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Research Article

Evaluation of Synthetic Poison and Biological Pesticides against *Diaphorina citri* in Citrus in Dir

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ABSTRACT

On *Diaphorina citri* in 2020 at Citrus Orchard, Rabbat District Dir Lower, this study was performed to assess the impacts of extract of neem seeds artificial insecticides and bio-pesticides on *Diaphorina citri* in 2020. The study comprised five procedures: extract of neem seed, bifenthrin, cypermethrin, a control group along with indoxacarb. This study utilised a randomised complete block design (RCBD). In a citrus orchard, a total of 5 samples were selected, and every plant was partitioned into four different sections. From each branch, five leaves were collected. This finding demonstrated that synthesized insecticides offered more rapid and efficient control than herbal extract, that exhibited a slower response. In the experiment, indoxacarb, cypermethrin, neem seed extract, and also bifenthrin were applied administered to combat Citrus psylla, while the remaining control plants remained untreated for comparative purposes. The results indicated that, among all tested chemicals, bifenthrin was efficient in control of pest, accompanied by cypermethrin, neem seed botanical extract, and indoxacarb. The experiment further validated the superior performance of bifenthrin compared to the herbal extract.

Keywords: *Citrus* psylla, Botanical extract, pesticides, Citrus pests, Pakistan.

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INTRODUCTION

A highly esteemed fruit in Pakistan along with ranks first in global production of citrus is Kinnow (FAO, 2005; Ali et al., 2023). It is cultivated over expanse of 192.3 thousand hectares, yielding a total output of 2,458.4 thousand tonnes. The mean production of citrus throughout country is approximately 12.78 tonnes per hectare (Government of Pakistan, Economic Survey, 2006). The potential production of citrus plant is 18-20 tonnes per hectare (PHDEB, 2006). A significant disparity in its average yield and potential yield exists there. This gap in yield may be ascribed to several challenges encountered by citrus cultivators, which require adequate resolution; among these challenges, issues related to information and inputs appear to significantly contribute to this substantial yield gap.

Pakistan's agro-climate is optimally conducive to fruit cultivation, particularly in the Indus plains, which are exceptionally favorable for growing fruits. Pakistan cultivates a diverse array of fruits across an extensive area of 746,628 hectares, yielding a total production of 6,963,577 million tones (Government of Pakistan, Economic Survey, 2018-19). In Khyber Pakhtunkhwa, the area dedicated to fruit cultivation

spans 81,359 hectares, yielding a production of 721,926 tones (CRS-KP 2018-19). A predominant fruit cultivated in Pakistan is Citrus. It is a vital supplier of vitamins along with minerals and carbohydrates, all of which are essential for health of human. This fruit has been documented to inhibit lungs, skin, and liver cancers; cardiovascular diseases; and congenital anomalies, while promoting a healthy and balanced way of life (Ghirdharilal, 2000).

Citrus psylla (Homoptera: Psyllidae) (*Diaphorina citri* kuwayama) is a highly destructive and significant pest of citrus, inflicting substantial damages to orchards of citrus by transmitting the viral greening disease (Hall, 2008; Hall et al., 2012; Corallo et al., 2021). They deposit eggs individually or in clusters on the innermost layer of the plants. The pest undergoes 9 to 10, or even as many as 16, overlapping generations annually (Mangat, 1966). Both nymphs and adults extract cell sap from freshly emerging leaves, resulting in leaf mortality. Both the quantity and quality of fruits are influenced by *D. citri* infestation (Bindra, 1969; Kalile et al., 2021). Management incorporated various prevention strategies, including botanicals, insecticides, and regulators of insect growth (Khan et al., 2013; Khan et al., 2024). Control measures for *Citrus psylla* were advised to be implemented at intervals of 10 to 15 days (Shivinakar et al., 2000). The population of *C. psylla* varies in accordance with temperature and humidity levels. *C. psylla* exhibits two population peaks annually, aligning with the citrus flushing periods in spring and summer. This study compared chemical control measures, including the insecticides Cypermethrin, Indoxacarb, and Bifenthrin, as well as the botanical pesticide neem oil, against *C. psylla.*

MATERIALS AND METHODS

Study Area

This research was conducted in a citrus orchard in the Rabat District of Dir Lower to evaluate the effectiveness of synthetic insecticides and extract of neem seeds to combat *Diaphorina citri* in 2020.

