Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(3): 789-792

Received: 20-03-2018
Accepted: 21-04-2018

Soumya Sarathi Kundu
Krishi Vigyan Kendra, Burdwan (CRIJAF). Budbud, Burdwan, West Bengal, India

Dhiren Chettri
Department of Agricultural Entomology, B.C.K.V., Mohanpur, Nadia, West Bengal, India

Subrata Chatterjee
Department of Agricultural Entomology, B.C.K.V., Mohanpur, Nadia, West Bengal, India

Ajoy Kumar Mukhopadhyay
Department of Agricultural Entomology, B.C.K.V., Mohanpur, Nadia, West Bengal, India

Correspondence
Soumya Sarathi Kundu
Krishi Vigyan Kendra, Burdwan (CRIJAF). Budbud, Burdwan, West Bengal, India

Evaluation of Novaluron 5.25% + Emamectin benzoate 0.9% SC against yellow stemborer (*Scirpophaga incertulas*) on rice

Soumya Sarathi Kundu, Dhiren Chettri, Subrata Chatterjee and Ajoy Kumar Mukhopadhyay

Abstract
A field experiment was conducted in the kharif, 2015 and Boro, 2016 – 17 to evaluate the efficacy of the Novaluron 5.25% + Emamectin benzoate 0.9% SC against Rice stem borer (*Scirpophaga incertulas*) on rice cv MTU-7029 (Swarna). In both the seasons Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500-1750ml/ha gave best control of stem borer with maximum percent reduction of dead hearts. The highest yield and highest cost-benefit ratio was recorded with Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500 ml/ha in both the seasons. No effect on natural enemies was found or recorded.

Keywords: Novaluron 5.25% SC, Emamectin benzoate 0.9% SC, Rice stem borer and rice

1. Introduction
Rice is life and princess among the cereals, the staple food of 65% of the total population in India and it covers an area of 5.38 million ha with the average productivity of 2.6 tonnes/ha in the state of West Bengal accounting for 14-16% of India's rice production [1].
Stem borers (SBs) are a key group of insect pests of rice. Among the borers, yellow stem borer (YSB), *Scirpophaga incertulas Walker* (Pyralidae: Lepidoptera) is distributed throughout India and is regarded as the most dominating destructive pest species [11]. Yellow stem borer (*Scirpophaga incertulas)* is one of the widely distributed, monophagous and cosmopolitan pest of paddy in the Indian subcontinent rendering extensive damage to growing stems at pre-harvest condition. It building damage in the nursery as well as in transplanted crop causing drying of the central shoot known as 'dead heart' (DH) in young plants, boring at heading stage usually occurs at the peduncle node and 'white earhead' (WEH) formed [8]. Larval infestation during reproductive growth stages of rice causes the damage of the growing panicle resulting in 'white head' symptoms. After entering within the stem by successful boring/tunneling, the larvae mature and subsequently pupates [13]. Severe infestation by YSB often results in complete crop failure [10]. West Bengal tops the list in consideration of rice production in India. YSB is reported to ravage in all of the agro-ecological regions of West Bengal sharing about 89.50% of the total rice borer population [2].
Till today, the one of the most efficient control of rice stem borer is generally done by the application of different insecticides of newer brands despite of its various resistance, resurgence, environmental hazards and residual toxicity problems. Several brands of inorganic insecticides had been tested to check YSB menace which conceives no definite plant protection schedule appropriate for all of the Indian agro-ecological zones. In spite of that, synthetic insecticides are still the most trusted way to control YSB incidence [12, 14]. Considering the above facts the present experiment was carried out in the kharif 2015 and boro 2016-17, with the objectives to study the bio-efficacy of Novaluron 5.25% + Emamectin benzoate 0.9% SC against yellow stem borer on rice and their effects on the natural enemies of the pest in concerned.

