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Study on varietal preferences and seasonal incidence of parasitoids of rice pests

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ABSTRACT: The egg masses of yellow stem borer, larvae of leaf folder and rice horned caterpillar and eggs of ear head bug were collected randomly at fortnightly interval from four different varieties *viz*., CO 43, CO 50, CO 51 and CR 1009 from the rice field. The data was pooled and per cent parasitization was calculated to find out the varietal preference and seasonal variations of parasitoids. Among the four different varieties tested for the preference of parasitoids, per cent parasitization of stem borer egg mass was found to be more (26.59) in CO 50. The per cent parasitization of leaf folder larvae and rice horned caterpillar was found to be maximum in CO 51(40.29) and CO 43(33.21), respectively. In case of ear head bugs, the egg parasitization was maximum (27.70) in CO 50. The mean egg mass parasitization of stem borer was highest (71.88) in first fortnight of December. The larval parasitization of leaf folder and rice horned caterpillar were found to be maximum during the second fortnight of December (64.3) and the first fortnight of January (71.88), respectively. The parasitism rate of ear head bug eggs was maximum (62.95) during the second fortnight of December. Interestingly, phoresy exhibited by *Sceliocerdo* sp. an egg parasitoid of *Neorthacris* sp. was also recorded.

KEY WORDS: Rice, varieties, preferences, parasitoids, seasonal variations

INTRODUCTION

In India, rice is not just a food stuff, but a culture. Tamil Nadu, one of the leading rice growing states in India, has been cultivating rice from time immemorial as this state is endowed with all favourable climatic conditions suitable for growing rice. Insect pests are reported as the major threat to rice production and the overall losses due to insect pest damage in rice is estimated as 25 per cent (Pathak and Dhaliwal, 1981; Dale, 1994). Farmers generally rely on insecticides to combat pest problems. Indiscriminate use of insecticides resulted in the loss of biodiversity of beneficial organisms like parasitic hymenopterans (Dudley *et al.,* 2005). Reducing the mortality of parasitic hymenopterans caused by insecticides is essential for greater sustainability in rice pest management (Heong and Hardy, 2009; Gurr *et al*., 2011). If the use of insecticides is to be reduced through Integrated Pest Management, then the consequent reduction in pest control has to be augmented in some way and no

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doubt, parasitic hymenopterans are the best alternatives to pesticides. They show greater stability to ecosystem than any group of natural enemies of insect pests because they are capable of living and interacting at lower host population level. To aid this means of pest control, it is essential that the diversity and host range, varietal preferences and seasonal incidence of parasitoids needs to be studied first (Dey *et al.,* 1999). Despite their importance, our understanding of their biology and diversity is clearly wanting. Therefore, more emphasis should be given for the identification, conservation and use of parasitic Hymenoptera in insect pest management programmes. This will render high economic returns to the farmers besides sustainable ecofriendly pest management.

Wagge (1991) has pointed out that it is fundamentally important to conserve a large reservoir of parasitic hymenopteran diversity, regardless of what we know about the taxonomy or biology of that reservoir, because we can not predict which species might become pest in the future. We will not make any real progress in our understanding of parasitic Hymenoptera without additional commitment to research. Any additional knowledge in seasonal incidence, biology, host range is of potential practical value. In these context, the present study was undertaken.

MATERIALS AND METHODS

The egg masses of yellow stem bores, larvae of leaf folder and rice horned caterpillar and eggs of ear head bug were collected randomly at fortnightly interval from four different varieties viz., CO 43, CO 50, CO 51 and CR 1009 from the rice field of Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore during December 2016 to May 2017. The collected host insects were placed in suitable emergence cages/ vials and Petri dishes are monitored for the emergence of parasitoids. Emerged were preserved in 70% ethyl alcohol. The dried specimens were mounted on pointed triangular cards and studied under a Stemi (Zeiss) 2000-C and Photographed under Leica M 205-A stereo zoom microscope and identified through conventional taxonomic techniques by following standard keys. In addition, help was also taken from already identified collection of parasitoids at Parasitoid Taxonomy Lab, Annamalai University, Chidambaram. Identified collections are deposited at Insect Biosystematics lab, Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore.

The data was pooled and per cent parasitization was calculated to find out the varietal preference and seasonal variations of parasitoids. The statistical test ANOVA was also used to check whether there was any significance in varietal preferences of parasitoids and seasonal variations among them. The data on per cent were transformed into arc sine before statistical analysis. The per cent parasitization from four different varieties and per cent parastization among six months were analyzed by adopting Randomized block design (RBD) to find least significant difference (LSD). Critical difference (CD) values were calculated at five per cent probability level. All these statistical analyses were done using Microsoft Excel 2016 version and Agres software version 3.01.

