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Insecticidal Effect on Natural Enemies in Rice Ecosystem of Kanpur (Central Uttar Pradesh)

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A B S T R A C T

The maximum number of natural enemies was recorded in chlorantraniliprole 18.5% SC treated plots except checked (untreated or control) followed by buprofezin 25 SC, imidacloprid 17.8SL, cartap hydrochloride 4G, malatian 5% D and fipronil 5 SC, respectively in both the experimental years.

Introduction

Rice (*Oryza sativa* L.) is the world's second most important cereal crop, cultivated in the most divers ecosystems of tropical and subtropical regions of 117 countries and known with different names in India as Dangar (Gujarat), Bhatt (Maharashtra), Chawal (U.P., Bihar), Voldu (A.P.), Dhan (W.B.), Chaul (Punjab), Shali (J & K), Nellu (Tamil Nadu, Kerala). It is one of the oldest and second most intensively grown cereal crops next to wheat and ranks third in grain production. Rice is life and princess among the cereals, the staple food of 65% of the total population in India. It constitutes about 52% of the total food grain production and 55% of total cereal production. Rice is grown under diverse growing conditions such as irrigated, rainfed lowland, rainfed upland and flood prone ecosystems. India is the largest rice growing country, while China is the largest producer of rice in the world. India produced 105.42 million tones during 2015-16 from 43.70 million hectare with average productivity (2412 kg/ha (Anonymous, 2017 a). Over 800 species of pests and numerous species of natural enemies occupy the rice crop during vegetative and reproductive stages (Hafeez *et al.*, 2010). The natural enemies, predators and parasitoids will impart the effect over the population of rice pests under favourable environmental conditions. The use of insecticides remains the major strategy in dealing with insect-pests as it is quick, cost-effective and effective. However, lethal and sub-lethal effects of broad-spectrum insecticides may impact beneficial species (Wang *et al.,* 2012 and Fogel *et al.,* 2013). Misuse of insecticides might account for pest outbreaks because extensive and intensive insecticides applied to target pests and may accelerate resistance development. Another important factor is environmental pollution, side effect on non-target organism and insecticides may indiscriminately kill natural enemies. In fact, natural enemies tend to be more susceptible to insecticides than pests (Kiritani, 1979, Bacci, L. *et al.,* 2007 and Preetha *et al.,* 2010). Some insecticides have disrupted natural enemy complexes and induced a resurgence of the target pests or non-target minor pests in paddies (Gallagher *et al.,* 1994 and Heinrichs, 1994). Insecticides and biological control are two important management strategies. Integrating these two strategies is important for the success of any management program (Wright & Verkert, 1995). In contrast use of selective insecticides that are less toxic to natural enemies than to pests should conserve natural enemy populations, and the surviving natural enemies may suppress the pest populations, which in turn will reduce the rate of insecticide application. Insecticides should be only used when necessary and be least disruptive to biological control (Wang *et al.,* 2008). Knowing the impact of insecticides on natural enemies is essential for integration of these two strategies (Greathead, 1995). It is essential to understand the dynamics of integrating prudently used chemical pesticides along with biological control organisms for the effective implementation of an IPM. To effective utilize the natural enemies as biological control agents, we should acquire information about the effects of pesticides on them. Many investigations have assessed the effect of insecticides on predators of rice insect-pests simply by applying insecticides paddy fields (*e.g*. Ito *et al.,* 1962; Toyoda and Yoshimura, 1966, 1967; Heinrichs *et al.,* 1982a, b; Reissig *et al.,* 1982a, b and Tanaka & Sato, 1988).

Materials and Methods

A field experiment was carried out during *kharif,* 2015 and *Kharif,* 2016 at the Student Instructional Farm of C. S. Azad University of Agriculture and Technology, Kanpur (U.P.) to evaluate the effect of newer insecticides over natural enemies of paddy pests. The experiment was laid out in a Randomized Block Design (RBD) with seven treatments replicated thrice. The ruling rice variety Pusa Basmati-1 was transplanted in 5 × 4 m square meter plots with a spacing of 25 × 15 cm. The recommended dose of fertilizer of 120:40:40 kg / ha as N: P2O5: K2O was applied, respectively. About 25 per cent N and K2O and 100 per cent P2O5 were applied as basal and rest of N and K2O were applied in three equal split doses at tillering, panicle initiation and flowering stages. The details of the treatments were T1- Chlorantraniliprole 18.5% SC at 30 g a. i. / ha; T2- Imidacloprid 17.8 SL at 25 g a. i. / ha; T3- Buprofenzin 25 SC at 200 g a. i. / ha; T4- Cartaphydrachloride 4 G at 750 g a. i. / ha; T5- Malathion 5% Dust at 25 kg / ha; T6- Fipronil 5 SC at 75g a. i. / ha and T7- Control. Two sprayings were given at an interval of fifteen days. The insecticides were sprayed in their respective doses by diluting in sufficient amount of water (based on crop stage) with the help of Knapsack sprayer fitted with hollow cone nozzle. The incidence of natural enemies was recorded one day before of spray as pre-treatment observation and post treatment observations were taken at 3and 10 after spraying different times. The population of natural enemies was recorded at ten randomly selected hills leaving the border rows. The total number of natural enemies were counted and expressed as number per hill.

