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# Comparative effects of insecticides on mortality, longevity and fecundity of C*hrysoperla spp*. (Neuroptera: Chrysopidae)

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**Abstract**
The experiment was conducted to evaluate the toxicity of insecticides *viz*., chlorantraniliprole 18.5 SC, flubendiamide 20 WG, buprofezin 25 SC, lambda cyhalothrin 9.5 + thiamethoxam 12.6 ZC, lambda cyhalothrin 5 EC, azadirachtin 5 w/w, thiamethoxam 25 WG, thiachloprid 21.7 SC on adults of *Chrysoperla spp.* The maximum adult mortality, from exposure to till death was observed in lambda cyhalothrin + thiamethoxam (86.66%) whereas, azadirachtin recorded minimum mortality of *Chrysopa* adult (23.33%). The toxicity of lambda cyhalothrin + thiamethoxam had an adverse effect on male and female longevity and application of azadirachtin have no adverse effect when compared with untreated control. Maximum reduction in fecundity was observed in lambda cyhalothrin + thiamethoxam (190.00 eggs/female and 54.76%). However, minimum percent reduction in fecundity were observed in azadirachtin (380.00 eggs/female and 9.52%).

**Keywords:** *Chrysoperla spp.*, mortality, longevity, fecundity, insecticides

## Introduction
In different agro-ecosystem the Green lacewing is an important natural enemy, belonging to family Chrysopidae, order Neuroptera. Green lacewing is a generalist and widely distributed in different agronomical crops, which act as predator of many soft bodied insect pest such as aphids, scale insect, leafhoppers, whiteflies, psyllids, thrips, psocids, neonate of lepidoptera and mites [19]. Green lacewing is a native North American species [6]. *Chrysoperla carnea* is predominant species of green lacewing, having green cylindrical body, transparent wing with light green veins, long filiform antennae, golden eyes and stalked eggs that offer protection from predation [17]. Larval stage is active predatory stage [15]. Adults of *Chrysoperla spp.* are pale green, about 12-20 mm long, with long antennae and bright, golden eyes. They have large, crystal clear, pale greenish wings and a soft body. Adults are active fliers and have a distinctive, palpitating flight. Oval shaped eggs are laid singly at the end of long silken stalks. Adults feed only on nectar, pollen, and aphid honeydew [6]. There may be two to several generations per year [13, 25].
Indiscriminate use of pesticides not only results in development of insecticide resistance but also eliminates the natural enemies of insect pests [3]. Integrated pest management (IPM) programs emphasize the utilization of chemical and biological control measures to maintain pest populations below economic thresholds [19] with their lower operational impact on agro-ecosystem [12]. It stresses upon using as little pesticides as possible and especially those molecules which are reasonably compatible with the natural enemies [9]. In present experimental study, the noxious effects of different insecticides were compared under laboratory conditions to find out suitable insecticide which is least toxic to *Chrysoperla spp.* but manage the insect pests effectively.

## Materials and Methods
Laboratory studies were conducted to find out the toxicity of newer group of insecticides on *Chrysoperla spp.* (carnea-group) during Kharif 2017-2018. The rearing of the host insect and predator was done under controlled room temperature and relative humidity conditions ranging between 26 ± $2^0$c and 60 ± 5%, respectively and commercial formulations of insecticides used for the study were procured from the market. Mass multiplication of *Chrysopa* was done in the

laboratory to obtain healthy culture of the test predator. The initial culture was obtained from the already established culture of *Chrysopa* in Biocontrol laboratory, Entomology Section College of Agriculture, Nagpur and was further multiplied on the factitious laboratory host, eggs of rice moth. To obtain the eggs of *Corcyra cephalonica* throughout the experimental period, rearing of rice moth was done in the laboratory and the culture was maintained on sorghum based artificial diet.

The insecticides were classified in different categories on the bases of per cent mortality of larvae, as suggested by IOBC/WPRS (Sterk G *et al*. 1999) [23] as under:

Harmless (toxicity class 1) = less than 30% mortality,
Slightly harmful (toxicity class 2) = 30-79% mortality,
Moderately harmful (toxicity class 3) = 80-89% mortality,
Harmful (toxicity class 4) = more than 90% mortality.

