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Original article

Toxicity of four different insecticides against *Trilocha varians* (Bombycidae: Lepidoptera)

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ABSTRACT

Ficus benjamina is an important ornamental plant in many countries of the world. Recently, this plant is attacked by a lepidopteran insect pest known as *Trilocha varians* (Bombucidae: Lepidoptera) in Pakistan. This pest eats the leaves making the plant unaesthetic. In the current study, toxicity of four insecticides (deltamethrin, chlorantraniliprole, fipronil and emamectin benzoate) was evaluated against *T. varians*. Different concentrations of these insecticides were prepared in distilled water and 3rd instar larvae were exposed using leaf dip bioassay method. The results showed that deltamethrin was more toxic to *T. varians* followed by emamectin benzoate, fipronil, and chlorantraniliprole. The LC_{50} of deltamethrin after 12, 24, 36, 48, and 60 h were 18.04, 16.67, 5.74, 2.46, and 1.79 ppm respectively. The results will be useful for management of *T. varians*.

1. Introduction

Ficus benjamina L. is an important ornamental plant of family Moraceae and is commonly known as weeping fig. It is native to tropical and sub-tropical countries and is planted along roadsides and in lawns (Zolotuhin & Witt, 2009). Some parts of this plant have anti-fungal and anti-tumor properties, and are also used for making cloth and shelter for human being (Lansky et al., 2008; Sirisha et al., 2010). In some countries, these ficus plants are treated as sacred in various religious believes (Lansky and Paavilainen, 2010).

Several insect pests such as whitefly and mealybug attack on the *F. benjamina* (Avery et al., 2011). Leaf eating caterpillar, *Trilocha varians* (Bombucidae: Lepidoptera) is one of the major pest of *Ficus* spp. in many countries including Nepal, India, Thailand, Taiwan, Java, Malyisha, Southern China, Japan, Philippines and Indonesia (Zolotuhin and Witt, 2009; Chuenban et al. 2017). It is also an economic pest of jackfruit and many other *Ficus* spp. The major hosts of *T. varians* are *F. religiosa*, *F. infectoria*, *F. elastica* and *F. benghalensis* (Kedar et al., 2014).

Recently, this pest has been found to attack *F. benjamina* in Pakistan (Ramzan et al., 2019). Some plants were severely infested by *T. varians* larvae causing up to 100% defoliation and death of the plants. Insecticides can play an important role to save this plant from attack of *T.* varians. Previously some scientists have tested fipronil and malathion to manage this pest in Malaysia (Basari et al. 2019) but such studies are lacking in Pakistan and needs evaluation of some other insecticides too. By keeping in view the importance of this pest, toxicity of different insecticides was

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evaluated under laboratory conditions. The aim was to find a suitable insecticide for the control of *T. varians*. This was the first study regarding to control of present pest in Pakistan.

2. Materials and methods

2.1. Collection and rearing of Trilocha varians

The larvae of *T. varians* were collected from the unsprayed *F. benjamina* plants at MNS-University of Agriculture Multan. The collected larvae were brought to rearing laboratory of Institute of Plant Protection by following the methodology of Basari et al. (2019) with some modification. Briefly, they were placed in plastic jars containing fresh *F. benjamina* leaves and reared at 26 ± 2 °C temperature, 50–60% relative humidity (RH) and 14/10 h day-night photoperiod. The larvae were given fresh and tender leaves of *F. benjamina* on daily basis. The full grown larvae were shifted into new plastic jars for pupation. After emergence from pupae, adults (male and female) were released in pairs into separate plastic jars covered with muslin cloth for egg laying on fresh leaves. The eggs were shifted into separate plastic containers for hatching. All this culture was maintained till five generations.

2.2. Insecticides

Four insecticides, chlorantraniliprole (Coragen 20SC, FMC, Pakistan), deltamethrin (2.5% EC, Jaffer Agrochemicals), emamectin benzoate (Proclaim 019 EC, Syngenta Pakistan) and fipronil (Regent 5% SC, Bayer CropScience) were purchased from the market for bioassay studies against *T. varians*.