Field Experiment

Research studies were performed to ascertain the effectiveness of both herbal and chemical extracts in the 2020.

Experimental Methodology

The experiment was structured using a Randomised Complete Block Design (RCBD) comprising five treatments, including a control group. Every procedure was replicated thrice. The following are synthetic chemicals coupled with their recommended dosages.

Table 1. List of synthetic chemicals applied

Sr#	Treatments	Trade Name	Chemical /scientific Name/ Active-ingredient	Recommended Dose
1	T1	Arrive 10 EC	Cypermethrin	3.1 ml/lit
2	T2	Steward 150 EC	Indoxacarb	0.54ml/lit
3	T3	TALSTAR 10EC	Bifenthrin	2.53ml/lit
4	T5	Neem Seed Extract	*Azadirachta indica*	90gm/L
5	T8	Control	----------	----------

Plant Resource

Neem seed (*Azadirachta indica* L.).

Synthetics Insecticides

Arrive 10 EC (Cypermethrin), Telstar 10 EC (Bifenthrin), Steward 150 EC (Indoxacarb). All insecticide compositions were prepared in accordance with the recommended rates.

Pesticide Formulations

Prior to applying the chemical insecticide, a blank spray was conducted to determine the necessary quantity. Three insecticides, namely Cypermethrin at 3.1 ml/L, Indoxacarb at 0.54 ml/L, and Bifenthrin at 2.53 ml/L, along with a botanical extract of Neem Seeds at 90 g/3 litres, were applied on every tree (North, East, West, and South), respectively. Data were collected at intervals of 1 day, 3 days, 7 days, 15 days, and 30 days following the spray.

Quantity of Trees Per Plant

Five specimens from each treatment group were selected and subjected to spraying. Each procedure was conducted three times.

Preparation of plant Extracts (neem)

Seeds of neem were procured from the local market, then the coverings of seed were taken away for further procedure. The extracted solution was synthesized by dissolving 90 grammes of powder in water within a conical flask to achieve a final volume of 1 litre. From the stock solutionField application solutions at a concentration of 5% were formulated. (Munir, 2006; Mochiah et al., 2011; Fiaz et al., 2012). Throughout the procedure, 12 applications were administered at 7-day intervals using a knapsack sprayer. Control plots were irrigated with tap water. The spray machine and additional tools were meticulously sanitised prior to every application.

Process for the Preparation of Synthetic insecticides

The chemical insecticides were withheld from outside, and different spray solutions were formulated for application in accordance with their prescribed dosages, utilising an electronic balance along with graduated tube.

Collection of Data

Forgathering data, the selected plants were divided into four quadrants: North, West, South, and East. A portion of five leaves each branch was subsequently collected and labelled in each quadrant. The plants were thoroughly inspected. Data on Citrus psylla was recorded from five leaves on every stem of the selected side of the plants, both before and after the application of the spray, at regular inspection intervals. The number and density of natural adversaries of the canola crop will be documented weekly, four times each month.

$$\%\ Mortalilty = \frac{Pests\ \ population\ after\ treatment}{Pest\ population\ before\ treatment} \times 100$$

Statistical Analysis

The recorded data were analysed using STATTISTIC-8.1. Means were separated at an alpha level of 5% following the usage of LSD (Gomez and Gomez, 1982). Graphs depicting mean (SEM) results were constructed to ascertain population density at various time intervals.

RESULTS AND DISCUSSION

This research was conducted in a citrus orchard in the Rabat district to examine the efficacy of synthetic insecticides neem seed extract to combat *Diaphorina citri* in year 2020. Figure 1 indicated that the highest density of population of citrus psylla was noted on Sample 1, Tree 3, followed by Tree 2, while Trees 1 along with 4 exhibited similar densities; the lowest density was noted on Tree 5. The bar chart indicated that sample 2, which exhibited high density of population on Tree 1, was consistent in its ranges compared to Trees 2, 3, and 4, while Tree 5 recorded the lowest density. The current bar chart demonstrates that in the sample, tree 1 exhibited the highest citrus psylla population, followed by tree 2 and tree 4, while tree 3 had a lower population; additionally, the least citrus psylla population was observed on tree 5. Figure 1 indicates that the highest population was detected on trees 1 and 3, followed by tree 2, while the lowest was on tree 5.

