Int.J.Curr.Microbiol.App.Sci (2018) *7*(10): 374-379

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 10 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.710.040

Evaluation of the Efficacy of New Generation Granular Insecticides against Rice Yellow Stem Borer, *Scirpophaga incertulas* (Walker) in Thiruvananthapuram District, Kerala, India

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Keywords

Chlorantraniliprole 0.4 G, Cartap hydrochloride 4G, Fipronil 0.3G, Yellow stem borer, *Scirpophaga incertulas*

Article Info

Accepted:
04 September 2018
Available Online:
10 October 2018

A B S T R A C T

A field experiment was carried out at Integrated Farming Systems Research Station, Karamana, on rice variety Uma (MO 16) during Kharif 2017, to study the impact of new generation granular insecticides on rice yellow stem borer, *Scirpophaga incertulas* (Walker). Results showed that in terms of efficacy against stem borer, on the basis of overall performance of granular insecticides, fipronil 0.3G at 10 and 20 kg ha^{-1} was found to be more effective and superior among other granules in reduction of stem borer infestation to minimum of 1.84 and 2.13 per cent of dead hearts (DH) and 5.63 and 4.07 per cent of white ear heads (WEH) respectively. This was followed by Cartap hydrochloride 4G at 25 and 50 kg ha^{-1} with 4.61 and 4.63 per cent of DH; 7.00 and 6.40 per cent of WEH respectively. The untreated control recorded 9.61 per cent of DH and 12.41 per cent of WEH respectively. Chlorantraniliprole 0.4 G at 10 kg ha^{-1} found to be the least effective one with 5.46 and 9.23 per cent of DH and WEH respectively.

Introduction

Rice (*Oryza sativa* L.), the most vital cereal crop of India, is grown in an area of 43.39 million hectares with a production of 104.32 million tons in the year 2015-16 (D and ES, 2017). To deal with eternally exigent insect pest tribulations in rice, IPM practices like integration of varietal technology, cultural methods, biological control and utilization of insecticides is the most important and effective tool available to the rice farmer. The farmer has to adopt these latest technological interventions in pest management. The yellow stem borer is the most serious pests of rice in all parts of India, South and South East Asia, Japan and Korea and causes heavy yield losses. Pesticides are most commonly used to manage rice pests. Misra and Parida (2004) found the positive impact of insecticidal use in the production of rice. Production is linearly interrelated with insecticide use in rice. Khan *et al.,* (2010) claimed that insecticide application in paddy increased the yield of Basmathi-385 by 42.6 to 54.5 per cent compared to control and attained the cost

benefit ratio of 1:7 to 1:14. Since rice borers cause heavy loss to rice crop, the study dealt with the evaluation of new generation granular insecticides for the management of stem borer, *Scirpophaga incertulas* Walker, in rice.

Materials and Methods

The study on evaluation of the efficacy of granular insecticides in rice against rice yellow stem borer, *Scirpophaga incertulas* (Walker) was carried out in the department of Agricultural Entomology, College of Agriculture, Vellayani during 2016-2018. The field experiment was conducted in Integrated Farming Systems Research Station, Karamana during the first crop season from June 2017 to October 2017 to evaluate the impact of new generation granular insecticides *viz.* chlorantraniliprole 0.4G, fipronil 0.3G and cartap hydrochloride 4G at recommended and double the recommended doses on rice pests.

The experiment was laid out in a randomised block design using the medium duration variety Uma with seven treatments replicated thrice. The treatments included Chlorantraniliprole 0.4G @ 10 kg ha^{-1}, Chlorantraniliprole 0.4G @ 20 kg ha^{-1}, Fipronil 0.3G @ 10 kg ha^{-1}, Fipronil 0.3G @ 20 kg ha^{-1}, Cartap hydrochloride 4G @ 25 kg ha^{-1}, Cartap hydrochloride 4G @ 50 kg ha^{-1} and Untreated control. A spacing of 20 cm between rows and 15 cm between plants was adopted with a plot size of 5M x 4M. All the other agronomic practices were followed according to the Package of Practices recommendations of Kerala Agricultural University (KAU, 2016).

The application of insecticides was done at 15 and 30 days after transplanting by mixing it with sand. The observations on the DH and WEH were recorded from randomly selected ten hills at fortnightly intervals after second application of insecticides at 30, 45,60,75 and 90 days after transplanting and expressed as per cent damage by following the below mentioned formula

$$\text{Per cent DH / WEH} = \frac{\text{Number of DH or WEH / hill}}{\text{Total number of tillers / hill}} \times 100$$

Results and Discussion

The efficacy of different granular insecticides against rice yellow stem borer was measured on the basis of observation recorded and expressed as per cent DH on 30, 45, 60 and 75 days after transplanting and WEH recorded at 90 days after transplanting. The data representing DH and WEH incidence due to infestation by stem borer under field conditions are given in Table 1. The result revealed that all the insecticide treatments recorded significantly low per cent of dead heart as compared to the untreated control.

