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COMPARISON OF BIOPESTICIDES AND SYNTHETIC INSECTICIDES AGAINST CITRUS PSYLLA (*DIAPHORINA CITRI*) IN CITRUS ORCHAD RABBAT DISTRICT DIR LOWER

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A B S T R A C T

The research was conducted at Citrus Orchard, Rabbat district Dir Lower to examine the impact of neem seed extract biopesticides and synthetic insecticides on *Diaphorina citri* in 2020. Biopesticides acts as active chemical against antifungal and insecticides which control stress of pathogen and biotic stresses in harvest stage of fruits. The experiment consisted of five treatments neem seeds extract, cypermethrin, indoxacarb, bifenthrin, and a control. Five plants were chosen in citrus orchard with was divide into four sections followed by complete design RCB. Five leaves were sampled from each branch and the selected pesticide provided faster and effective control compared to botanical extract. During the study, cypermethrin, indoxacarb, bifenthrin, and neem seeds extract were used against *Citrus psylla*, while the control plants were left untreated for comparison. The results showed that among all the tested chemicals like cypermethrin, bifenthrin, indoxacarb including the botanical extract. The result showed that bifenthrin was found to be the most effective in controlling the pest, followed by indoxacarb, cypermethrin, and the botanical extract of neem seed. According to study that highest population density was recorded in tree1 as compared to tree 2 while lowest in tree 5. *C. psylla* observed after the 24 hours of treatment showed similar effect while the neem extract was lit bit toxic compared to other biopesticides. The *C. psylla* after the treatment of 3 days showed that the cypermethrin, indoxacarb and bifenthrin was same in ratio (1%) as follow by Neem, sample 1 and sample 2 was same in numbers (2%) than sample 3 and sample 4 was similar too (1%). Additionally, the field experiment confirmed the superiority of bifenthrin over the botanical extract.

Keywords: Citrus psylla, Botanical extract, Pesticides, Citrus pests, Pakistan.

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INTRODUCTION

Pakistan produces more than 30 types of different fruits in which citrus fruit industry is leading among all fruit and constitutes about 30% of the total fruit production in country. It is estimated in Punjab that 90% of citrus fruit produces value chains in domestic as well as in international markets. About 10-12% is mostly consumed locally without much value addition (Siddique and Garnevska, 2018). Citrus fruit industry is ranked 1st among all fruits in term of area and national production (Mahmood et al., 2014). Climatic conditions of Pakistan are susceptible to quality production of citrus (Naz et al., 2014).

In Pakistan, agro-climate is best suited for fruit production; especially the Indus plains are very well suited to grow fruits. Pakistan is producing a large variety of fruits on a large area of 746628 hectares with a total production of 6963577 million tones (GOP, 2018). In Khyber Pakhtunkhwa area under cultivation of fruit is 81359 hectares and production

was 721,926 tons (CRS-KP 2018-19). Citrus is one of the major fruits grown in Pakistan. It is an important source of vitamins and minerals in addition to carbohydrates, which are essentially needed for human health. A citrus fruit has been reported to prevent liver, lungs, and skin cancers; heart diseases; and birth defects and contributes to a balanced and healthy lifestyle (Ghirdharilal, 2000). Biopesticides produced from living organisms plants, animals, and microorganisms to control the protection against damaging pathogens by nontoxic, Eco-friendly mechanism of action.

They are effective in low quantity and no residual effects. The biopesticides are effective, biodegradable, non-toxic, different mode of action and available raw materials (Neeraj *et al*., 2017). Citrus fruits possess antimicrobial, anti-inflammatory, analgesic, anti-diabetic, reproductive, gastrointestinal, immunological, and many other pharmacological effects (Al-Snafi, 2016). Citrus fruit is a good source of vitamin C, Vitamin B and Phytochemicals such as flavonoid, carotenoids and limonoids. It also plays a vital role in health improvement due to antioxidant properties and its ability to convert into vitamin A and protects from chronic diseases (Liu et al., 2012).

Citrus psylla (Diaphorina citri kuwayama) (Homoptera: Psyllidae) is the most devastating and important insect pest of citrus cause heavy losses to citrus orchards through the greening disease of citrus being a viral vector (Hall et al., 2013). They lay eggs singly or in batches on the inner surface of the plants. The pest completes 9-10 or even up to 16 overlapping generations in a year. Both nymph and adult suck the cell sap from newly emerged leaves as a result the leaves die. Both the quality and quantity of fruits are affected by *D. citri* attack. Management included different control measures like insecticides, botanicals, and insect growth regulators (Khan et al., 2013). Application of these control measures against *Citrus psylla*, were recommended at 10-15 days intervals (Shivankar et al., 2000). The population of *C. psylla* fluctuates in relation to the temperature and relative humidity. *C. psylla* peaks twice a year, which coincides with the periods of citrus flushing in the spring and summer.