**Table 1:** Treatment details:

| Tr. No. | Treatment name | Conc. (%) |
|---|---|---|
| T1 | Chlorantraniliprole 18.5 SC | 0.005 |
| T2 | Flubendiamide 20 WG | 0.01 |
| T3 | Buprofezin 25 SC | 0.05 |
| T4 | Lambda cyhalothrin 9.5 + thiamethoxam 12.6 ZC | 0.008 |
| T5 | Lambda cyhalothrin 5 EC | 0.003 |
| T6 | Azadirachtin 5 w/w | 0.002 |
| T7 | Thiamethoxam 25 WG | 0.005 |
| T8 | Thiachloprid 21.7 SC | 0.004 |
| T9 | Control (water spray) | - |

**Treatment of adults**

To study the effect of toxicity of insecticides on adults of *Chrysopa*, experiments was conducted by obtaining emerged adults from rearing chamber and were examined critically and on the basis of shape of the abdomen counted as male and female separately and 5 pairs were housed in each mating chamber. The top of chamber covered with muslin cloth on which two or three bits of foam/sponge (5 cm x 5 cm x 1 cm thick) soaked in the adult diet was kept. The adult diet was prepared by mixing Protinex – 5 g, Honey - 2.5 g, Yeast granules of 7-10, Water- 50 ml.

Then these mated adults were used for treating with insecticide solution by vial assay test. The clean and well sterilized glass vials were utilized for treating the adult of *Chrysopa*. A set of ten glass vials were used for a treatment which were replicated three times (i.e. 30 test insects per treatment). The desired concentration of insecticide solution was applied to side of vial by rolling it and care was taken to cover the whole surface of vial. Control treatment was sprayed with tap water. When insecticide deposits dried, these vials were used as testing arena. In each glass vial a single mated adult of *Chrysopa* with known age was transferred and mouth of vial was closed with muslin cloth. Then, the individual adult was provided with food containing honey, protinex and yeast mixture diet with the help of sponge and the sponge was replaced daily. When probed with camel hair brush, if the movement of *Chrysopa* was not noticed, it was considered dead. Data on mortality, fecundity and longevity of adults was noted after every 24 hrs till the end.

**Statistical Analysis**

The data on all relevant observation thus obtained were subjected for appropriate statistical analysis, Gomez and Gomez (1984). The corrected per cent mortalities were transformed to arcsine percentage and subjected to statistical analysis adopting Completely Randomized Design (CRD).

**Results and Discussion**

The present research work was carried out for the evaluation of safer insecticides against the *Chrysoperla spp*. The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

**Effect of various insecticides on per cent mortality of *Chrysoperla spp.* adult**

The data on per cent mortality of all tested insecticides on adult of *Chrysopa* from exposure to till death was presented in table 2, revealed that the mean comparison regarding per cent mortality of adult stage of *Chrysopa* for all the treatments differed significantly at 5 percent level of significance and indicated that lambda cyhalothrin + thiamethoxam appeared as the most toxic insecticide showing 86.66 per cent mortality of the adults followed by chlorantraniliprole, lambda cyhalothrin, thiamethoxam, thiachloprid, buprofezin and flubendiamide with 80.00, 76.66, 56.66, 43.33, 33.33 and 26.66 percent mortality, respectively. However, azadirachtin recorded minimum mortality of *Chrysopa* adult (23.33%).

**Table 2:** Effect of various insecticides on per cent mortality of *Chrysoperla spp.* adult.

| Tr. No | Treatments | Dose/l | Adult mortality (%) | | | |
|---|---|---|---|---|---|---|
| | | | RI | RII | RIII | Mean |
| $T_1$ | Chlorantraniliprole 18.5 SC | 0.27ml | 80 (63.43) | 80 (63.43) | 80 (63.43) | 80 (63.43) |
| $T_2$ | Flubendiamide 20 WG | 0.5gm | 30 (33.21) | 40 (39.23) | 30 (33.21) | 33.33 (35.24) |
| $T_3$ | Buprofezin 25 SC | 2ml | 30 (33.21) | 30 (33.21) | 20.00 (26.57) | 26.66 (31.05) |
| $T_4$ | Lambda cyhalothrin 9.5 + thiamethoxam 12.6 ZC | 0.36ml | 90 (71.57) | 80 (63.43) | 90 (71.57) | 86.66 (68.53) |
| $T_5$ | Lambda cyhalothrin 5 EC | 0.6ml | 80 (63.43) | 70 (56.79) | 80 (63.43) | 76.66 (61.07) |
| $T_6$ | Azadirachtin 5 w/w | 0.4ml | 20 (26.57) | 30 (33.21) | 20 (26.57) | 23.33 (28.86) |
| $T_7$ | Thiamethoxam 25 WG | 0.2gm | 50 (45.00) | 60 (50.77) | 60 (50.77) | 56.66 (48.79) |
| $T_8$ | Thiachloprid 21.7 SC | 0.18ml | 50 (45.00) | 40 (39.23) | 50 (45.00) | 43.33 (41.15) |
| $T_9$ | Control | Water | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| | 'F' test | | | | | Sig. |
| | SE (m) ± | | | | | 1.80 |
| | CD at 5% | | | | | 5.25 |

