https://doi.org/10.29321/MAJ.10.A03256

Madras agric. J. 64 (11) : 733—739, Nov., 1977

Studies on Resistance and Mass Rearing of Rice Gall Midge *Orseolia (Pachydiplosis) oryzae* (Wood-Mason)*

M. B. KALODE[1], D. J. POPHALY[2], P. R. KASI VISWANATHAN[3] and M. SREERAMULU[4]

Attempts were made to develop suitable techniques for continuous mass rearing of gall midges and screening of varieties under artificial infestation in greenhouse conditions. Studies on the biology showed that majority of the gall midge males and females emerged before and after mid-night, respectively. There was a distinct perference to leaf sheath and leaf blade than the auricle for ovi-position. The total period taken from egg to adult emergence was 23 to 25 days, except during the cooler months.

Infestation of 120 seedlings at 12 to 15 days age with 10 females and 5 males of gall midge was found adequate and rapid for mass screening of the varieties. Resistance of some of the rice cultures/varieties to gall midge was confirmed under green-house conditions.

The rice gall midge, *Orseolia (Pachydiplosis) oryzae* (Wood-Mason) is a serious pest in several countries in Asia and Far East, causing considerable damage. In the past, the insect was found to occur only during *kharif*, but of late, the damage had been noticed even in the *rabi*, in certain parts of India (Kalode and Kasi Viswanathan, 1976). The damaged tillers are stunted and develop tubular structures, commonly called "silver shoots".

Although attempts have been made to control this pest by using insecticides and by developing resistant varieties, the information obtained in most cases, is not consistent, as the studies were carried out under varying levels of infestation under field conditions. Eventhough earlier workers (Parera and Fernando, 1967; and Leaumsang *et al.*, 1968) reported mass rearing techniques, there was no evidence of such technique to provide enough insects for carrying out a continuous mass screening programme for resistance. Experiments were hence undertaken at All-India Coordinated Rice Improvement Project, Hyderabad to obtain further information on the biology of the insect and to compare and develop suitable techniques for continuous mass rearing and resistance studies.

MATERIALS AND METHODS

The initial population of gall midge (20 females : 17 males) collected from infested plants from AICRIP fields

---

* AICRIP Publication No. 131

1. Entomologist, 2. Research Assistant, 3. Research Fellow and 4. Research Assistant All-India Coordinated Rice Improvement Project, Rajendranagar, Hyderabad 500030 (Andhra Pradesh).

was maintained under air-cooled green house conditions on the susceptible variety, Taichung (Native)1. The general population was then developed by infesting T(N)1 potted plants with gall midge adults in suitable cages placed in zinc trays filled with water upto 3-4 cm depth to maintain proper humidity. After 24 hours, the ovi-posited seedlings in pots were transferred to the humidifying chamber, where more than 90 per cnet relative humidity was maintained with the help of humidifier (Model : Walton Humidifier, Walton Laboratories, USA). Four days after exposure under high humidity, the pots were transferred to another chamber for further development. As soon as the silver shoots were noticed the potted plants were transferred to rearing cages for collection of the adults. This general procedure for the maintenance of the infested plants and for hatching of eggs was kept uniform throughout.

In order to study the perference and extent of damage by gall midge, ten varieties, viz, RPW 6-13, RPW 6-17, RP 9-4, RP 9-6, and Taichung (Native)1 in one set and Ptb 18, Kakatiya, Eswarakora, CR 57-MR 1523 and Jaya in anothur set, were planted randomly in a wooden flat (50 x 40 x 8 cm) @ five seedlings / variety. When the seedlings were 20 days old, they were exposed to 20 females: 10 males of gall midge as per procedure described earlier. The observations were taken on the number of insects alighting on seedlings at 4 and 8 hours after the release and extent of damage caused after 44 days of infestation.

