Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(2): 804-807

Received: 11-01-2018
Accepted: 12-02-2018

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Influence of different stages of rice crop on yellow stem borer, *Scirpophaga incertulas* (Walker) and its egg parasitoids

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Abstract
A preliminary data was generated to ascertain the damage by stem borer at different age of rice crop and efficiency of its natural egg parasitoids at different stage of crop. The study was carried during August 2016 to May 2017 in the variety CO 51 at different age *viz*., 30, 45, 60, 75 and 90 DAP. The results revealed maximum dead heart damage (10.47%) at 60 DAP and minimum (3.98%) at 45 DAP. Four different egg parasitoids were recorded *viz*., *Telenomus* sp., *Tetrastichus schoenobii, Trichogramma japonicum, Trichomalopsis* sp. The influence of crop age on individual egg parasitization revealed highest parasitization of *T. schoenobii* (40.64%) followed by *Telenomus* sp. (19.69%) at 30 DAP while that of *T. japonicum* (1.65%) and *Trichomalopsis* sp. (0.87%) during 45 DAP. Total eggmass parasitisation was also highest at 30 DAP (34.48%). The stem borer damage was minimum in the crops while the egg parasitoids were higher.

Keywords: rice, different stages, yellow stem borer, egg parasitoids, parasitization

1. Introduction
Rice (*Oryza sativa* L.) is the most widely consumed staple food for a large part of the world's human population especially in Asia. It is the agricultural commodity with the third highest worldwide production. Almost 90 per cent of the rice is grown and consumed in Asia [1]. Out of 722.22 MT production of rice in the world, Asian countries shared 653.83 MT and India shared 157.90 MT contributing 22 per cent of world's and 24 per cent of Asian countries rice production [2]. The productivity of this crop is being affected by various factors that include biotic and abiotic. Among these factors insects play a major role in causing considerable loss to the crop. In India, approximately 100 insect pests have been reported as pests of rice and 20 of them are considered to be major pests causing 30 per cent yield loss. Stem borer is one among the major pests having an inevitable role in causing intense damage to the rice crops all over the world [3]. Almost 21 species of lepidopteran stem borers have been recorded as rice pests throughout the world. Of these 8 species are known to occur in India [4, 5]. As the stem borers attack the crop at all stages right from seedling to maturity, it's important to know the stage that is highly susceptible. This information will help determine timing to initiate pest control activities. The present study was carried out to know the influence of different age of rice crop on yellow stem borer, *Scirpophaga incertulas* (Walker). Attempts were also made to know the influence of age of rice crop on yellow stem borer egg parasitoids.

2. Materials and Methods
2.1 Study Area
The study on influence of age of the rice crop on stem borer damage and on egg mass parasitisation was carried out at both the *kharif* and *rabi* seasons (August 2016 to May 2017). The study was conducted in the fields located at Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore with the short duration, high yielding, popular variety CO-51.

2.2 Incidence of stem borer at different age of the crop
Rice crop *var*. CO-51 were raised in the field in such a way that different age crops were available at same period during kharif and rabi season in 10 cent area. The field was maintained with recommended agronomic practices without use of chemical insecticides through the period. The rice crops at different age groups *viz.*, 30 DAP, 45 DAP, 60 DAP, 75

DAP and 90 DAP were observed. The crops of age group 30 DAP and 45 DAP were considered as vegetative stage, 60 DAP to 75 DAP as reproduction stage and above 75 DAP as ripening stage as the variety CO 51 is a short duration variety. Randomly 10 plots were selected in a field and in each plot 5 plants were selected to record the stem borer damage. At vegetative stage of the crop dead heart and at reproductive stage white ear were observed. Then dead heart and white ear per cent at each plot was calculated by using the standard formulae [6]. Finally the data of every age group was pooled and their mean was worked out.

$$\text{Dead heart (\%)} = \frac{\text{No. of dead hearts}}{\text{Total no. of tillers in the particular hill}} \times 100$$

$$\text{White ear (\%)} = \frac{\text{No. of white ears}}{\text{Total no. of productive tillers in the hill}} \times 100$$

2.3 Influence of age of the crop on egg mass parasitization

The egg masses of yellow stem borer were collected from different age of crop *viz*., 30 DAP, 45 DAP, 60 DAP and 75 DAP from the rice field. Around 20-25 egg masses were collected along with the leaf bits, were placed singly in small vials and kept in the laboratory. The vials were periodically monitored for the emergence of egg parasitoids. Species of parasitoids was also noted. The emerged parasitoids and the stem borer larvae were counted under a compound microscope. Then the egg masses were dissected to count the unemerged parasitoid adults, pupae and unhatched yellow stem borer larvae (SB larva) and included in the totals while analyzing the data. The data were then pooled and the percent parasitization was calculated using the formula [7].

$$\text{Parasitization \%} = \frac{\text{Number of parasitoids emerged}}{\text{Number of parasitoids emerged + SB larvae hatched + unhatched eggs}} \times 100$$

Influence of age of the rice crop on both the total egg mass and individual egg parasitisation was observed.