RESULTS

In the present study, major parasitoids of egg masses of rice stem borer, larvae of rice leaf folder, larvae of rice horned caterpillar and egg masses of rice ear head bug were identified *viz*., *Tetrastichus schoenobii* Ferriere, *Goniozus indicus* (Ashmead), *Pediobius inexpectatus* Kerrich, and *Gryon orestes* (Dodd) respectively (Fig. 1-4). Among the four different varieties tested, per cent parasitization of stem borer egg mass was found to be more in CO 50 (26.59) followed by CR 1009 (26.25). The per cent parasitization of leaf folder larvae was found to be maximum in CO 51 (40.29) followed by CO 50 (38.12). CO 43 and CR 1009 were found to be almost on par with each other. The parasitization efficiency in rice horned caterpillar was more in CO 43 (33.21%) followed by CR 1009 (30.29%). In case of ear head bugs, the egg parasitization was maximum in CO 50 (27.70%) followed by CO 51 (24.31%) (Table 1). The per cent parasitization by rice parasitoids was comparatively higher in case of CO 50 and CO 51 for stem borer, leaf folder and ear head bug, whereas it was less in rice horned caterpillar;

although no statistical significance was observed amongst any of the varieties and pest incidence.

There was no statistical significance difference in the per cent parasitizaton of parasitoids (Table 2). However egg mass parasitization of stem borer was the highest in first fortnight of December (71.88%) followed by December second fortnight (44.74%) and from January, it started declining and reached a peak at first fortnight of March (31.59%) and reached nil during May. The larval parasitization of leaf folder was found to be maximum during the second fortnight of December (64.3%) and was comparatively nil during second week of January. The parasitization of rice horned caterpillar reached its peak during the first fortnight of January (71.88%) and the least during second fortnight of April (6.25%). Egg parasitization of ear head bug was observed from December to May except second fortnight of January and first fortnight of April. The parasitism rate of ear head bug eggs was maximum in second fortnight of December. It started declining from fortnight of March and found nil parasitism during first fortnight of April (Fig. 5). So it is clear

Fig. 1. *Tetrastichus schoenobii* Ferriere parasitizing egg masses of rice stem borer

Fig. 2. *Pediobius inexpectatus* Kerrich parasitizing the larva of rice horned caterpillar