RESULTS AND DISCUSSION

I. Life history studies: The infested plants kept in the rearing cages were observed carefully for emergence of the gall midge adults during 6.00 PM to 9.00 AM. It is evident from Table I that majority of the males (104) emerged between 6.00 PM to 12.00 mid-night, while most of the females emerged after the mid-night. These results are in conformity with the observations made by Leaumsang *et al.* (1968), but different from Hidaka *et al.* (1974), who reported peak emergence period as 10 to 11 PM for gall midges, based on field observations.

The adults copulated soon after emergence and laid eggs in the following nights singly or in group of 3 to 7. More than 75 per cent of the eggs were laid during first night after emergence. Greater percentage of eggs was noticed on the leaf sheath (43.7) than on the leaf blade (42.0) or auricle (14.3). However, according to Parera and Fernando (1968), the eggs were predominantly laid on leaves with very few upon the leaf sheaths.

The mated females laid from 13 to 319 eggs with an average of 124.1 eggs and survived for an average period of 33.1 hours. Unmated females lived for a longer period of 56 hours and laid on average 16 unfertilized eggs (Table I). The longevity of males varied from 23 to 30 hours.

The fertilized eggs developed black eye-spots by the third day and hatched within the next 24 hours. As many as seven maggots were noticed feeding on

TABLE I. Emergence, oviposition and longevity of gall midge, *Orseolia (Pachydiplosis) oryzae*. green house conditions

(a) Emergence

No. of adults observed	Time of adult emergence					
	6 - 7 P.M.		11 - 12 (mid-night)		8 - 9 A.M.	
	F	M	F	M	F	M
324	7	29	1	75	201	1

(b) Oviposition site

No. of eggs studied	Site of oviposition and % eggs laid on			
	Leaf sheath	Leaf blade		Auricle
		Dorsal	Ventral	
432	43.7	16.0	26.0	14.3

(c) Fecundity and Longevity

No. of females studied	Average eggs laid per female	No. of adults studied	Average longevity (hours)	
			F	M
18 (mated)	124.1	52 (mated)	33.1	23.1
3 (unmated)	16.0	6 (unmated)	56.0	30.0

the growing point five days after oviposition, but only one adult was found emerging from each silver shoot. Under normal conditions (August-September), the immature stages took on an average, 19 to 21 days to reach the adult stage, but in cooler months (December-January) it took 32 to 39 days.

The total life cycle varied from 19 to 39 days and sex-ratio fluctuated from 1.2 to 3.9 females to one male in different months (Fig. 1). Similar observations were made by Leaumsang *et al.* (1968) and Hidaka *et al.* (1974) on the total period of life cycle.

II. Comparison of techniques for mass rearing of gall midge: Earlier workers suggested various methods, viz., (a) infestation with eggs applied in between rows of plants, (b) release of adults, (c) infestation with eggs on the plant after spraying with water.

