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Effect of insecticides on parasitism by egg parasitoids of the rice yellow stem borer, *Scirpophaga incertulas*

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Abstract
Greenhouse studies were undertaken to study the effect of commonly used insecticides in rice against the egg parasitoids of yellow stem borer. Our study observed that *Tetrastichus schoenobii* Ferriere is an efficient egg parasitoid on rice yellow stem borer, *Scirpophaga incertulas* (Walker) followed by *Telenomus dignus* Gahan at Rajendranagar, India. The results revealed that egg mass parasitization was not effected in chlorantraniliprole and spinosad treatments. Among the two species, insecticide treatment of egg mass had less effect on *Tetrastichus* as compared to *Telenomus*. Parasitization by *T. dingus* was observed only in fipronil and cartap hydrochloride treated egg mass and was similar to the untreated control which indicated that they were safer to this parasitoid. The results can have an implication in the choice of insecticides that can be used for control of the rice pests.

Keywords: Foliar insecticides, efficacy, rice, *Scirpophaga incertulas*, egg parasitoids

1. Introduction

Rice (*Oryza sativa* L.) is one of the major food grain crops for more than two thirds of the population in India and is grown under diverse conditions of climate, soils and water. Intensive use of nitrogenous fertilizers, high yielding varieties, sequential cropping and indiscriminate use of insecticides has resulted in various insect pest problems in rice crop. Of the 100 or more species of insects known to attack rice crop, yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) (Lepidoptera: Crambidae) is the dominant species causing heavy yield losses in the range of 21-51% [8]. It is a widely distributed monophagous pest and infests the crop from seedling to maturity. The larvae of *S. incertulas* cause dead hearts during vegetative phase and white ears during reproductive phase. Rice plant can compensate for dead heart (DH) infestation but not compensate for white ear loss [12].

However, timely application of insecticides is the only and most commonly used measure for reducing pest population and mitigates the damage. Apart from chemicals, natural enemies are also important mortality factors affecting the insect pest population [13]. Egg parasitoids play an important role in population regulation of YSB by parasitizing most of the egg mass and preventing the hatching of stem borer eggs. In Andhra Pradesh, India, [3] assessed the extent of parasitism by *Telenomus* sp. at 26.84 %. In a season, 90 % of the egg mass was completely parasitized and the parasitoids recorded were *Tetrastichus schoenobii*, *Telenomus dignus* and *Trichogramma japonicum* but the extent of parasitization varied in time and space. Among these, *Tetrastichus schoenobii* was the dominant species followed by *Telenomus dignus* [5]. But here we report the effect of commonly used insecticides on the parasitization of stem borer egg mass.

2. Materials and methods

2.1 Plant material: Plants of var. TN1 were raised in the pots as per normal agronomic practice and 30 day old plants were used for experimentation**.** Eight commonly recommended insecticides for stem borer control at the recommended dose were chosen in this study along with water spray as control treatment.

Table 1: Insecticides used in the study

Chemical group	Common name	Dosage
Diamide	Flubendiamide 48 SC	24 g a.i./ha
Diamide	Chlorantraniliprole 20 SC	3 g a.i./ha.
Spinosyns	Spinosad 45 % SC	54 g a.i./ha.
Avermectins	Emamectin benzoate 2% EC	15 g a.i./ha
Phenyl pyrazoles	Fipronil 5 FS	50 g a.i./ha
Nereis toxin	Cartap hydrochloride 4 G	1 kg a.i./ha.
analogues		
Organophosphate	Monocrotophos 36 WSC	500 g a.i./ha.
Organophosphate	Chlorpyriphos 20 EC	510 g a.i./ha.

2.2 Test insects: During wet season 2012, adult female moths of yellow stem borer were collected from the field. They were released on 30 days old potted plants (27 numbers i.e., 9x3 replications) allowed to lay the egg mass. Egg mass (3 day old) were used in the present study.

2.3 Exposure of the treated egg mass

On the 4th day, insecticidal treatments as per table 1 were given on to the potted plants with egg masses. The leaf bits containing the egg masses (9 egg masses per treatment) were detached four hours after the insecticide treatment, placed in test tubes and they were pinned in the main rice field. The treated egg mass were exposed for 5 days for the natural parasitization to occur.

