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Selectivity of Some Insecticides to *Chrysoperla carnea* (Stephen) (Neuroptera: Chrysopidae) in Laboratory

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Abstract: We tested some commercial insecticides in laboratory for contact toxicity to *Chrysoperla carnea* (Stephen) to evaluate potential compatibilities in integrated pest management programme. A standard deposit of 2 mg/cm^2 of field recommended concentration of each insecticide *viz.* abamectin, *Bacillus thuringiensis*, chlorfenapyr, endosulfan, indoxacarb, profenofos and spinosad were coated as inner lining of glass vials. The larvae of *C. carnea* at 2nd instar from the laboratory stocks were exposed to the insecticide deposits. All the concentrations were found safer (caused mortality < 50%) to the larvae tested except two, indoxacarb and profenofos (mortality caused > 90%) within 24 h. Mortalities of the test insects within 6 h of treatments were recorded 100% for profenofos and it was 65% for indoxicab. All the larvae in both indoxacarb and profenofos were dead recorded after 24 h. The both toxic insecticides were suggested for higher tire testing in semifield and field conditions.

Key words: Predator, toxicity, plant protection products, IPM

Introduction

Presence and role of predators and parasitoides in orchards, field crops and vegetables have been a subject of many studies (WhiteComb and Bell, 1964; Dean and Sterling, 1992) to reduce the use of insecticides and environmental pollution. *Chrysoperla carnea* is a voracious feeder of whiteflies, aphid, eggs of moths, and other soft-bodied insects. Its larvae (aphid lion) have a relatively broad range of acceptable prey (Hydron and WhiteComb, 1979). Due to its geographical distribution (New, 1975), its polyphagous and voracious larvae, its tolerance to some pesticides (Hassan *et al*., 1985) and its relative ease of mass production (Araújo and Bicháo, 1990), it has received much attention from researchers as a potential biological pest control agent.

Effectiveness of *C. cerenea* as biological control agent has been demonstrated in field crops, orchards and in green houses (Hagley and Miles, 1987), it gave about 100% Lepidoptran pest control when used in combination with *Trichogramma* spp. (Rincon Vitova, 1999). The IPM practioners (Anonymous, 1992) listed 20 different companies in four countries that produce and market *Chrysoperla* spp.

Inspite of all this preciousness *C. carnea* with many other beneficials has almost been eliminated from fields due to frequent use of non-selective agrochemical. Now we are looking forward 21st. century and recognising the importance of biologically based pest management technology. We have to introduce such techniques with holistic approach. It could be achieved only by selecting such chemicals, which are harmless to beneficials and give good control of the target pests. The proposed project was first aimed to screen out such chemicals that are safer to *C. carnea* in the laboratory toxicity tests.

Materials and Methods

Rearing of *Chrysoperla carnea*: Adults were collected from field and kept in wooden rearing cages (45x45x50 cubic centimetre) having arrangement for egg collection on top cover (lined inside with black cloth). The eggs were collected daily and placed (one egg per vial) in rearing vials (1.5 cm diameter and 1.0 cm deep) along with food, frozen eggs of *Sitotroga cerelella*). The hatched larvae will be raised to the required stage (2nd instar) to test against the insecticides.

Screening of Insecticides: Formulated plant protection chemicals were used at recommended dose rate (Table 1). The test substances were diluted to make solution in tap water. The dilution level was as per application volume 250 litres per hectare and applied as inner lining into the glass vials. Inner surface area of the test vial will be calculated and a deposit of two milligrams per square centimetre was applied. The solution in the vial was sprinkled on inner surface of the vial by creating vacuum inside with the help of vacuum sucker and it was kept rolling until the deposit dried. A control treatment of water application was also included to assess the natural

Table 1: List of the insecticides tested

	Tradename	Common name	Chemical name	Mode of action	Class	Dose g h^{-1}	Conc.(ppm)
T1 =	Agrimec 1.8 EC	abamectin	(avermectin B_{1a}); (avermectin B_{1b}) in the proportion (80:20)	Stomach/ Contact	Aver	18.0	7.2
T2 =	LarvoBT 26.4 FL	Bt	Scientific name: *Bacillus thuringiensis* Berliner Subsp. *Kurstaki*	Stomach	Bact	39.6	158.4
T3 =	Pirate 36 SC	chlorfenapyr	4-bromo-2-(4-chloro phenyl)-1-(ethoxymethyl-5-(triflouro methyl-1*H*-pyrrole-3 carbo nitrile	Stomach/ Contact	Pyr	297.0	1180.0
T4 =	Thiodan 35 EC	endosulfan	6,7,8,9,10,10-hexachloro-1,5, 5a, 6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxa thiepine-3-xide	Stomach/ Contact	OC	1050.0	4200.0
T5 =	Steward 15 EC	indoxacarb	Methyl(S)-7-chloro-2,5-di hydro-2[[(methoxy carbonyl) [4-triflouro meth oxy) phenyl] amino] carbonyl]-indeno[1,2-e] [1,3,4]oxadiazine-4a*(3H)*-carboxylate	Stomach/ Contact	Oxa	62.6	250.5
T6 =	Curacran 50 EC	profenofos	O-(4-bromo-2-chloro phenyl) O-ethyl S-propyl phosphoro thioate	Stomach/ Contact	OP	1250.0	5000.0
T7 =	Tracer 4.8 SC	spinosad	(spinosyn A); (spinosyn D) in the proportion (50-95% to 50-5%)	Stomach/ Contact	Acti	7.2	28.8
T8 =	Control	Water					