2. Materials and methods
The field trials were conducted in Kharif 2015 and Boro 2016 at Instructional farm, BCKV, Nadia, West Bengal. The profuse tillering variety MTU-7029 (Swarna) was used for the experiment and laid in a completely randomised block design with six insecticidal treatments and a control (Table 1). All the treatments were replicated thrice.

The experimental crop was grown by adopting locally accepted agronomical practices at 20 cm x 15 cm spacing in the plot size of 4 m x 5 m. All the treatments were applied thrice at 10 days interval and the first spray was made at 18 days after transplanting with hand operated knap-sack sprayer. The observations on dead hearts due to yellow stem borer were taken on ten randomly selected hills / plot, before 1 day and after 3, 5 and 10 days of application. The percentage of dead hearts was worked out using the following formula.

$$\% \text{ Dead heart} = \frac{\text{No.of dead hearts}}{\text{No.of total tillers}} \times 100$$ [7]

Grain yield / plot were also recorded at harvest and it was converted in to quintal / ha. for analysis and comparison. The economics of each treatment was also worked out on the basis of cost benefit ratio. The chemicals were also evaluated for their effect on the natural enemies of rice yellow stem borer.

3. Results and Discussion

All the treatments were significantly effective in reducing the infestation of rice yellow stem borer (YSB) and thus, reducing the formation of dead heart and white ear significantly as compared to the control (Table 2).

The efficacy of different treatment schedules of Novaluron 5.25% + Emamectin Benzoate 0.9% SC against Yellow stem borer has been presented in Table 2 for 1st season (Kharif, 2015) and in Table 3 for 2nd season (Boro, 2016-17).

Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500-1750ml/ha gave best control of stem borer with maximum percent reduction of dead hearts in both the seasons. Novaluron 5.25% + Emamectin Benzoate 0.9% SC @1750 ml/ha treatment which was found at par with Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500 ml/ha recorded 47.34 q/ha and 49.35q/ha paddy yield during Kharif season and 48.50 q/ha and 50.14q/ha paddy yield during Rabi season (Table 4). Highest cost-benefit ratio of 1: 2.27 and 1: 2.29 was recorded by Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500 ml/ha (Table 5) during first and second season respectively.

The present finding also shows no effect of Novaluron 5.25% + Emamectin Benzoate 0.9% SC on the natural enemies of the rice yellow stem borer at any treatment level (Table 6).

The present finding shows a good control of YSB with Novaluron 5.25% + Emamectin Benzoate 0.9% SC whereas, [9, 4] reported that, Novaluron 10 EC was not able to provide a good control over the yellow stem borer. The reason may be the sole use of novaluron only [3]. Reported the use of emamectin benzoate in combination with NSKE (5%) + NLE (5%) + clorpyriphos combination as the safest treatment for sustainable management of the *S. incertulas* in paddy [6]. recorded highest net profit with emamectin benzoate 5SG@0.25g/l against Yellow stem borer. The report on combine product of Novaluron 5.25% + Emamectin Benzoate 0.9% against rice borer have not been found but, a report on the use of Novaluron 5.25% + Emamectin Benzoate 0.9% to control the *Pluttela xylostella* was reported by [5] and also stated that the combination provides a good control of the pest.

Table 1: Details of the treatments:

Treatments		Dose/ ha (g or ml)	
		a.i	Formulation
T1	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	(65.62 + 11.25)	1250
T2	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	(78.75 + 13.50)	1500
T3	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	(91.87 + 15.75)	1750
T4	Novaluron 10% EC	100	1000
T5	Emamectin Benzoate 5% SG	11	220
T6	Fipronil 5% SC	75	1500
T7	Untreated control	-	-

Table 2: Bio-efficacy of Novaluron 5.25% + Emamectin benzoate 0.9% SC and other insecticides against Yellow stem borer (*Scirpophaga incertulas*) infesting rice during Kharif, 2015.

