RESEARCH ARTICLE

SAFETY OF NOVEL INSECTICIDES TO NATURAL ENEMIES IN BASMATI RICE ECOSYSTEM OF WESTERN UTTAR PRADESH

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Abstract: Field experiments were conducted during *Kharif* 2014 and 2015 at crop research centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U.P., India to evaluate the effect of various novel chemical insecticidal treatments on natural enemies. Altogether, 11 treatments including 9 novel insecticides, viz. (T1) indoxacarb 14.5% SC @ 500 ml, (T2) fipronil 5% SC @ 1000 ml, (T3) novaluron 10% EC @ 600 ml, (T4) cartap hydrochloride 50 % SP @ 1.0 Kg, (T5) cartap hydrochloride 4 GR @ 18 Kg, (T6) spinosad 45 % SC @ 220 ml, (T7) flubendiamide 39.35 % SC @ 75 ml, (T8) chlorantraniliprole 18.5 % SC @ 150 ml and (T9) chlorantraniliprole 0.4 % GR @ 10 Kg besides insecticidal check (T11) chlorpyriphos 50% + cypermethrin 5% EC @ 1200 ml and (T11) untreated control. The results showed that the overall mean population of Spiders was found to be more in the untreated check (2.33 and 3.24/hill) followed by chlorantraniliprole 0.4 % GR (1.85 and 2.09/ hill) in the first and second foliar application. The overall mean population of predators was high in the untreated check (1.94 and 2.90/ hill), followed by chlorantraniliprole 0.4 % GR (1.62 and 2.17/ hill) over the other treatments.

Keywords: Basmati rice, Ecosystem, Insecticides, Uttar Pradesh

INTRODUCTION

Rice (*Oryza sativa* L.) an important cereal crop in the world provides a staple food for nearly half of the global population. Almost 90% of rice is grown and consumed in Asia (Khush and Brar, 2002). Well over, 848 different types of natural enemies such as Spiders, Mirid bugs, Coccinellids, Damsel and Dragon flies and Water spiders etc., are present in the rice eco-system to suppress the harmful insect pests naturally, which is known as natural biological control (Bhavani and Rao, 2005). Oft, misapply of insecticidal applications are common in rice eco-system. Several studies have been conducted on the efficacy of insecticides (Prasad et al., 2014; Chatterjee and Mondal, 2014; Karthick, et. al., 2014). Research on the effects of insecticides against natural enemies is meagre. Therefore an effort has been made in present investigation to safety of novel insecticides to natural enemies in basmati rice. In view of rich natural enemy complex of the pests of rice, it is also necessary to select relatively safer insecticides with a view to conserve them. Therefore, it is imperative that alternative insecticides be explored for managing rice pests especially in basmati rice which has high export value. The novel insecticides should be effective in reducing the pest damage, cost effective, biodegradable, and safer to natural enemies and other non-target organisms.

METHOD AND MATERIAL

Research trial was conducted during *Kharif* 2014 and 2015 at CRC, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India to find out the effectiveness of novel insecticides. The study was conducted with the basmati rice cultivar Pusa 1121. Experiment was conducted in a randomized block design with eleven treatments and three replications and the plot size was 4.0 X 3.0 m. Twenty five days old seedlings were transplanted with inter and intra row spacing of 20 X 10 cm. All the agronomic practices were followed as per the recommendations. All the novel insecticides under study were applied as foliar spray using knapsack sprayer except controlled release formulation (CRF) of chlorantraniliprole and cartap hydrocholoride granules. The dose of insecticides expressed in terms of ml or g per ha. The soluble insecticides were applied after duly mixing with water (300 lit/ha and 500 lit/ha each corresponding to the respective growth stage of the crop at the time of spraying) at 50 and 75 days after transplanting (DAT) with due care taken for preventing insecticidal drift. Bunds were formed around the treatment plot and the granular insecticide chlorantraniliprole 0.4 GR and cartap hydrocholoride 4G (CRF) were broadcasted on standing crop after 50 and 75 days of transplanting. In control plot, only water was used.
The population of predators *i.e.*, spiders, coccinellids and rove beetle was recorded at one day before first spray and third, seven, fourteen and twenty one days after first and second spray. The population (both

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mature and immature stages) of predator complex was recorded separately from five randomly selected hills in each plot. The total number of natural enemies were counted and expressed as number per hill.

