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Residual toxicity of some newer insecticides against *Trichogramma chilonis* Ishii under laboratory conditions

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Abstract
The laboratory studies were conducted to evaluate residual toxicity of some newer insecticides against *Trichogramma chilonis* Ishii at insect-biocontrol laboratory, Entomology Section, College of Agriculture, Nagpur (Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola). The results of present study revealed that the increasing order of residual toxicity of insecticides was as: azadirachtin 1500 ppm <spiromesifen 22.9 SL <diafenthiuron 50% WP <buprofezin 25 SC < imidacloprid 17.8 SL <acephate 75% SC < lambda cyhalothrin 9.5% + thiamethoxam 12.6% ZC. Botanical insecticide had significantly less residual problem than chemical insecticides. Azadirachtin, a neem based botanical insecticide was found safest to *T. chilonis* in terms of its residual toxicity whereas, lambda cyhalothrin 9.5% + thiamethoxam 12.6% ZC recorded maximum residual toxicity. It was also observed that the insecticide residues persisted upto 10 days of treatment. Hence, it is advisable that release of *T. chilonis* should be withheld at least up to 10 days of insecticide applications in field in order to achieve better parasitization of host insect.

Keywords: *Trichogramma chilonis*, residual toxicity, newer insecticides

Introduction
In India, inundative releases of *T. chilonis* have successfully controlled borer pests of sugarcane and rice, fruit borers in vegetables and bollworms in cotton ecosystems (Singh and Jalali 1994; Vennila 2006; Padmashri and Rani 2014) [8, 11, 4].
The biointensive pest management approach allows safe integration of chemical pesticides along with biocontrol agents without negatively affecting their efficacy. However, one should clearly bear in mind that, simultaneous parasitoid release and insecticidal applications cannot work together. Therefore, application of chemical insecticides with temporal synchronization of parasitoid release at a specified period is of vital importance for effective pest management. The findings of the present study will reveal the extent of safety and residual toxicity of selected newer insecticides to *T. chilonis* and will thus help in application and timing the parasitoid releases in the field for achieving better pest control efficacy.

Methods and Material
Fresh UV irradiated and unirradiated eggs of *Corcyra cephalonica* Stainton (Lepidoptera: Pyralidae), Culture of *T. chilonis* Insecticides for treatments, Ethanol for disinfection and or sterilization of glass wares, Sodium hypochlorite for sterilization, glassware and laboratory equipments were used.
An experiment was performed to work out the residual effect of insecticides to adult wasps of *T. chilonis* under laboratory conditions. The effect of insecticide residues on survival of adult *T. chilonis* was studied by glass vial bioassay method. For this purpose, the glass vials measuring about 15x4cm size were taken. Sufficient quantity of insecticidal solution at recommended concentration of each insecticide was prepared using acetone as a solvent. A thin uniform film of each insecticide was applied to each vial by taking 1 ml of spray liquid in it and quickly rotating by hand, so that vials get uniformly coated with the insecticides. The treated vials were then shade dried to have insecticide residues as a dry film. A batch of glass vials treated with acetone only was kept as control for comparison. After drying of insecticides, 20-25 newly emerged adults of *T. chilonis* were released inside each vial at an interval of 1st, 5th and 10th days after treatment to the vials to test the residual toxicity. The adults were exposed to insecticide residues for 4 h and observations were recorded on number of dead and live adults. The proportions of surviving and dead adult parasitoids were worked out for each of the test insecticides.

Results and Discussion

Residual toxicity of newer insecticides after 1st day of treatment

The results revealed that the treatment of azadirachtin (38.67%) and spiromesifen (44.00%) were at par with each other and relatively safer to the adult parasitoids which recorded lowest mortality after control (0.00%). The next relatively less persistent chemicals observed in increasing order of their residual toxicity were: diafenthiuron (52.00%) < buprofezin (57.33%) < imidacloprid (61.33%) < acephate (64.00%), all being at par with each other. The later two chemicals were also at par with chlorantraniliprole in which 65.33 percent mortality of adults of *T. chilonis* was observed. Similar to the experiment on percent parasitization, in this experiment also a combination product of lambda cyhalothrin + thiamethoxam recorded its highest residual toxicity to the parasitoid adults (88.00%).

