

Effect of Bifenthrin and Lambda Cyhalothrin on feeding behaviour of tent web spiders, *Cyrtophora citricola* (Araneae: Araneidae)

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ABSTRACT

Background: This research work was designed to examine the effects of selected pyrethroids i.e., Bifenethrin and Lambda Cyhalothrin on predatory behavior of spiders (*Cyrtophora citricola*). **Methods:** The collected samples of spiders were fed on *Drosophila melanogaster* till satisfaction and then starved for two days and maintained in laboratory conditions. Treated groups were exposed to filter paper treated with i field dose (200µl/500ml) of Bifenthrin and (800µl/ 400ml) Lambda Cyhalothrin). However, control group was exposed to water treated filter paper for one hour. Spiders of both groups were offered with five adult fruit flies. Then, the number of flies consumed by each spider was recorded after regular intervals as 4, 8, 12, 16, 20, 24 and 48 hours of exposure. **Results:** Results showed that predation rate of Bifenthrin treated spiders was reduced after 20 hours of exposure. However, in case of Lambda Cyhalothrin treatment, no reduction in predation rate was recorded. **Conclusion:** It was concluded that *C. citricola* feeding activity was reduced for short period of time due to Bifenthrin and not effected by Lambda Cyhalothrin.

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INTRODUCTION

Insects are the most successful and versatile group of terrestrial habitats that comprises 66% of all living species; they become a major pest in the agroecosystem (Van Lenteren, 2021; Jankielsohn, 2018). Today, pest control has become a crucial component of modern agriculture (Fei et al., 2023). Integrated Pest Management (IPM) approved various methods to control and manage the pest population (Packard, 2023). According to a report of the United Nations Organisation, pesticides are chemical substances which are used to manage pest species (Sharif et al., 2023). Their application for pest control has a well-documented history of enhancing crop protection and productivity in developed countries (Slafer et al., 2021). However, extensive use of pesticides causes harmful effects on non-target organisms such as spiders, beetles or carabid (Michalko et al., 2024; Pecker, 2021). Spiders are important biological control agents in

agroecosystems. They are highly sensitive to some pesticides (Michalko & Pekár, 2016).

Pyrethroid is a group of chemical insecticides and derivatives of the natural compound pyrethrin I, dried flower extract of *Chrysanthemum cinerariaefolium* (Henault-Ethier, 2015). Pyrethroids are widely used in agriculture to control crop pests (Saillenfait et al., 2015). It is toxic to insect pests but least toxic to mammals (Chrutek et al., 2021). Its extensive use in agricultural fields causes sub-lethal and lethal effects on natural predators, including spiders. In sublethal effects, alterations in the movements of spiders were observed (Duque et al., 2024). In lethal effects, before death, certain symptoms are shown by the spiders as the type 1 pyrethroids caused ataxia, convulsions and finally paralysis and type 2 caused water imbalance by neurosecretions (Essa et al., 2020). Furthermore, behavioural changes were

also observed. Insecticides also have negative impacts on their life span, reproduction rate, gender ratio, web building capacity, feeding rate and mobility (Ribeiro et al., 2021). The outcome of experimental research revealed that the feeding behaviour of spiders was more affected by Lambda cyhalothrin as compared to Emamectin Benzoate (Tahir et al., 2015). Later, it was recorded that the prey consumption rate is also decreased in *Neoscona theisi* after treatment with sub-lethal doses of lambda Cyhalothrin and Bifenthrin as compared to the control group spiders (Tahir et al., 2019).

In fact, it is a difficult task to manage the pest species due to its high reproductive potential, scarcity of natural enemies, abundance of host species and genetic diversity (Ramzan et al., 2021). The frequent use of insecticides has caused the progression of resistance in some crop pests (Yuan et al., 2021). If this resistance is also developed in natural predators like spiders, it would be a positive aspect. Reviewing all problems, the present experiment was designed to evaluate the effects of field doses of the most commonly used agrochemical pyrethroids, such as bifenthrin and Lambda cyhalothrin, on the predatory activity of the tent web spiders (*C. citricola*).

MATERIALS AND METHODS

This experiment was performed from November 2018 to June 2019 in the Research laboratory of Zoology at the University of Education, Lower Mall Campus, Lahore. Spiders of model species, *C. citricola*, were collected from various localities, i.e. Julo Park (31.5715N°-74.4769E°), Changa Manga (31.0848N°-73.9641E°) and Punjab University Lahore Botanical Garden (31.2956N°-74.1757E°) by jarring, hand picking and tree jerking methods. The spiders were identified by using keys and catalogues available. To avoid cannibalism, each spider was placed in a separate transparent box of about 6.8 cm in length and 5 cm in width. Muslin cloth was used to cover each box and maintained in a lab environment. In the present study, recommended field doses of two selected pyrethroids, i.e., Bifenthrin

(200µl/500ml) and Lambda cyhalothrin (LC) (800µl/ 400ml), were prepared.

To standardise the hunger level, spiders were fed with cultured *Drosophila melanogaster* (fruit fly) till satiation for about 5 days and then starved for two days before using them in the experiment. To examine the effects, 20 adult (both male and female) spiders were selected and divided into two equal groups, each containing 10 spiders; one was a control group and the second experimental group (Tahir et al., 2014). In this experiment treated group was exposed to insecticide-treated filter paper (15 cm length and 5 cm width) for about 1 hour and then placed in a separate clean glass jar. Spiders of the control groups were exposed to filter paper dipped in water, then transferred to clean, separate boxes. Each individual spider was provided with five live adult fruit flies. To maintain the flies in these boxes, the water was dipped cotton balls and a small amount of sugar was added. The number of consumed fruit flies was recorded after 2, 4, 8, 12, 16, 20, 24 and 48 hours of treatment. The feeding rate of spiders of both groups was recorded. An independent sample t-test was used to compare the control and treated groups via SPSS (version 16).

