] , Basavanjali Kaman[1], Mahantashivayogayya K.[3], Shweta B. N.[4] and Shivukumar[1]

[1]Department of Agriculture Entomology, University of Agricultural Sciences, Raichur, Karnataka, India
[2]Department of Entomology, Indian Institute of Rice Research, Hyderabad - 500030, Telangana, India
[3]Department of Genetics and Plant breeding University of Agricultural Sciences, Raichur, Karnataka, India
[4]Department of Agronomy, University of Agricultural Sciences, Raichur, Karnataka, India
*Corresponding author: sujay_huralient@uasraichur.edu.in
(Date of Receiving : 09-04-2025; Date of Acceptance : 20-06-2025)

ABSTRACT

The Asian rice gall midge, *Orseolia oryzae* (Wood-Mason) (Diptera: Cecidomyiidae), is a major pest of rice (*Oryza sativa* L.) in India. To date, seven distinct biotypes of this pest have been identified from various regions across the country. To determine the biotype(s) prevalent in the TBP command area, a field study was conducted under natural conditions at the Agricultural Research Station (ARS), Gangavathi. A set of 20 standard rice differential lines, classified into five groups and widely used for biotype characterization in India, were evaluated against the local gall midge population. The findings from the study indicated that the differentials from groups I, II, III, IV, and V, along with the susceptible check (TN1), exhibited a R-S-S-S reaction pattern during both kharif seasons of 2022 and 2023. This reaction pattern corresponds to that of biotype 6.
***Keywords*:** Asian rice gall midge, biotypes, *Orseolia oryzae,* rice differentials.

Introduction

Rice (*Oryza sativa* L.), often referred to as the "Global Grain," is the most important staple food crop worldwide, serving as a major source of carbohydrates for over half of the global population. India ranks first in terms of rice cultivation area, with 44.62 million hectares under production, and is the second-largest producer globally, contributing approximately 26% of the world's rice supply, totaling around 161.5 million tonnes (FAO, 2016). However, rice productivity is frequently constrained by various biotic and abiotic stresses. Among the biotic factors, the Asian rice gall midge (*Orseolia oryzae* Wood-Mason) (Diptera: Cecidomyiidae) is a significant pest in India, responsible for an estimated annual yield loss of around US $80 million. Given that the gall midge is an endophytic pest, breeding and cultivating resistant rice varieties has proven to be an effective and environmentally sustainable management strategy (Heinrichs and Pathak, 1981). Since the 1970s, more than 56 high-yielding rice varieties resistant to gall midge-incorporating various resistance genes have been released for commercial cultivation (Bentur *et al*., 2003). However, the widespread adoption of these resistant varieties has led to the emergence of different gall midge populations or biotypes, capable of overcoming existing resistance mechanisms (Singh, 1996).

To mitigate its impact, host plant resistance has been the most eco-friendly and sustainable strategy. Since the 1970s, more than 56 high-yielding gall midge-resistant rice varieties incorporating various resistance genes have been released in India (Bentur *et al.,* 2003). However, the widespread deployment of these varieties has led to the emergence of virulent biotypes capable of overcoming resistance, highlighting the need for continuous monitoring (Singh, 1996). Till date 12 gall midge resistant genes were identified of which three genes (*Gm4* and *Gm 8* and *gm3*) were cloned and seven insect biotypes were reported in India based on their reaction to a set of host plant differentials. Although gall midge is considered as an early duration pest, incidence at reproductive stage at few locations where the tillers are affected with galls was observed (Anon, 2023). Recent studies have shown that resistance genes such as gm3, Gm4, and Gm8 confer effective resistance against several biotypes, including GMB1 to GMB4M (Bentur *et al.,* 2009; Dutta *et al.,* 2014). The geographical distribution of these biotypes is well documented and monitored annually through national gall midge biotype surveillance programs conducted under the All India Coordinated Rice Improvement Programme (AICRIP). Despite these efforts, several endemic regions continue to report the emergence of new, virulent gall midge populations capable of breaking resistance (Srinivas *et al.,* 1994). In light of these challenges, the current study was undertaken to assess the prevailing biotypes and their impact on rice varietal resistance in TBP command area.