2.4 Statistical analysis

Statistical analysis was performed for both the field and laboratory conducted experiments. Standard deviation was calculated with the help of MS excel (Windows XP) and standard error was worked out for the stem borer damage at different age of crop and egg mass parasitisation.

3. Results and Discussion

The results of the study on influence of age of the crop on stem borer damage highlighted that the crop at 60 DAP, the reproductive stage recorded more dead heart damage of 10.47 per cent whereas 30 DAP and 45 DAP crops had 4.83 and 3.98 per cent damage respectively (Table 1, Fig. 1). Minimum of 3.98 per cent damage during the vegetative stage of the crop (45 DAP) might be due to their active growth and compensation effect of the damaged tillers. The crop of 90 DAP (ripening stage) had maximum white ear damage of 5.52 per cent. Nonetheless at reproductive stage 60 DAP and 75 DAP also had white ear damage more than the ETL. It is clear that stem borer damage effect is minimum during the early stage of the crop after transplanting and it has more impact during the late stages. This was in agreement with the findings [8] where it has been mentioned that the susceptibility of early maturing varieties increase 9th week after transplanting which is around 60 DAP. It was reported that they had resistance at 4 to 7th week after transplanting which lies around 30 and 45 DAP. It was observed by [9] that yellow stem borer occurred in two broods, first peak during last week of September and second peak during second week of September which coincided with dough stage of *kharif* season crop. According to the report of [10] *kharif* season had less incidence of yellow stem borer than *rabi* season. Similarly the stem borer damage was nil or less in early sown crops as compared to late sown crops and the yield was maximum in the early sown crop. Rana *et al.* [11] revealed that the peak period of pooled maximum dead hearts (9.46%) of *kharif* seasons 2014 and 2015 was recorded in 35th standard week and the pooled maximum white ears (8.48%) infestation was recorded during both the seasons at 40th standard week. But in contrast, Verma *et al.* [12] observed three peak periods of *S. incertulas* moth activity during *kharif* season (July, August, September) and two during *rabi* season (January and March/April) at Andhra Pradesh and concluded that late planted crop was more affected than the early planted crop.

Influence of age of the crop on the total egg mass parasitization and individual egg parasitization studies revealed that the total egg mass parasitization was highest in the crop at early vegetative stage, 30 DAP (34.48%) followed by 45 DAP (30.47%), 75 DAP (20.28%) and 60 DAP (18.56%) (Table 2; Fig. 2). Individual egg parasitization by *Telenomus* sp. (19.69%) and *T. schoenobii* (40.64%) was also highest in the egg masses collected from the early vegetative stage of the crop. This affirms that it might be one of the reasons for minimum stem borer damage in the crop at 30 DAP. The individual egg parasitization of *T. japonicum and Trichomalopsis* sp. was high in egg mass collected in 45 DAP crops (Table 3, Fig 3.). Similarly, Rao *et al.* [13] have recorded maximum egg mass parasitism at 40 days old plants. Very little works have been carried out on influence of age of crop on yellow stem borer egg mass parasitisation. Few reports [14] indicated that parasitization on yellow stem borer egg masses were 30.6 per cent during *kharif* and 23.7 per cent during *rabi* season by *T. schoenobii* and upto 48 per cent under laboratory condition.