Treatments	Formulation Dose (g or ml)/Ha	Pre-count	Mean incidence of Dead heart (%) per 2 hills									Reduction of dead heart (%)
			After First Spray			After Second spray			After Third spray			
			3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS	
*Novaluron 5.25% + Emamectin benzoate 0.9% SC	1250	5.41 (13.45)	4.48 (12.23)	4.33 (12.01)	4.59 (12.37)	4.13 (11.70)	3.99 (11.48)	4.16 (11.76)	3.07 (10.06)	2.88 (9.74)	2.07 (8.26)	85.52
*Novaluron 5.25% + Emamectin benzoate 0.9% SC	1500	5.26 (13.25)	3.43 (10.67)	3.28 (10.44)	3.47 (10.73)	2.43 (8.97)	2.32 (8.75)	2.51 (9.12)	1.26 (6.44)	1.12 (6.07)	0.27 (2.40)	98.11
*Novaluron 5.25% + Emamectin benzoate 0.9% SC	1750	5.51 (13.51)	3.25 (10.39)	3.12 (10.17)	3.33 (10.52)	2.23 (8.58)	2.12 (8.37)	2.39 (8.88)	1.21 (6.30)	1.11 (6.03)	0.13 (1.21)	99.09
Novaluron 10% EC	1000	5.71 (13.77)	4.85 (12.72)	4.66 (12.47)	4.89 (12.77)	4.36 (12.05)	4.20 (11.82)	4.43 (12.15)	3.62 (10.94)	3.45 (10.69)	2.28 (8.67)	84.05
Emamectin Benzoate 5% SG	220	5.63 (13.73)	4.14 (11.74)	4.00 (11.54)	4.22 (11.86)	3.78 (11.18)	3.63 (10.99)	3.91 (11.40)	2.87 (9.75)	2.70 (9.45)	0.93 (5.54)	93.49
Fipronil 5% SC	1500	5.98 (14.14)	4.49 (12.23)	4.33 (12.01)	4.52 (12.27)	4.11 (11.69)	3.96 (11.46)	4.19 (11.79)	3.12 (10.17)	3.02 (9.99)	1.30 (6.51)	90.90
Untreated control	-	5.37 (13.38)	5.61 (13.70)	5.43 (13.47)	6.11 (14.31)	6.61 (14.89)	7.75 (16.16)	8.60 (17.05)	9.67 (18.11)	12.00 (20.27)	14.30 (22.22)	85.52
SEM(±)		NS	0.10	0.13	0.15	0.20	0.34	0.28	0.35	0.37	0.65	-
CD at 5%		NS	0.31	0.42	0.47	0.61	1.04	0.87	1.09	1.15	2.01	-

DAS - Days after spraying. *Figures in the parentheses are Angular transformed values,*

Table 3: Bio-efficacy of Novaluron 5.25% + Emamectin benzoate 0.9% SC and other insecticides against Yellow stemborer (*Scirpophaga incertulas*) infesting rice during *boro* (Rabi), 2016-17.