Later leaf bits along with egg mass were brought back to the lab, and kept singly in glass vials (5ml capacity) and allowed for the stem borer larvae and parasitoids to emerge. When insects stopped emerging the egg mass were opened under a stereoscopic binocular microscope (Nikon-SMZ, Magnification-3.35-300x) and assessed for unhatched eggs [6]. Observations were recorded on the number of larvae and the egg parasitoids of yellow stem borer that emerged from each of treated egg mass. Both egg mass parasitization and egg parasitization were quantified as some of the parasitoid species cause only partial parasitization of egg mass. The percentage of egg mass parasitized by single species, *viz., T. schoenobii* or *T. dignoides* or both were recorded and the results were calculated in percentage by using the following formula as given by [17].

$$\text{Egg parasitization (\%)} = \frac{\text{Number of parasitoids emerged}}{\text{Number of parasitoids emerged + Number of larvae emerged + Unhatched eggs}} \times 100$$

The statistical methods, OPSTAT, was adopted in the present investigations. The data was subjected to angular transformation values wherever necessary and analysed by adopting completely randomized design as suggested by [9].

3. Results and Discussion

3.1 Effect of foliar insecticide spray on egg parasitization

Egg mass parasitization: The data on egg mass parasitization after treatment with insecticide spray indicated (Table 2) that the egg mass parasitization varied from 11.11-33.33% among the various insecticidal treatments as compared to 44.44% in the untreated control though the treatments were statistically not significant. In the present study, egg mass parasitization by two species *Tetrastichus schoenobii* and *Telenomus dignus* was observed. The ratio of egg mass parasitization by *T. schoenobii* and *T. dignus* was 3:1 in untreated control. Chlorantraniliprole and spinosad treated egg mass had 33.33% parasitization by *T. schoenobii* and was on par with the untreated control indicating their safety to this parasitoid. Fipronil and cartap hydrochloride treated egg mass recorded 22.22% parasitization whereas 11.11% parasitization was observed in case of monocrotophos, chlorpyriphos, flubendiamide and emamectin benzoate treated egg mass. Parasitization by *T. dignoides* was observed only in fipronil and cartap hydrochloride treated egg mass and was on par with the untreated control (11.11%). Usually in the early part of the *kharif* season parasitization by either *Trichogramma* sp. or *Telenomus* sp either alone or in combination is observed. As the season advances the species changes to *Telenomus* or *Tetrastichus* either alone or in combination. So the parasitoid observed depends on the time of observation.

Egg parasitization: From the results it is evident that all the insecticide sprays had affected the egg mass parasitization. Parasitization by *T. schoenobii* was observed in all the treatments but the extent varied from 11.1-33.3 % suggesting that the parasitoid had a fair level of tolerance to insecticide application. The number of *Tetrastichus* adults that emerged from a single parasitized egg mass varied from 11-40 with a maximum of 40 in untreated control and minimum in monocrotophos treatment. Parasitization by *T. dignoides* was observed in four treatments *viz*., Chlorantraniliprole, spinosad, fipronil and cartap hydrochloride which indicated that they were relatively safer to this parasitoid. From each parasitized egg mass, 20-31 *Telenomus* adults emerged (Figure1). This species was sensitive to chlorpyriphos, monocrotophos, and fipronil treatments. But surprisingly in our study we could observe parasitization by one species alone at a time though a combination of 2-3 parasitoids in an egg mass was observed in earlier studies. It was also observed that parasitoids emerged late as compared to larvae and there were no unhatched eggs in the egg mass.

The most prevalent spp. in rice ecosystem are *Trichogramma minutum*, *T. schoenobii, Tetrastichus israeli* and *T. dignus* but the relative abundance of each of the species varies in time and space. The present study was conducted in the month of October 2nd week during which more number of egg mass were parasitized by *T. schoenobii.* Our studies corroborate with the findings of [11] who observed that the parasitization of YSB egg mass was more during the months of June to December. Also [2] reported that the relative abundance of parasitoids of paddy pests was more during August to October after which the numbers started declining in the field. Most dominant among the superfamilies recorded were Ichneumonoidea and Chalcidoidea. [7] reported that *T. schoenobii* and *T. rowani* to be the predominant egg parasitoids of YSB in lowland rice. [17, 16] found that parasitization by *Tetrastichus sp.* dominated during the later phase of crop growth (15.32% to 71.66%) and reached maximum in the third week of October. Parasitization by *T. schoenobii* in the egg mass treated with chlorantraniliprole and spinosad was on par with the untreated control indicating that they were safer to *T. schoenobii.* [10] recorded that chlorpyriphos treated plots (2.5 lit ha-1) showed more parasitized eggs followed by quinalphos, fenthion and phosphomidon. [14] also reported that monocrotophos was moderately toxic to *T. dignoides*. Fipronil [1] and certain neem formulations [5] were reported as non toxic to *T. japonicum*. [15] reported that cartap hydrochloride was safe and selective to the egg parasitoid *T. dignoides* [4] found that flubendiamide was safe to parasitization and adult emergence of *Trichogramma chilonis*. Our studies corroborate the findings of earlier workers who showed that fipronil and cartap hydrochloride act as effective ovicide as well as larvicide against the yellow stem borer to a satisfactory level and were safer to *T. schoenobii* and *T. dignus*. The information generated in the present study will help in recommending suitable and safer insecticides with reference to the parasitoid species prevailing at a location