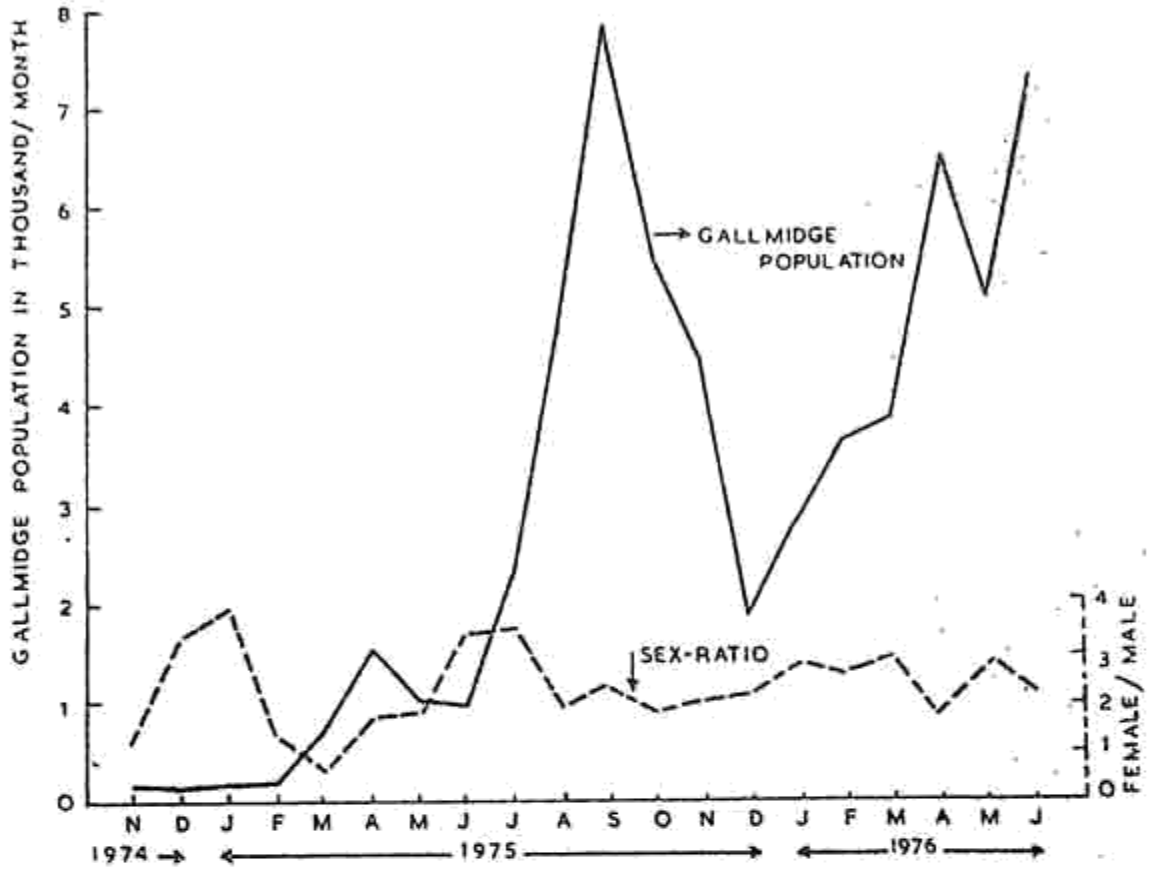

FIG. 1. Population fluctuation and sex ratio of gall midge reared on T(N)1 under green house condition (1974 to 76)

(a) **Infestation using eggs :** The eggs obtained by the method described by Parera and Fernando (1968) were kept in a desiccator under 100 per cent relative humidity. After three days, those with black eye-spots were used for inoculation. When the eggs were put in standing water at the rate of 15 eggs per pot containing five seedlings (1 month old), no seedling showed silver shoot even 40 days after infestation. However inoculation with eggs on auricle manifested silver shoots. A minimum of two eggs per seedling were necessary and with this technique silver shoots were observed in 84 per cent of the seedlings tested. Although infestation with the eggs on the plant was reported to be a satisfactory method for screening the varieties by Misra and Kulshrestha (1971), it is a tedious process and may be useful only for a limited screening programme in the absence of mass culture of gall midges.

(b) Infestation using adults:

(i) **Dense population of seedlings:** Pots (20 cm diameter) consisting of 700 seedlings (10 day old) were infested with 10 females and five males per pot. After eight days the seedlings were uprooted and transplanted at the rate of 3-4 seedlings per hill. In this technique although the surviving seedlings (50 per cent)showed

100 per cent manifestation of silver shoot the technique may not be suitable for mass rearing because of the low survival in the transplanted seedlings.

(ii) **Age of seedlings:** Parera and Fernando (1968) and Misra and Kulshrestha (1971) recommended 10-14 and 20-25 day old seedlings respectively as suitable for the development and emergence of both males and females. In order to ascertain a suitable age of the plant for mass culture of gall midge, 150 seedlings were grown in wooden flats (52 x 28 x 14cm) for 10, 15, 20 days separately. The seedlings in each flat were then infested with 10 females and five males of gall midge. Twenty day old seedlings at the time of infestation were the best for a high recovery of the adults. By adopting this method a high population ranging from 4 to 7 thousands was obtained even during summer months (Fig. 1).

III. Standardization of techniques for mass screening of varieties for resistance:

(a) **Rate of silver shoot emergence :** The time required for the occurrence of silver shoot in two different periods, viz., August-September and December-January was assessed.

