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Bio-efficacy and phytotoxicity of cartap hydrochloride 50% + buprofezin 10% WP against yellow stem borer of rice

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Abstract
Field experiment were conducted in the Instructional Cum Research (ICR) farm, Assam Agricultural University, Jorhat during *rabi* and *kharif* seasons (2015) to evaluate the bio-efficacy and phytotoxicity of cartap hydrochloride 50% + Buprofezin 10% against yellow rice stem borer, *Scirpophaga incertulas* Walker (Lepidoptera: Pyralidae). Ten treatments of chemicals at different doses and untreated control (Water Spray) were laid out in randomized block design with three replications. The results showed that cartap hydrochloride 50% + buprofezin 10% @ 480 g/ha significantly reduced the infestation of dead heart (2.87% and 2.98%), white earhead (1.97% and 1.51%) with maximum grain yield (6250 kg/ha and 4900 kg/ha) in both the seasons at 15 days after treatment, respectively in compared to the standard checks *viz.* chlorpyriphos 20% EC @ 250 g a.i./ha and Lambda cyalothrin 5% EC.

Keywords: Bio-efficacy, phytotoxicity, *Scirpophaga incertulas*, Lambda cyalothrin

Introduction
Rice (*Oryza sativa* L.) is one of the most important cereal crops of India and is a staple food of more than 65 percent of its population. India, being the largest rice growing country, covers an area of about 44.6 million hectares with second largest production of 90.6 million tonnes of rice but productivity still low at around 2424 kg/ha in 2014-2015 [1]. A critical analysis of the gap between the potential and actual rice yield across the nation reveals that several factors act as yield constraints. Among these factors, insect-pests contribute 10-15 percent yield losses. The rice crop is subjected to a considerable damage by a number of insect pests, among them yellow stem borer, *Scirpophaga incertulas* (Walk.) is the principal devastators, which causes economic losses under local conditions [2]. This insect attack the crop from the seedlings stage to the harvesting stage and thus causes complete loss of infected tillers. Dead hearts are produced when the insect attacks at vegetative stage while white heads occur when the stem borer attacks at the time of heading. Chemical control is a popular option for the farmers and is also option in rice pest management. In order to include newer formulation in the package of practices, present studies were conducted and results thus obtained are presented herein.

Materials and methods
A field experiment was conducted to determine the bio-efficacy and phytotoxicity of cartap hydrochloride 50% + buprofezin 10% against insect pest of rice during *rabi* and *kharif* season 2015 in the Instructional Cum Research (ICR) farm, Assam Agricultural University, Jorhat situated at 94°10′ E longitude and 26°44′ N latitude with an altitude of 91 m above mean sea level. The experiment was laid out in a randomized block design with ten treatments and three replications. The variety Ranjit was sown in an area with plot size of 20m^2. Seedlings were transplanted 30 days after sowing with inter and intra row spacing of 20×15 cm. All the agronomic practices were followed as per the recommended package of practices, the knapsack and spray volume @ 500 l/ha was with hollow cone nozzle to impose the spray treatments. Two sprayings were performed where first spraying was done on 15 days after transplanting (DAT) and second spraying on 35 DAT. The details of the treatments are given below:

Details of treatment for bio-efficacy

No	Treatments	Dosagea.i./ha (in gm)
T1	CartapHydrochloride50% + Buprofezin 10%WP	390
T2	Cartap Hydrochloride 50% + Buprofezin 10%WP	420
T3	Cartap Hydrochloride50% + Buprofezin 10%WP	480
T4	Cartap Hydrochloride50% + Buprofezin 10%WP	540
T5	Cartap Hydrochloride 50% + Buprofezin 10%WP	600
T6	Cartap Hydrochloride 50%	500
T7	Buprofezin 25%	200
T8	Chlorpyriphos 20% EC	250
T9	Lambda Cyhalothrin 5% EC	12.5
T10	Untreated Control	-

