Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

ISSN 2320-7078
JEZS 2014; 2 (6): 86-90

Received: 21-10-2014
Accepted: 05-11-2014

C. Gailce Leo Justin
Professor (Entomology), Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti - 628 501, Tuticorin Dist., Tamil Nadu, India.

G. Preetha
Assistant Professor (Entomology), Agricultural Research Station, TNAU, Thirupathisaram - 629 901.

.

Correspondence:
C. Gailce Leo Justin
Professor (Entomology), Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti - 628 501, Tuticorin Dist., Tamil Nadu, India.

Survey on the occurrence, distribution pattern and management of stem borers on rice in Kanyakumari District, Tamil Nadu

C. Gailce Leo Justin and G. Preetha

Abstract
Survey of rice growing blocks in Kanyakumari District was carried out during 2008-09, 2009-10 and 2010-11 to establish the stem borer incidence and damage per cent in the farmers field. The maximum incidence was observed in Agasteeswaram, Thovalai and Thuckalay blocks and minimum incidence in Thuckalay, Killiyoor and Thiruvattar blocks during 2008-09, 2009-10 and 2010-11, respectively. The distribution of stem borer complex was also assessed for three years in two rice cultivars *viz*., TPS 3 and CR 1009 and the data revealed that the yellow stem borer, *Scirpophaga incertulas* was found to be dominant in Kanyakumari District. The field experiments revealed that chlorantraniliprole 0.4 GR was proved to be the best among all the tested insecticides with reduced stem borer infestation and recorded higher yield. Neem oil and *Trichogramma japonicum* exerted minimum reduction percentage of stem borer. However, they were found to be superior over untreated control which can be included as a component in Integrated Pest Management programme.

Keywords: Distribution, insecticides, neem oil, stem borer, survey, *T. japonicum*, yield.

1. Introduction
Rice (*Oryza sativa* L.) is an important staple food crop for more than two third of the population of India and more than 65 per cent of the world population [1]. Rice is a good source of complex carbohydrates and is rich in several essential nutrients. Nearly 300 species of insect pests attack the paddy crop at various stages and among them only 23 species cause notable damage [2]. Stem borers are key group of insect pests of rice [3]. Yellow stem borer, *Scirpophaga incertulas* (Walker), a monophagous pest of paddy is considered as the most important nuisance of rainfed, low land and flood prone rice ecosystems [4]. Globally, yellow rice stem borer alone causes yield loss of 10 million tonnes and 50 per cent of the insecticides are used for their management in the rice field [5]. The infestation of stem borer in rice causes dead heart when the insect attacks at vegetative stage, while white ears occur when the rice stem borer attacks at the time of ear development [6]. Stem borer is more prevalent during the second season in Kanyakumari District [7]. Farmers rely heavily on insecticides for pest management. Many conventional insecticides though have been evaluated against such insects, yet, most of the chemicals have failed to provide adequate control. Hence, new molecules are being added for their evaluation with an aim to restore environmental quality. The present study has been undertaken by considering the severity of stem borer during the *rabi* season in Kanyakumari District and to reduce the pesticide load by incorporating other management methods for the effective management of rice stem borer.

2. Materials and Methods
2.1. Survey on the incidence of rice stem borer
Survey was conducted for three consecutive years (2008, 2009 and 2010) in eight different blocks of Kanyakumari District (Fig. 1) in order to study the incidence of stem borers associated with paddy crop. In each block three fields were selected at random to be surveyed. The survey was conducted during the *rabi* season of all the three years and observations were recorded for dead heart at 40 and 60 DAT and white ear at 90 and 110 DAT in every season in ten hills/ replication for thirty hills/ field and converted to percentage.