In this study chemical control measures by spraying insecticides Cypermethrin, Indoxacarb, Bifenthrin, and botanical pesticide such as neem oil were compared against *C. psylla*.

MATERIALS AND METHODS

Study Area

The present research work was carried out at citrus Orchard, Rabat District Dir lower to study the effect of Neem Seeds Extract and Synthetic Insecticides against *Diaphorina citri* during 2020.

Field Experiment

Research study was conducted to determine the efficacy of chemical and botanical extracts during year 2020.

Experimental Procedure

The experiment was laid out in Randomized Complete Block Design (RCBD) which was consisted of five treatments including control. Each treatment was replicated three times. Synthetic chemical along with their recommended doses is the followings. Following treatment were used to spray the plants at field recommended dose

T1: Cypermethrin+arrive (10EC) 35ml/litre

T2: Indoxacarb +Steward (150EC) 0.5ml/Litre

T3: Bifenthrin +biflex (60EC) 2ml/litre

Synthetics Insecticides

Arrive 10 EC, (Cypermethrin), Steward 150 EC (Indoxacarb), Telstar 10 EC (Bifenthrin) were used as chemical control. All insecticide formulations were prepared according to recommendations rate

Pesticide Formulations

To calculate the required amount of chemical insecticide, blank spray was done before spraying. Three insecticides i.e. Cypermethrin @3ml/L, Indoxacarb@.5ml/L, Bifenthrin @2.5/L, and botanical extract 90g/3litres (Neem Seeds Extract) were sprayed on each tree (West, North, East and South), respectively. Data were recorded on 1 day, 3 days, 7 days, 15 days, 30 days intervals after the spray. Five plants per treatment were selected and sprayed. Each treatment was replicated three times.

Preparation of Plant Extracts (Neem)

Neem seeds were obtained from local market and then seed covers were removed for further processing. Extract was prepared by mixing 90gm powder in water in a conical flask to make the final volume of 1L. Solutions for field application (5% concentration) were prepared from the stock solution (Munir, 2006; Mochiah et al., 2011; Fiaz et al., 2012). During the entire experiment, 12 sprays were applied at interval of 7 days using knapsack sprayed. Control plots were sprayed with tap water. The spray machine and other tools were thoroughly cleaned for each treatment preparation application.

Synthetic Insecticides Preparation Process

The chemical insecticides were kept from local market and spray solutions were prepared for foliar application according to their recommended doses with the help of electric balance and graduated cylinder.

Data Collection

For data collection the treated plants were selected and each

plant was divided into four sides (North, West, South, East), and then took sample of 5 leaves per branch and tagged them on each side. The plants were thoroughly checked. The data of citrus psylla was recorded on five leaves of each branch of the selected side of the plants before spray and after the spray at regular inspection time periods. In order to study the population density of natural enemies of canola crop will be recorded on weekly base four times in a month.

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

Statistical Analysis

The recorded data was analyzed by STATTISTIC-8.1 and means were separated at alpha 5% after the application of LSD. Graphs with mean (SEM) values were drawn to determine population density at different time intervals.

RESULTS

The present research work was carried out at citrus Orchard, Rabat district lower Dir to study the effect of Neem Seeds Extract and Synthetic insecticides against *Diaphorina citri* during 2020. The figure 1 showed that maximum of *citrus psylla* population density was recorded on sample 1, Tree 3 as follow by Tree 2 than tree 1 and tree 4 were similar in ranges while the minimum observed on tree 5. Similarly, the particular bar chart also showed that the sample 2 on which high population density were investigated on Tree 1 than tree 2, tree 3 and tree 4 was same in the ranges while the lowest recorded on tree 5. The current bar chart proof that on the sample 3 extreme of *citrus psylla* population noted tree 1 as follow by tree 2 and tree 4 than tree 3 beside this slightest population of *citrus psylla* were observed on tree 5. Figure 1, indicated that maximum of population was observed on tree 1 and tree 3 than tree 4 as follow by tree 2 while minimum on the tree 5.

Figure 2 showed population of *C. psylla* after 24-hour treatments. The current bar graph indicated the different chemicals against *C. psylla*. The bar chart showed that the different chemical (cypermethrin, indoxacarb and bifenthrin) showed similar result against the *C. psylla* population. As follow by Neem were showed a bit toxic to the *C. psylla* in sample 3 and sample 4 while sample 1 and sample 2 were similar in range (1%). Beside these the in-control maximum of citrus psylla population were noted on sample 2 followed by the rest 3 samples.