rice

Fig. 3. *Gryon orestes* (Dodd) emerging from the eggs of rice ear head bug

Fig. 4. *Goniozus indicus* (Ashmead) feeding on rice leaf folder larva

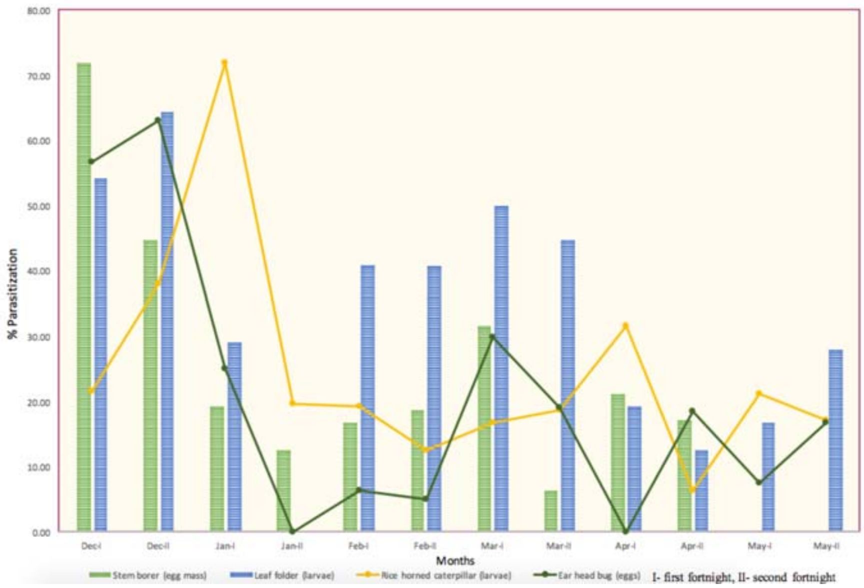

Fig. 5. Seasonal variations in per cent parasitization of different parasitoids

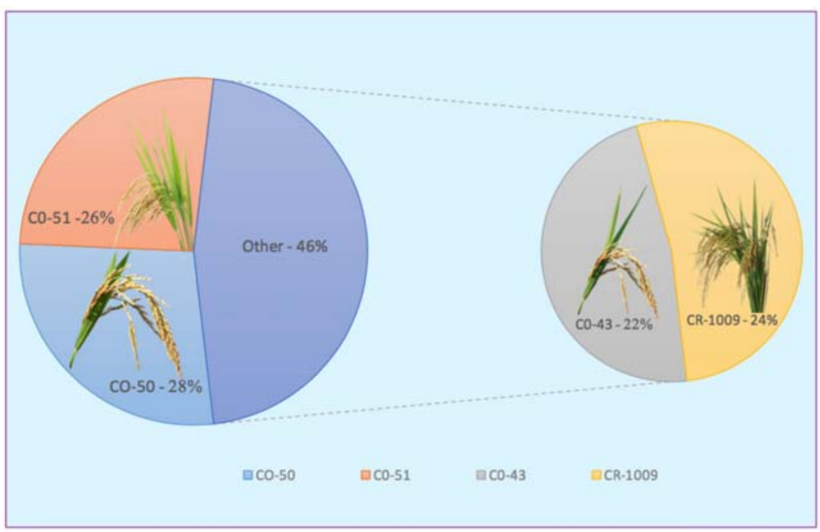

Fig. 6 Varietal preference of parasitoids from rice ecosystem (% parasitization by different parasitoids)

Fig 7. Phoresy exhibited by *Sceliocerdo* sp. on *Neorthacris* sp

that among the six months, i.e. from December to May, parasitoid activity for all the pests was maximum between December and January.

DISCUSSION

Varietal preferences of parasitoids towards the host insects in different varieties of plant species have been reported (Loughrin *et al.,* 1995; Turlings *et al.,* 1998; Krips *et al.,* 2001; Degen *et al.,* 2004).

Table 1. Varietal preference of different parasitoids on rice pests

Variety	Per cent parasitization on			
	Stem borer (egg mass)	Leaf folder (larvae)	Rice horned caterpillar (larvae)	Ear head bug (eggs)
CO 43	10.32 ± 7.64(9.62)	27.84 ± 9.85(24.74)	33.21 ± 10.04(30.24)	16.73 ± 9.35(14.65)
CO 50	26.59 ± 9.86(22.76)	38.12 ± 12.29(33.21)	17.92 ± 10.07(16.37)	27.70 ± 11.81(25.64)
CO 51	23.47 ± 9.75(22.03)	40.29 ± 11.46(35.64)	16.73 ± 9.35(14.65)	24.31 ± 9.45(23.67)
CR 1009	26.25 ± 11.98(23.72)	27.08 ± 12.10(24.20)	30.29 ± 9.65(26.16)	13.75 ± 7.52(12.69)
S.E.D	11.07	13.85	11.43	10.45
C.D (p=0.05)	22.53 NS	28.18 NS	23.27 NS	21.27 NS

Figures in parentheses are Arc sine transformed values; NS = nonsignificant.

Table 2. Seasonal incidence of parasitoids in rice ecosystem (2016 – 2017)

Months	Per cent parasitization			
	Stem borer (egg mass)	Leaf folder (larvae)	Rice horned caterpillar (larvae)	Ear head bug (eggs)
December- I	71.88 ±24.1(62.12)	54.2 ± 20.8(47.44)	21.57 ± 12.46(20.94)	56.73 ± 21.49(49.07)
December- II	44.74 ± 26.2(38.38)	64.3 ± 12.0(57.07)	37.98 ± 21 .93(30.74)	62.95 ± 19.39(56.42)
January- I	19.23 ± 19.2(15.94)	29.2 ± 23.9(28.73)	71.88 ± 24.14(62.12)	25.00 ± 25.00(22.91)
January- II	12.50 ±12.5(11.87)	0.0 ± 0.0(0.83)	19.74 ± 19.74(16.29)	0.00 ± 0.00(0.83)
February- I	16.67 ± 16.7(14.30)	40.8 ± 15.8(36.06)	19.23 ± 19.23(15.94)	6.25 ± 6.25(8.12)
February- II	18.75 ± 18.8(15.62)	40.6 ± 23.6(32.74)	12.50 ± 12.50(11.87)	5.00 ± 5.00(7.26)
March- I	31.59 ± 10.9(30.54)	50.0 ± 28.9(45.00)	16.67 ± 16.67(14.30)	29.86 ± 18.33(25.87)
March- II	6.25 ± 6.3(8.12)	44.7 ± 26.2(38.38)	18.75 ± 18.75(15.62)	19.09 ± 11.05(19.49)
April- I	21.25 ± 12.3(20.75)	19.2 ± 19.2(15.94)	31.59 ± 10.92(30.54)	0.00 ± 0.00(0.83)
April- II	17.05 ± 17.0(14.54)	12.5 ± 12.5(11.87)	6.25 ± 6.25(8.12)	18.42 ± 18.42(15.40)
May- I	0.00 ± 0.0(0.83)	16.7 ± 6.7(14.30)	21.25 ± 12.31(20.75)	7.50 ± 7.50(8.92)
May- II	0.00 ± 0.0(0.83)	27.8 ± 17.9(24.69)	17.05 ± 17.05(14.54)	16.67 ± 16.67(14.30)
S.E.D	19.18	23.99	19.81	18.11
C.D . (p=0.05)	39.03 NS	48.82 NS	40.31 NS	36.84 NS