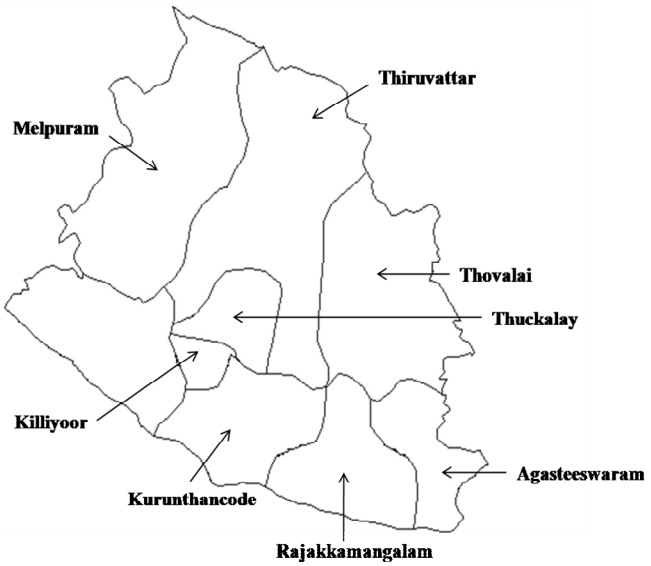

Fig 1: Sampling locations of rice stem borer in Kanyakumari District.

2.2. Distribution pattern of stem borer species complex

To assess the distribution complex of stem borer in Kanyakumari District larvae of rice stem borers were gathered from rice tillers exhibiting damage symptoms *i.e*. dead heart or white ear. During each sampling 100 larvae were collected from which the stem borer species were sorted out according to the identification characters [8].

2.3. Field experiments

Field experiments were conducted at Agricultural Research Station Farm, Tamil Nadu Agricultural University (TNAU), Thirupathisaram, Kanyakumari District, Tamil Nadu, India for the management of rice stem borers in a Randomized Block Design (RBD) during *kharif* and *rabi* 2010 using the rice cultivars ASD 16, TPS 3 and pre release culture TP 08010 (TPS 5). The plot size was 20 m^2. The agronomic practices except plant protection recommended by Tamil Nadu Agricultural University were followed [9]. Nine treatments including insecticides from five classes *viz.*, organophosphates (profenofos, chlorpyriphos), synthetic pyrethroid (λ - cyhalothrin), phenyl pyrazole (fipronil), oxadiazine (indoxacarb), anthranilic diamide (chlorantraniliprole), botanical (neem oil) and egg parasitoid (*Trichogramma japonicum*) were used along with an untreated control and replicated thrice. The insecticides were sprayed using a hand operated knapsack sprayer with a spray fluid of 500 l ha^{-1}. Data were recorded from 10 randomly selected hills/ plot at 7 and 14 days after application of insecticides.

2.4. Stem borer damage

The effectiveness of treatments against stem borer of rice was assessed on the basis of total number of dead hearts and white ears. Per cent damage was subsequently worked out [10].

$$\text{Per cent dead heart} = \frac{\text{Number of dead hearts}}{\text{Number of total tillers}} \times 100$$

$$\text{Per cent white ear} = \frac{\text{Number of white ears}}{\text{Number of productive tillers}} \times 100$$

2.5. Statistical Analysis

The data thus obtained from field experiments were analyzed statistically by ANOVA using the package AGRES after converting it to arcsine percentage. The grain yield was recorded in plot basis and expressed in tonnes ha^{-1}.

3. Results and Discussion

3a. Results

3.1. Survey for incidence of stem borer in different parts of Kanyakumari District

Survey was carried out in eight blocks of Kanyakumari District for the incidence of stem borer and the results are presented in Table 1. Stem borer incidence was observed only during the second season. During 2008-09 maximum incidence was observed in Agasteeswaram block which was witnessed by maximum dead heart (11.5 and 13.0% at 40 and 60 DAT) and white ear (6.0 and 7.5% at 90 and 110 DAT) and the minimum incidence was recorded in Thuckalay block with 4.0, 5.0 per cent dead heart at 40 and 60 DAT and 2.5, 3.0 per cent white ear at 90 and 110 DAT, respectively. In the second year (2009-10) maximum per cent dead heart and white ear was recorded in Thovalai block and minimum in case of Killiyoor block. During 2010-11, Thuckalay block recorded maximum dead heart percentage at 40 DAT and Thovalai block at 60 DAT whereas, minimum was found to be at Killiyoor and Thiruvattar blocks. At 90 and 110 DAT, white ear was found to be maximum at Thovalai block and minimum at Killiyoor block (Table 1).

