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Bio-efficacy trials of carbofuran 3% CG against insect pests of Rice

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Abstract

The present investigation was conducted in kharif 2017 at BCKV Teaching Farm, Mandouri, Nadia, West Bengal, to evaluate the efficacy insecticide, viz., Carbofuran 3% CG at different doze rates, Fipronil 0.3% GR, Carbosulfan 25% EC and Cartap Hydrochloride 4% GR against yellow stem borer, *Scirpophaga incertulas* and Rice leaf folder, *Cnaphalocrosis medinalis* infesting rice. The pooled data on efficacy of different treatment schedules of Carbofuran 3% CG against major insect pests of Rice i.e. stem borer and Leaf folder. All the treated plots provided significant reduction of pest infestation along with significant yield increase but the best protection was obtained from the plots treated with Carbofuran 3% CG @ 100kg/ha followed by Carbofuran 3% CG @ 50kg/ha & Carbofuran 3% CG @ 25 kg/ha. All the treatments were on par with each other and significantly superior over the other comparative treatments and untreated control regarding pest control.

Keywords: Rice, stem borer, leaf folder, bio-efficacy

1. Introduction

Rice (*Oryza sativa* L.) is the most important cereal food crop of the world providing major source of the food energy for more than half of the human population. In world the total production of rice is 463.3 million tonnes (Thawait *et al.*, 2014) ^[1]. India is world's second largest rice producer and consumer next to China. Total area under rice in India is 45.4 million hectare with annual production of 99.2 million tonnes and productivity is 2.18 tonnes/ha. (Anonymous, 2011) ^[2]. There are more than seventy pest infesting rice crop in India and twenty are of regular occurrence (Pathak, 1975) ^[3]. The stem borer and leaf folder are the worst pests which can cause severe damage and yield loss to the rice crop in the later stage. 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 alone done by yellow stem borer, *Scirpophaga incertulas* (Walker) (Lal, 1996) ^[4]. The yellow stem borer *Scirpophaga incertulas* (Walker) has assumed the number one pest status and attacks the rice crop at all stages of its growth (Pasulu *et al.*, 2002.) ^[5]. It causes dead hearts at active tillering stage and white ears at harvest stage, which can lead to complete failure of the crop (Karthikeyan and Purushothaman, 2000) ^[6].

Among the various strategies adopted to combat the pest of rice, insecticides are the first line of defence. Most of the insecticides used on agricultural crops are based on quit limited number of chemically different classes out of them the most important inorganic insecticides that are used against the pest on rice belongs to organophosphate and synthetic pyrethroids. Therefore an effort has been made in present investigation to evaluate the new molecules of chemical insecticides such as Carbofuran 3% CG at different doze rates supplied by NACL Industries Limited (Formerly known as Nagarjuna Agrichem Limited), Fipronil 0.3% GR, Carbosulfan 25% EC and Cartap Hydrochloride 4% GR against rice yellow stem borer and leaf folder.

2. Materials and Methods**2.1 Experimental Deign**

A field experiment was conducted at BCKV Teaching Farm, Mandouri, Nadia, West Bengal to evaluate insecticide molecules against yellow stem borer and Leaf folder in rice variety "Minicate/ Satapdi"(IET 4786) comprising seven treatments and three replication in randomized block design during kharif 2017 with individual plot size of 5 m x 5 m. The crop was transplanted with an ideal spacing of 25 x 18 cm.

2.2 Fertilizer and Pesticide application.

A recommended dose of nitrogenous fertilizer (100 kg N/ha) along with 3 ton of FYM as well as 60kg: 60kg (P:K)/ha & standard agronomic practices followed. Two rounds of insecticide applications were given one at active tillering upon the appearance of leaf folder when the pest status reached beyond ETL (one damaged leaf per hill) and second at panicle initiation stage by high volume Knapsack sprayer fitted with hollow cone nozzle using water @ 500 l/ha.

2.3 Observations

The observations on incidence of yellow stem borer were taken with respect to Dead Hearts (DH) & White ear head (WEH) count. Whereas leaf folder incidence was taken on the basis of no. of larvae. Observations to be taken on pests population in each plot before application and 1, 4, 7, 10 & 15 days after each application. In each plot 10 hills were randomly selected and the percentage of dead hearts & white ears per hill were observed randomly from top to bottom for calculating the insect pest population.

