*Pakistan J. Zool., vol. 44(4), pp. 1123-1127, 2012.*

# Evaluation of Toxicity of Some New Insecticides against Egg Parasitoid *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammitidae)

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**Abstract.-** Toxicity of some new insecticides *viz.*, spinosad, lufenuron, flubendiamide, chlorantraniliprole, emamectin benzoate and imidacloprid were tested against immature and adult stages of *Trichogramma chilonis* (Ishii) (Hymenoptera: Trichogrammitidae) under laboratory conditions. Exposure of spinosad to *T. chilonis* resulted in the lowest emergence at all the parasitism situations. The application of emamectin benzoate and lufenuron after 1st day parasitism, imidacloprid, emamectin benzoate and lufenuron after 3rd day parasitism, imidacloprid, emamectin benzoate, flubendiamide and lufenuron after 4, 5 and 7 days of parasitism, respectively showed minimum effect on the emergence of *T. chilonis* and were found to be safe to the parasitoid. After 8-days parasitism, chlorantraniliprole resulted in maximum emergence of *T. chilonis* and did not show significant difference with lufenuron and emamectin benzoate. Chlorantraniliprole showed maximum survival (42%) and did not differ significantly with lufenuron with 36% survival at 3 h post application. Emamectin benzoate was found to be a toxic insecticide which resulted in minimum survival of the parasitoid with 18.0% and did not show significant differences to those of imidacloprid with 22.0% survival. All the insecticides showed non-significant difference with one another on the survival of *T. chilonis* adults recorded 24 h post application and found toxic to the adults of *T. chilonis* regarding survival range between 8.0 to 14.0% as against control treatment with 92.0% survival of *T. chilonis* adult.

**Key words**: *Trichogramma chilonis*, egg parasitoid, spinosad, lufenuron, flubendiamide, chlorantrasiliprole, emamectin benzoate, imidacloprid.

## INTRODUCTION

The use of *Trichogramma* species in many crop ecosystems has achieved appreciable pest control success and its role in the biological control programs of pest management is well understood (Smith, 1996; Sorokina, 1999; Hussain *et al*., 2010). By the establishment of Bio-intensive Pest Management Programs (BIPM), bio-control agents, such as *Trichogramma* species are integrated with other control methods without affecting the efficiency of bio-control agents (Tiwari and Khan, 2004) and is most widely used in Pakistan, India, China, Korea, Taiwan, Japan, Nepal, and Reunion Island and as exotic species in Kenya, Spain, South Africa and Australia. *Trichogramma* can survive into a wide range of temperature and gave successful control of lepidopteran pests in many crops (Nadeem and Hamed, 2008; Nadeem *et al*., 2009, 2010; Nadeem and Hamed, 2011).

Application of selective insecticides to control pests could be useful in conservation of natural enemies associated with crops. The insecticides that are widely used to control different pests can affect the effectiveness of these beneficial agents. It is not fully clear, to what extent insecticides are harmful for other non-target organisms. More understanding of pest natural enemy insecticide interaction is needed to formulate more effective integrated pest management strategies (Preetha *et al.*, 2010). Some new insecticides are potentially more toxic to the target pest but not to natural enemies, thus playing significant role in conservation of biological control agents in agricultural environments. In some pest management systems, pesticides that have been used as selective shown harmful effects on beneficial species (Hill and Foster, 2000).

Work of the previous researchers like Charles *et al.* (2000), Ughade *et al.* (2002), Preetha *et al.* (2009) and Sattar *et al*. (2011) indicated toxic effects of different insecticides on *Trichogramma*

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0030-9923/2012/0004-1123 $ 8.00/0

spp. Williams and Price (2004) tested the toxic effects of spinosad, thiamethoxam and oxamyl) on egg parasitoid, *T. pretiosum,* with order of toxicity was thiamethoxam > spinosad > oxamyl (Vianna *et al.,* 2009) found that lufenuron had lowest negative effects on parasitism and viability of individuals of *T. pretiosum* populations. Hussain *et al*. (2010) revealed that emamectin benzoate, lufenuron, and imidacloprid had a significant adverse effect on the emergence of *T. chilonis* when exposed to all immature stages of development inside the host eggs of *Sitotroga cerealella* by exposure to imidacloprid, emamectin benzoate and lufenuron with 70.02, 27.62, and 18.48% survival, respectively, after 3 h but after 24 h none of the insecticides was found safe to *T. chilonis* adult. Preetha *et al.* (2010) found that imidacloprid 7.8 SL did not cause any adverse effect on the adult emergence and parasitism of *T. chilonis.* Numerous laboratory and field studies have revealed that *Trichogramma* wasps are highly susceptible to most broad spectrum insecticides. This is the reason that various attempts to suppress pest population by biological control measures have often failed because of deleterious effects of chemical on the beneficial insects (Borgemeister *et al.,* 1993).