Treatments	Formulation Dose (g or ml)/Ha	Pre-count	Mean incidence of Dead heart (%) per 2 hills									Reduction of dead heart (%)
			After First Spray			After Second spray			After Third spray			
			3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS	3 DAS	5 DAS	10 DAS	
Novaluron 5.25% + Emamectin benzoate 0.9% SC	1250	6.18 (14.39)	4.92 (12.81)	4.68 (12.50)	4.96 (12.87)	4.35 (12.04)	4.15 (11.73)	4.42 (12.12)	3.32 (10.49)	3.10 (10.13)	2.24 (8.58)	85.32
Novaluron 5.25% + Emamectin benzoate 0.9% SC	1500	6.32 (14.56)	3.94 (11.44)	3.79 (11.23)	3.98 (11.51)	2.86 (9.72)	2.54 (9.14)	2.98 (9.92)	1.52 (7.01)	1.26 (6.42)	0.38 (3.49)	97.50
Novaluron 5.25% + Emamectin benzoate 0.9% SC	1750	6.24 (14.47)	3.76 (11.18)	3.52 (10.81)	3.82 (11.27)	2.65 (9.35)	2.38 (8.86)	2.80 (9.61)	1.44 (6.84)	1.20 (6.26)	0.25 (2.83)	98.36
Novaluron 10% EC	1000	6.12 (14.32)	4.98 (12.90)	4.76 (12.60)	5.04 (12.97)	4.72 (12.55)	4.50 (12.23)	4.94 (12.83)	3.92 (11.41)	3.64 (10.98)	2.72 (9.46)	82.17
Emamectin Benzoate 5% SG	220	6.40 (14.65)	4.52 (12.28)	4.30 (11.96)	4.66 (12.46)	3.98 (11.51)	3.86 (11.32)	4.12 (11.69)	3.20 (10.29)	2.92 (9.82)	0.99 (5.58)	93.51
Fipronil 5% SC	1500	6.36 (14.61)	4.90 (12.79)	4.64 (12.44)	4.94 (12.84)	4.32 (12.00)	4.10 (11.67)	4.46 (12.14)	3.40 (10.61)	3.16 (10.22)	1.65 (7.78)	89.18
Untreated control	-	6.22 (14.44)	6.46 (14.73)	6.65 (14.94)	6.78 (15.09)	6.96 (15.30)	8.02 (16.45)	9.54 (17.99)	10.24 (18.66)	12.62 (20.81)	15.26 (22.99)	
SEM(±)		NS	0.09	0.11	0.13	0.22	0.31	0.25	0.35	0.38	0.55	-
CD at 5%		NS	0.28	0.36	0.41	0.69	0.96	0.79	1.11	1.19	1.71	-

DAS - Days after spraying. *Figures in the parentheses are Angular transformed values.

Table 4: Effect of different doses of Novaluron 5.25% + Emamectin benzoate 0.9% SC on grain yield of rice during *kharif* 2015 and *boro*(Rabi), 2016 - 17

Treatments	Dose g or ml/ha	Formulation dose (g or ml)/ha	Yield (Q/Ha)	
			kharif 2015	*boro*, 2016 - 17
Novaluron 5.25% + Emamectin benzoate 0.9% SC	(65.62 + 11.25)	1250	35.56 (6.00)	36.62(6.09)
Novaluron 5.25% + Emamectin benzoate 0.9% SC	(78.75 + 13.50)	1500	47.34 (6.92)	48.50 (7.00)
Novaluron 5.25% + Emamectin benzoate 0.9% SC	(91.87 + 15.75)	1750	49.35 (7.06)	50.14 (7.11)
Novaluron 10% EC	100	1000	35.99 (6.04)	36.72 (6.10)
Emamectin benzoate 5% SG	11	220	36.09 (6.05)	36.93 (6.12)
Fipronil 5% SC	75	1500	34.75 (5.93)	35.95 (6.03)
Untreated control	-	-	29.17 (5.45)	30.20 (5.54)
SEM(±)	-	-	0.06	0.05
CD at 5%	-	-	0.21	0.17

SEM – Standard Error of Mean; CD – Critical Difference.

Table 5: Cost benefit ratio (C: B ratio) of Novaluron 5.25% + Emamectin benzoate 0.9% SC and other insecticides on rice during Kharif, 2105 and Rabi, 2016-17.