Material and Methods

A field investigation was conducted during the *kharif* season of 2022–23 and 2023–24 at the Agricultural Research Station (ARS), Gangavathi, to identify the prevalent rice gall midge biotypes. The experiment involved a set of 20 standard rice differential lines (Table 1), categorized into five groups as per the classification system developed by the Indian Institute of Rice Research (IIRR), Hyderabad. These differentials are part of a multi-location trial under the All India Coordinated Rice Improvement Programme (AICRIP) for biotype identification. The seedlings, aged 20–25 days, were transplanted in single rows, each comprising 20 hills, with a spacing of 20 × 15 cm between rows and plants, respectively. A susceptible check variety, TN1, was planted after every ten test entries. To enhance gall midge infestation levels, favorable microclimatic conditions were created by maintaining a constant water depth of 5 inches and applying 25% more nitrogen fertilizer (urea) than recommended. Standard agronomic practices were followed to cultivate the crop; however, no insecticides or plant protection measures were applied, allowing for natural pest buildup.

Plant damage assessments were made at 50 days after transplanting (DAT). Observations included total number of plants, number of infested plants exhibiting silver shoots, total tillers, and silver shoot counts at both 30 and 50 DAT. The percentage of damaged plants and silver shoots was calculated using standard formulas. Each entry was rated as resistant (R) if less than 10% plant damage was observed or susceptible (S) if the damage exceeded this threshold, following the criteria by Kalode and Bentur (1989). Based on the resistance or susceptibility reactions across the five groups, gall midge biotypes were classified as follows: Biotype 1 (R-R-R-R-S), Biotype 2 (S-R-R-R-S), Biotype 3 (R-S-R-R-S), Biotype 4 (S-S-R-R-S), Biotype 4M (S-S-S-R-S), Biotype 5 (R-R-R-S-S) and Biotype 6 (R-S-S-S-S) (Vijayalakshmi *et al.,* 2006).

Results and Discussion

A standard set of 20 rice differentials representing five groups, including entries with known resistance genes, unknown genes, and the susceptible check TN1, was evaluated during the *Kharif* season of 2022–23 and 2023–24 at the Agricultural Research Station (ARS), Gangavathi. The results showed that silver shoot (SS%) incidence, a characteristic symptom of gall midge infestation, was comparatively higher in 2022 than in 2023.

In *Kharif* 2022–23, gall midge infestation ranged from low to high across entries, with silver shoot percentages varying between 0% and 57.41%. The susceptible check TN1 recorded the highest damage at 57.41%. Among all tested groups (I to V), only Group I showed resistance, while Groups II to V including TN1 were susceptible. Within Group IV, seven differentials (RP 2068-18-3-5, ABHAYA, INRC 15888, RP 5925-24, RP 5922-21, RP 5923, and INRC 17470) were susceptible, while INRC 3021 and INRC 302110 exhibited lower silver shoot incidence at 0% and 3.88%, respectively. During *Kharif* 2023–24, gall midge infestation levels ranged from low to moderate. The silver shoot percentage ranged between 0% and 31.79%, with TN1 recording 31.79% damage (Table 1). In Group IV, seven differentials again showed susceptibility, while INRC 3021 and Aganni had low silver shoot percentages of 3.21% and 4.04%, respectively.

Analysis of the reactions of the 20 rice differentials revealed a consistent resistance pattern of R-S-S-S-S, corresponding to Biotype 6. ARC 6605 exhibited complete resistance, followed by INRC 3021 (1.61%) and Aganni (3.99%)(Table 2). These results align with previous findings by Vijay Kumar *et al.* (2008), who reported Biotype 1 (R-R-R-S) in other parts of Karnataka. However, the current findings confirm the presence of Biotype 6 (R-S-S-S-S) in the TBP command area, consistent with the classification system by Vijayalakshmi *et al.* (2006). The study also showed that Group IV entries, particularly ARC 6605, INRC 3021 (Gm8), and Aganni (Gm8), were promising in terms of resistance. Nonetheless, the virulence observed in entries like Aganni and INRC 3021 suggest that the local gall midge population may be evolving to overcome Gm8-based resistance. This highlights the need for ongoing surveillance and further testing under both field and greenhouse conditions to inform resistance breeding and integrated pest management strategies.