During August-September there was a daily emergence of silver shoots from 16th day (onwards and 9.5per cent of the silver shoots were formed by 27th day) after infestation in Taichung (Native) 1. On the other hand, in cooler months (December-January), a minimum period of 30 days was required for initiation of the silver shoots and all the silver shoots were produced in 38 days in three susceptible varieties viz., T(N)1, Jaya and IR 26 (Fig. 2).

The results revealed that under greenhouse conditions final observations on the damage reaction in the test varieties could be stopped by 25-27th and 37-38th day in August-September and December-January, respectively.

(b) **Effect of different levels of gall midge population on silver shoot production:** It was found that even with a low level (5 females : 3 males) of gall midge population, more than 80 per cent of the seedlings [Taichung (Native 1] manifested silver shoot indicating that this level of population is adequate to identify the susceptible varieties in the mass screening test.

In another experiment 15-day seedlings of selected resistant varieties were exposed to different levels of gall midge population (10F : 5M; 20F : 10M; 30F : 15M and 40F : 20M). None of the resistant varieties indicated silver shoot even at increased level of gall midge population (40F : 20M), T(N)1 (susceptible) indicated 100 per cent damage at all levels of gall midge populations. The studies showed that a minimum population of 10 females:five males for infesting 120 seedlings (12 varieties with 10 seedlings each) was adequate to identify varieties as resistant to gall midge.

It can be concluded that growing of test entries 4 cm apart in rows along with resistant and susceptible check