Table 1: Survey for the incidence of stem borer in Kanyakumari District

Blocks	2008 - 09				2009 - 10				2010 - 11			
	Dead heart (%)		White ear (%)		Dead heart (%)		White ear (%)		Dead heart (%)		White ear (%)	
	40 DAT	60 DAT	90 DAT	110 DAT	40 DAT	60 DAT	90 DAT	110 DAT	40 DAT	60 DAT	90 DAT	110 DAT
Agastheeswaram	11.5	13.0	6.0	7.5	13.5	18.0	7.5	12.5	12.0	15.5	6.0	10.5
Rajakkamangalam	6.0	8.0	4.0	4.5	6.5	9.0	3.5	6.0	4.5	8.0	2.5	4.0
Thovalai	8.5	11.0	5.5	6.0	16.0	20.5	9.0	14.5	15.0	17.5	7.0	13.0
Kurunthancode	5.0	6.0	3.0	4.0	4.0	6.0	3.0	4.5	3.0	5.5	2.0	3.5
Thuckalay	4.0	5.0	2.5	3.0	5.5	7.0	2.5	3.0	4.5	6.0	2.0	2.0
Thiruvattar	6.0	7.5	4.0	4.5	3.0	4.5	2.5	4.0	2.0	3.5	2.0	3.0
Melpuram	4.5	5.0	5.0	6.5	4.0	4.0	3.5	4.0	3.0	4.0	2.0	3.0
Killiyoor	5.0	6.0	4.0	4.5	2.0	2.0	1.5	3.0	2.0	3.0	1.0	2.0

3.2. Distribution pattern of stem borer species complex

Observations on the distribution of different stem borer species complex during various stages of the crop showed maximum incidence of yellow stem borer, *Scirpophaga incertulas* (Walker) and minimum incidence of pink stem borer, *Sesamia inferens* (Walker) in all the three consecutive years in both the rice cultivars TPS 3 and CR 1009 (Table 2). During 2008-09, the incidence of golden fringed borer, *Chilo auricilius* (Dudgeon) was found to be more in the maximum tillering stage and maturity stage and during 2010-11, nil incidence was observed in both the cultivars.

Table 2: Distribution Pattern of Stem borer Complex on Rice

Crop Stage	2008 - 09						2009 - 10						2010 - 11					
	TPS 3			CR 1009			TPS 3			CR 1009			TPS 3			CR 1009		
	YSB	GFB	PB	YSB	GFB	PB	YSB	GFB	PB	YSB	GFB	PB	YSB	GFB	PB	YSB	GFB	PB
MTS	15.5	81.4	3.1	11.6	86.4	2.0	85.7	10.3	4.0	79.4	16.4	4.2	96.4	0.0	3.6	96.4	0.0	3.6
PS	83.5	16.5	0.0	75.0	25.0	0.0	77.6	22.4	0.0	85.6	14.4	0.0	100.0	0.0	0.0	100.00	0.0	0.0
MS	25.0	42.5	32.5	30.0	37.5	32.5	52.0	26.5	21.5	62.1	25.5	12.4	95.7	0.0	4.3	91.5	0.0	8.5

MTS - Maximum Tillering Stage; PS - Panicle Stage; MS - Maturity Stage
Yellow stem borer (YSB), *S. incertulas*; Gold fringed borer (GFB), *C. auricilius*
Pink stem borer (PSB), *S. inferens*

3.3. Efficacy of different treatments against rice stem borer

3.3.1. *Kharif* 2010 (Cv. ASD 16)

The efficacy of different treatments on the stem borer infestation in rice is presented in Tables 3-5. The data given in Table 3 revealed that all the treatments were significantly superior in reducing the stem borer infestation in terms of dead heart and white ear and thus increasing the yield significantly. Chlorantraniliprole 0.4 GR was found to be the most effective with nil incidence of stem borer followed by chlorantraniliprole 20 SC with 0.2 per cent dead heart and 0.4 per cent white ear. The synthetic pyrethroid λ-cyhalothrin 5 EC was found to be less effective insecticide with a reduction percentage of 55.2 and 55.6 per cent of dead heart and white ear, respectively, over control. The neem oil recorded 44.1 and 20.0 per cent reduction of dead heart and white ear over control followed by egg parasitoid, *T. japonicum* with 27.6 and 13.3 per cent reduction.