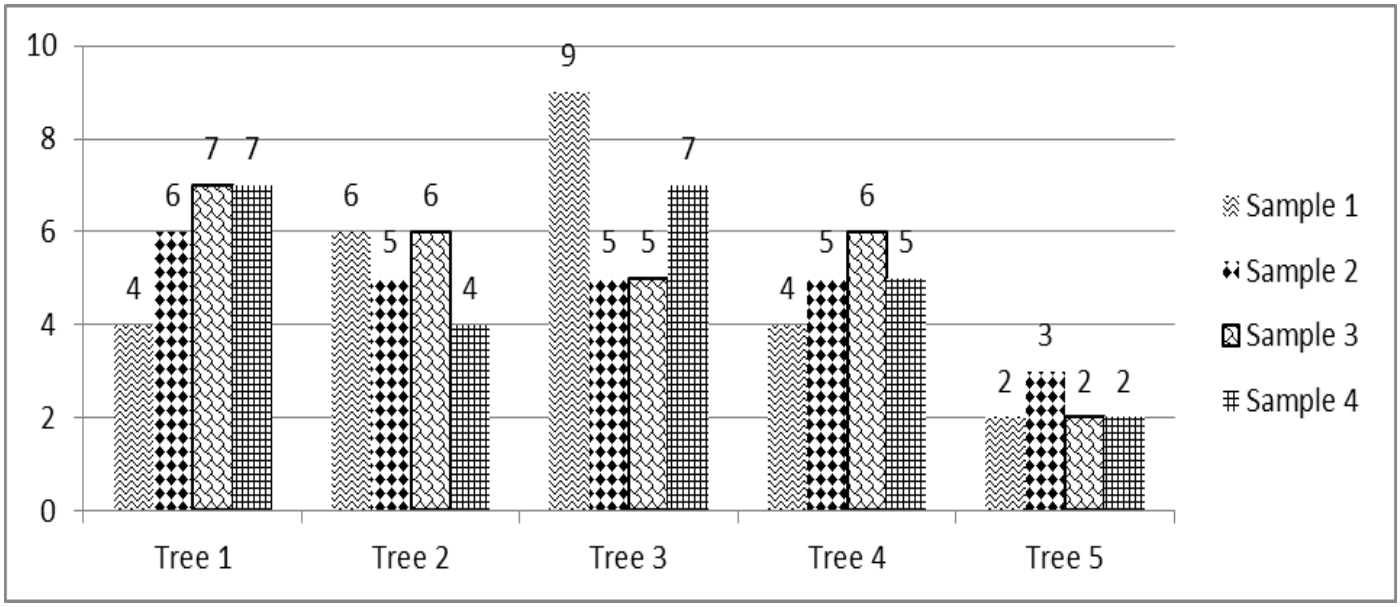

Figure 1. *C. psylla* population before spray.

Following a 24-hour treatment, the *C. psylla* population was depicted in Figure 2. The various compounds that are effective against C. psylla were shown in the current bar graph. Cypermethrin, indoxacarb, and bifenthrin all demonstrated comparable effects on the *C. psylla* population, as the bar chart demonstrated. The Neem samples exhibited slight toxicity to C. psylla in samples 3 and 4, whereas samples 1 and 2 were comparable, both at 1% concentration. In addition, sample 2 had the highest in-control citrus psylla population, followed by the other three samples.