Treatments	Formulation dose (g or ml)/ha	Yield (q/ha)		Cost of inputs (Cost of insecticide/ha + Cost of labour for spraying/ha)	Extra yield over untreated control (yield in treatment - yield in untreated control)		Value of additional yield (Rs.)		Cost Benefit Ratio	
		kharif	rabi		kharif	rabi	kharif	rabi	kharif	rabi
Novaluron 5.25% + Emamectin benzoate 0.9% SC	1250	35.56	36.62	12150	6.39	6.42	11503.20	11556.00	1: 0.95	1: 0.95
Novaluron 5.25% + Emamectin benzoate 0.9% SC	1500	47.34	48.50	14400	18.16	18.30	32693.40	32940.00	1: 2.27	1: 2.29
Novaluron 5.25% + Emamectin benzoate 0.9% SC	1750	49.35	50.14	16650	20.18	19.94	36324.30	35892.00	1:2.18	1: 2.16
Novaluron 10% EC	1000	35.99	36.72	11538	6.81	6.52	12262.80	11736.00	1: 1.06	1: 1.02
Emamectin benzoate 5% SG	220	36.09	36.93	5737.8	6.92	6.73	12451.20	12114.00	1: 2.17	1: 2.11
Fipronil 5% SC	1500	34.75	35.95	6165	5.58	5.75	10044.00	10350.00	1: 1.63	1: 1.68
Untreated control	-	29.17		30.20	-		-		-	

Market rates: Novaluron 5.25% + Emamectin benzoate 0.9% SC- Rs. - 3000/litre; Market rate of rice per quintal- Rs. – 1800/-;Novaluron 10% EC- Rs – 3546.litre; Emamectin benzoate 5% SG - Rs – 7330/Kg; Fipronil 5% SC- Rs - 1170/Litre; Labour charge for spray- Rs. 300/ha.

Table 6: Effect of different doses of Novaluron 5.25% + Emamectin benzoate 0.9% SC on Natural enemies of rice stem borer during Kharif – 2015 and Rabi – 2016-17.

S. No	Treatments	Formulation dose (g or ml)/ha	Dragonfly				Spiders			
			Before spray		10 days after spray		Before spray		10 days after spray	
			kharif	rabi	kharif	rabi	kharif	rabi	kharif	rabi
1.	Novaluron 5.25% + Emamectin benzoate 0.9% SC*	1250	0.93 (1.19)	1.04 (1.24)	0.93 (1.20)	1.06 (1.25)	0.90 (1.18)	0.98 (1.22)	0.88 (1.17)	0.99 (1.22)
2.	Novaluron 5.25% + Emamectin benzoate 0.9% SC*	1500	0.83 (1.14)	1.06 (1.25)	0.85 (1.16)	1.04 (1.24)	0.85 (1.16)	0.96 (1.21)	0.92 (1.19)	0.96 (1.21)
3.	Novaluron 5.25% + Emamectin benzoate 0.9% SC*	1750	0.93 (1.20)	1.04 (1.24)	0.90 (1.18)	1.06 (1.25)	0.96 (1.21)	0.99 (1.22)	0.80 (1.14)	0.98 (1.22)
4.	Novaluron 10% EC	1000	0.90 (1.18)	1.02 (1.23)	0.83 (1.15)	1.03 (1.24)	0.88 (1.18)	0.97 (1.21)	0.87 (1.17)	0.99 (1.22)
5.	Emamectin benzoate 5% SG	220	0.94 (1.20)	1.05 (1.24)	0.87 (1.17)	1.06 (1.25)	0.92 (1.19)	0.96 (1.21)	0.93 (1.20)	0.97 (1.21)
6.	Fipronil 5% SC	1500	0.94 (1.20)	1.06 (1.25)	0.85 (1.16)	1.04 (1.24)	0.91 (1.19)	0.98 (1.22)	0.91 (1.18)	0.96 (1.21)
7.	Untreated control	-	0.97 (1.21)	1.00 (1.22)	0.97 (1.21)	1.03 (1.24)	0.93 (1.20)	0.97 (1.21)	0.86 (1.17)	0.98 (1.22)
	SEM(±)	NS	NS	NS	NS	NS	NS	NS	NS	NS
	CD(P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

SEM = Standard Error of Mean; CD = Critical Difference; NS = Non Significant.