Results and Discussion

Kharif, 2015

The results of the present investigation showed that The number of natural enemies among all treatments were non-significant before application of the insecticides which ranged from 8.37 to 10.01 No./5 sweeps, during *Kharif*, 2015 (Table-1). At three days after first spraying of insecticides, the incidence of natural enemies varied from 3.36 to 9.75 (No./5 sweeps), all the treatments were found effective and significantly superior over the untreated plots or control (9.75 no./5 sweeps). Except control plots, the maximum number 7.14 No./ 5 sweeps of natural enemies were found in chloreantraniliprole 18.5 SC treated plots followed by 6.31 No./ 5 sweeps in buprofezin 25 SC treated plots and the least number of natural enemies 3.36 No./ sweeps was recorded in fipronil 5 SC treated plots. The result revealed that after ten days of first spraying the highest population of natural enemies 10.25 No/5 sweeps found in untreated plots followed by 6.88 chloreantaniliprole treated plots. The lowest population 2.76 No./5 sweeps was observed in fipronil 5 SC treated plots followed by 3.79 No./ 5 sweeps in malathion 5 D treated plots.

After the second foliar application of insecticides there was a decline in the number or population of natural enemies from three days after spraying and continued upto ten days after spraying. It was found that the highest population 10.25 No./ 5sweeps of natural enemies was recorded in the untreated or checked plots followed by 6.88 and 6.02 No./ 5sweeps in buprofezin SC and imidacloprid 17.8 SL treated plots, respectively. The lowest number 2.76 No./ 5 sweeps of natural enemies was observed in fipronil 5 SC treated plots followed by 3.79 No./ 5 sweeps in malathion treated plots.

After ten days of second folier application of insecticides all insecticides were responsible for reducing the population of natural enemies. The lowest number 1.96 No./ 5 sweeps of natural enemies was recorded in fipronil 5 SC treated plots followed by 3.17 and 3.83 No./ 5sweeps in malation 5 D and cartap hydrochloride 4 G treated plots, repectively. The highest movement of natural enemies was found in utreated plots (12.39 No./ 5 sweeps) followed by 4.83 No./ 5 sweeps in chloreantraniliprole 18.5 SC treated plots.

Kharif, 2016

The number of natural enemies *viz.* spider, dragon fly, damsel fly and lady bird beetle (in the form of mean value), among all treatments were non-significant before application of the insecticides which ranged from 8.75 to 10.01 No./5 sweeps, during *Kharif*, 2016 (Table-2). The result of the present study showed that before the first foliar application of insecticides the population ranged from 3.31 to 9.71 No./ 5 sweeps at three days of spraying. The highest population 9.71 No./ 5 sweeps was in control plots followed by 7.12 and 6.25 No./ 5 sweeps in chloreantraniliprole 18.5 SC and buprofezin 25 SC treated plots, respectively. The minimum number 3.31 No./ 5 sweeps of natural enemies found in fipronil treated plots followed by 4.49 No./ 5 sweeps in malahion 5 D treated plots.

After ten days of first spraying the maximum number (10.22 No./ 5 sweeps) of natural enemies was found in untreated plots followed by 6.85, 6.05 and 5.81 No./ 5 sweeps in chloreantraniliprole 18.5 SC, buprofezin 25 SC and imidacloprid 17.8 SL treated plots, respectively. The least number

(2.84 No./ 5 sweeps) of natural enemies observed in fipronil 5 SC treated plots.

After second foliar spray of insecticides the observations were recorded after three and ten days of spraying. The highest population (11.43 No./ 5 sweeps) was found in control plots followed by 5.37 and 5.04 No./ 5 sweeps in chloreantraniliprole 18.5 SC and buprofezin 25 SC treated plots after three days of spraying, respectively. The lower populations (2.46 and 3.49 No./ 5 sweeps) of natural enemies were observed in fipronil 5 SC and malathion 5 D treated plots, respectively.