Statistical analysis

The data, recorded during the course of investigation, were analyzed with the help of computer software "OPSTAT1" developed by O. P. Sheoren, CCS HAU Hisar.

RESULT AND DISCUSSION

Spiders, Coccinelids and rove beetle are major predator group recorded in the experimental field. The result regarding the effect of novel insecticide on natural enemies summarized in table 1-4.

The statistically analyzed pooled data of both the year indicated that mean maximum spider population was recorded from the untreated control 2.33/hill and 3.24/hill after first and second spray, respectively. The overall picture regarding effect of various novel insecticides on spider population showed that the mean maximum spider population was recorded in chlorantraniliprole 0.4 % GR 1.85 and 2.09/hills after first and second spray and followed by chlorantraniliprole 18.5 % SC with 1.65 and 1.91/hill, flubendiamide 39.35 % SC with 1.47 and 1.66/hill, spinosad 45 % SC with 1.32 and 1.47/hill, fipronil 5 % SC 1.22 and 1.33/hill, indoxacarb 14.5 % SC with 0.98 and 1.19/hill, cartap hydrochloride 4 % GR with 0.88 and 1.03/hill, novaluron 10 EC with 0.75 and 0.88/hill and cartap hydrochloride 50 % SP with 0.67 and 0.70/hill, respectively. Whereas, the minimum spider population was recorded from chlorpyriphos 50 % + cypermethrin 5 % EC treated plots with 0.57 and 0.52/hill among all the treatments after first and second spray, respectively. All the treatments were found significantly differ from each other (Table 1). The safety of chlorantraniliprole to spider is in agreement with findings of Shanwei *et al*., (2009). Similarly, *Dhaka et al.*, (2011) also reported cartap hydrochloride 4G safer for the spiders. Mukherjee *et al.*, (2011) reported that spider population was not significantly affected by indoxacarb. These findings are also in agreement with present investigation.

The statistically analyzed pooled data regarding effect of various novel insecticides on predators (Coccinelids and Rove beetle) during *kharif*, 2014 and 2015 revealed that throughout the spray period untreated control (1.94 and 2.90/hill) had high predatory population. Results also showed that among novel insecticides chlorantraniliprole 0.4 % GR, (1.62 and 2.17/hill) and chlorantraniliprole 18.5 % SC (1.42 and 1.86/hill) consistently showed higher predators population, while chlorpyriphos 50 % + cypermethrin 5 % EC (0.41 and 0.66/hill) showed low population. Pooled data of both the years also revealed that novel insecticidal treatments *viz.*, flubendiamide 39.35 % SC (1.29 and 1.70/hill), spinosad 45 % SC (1.18 and 1.53/hill), fipronil 5 % SC (1.03 and 1.35/hill), indoxacarb 14.5 % SC (0.92 and 1.22/hill), cartap hydrochloride 4 % GR (0.78 and 1.06/hill), novaluron 10 EC (0.63 and 0.96/hill) and cartap hydrochloride 50 % SP (0.52 and 0.83/hill) were the next best treatments after first and second spray, respectively.(Table 2). The results obtained by Mishra, 2008; Shanwei *et al*., 2009 are in support with present findings as they reported that chlorantraniliprole was highly safer to natural enemies in rice eco system. Similarly, Jafar *et al*., 2013 also reported that Chlorantraniliprole, indoxacarb were safer to natural enemies of rice insect pests and Hall, 2007 and Chormule, 2014 reported that flubendiamide was moderately safe to natural enemies.