4. Conclusion

It is evident from the present investigation that the yield in all treatments was significantly higher than untreated control in both the seasons. The plot treated with Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1750 ml/ha gave good control of pest with high yields and The treatment Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500 ml/ha was found to be at par with the Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1750 ml/ha in respect with control and yields but has the highest cost-benefit ratio. Therefore, Novaluron 5.25% + Emamectin Benzoate 0.9% SC @ 1500 ml/ha could be recommended for safe and economic use in rice for effective control of yellow stem borer.

5. References

1. Agricultural Statistics at a glance, 2015; (https://eands.dacnet.nic.in/PDF/Agricultural_Statistics_At_Glance-2015.pdf)
2. Biswas S. Studies on the stem borer, leaf folder and gall midge under terai agro-ecology of West Bengal. M.Sc (Agriculture) Thesis submitted to the Uttar Banga Krishi Viswavidyalaya, 2006, 1-46.
3. Chakraborty Kaushik. Effective Management of *Scirpophaga incertulas* Walker on rice crop during kharif season in West Bengal, India. American-Eurasian Journal of Agricultural & Environmental Science. 2012; 12(9):1176-1184.
4. Dash D, Mukherjee SK. Evaluation of insecticides against rice yellow stem borer, *Scirpophaga incertulas* (Walker). Journal of Insect Science. 2010; 23:184-187 ref.11.
5. Dash Lipsa, Mishra Ashima. Bioefficacy of a combination product (Novaluron 5.25% SC + Emamectin benzoate 0.9% SC) against diamond back moth, *Plutella xylostella* (L.) (Plutellidae, Lepidoptera). 1st International Conference on "Bio-resource, Environment and Agricultural Sciences (ICBEAS)" February 4-6, 2017.
6. Hegde Mahabaleswar, Girish VP, Balikai Rayappa. Field efficacy of some new insecticides against rice yellow stem borer *Scirpophaga incertulas* and effect on yield. Journal of Experimental Zoology. 2016; 19(1):583-586.
7. Heinrichs EA, Medrano FG, Rapusas H. (Eds.).Genetic evaluation for insect resistance in Rice in Rice. IRRI, Los Banos, Philippines, 1985.
8. Kakde AM, Patel KG. Seasonal Incidence of Rice Yellow Stem Borer (*Scirpophaga Incertulas* Wlk.) In Relation to Conventional and Sri Methods of Planting and Its Correlation with Weather Parameters, IOSR Journal of Agriculture and Veterinary Science. 2014; 7:05-10.
9. Kulagod Suresh D, Hegde Mahabaleshwar, Nayak GV. Evaluation of insecticides and bio-rationals against yellow stem borer and leaf folder on rice crop. Karnataka Journal of Agricultural Sciences. 2011; 24(2):244-246.
10. Kushwaha KS. Chemical control of Rice stem borer, *Scirpophaga incertulas* (Walker) and leaf folder *Cnaphalocrocis medinalis* Guenee on Basmati. Journal of Insect Science. 1995; 8(2):225-226.
11. Mahar MM, Bhatti IM, Dhuyo AR. Stem borer infestation and yield loss relationship in rice and cost-benefits of control. Paper presented at 5 National Sem. on Rice and Production. th Kalashakaku, April, 23-25, 1985.
12. Prasad R, Prasad D. Account of insect pests problem in rice-system in Ranchi. Indian Journal of Entomology. 2006; 68(3):240-246.
13. Sarwar M. Management of rice stem borers (Lepidoptera: pyraridae) through host plant resistance in early, medium and late planting of rice (*Oryza sativa*. L).Journal of cereals and oil seeds. 2012; 3(1):10-14.
14. Sasmal A, Bhattacharya DK, Nanda LR. Eco-friendly management of rice leaf folder and case worm in Odisha. National Symposium on sustainable pest management of safer environment organized by OUAT. Bhubaneswar. 2007, 33-34.