2.4 Statistical Analysis

The obtained mean values are used for ANOVA. The populations of natural enemies were recorded before and after the imposition of first and second application.

3. Results and Discussions

3.1 Bio-efficacy of Carbofuran 3% CG against Leaf folder of Rice in Kharif 2017.

Before the imposition of the treatments the number of no. of larvae ranged from 7.67 to 9.78 larvae per 10 hill. After the imposition of treatments the number of larvae decreased

gradually till fifteen days and all the treatments were significantly superior to the untreated control. At fifteen days after the application no infestation i.e. 0.00 and 0.00 was recorded in the treatments Carbofuran 3% CG @ 100kg/ha & Carbofuran 3% CG @ 50kg/ha. (and 100% reduction over control) and were on par with Carbofuran 3% CG @ 25 kg/ha, Cartap Hydrochloride 4%G@ 18.75 kg/ha & Carbosulfan 25% EC were recorded 0.33 larvae/10 hill (96.13, 96.13 & 96.13% reduction over control). These were followed by 0.67 (92.27% reduction over control) in Fipronil 0.3% GR @ 25 kg/ha. In untreated control the maximum number of larvae was 11.00 per 10 hills was recorded (Table 1).

Similar trend was observed after the second application imposition. Before the imposition of treatments the number of larvae i.e. the leaf folder infestation ranged from 7.67 to 9.67 larvae per 10 hill. After the imposition of treatments the population of leaf folder decreased gradually till fifteen days and all the treatments were significantly superior to the untreated control. At fifteen days after the application the least leaf folder infestation i.e. 1.00 and 1.33 larvae per 10 hill was recorded in the treatments Carbofuran 3% CG @ 100kg/ha & Carbofuran 3% CG @ 50kg/ha. (90.91% and 87.91% reduction over control respectively) and were on par with Carbofuran 3% CG @ 25 kg/ha & Cartap Hydrochloride 4%G@ 18.75 kg/ha recorded 1.67 leaves (84.82% reduction over control). These were followed by 2.00 and 2.33 (81.81 and 78.81% reduction over control) in Carbosulfan 25% EC @ 1000ml/ha and Fipronil 0.3% GR @ 25 kg/ha. In untreated control the maximum number of larval population of 11.51 per 10 hills was recorded (Table 2).

Table 1: Bioefficacy of Carbofuran 3% CG on Leaf folder (First application).

Sr. No.	Treatment	Dose g a.i/ha	Formulation (kg or ml/ha)	No. of leaf folder larvae / 10 hills.					% reduction at 15 days after application	
				PT [^]	1	4	7	10		15
T1	Carbofuran 3% CG	750	25	9.65 (3.19)	7.56 (2.84)	3.67 (2.02)	1.67 (1.46)	0.67 (1.05)	0.33 (0.88)	96.13
T2	Carbofuran 3% CG	1500	50	8.43 (2.99)	6.71 (2.69)	3.33 (1.95)	1.33 (1.34)	0.33 (0.88)	0.00 (0.71)	100
T3	Carbofuran 3% CG	3000	100	8.67 (3.03)	5.33 (2.41)	2.67 (1.77)	1.00 (1.22)	0.00 (0.71)	0.00 (0.71)	100
T4	Fipronil 0.3% GR	75	25	7.67 (2.86)	6.96 (2.73)	3.67 (2.02)	2.00 (1.56)	1.00 (1.22)	0.67 (1.05)	92.27
T5	Carbosulfan 25% EC	250	1000	8.47 (2.99)	6.58 (2.66)	4.00 (2.11)	2.33 (1.68)	1.00 (1.17)	0.33 (0.88)	96.13
T6	Cartap Hydrochloride 4%G	750	18.75	9.12 (3.01)	7.18 (2.77)	3.67 (2.03)	1.67 (1.46)	0.67 (1.05)	0.33 (0.88)	96.13
T7	Untreated control	-	-	9.78 (3.21)	11.00 (3.39)	11.00 (3.39)	11.00 (3.39)	10.33 (3.29)	8.67 (3.02)	-
	Sem		-	0.16	0.06	0.12	0.11	0.12	0.11	-
	CD (p=0.05)		-	0.49	0.17	0.38	0.34	0.38	0.34	-
	CV%		-	9.28	9.38	9.83	11.13	16.11	16.50	-

*Mean of three replications

PT[^] Pretreatment.