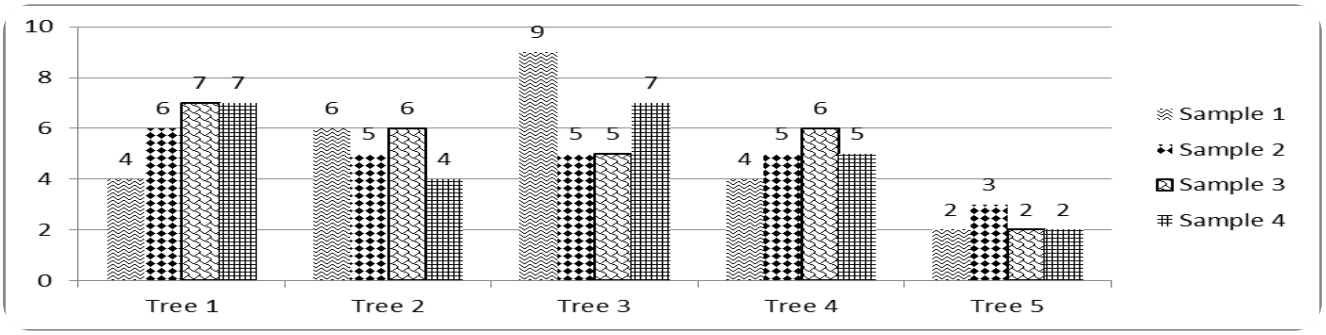

Figure 1: *C. psylla* population before spray.

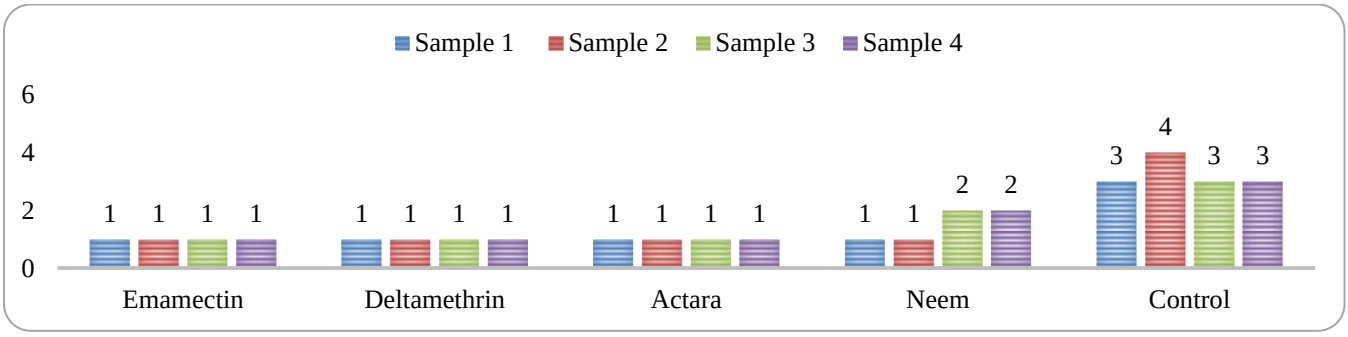

Figure 2: *C. psylla* population after 24 hours of spraying.

The figure 3 contained the data of different chemical toward *C. psylla* population after 3 days of sprayed. The particular bar graph indicated that the cypermethrin, indoxacarb and bifenthrin was same in ratio (1%) as follow by Neem, sample 1 and sample 2 was same in numbers (2%) than sample 3 and sample 4 was similar too (1%). The bar graph

also contain control in which sample 2 was on the top follow by sample 4 and sample 1 and sample 3 was parallel to the each other (2%).

Figure 4 showed the underneath bar chart visible that cypermethrin, indoxacarb and bifenthrin was same in ratio (1%) as follow by Neem, the sample 1 was on the top and the rest 3 sample were same in rage (1%). The Figure 4 also investigated that the control, in the control maximum of citrus psylla population were noticed on sample 2 and sample 4 as follow by sample 3 while minimum on sample 1 (Figure 4).

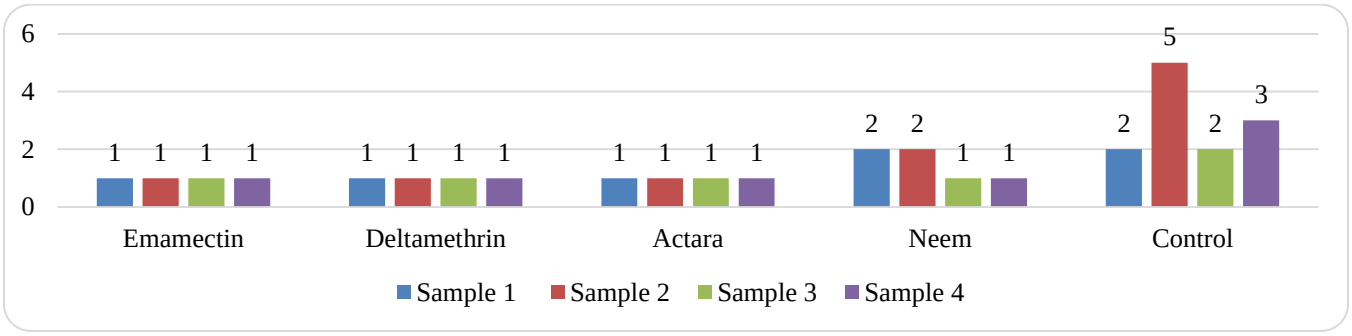

Figure 3: *C. psylla* population after 3 days of spraying.