Details of treatment for Phytotoxicity

No.	Treatments	Dosagea.i/ha (in gm)
T1	Cartap Hydrochloride 50% + Buprofezin 10%WP	420
T2	Cartap Hydrochloride 50% + Buprofezin 10%WP	480
T3	Cartap Hydrochloride 50% + Buprofezin 10%WP	840
T4	Cartap Hydrochloride 50% + Buprofezin 10%WP	960
T5	Cartap Hydrochloride 50% + Buprofezin 10%WP	1680
T6	Cartap Hydrochloride 50% + Buprofezin 10%WP	1920
T7	Cartap Hydrochloride 50% + Buprofezin 10%WP	Untreated control

The observations on percent infestation of stem borer dead heart (DH) and white ear head (WEH) were recorded from 10 hills selected randomly and averaged to per hill basis. Observations were recorded a day before and 5, 10 and 15 days after imposing the treatments. Yield data after harvesting was also recorded from one sq. m (25 plants) area of the plots. Counts were taken on the number of dead hearts/white ear heads and the total number of tillers per panicle from 10 randomly selected hills. The percent (dead heart/white ear heads) was calculated as follows

$$\text{Percent infestation} = \frac{\text{Number of dead heart/white ear head}}{\text{Total number of tillers per panicle}} \times 100$$

The data thus obtained from all the observations were subjected to analysis of variance after making necessary transformation whatever necessary.

Results and discussion

Bio-efficacy

The data on bio-efficacy of different treatments dosages of cartap hydrochloride 50% + buprofezin 10% WP and other insecticides against rice yellow stem borer along with natural enemies of rice in both *rabi* and *kharif* seasons during 2015 (Table 1-3) revealed that all the insecticide treated plots were superior to reduce the incidence of stem borer population compared to untreated control. Out of different insecticides tested against rice stem borer, cartap hydrochloride 50% + buprofezin 10% WP @ 480g a.i./ha significantly reduced the infestation of dead heart (2.87% and 2.98%), white ear head (1.97% and 1.51%) with maximum grain yield of (6250 kg/ha and 4900 kg/ha) in both the season at 15 days of treatment respectively. Similarly cartap hydrochloride 50% @ 500 g a.i./ha was the next best treatment which could significantly reduced the infestation of dead heart, white ear head effectively with next higher yield of (6000 kg/ha and 4666 kg/ha) during *kharif* and *rabi* seasons respectively. However both the treatments of cartap hydrochloride 50% + buprofezin 10% WP@ 480 g a.i./ha and cartap hydrochloride 50% @ 500 g a.i./ha was on par in their efficacies.

In respect of standard checks insecticides *viz.*, chlorpyriphos 20% EC @ 250 g a.i./ha and lambda cyhalothrin 5% EC to cartap hydrochloride 50% + buprofezin 10% WP, chlorpyriphos was the best with a grain yield of 5500 kg/ha and 4150 kg/ha during *kharif* and *rabi* seasons respectively. But no significant difference was observed in the efficacies between these two insecticides. Amongst the different insecticides, higher number of spider and coccinellid beetle recorded in treated cartap hydrochloride 50% + buprofezin 10% WP @ 480 g a.i./ha was 4.00 and 4.33 per five hills followed by cartap hydrochloride 50% @ 500g a.i./ha with 3.33 and 3.67 per five hills and chlorpyriphos 20% EC @ 250 g a.i./ha with 3.33 and 3.67 per five hills respectively during *kharif* season. Similar trend was observed during*rabi* season also. However, the highest spider and coccnellids was observed in untreated control plots where it was 4.67 and 5.33 per five hills in *kharif* season (Table 3). Application of cartap hydrochloride 50% + buprofezin 10% WP @ 480 g a.i./ha significantly reduced the infestation of dead heart and white ear head, increased the filling of rice grains and rice crop compared with other insecticides. There are many studied reported in the literature on the effect of insecticides in reducing infestation of rice stem borer.

