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Effect of certain insecticide on natural enemies of rice stem borer, *Scirpophaga incertulas* (walker) on rice, *Oryza sativa* L.

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Abstract
An experiment was conducted during *Kharif* season in 2015 at the Agricultural Research Farm, SHUATS, Allahabad to observe the effect of four applications of seven insecticides viz: Monocrotophos 36%SL, Chlorpyriphos 20%SP, Flubendiamide 20%WG, Cartap hydrochloride 50%SP, Fipronil 5%SC, Imidacloprid 17.8%WP, Acephate 75 %SP on natural enemies of insect pests in rice field under agro-climatic condition of Allahabad. Results revealed that all the treatments were effective significantly to suppress the population of Coccinellids as compared with control (1.32 Coccinellids/hill). The treatment Monocrotophos recorded lowest population of Coccinellids with (0.63 Coccinellids/hill) and found to be superior among all other treatments. This was followed by Acephate (0.69 Coccinellids /hill), Flubendiamide (0.74 Coccinellids/hill), Cartap hydrochloride (0.74 Coccinellids/hill), Fipronil (0.82 Coccinellids/hill), Chlorpyriphos (0.85 Coccinellids/hill) and Imidacloprid (0.93 Coccinellids/hill) respectively.

Keywords: Coccinellids, insecticides, insect pests, rice

Introduction
Rice (*Oryza sativa* L) belongs to family Poaceae, the 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. In India, paddy is grown in 44.06 million ha constituting 34.4% of the total cultivable area. About 70% of our farmers are cultivating paddy and the production is about 105.31 million tonnes and productivity being 2178 t/ha. The productivity of rice has increased from 1984 kg per hectare in 2004-05 to 2393 kg per hectare in 2011-12, In Gujarat, it occupies about 2% of area among rice growing states. It is grown on 8.36 lakh ha area, which comprises nearly 90% of *kharif* and 10% of *summer* season rice with a total production of 17.90 Lakh tonnes and the productivity of 2141 kg/ha (Anonymous, 2012).

The major constraints of rice production are the high incidence of pests and the consequent over-use of chemical insecticides (Rola and Pingali 1993) [13], which disrupts the natural balance between insect pests and their natural enemies (Gangurde 2007) [3]. In particular, the spray formulations of insecticides (Patel *et al*. 1997) [10] in addition to their indiscriminate and repeated usage have adversely affected the predators and parasitoids of major rice pests innundative release of natural enemies along with selected insecticides, which have no effect on them, is effective in depressing the population density of the pest. Assessment of the effects that pesticides have on the natural enemies is therefore an important part of a successful rice IPM program in this area. Some insecticides have disrupted natural enemy complexes and induced resurgence of the target pests and outbreak of secondary pest (Heinrich *et al.*, 1984) [5]. 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. Avoid or reduce use of broad-spectrum insecticides. Horticultural oils and insecticidal soaps are less harmful to lady beetles than some residual conventional pesticides (Kumar *et al*. 2013) [9]. Detailed knowledge of the effects of different pesticides on the natural enemies will help to determine the type of spray and the timing of sprays, thus avoiding contact with their most susceptible stages.

Materials and methods

An experiment was conducted during *Kharif* season in 2015 at the Agricultural Research Farm, SHUATS, Allahabad, Uttar Pradesh during *kharif* season 2015. To study the efficacy of certain chemical insecticide on cocinellids population a experiment was laid out in RBD block design with 8 treatment, replicated four times. "The rice variety is IR6444" was used and a healthy crop was raised by following all the recommended agronomic practice. The plot size was 5m x 5m and the spacing between row to row and plant to plant was maintained at 20cm and 10cm, respectively.

Seven formulations of insecticides viz., Monocrotophos 36 %SL @1390ml/ha, Chlorpyriphos 20%EC @ 1750ml, Flubendiamide 20%WG @ 500ml/ha, Cartap hydrochloride 50%SP @ 1000gm/ha, Fipronil 5%SC@ 18.75ml/ha, Imidacloprid 17.8%SL @ 1000ml/ha and Acephate 75%SC@ 875ml/ha were evaluated to know the effect of chemicals on natural enemies of insect pests in rice field. The trial was laid out in randomized block design with four replications.

