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Efficacy of some granular and sprayable formulations of insecticides against stem borer of rice

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ABSTRACT

The experiment on efficacy of some granular and sprayable formulations of insecticides against stem borer of rice was conducted at the Central Farm of OUAT, Bhubaneswar, Odisha during 2015 with the objective of evaluating the efficacy of both sprayable and granular formulations of some newer insecticides having different mode of action in controlling stem borer of rice. Rice variety TN1 and Swarna were taken as test cultivar during rabi and kharif, respectively. Both granular and spray formulations of chlorantraniliprole exhibited better control of stem borer at vegetative stage of the crop resulting in 8.33-9.05% dead heart (DH) as against 24.57% in control during the peak activity of borer population, followed by the granular application of fipronil (12.25% DH). At heading stage also, chlorantraniliprole was highly effective and inflicted about 2.62 and 3.73% white ear head (WEH) as against 13.38% in control. Hence chlorantraniliprole in both granular and spray formulation can be recommended for effective control of stem borer.

Keywords: Chlorantraniliprole, fipronil and rice stem borer

Rice (*Oryza sativa* L.) is an important staple food crop for world's more than half of the population and it accounts for more than 50 per cent of the daily calorie intake (Khush, 2005). According to FAO (2004), this crop is cultivated in at least 114 countries and is the primary source of income and employment for more than 100 million households in Asia. Within the country, rice occupies one quarter of the total cropped area, contributes about 40 to 43 per cent of total food grain production and continues to play a vital role in the national food and livelihood security system. Insect pests and diseases pose a very serious challenge in improving the productivity and achieving sustainability. Approximately, 52 per cent of the global production of rice is lost annually owing to the damage caused by biotic stress factors, of which 21per cent is attributed to the attack ofinsect pests (Yarasi *et al*., 2008). More than 128 species of insects have been reported to ravage the rice crop, of these 15-20 are considered to be economically important (Kalode, 2005). Among these, stem borer (*Scirpophaga incertulas* Walker) and leaf folder (*Cnaphalocrocis medinalis* Guenee) are some of the dominating ones. In India, the losses incurred by different insect pests are reported to the tune of 55.12 million rupees which in turn workout to 18.16 per cent of total losses. Out of this, 20 to 30 per cent damage is done by yellow stem borer alone (Lal, 1996). However, Singh *etal.* (2003) reported 12-18.8 per cent yield loss due to leaf folder in irrigated rice crop. Application of various granular and sprayable insecticidal formulation results in effective control of rice pests (Dash *et al.*, 1996). However, the indiscriminate use of chemical insecticides can be environmentally disruptive and can result in the accumulation of residues in the harvested produce (Dodan and Lal, 1999; Kaul and Sharma, 1999 and Rath, 1999 and 2001). Besides, new chemical products are being introduced in market every year in both granular and sprayable formulations. Several of the new products are effective against rice pests at very low amount of active ingredient and thus potentially less disruptive to the environment. Hence, attempts were made to study the bio-efficacy of some novel insecticides and compare both granular and spray formulations of such new insecticides which may be of immense value against stem borer of rice in integrated pest management system.

The experiment was conducted during *rabi* and *kharif*, seasons of 2015 in lowlands of Central Research Farm of Orissa University of Agriculture and Technology, Bhubaneswar. Rice variety Swarna was considered during *kharif* season and TN1 was taken during *rabi.* In the present experiment both granular and sprayable formulations of four insecticides *viz.*, imidacloprid, cartap hydrochloride, fipronil and chlorantraniliprole were tested along with carbofuran and phorate as granular insecticidal check and monocrotophos as sprayable check and treated with untreated check. The experiment was laid down following Randomized Block Design having twelve treatments and three replications with each plot size of 6.5 x 2.5m. Seeds for *rabi* and *kharif* season were sown

