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Laboratory evaluation of imidacloprid against *Trichogramma chilonis* Ishii and *Chrysoperla carnea* (Stephens)

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ABSTRACT: In the laboratory, the safety of imidacloprid (Confidor) 200SL as foliar treatment against *Trichogramma chilonis* Ishii and *Chrysoperla carnea* (Stephens) was evaluated. The results revealed that there was no significant adverse effect on adult emergence and per cent parasitisation of *T. chilonis* and per cent hatchability of *Chrysoperla carnea*. There was a significant adverse effect on *C. carnea* grubs and adult longevity when they were fed with imidacloprid. These adverse effects can be overcome by adopting seed treatment.

KEY WORDS: *Chrysoperla carnea*, imidacloprid, safety, *Trichogramma chilonis*

Cotton is damaged by more than 170 insects in India (Anon., 1998) right from germination to the final picking of the produce. The important insect pests are the sap feeding insects (aphids, jassids, thrips and whiteflies) and the bollworms (spotted, American and pink). Among the various strategies adopted to combat these pests, insecticides form the first line of defense in spite of their drawbacks. Chemists of Nihon – Bayer in Japan synthesised imidacloprid and the formulations were introduced to combat these sucking pests. It has an excellent insecticidal activity by interfering with the post synaptic receptors (Abbink, 1991). Laboratory experiments were conducted to assess the safety of imidacloprid to *Trichogramma chilonis* Ishii and *Chrysoperla carnea* (Stephens).

MATERIALS AND METHODS

The experiments were conducted in completely randomised block design and each treatment was replicated six times. The treatments were: imidacloprid (0.004 and 0.006%), methyl-o-demeton 25 EC (0.025%) and untreated check.

Trichogramma chilonis

The parasitoid was mass cultured in the biocontrol laboratory on the eggs of *Corcyra cephalonica* (Stainton) as per the method developed by Prabhu (1991). Fresh *Corcyra* eggs collected in the early morning were sterilized under UV radiation of 15W capacity for 20 minutes duration at a distance of 15 cm to avoid the emergence of *Corcyra* larvae. Then these eggs were pasted on paper cards of 21 x 30 cm size having thirty 7 x 2 cm rectangles. These egg cards were placed in polythene bags along with the nucleus card at 6:1 ratio for parasitisation. The parasitised egg cards were cut into one cm^2 bits and the three day old, hundred per cent parasitised eggs (eggs appearing black and plumpy) were sprayed with the insecticide at different concentrations as mentioned above. For untreated check, only distilled water was sprayed using an atomiser. The treated egg cards were shade-dried for 10 min and then kept inside a test tube 20 x 1.5cm size. The number of parasitoids emerged from each treatment was recorded and per cent emergence was worked out. Fresh eggs were provided to these parasitoids at 6: 1 ratio and per cent parasitisation was recorded.

Chrysoperla carnea

a. Ovicidal action

Laboratory studies were conducted to assess the effect of imidacloprid on the eggs of Chrysoperla carnea, as per the method described by Krishnamoorthy (1985). The eggs along with stalk collected on brown paper strips were sprayed with imidacloprid (0.004 and 0.006%) and methyl-o-demeton (0.025%) using an atomizer. Each treatment was replicated five times with 75 eggs per treatment. Untreated check was maintained by spraying distilled water. The number of grubs hatched from each treatment was recorded and per cent hatching was worked out.

b. Larval feeding method

Eggs of *C. cephalonica* were exposed to UV radiation of 15 W capacity for 15 minutes to kill the embryos and then sprayed with different concentrations of the insecticide with an atomizer.

The eggs were shade-dried for 10 minutes and transferred to test tubes of size 20 x 35cm. For control, the eggs were sprayed with distilled water. First instar grubs of *C. carnea* were transferred to these test tubes at the rate of 10 per test tube. After the grubs completely ate the treated eggs, they were provided with untreated *Corcyra* eggs until pupation. Observations were made on the larval mortality, pupation and adult emergence.

c. Adult feeding method

Five pairs of *C. carnea* adults were allowed in separate galvanised iron cage of size 12.5cm ht x 30cm diam and covered with white georgette cloth. The adults were fed with 10 per cent honey solution containing different concentrations of imidacloprid and methyl-o-demeton through oral feeding. In untreated check, the adults were fed with 10 per cent honey solution alone. The eggs laid in each treatment were collected daily by keeping

a brown paper sheet of size 21x 6cm along the inner side of the plastic container. Observations were made on the adult longevity and number of eggs laid.

RESULTS AND DISCUSSION

1.*Trichogramma chilonis*

The results revealed that the adult emergence ranged from 87.82 to 89.53 per cent with the maximum adult emergence of 89.53 per cent in untreated check followed by methyl-o-demeton 0.025 per cent (88.16%) and imidacloprid 0.004 per cent (87.82%) and 0.006 per cent (87.83%) and the same trend was observed in per cent parasitisation which varies from 88.09 to 90.56 per cent with maximum parasitisation in untreated check followed by the insecticide treatments indicating the safety of imidacloprid to *T. chilonis* (Table 1).