Observations on the incidence of Coccinellids population was calculated by counting per hill of Coccinellids from each plot, on ten randomly selected plants at 1st day before and 2nd, 7th and 14th days after imposing treatment. Data was recorded in the different treatments were subjected to statistical analysis after suitable transformation by following standard procedures of RBD experiment (Kalita *et al*. 2015) [6].

Results and discussion

Population of Coccinellids per hill 1st spray on 2nd DAS

All insecticides were effective over control in reducing the population of coccinellids recorded at 2nd day after insecticidal applications. Monocrotophos was found most effective (0.61) followed by Acephate (0.62), Flubendiamide (0.68), Chlorpyriphos (0.71), Cartap hydrochloride (0.71), Fipronil (0.74) and Imidacloprid (0.90) as compared to control (1.11) at 2nd day after spray.

Population of Coccinellids per hill on 7th DAS

All insecticides were effective over control in reducing the population of coccinellids recorded at 7th day after insecticidal applications. Monocrotophos was found effective (0.49) followed by Acephate (0.50), Chlorpyriphos (0.55), Flubendiamide (0.60), Fipronil (0.61), Cartap hydrochloride (0.68) and Imidacloprid (0.81) as compared to control (1.16) at 7th day after spray.

Population of Coccinellids per hill on 14th DAS

All insecticides were effective over control in reducing the population of coccinellids recorded at 14th day after insecticidal applications. Monocrotophos was found effective (0.90) followed by Acephate (0.90), Flubendiamide (0.94), Cartap hydrochloride (0.98), Chlopyriphos (0.99), Fipronil (1.01) and Imidachloprid (1.04) as compared to control (1.39) at 14th day after spray.

Over all mean Population of Coccinellids per hill

All insecticides were effective over control in reducing the population of coccinellids recorded at 2nd, 7th and 14th days mean after insecticidal applications. Monocrotophos was found effective (0.66) followed Acephate (0.67), Flubendiamide (0.74), Chlorpyriphos (0.75), Fipronil (0.78), Cartap hydrochloride (0.79) and Imidacloprid (0.91) as compared to control (1.36) at 2nd, 7th and 14th days mean after spray.

Table 1: Effect of certain chemical insecticides on Coccinellids in rice field during *kharif* season (1st spray).

S. No.	Treatments	Population of coccinellids/hill				
		One day before spray	After spray			
			2nd day	7th day	14th day	Mean
T0	Control	0.95	1.11	1.16	1.39	1.22
T1	Monocrotophos	0.79	0.61	0.49	0.90	0.66
T2	Chlorpyriphos	0.94	0.71	0.53	0.99	0.75
T3	Flubendiamide	1.05	0.68	0.60	0.94	0.74
T4	Cartap hydrochloride	1.03	0.71	0.68	0.98	0.79
T5	Fipronil	1.00	0.74	0.61	1.01	0.78
T6	Imidacloprid	1.12	0.90	0.80	1.04	0.91
T7	Acephate	1.03	0.62	0.50	0.90	0.67
	F- test	NS	S	S	S	S
	CD(5%)	0.11	0.01	0.02	0.26	0.09
	S.Ed.	0.05	0.01	0.01	0.12	0.04
	CV %	7.66	1.20	2.00	17.78	5.00

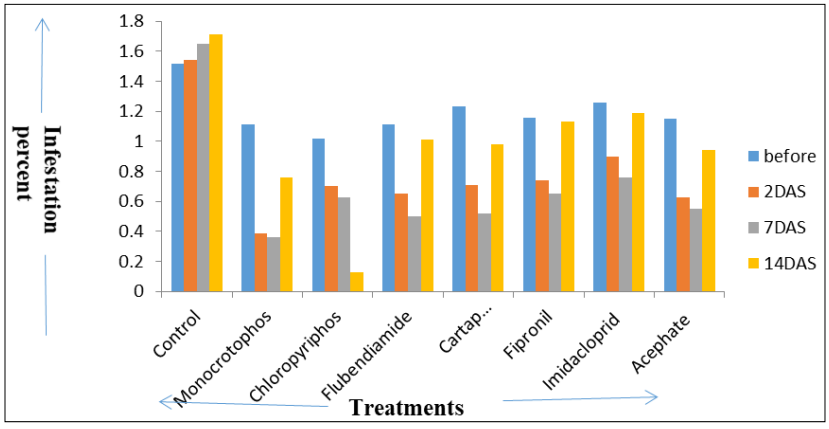

Fig 1: Graphical representation of Coccinellids Population per hill.