Table 2: Effect of foliar insecticide sprays on parasitization of YSB egg mass

S. No		Total egg mass parasitization	Parasitoids species identified per egg mass		
	Insecticide Treatments	**(%)**	**A**	**B**	**Ratio of A:B**
1.	Flubendiamide	11.11 (11.74)	*T. schoenobii*	Nil	1:0
2.	Chlorantraniliprole	33.33 (29.79)	*T. schoenobii*	Nil	2:0
3.	Spinosad	33.33 (29.79)	*T. schoenobii*	Nil	2:0
4.	Emamectin benzoate	11.11 (11.74)	*T. schoenobii*	Nil	1:0
5.	Fipronil	22.22 (18.23)	*T. schoenobii*	*T. dignus*	1:1
6.	Cartap hydrochloride	22.22 (18.23)	*T. schoenobii*	*T. dignus*	1:1
7.	Monocrotophos	11.11 (11.74)	*T. schoenobii*	Nil	1:0
8.	Chlorpyriphos	11.11 (11.74)	*T. schoenobii*	Nil	1:0
9.	Untreated control	44.44 (41.79)	*T. schoenobii*	*T. dignus*	3:1
	SEm±	10.392			
	CD at 5% L.S	N.S			

Sample size : 9 egg mass/treatment : Age of the egg mass - 4 day old
EM The values in parentheses are arc sine transformations

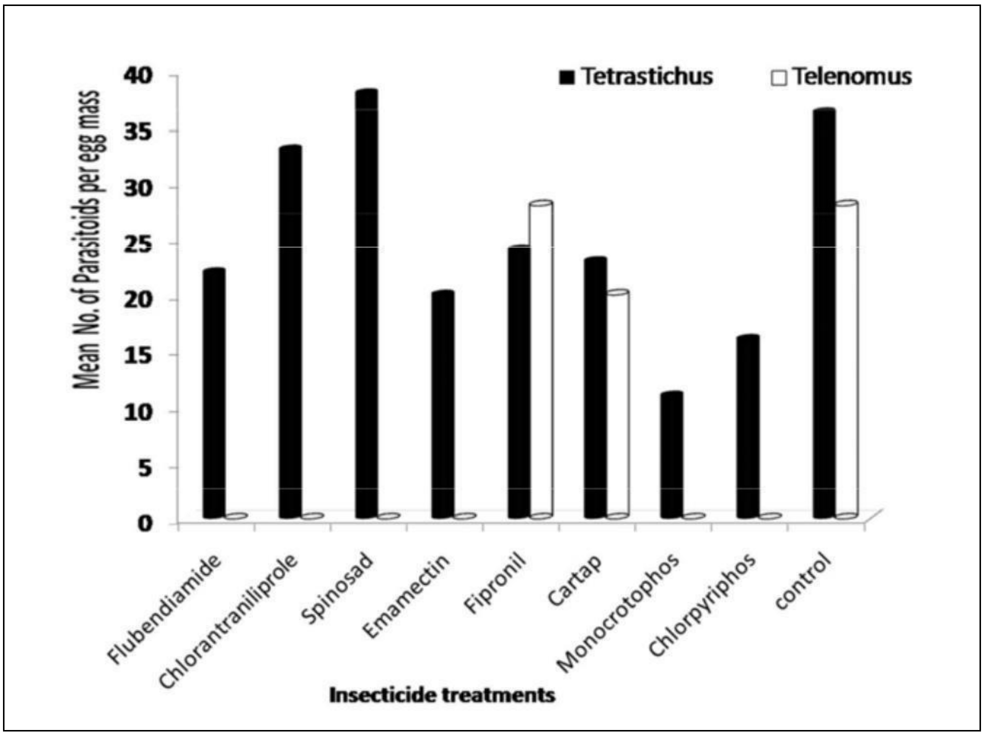

Fig 1: Effect of insecticides on emergence of parasitoids from YSB egg mass

4. Conclusion

From the results it can be concluded that chlorantraniliprole and spinosad treatments did not effect stem borer egg mass parasitization by *Tetrastichus schoenobii* and *Telenomus dignus* Among the two species, insecticide treatment of egg mass had less effect on *Tetrastichus* as compared to *Telenomus*. Parasitization by *T. dingus* was observed only in fipronil and cartap hydrochloride treated egg mass and was similar to the untreated control which indicated that they were safer to this parasitoid.

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