The current study at ARS, Gangavathi, was aimed at determining the prevailing biotype of rice gall midge in the TBP command area through the use of 20 standard rice differentials. The consistent reaction pattern of R-S-S-S-S across two consecutive *kharif* seasons clearly indicates the presence of Biotype 6 in this region. Notably, Biotype 6 is known for its ability to overcome resistance in several differential lines, especially those in Groups II, III, IV, and V. Although entries such as ARC 6605, INRC 3021, and Aganni showed promising levels of resistance, the moderate susceptibility observed in the latter two suggests the emergence of virulence against the Gm8 gene. This aligns with earlier concerns regarding the adaptation of gall midge populations to deployed resistant genes (Bentur *et al.,* 2009; Vijayalakshmi *et al*., 2006). Comparatively lower infestation levels in 2023–24 may be attributed to climatic variability or natural fluctuations in pest populations. However, the overall trend reflects a shift in the virulence spectrum of the local gall midge population, warranting continuous monitoring.

Conclusion

The field evaluations conducted over two seasons at ARS, Gangavathi, confirmed the presence of rice gall midge Biotype 6 (R-S-S-S-S) in the TBP command area. While ARC 6605 demonstrated strong resistance, the partial susceptibility of INRC 3021 and Aganni both carrying the Gm8 gene suggests the beginning of resistance breakdown. This highlights the importance of regular monitoring and biotype mapping to support effective resistance breeding strategies. Given the observed virulence trends, it is recommended that both field and greenhouse studies be expanded to further validate these findings. Incorporating multiple resistance genes and diversifying pest management approaches will be essential for sustaining long-term control of gall midge in rice-growing regions. Molecular Characterization of Virulent Biotypes and Conduct multi-location and multi-season surveillance of gall midge populations across the TBP command area and adjoining regions to track biotype dynamics will need to be conducted in future studies.

Table 1 : Reaction of differentials to gall midge population at ARS, Gangavathi during *Kharif* - 2022 and 2023

Group	Entry No.	Differential	Gene	2022		2023	
				%SS	R/S	%SS	R/S
I	1	KAVYA	*Gm 1*	12.44	S	13.15	S
	2	W 1263	*Gm 1*	2.31	R	3.33	R
	3	ARC 6605	*(?)*	0	R	0	R
II	4	PHALGUNA	*Gm 2*	4.39	R	4.97	R
	5	ARC 5984	*Gm 5*	19.36	S	13.09	S
	6	DUKONG 1	*Gm 6*	49.26	S	26.28	S
	7	RP 2333-156-8	*Gm 7*	36.11	S	14.1	S
	8	MADHURI L 9	*Gm 9*	35.32	S	18.53	S
	9	BG 380-2	*Gm 10*	25.38	S	24.25	S
III	10	MR 1523	*Gm 11*	50.12	S	21.5	S
IV	11	RP 2068-18-3-5	*gm 3*	21.93	S	16.99	S
	12	ABHAYA	*Gm 4*	45.81	S	28.04	S
	13	INRC 3021	*Gm 8*	0	R	3.21	R
	14	AGANNI	*Gm 8*	3.88	R	4.09	R
	15	INRC 15888	*Gm 8*	24.31	S	14.05	S
	16	RP 5925-24	*Gm 8*	23.06	S	30.98	S
	17	RP 5922-21	*Gm 1*	36.55	S	28.1	S
	18	RP 5923	*gm 3*	34.54	S	19.26	S
	19	INRC 17470	?	24.32	S	9.18	S
V	20	TN1	*none*	57.41	S	31.79	S