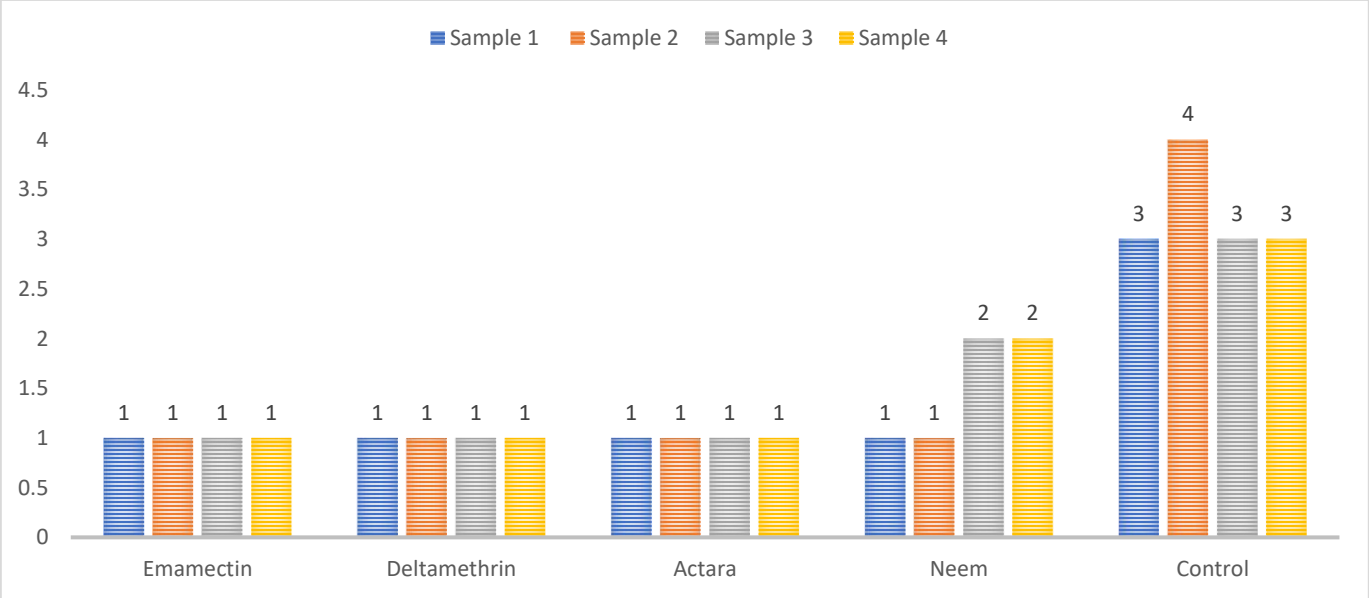

Figure 2. *C. psylla* population after 24 hours of spraying.

Figure 3 presented the data on various chemicals' effects on the population of *C. psylla* after three days of application. The bar graph demonstrated that indoxacarb , cypermethrin, and bifenthrin were present in equal proportions (1%), while Neem, sample 1 and 2 exhibited identical values (2%), and sample 3 and 4 were also comparable (1%). The bar graph also includes a sample 2 with a control at the highest position, followed by sample 4, then sample 1, while samples 3 and 1 were parallel to each other (2%).

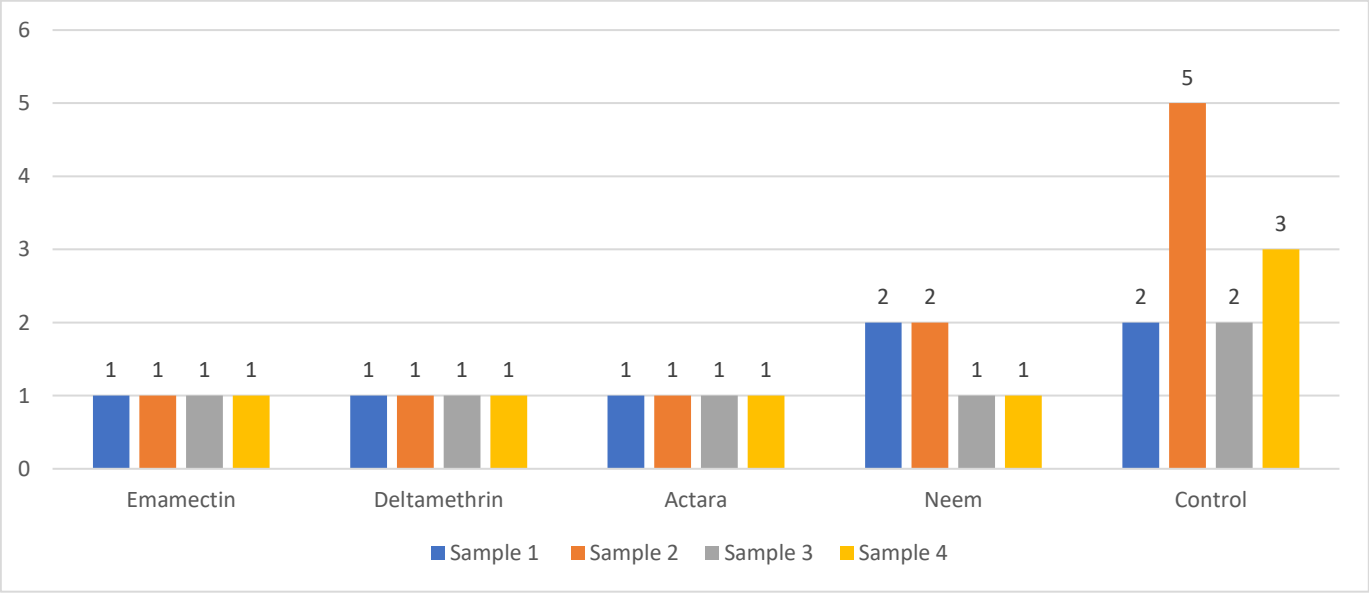

Figure 3 *C. psylla* population after 3 days of spraying.