Table 1. Pooled effect of different treatments on spider populations after first and second spray during *kharif* 2014 and 2015

Treatments	1 day Before spraying	After first spray Spider population/hills					After second spray Spider population/hills				
		3 DAS	7 DAS	14 DAS	21 DAS	Mean	3 DAS	7 DAS	14 DAS	21 DAS	Mean
T1	1.27(1.50*)^{a}	0.77(1.32)^{e}	0.80(1.34)$_{e}$	1.07(1.44)$_{e}$	1.30(1.52)^{e}	0.98	1.10(1.45*)^{c}	1.17(1.47)^{e}	1.57(1.60)^{e}	1.30(1.52)^{e}	1.19
T2	1.17(1.47)^{a}	0.84(1.35)^{f}	0.93(1.39)$_{f}$	1.30(1.52)$_{f}$	1.43(1.56)^{f}	1.12	1.23(1.50)^{c}	1.33(1.53)^{f}	1.70(1.64)^{f}	1.50(1.58)^{f}	1.33
T3	1.30(1.52)^{a}	0.54(1.23)^{c}	0.64(1.28)$_{c}$	0.83(1.36)c	1.00(1.41)^{c}	0.75	0.80(1.34)^{b}	0.90(1.38)^{c}	1.10(1.45)^{c}	0.97(1.40)^{c}	0.88
T4	0.94(1.39)^{a}	0.47(1.21)^{b}	0.57(1.25)$_{b}$	0.73(1.32)^{b}	0.90(1.38)^{b}	0.67	0.63(1.28)^{b}	0.77(1.33)^{b}	0.83(1.36)^{b}	0.73(1.32)^{b}	0.7
T5	1.40(1.55)^{a}	0.70(1.30)^{d}	0.70(1.30)$_{d}$	0.94(1.39)^{d}	1.17(1.47)^{d}	0.88	0.90(1.38)^{bc}	1.03(1.42)^{d}	1.37(1.54)^{d}	1.13(1.46)^{d}	1.03
T6	1.40(1.55)^{a}	0.90(1.37)^{g}	1.20(1.48)$_{g}$	1.47(1.57)^{g}	1.70(1.64)^{g}	1.32	1.43(1.56)^{d}	1.50(1.58)^{g}	1.83(1.68)^{g}	1.60(1.61)^{g}	1.47

T7	1.47(1.57)^{a}	1.10(1.44)^{h}	1.30(1.52)$_{h}$	1.60(1.61)^{h}	1.87(1.69)^{h}	1.47	1.63(1.62)^{e}	1.70(1.64)^{h}	2.00(1.73)$_{h}$	1.73(1.65)^{h}	1.66
T8	1.43(1.56)^{a}	1.30(1.51)^{i}	1.44(1.56)$_{i}$	1.83(1.68)^{i}	2.04(1.74)^{i}	1.65	1.77(1.66)^{f}	1.87(1.69)^{i}	2.13(1.77)$_{i}$	1.90(1.70)^{i}	1.91
T9	1.64(1.62)^{a}	1.50(1.58)^{j}	1.57(1.60)$_{j}$	2.03(1.74)^{j}	2.30(1.82)^{j}	1.85	1.90(1.70)^{g}	2.00(1.73)^{j}	2.40(1.84)$_{j}$	2.10(1.76)^{j}	2.09
T10	1.20(1.48)^{a}	0.37(1.16)^{a}	0.50(1.23)$_{a}$	0.63(1.28)^{a}	0.77(1.33)^{a}	0.57	0.37(1.17)^{a}	0.60(1.27)^{a}	0.63(1.28)$_{a}$	0.50(1.23)^{a}	0.52
T11	1.57(1.60)^{a}	1.80(1.67)$_{k}$	2.07(1.75)$_{k}$	2.63(1.91)^{k}	2.84(1.96)^{k}	2.33	2.97(1.99)^{h}	3.30(2.07)^{k}	3.73(2.18)k	3.13(2.03)^{k}	3.24
SEm(±)	**0.04**	**0.02**	**0.01**	**0.02**	**0.02**		**0.02**	**0.01**	**0.02**	**0.02**	
CD at 5%	**NS**	**0.05**	**0.04**	**0.05**	**0.05**		**0.06**	**0.04**	**0.05**	**0.06**	

*Figures in parentheses are square root transformed values
DAS= Days after spray

Table 2. Pooled effect of different treatments predator's population after first and second spray during *kharif* 2014 and 2015