Table 3: Effect of Insecticides for the Management of Stem borer on Rice (Cv. ASD 16) - Kharif 2010

Treatments	Dose (/ l)	Dead heart (%)		Reduction over control (%)	White ear (%)	Reduction Over Control (%)
		7 DAA	14 DAA			
T1 - Profenofos 50 EC	2.0 ml	1.2 (6.3)	1.0 (5.7)	91.3	1.6 (7.3)	82.2
T2 - Indoxacarb 14.5 SC	0.5 ml	3.4 (10.6)	3.8 (11.2)	71.7	3.2 (10.3)	64.4
T3 - Chlorpyriphos 20 SC	2.0 ml	2.0 (8.1)	2.4 (8.9)	82.7	2.0 (8.1)	77.8
T4 - Chlorantraniliprole 20SC	0.5 ml	0.2 (2.6)	0.2 (0.8)	98.4	0.4 (3.6)	95.6
T5 - Fipronil 5 SC	0.5 ml	2.6 (9.2)	3.0 (9.9)	77.9	3.2 (10.3)	64.4
T6 - Chlorantraniliprole 0.4 G	4 kg/ac	0.0 (0.0)	0.0 (0.0)	100	0.0 (0.0)	100
T7 - λ Cyhalothrin 5 EC	1.0 ml	5.4 (13.4)	6.0 (14.2)	55.2	4.0 (11.5)	55.6
T8 - Neem oil	3.0 ml	6.2 (14.4)	8.0 (16.4)	44.1	7.2 (15.6)	20.0
T9 - *Trichogramma japonicum*	5cc/ ha	8.4 (16.8)	10.0 (18.4)	27.6	7.8 (16.2)	13.3
T10 - Untreated control	-	10.6 (19.0)	14.8 (22.63)	-	9.0 (17.5)	-
CD (p=0.05)		**0.7**	**0.8**		**0.9**	

Figures in parenthesis are arc sine transformed values; DAA - Days after application.

3.3.2. *Rabi* 2010 (Cv. TPS 3)

From the *rabi* 2010 field trial using the rice cultivar, TPS 3 the results obtained from various treatments were significantly different from the untreated control which exhibited the highest damage of 10.6 to 18.4 per cent dead heart and 16.5 per cent white ear, respectively (Table 4). Application of chlorantraniliprole 0.4 GR gave the best results with 100 per cent reduction of stem borer over control followed by chlorantraniliprole 20 SC where the stem borer damage was significantly the lowest (0.8, 1.4 and 1.0, 1.2 per cent dead heart at 7 and 14 days after application of insecticides). It was followed by profenofos 50 EC with 83.28 and 79.39 per cent reduction of dead heart and white ear over control. Apart from insecticides, neem oil and *T. japonicum* exerted minimum reduction of stem borer.

Table 4: Effect of Insecticides for the Management of Stem borer on Rice (Cv. TPS 3) - Rabi 2010

Treatment	Dose (/ l)	Dead heart (%)				Reduction over control (%)	At harvest (WE %)	Reduction over control (%)
		I st application		2nd application				
		7 DAA	14 DAA	7 DAA	14 DAA			
T1- Profenofos 50 EC	2 ml	1.8 (7.7)	3.0 (9.9)	2.2 (8.5)	2.6 (9.3)	83.28	3.4 (10.6)	79.39
T2 - Indoxacarb 14.5 SC	0.5 ml	2.6 (9.8)	4.8 (12.6)	3.4 (10.6)	5.4 (13.9)	71.78	4.8 (12.7)	70.91
T3 - Chlorpyriphos	2 ml	1.7 (7.5)	3.8 (11.2)	2.0 (8.1)	4.0 (11.5)	79.93	3.6 (10.9)	78.18
T4 - Chlorantraniliprole 20 SC	0.5 ml	0.8 (5.1)	1.4 (6.8)	1.0 (5.7)	1.2 (6.3)	92.33	1.4 (6.8)	91.52
T5 - Fipronil 5 SC	0.5ml	2.6 (9.3)	3.6 (10.9)	3.0 (9.9)	4.0 (11.5)	77.00	3.2 (10.3)	80.61
T6 - Chlorantraniliprole 0.4 G	4 kg/ac	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	100.00	0.0 (0.0)	100.00
T7 - λ Cyhalothrin 5 EC	1 ml	4.2 (11.8)	5.2 (13.2)	5.4 (13.4)	4.8 (12.7)	65.85	4.2 (11.8)	74.55
T8 - Neem oil	3 ml	6.8 (15.1)	12.4 (20.6)	9.0 (17.5)	14.6 (22.5)	25.44	14.2 (22.2)	13.94
T9 - *Trichogramma japonicum*	5cc	8.4 (16.8)	14.6 (22.7)	12.0 (20.3)	16.8 (24.2)	9.76	14.6 (22.5)	11.52
T10 - Untreated control		10.6 (19.0)	16.4 (23.8)	12.0 (20.3)	18.4 (25.4)	-	16.5 (23.9)	-
CD (p = 0.05)		**0.7**	**1.2**	**0.7**	**1.0**		**1.2**	