At 30 days after transplanting, the per cent DH ranged from 1.06 to 6.20 per cent as against 11.18 per cent in untreated control. Among the insecticide tested, the soil application with fipronil 0.3G at 10 kg ha^{-1} was observed to be the most effective one with 1.06 per cent DH incidence. This was followed by the treatment fipronil 0.3G at 20 kg ha^{-1} with 1.20 per cent DH and found to be statistically on par with fipronil 0.3G at 10 kg ha^{-1}.

At 45 DAT also the lowest per cent incidence of DH was recorded in the treatment fipronil 0.3G 10 kg ha^{-1} (1.63 per cent) which was significantly superior over control and on par with the treatment fipronil 0.3G 20 kg ha^{-1} (1.73 per cent). The highest incidence was observed in untreated control with 11.70 per cent DH. The treatments chlorantraniliprole 0.4G 10 kg ha^{-1}, chlorantraniliprole 0.4G 20 kg ha^{-1} and cartap hydrochloride 4G 50 kg ha^{-1} with per cent incidence of 7.45, 6.67 and 6.40 DH respectively were on par with control.

At 60 DAT, significant reduction in dead heart symptoms was recorded by all the treatments when compared to control (10.96). However the lowest per cent incidence of 2.33 was recorded by the treatment fipronil 0.3G 10 kg ha^{-1} which was on par with all the other treatments *viz.* fipronil 0.3G 20 kg ha^{-1}, chlorantraniliprole 0.4G 20 kg ha^{-1}, cartap hydrochloride 4G 25 kg ha^{-1}, cartap hydrochloride 4G 50 kg ha^{-1} and chlorantraniliprole 0.4G 10 kg ha^{-1} with per cent dead heart incidence of 2.80, 3.73, 3.80, 4.17 and 4.44 respectively. No significant reduction of DH incidence was recorded in any of the treatments including untreated control at 75 DAT. However the lowest incidence of 2.33 per cent was recorded in the treatment fipronil 0.3G 10 kg ha^{-1} and the highest being 4.60 recorded in control.

Overall performance of different insecticidal treatments as granular application based on the mean dead hearts indicated that treatment fipronil 0.3G 10 kg ha^{-1} was the most effective insecticide. The effectiveness of the treatments were in the order of Fipronil 0.3G 10 kg ha^{-1} > Fipronil 0.3G 20 kg ha^{-1} > Cartap hydrochloride 4G at 25 kg ha^{-1} > Cartap hydrochloride 4G at 50 kg ha^{-1} > Chlorantraniliprole 0.4 G 20 kg ha^{-1} > Chlorantraniliprole 0.4 G 10 kg ha^{-1}

The mean percent WEH incidence observed at 90 days after transplanting is given in Table 1. At 90 DAT the treatment fipronil 0.3G 20 kg ha^{-1} recorded significantly low incidence of WEH symptoms with a per cent incidence of 4.07 compared to control. This was on par with the treatments fipronil 0.3G 10 kg ha^{-1}, cartap hydrochloride 4G 50 kg ha^{-1} and cartap hydrochloride 4G 25 kg ha^{-1} with per cent incidence of 5.63, 6.40 and 7.00 respectively. The treatments chlorantraniliprole 0.4G 10 kg ha^{-1} and 20 kg ha^{-1} with mean percent incidence of 9.23 and 8.93 respectively were on par with control (12.41).

Among the granular formulations Huger *et al.*, (2009) found the superiority of fipronil 0.3G at 7.5 g a.i. ha^{-1} against yellow stem borer of rice with the least per cent infestation of 3.40 and 2.43 per cent of DH and 2.59 per cent of WEH respectively. Fipronil both as foliar and granular application in rice because of its systemic activity and its persistent toxicity effectively managed the stem borer incidence in rice (Dhaka *et al.*, 2009). The present findings are also in coherence with works of Satyanarayana *et al.*, (2014) in two different studies found that fipronil 0.6GR and 0.3GR were effective in managing stem borer and in reduction of hopper infestation. Panda *et al.*, (2004) also observed that fipronil application significantly reduced DH. The findings are also in agreement with the works of Firake *et al.*, (2010), Mishra *et al.*, (2012), Vennila *et al.*, (2014) and Singh *et al.*, (2015) who reported the superiority of fipronil in managing rice stem borer followed by cartap hydrochloride. Cartap hydrochloride 50 SP @1 g/lit and fipronil 2.5 ml/lit recorded the lowest per cent of WEH and leaf damage, respectively (Kulagod *et al.*, 2011)

In the case of grain yield, the highest yield of 5.43 t ha^{-1} was recorded in the treatment chlorantraniliprole 0.4 G 10 kg ha^{-1} (Table 2). This treatment recorded 25.40 per cent increase in yield over control (4.33 t ha^{-1}). The next best treatment was cartap hydrochloride 4G at 50 kg ha^{-1} which recorded a grain yield of 5.42 t ha^{-1} with 25.17 per cent increase in yield over control.