Population of Coccinellids per hill 2nd spray on 2nd DAS

All insecticides were effective over control in reducing the population of coccinellids recorded at 2nd day after insecticidal applications. Monocrotophos was found effective (0.58) followed by Cartap hydrochloride (0.60), Flubendiamide (0.70), Acephate (0.71), Imidacloprid (0.90), Fipronil (0.91) and Chlorpyriphos (0.92%) as compared to control (1.31) at 2nd day after spray.

Population of Coccinellids per hill on 7th DAS

All insecticides were effective over control in reducing the population of coccinellids recorded at 7th day after insecticidal applications. Monocrotophos was found effective (0.43) followed Cartap hydrochloride (0.47), Flubendiamide (0.50) Acephate (0.61), Fipronil (0.67), Imidacloprid (0.72), and Chlorpyriphos (0.77) as compared to control (1.41) at 7th day after spray.

Population of Coccinellids per hill on 14th DAS

All insecticides were effective over control in reducing the population of coccinellids recorded at 14th day after insecticidal applications. Monocrotophos was found effective (0.81) followed by Acephate (0.81), Cartap hydrochloride (1.03), Fipronil (1.04), Flubendiamide (1.05), Chlopyriphos (1.16), and Imidachloprid (1.27), as compared to control (1.54) at 14th day after spray.

Over all mean Population of Coccinellids per hill

All insecticides were effective over control in reducing the population of coccinellids recorded at 2nd, 7th and 14th days mean after insecticidal applications. Monocrotophos was found effective (0.60) followed Cartap hydrochloride (0.70), Acephate (0.71), Flubendiamide (0.75), Fipronil (0.87), Chlorpyriphos (0.95) and Imidacloprid (0.96) as compared to control (1.36) at 2nd, 7th and 14th days mean after spray.

Table 2: Effect of certain chemical insecticides on Coccinellids in rice field during *kharif* season (2nd spray).

S. No.	Treatments	Population of coccinellids/hill				
		One day before spray	After spray			
			2nd day	7th day	14th day	Mean
T0	Control	1.13	1.27	1.35	1.47	1.36
T1	Monocrotophos	1.17	0.87	0.65	0.9	0.81
T2	Chlorpyriphos	1.23	0.7	0.55	0.88	0.71
T3	Flubendiamide	1.03	0.65	0.5	0.7	0.62
T4	Cartap hydrochloride	1.1	0.85	0.7	0.8	0.78
T5	Fipronil	1	0.88	0.88	0.95	0.9
T6	Imidacloprid	1.07	0.75	0.65	0.85	0.75
T7	Acephate	1.1	0.8	0.7	0.87	0.79
	F- test	NS	S	S	S	S
	CD (5%)	0.09	0.07	0.07	0.07	0.07
	S.Ed.	0.04	0.04	0.03	0.03	0.04
	CV %	6.29	5.89	6.19	4.79	6.00