Values in parenthesis are ArcSine transformed

Table 2: Bioefficacy of Carbofuran 3% CG on Leaf folder (Second application).

Sr. No.	Treatment	Dose g a.i/ha	Formulation (kg or ml/ha)	No. of leaf folder larvae / 10 hills.					% reduction at 15 days after application	
				PT [^]	1	4	7	10		15
T1	Carbofuran 3% CG	750	25	9.00 (3.07)	7.33 (2.78)	6.48 (2.78)	5.37 (2.42)	3.67 (2.02)	1.67 (1.46)	84.82
T2	Carbofuran 3% CG	1500	50	8.00 (2.90)	6.00 (2.53)	5.35 (2.53)	4.77 (2.30)	3.33 (1.95)	1.33 (1.34)	87.91
T3	Carbofuran 3% CG	3000	100	7.67 (2.85)	5.00 (2.34)	4.64 (2.34)	3.51 (2.00)	2.67 (1.77)	1.00 (1.22)	90.91
T4	Fipronil 0.3% GR	75	25	7.67 (3.02)	6.33 (2.61)	5.29 (2.61)	4.34 (2.20)	3.67 (2.02)	2.00 (1.56)	81.81
T5	Carbosulfan 25% EC	250	1000	8.33 (2.95)	6.33 (2.61)	5.14 (2.61)	4.95 (2.33)	4.00 (2.11)	2.33 (1.68)	78.81
T6	Cartap Hydrochloride 4%G	750	18.75	9.33 (3.12)	8.00 (2.90)	6.80 (2.90)	5.93 (2.54)	3.67 (2.03)	1.67 (1.46)	84.81
T7	Untreated control	-	-	9.67 (3.18)	11.00 (3.39)	11.51 (3.39)	11.21 (3.42)	11.00 (3.39)	11.00 (3.39)	-
	Sem		-	0.16	0.15	0.02	0.02	0.12	0.11	-
	CD (p=0.05)		-	0.49	0.45	0.05	0.05	0.38	0.34	-
	CV%		-	0.70	0.54	1.05	1.21	1.18	3.38	-

*Mean of three replications

^ Pretreatment.

Values in parenthesis are ArcSine transformed.

3.2 Bio-efficacy of Carbofuran 3% CG against Stem Borer of Rice in Kharif 2017.

Before the imposition of the treatments the stem borer infestation the percentage of dead hearts ranged from 10.21% to 10.74%. After the imposition of treatment the percentage of dead hearts decreased gradually till fifteen days and all the treatments were significantly superior to the untreated control. At fifteen days after the application the least percentage of dead hearts 0.55% and 0.91% was recorded in the treatments Carbofuran 3% CG @ 100kg/ha followed by Carbofuran 3% CG @ 50kg/ha. (94.10% and 90.24% reduction over control) and were on par with other. These were followed by 1.42%, 1.70%, 1.83% and 3.05% in Carbofuran 3% CG @ 25kg/ha, Fipronil 0.3% GR @ 25 kg/ha, Carbosulfan 25% EC @ 1000kg/ha and Cartap Hydrochloride 4%G@ 18.75 kg/ha.

(Table 3).

Similar trend was observed after the second application imposition. Before the imposition of treatments the stem borer population i.e. the percentage of white earheads ranged from 4.94% to 5.35% per plant. At 15 days after the second application the least percentage of white earheads ranged 0.00% and 0.71% was recorded in the treatments Carbofuran 3% CG @ 100kg/ha and Carbofuran 3% CG @ 25kg/ha. (100% and 86.23% reduction over control) and were on par with each other. These were followed by 0.93%, 0.98%, 1.28% and 1.49% in Fipronil 0.3% GR @ 25 kg/ha, Carbofuran 3% CG @ 50kg/ha, Carbosulfan 25% EC @ 1000ml/ha and Cartap Hydrochloride 4%G@ 18.75 kg/ha. In untreated control the maximum percentage of white earheads ranged 4.97 was recorded. (Table 4).

Table 3: Bioefficacy of Carbofuran 3% CG on Stem borer (First application).