Cartap hydrochloride 50 SP was found effective in present studies, which is in agreement with the results obtained by [3, 4, 5, 6, 7]. The efficacy of chemical insecticides like trizophos and chlorpyriphos against *S.incertulas* recorded in present studies are in conformity with the findings of earlier studies conducted by [3, 8, 5]

Phytotoxicity

Phytotoxicity symptoms like leaf tip burning (leaf injury on tips), leaf curling, necrosis, epinasty, hyponasty and wilting, were recorded after 1, 3, 7 and 10 DAS of each sprays. For recording phytotoxicity, 0-10 scale was followed where, 0=no phytotoxicity, 1=1-10%, 2=11-20%, 3=21-30%, 4=31-40%, 5=41-50%, 6=51-60%, 7=61=70%, 8=71-80%, 9=81-90% and 10=91-100% phytotoxicity. The cartap hydrochloride 50% + buprofezin 10% WP did not produce any phytotoxic

symptoms. No phytotoxic symptoms as leaf tip burning, leaf curling, necrosis, epinasty, hyponasty etc were recorded in any of the treated plot with cartap hydrochloride 50% + buprofezin 10% WP during this trial (Table 4).

Table 1: Bio-efficacy of different treatments against stem borer of rice during *rabi* 2015 (1st season)

Treatment	Dosage a.i./ha (in g)	PTC	Post treatment					
		% DH	% DH			% reduction over control	%WEH	% reduction over control
			5 DAS	10 DAS	15 DAS			
T1	390	6.23	5.57 (13.65)	4.80 (12.66)	4.60 (12.38)	32.65	2.93 (9.86)	16.29
T2	420	6.38	5.72 (13.84)	4.53 (12.29)	3.73 (11.14)	45.09	2.80 (9.63)	20.00
T3	480	5.95	4.95 (12.86)	3.51 (10.80)	2.98 (9.94)	56.36	1.51 (7.06)	56.85
T4	540	6.03	5.03 (12.96)	4.11 (11.70)	3.45 (10.70)	49.49	1.82 (7.75)	48.00
T5	600	6.58	5.92 (14.08)	4.27 (11.93)	3.73 (11.14)	45.53	2.07 (8.27)	40.85
T6	500	6.84	6.18 (14.39)	4.32 (11.99)	3.18 (10.27)	53.54	1.80 (7.71)	48.57
T7	200	6.98	5.98 (14.15)	5.69 (13.80)	4.99 (12.91)	26.94	2.97 (9.92)	15.14
T8	250	5.82	5.15 (13.12)	4.22 (11.85)	3.36b (10.56)	50.80	2.02 (8.17)	42.29
T9	12.5	6.63	6.10 (14.30)	5.27 (13.27)	3.45 (10.70)	49.48	2.12 (8.37)	39.43
T10	-	6.17	6.43 (14.69)	4.80	6.83 (15.15)	-	3.50 (10.78)	-
S. Ed. (±)		0.70	0.41	0.51	0.41		0.46	
CD (P=0.05)		NS	(0.92)	(1.15)	(0.92)		(1.02)	

Figures in parenthesis are arc sin transformed values.
All values are mean of three replications and two sprays.
PTC-Pre-treatment count

Table 2: Bio-efficacy of different treatments against stem borer of Rice during *kharif* 2015 (2nd season)

Treatment	Dosage a.i./ha (in g)	PTC	Post treatment					
		% DH	% DH			% reduction over control	% WEH	% reduction over control
		Before spray	5 DAS	10 DAS	15 DAS			
T1	390	7.49 (15.88)	7.16 (15.52)	5.58 (13.56)	4.01 (11.55)	48.72	3.63 (10.98)	9.25
T2	420	7.10 (15.45)	7.03 (15.37)	5.50 (13.56)	4.25 (11.90)	45.65	3.77 (11.20)	5.75
T3	480	5.46 (13.51)	5.12 (13.08)	4.37 (12.07)	2.87 (9.75)	63.29	1.97 (9.13)	50.75
T4	540	6.31 (14.55)	5.97 (14.14)	5.17 (13.14)	3.02 (10.01)	61.38	3.03 (10.58)	24.25
T5	600	7.13 (15.49)	6.80 (15.12)	5.37 (13.40)	3.37 (10.58)	56.90	3.47 (10.74)	13.25
T6	500	6.31 (14.55)	5.98 (14.15)	5.07 (13.01)	2.88 (9.77)	63.17	2.97 (10.51)	25.75
T7	200	7.35 (15.73)	7.01 (15.45)	6.36 (14.61)	4.26 (11.91)	45.52	3.50 (10.78)	12.50
T8	250	7.01 (15.35)	6.68 (14.97)	5.08 (13.03)	3.66 (11.03)	53.20	3.23 (9.68)	19.25
T9	12.5	7.49 (15.88)	7.15 (15.51)	6.23 (14.45)	3.88 (11.36)	50.38	3.87 (11.35)	3.25
T10	-	7.65 (16.06)	7.65 (16.06)	7.79 (16.20)	7.82 (16.24)		4.00 (11.54)	
S. Ed. (±)		0.80	0.63	(0.81)	0.66		0.40	
CD (P=0.05)		NS	(1.42)	(1.83)	(1.49)		(0.90)	