After ten days of second foliar spray of insecticides the least number (1.97 No./ 5sweeps) of natural enemies was found in fipronil 5 SC treated plots followed by malathion 5 D treated plots with (3.19 No./ 5 sweeps) of natural enemies. The maximum number (12.21 No./ 5 sweeps) of natural enemies was found in control plots followed by 4.81 and 4.41 No./ 5 sweeps in chloreantraniliprole 18.5 SC and buprofezin 25 SC treated plots.

Kharif, 2015 & 2016 (Pooled)

Pooled data of both the experimental year (*kharif*, 2015 & 2016) showed that the Ist application of insecticides was done, when the insect-pests infestation reached at its ETL. The effect of insecticides on natural enemies was seen in the rice crop.

The population of natural enemies before the first foliar application of insecticides ranged from 8.56 to 9.95 No./ 5 sweeps. After the first insecticidal application, there was a decline in the natural enemies' population.

The maximum number (9.73 No./ 5 sweeps) of natural enemies was recorded in untreated plots followed by 7.130 and 6.280 No./ 5 sweeps in chloreantraniliprole 18.5 SC and buprofezin 25 SC treated plots, respectively (Table-3). The fipronil 5 SC treated plots registered the lowest number 3.33 followed by malathion 5 % D treated plots 4.49 No./ 5 sweeps of natural enemies.

After ten days of first insecticidal application chloreantraniliprole 18.5 SC was the most safer insecticide among all the insecticides with mean value 6.86 No./ 5 sweeps followed by buprofezin 25 SC with 6.037 No./ 5 sweeps. The fipronil 5 SC (2.80 No./ 5 sweeps) registered the worst performance in the survival of natural enemies among all the treatments followed by malathion 5 % D (3.76 No./ Sweeps).

The population of insect-pests was reduced with first spray. After some days an accidental increase was noticed in the crop therefore there was a need for second insecticidal spray. At three days of second spray the maximum population of natural enemies (10.97 No./ 5 sweeps) was recorded in control plots. All treatments were significantly effective except untreated plots. Chloreantraniliprole 18.5 SC treated plots registered the maximum mean value 5.35 No./ 5 sweeps of natural enemies followed by buprifezin 25 SC with 5.03 No./ 5 sweeps.

The lowest number (2.44 No./ 5 sweeps) was observed in fipronil 5 SC treated plots followed by malathion 5% D with mean value 3.50 of No./ 5 sweeps. After ten days of second insecticidal application the lowest number (1.96 No./ 5 sweeps) of natural enemies was observed in fipronil 5 SC treated plots followed by malathion 5 % D and cartap hydrochloride 4 G with mean value 3.81 and 3.84 No./ 5 sweeps, respectively. The higher number 12.30 and 4.82 No./ 5 sweeps was recorded in untreated and chloreantraniliprole 18.5 SC, respectively.

Table.1 Insecticidal effect on natural enemies *Khrif*, 2015

Sr. No.	**Treatment**	**Doses (g. ai/ha)**	**Pretreatment**	**First Spray**		**Second Spray**	
				3 Days	10 Days	3Days	10 Days
1	Chlorantraniliprole 18.5 SC	30	8.75 (3.11)	7.14 (2.84)	6.88 (2.80)	6.88 (2.50)	4.83 (2.39)
2	Buprofezin 25 SC	200	9.1 (3.14)	6.31 (2.68)	6.02 (2.62)	6.02 (2.44)	4.48 (2.34)
3	Imidacloprid 17.8 SL	25	8.37 (3.03)	6.12 (2.66)	5.87 (2.60)	5.87 (2.25)	3.98 (2.21)
4	Fipronil 5 SC	75	9.96 (3.28)	3.36 (2.08)	2.76 (1.92)	2.76 (1.83)	1.96 (1.70)
5	Cartaphhloride 4 G	750	9.37 (3.19)	5.37 (2.50)	4.97 (2.43)	4.97 (2.28)	3.83 (2.18)
6	Malathion 5 D	25 kg	10.01 (3.29)	4.49 (2.31)	3.79 (2.16)	3.79 (2.10)	3.17 (2.03)
7	CONTROL	-	9.31 (3.19)	9.75 (3.25)	10.25 (3.27)	10.25 (3.35)	12.39 (3.64)
SEm±			1.272	1.411	1.388	1.119	1.184
CD			NS	NS	4.325	3.485	3.689