Residual toxicity of newer insecticides after 5th day of treatment

The results indicated that no mortality of *T. chilonis* adults was recorded in control treatment (0.00%). Amongst the insecticides tested, azadirachtin and spiromesifen recorded with 32.00 percent adult mortality in both cases which were at par with each other indicating less residual problem to the bioagent. The next relatively less toxic chemicals to the parasitoid wasp were diafenthiuron, buprofezin and imidacloprid with 45.33, 49.33 and 49.33 percent mortalities, respectively all being at par with each other. The treatment of buprofezin and imidacloprid were also found at par with chlorantraniliprole (52.00%) and acephate (54.67%). Highest adult mortality was recorded in treatment of lambda cyhalothrin + thiamethoxam (74.67%).

Residual toxicity of newer insecticides after 10th day of treatment

The results indicated that no mortality of *T. chilonis* adults was recorded in control treatment (0.00%). Among the insecticides tested, azadirachtin with 18.67 percent mortality had least residual toxicity to the adults of *T. chilonis* whereas, next safer compound observed was spiromesifen with 26.27 percent adult mortality. The next relatively less toxic chemicals to the parasitoid wasp were diafenthiuron, chlorantraniliprole, imidacloprid and buprofezin with 36.00, 38.67, 40.00 and 40.00 percent mortalities, respectively which were recorded at par with each other, whereas the later two insecticides were also found at par with acephate (45.33%). The treatment of lambda cyhalothrin + thiamethoxam recorded highest mortality indicating its residual toxicity to adult parasitoids (66.67%). A progressive decrease in adult mortality was observed with advancement of time from 1st to 10th days of treatment.

These findings are in line with the reports of earlier workers. Fand *et al.* (2009) [2] who also reported a progressive decline in residual toxicity of test insecticides towards adults of *T. chilonis* by vial residue bioassay from the day of treatment till 10 days. Sidi *et al.* (2012) [7], Edirisinghe and Hemachandra (2014) examined the residual effects of neem extract against *Trichogramma chilonis* and *Trichogramma achae* after 0, 5, 15 and 25 days of spraying and found that mortalities between neem and control were not significant among the growth stages of both species, thus indicating safety of neem to the biocontrol agent., Sabry *et al.* (2014) [5] evaluated residual effects of chlorantraniliprole and thiamethoxam on natural enemies and found thiamethoxam as less toxic than chlorantraniliprole against the natural enemies evaluated. Uma *et al.* (2014) [10] tested the toxicity of eighteen novel insecticides against *T. japonicum* and observed that acephate as moderately harmful causing 88.75 percent adult mortality, thiamethoxam as slightly harmful with 40.00 percent mortality whereas, imidacloprid as harmless with 23.75 percent adult mortality. Ko *et al.* (2015) [3], Shorabi and Amini (2015) [6] reported that imidacloprid was moderately persistent with its residual effects upto 16-30 days, Singhamuni *et al.* (2015) [9] reported neem as safer for adults of *T. chilonis.*

Table 1: Residual Toxicity of Newer Insecticides to Adults of *T. chilonis*

S. No.	Treatment	Conc. (%)	No. of Adults released in each Vial	Number of adults dead (Mortality%)		
				1st day	5th day	10th day
1.	Chlorantraniliprole 18.5% SC	0.005	25	65.33	52.00	38.67
2.	Imidacloprid 17.8% SL	0.005	25	61.33	49.33	40.00
3.	Acephate 75% SC	0.05	25	64.00	54.67	45.33
4.	Diafenthiuron 50% WP	0.06	25	52.00	45.33	36.00
5.	Buprofezin 25% SC	0.005	25	57.33	49.33	40.00
6.	Spiromesifen 22.9% SC	0.006	25	44.00	32.00	26.67
7.	Azadirachtin 1500 Ppm	0.005	25	38.67	32.00	18.67
8.	Lambda cyhalothrin 9.5%+thiamethoxam 12.6% ZC	0.002	25	88.00	74.67	66.67
9.	Control	Water Spray	25	0.00	0.00	0.00
10.	F test			Sig.	Sig.	Sig.
11.	SE (diff.)			3.35	3.68	3.35
12.	CD (%)			7.05	7.73	7.05

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