Sr. No.	Treatment	Dose g a.i/ha	Formulation (kg or ml/ha)	Percentage of Dead heart (%)					% reduction at 15 days after application	
				PT [^]	1	4	7	10		15
T1	Carbofuran 3% CG	750	25	10.42 (19.28)	7.33 (15.84)	6.43 (15.26)	6.27 (15.08)	3.73 (13.04)	1.42 (7.96)	84.78
T2	Carbofuran 3% CG	1500	50	10.46 (19.33)	6.00 (14.80)	5.73 (14.45)	5.43 (14.05)	3.47 (12.33)	0.91 (6.80)	90.24
T3	Carbofuran 3% CG	3000	100	10.52 (19.34)	5.00 (13.09)	4.23 (12.56)	4.10 (12.38)	2.30 (10.40)	0.55 (5.87)	94.10
T4	Fipronil 0.3% GR	75	25	10.55 (19.42)	6.33 (15.82)	6.43 (15.26)	6.37 (15.18)	2.70 (12.02)	1.70 (8.52)	81.77
T5	Carbosulfan 25% EC	250	1000	10.57 (19.53)	6.33 (16.32)	7.07 (15.96)	6.60 (15.45)	2.50 (11.63)	1.83 (8.77)	80.38
T6	Cartap Hydrochloride 4% G	750	18.75	10.21 (19.05)	8.00 (19.81)	6.63 (15.49)	6.27 (15.07)	0.67 (14.12)	3.05 (10.75)	67.30
T7	Untreated control	-	-	10.74 (19.56)	11.00 (19.81)	11.33 (20.12)	11.00 (19.81)	10.33 (19.79)	9.33 (18.26)	-
	Sem		-	0.67	0.35	0.28	0.36	0.76	0.53	-
	CD (p=0.05)		-	2.03	1.05	0.85	1.08	2.30	1.61	-
	CV%		-	5.99	3.78	3.12	4.02	9.79	9.65	-

*Mean of three replications

Values in parenthesis are Angular transformed.

Table 4: Bioefficacy of Carbofuran 3% CG on Stem borer (Second application).

Sr. No.	Treatment	Formulation (kg or ml/ha)	Percentage of White ear (%)					% reduction at 15 days after application	
			PT [^]	1	4	7	10		15
T1	Carbofuran 3% CG	25	4.94 (13.48)	1.14 (7.32)	0.78 (6.48)	0.76 (6.41)	0.73 (6.33)	0.71 (6.29)	82.11
T2	Carbofuran 3% CG	50	5.10 (13.68)	0.80 (6.53)	0.56 (5.90)	0.53 (5.80)	0.43 (5.49)	0.98 (5.31)	75.31
T3	Carbofuran 3% CG	100	5.35 (14.00)	0.16 (4.66)	0.15 (4.63)	0.13 (4.56)	0.03 (4.18)	0.00 (4.05)	100.00
T4	Fipronil 0.3% GR	25	5.05 (13.63)	1.25 (7.59)	1.18 (7.45)	1.17 (7.43)	1.16 (7.39)	0.93 (6.85)	76.57
T5	Carbosulfan 25% EC	1000	5.15 (13.75)	1.55 (8.23)	1.37 (7.84)	1.33 (7.75)	1.30 (7.71)	1.28 (7.66)	67.75
T6	Cartap Hydrochloride 4% G	18.75	5.25 (13.88)	2.05 (9.18)	1.72 (8.54)	1.54 (8.18)	1.51 (8.13)	1.49 (8.08)	62.46
T7	Untreated control	-	4.97 (13.51)	4.92 (13.45)	4.48 (12.88)	4.04 (12.29)	4.01 (12.25)	3.97 (12.19)	-
	Sem	-	0.20	0.32	0.35	0.32	0.36	0.41	-
	CD (p=0.05)	-	0.61	0.98	1.06	0.98	1.10	1.26	-
	CV%	-	2.54	6.84	7.90	7.49	8.55	9.95	-

*Mean of three replications

Values in parenthesis are Angular transformed

3.3 Effect of different insecticidal treatments on the yield.

All the treatments were superior over the untreated check. The yield data of Rice grain was highest 33.50 and 32.50 q/ha Carbofuran 3% CG @ 100kg/ha and Carbofuran 3% CG @ 50kg/ha. Both the treatments were on par with each other and were significantly superior to the standard checks. These were

followed by 30.00 q/ha in Carbofuran 3% CG @ 25q/ha, 28.75 q/ha in Fipronil 0.3% GR @ 25 kg/ha @ 600 m/ha, 28.50q/ha in Carbosulfan 25% EC @ 1000ml/ha, and 27.20 q/ha in Cartap Hydrochloride 4%G@ 18.75 kg/ha. In untreated check the lowest yield 24.05 q/ha was recorded. (Table 5).