Figure 4 illustrated that the bar chart indicated cypermethrin, indoxacarb, and bifenthrin were equivalent in proportion (1%), followed by Neem. Sample 1 was at the top, while the remaining three samples were identical in range (1%). Figure 4 also examined that the control exhibited the highest citrus psylla population in samples 2 and 4, followed by sample 3, while sample 1 recorded the lowest population (Figure. 4).

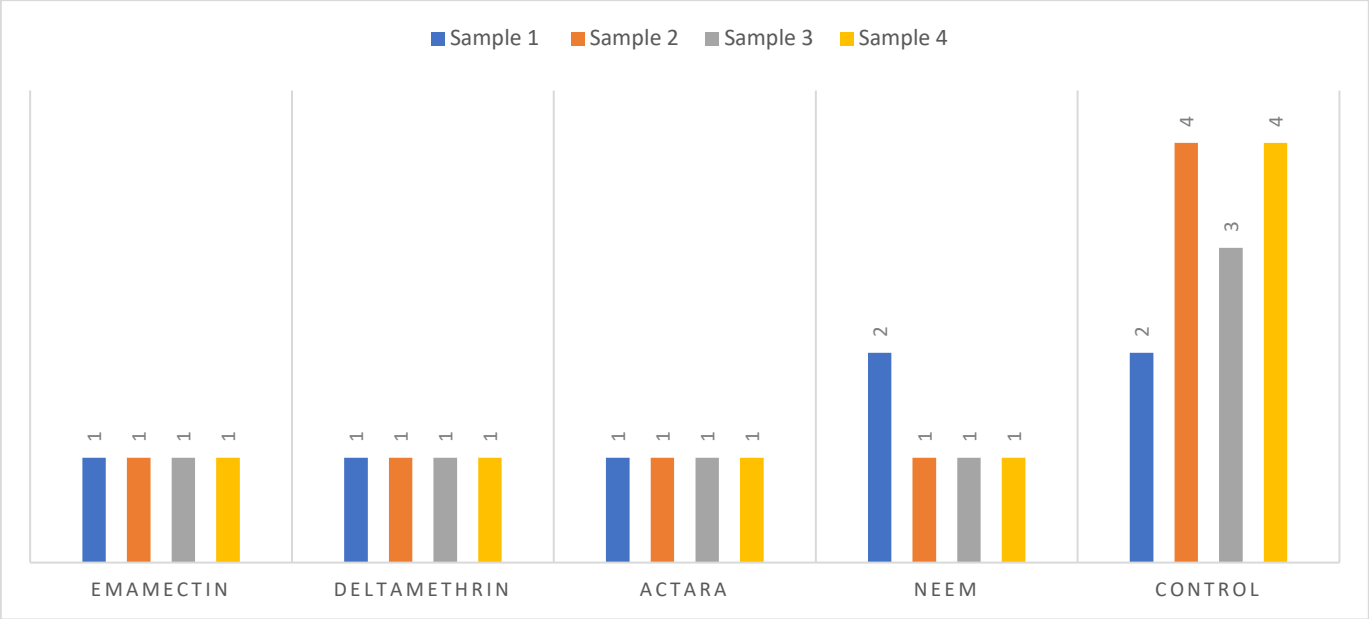

Figure 4. *C. psylla* population after 7 days of spraying.

Figure 5 demonstrated that cypermethrin, indoxacarb, and bifenthrin were present in equal proportions (1%), alongside Neem, sample 1, sample 2, and sample 3, which also exhibited the same ratio (1%), while sample 4 recorded a concentration of 2%. The bar graph also includes a control, with sample 4 at the highest position, followed by samples 3 and 2, which exhibited identical values, while sample 1 displayed the lowest population.