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on 12th December, 2014 and 25th July 2015, respectively maintaining seed rate 25kg ha^{-1} in nursery. Twenty one days seedlings were transplanted in main field with a spacing of 20 × 15cm. Proper agronomic management was followed including fertilizer application in recommended doses. Each of the insecticidal formulations was weighed properly using electronic balance for granular formulation and disposable syringe for sprayable formulation. For uniform application granular insecticides were mixed with sand in the ratio 1:10. Sprayable insecticides were applied by means of high volume air compression Knapsack sprayer using 500 litre of spray solution per hectare. The insecticides were applied two times *i.e*. at 20 days after transplanting (DAT) and 50 DAT in morning hours. Observations were taken from 10 randomly selected hills from each plot at 10, 20 and 30 days after insecticide application (DAA). Stem borer (SB) damage was assessed at the vegetative stage by counting the total number of tillers to the infested ones (Dead heart) and at the reproductive stage by counting the total panicle bearing tillers to the borer infested ones (White Ear Head which was recorded as the pre-harvest observation. The data recorded on pest population and extent of insect damages obtained from field experiments were subjected to square root transformation, and then data were analyzed following procedures laid out by Gomez and Gomez (1984). The treatment variations were tested for significance by 'F test'. The standard error of means and critical differences at 5% level of significance were calculated following the standard procedure and treatment means were compared using critical differences.

Efficacy against stem borer in rabi season

From the data generated after the first insecticidal spray at 20 DAT given in table 1, it is observed that the mean data over three periods of observation (10 DAA, 20 DAA, 30 DAA) showed greater efficacy of both formulations of chlorantraniliprole and granular fipronil over other treatments with a record of 3.77-4.79% DH as against 6% DH in carbofuran 3G (check) and 11.81% DH in monocrotophos (check) treated plots. Granular imidacloprid along with phorate and cartap hydrochloride failed in controlling this pest with an incidence of 9.04-15.10% DH compared to 14.75% in untreated check. Second insecticidal application at 50 DAT led to an declining trend in stem borer damage with an incidence of 19.76% DH at 10 DAA (Table 1).At this stage granular fipronil, chlorantraniliprole, carbofuran exhibited superior performance in controlling stem borer. Similar kind of control was also observed in plots received sprayable fipronil and chlorantraniliprole. Supremacy of granular chlorantraniliprole could be observed at 30 days after 2ndapplication with a record of 3.92% DH which remained on par with that of granular cartap hydrochloride,fipronil and sprayable formulations of cartap hydrochloride and chlorantraniliprole. The mean observation revealed better efficacy of granular chlorantraniliprole followed by fipronil and chlorantraniliprole spray which restricted the borer damage to single digit percentage (5.99-9.35) as against 16.41% DH in control.At heading stage stem borer damage varied from 2.62 to 8.69 per cent WEH in plots receiving various treatments as against 13.38 per cent in untreated check.Except imidacloprid granule rest of the granular treatments along with sprayable chlorantraniliprole (2.62-5.94% WEH) were highly effective. Spraying of imidacloprid, cartap hydrochloride, fipronil were found moderately effective against this borer with a record of 6.4-7.52% WH (Table 1).

Efficacy against stem borer in kharif season

From the mean observation after 1st insecticidal application it was observed that plants receiving granular cartap, fipronil, carbofuran and phorate along with spraying of fipronil and chlorantraniliprole remained completely free from stem borer damage at the early vegetative stage (Table 2). At 10 days after 2nd insecticidal application all the test molecules excepting imidacloprid 17.8 SL proved highly toxic to borers with a record of 0-0.72% DH in different treatments as against 1.56% in control. Observations on borer damage at 20 and 30 days after 2nd application remained non-significant.The average borer damage after 2nd insecticidal application was too mere (0-1.33% DH) to assess the efficacy of the test compounds as against 2% DH in check.Borer damage at heading stage didn't vary significantly in different treatments. Plots receiving fipronil 0.3 G, cartap hydrochloride 50 SP, fipronil 5 SC and chlorantraniliprole 18.5 SC remained completely free from borer damage as against 1.99% WEH in control.

During the *kharif* season stem borer incidence was very low to draw any conclusion based on mean observations at different stages of growth. However, numerical values confirm the trend which has been observed in *rabi* season.