RESULTS

The present study did not show any significant variation ($P>0.05$) in feeding among spiders (*C. citricola*) of control and Bifenthrin-treated groups after 4, 8, 12 and 16 hours of treatment. But a significant difference ($P<0.05$) was observed in predation after 20 and 24 hours of treatment among both groups, as depicted in Table 1. It was observed that the Lambda cyhalothrin-treated group didn't feed after 4 and 8 hours of treatment, but the control group fed normally and was not comparable with the control. In later hours, these spiders started predation. But non-significant difference ($P>0.05$) was recorded in the feeding after 12, 16, 20 and 24 hours of treatment between the control and treated group as shown in Table 2. Results revealed that pyrethroids have a short-term negative effect on the feeding behaviour of spiders, as in the case of

Bifenthrin after 20 hours and in Lambda cyhalothrin in start hours of treatment.

Table 1: Comparison of feeding between Bifenthrin treated and control groups of spiders at different intervals of time after treatment.

Time	Group	Prey consumed (Mean $\pm$ SE)	F	P	df	T
4 hr	Control	3.1 $\pm$ 0.48	7.83	0.542	18	- 0.85
	Bifenthrin	2.6 $\pm$ 0.30				
8 hr	Control	3.2 $\pm$ 0.36	0.005	0.945	18	1.494
	Bifenthrin	2.5 $\pm$ 0.28				
12 hr	Control	3.66 $\pm$ 0.44	1.02	0.325	18	2.22
	Bifenthrin	2.54 $\pm$ 0.28				
16 hr	Control	3.2 $\pm$ 0.36	2.33	0.144	18	1.317
	Bifenthrin	2.45 $\pm$ 0.43				
20 hr	Control	3.7 $\pm$ 0.277	4.45	0.049	18	2.19
	Bifenthrin	2.6 $\pm$ 0.411				
24 hr	Control	3.3 $\pm$ 0.44	5.09	0.037	18	1.59
	Bifenthrin	2.5 $\pm$ 0.22				

Table 2: Comparison of feeding between Lambda Cyhalothrin treated and control groups of spiders at different intervals of time after treatment.

Time	Group	Prey consumed (Mean $\pm$ SE)	F	P	df	T
12 hr	Control	1.3 $\pm$.15	3.3	0.086	18	0.818
	LC	1.0 $\pm$.33				
16 hr	Control	3.6 $\pm$.33	1.45	0.243	18	3.53
	LC	2.0 $\pm$.29				
20 hr	Control	3.6 $\pm$.33	0.031	0.861	18	2.496
	LC	2.4 $\pm$.33				
24 hr	Control	4.0 $\pm$.33	0.108	0.746	18	2.53
	LC	2.9 $\pm$.27				

DISCUSSION

The insecticides kill insects by disturbing their nervous or endocrine systems. Low and sub-lethal doses of pesticides influence the behaviour of insects. Insecticides used to control insect pests can also affect spider populations in either a direct or indirect manner (Naz et al., 2023). In the present study, the effects of two pyrethroids on feeding Spiders were exposed to a field dose of Bifenthrin. Their behaviour was not changed at the start, but with the passage of time, feeding in the experimental group

was reduced. Our results were similar to Brown et al. (2014). Their investigation was on predatory activity of lynx spiders (*Oxyopes salticus*). When the spiders were exposed to Bifenthrin their prey capture ability was decreased over time, then spiders recover again (Brown et al., 2014). These results are in accordance to Mukhtar et al. (2018) They studied the effect of prey density and sub lethal doses of Bifenthrin and chlorpyrifos on feeding activity of spiders *C. citrocola*. There was non-significant variation in the predatory activity of the spiders due to bifenthrin. This short term negative effects on spiders predatory activity might be due neurotoxins effects that make poor coordination in body. Then, spiders were unable to prey recognition and capture ability (Petcharad et al., 2018).

The outcome of present work on lambda Cyhalothrin showed no effect on feeding behavior of spiders. These results are contrary to Tahir et al. (2015). They studied the effect of λ -cyhalothrin and emamectin benzoate on predatory behavior of lycosid spiders (*Pardosa birmanica*). Their results revealed that both pesticides significantly affect the predation of spiders (Tahir et al., 2015). Another experiment was performed by Tahir et al. (2019) to check the effect of λ -cyhalothrin and Bifenthrin, on the mortality, avoidance and foraging activity in *Neoscona theisi*. When spiders were offered insecticide treated prey, their predation rate reduced with time. There results revealed that λ -cyhalothrin is more toxic to spiders as compared to Bifenthrin (Tahir et al., 2019). Another study was performed by Rodrigues et al. (2013) on the toxic effects of pyrethroid insecticide lymbda cyhalothrin on 12 different families of spider population in rice field of Brazil. From all families, 50% population of Tetragnathidae and Araneidae were adversely affected (Rodrigues et al., 2013). In literature, we studied that there is a contradiction in results of each research. The effects of these chemicals on feeding behavior are species specific (Baron et al., 2017). It is concluded in present study that the effects of insecticides depends on type

of experimental organism, concentration of dose, method of application of chemicals and all other environmental factors.

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Conflict of interest

The authors have declared no conflict of interest.

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