The integration of biological and chemical control tactics requires a thorough understanding of effects on biological control agents. A step-wise assessment, moving from the laboratory to the field, with proper consideration of both direct and sub-lethal effects is recommended in the screening of pesticides against biological control agents (Croft, 1990). The present investigation was undertaken to study the selective toxicity of different new insecticides against *T. chilonis* under laboratory conditions with an objective to search for comparatively less toxic insecticide against *T. chilonis,* to be incorporated into IPM programs.

## MATERIALS AND METHODS

Six insecticides were tested against *T. chilonis* at adult and immature stages in the Insect Rearing Laboratory of Entomological Research Institute, Ayub Agricultural Research Institute, Faisalabad. The experiment was laid out in completely randomized design with five repeats. The control treatment was also maintained where only tap water was sprinkled. Some new insecticides which are being commonly used to control insect pests of many crops in the field were selected (Table I).

Each insecticide was measured with micro pipette and was kept in a beaker to make the volume 500 ml with distilled water, shaken to ensure the thorough mixing. The following bio-assays were done.

*Egg card bioassay*

The effect of dipping parasitized (*T. chilonis* on host eggs) *S. cerealella* in different insecticides were studied during different immature stages of *T. chilonis*. Five randomly selected egg cards, each having 40 parasitoid eggs were dipped into each treatment for one second on 1$^{st}$, 3$^{rd}$, 4$^{th}$, 5$^{th}$, 7$^{th}$ and 8$^{th}$ day of age of parasitoid eggs. These days corresponded to the developmental stages of *Trichogramma:* eggs 1d, larvae 3d, pre-pupae 4d, early pupae 5d, pupae 7d, and late pupae or one day before adult emergence 8d. Dipped egg cards were dried at ambient room temperature. Once dried, each egg card was placed in a small glass petri dish (5 cm diameter and 0.5cm deep) held at 27±1°C and relative humidity 65±5% until all healthy parasitoids had emerged. The eggs were then observed under microscope for their emergence.

*Dipped surface residue bioassay*

The effect of insecticide residues on the survival of adult of *T. chilonis* was studied in ventilated glass bio-assays chambers measuring 15x4 cm (Scholz, 1994). Whatman filter paper was saturated in a solution of each treatment then dried and were kept into the glass bio-assays tube to fully exposed the treatment. Approximately ten newly emerged *T. chilonis* adults were released in each bio-assay tube and exposed to the treated filter paper for 3 h and 24 h. After exposure, the number of dead and alive wasps was recorded. Each of the treatment was replicated 5 times.

*Statistical analysis*

The data were subjected to analysis of variance (ANOVA) followed by means separation using Fisher's least significant difference (LSD) test at 5% (Steel *et al*., 1997).

**Table I.- Insecticides tested against *T. chilonis*.**

| Name of insecticides | Trade name | Dose rate ml/ha | Manufacturer/Distributor |
|---|---|---|---|
| Spinosad 240 SC | Tracer | 198 | Dow Agro Sciences/ Arysta Life Science Pakistan |
| Lufenuron 50 EC | Match | 494 | Syngenta, Pakistan |
| Flubendiamide 480 SC | Belt | 432 | Bayer Crop Sciences |
| Chlorantraniliprole 20 SC | Coragen | 72 | DuPont Pakistan/ UDL, Pakistan |
| Emamectin benzoate 1.9 EC | Proclaim | 494 | Syngenta, Pakistan |
| Imidacloprid 200 SL | Confidor | 618 | Bayer Crop Sciences |

## RESULTS AND DISCUSSION

Table II shows that the exposure of spinosad to parasitoids, *T. chilonis,* resulted in the lowest emergence (4.6% to 26.8%), while the highest emergence (17.8% to 70.5%) was observed after exposure to Chlorantraniliprole. The present results agree to the findings of Ughade *et al.* (2002) who reported that spinosad was moderately safer to *T. chilonis*. The order of toxicity was thiamethoxam > spinosad >oxamyl as reported by Williams *et al.* (2004) also did not agree to our findings. Emergence of parasitoids after application of emamectin benzoate (67.5%) and lufenuron (64.0%) after 1st day parasitoids, imidacloprid (62.5%), emamectin benzoate (68.5%) and lufenuron (65.0%) after 2nd day parasitoids, imidacloprid (63.9, 65.0 and 65.0%), emamectin benzoate (70.5, 68.8 and 68.9%), flubendiamide (62.4, 64.0 and 62.5%) and lufenuron (66.0, 67.5 and 66.0% after 4, 5 and 7 days parasitism, respectively) showed minimum effect on the emergence of *T. chilonis* and was found safer to the parasitoid eggs. Emamectin benzoate, lufenuron, flubendiamide and imidacloprid were observed to be safer compared to chlorantraniliprole against *Trichogramma*. The present findings are in conformity to those of Ughade *et al.* (2002) who reported that imidacloprid was moderately safe towards the emergence of *T. chilonis*. Our findings did not agree to those of Nasreen *et al.* (2004) and Preetha *et al.* (2009) who found that imidacloprid was toxic to *T. chilonis* under laboratory conditions.