Chlorantraniliprole either as granule or as spray was proved highly effective in controlling this serious pest. This new molecule through unique mode of action of inactivating the muscle contraction in insects shows excellent result in controlling this important pest of rice. The present finding is in agreement with that of Murali Baskaran *et al*., 2013; Chormule *et al*., 2014; Vinothkumar, 2014. However, sprayable formulations

Table 1: Field efficacy of granular and sprayable formulations of insecticides on stem borer damage in *rabi* rice in Bhubaneswar

Tr.No	Insecticides and formulations	Dose (commercial product ha^{-1})	Stem borer damage (% Dead heart and WEH)								
			1st insecticide application				2nd insecticide application				WEH (Pre harvest)
			10DAA	20 DAA	30DAA	MEAN	10DAA	20DAA	30DAA	MEAN	
T_1	Imidacloprid 0.3 G	12.50 kg	2.80 (1.81)	10.40 (3.29)	32.10 (5.64)	15.10	19.95 (4.49)	11.63 (3.48)	10.93 (3.38)	14.17	8.69 (3.02)
T_2	Cartap hydrochloride 4 G	20.00 kg	0.41 (0.91)	6.74 (2.64)	20.45 (4.57)	9.04	14.99 (3.92)	12.01 (3.49)	7.17 (2.74)	11.39	4.98 (2.28)
T_3	Fipronil 0.3 G	20.00 kg	0.44 (0.92)	1.70 (1.48)	12.25 (3.32)	4.79	10.76 (3.35)	8.52 (2.98)	6.74 (2.53)	8.67	3.38 (1.97)
T_4	Chlorantraniliprole 0.4 G	10.00 kg	0.48 (0.94)	1.77 (1.48)	9.05 (3.08)	3.77	9.33 (3.10)	4.72 (2.25)	3.92 (2.08)	5.99	2.62 (1.76)
T_5	Carbofuran 3G	33.00 kg	0.00 (0.71)	2.12 (1.59)	15.89 (4.02)	6.00	13.01 (3.67)	12.45 (3.58)	8.05 (2.88)	11.17	5.94 (2.52)
T_6	Phorate 10 G	12.50 kg	1.18 (1.23)	9.43 (3.12)	20.52 (4.57)	10.37	14.08 (3.79)	13.76 (3.74)	8.46 (2.98)	12.10	3.42 (1.90)
T_7	Imidacloprid 17.8 SL	150 ml	0.80 (1.04)	11.27 (3.33)	16.55 (4.01)	9.54	20.02 (4.51)	15.65 (4.01)	10.74 (3.35)	15.47	7.52 (2.81)
T_8	Cartap hydrochloride 50 SP	750 g	1.15 (1.25)	10.96 (3.28)	17.85 (4.24)	9.99	18.41 (4.34)	14.62 (3.87)	5.91 (2.49)	12.97	6.73 (2.67)
T_9	Fipronil 5 SC	1000 ml	1.06 (1.24)	4.83 (2.30)	15.50 (3.98)	7.13	11.23 (3.42)	10.53 (3.32)	9.46 (3.15)	10.40	6.40 (2.62)
T_{10}	Chlorantraniliprole 18.5 SC	150 ml	0.00 (0.71)	5.99 (2.57)	8.33 (2.95)	4.77	12.53 (3.59)	7.43 (2.81)	8.10 (2.91)	9.35	3.73 (2.05)
T_{11}	Monocrotophos 36 SL	1000 ml	1.03 (1.24)	8.84 (2.92)	26.59 (5.19)	11.81	17.53 (4.24)	16.85 (4.16)	10.99 (3.36)	15.12	6.14 (2.51)
T_{12}	Untreated control	-	4.87 (2.31)	14.82 (3.87)	24.57 (4.99)	14.75	19.76 (4.50)	19.36 (4.43)	10.12 (3.26)	16.41	13.38 (3.70)
	SEm (±)		**0.20**	**0.34**	**0.28**		**0.25**	**0.26**	**0.29**		**0.27**
	LSD (0.05)		**0.59**	**1.01**	**0.82**		**0.75**	**0.77**	**NS**		**0.79**