Table 5: Yield of Rice in various treatments of Carbofuran 3% CG for the management of various insect pests of Rice.

Sr. No.	Treatment	Formulation (gm or ml/ha)	Grain Rice Yield in q/ha*
1	Carbofuran 3% CG	25	30.00
2	Carbofuran 3% CG	50	32.50
3	Carbofuran 3% CG	100	33.50
4	Fipronil 0.3% GR	25	28.75
5	Carbosulfon 25% EC	1000	28.50
6	Cartap Hydrochloride 4%G	18.75	27.20
7	Untreated control		24.05
	Sem		1.51
	CD (p=0.05)		4.58
	CV%		8.95

3.4 Effect of different insecticidal treatments on the natural enemies in rice ecosystem.

Natural enemies like Spiders and Dragonflies were observed in the experimental plot before the imposition of the treatments. Before the imposition of the first application the spiders ranged from 0.28 to 0.36 and Dragonflies ranged from 0.48 to 0.56 per plot.

After the first application the spiders in Carbofuran 3% CG treatments ranged from 0.33 to 0.36 per plot and Dragonflies ranged from 0.53 to 0.56. After the second application spiders were 0.33 in higher dose treated plot of Carbofuran 3% CG @100kg/ha, 0.35 in Carbofuran 3% CG @ 50 kg/ha and Carbofuran 3% CG @ 25 kg/ha., Dragonflies were 0.52, 0.56 and 0.55 in Carbofuran 3% CG @ 100kg/ha Carbofuran 3%

CG @ 50kg/ha and Carbofuran 3% CG @ 25 kg/ha treated plots, clearly indicating that the test molecule Carbofuran 3% CG was safe to the natural enemies in the Rice ecosystem.(Table 6).

Among the new molecules of insecticides Carbofuran 3% CG found to be significantly superior in reducing the per cent dead hearts and white ear heads. These result are in agreement with Dash and Mukherjee (2003) [7], Hugar *et al.* (2007) [8], Rao *et al.* (2008) [9] and (Wakil *et al.*,2001) [10] who stated that carbofuran application proved to be the best both in controlling the attack of stem borer and leaf folder as well as better yield per acre. it gave the maximum reduction in rice borer and leaf folder infestation with maximum cost benefit ratio 1:6.67.

Table 6: Studies on the effect Carbofuran 3% CG on natural enemies of Rice insect pests.

Sr. No.	Treatments	Dosage a.i/ha	No. of natural enemies/plant*					
			Before application		After first application		After second application	
			Spiders	Dragonflies	Spiders	Dragonflies	Spiders	Dragonflies
1	Carbofuran 3% CG	25	0.32 (0.91)	0.54 (1.02)	0.33 (0.91)	0.53 (1.01)	0.35 (0.92)	0.55 (1.02)
2	Carbofuran 3% CG	50	0.33 (0.91)	0.52 (1.01)	0.34 (0.92)	0.54 (1.02)	0.35 (0.92)	0.56 (1.03)
3	Carbofuran 3% CG	100	0.30 (0.89)	0.51 (1.00)	0.36 (0.93)	0.56 (1.03)	0.33 (0.91)	0.52 (1.01)
4	Fipronil 0.3% GR	25	0.28 (0.88)	0.56 (1.03)	0.35 (0.92)	0.55 (1.02)	0.32 (0.91)	0.57 (1.00)
5	Carbosulfon 25% EC	1000	0.31 (0.89)	0.54 (1.02)	0.32 (0.90)	0.52 (1.01)	0.35 (0.92)	0.50 (1.00)
6	Cartap Hydrochloride 4%G	18.75	0.36 (0.93)	0.53 (1.01)	0.34 (0.91)	0.50 (1.00)	0.34 (0.92)	0.48 (0.99)
7	Untreated control	-	0.32 (0.91)	0.48 (0.99)	0.52 (1.01)	0.52 (1.01)	0.37 (0.93)	0.58 (1.04)
	Sem		0.01	0.01	0.02	0.02	0.02	0.02
	CD (p=0.05)		0.04	0.04	0.06	0.06	0.06	0.05
	CV%		2.77	2.33	3.50	3.58	3.76	2.67

*Average of 10 plants per treatment

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