Figures in parenthesis are arc sin transformed values
All values are mean of three replications and two sprays.
DAS: Days after spray

Table 3: Impact of different treatments on natural enemies and rice yield during *rabi* 2015 (1st season) and *kharif* 2015 (2nd season)

Treatment	Dosage a.i./ha (in gm)	Spider population (Number per five hills)		Coccinellid population (Number per five hills)		Grain yield (kg/ha)	
		Kharif 2015	Rabi 2015	Kharif 2015	Rabi 2015	Kharif 2015	Rabi 2015
T1	390	2.33 (1.68)	2.00 (1.58)	3.00 (1.87)	2.67 (1.78)	5250.00	3746.67
T2	420	2.67 (1.78)	2.33 (1.68)	3.67 (2.04)	2.67 (1.78)	5500.00	4333.33
T3	480	4.00 (2.12)	3.00 (1.87)	4.33 (2.20)	3.67 (2.04)	6250.00	4900.00
T4	540	3.00 (1.87)	2.00 (1.58)	3.67 (2.04)	2.67 (1.78)	5850.00	4616.67
T5	600	3.00 (1.32)	2.00 (1.58)	2.00 (1.58)	1.67 (1.47)	5150.00	3500.00
T6	500	3.33 (1.96)	2.67 (1.78)	3.67 (2.04)	3.00 (1.87)	6000.00	4666.67
T7	200	3.00 (1.87)	2.00 (1.58)	3.33 (1.96)	2.00 (1.58)	5000.00	3333.33
T8	250	3.33 (1.96)	2.67 (1.78)	3.67 (2.04)	3.00 (1.87)	5500.00	4150.00
T9	12.5	2.67 (1.78)	2.33 (1.68)	3.00 (1.87)	3.00 (1.87)	5250.00	3666.67
Control	-	4.67 (2.27)	3.67 (2.04)	5.33 (2.41)	4.00 (2.12)	4900.00	3000.00
S. Ed (±)		0.61	0.67	0.62	0.82	38.23	47.85
CD (p=0.5%)		(1.38)	(1.51)	(1.40)	NS	(86.39)	(108.14)

Figures in parenthesis are square root (X+0.5) transformed values.
All values are mean of three replications and two sprays.
PTC: Pre-treatment count
DAS: Days after spray.

Table 4: Phytotoxicity of different treatments on rice during *rabi* 2015 (1st season) and *kharif* 2015 (2nd season)

Treatment	Dosage a.i./ha (in gm)	Phytotoxicity symptoms at 0 to 10 scale					
		Observation at 1, 3, 7 and 10 DAS					
		Leaf tip burning	Leaf curling	Necrosis	Epinasty	Hyponasty	Wilting
T1	420	0	0	0	0	0	0
T2	480	0	0	0	0	0	0
T3	840	0	0	0	0	0	0
T4	960	0	0	0	0	0	0
T5	1680	0	0	0	0	0	0
T6	1920	0	0	0	0	0	0
T7	Untreated control	0	0	0	0	0	0

Conclusion

From the present study, it was concluded that rice yellow stem borer can be managed successfully and grain yield can be increased by using cartap hydrochloride 50% + buprofezin 10% WP at @ 480g./ha. Cartap hydrochloride 50% + buprofezin 10% WP did not cause phytotoxicity (leaf tip burning, leaf curling, necrosis, epinasty, hyponasty and wilting) even up to 1920 g/ha doseand alsoall the test doses of Cartap Hydrochloride 50% + Buprofezin 10% WP was found to be safer on natural enemies *viz.* predatory spiders and coccinellid predators.

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