Table 1: Incidence of yellow stem borer at different age of the rice crop

Age of the crop	Dead heart (%) (Mean ± S.Ed)	White ear (%) (Mean ± S.Ed)
30 DAP	4.83±1.35	-
45 DAP	3.98±1.00	-
60 DAP	10.47±1.02	4.78±1.23
75 DAP	-	4.92±0.67
90 DAP	-	5.52±0.74

Table 2: Influence of age of rice crop on yellow stem borer egg mass parasitization

Duration	Parasitization (%) (Mean ± S.Ed)
30 DAP	34.48±9.07
45 DAP	30.47±8.54
60 DAP	18.56±7.21
75 DAP	20.28±8.54

Table 3: Influence of age of rice crop on individual egg parasitization of yellow stem borer

Age of the crop	Per cent Parasitism (%)			
	***Telenomus* sp.** (Mean ± S.Ed)	***Tetrastichus Schoenobii*** (Mean ± S.Ed)	***Trichogramma japonicum*** (Mean ± S.Ed)	***Trichomalopsis* sp.** (Mean ± S.Ed)
30 DAP	19.69±3.54	40.64±4.512	0	0.16±0.13
45 DAP	13.49±3.32	19.58±4.22	1.65±1.26	0.87±0.58
60 DAP	16.71±3.94	26.61±5.07	1.79±1.39	0
75 DAP	12.92±5.13	20.98±7.74	0	0.45±0.43

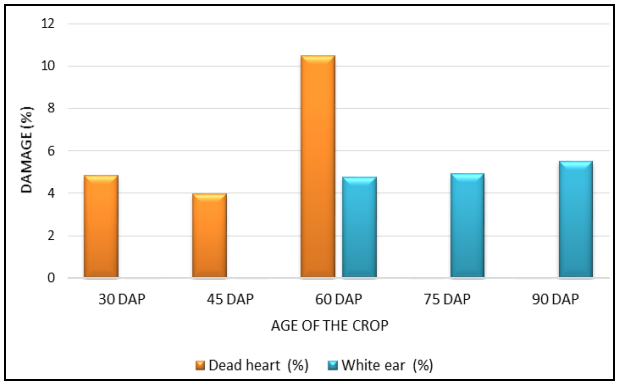

Fig 1: Incidence of yellow stem borer at different age of crop

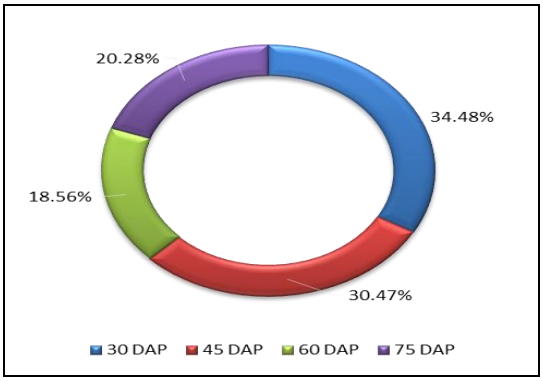

Fig 2: Influence of age of crop on total egg mass parasitization

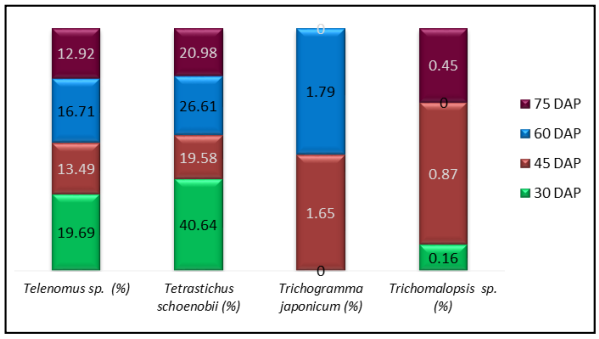

Fig 3: Influence of age of crop on individual egg parasitization

4. Conclusion

The present study concludes that dead heart by stem borer and white ear was maximum at reproductive stage (10.47%) and ripening stage (5.52%) respectively. Influence of age of the crop on individual egg parasitization of yellow stem borer revealed highest parasitization of *T. schoenobii* (40.64%) followed by *Telenomus* sp. (19.69%) in the egg masses collected at vegetative stage, 30 DAP crops, that of *T. japonicum* (1.65%) and *Trichomalopsis* sp. (0.87%) were more during 45 DAP. Total egg mass parasitisation was also highest at 30 DAP (34.48%). From these results it is evident that it would be better if the release of biocontrol agents is done at the early crop stage. Likewise mass production of *Tetrastichus schoenobii* should be attempted as its efficiency of parasitsation is higher in yellow stem borer egg masses.

5. Acknowledgement

The authors are greatly acknowledge Dr. P. Jeyaprakash, Head and Dr. S. Robin, Professor, Paddy Breeding Station, Department of Rice, Tamil Nadu Agricultural University, Coimbatore for providing facilities and encouragement to conduct the experiments.

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