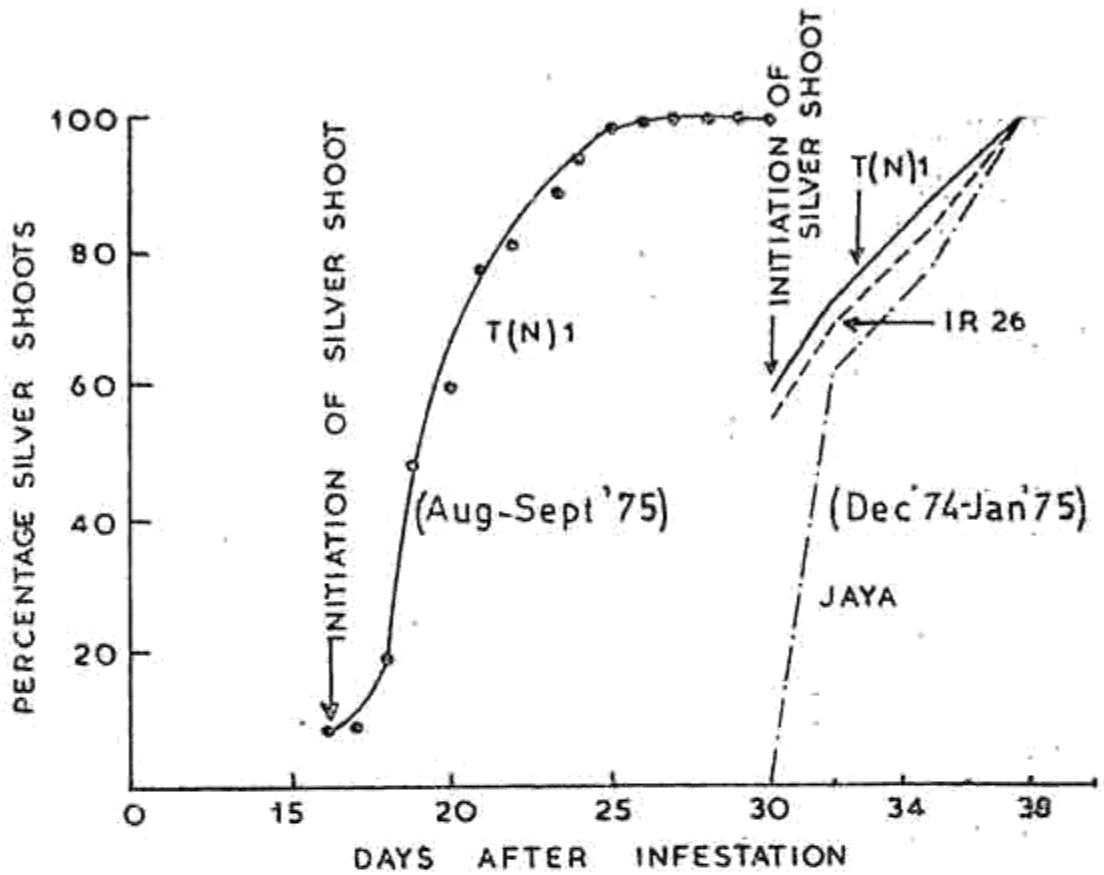

FIG. 2. Time taken for silver shoots formation after gall midge infestation in the different periods

TABLE II. Reaction of selected resistant and susceptible rice varieties to gall midge under artificial infestations

Varieties/ cultures	Cross	Average insects alighted (no.)	Plant damage after 44 days (Per cent)	Silver shoots per plant (Per cent)
Resistant				
RPW 6 - 13	IR 8 × Siam 29	2.8	0	0
RPW 6 - 17	IR 8 × Siam 29	3.0	0	0
RP 9 - 4	IR 8 × W 1251	1.8	0	0
RP 9 - 6	IR 8 × W 1251	2.0	0	0
Susceptible				
T (N) 1		4.5	86.7	3.0
Resistant				
Ptb 18		3.0	0	0
Kakatiya	IR 8 × W 1216	1.0	0	0
Eswarakora		1.3	0	0
CR 57 MRI 523	Ptb 21 × IR 8	1.8	0	0
Susceptible				
Jaya		2.8	53.3	0.9

each for 12 to 15 days in wood flats (52 x 28 x 14 cm) and then infesting them with (10F : 5M) adults was found rapid and suitable for mass screening of the varieties for resistance. By adopting this method, 300 to 400 entries per month are being screened throughout the year.

(c) **Preference and extent of damage in selected resistant and susceptible varieties :** The greater number of insects were attracted towards susceptible variety, T(N)1 followed by resistant varieties RPW 6-17 and Ptb 18, while the lowest number of insects settled on Kakatiya and Eswarakora, indicating a sort of preference for the first group of varieties (Table II). However, the resistant varieties like RPW 6-17 and Ptb 18 although had greater population did not show damage symptoms possibly due to high level of antibiosis mechanism operating in these varieties. On the other hand, comparatively low population settled on Jaya (2.8) but had damage to an extent of 53.3 per cent.

The greenhouse studies thus, confirmed the field reactions of these varieties with the gall midge population at Hyderabad, indicating the validity of the screening methodology in resistance studies to gall midge.

The authors express their sincere thanks to Dr. R. Seetharaman, Project Director, for going through the manuscript and making valuable suggestions and Dr. S. V. S. Shastry and Dr. W. H. Freeman for their keen interest and encouragement.

REFERENCES

HIDAKA, T., A. VUNGSILABUTR, and S. KADKAO. 1974. *Studies on ecology and control of the rice gall midge in Thailand.* Tech. Bull. IARI, Tokyo, Japan, pp. 1-106.

KALODE, M. B. and P. R. VISWANATHAN. 1976. Changes in relative status of insect pests in rice. *Indian J. P. Prot.* 4 : 79-91.

LEAUMSANG, P., A. BHANDAFALCK, and T. WONGSIRI. 1968. Mass rearing techniques of rice gall midge. *Pachydiplosis oryzae* (Wood-Mason) Mani and Notes on its biology. *Int. Rice Comm. News Letter.* 17 : 34-42.

MISRA, B. C., and J. P. KULSHRESTHA. 1971. Screening for green leafhopper and gall midge resistance in rice. *Oryza* 8 : 145-52.

PARERA, N., and H. E. FERANDO. 1968. Laboratory culture of rice gall midge, *Pachydiplosis oryzae* (Wood-Mason) *Bull. Ent. Res.* 58 : 439-54.