(Values in the parenthesis are arc sine transformed)

Similar results were also reported by [22] tested azatin EC on two species of green lacewings and found that the neem products was not toxic to adults, topically or residually. [21] observed that buprofezin was least toxic to adults of *C. carnea* and lambda cyhalothrin caused 85.7 per cent adult mortality [7]. reported that flubendiamide was harmless (IOBC class 1) to adults of *C. carnea*. [1] found that neonicotinoids (nitenpyram, thiacloprid, imidacloprid and acetamaprid) safer

to natural enemies [11]. found that thiamethoxm (0.12 g/l) caused toxicity to adults of *C. carnea* at about 57.50 percent mortality under laboratory conditions.

**Effect of various insecticides on adult longevity of *Chrysoperla spp.***

**A) Male longevity (in days)**

The observations recorded on male longevity of *Chrysopa* as influenced by toxicity of different insecticides from exposure to till death are presented in table 3, revealed that among the tested insecticides, the maximum effect of toxicity was found by lowering down longevity of male in lambda cyhalothrin + thiamethoxam (9.00 days) followed by lambda cyhalothrin > thiamethoxam > chlorantraniliprole > thiachloprid > flubendiamide > buprofezin > azadirachtin and control with adult male longevity of 11.66, 14.33, 15.33, 23.33, 25.66, 27.00, 29.66 and 32.00 days, respectively.

**B) Female longevity (in days)**

Pertaining to the observations recorded on female longevity of *Chrysopa* as influenced by toxicity of different insecticides from exposure to till death are presented in table 3 exhibited that all tested insecticides significantly influenced the female longevity over untreated control. Among the tested insecticides, ascending order with longevity of female was found in control (44.33 days) followed by azadirachtin > buprofezin > flubendiamide > thiachloprid > chlorantraniliprole > thiamethoxam > lambda cyhalothrin > lambda cyhalothrin + thiamethoxam with 40.00, 37.66, 36.33, 34.00, 30.00, 28.00, 25.66 and 19.66 days, respectively. Thus, it is indicated that the toxicity of lambda cyhalothrin + thiamethoxam had an adverse effect on male and female longevity and application of azadirachtin 5 w/w have no adverse effect when compared with untreated control.

Similar results were also reported by [4] demonstrated the survival of predaceous arthropods on cotton after insecticides spray and stated that IGR had low toxicity and chloronicotinyl and organophosphate classes were the most toxic causing dramatic reductions in predator survival which is in line with the present study of buprofezin (IGR) which observed as harmless [5]. reported that toxicity of pesticides to natural enemies depends upon many factors, such as intrinsic toxicity of compound to natural enemies, formulation, time and method of application. However [10], reported that due to lambda cyhalothrin adult longevity was reduced to 7.5 to 11.8 from 15.3 days whereas [14, 16], also proved lethal effects of thiamethoxam which was most potent toxicant against males and females.

**Table 3:** Effect of various insecticides on the adult longevity of *chrysoperla spp.* (in days).

| Tr. No | Treatments | Dose/l | Male longevity (days) | Female longevity (days) |
|---|---|---|---|---|
| $T_1$ | Chlorantraniliprole 18.5 SC | 0.27ml | 15.33 (23.03) | 30.00 (33.21) |
| $T_2$ | Flubendiamide 20 WG | 0.5gm | 25.66 (30.40) | 36.33 (37.05) |
| $T_3$ | Buprofezin 25 SC | 2ml | 27.00 (31.31) | 37.66 (37.82) |
| $T_4$ | Lambda cyhalothrin 9.5 + thiamethoxam 12.6 ZC | 0.36ml | 9.00 (17.46) | 19.66 (25.35) |
| $T_5$ | Lambda cyhalothrin 5 EC | 0.6ml | 11.66 (19.91) | 25.66 (30.46) |
| $T_6$ | Azadirachtin 5 w/w | 0.4ml | 29.66 (32.96) | 40.00 (39.23) |
| $T_7$ | Thiamethoxam 25 WG | 0.2gm | 14.33 (22.22) | 28.00 (31.95) |
| $T_8$ | Thiachloprid 21.7 SC | 0.18ml | 23.33 (28.86) | 34.00 (25.67) |
| $T_9$ | Control | Water | 32.00 (34.45) | 44.33 (41.73) |
| | 'F' test | | Sig. | Sig. |
| | SE (m) ± | | 0.32 | 0.83 |
| | CD at 5% | | 0.95 | 2.42 |