Figures in Parenthesis are arc sine transformed values (DAA - Days after application; WE: White ear)

3.3.3. *Rabi* 2010 (Cv. TPS 5)

Among the treatments, chlorantraniliprole 0.4 GR stood superior by recording significantly nil per cent dead heart, white ear and highest grain yield (Table 5). This was followed by chlorantraniliprole 20 SC with 0.8 and 1.4 per cent dead heart at 7 and 14 days after application and 1.2 per cent white ear and profenofos 50 EC with 79.7 and 81.6 per cent reduction of dead heart and white ear over control. Though neem oil and egg parasitoid gave minimum reduction of dead heart and white ear, it was found to be superior over untreated control.

Table 5: Effect of Insecticides for the Management of Stem borer on Rice (TPS 5) - Rabi 2010

Treatment	Dose (/l)	Dead heart (%)		Reduction over control (%)	White ears (%)	Reduction Over Control (%)
		7 DAA	14 DAA			
T1 - Profenofos 50 EC	2 ml	1.2 (6.3)	1.8 (7.7)	79.7	1.8 (7.7)	81.6
T2 - Indoxacarb 14.5 SC	0.5 ml	2.6 (9.3)	3.2 (10.3)	60.8	2.4 (8.9)	75.5
T3 - Chlorpyriphos 20 EC	2 ml	2.0 (8.1)	2.6 (9.3)	68.9	2.6 (9.3)	73.5
T4 - Chlorantraniliprole 20 SC	0.5 ml	0.8 (1.6)	1.4 (6.8)	85.0	1.2 (6.3)	87.8
T5 - Fipronil 5 SC	0.5 ml	2.4 (8.9)	3.8 (11.2)	58.1	2.8 (9.6)	35.7
T6 - Chlorantraniliprole 0.4 G	4 kg/ac	0.0 (0.0)	0.0 (0.0)	100	0.0 (0.0)	100
T7 - λ Cyhalothrin 5 EC	1 ml	2.6 (9.3)	3.6 (10.9)	58.1	3.8 (11.2)	61.2
T8 - Neem oil	3 ml	3.6 (10.9)	4.8 (12.6)	43.2	6.2 (14.4)	36.7
T9 - *Trichogramma japonicum*	5cc/ha	6.0 (14.2)	7.2 (15.6)	10.8	8.0 (16.4)	18.4
T10 - Untreated control	-	6.8 (15.1)	8.0 (16.4)	-	9.8 (18.2)	-
CD (P=0.05)		**0.7**	**1.2**		**1.0**	

Figures in parenthesis are arc sine transformed values; DAA - Days after application.

3.4. Grain yield

The maximum yield was obtained from rice crop treated with chlorantraniliprole 0.4 GR followed by chlorantraniliprole 20 SC and profenofos 50 EC (Fig. 2).

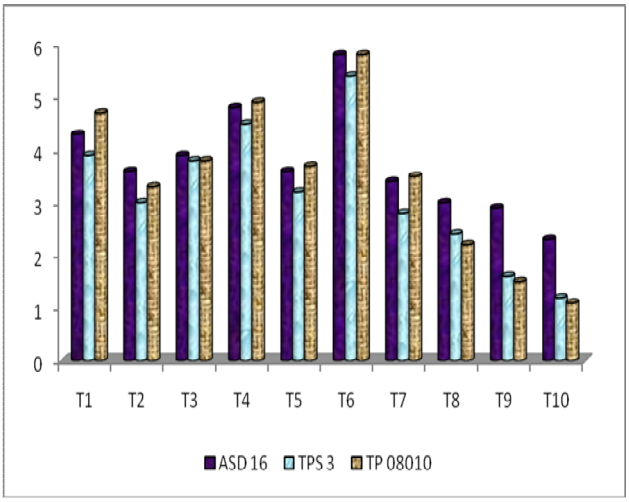

Fig 2: Effect of insecticidal treatments on the grain yield of rice

T1 – Profenofos, T2 – Indoxocarb, T3-Chlorpyriphos
T4 - Chlorantraniliprole 0.4 GR T5 - Fipronil
T6 - Chlorantraniliprole 20 SC T7 - λ Cyhalothrin
T8 - Neem oil T9- *T. japonicum* T10- Control