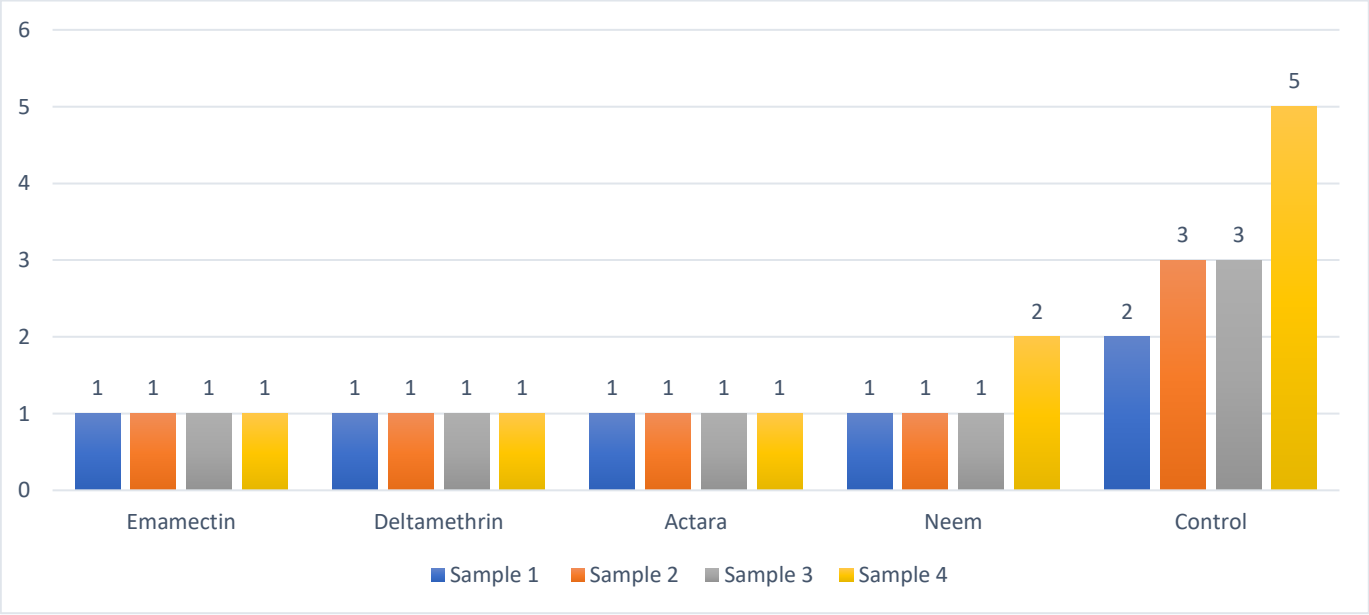

Figure 5. *C. psylla* population after 15 days of spraying.

Figure 6 indicated that the citrus psylla population in samples 1, 2, 3, and 4 was recorded at 1%, 1%, 1%, and 1%, respectively, on cypermethrin. The bar graph indicated that the sample 4 exhibited the highest levels of indoxacarb, whereas samples 1, 2, and 3 displayed the lowest levels. Bifenthrin exhibited consistent levels across all samples. The

figure indicated that the Neem population peaked in sample 3, while the remaining samples exhibited identical numbers (1%). Samples 2 and 4 exhibited the highest levels in the control, while the lowest population was recorded in samples 1 and 3.