(Values in the parenthesis are arc sine transformed)

**Effect of various insecticides on fecundity of *Chrysoperla spp.* (eggs/female and per cent reduction)**

The effect of toxicity of different insecticides on fecundity of *Chrysopa* was assessed on the basis of average number of eggs laid per female and per cent reduction over control under different treatments presented in table 4 it is observed that all the tested insecticides had affected fecundity of *Chrysopa* significantly at 5 percent level of significance over untreated control. Maximum reduction in fecundity was observed in lambda cyhalothrin + thiamethoxam (190.00 eggs/female and 54.76%) followed by lambda cyhalothrin, chlorantraniliprole, thiamethoxam, thiachloprid, flubendiamide, buprofezin, azadirachtin and control with on an average of 217.66, 235.00, 240.66, 312.00, 336.66, 345.00, 380.00 and 420.00 eggs per female and 48.18, 44.05, 42.7, 25.56, 19.84, 17.86 and 9.52 percent, respectively.

Similar results were also reported by [24] reported that mean fecundity reproductive age of adult females varied significantly and affected by the insecticide treatment of NSKE when compared with the untreated check [18]. found that mean fecundity of *Chrysopa* due to flubendiamide 20 WG and thiamethoxam 25 WG were 326.33 and 245.00 eggs/female respectively, whereas [14] reported that thiamethoxam affected adult longevity and mean number of eggs laid by 5 females which was lower with thiamethoxam compared to control [10]. also observed that fecundity reduced to 145.3 to 213.0 as compared to 369.3 eggs due to lambda cyhalothrin which is again found in line with the present studies.

**Table 4:** Effect of various insecticides on the fecundity of *Chrysoperla spp.* (eggs/female and per cent reduction)

| Tr. No | Treatments | Dose/lit. | Fecundity (eggs/ female) | | | | Per cent reduction in fecundity over control |
|---|---|---|---|---|---|---|---|
| | | | RI | RII | RIII | Mean | |
| $T_1$ | Chlorantraniliprole 18.5 SC | 0.27ml | 232.00 | 238.00 | 235.00 | 235.00 | 44.05 |
| $T_2$ | Flubendiamide 20 WG | 0.5gm | 338.00 | 332.00 | 340.00 | 336.66 | 19.84 |
| $T_3$ | Buprofezin 25 SC | 2ml | 345.00 | 342.00 | 348.00 | 345.00 | 17.86 |
| $T_4$ | Lambda cyhalothrin 9.5 + thiamethoxam 12.6 ZC | 0.36ml | 190.00 | 188.00 | 192.00 | 190.00 | 54.76 |
| $T_5$ | Lambda cyhalothrin 5 EC | 0.6ml | 215.00 | 220.00 | 218.00 | 217.66 | 48.18 |
| $T_6$ | Azadirachtin 5 w/w | 0.4ml | 380.00 | 382.00 | 378.00 | 380.00 | 9.52 |
| $T_7$ | Thiamethoxam 25 WG | 0.2gm | 240.00 | 242.00 | 240.00 | 240.66 | 42.7 |
| $T_8$ | Thiachloprid 21.7 SC | 0.18ml | 310.00 | 312.00 | 314.00 | 312.66 | 25.56 |
| $T_9$ | Control | Water | 425.00 | 420.00 | 415.00 | 420.00 | - |
| | 'F' test | | | | | Sig. | |
| | SE (m) ± | | | | | 1.72 | |
| | CD at 5% | | | | | 5.00 | |

(Values in the parenthesis are arc sine transformed)

## Conclusion

Considering ecofriendliness, it can be concluded from the present investigation that insecticides azadirachtin, buprofezin and flubendiamide were found most safer to adults of *Chrysoperla spp.* which can be taken successfully in the IPM programmes. Where as lambda cyhalothrin + thiamethoxam was found most harmful to aduls of *Chrysoperla spp.*

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