Aver = Avermectins; Bact = Bacterium; Pyr = Pyrazole; OC = Organochlorine; Oxa = Oxadiazines; OP = Organophosphate; Acti = Actinomycetes derivative

Table 2: Mortality of *C. carnea* larvae caused by insecticides

		Mortality (%) After (h)			Toxicity class After (h)		
Treatments	Insecticide	6	24	48	6	24	48
T1	Agrimec	0	0	5	1	1	1
T2	Larvo BT	0	0	0	1	1	1
T3	Pirate	0	20	30	1	1	1
T4	Thiodan	5	12	25	1	1	1
T5	Steward	65	100	100	2	4	4
T6	Curacran	100	100		4	4	4
T7	Tracer	0	0	10	1	1	1
T8	water (Control)	0	0	0	1	1	1

mortality rates of the test insect. A minimum of 40 insects was tested against each of the insecticide treatment and control treatment. Each treatment was divided into at least four replications each containing 10 test-organisms.

The test insects of uniform age (2nd instar larvae) of *C. carnea* were placed into the treated vials so each vial was having one insect to avoid the complexities of cannibalism. Assessment of treatment effects was made after 6, 24 and 48 h. The over all effect of a test substance was judged on the basis of insect mortality levels. A test was considered valid if the natural mortality in control was not increased 12.5%. The insecticides will be categorized harmless (<50% mortality); slightly harmful (50-79% mortality); moderately harmful (80-89% mortality); and harmful (> 90% mortality) in a "worst case" laboratory test for initial contact toxicity, recommended by IOBC/ WPRS working group (Hassan, 1989).

Test conditions: The test units were kept in a controlled environment room maintained at 27±3 centigrade and 60±5 relative humidity.

Results and Discussion

According to guidelines of IOBC/WPRS plant protection product (PPP) was considered harmless if it caused mortality less than 50% of the larvae treated in initial laboratory test and no further test in semi-field and field conditions is recommended. According to the general agreement when PPP proved harmless in initial laboratory test for a particular beneficial, is most likely to be harmless to the same organism in the field. Further testing (semi-field and field) is necessary when a pesticide is found to be harmful (class 3 and 4) that it caused more than 99 percent mortality to a beneficial in initial laboratory toxicity test.

The results showed the insecticides *viz.* indoxacarb and profenofos out of the seven tested found harmful to C. carnea larvae after 24 h. Results about steward are similar to the fidings Sansone *et al.* (2000) that Steward treated plots have significantly lower number of predators than Tracer treated plots but different to the findings of Roberson *et al.* (1999) that none of the insecticides *viz.* Tracer, Karate and Steward effected survival of green lacewing regardless the time of collection for treated leaves or duration of exposure to insecticides. All other insecticides *viz.* abamectin, *Bacillus thuringiensis*, chlorfenapyr, endosulfan and spinosad were harmless and caused mortality less than 50% even after 48 h of continuous contact with the chemicals. These results are supported by Peer (1989) he found that *Chrysoperla* *carnea* was resistant to a wide range of pesticides. *In vitro* inhibition studies and hydrolysis assays showed that the lacewing larvae, *C. carnea*, have unusually active esterases to detoxify pyrethroids (Ishaaya and Casida, 1981).

Holloway *et al.* (1999) found abamectin rapidly absorbed into leaf, that delayed its degradation and rendered it safer to the beneficial insects. There was no need of further testing for the safer PPP and were considered compatible with biological control in IPM system. The results for endosulfan produced in the experiments are confirming the findings of Hassan *et al.* (1983). The toxic concentrations will be recommended for further testing particularly the indoxacarb that is slightly harmful during first 6 h of treatment. It will be most likely harmless in field and semifield conditions. The idea is supported by Nasreen *et al.* (2000) Steward (indoxacarb) remained slightly toxic for *Trichogramma chilonis* even after 48 h of exposure of insecticide treatment. However, it would be regrettable to exclude toxic compounds without looking for their specific uses. Selection of a suitable insecticide in an IPM program not depends only on its toxicity level to beneficial insects but also its efficacy against the target pest, its weathering and persistency also.

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