Table 2 : Reaction of differentials to gall midge population at ARS, Gangavathi (Pooled data two years *i.e.,* 2022, 2023)

Group	Entry No.	Differential	Gene	%SS	SES	Biotype pattern
I	1	KAVYA	*Gm 1*	12.80	S	**R**
	2	W 1263	*Gm 1*	2.82	R	
	3	ARC 6605	*(?)*	0.00	R	
II	4	PHALGUNA	*Gm 2*	4.68	S	**S**
	5	ARC 5984	*Gm 5*	16.23	S	
	6	DUKONG 1	*Gm 6*	37.77	S	
	7	RP 2333-156-8	*Gm 7*	25.11	S	
	8	MADHURI L 9	*Gm 9*	26.93	S	
	9	BG 380-2	*Gm 10*	24.82	S	
III	10	MR 1523	*Gm 11*	35.81	S	**S**
IV	11	RP 2068-18-3-5	*gm 3*	19.46	S	**S**
	12	ABHAYA	*Gm 4*	36.93	S	
	13	INRC 3021	*Gm 8*	1.61	R	
	14	AGANNI	*Gm 8*	3.99	R	
	15	INRC 15888	*Gm 8*	19.18	S	
	16	RP 5925-24	*Gm 8*	27.02	S	
	17	RP 5922-21	*Gm 1*	32.33	S	
	18	RP 5923	*gm 3*	26.90	S	
	19	INRC 17470	?	16.75	S	
V	20	TN1	*none*	44.60	S	**S**

SS: Silver shoot, SES: Standard evaluation system

Reference

Anonymous (2024). In: Proceedings of the Brain storming session on Asian Rice Gall midge- Present status and way forward, July 4th 2023, Indian Institute of rice research.

Bentur J.S., Pasalu I.C., Sarma N.P., Rao U.P. (2003). Mishra B. Gall midge resistance in rice. DRR Research paper Series 01/2003. Directorate of Rice Research, Hyderabad, India, 20.

Bentur, J.S., Lakshmi, V., Sama, V.S.A.K., Padmavathy, Ch, Himabindu, K., (2009). Sources of resistance to the new 4M biotype of rice gall midge, *Orseolia oryzae* (Wood-Mason). *Indian J. Agric. Sci.,* **79**: 844-846.

Dutta, S.S., Divya, D., Durga Rani, Ch., Dayakar, R.T., Visalakshmi, V., Cheralu, C. *et al.* (2014). Characterization of gall midge resistant rice genotypes using resistance gene specific markers. *J. Exp. Biol. Agric. Sci.,* **2**(4):440-446.

FAO- Food and Agricultural Organisation. (2016). FAOSTAT: Information system on food and agriculture. FAO, Rome.

Heinrichs, E.A., Pathak, P.K. (1981). Resistance to the rice gall midge, *Orseolia oryzae* in rice. *Int. Trop. Insect Sci.,* **1**(2):123-132.

Singh, M.P. (1996). Identification of rice cultivars/donors resistant to gall midge biotype occurring in Manipur. *Indian J. Hill Farming,* **5**:17-25.

Srinivas, C., Narsimha, R.V., Seshagiri, R.P., Ramesh, P. (1994). Rice gall midge, *Orseolia oryzae* (Wood-Mason) biotype in Karimnagar District, Andhra Pradesh, India. *Int. Rice Res. Notes* (Philippines).

Lingaraj, V.K., Chakravarthy, A.K. and Eregowda, T.N. (2008). Detection of Asian rice gall midge (*Orseolia oryzae*) biotype1 in the new locations of Karnataka, South India. *Bull. Insectology*., **61**(2): 277-281.

Vijaya, L.P., Amudhan, S., Himabindu, K., Cheralu, C., Bentur, J.S. (2006). A new biotype of the Asian rice gall midge, *Orseolia oryzae* (Diptera: Cecidomyiidae) characterized from the Warangal population in Andhra Pradesh, India. *Int. J. Trop. Insect Sci.,* **26**: 207-211.