3b. Discussion

The present findings are in agreement with the results [11] who reported the superiority of chlorantraniliprole 0.4 GR at 40 and 50 g a.i/ ha against stem borer on rice. The effectiveness of chlorantraniliprole 20 SC was reported against rice stem borer, *Chilo supressalis* [12]. The efficacy of neem oil against stem borer was in line with the findings [13] that the application of plant extract formulation resulted in maximum range of infestation and it was on a par with the field of no pesticide application. The egg parasitoid, *T. japonicum* exhibited minimum control over stem borer deviating several findings [14, 15].

4. Conclusion

Thus, the present study revealed that the newer insecticide molecule chlorantraniliprole can be used for the effective management of rice stem borer especially in the *rabi* season which creates greater havoc in Kanyakumari District.

5. References

1. Mathur KC, Reddy PR, Rajamali S, Moorthy BTS. Integrated pest management of rice to improve productivity and sustainability. Oryza 1999; 36(3):195-207.
2. Pasalu IC, Katti G. Advances in ecofriendly approaches in rice IPM. J Rice Res 2006; 1(1):83-90.
3. Dhaliwal GS, Arora R. An estimate of yield losses due to insect pests in Indian Agriculture. Indian J Ecol 1996; 23(1):70-73.
4. Deka S, Barthakur S. Overview on current status of biotechnological interventions on yellow stem borer, *Scirpophaga incertulas* (Lepidoptera: Crambidae) resistance in rice. Biotechnol Adv 2010; 28(1):70-81.
5. Huesing J, English L. The impact of *Bt* Crops on the developing world. Ag Bio Forum 2004; 7(1-2):84-95.
6. Reeman MU, Rashid H, Shahid AA, Bashir K, Hussain T, Riazuddin S. Insect resistance and risk assessment studies of advanced generation of basmati rice expressing two genes of *Bacillus thuringiensis*. Electron J Biotechnol 2007; 10:1-13.
7. Gailce Leo Justin C, Preetha G. Seasonal incidence of rice yellow stem borer, *Scirpophaga incertulas* (Walker) in Tamil Nadu. Indian Journal of Entomology 2013; 75(2):109-112.
8. Katti G, Chitra S, Padmakumari AP, Pasalu IC. Rice stem borers in India- species composition and distribution. Technical Bulletin No. XX, Directorate of Rice Research, Rajendranagar, Hyderabad - 500 030, AP, India, 2011.
9. CPG. Agricultural Crop Production Guide. Tamil Nadu Agric. Univ., Coimbatore and Department of Agriculture, Government of Tamil Nadu, India, 2005, 4-43.
10. Heinrichs EA, Medrano FG, Rapusas H. Genetic evaluation for insect resistance in Rice. (eds.), IRRI**,** Los Banos, Philippines, 1985.
11. Sarao PS, Kaur H. Efficacy of Ferterra 0.4% GR (chlorantraniliprole) against stem borers and leaffolder insect-pests of basmati rice. Journal of Environmental Biology 2014; 35(5):815.
12. Shui-jin H, Wen-jing Q, Hui L. Using 20% Chlorantraniliprole SC to Control Rice Stem Borer (*Chilo suppressalis* Walker). Acta Agriculturae Jiangxi 2009, 21.
13. Chakraborty K. Assessment of the efficacy of some bio-rational pesticide formulations for the management of yellow stem borer, *Scirpophaga incertulas* Wlk. in paddy field. Journal of Biopesticides 2011; 4(1):75-80.
14. Bhushan S, Singh RP, Shanker R. Biopesticidal management of yellow stem borer (*Scirpophaga incertulas* Walker) in rice. The Bioscan 2012; 7(2):317-319.
15. Kumar S, Khan MA. Bio-efficacy of *Trichogramma* spp. against yellow stem borer and leaf folder in rice ecosystem. Annals of Plant Protection Sciences 2005; 13(1):97-99.