Note: Data in the parenthesis are (x +0.5) square root transformed

Table 2: Field efficacy of granular and sprayable formulations of insecticides on stem borer damage in rice during *kharif* season in Bhubaneswar

Tr.No	Insecticides and formulations	Dose (commercial product ha^{-1})	Stem borer damage (% Dead heart and WEH)							
			1st insecticide application			2nd insecticide application				WEH
			20DAA (40DAT)	30 DAA (50DAT)	MEAN	10DAA (60DAT)	20DAA (70DAT)	30DAA (80DAT)	MEAN	(Pre harvest)
T_1	Imidacloprid 0.3G	12.50 kg	0.00 (0.71)	1.04 (1.11)	0.52	0.72 (1.07)	1.33 (1.18)	1.96 (1.46)	1.33	1.34 (1.29)
T_2	Cartap hydrochloride 4 G	20.00 kg	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)	0.00 (0.71)	1.82 (1.39)	0.60	0.69 (1.01)
T_3	Fipronil 0.3 G	20.00 kg	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)
T_4	Chlorantraniliprole 0.4 G	10.00 kg	0.00 (0.71)	0.33 (0.88)	0.17	0.00 (0.71)	0.00 (0.71)	0.68 (1.00)	0.22	0.30 (0.87)
T_5	Carbofuran 3 G	33.00 kg	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)	0.00 (0.71)	0.35 (0.89)	0.11	0.60 (0.98)
T_6	Phorate 10 G	12.50 kg	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)	1.11 (1.12)	1.56 (1.23)	0.89	0.66 (1.00)
T_7	Imidacloprid 17.8 SL	150 ml	1.01 (1.10)	0.00 (0.71)	0.51	1.01 (1.20)	0.89 (1.06)	0.90 (1.07)	0.93	0.66 (1.05)
T_8	Cartap hydrochloride 50 SP	750 g	0.34 (0.88)	0.34 (0.88)	0.34	0.70 (1.01)	0.00 (0.71)	0.72 (1.02)	0.47	0.00 (0.71)
T_9	Fipronil 5 SC	1000 ml	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)	0.00 (0.71)	0.79 (1.04)	0.26	0.00 (0.71)
T_{10}	Chlorantraniliprole 18.5 SC	150 ml	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00	0.00 (0.71)
T_{11}	Monocrotophos 36 SL	1000 ml	0.00 (0.71)	0.34 (0.88)	0.17	0.00 (0.71)	0.60 (0.98)	0.98 (1.17)	0.52	0.98 (1.09)
T_{12}	Untreated control	-	0.23 (0.85)	1.27 (1.33)	0.75	1.56 (1.43)	1.96 (1.56)	2.49 (1.73)	2.00	1.99 (1.56)
	SEm (±)		**0.13**	**0.14**		**0.12**	**0.23**	**0.32**		**0.21**
	LSD (0.05)		**NS**	**NS**		**0.35**	**NS**	**NS**		**NS**

Note: Data in the parenthesis are (x + 0.5) square root transformed

of fipronil and cartap hydrochloride showed similar performance in controlling stem borer during most of the time. Effective control of stem borer by fipronil has earlier been reported by Satyanarayana *et al*. (2014), Hugar (2010) and Prasad *et al*. (2005). Earlier field trial of Virtako which is a combination product of chlorantraniliprole 20% and thiamethoxam 20% also showed superiority in controlling stem borer over fipronil granule (Murali Baskaran *et al*., 2013). During both the seasons compounds like imidacloprid (both granule and spray) and phorate granule miserably failed to control the borers.

From the overall performance of the test molecules, chlorantraniliprole both as spray and granule exhibited excellent control of stem borer of rice followed by fipronil granules. Since, it is a green label insecticide, it can be considered as a novel insecticide for integration into the IPM system in rice.

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