Treatment	**1 Day Before spraying**	**After first spray predator's population /hills**					**After second spray predator's population/hills**				
		3 DAS	**7 DAS**	**14 DAS**	**21 DAS**	**Mean**	**3 DAS**	**7 DAS**	**14 DAS**	**21 DAS**	**Mean**
T1	0.87(1.37*)^{a}	0.50(1.22)^{d}	0.67(1.29)^{e}	1.17(1.47)^{e}	1.37(1.54)^{e}	0.92	0.87(1.37*)^{d}	1.07(1.44)^{d}	1.60(1.61)^{e}	1.47(1.57)^{e}	1.22
T2	0.94(1.39)^{a}	0.63(1.27)^{e}	0.77(1.33)^{f}	1.24(1.50)^{f}	1.50(1.58)^{f}	1.03	0.97(1.40)^{d}	1.20(1.48)^{e}	1.77(1.66)^{f}	1.63(1.62)^{f}	1.35
T3	1.00(1.41)^{a}	0.32(1.14)^{b}	0.47(1.21)^{c}	0.77(1.33)^{c}	0.97(1.40)^{c}	0.63	0.63(1.28)^{c}	0.87(1.37)^{c}	1.27(1.50)^{c}	1.1791.47)^{c}	0.96
T4	1.17(1.47)^{a}	0.27(1.12)^{ab}	0.37(1.17)^{b}	0.60(1.27)^{b}	0.87(1.37)^{b}	0.52	0.57(1.25)^{b}	0.70(1.30)^{b}	1.17(1.47)^{b}	1.03(1.43)^{b}	0.83
T5	1.23(1.49)^{a}	0.40(1.18)^{c}	0.57(1.25)^{d}	1.00(1.41)^{d}	1.17()1.47)^{d}	0.78	0.73(1.32)^{c}	1.00(1.41)^{d}	1.37(1.54)^{d}	1.27(1.51)^{d}	1.06
T6	0.97(1.40)^{a}	0.77(1.32)^{f}	0.87(1.37)^{g}	1.44(1.56)^{g}	1.64(1.62)^{g}	1.18	1.17(1.47)^{e}	1.47(1.57)^{f}	1.90(1.70)^{g}	1.83(1.68)^{g}	1.53
T7	0.97(1.40)^{a}	0.83(1.35)^{g}	0.94(1.39)^{h}	1.53(1.59)^{h}	1.87(1.69)^{h}	1.29	1.37(1.54)^{f}	1.60(1.61)^{g}	2.10(1.76)^{h}	1.97(1.72)^{h}	1.7
T8	1.24(1.50)^{a}	0.93(1.38)^{h}	1.07(1.44)^{i}	1.67(1.63)^{i}	2.04(1.74)^{i}	1.42	1.70(1.64)^{g}	1.80(1.67)^{h}	2.30(1.82)^{i}	2.07(1.75)^{i}	1.86
T9	1.07(1.44)^{a}	1.00(1.41)^{i}	1.30(1.52)^{j}	1.97(1.72)^{j}	2.20(1.79)^{j}	1.62	1.87(1.69)^{h}	2.03(1.74)^{i}	2.60(1.90)^{j}	2.57(1.89)^{j}	2.17
T10	0.94(1.39)^{a}	0.20(1.09)^{a}	0.30(1.14)^{a}	0.44(1.20)^{a}	0.70(1.30)^{a}	0.41	0.37(1.17)^{a}	0.57(1.25)^{a}	0.97(1.40)^{a}	0.8391.36)^{a}	0.66
T11	1.07(1.44)^{a}	1.24(1.49)^{j}	1.77(1.66)^{k}	2.27(1.81)^{k}	2.50(1.87)^{k}	1.94	2.77(1.94)^{i}	2.97(1.99)^{j}	3.27/(2.07)^{k}	3.03(2.01)^{k}	2.9
SEm(±)	**0.03**	**0.02**	**0.02**	**0.02**	**0.02**		**0.03**	**0.02**	**0.02**	**0.02**	
CD at 5%	**NS**	**0.06**	**0.06**	**0.05**	**0.04**		**0.1**	**0.06**	**0.06**	**0.07**	

*Figures in parentheses are square root transformed values
DAS= Days after spray

CONCLUSION

Thus on the basis of present findings, it may be concluded that all the treatments reduce the natural enemies population as compared to control at different intervals. When the data of both the years were pooled the treatment Chlorantraniliprole, 0.4 GR and 18.5 SC was found highly safer among all the treatments with maximum natural enemies population/hill. So these insecticides may be use for control the insect pest in rice eco system.

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