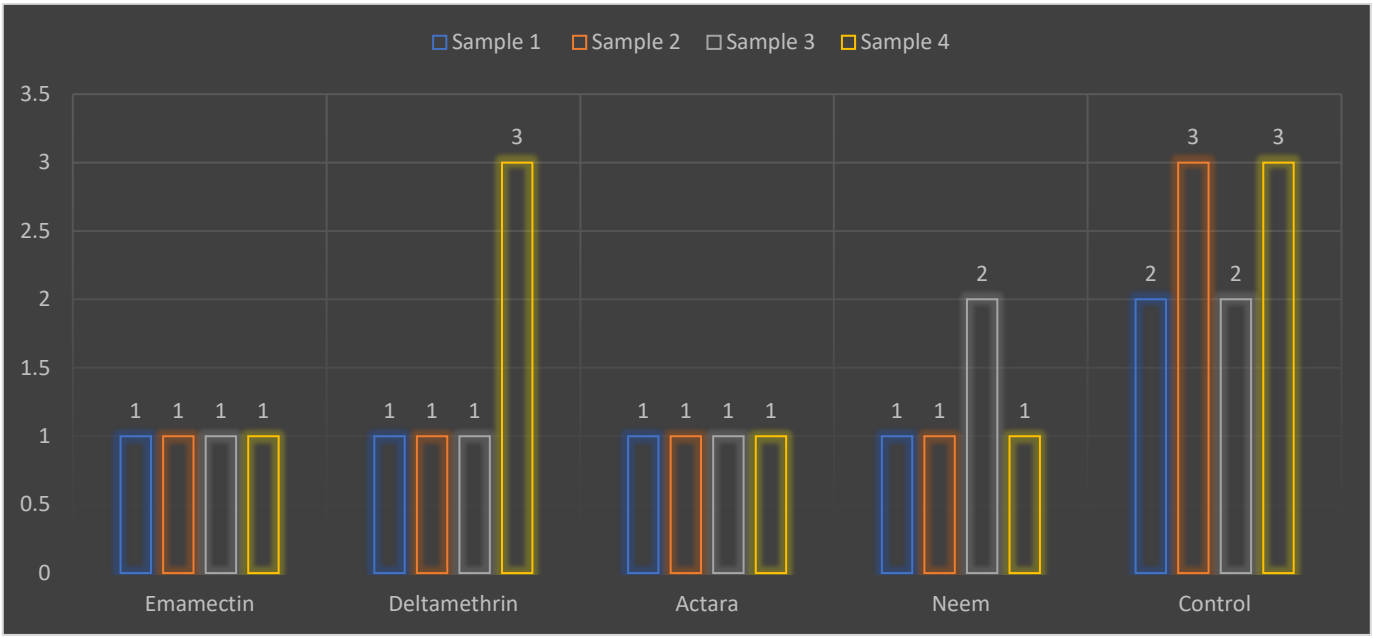

Figure 6. *C. psylla* population after 1 month of spraying.

The citrus psylla population was found to be 1%, 1%, 1%, and 1% in all bifenthrin and cypermethrin (1, 2, 3, and 4) samples, as illustrated in Figure 7. Indoxacarb was administered at concentrations of 1%, 1%, 1%, and 3% in samples 1, 2, 3, and 4, respectively. The graph indicates that sample 4 exhibited the highest level of toxicity, whereas samples 1, 2, and 3 demonstrated lower toxicity levels. The figure indicated that in the control group, the maximum population was noticed in samples 2 and 4, while the minimum population was noted in sample 1. Table 2 presents the mortality percentages of *Diaphorina citri* after exposure to various synthetic insecticides and botanical extracts over 24, 48, and 72 hours, highlighting significant differences in effectiveness between treatments.

Table 2. Influence of different synthetic insecticides and botanical extracts on Mortality (%) of (*Diaphorina Citri*). Orchid Rabat District Dir Lower.

Treatments	Doses	Mean % Mortality after		
		24 Hrs.	48Hrs	72Hrs
T1 cypermethrin	1.5-2ml/lit	34.50 a	63.78 a	80.00 a
T2 indoxacarb	3 ml/lit	32.52 a	62.12 a	80.00 a
T3 bifenthrin	5%	6.80 b	37.60 b	61.00 b
T4 Neem seed extract	5%	3.80 b	33.40 b	58.80 b
T5 tap water	Water	0.00 c	0.00 c	0.00 c
LSD		3.9075	4.4884	3.1566

Means followed by different letter (s) are significantly different from one another at (P≤0.05), using LSD test.

CONCLUSIONS

Citrus psylla is identified as a primary agricultural pest in Pakistan's citrus industry, necessitating the application of various chemical insecticides to control its population below threshold levels. Three insecticides and one herbal extract were evaluated for controlling the growth of *D. citri* in the orchard. Bifenthrin was demonstrated to be superior to cypermethrin, indoxacarb, and Neem seed extract; additionally, the efficacy of bifenthrin and the herbal extract was evaluated in the field, where bifenthrin outperformed the herbal extract. It is recommended that applications be

conducted regularly during specific seasons based on ecological circumstances; otherwise, the population may exceed the economic injury threshold, rendering administrative methodologies ineffective.

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Not available

AUTHOR CONTRIBUTIONS

All the authors contributed equally to this research

COMPETING OF INTEREST

No conflicts of interest have been disclosed by the authors.

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