2.3. Bioassay and lethal concentration and time estimation

Toxicity of insecticides was tested against 3rd instar larvae of *T. varians.* Five concentrations of each insecticide (causing >0% and <100% mortality) were prepared in distilled water. The bioassays were conducted using leaf dip method. The fresh and equal size *F. benjamina* plant leaves were collected from unsprayed plants grown in the yard of University. Leaves were washed in flowing water and placed in laminar flow for 1–2 h for water evaporation before treatment. Ten leaves were then dipped into a specific concentration for 30 s and then placed at tissue paper for 1 h. After one hours of drying two treated leaves were placed into each glass petri-dish (6 cm diameter) by using forceps. Five larvae were shifted to each per petri-dish with the help of camel hair brush. The petri-dishes were covered with lid to avoid larvae escape. Each concentration was replicated five times. Equal number of petridishes contained untreated leaves served as control. All petridishes were placed in the laboratory under controlled temperature (26 ± 2 °C) relative humidity (50–60%) and photoperiod (14/10 h day-night). The data of mortality was recorded after 12, 36, 48, 60 and 72 h of application.

2.4. Data analysis

The mortality data were corrected using Abbott's formula (Abbott, 1925), if the mortality rate in the control was more than 5%. The lethal concentrations (LC_{50} and LC_{90}) of insecticides were calculated through probit analysis using SPSS software ((IBM SPSS Statistics for Windows, Version 23.0, IBM Corp, Armonk, NY, USA).

3. Results

3.1. Lethal concentration estimation

The toxicity of four insecticides against third larval instars of *T. varians* after 12, 24, 36, 48, 60 and 72 h is shown in Table 1. Deltamethrin was more toxic insecticide followed by emamectin benzoate, fipronil and chlorantraniliprole. The LC_{50} values of deltamethrin after 12, 24, 36, 48 and 60 h were 18.04, 16.67,5.74, 2.46 and 1.79 ppm, respectively. The LC_{90} values of deltamethrin after 12, 24, 36, 48 and 60 h were 227.76, 201.44, 150.36, 99.38 and 26.19 ppm, respectively. All exposed larvae were dead after 72 h at almost all of the concentrations of deltamethrin.

The LC_{50} values of emamectin benzoate and chlorantraniliprole after 12 h were 47.61 and 84.30 ppm while after 72 h, they were 5.84 and 9.87 ppm respectively (Table 1). Emamectin benzoate was found to be more toxic than fipronil and chlorantraniliprole. However, LC_{50} and LC_{90} values of fipronil after 12, 24, 36, 48, 60 and 72 h were 66.57, 36.60, 21.99, 19.10, 6.03, 4.64 and 911.32, 721.74, 605.73, 352.17, 70.45, 51.22 ppm, respectively (Table 1).

4. Discussion

The various methods such as cultural, physical, botanical, biological and chemical have been practiced at national and international level to control the pest population in different countries (Udayagiri, 1988; Kedar et al., 2014). Among all these methods, chemical method is the most effective and widely used to control insect pests. If proper concentration of an insecticide is applied, it can kill the insect pest within shorter period of time. The use or exposure of similar groups of insecticides for long time can cause insecticide resistance in insect pests. It is advised to use different insecticides in rotation to manage the pest population.

Current study was conducted to test the efficacy of different insecticides to control the pest population under laboratory conditions. For this purpose, four insecticides, chlorantraniliprole, deltamethrin, emamectin benzoate and fipronil were chosen to test the LC_{50} and LC_{90} against the larvae of *T. varians*. There are limited studies conducted against this pest that involve testing different insecticides. In Malaysia a study has been conducted to determine the lethal time 50 (LT_{50}) and lethal time 90 (LT_{90}) by using two insecticides, fipronil and malathion. However, studies using newer chemicals had not been conducted before to determine the LC_{50} and LC_{90} against this pest in the world including Pakistan. Thus, we intended to calculate LC_{50} and LC_{90} of four insecticides by using different concentrations against this pest.