The next best treatment was fipronil 0.3G 20 kg ha^{-1} which recorded 5.33 t ha^{-1} yield with with 23.09 per cent increase over control. This was followed by the treatments fipronil 0.3G 10 kg ha^{-1} (5.2 t ha^{-1}), cartap hydrochloride 4G at 25 kg ha^{-1} (5.12 t ha^{-1}) and chlorantraniliprole 0.4 G 20 kg ha^{-1} (5.1 t ha^{-1}). The untreated control recorded the lowest yield of 4.33 t ha^{-1}.

Table.1 Evaluation of new generation granular insecticides for the management of stem borer in rice

Treatments	Dose (kg ha^{-1})	% dead hearts				Mean	% white ear heads
		30 DAT	45 DAT	60 DAT	75 DAT		90 DAT
Chlorantraniliprole 0.4 G	10	6.20^{b} (14.16)	7.45^{ab} (15.82)	4.44^{b} (11.96)	3.72 (10.84)	5.46^{b} (13.42)	9.23^{ab} (17.67)
Fipronil 0.3G	10	1.06^{c} (5.13)	1.63^{c} (6.24)	2.33^{b} (8.75)	2.33 (8.75)	1.84^{c} (7.74)	5.63^{bc} (13.43)
Cartap hydrochloride 4G	25	3.96^{b} (11.38)	6.03^{b} (14.11)	3.80^{b} (11.14)	4.62 (11.99)	4.61^{b} (12.36)	7.00^{bc} (15.29)
Chlorantraniliprole 0.4 G	20	5.47^{b} (13.25)	6.67^{ab} (14.92)	3.73^{b} (11.11)	4.01 (11.49)	4.97^{b} (12.83)	8.93^{ab} (17.37)
Fipronil 0.3G	20	1.20^{c} (6.01)	1.73^{c} (6.31)	2.80^{b} (9.54)	2.79 (9.60)	2.13^{c} (8.33)	4.07^{c} (11.37)
Cartap hydrochloride 4G	50	3.83^{b} (11.23)	6.40^{ab} (14.62)	4.17^{b} (11.65)	4.13 (11.53)	4.63^{b} (12.43)	6.40^{bc} (14.48)
Untreated control		11.18^{a} (19.52)	11.70^{a} (19.99)	10.96^{a} (19.23)	4.60 (11.68)	9.61^{a} (18.03)	12.41^{a} (20.46)
C.D. (P=0.05)		4.851	5.464	3.463	NS	2.415	4.833

**Figures in parenthesis are arsine transformed values, DAT – Days after transplanting, NS = Non-significant

Table.2 Effect of new generation granular insecticides on yield of grain in rice (t ha^{-1})

Treatments	Dose (kg ha^{-1})	Mean yield of grain	Increase over control	Percent increase over control
Chlorantraniliprole 0.4 G	10	5.43	1.10	25.40
Fipronil 0.3G	10	5.20	0.87	20.09
Cartap hydrochloride 4G	25	5.12	0.79	18.24
Chlorantraniliprole 0.4 G	20	5.10	0.77	17.78
Fipronil 0.3G	20	5.33	1.00	23.09
Cartap hydrochloride 4G	50	5.42	1.09	25.17
Untreated control		4.33		
C.D. (P=0.05)		NS		

The results are in agreement with the findings of Dash *et al.,* (2004) and Panda *et al.,* (2004) who found that the highest yield was obtained from the treatments fipronil and cartap hydrochloride recorded with the maximum increase over the untreated control. Jena and Mayabini (2004) also reported that fipronil was found promising in controlling the pest as well as increasing rice grain yield. The findings are also in coherence with that of Chatterjee *et al.,* (2015), Seni and Naik, (2017) and Rana and Singh, (2017) who reported that chlorantraniliprole besides reduction of stem borer infestation in rice it also recorded the highest grain yield over control. It could be concluded that though all the treatments were found to be non-significant, they effectively managed the stem borer infestation in rice and increased the maximum grain yield over control. Out of which fipronil 0.3G can be recommended for the suppression of yellow stem borer in rice compared to other granular insecticides.

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How to cite this article:

Niranjan, H.P., G. Suja and Shobha, Y.B. 2018. Evaluation of the Efficacy of New Generation Granular Insecticides against Rice Yellow Stem Borer, *Scirpophaga incertulas* (Walker) in Thiruvananthapuram District, Kerala, India. *Int.J.Curr.Microbiol.App.Sci.* 7(10): 374-379.
doi: https://doi.org/10.20546/ijcmas.2018.710.040