Eight day old parasitoid eggs showed the highest emergence of *T. chilonis* (70%) after exposure to chlorantraniliprole which did not differ significantly from lufenuron (66.5%) and emamectin benzoate (69.5%). According to Vianna *et al.* (2009), lufenuron had lowest adverse effects on parasitism and viability of *Trichogramma* species. The present findings are consistent with those of Preetha *et al.* (2010) who reported that imidacloprid did not cause any adverse effect on the adult emergence and parasitism of *T. chilonis.* The results reported by Hussain *et al.* (2010) which showed that lufenuron, emamectin benzoate and imidacloprid have significant adverse effects on the emergence of *T. chilonis* are inconsistent to our present findings.

In the present experiments, all the insecticides differed significantly regarding survival of adults of *T. chilonis* 3 h post application (Table III). Chlorantraniliprole resulted in maximum survival *i.e.*, 42% 3 h after application and did not show significant difference from lufenuron which showed 36% survival. Emamectin benzoate was found to be a toxic insecticide resulted in low survival (18.0%) of the adult parasitoids and did not show significant difference from imidacloprid, where 22.0% survival was recorded. All the insecticides showed non-significant differences to each other on the survival of *T. chilonis* adults 24 h post application and were found toxic to the adults of *T. chilonis* where survival ranged between 8.0 to 14% compared to 92.0% in control. From these results, it is clear that chlorantraniliprole had less knockdown effect as compared to other insecticides and at 24 h post treatment, all the insecticides were equally toxic to the parasitoid at adult stage. The present findings agreed to the work of Preetha *et al.* (2009) who reported that Imidacloprid was toxic and chlorantraniliprole was harmless to *T. chilonis.* Vianna *et al.* (2009) also reported that lufenuron had lowest negative effects on parasitism and viability of individuals of *T. pretiosum* populations. Our findings are consistent to those of Hussain *et al.*

**Table II.- Adult emergence (%) of *T. chilonis* at different post treatment intervals of insecticides.**

| Insecticides | 1st Day | 3rd Day | 4th Day | 5th Day | 7th Day | 8th Day |
|---|---|---|---|---|---|---|
| Spinosad | 16.2 d | 26.8 d | 4.6 d | 25.6 d | 21.0 d | 24.0 d |
| Lufenuron | 64.0 bc | 65.0 b | 66.0 b | 67.5 b | 66.0 b | 66.5 bc |
| Flubendiamide | 61.1 c | 61.5 b | 62.4 b | 64.0 b | 62.5 b | 63.5 c |
| Chlorantraniliprole | 17.8 d | 37.4 c | 31.8 c | 44.2 c | 38.8 c | 70.0 b |
| Emamectin benzoate | 67.5 b | 68.5 b | 70.5 b | 68.8 b | 68.9 b | 69.5 bc |
| Imidacloprid | 61.6 c | 62.5 b | 63.9 b | 65.0 b | 65.0 b | 63.5 c |
| Control | 93.5 a | 95.0 a | 96.5 a | 94.4 a | 93.4 a | 93.0 a |
| LSD at *P* =5 % | 5.38 | 7.83 | 11.30 | 6.48 | 6.73 | 6.48 |
| F. Value | 226.0 | 67.00 | 57.79 | 92.65 | 99.65 | 83.48 |
| C.V. (%) | 7.62 | 10.16 | 15.43 | 8.15 | 8.75 | 7.79 |

Means sharing similar alphabets are not significantly different to each other.

**Table III.- Survival (%) of *T. chilonis* adults at different post treatment intervals of insecticides.**

| Insecticide | Survival (%) | |
|---|---|---|
| | After 3 h | After 24 h |
| Spinosad | 28.0 cd | 10.0 b |
| Lufenuron | 36.0 bc | 14.0 b |
| Flubendiamide | 32.0 c | 14.0 b |
| Chlorantraniliprole | 42.0 b | 8.0 b |
| Emamectin benzoate | 18.0 e | 8.0 b |
| Imidacloprid | 22.0 de | 12.0 b |
| Control | 94.0 a | 92.00 a |
| LSD at P =5 % | 9.29 | 9.05 |
| F. Value | 63.88 | 97.13 |
| C.V. (%) | 18.46 | 30.88 |

Means sharing similar alphabets in a column are not significantly different to each other.

(2010) who reported that at adult *Trichogramma* exposure to imidacloprid, emamectin benzoate and lufenuron had 70.0, 27.6, and 18.4% survival, respectively after 3 h, but for 24 h, none of the insecticides was found to be safe to adult of *T. chilonis*. The conclusion drawn from above results showed that spinosad was found to be very toxic based on the emergence of *T. chilonis* followed by chlorantraniliprole. Rest of the tested insecticides were found toxic based on the survival of adult parasitoids.

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*(Received 11 April 2012, revised 15 June 2012)*