Table 1. Effect of imidacloprid on *Trichogramma chilonis*

Treatment	Adult emergence (%)	Parasitisation (%)
Imidacloprid 0.01%	87.82 (69.61)[a]	88.67 (70.41)[a]
Imidacloprid 0.015%	87.83 (69.61)[a]	88.09 (69.85)[a]
Methyl-o-demeton 0.025%	88.16 (69.88)[a]	89.81 (71.13)[a]
Untreated check	89.53 (71.24)[a]	90.56 (72.16)[a]

In a column means followed by a common letter are not significantly different by DMRT (P=0.05).

Values in parentheses are arcsine transformed.

Zhang *et al.* (1997) reported that imidacloprid and buprofezin caused less mortality of the parasitoid *Trichogramma japonicum* Ashmead and are recommended for use in controlling the insects at the time when the parasitoid is at the egg stage of the life cycle. Zhang and Hirai (1997) stated that the toxicity of imidacloprid and buprofezin against *T. japonicum* was lower than that of fenitrothion.

Adults of the treated generation could oviposit and the fecundity, net reproduction rate, innate capacity for increase of the treated and the next generation showed no significant differences while fenitrothion had significant effect on the fecundity. However, the value of the population in the next generation recovered to the level of the untreated population.

2. *Chrysoperla carena*

a. Ovicidal action

The results revealed that per cent hatchability ranged from 92.07 to 96.71 per cent and maximum was in untreated check indicating there was no significant adverse effect on hatching due to imidacloprid treatments and they were on par with untreated check (Table 2).

Table 2. Effect of imidacloprid on *Chrysoperla carnea*

Treatment/Concentration	Ovicidal action		Larval feeding		Adult feeding		
	Hatchability (%)	Mortality of eggs (%)	Larval mortality (%)	Pupation (%)	Adult emergence (%)	Adult longevity (days)	Fecundity
Imidacloprid 0.01%	93.05^{a} (76.51)	6.95^{a} (13.49)	60.0^{c} (50.82)	40.0^{c} (39.18)	38.0^{c} (37.97)	11.0^{b}	61.6^{c} (1.79)
Imidacloprid 0.015%	92.07^{a} (75.53)	7.93^{a} (14.47)	70.0^{c} (56.91)	30.0^{c} (33.08)	28.0^{d} (31.88)	9.6^{b}	53.6^{c} (1.73)
Methyl-o-demeton 0.025%	92.77^{a} (78.81)	7.03^{a} (11.19)	20.0^{b} (26.26)	80.0^{b} (63.73)	78.0^{b} (62.24)	12.4^{b}	90.4^{b} (1.95)
Untreated check	96.71^{a} (77.83)	3.29^{a} (12.17)	6.0^{a} (12.68)	94.0^{a} (77.32)	90.0^{a} (73.62)	20.4^{a}	120.8^{a} (2.08)

In a column means followed by a common letter are not significantly different (P=0.05).
Values in parentheses are arcsine transformed values except fecundity in which the values in parantheses are log transformed.

b. Larval mortality

The results revealed that imidacloprid at all the concentrations tested caused larval mortality, the highest being 70 per cent in imidacloprid at 0.006 per cent followed by 0.004 per cent (60%) and methyl-o-demeton 0.025 per cent (20%). There was significant difference in the number of larvae pupated. The highest pupation was observed in untreated check (94%) and the lowest in imidacloprid 0.006 per cent (30%) followed by 0.004 per cent (40%). In methyl-o-demeton it was 80 per cent. With regard to adult emergence, in control it was 90 per cent followed by methyl-o-demeton 0.025 per cent (78%), imidacloprid 0.004 per cent (38%) and 0.006 per cent (28%) (Table 2).

c. Adult longevity and fecundity

Adult longevity was 20.4 days in untreated check while it was 12.4, 11.0 and 9.6 days in methyl-o-demeton 0.025 per cent, imidacloprid 0.004 and 0.006 per cent, respectively. The imidacloprid treatments were on par with the standard methyl-o-demeton. Significantly higher egg laying was recorded in untreated check (120.8) followed by methyl-o-demeton (90.4), imidacloprid 0.004 per cent (61.6) and 0.006 per cent (53.6) (Table 2).

Mizell and Sconyers (1992) reported that the imidacloprid had little impact on the predatory arthropod *C. macropilis* and *C. rufilabris* and indicated that seed treatment may allow growers to reduce the harmful effects to some biocontrol agents than foliar spray. Iwaya and Tsuboi (1992) stated that the toxicity of imidacloprid to two species of spiders in rice fields was low. Leicht (1993) reported that the predatory mites were not affected by imidacloprid. Late evening application of imidacloprid had minimal effect on leaf cutting bee, honeybees and bumblebees (Mayer *et al.*, 1994). In rice, differential toxicity was also observed. Imidacloprid had no significant effect on spiders but caused mortality in other hemipteran predators (Mao and Liang., 1995). Cock *et al.* (1996) reported that the toxicity of imidacloprid decreased in the order of topical exposure > ingestion > residual contact to a predatory bug, *Podisus maculiventris* (Say). Sun-Jian *et al.* (1996) reported that imidacloprid 10 per cent at 15 or 30g a. i. /km^2 in rice was found highly safer to the spider communities.

The present studies have indicated that the chemical imidacloprid has no significant effect on *T. chilonis*, while it has caused significant mortality of larvae and affected adult longevity of *C. carnea*. In the field, even these minor effects can be over come by going for imidacloprid seed treatment.

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