[Figures within parentheses are square root $\sqrt{x+0.5}$ transformed values]

Table.2 Insecticidal effect on natural enemies *Khrif*, 2016

Sr. No.	Treatment	Doses (g. ai/ha)	Pretreatment	First Spray		Second Spray	
				3 Days	10 Days	3Days	10 Days
1	Chlorantraniliprole 18.5 SC	30	8.8 (3.12)	7.12 (2.83)	6.85 (2.79)	5.37 (2.51)	4.81 (2.39)
2	Buprofezin 25 SC	200	9.96 (3.28)	6.25 (2.66)	6.05 (2.62)	5.04 (2.44)	4.41 (2.32)
3	Imidacloprid 17.8 SL	25	8.75 (3.09)	6.08 (2.65)	5.81 (2.59)	4.15 (2.25)	3.93 (2.20)
4	Fipronil 5 SC	75	8.89 (3.13)	3.31 (2.07)	2.84 (1.94)	2.46 (1.83)	1.97 (1.71)
5	Cartaphhloride 4 G	750	9.02 (3.141	5.38 (2.50)	4.9 (2.41)	4.31 (2.29)	3.86 (2.19)
6	Malathion 5 D	25 kg	9.9 (3.28)	4.44 (2.31)	3.73 (2.14)	3.49 (2.10)	3.19 (2.04)
7	CONTROL	-	10.01 (3.29)	9.71 (3.24)	10.22 (3.32)	11.43 (3.50)	12.21 (3.61)
SEm±			1.146	1.409	1.373	1.112	1.236
CD			NS	NS	4.279	3.498	3.850

Figures within parentheses are square root $\sqrt{x+0.5}$ transformed values

Table.3 Insecticidal effect on natural enemies Pooled (*Khrif*, 2015 & 2016)

S. No.	Treatment	Doses(g. ai/ha)	Pretreatment	First Spray		Second Spray	
				3 Days	10 Days	3Days	10 Days
1	Chlorantraniliprole 18.5 SC	30	8.777 (3.12)	7.130 (2.84)	6.867 (2.80)	5.353 (2.51)	4.823 (2.39)
2	Buprofezin 25 SC	200	9.533 (3.21)	6.280 (2.67)	6.037 (2.62)	5.033 (2.44)	4.443 (2.330
3	Imidacloprid 17.8 SL	25	8.563 (3.06)	6.100 (2.65)	5.840 (2.60)	4.163 (2.25)	3.953 (2.21)
4	Fipronil 5 SC	75	9.423 (3.21)	3.337 (2.07)	2.800 (1.93)	2.443 (1.83)	1.963 (1.71)
5	Cartaphhloride 4 G	750	9.197 (3.17)	5.373 (2.50)	4.940 (2.42)	4.290 (2.29)	3.843 (2.18)
6	Malathion 5 D	25 kg	9.953 (3.28)	4.493 (2.31)	3.763 (2.10)	3.500 (2.10)	3.180 (2.03)
7	CONTROL	-	9.660 (3.24)	9.733 (3.33)	10.237 (3.43)	10.917 (3.43)	12.300 (3.62)
		SEm±	1.201	1.410	1.381	1.121	1.209
		CD	NS	NS	4.302	3.493	3.767

Figures within parentheses are square root $\sqrt{x+0.5}$ transformed values

The maximum number of natural enemies was recorded in chlorantraniliprole 18.5% SC treated plots except check (untreated or control) followed by buprofezin 25 SC, imidacloprid 17.8SL, cartap hydrochloride 4G, malatian 5% D and fipronil 5SC, respectively in both the experimental years. The findings of present studies are in conformity with results of Rao *et al.*, (2006); Karthikeyan *et al.,* (2007); Bastidas (1996); Tanaka *et al.,* (2000); Ahmad *et al.*, (2011); Ahmad *et al.,* (2011) and Rodrigues *et al.*, (2013). Bora *et al.,* (2004) have also reported that population of predators, i.e. spiders, coccinellids, dragonflies and damselflies, was lowest in SBP (schedule-based pesticide application) and highest in NBC (natural biological control). The present finding supports neck to neck with the findings of Jaafar *et al.,* (2013); Karthick *et al.,* (2014) and Chatterjee *et al.*, (2015) they reported the spider population was recorded maximum in the chlorantraniliprole 18.5 SC scheduled plots. Seni and Naik (2017) observed almost the same pattern of insecticidal effect on natural enemies in their experiment which also support the present finding.

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