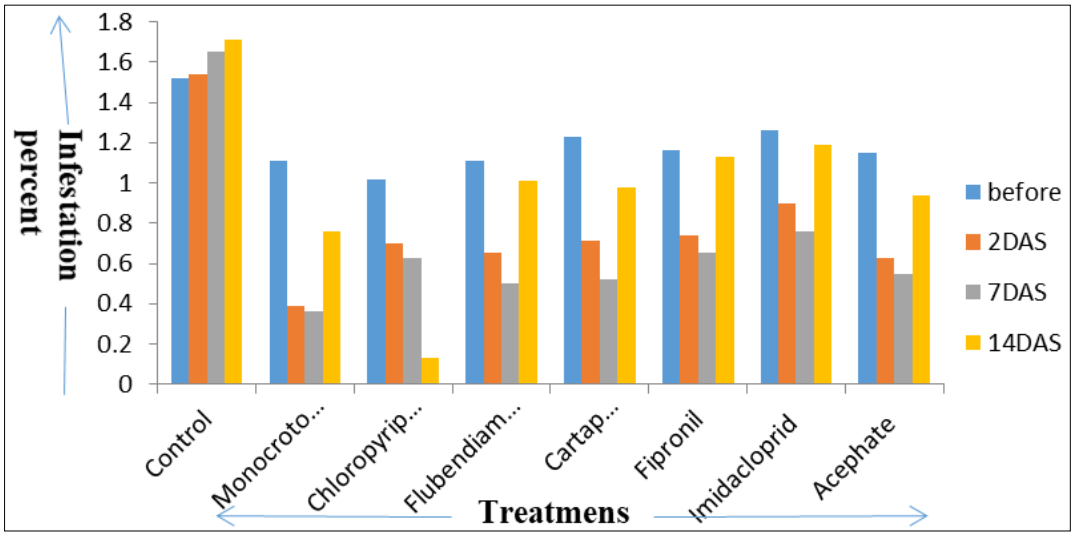

Fig 2: Graphical representation of Coccinellids Population per hill.

Pooled mean population of coccinellid (1st & 2nd Spray)

The mean populations of Coccinellids of spray were calculated and the result represented in the table reveals that all the treatments were significantly superior over control. Among all the treatments recorded on 2nd, 7th and 14th days after insecticidal applications showed in Table (3): Monocrotophos (0.63) was found significantly superior followed by Acephate (0.69), Flubendiamide (0.74), Cartap hydrochloride (0.74) and Fipronil (0.82) at par with each other and also Chlorpyriphos (0.85) found statistically at par with each other. Imidacloprid (0.93) was least effective among all other treatments. The spray revealed that Monocrotophos was found to be more effective than other Insecticides. Monocrotophos and Acephate were at par with each other, cartap hydrochloride were also at par with each other and Flubendiamide and Chlorpyriphos were also at par with each other. Similar finding were observed by researchers (Rath *et al.* 2014; Ashokappa 2015, Girish *et al.* 2015; Karthick *et al*. (2015) and Rath *et al.* 2015) [12, 2, 4, 7, 11].

Table 3: Pooled mean population of coccinellid per hill (1st & 2nd spray) of coccinellid.

S. No.	Treatments	Population of coccinellids/hill		
		1st spray	2nd spray	Pooled men
T_0	Control	1.22	1.42	1.32
T_1	Monocrotophos	0.66	0.60	0.63
T_2	Chlorpyriphos	0.75	0.95	0.85
T_3	Flubendiamide	0.74	0.75	0.74
T_4	Cartap hydrochloride	0.79	0.70	0.74
T_5	Fipronil	0.78	0.87	0.82
T_6	Imidacloprid	0.91	0.96	0.93
T_7	Acephate	0.67	0.71	0.69
	F test	S	S	S
	CD (5%)	0.09	0.07	0.09
	S.Ed.	0.04	0.04	0.04
	CV %	5.00	6.00	6.35
	Control	1.22	1.42	1.32

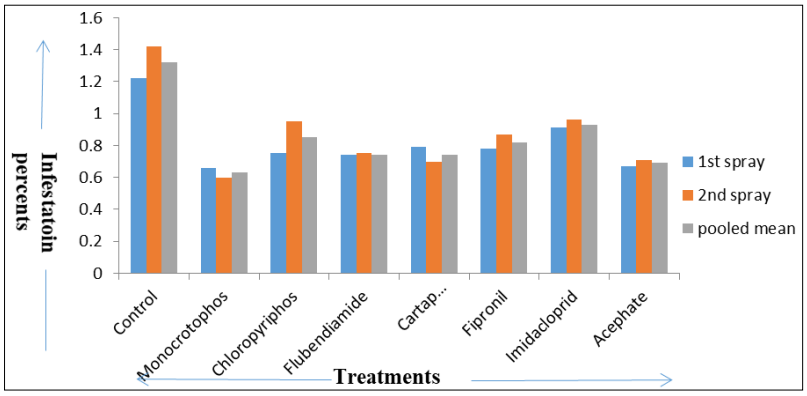

Fig 3: Graphical representation of Coccinellid Population per hill.

Conclusion

It is concluded that all chemicals caused mortality of Coccinellids. Monocrotophos were the most toxic insecticides in our experiment and it caused highest mortality to Coccinellids. In our experiment Imidacloprid was safest insecticide as it caused lowest mortality of the Coccinellids and this can be included in the integrated pest management (IPM) for the best control of insect pests.

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