Figures in parentheses are Arc sine transformed values; NS = nonsignificant

Many parasitoids are reported to have keen ability to learn and respond to specific odor by associating the odor emitted from host plant or host insect or host insect feces (Lewis and Tumlinson, 1988; Vet and Groenewold, 1990; Turlings *et al.,* 1993). Chemical and morphological plant attributes can directly influence the survival, fencundity, and foraging success of natural enemies on hosts. Morphological traits, such as prominent leaf veins or moderate pubescence, are reported to provide sheltered habitats for small natural enemies and promote their abundance (Drowning and Moillet, 1967; Walter and O'Dowd, 1992; Hance and Boivin, 1993; Karban *et al.,* 1995; Corbett and Rosenheim, 1996; Elkassabany *et al.,* 1996; Walter, 1996). This fact is in support of our findings (Fig. 6) which showed that the cumulative parasitization per cent of all parasitoids was comparatively higher in CO-51 and CO-50, the varieties with moderate pubescence. Such structures can supply water and shelter for parasitoids and constitute a key factor in the maintenance of their populations. A waxy surface and shape of a leaf are other morphological traits that can influence the host selection by parasitoids (Futuyma and Keese, 1992).

Only few studies have demonstrated the importance of different varieties of plants- induced odor emissions outside the laboratory (Scutareanu *et al.,* 1997; De Moraes *et al.,* 1998; Thaler, 1999; Kessler and Baldwin, 2001; Lou *et al.,* 2005; Rasmann *et al.,* 2005). One of those studies (Rasmann *et al.,* 2005) also shows that the effectiveness of the natural enemies in the field can be enhanced by planting crop varieties that emit the appropriate volatile signal from their leaves. The results reported here in the present study represent an example of varietal preferences of different parasitoids in the rice field. However, in the present study neither did the parasitoids show any significant preference for a variety nor was there any significant difference in the seasonal incidence of the parasitoids. Possibly encouraging results could have been obtained if the trials are repeated with more varieties and for more seasons. Therefore, more researches like this should be encouraged with more varieties and extended period of time to bridge the gap of the present study. Special emphasis should now be placed on breeding crop plants with natural enemy enhancing traits, thereby enhancing the parasitic potential of parasitoids in rice ecosystems.

From the present study, it is clear that among the six months, i.e. from December to May, parasitoid activity for all the pests was maximum between December and January. This is in accordance with the study conducted in Tamil Nadu Agricultural University by **Chandramohan and Chelliah (1990)** which revealed that, the peak activity of *Tetrastichus schoenobii* was seen between October to January months. They have also reported that, among the larval parasitoids, *Apanteles* sp. registered maximum parasitism during January-February months in Paddy Breeding Station, Coimbatore, the place where the present study was also conducted. The reason for the reduction of parasitization may be due to the increase in temperature in succeeding months. Increase in temperature during summer months might have impaired the parasitic activity resulting in negative association with maximum temperature. Parasitization by *T. schoenobii* in Andhra Pradesh, India was 30.6 per cent during kharif and 23.7 per cent during rabi season. But the rate of parasitization in laboratory condition, extended up to 48 per cent (**Gupta *et al.,* 1985**). *Tetrastichus* sp. was the main egg parasitoid during kharif season in Warangal, Haryana (**Rao *et al.,* 1983**). Parasitism by *Telenomus* during October and November was 26.84 per cent (Rao et al., 1976). *Telenomus dignoides* was found more during September, at Kapurthala, Punjab, whereas maximum activity of *T. dignoides* was noticed at Cuttack, Orrisa, during December. Both the incidence of egg mass and the extent of parasitism were more during rabi season (**Sukhija *et al.,* 1991**). These results are in accordance with our findings. Interestingly, phoresy exhibited by *Sceliocerdo* sp., an egg parasitoid of short horned wing less grasshopper pest of paddy, *Neorthacris* sp. on a weed from the bunds of rice fields (Fig. 7). This phoretic genera is the first report in rice ecosystem. Rajmohana (2014) have specifically mentioned that it is yet to be reported from rice ecosystem.

The majority of research related to arthropods in tropical rice has been directed towards the small number of pests and natural enemies species without examining the abiotic linkages to the rest of the system. Modern pest control tactics are mainly dependent on the exploitation of the linkages between biotic and abiotic factors to maximize pest population suppression. This can be possible only by understating the underpinnings of seasonal variations in parasitod activity.

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