Our study showed that all insecticides were proved toxic and effective to *T. varians*. Among all insecticides, deltamethrin was proved most toxic insecticide and caused high mortality of larvae as compared to other insecticides partularly chlorantraniliprole which caused least mortality. While authors in Malaysia (Basari et al., 2019) have reported that fipronil was most toxic insecticides than malathion. Our findings are not in line with the findings of their previous study (Basari et al., 2019). In other studies, fipronil has been reported very toxic insecticides with lower LT_{50} and LT_{50} values against other insect pests (Colliot et al., 1992; Zhang et al., 2015). which was not the case in our study against *T. varians*. Fipronil was slow acting insecticide in our study and similar observations have reported by earlier researchers against various insect pests (Gautam et al., 2012; Li et al., 2016). During the study no mortality was recorded under control and all larvae change into pupae and than emerged as adults after few (six) days. Overall, the present study reported that deltamethrin could be better option to control this the emerging insect pests (*T. varians*).

Table 1
Toxicity of insecticides against third instars larvae of *Trilocha varians* under laboratory conditions.

Insecticide	Time (hour)	LC_{50}[a] (ppm) (95% FL[b])*	LC_{90}[c] (ppm) (95% FL[b])*	df	χ^2[d]	P	N[e]
Chlorantraniliprole	12	84.30(51.89-235.87)	770.50(262.85-13775.56)	3	0.22	0.97	25
Deltamethrin	12	18.04(12.52-28.62)	227.76(63.26-598.97)	3	3.09	0.37	25
Emamectin benzoate	12	47.61(33.32-79.92)	845.36(177.92-4205803.58)	3	0.20	0.97	25
Fipronil	12	66.57(35.72-381.46)	911.32(145.93-1953.26)	3	0.95	0.81	25
Chlorantraniliprole	24	51.68(46.32-85.72)	754.35(197.87-4313401.43)	3	0.90	0.77	25
Deltamethrin	24	16.67(14.34-34.61)	201.44(98.85-1033.29)	3	0.24	0.97	25
Emamectin benzoate	24	20.61(9.01-39.02)	533.86(154.21-57114.25)	3	0.28	0.96	25
Fipronil	24	36.60(16.37-103.59)	721.74(183.65-64282.84)	3	0.87	0.83	25
Chlorantraniliprole	36	21.43(9.85-31.34)	509.03(199.99-1579.78)	3	2.16	0.98	25
Deltamethrin	36	5.74(0.44-11.75)	150.36(60.58-6011.57)	3	1.29	0.73	25
Emamectin benzoate	36	17.53(4.45-36.72)	307.09(149.89-1449.73)	3	0.57	0.90	25
Fipronil	36	21.99(13.36-52.25)	605.73(141.61-120706.82)	3	0.24	0.97	25
Chlorantraniliprole	48	19.87(4.78-40.63)	221.14(98.44-3443.15)	3	0.65	0.81	25
Deltamethrin	48	2.46(.002-7.23)	99.38(40.73-19950.68)	3	0.28	0.96	25
Emamectin benzoate	48	14.45(6.45-23.48)	213.18(90.56-2437.15)	3	1.39	0.71	25
Fipronil	48	19.10(9.32-83.16)	352.17(106.72-14372.21)	3	0.44	0.93	25
Chlorantraniliprole	60	14.87(7.32-23.45)	160.63(77.95-1368.58)	3	7.34	0.95	25
Deltamethrin	60	1.79(.008-5.06)	26.19(13.979-122.82)	3	1.29	0.73	25
Emamectin benzoate	60	12.93(5.92-20.38)	155.76(73.57-1138.93)	3	5.25	0.15	25
Fipronil	60	6.03(2.64-9.52)	70.45(34.38-458.59)	3	1.39	0.71	25
Chlorantraniliprole	72	9.87(5.45-8.88)	26.98(19.98-51.34)	3	0.31	0.99	25
Deltamethrin	72	-	-	-	-	-	-
Emamectin benzoate	72	5.84(2.65-8.55)	23.75(16.73-45.91)	3	0.40	0.94	25
Fipronil	72	4.64(1.74-7.49)	51.22(26.83-265.61)	3	0.30	0.96	25

[a] LC_{50} = Lethal concentration to kill 50% population.
[b] FL = Fiducial limits.
[c] LC_{90} = Lethal concentration to kill 90% population.
[d] = Chi-square.
[e] = Numbers of larvae exposed.

5. Conclusion

The current study revealed that deltamethrin and emamectin benzoate were more lethal and toxic to larvae of *T. varians*. Hence these two insecticides can be used for the management of *T. varians*.

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Conflict of interest

Authors have no conflict of interest.

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