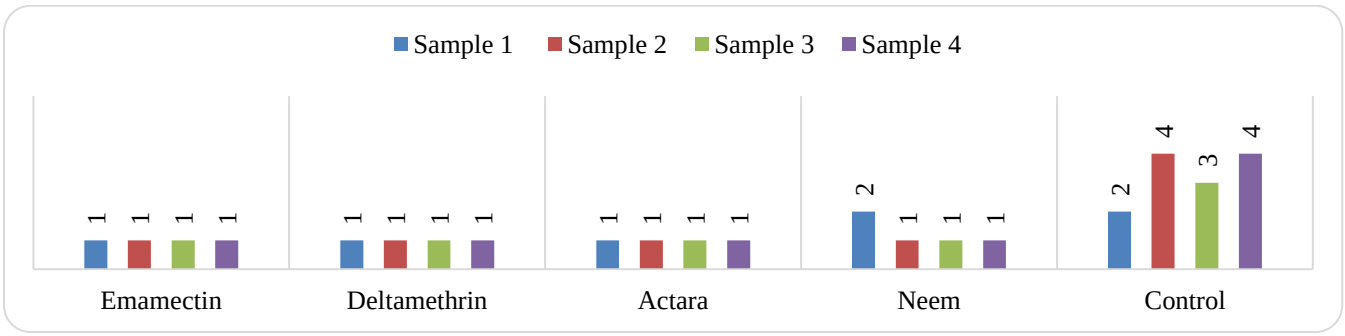

Figure 4: *C. psylla* population after 7 days of spraying.

The figure 5 showed that cypermethrin, indoxacarb and bifenthrin was same in ratio (1%) as follow by Neem, sample 1, sample 2 and sample 3 were same in ratio (1%) and sample 4 recorded 2%. The bar graph also contain control in which sample 4 was on the top as follow by sample 3 and sample 2 same in number while minimum population was noticed on sample 1.

Figure 6 showed that the population of citrus psylla on sample 1, sample 2, sample 3 and sample 4 was recorded (1%, 1%, 1% and 1%) respectively on the cypermethrin. The bar graph also showed that the sample 4 was on the top in indoxacarb while the bottom population was noticed on sample 1, sample 2 and sample 3. Beside these bifenthrin was same in ranges in all samples. The figure showed as well the Neem, maximum of population was recorded on sample 3 and the rest sample was same in numbers (1%). Sample 2 and sample 4 was on the top in the control and minimum of population were observed on the sample 1 and sample 3.

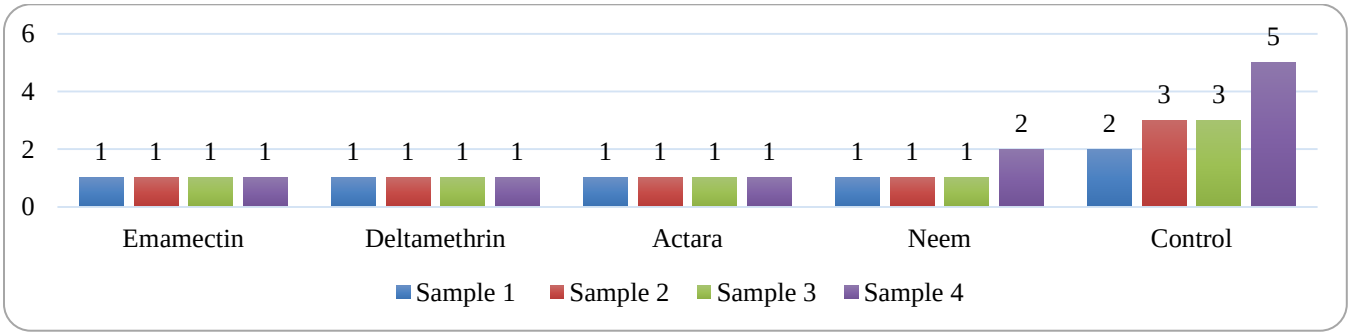

Figure 5: *C. psylla* population after 15 days of spraying.

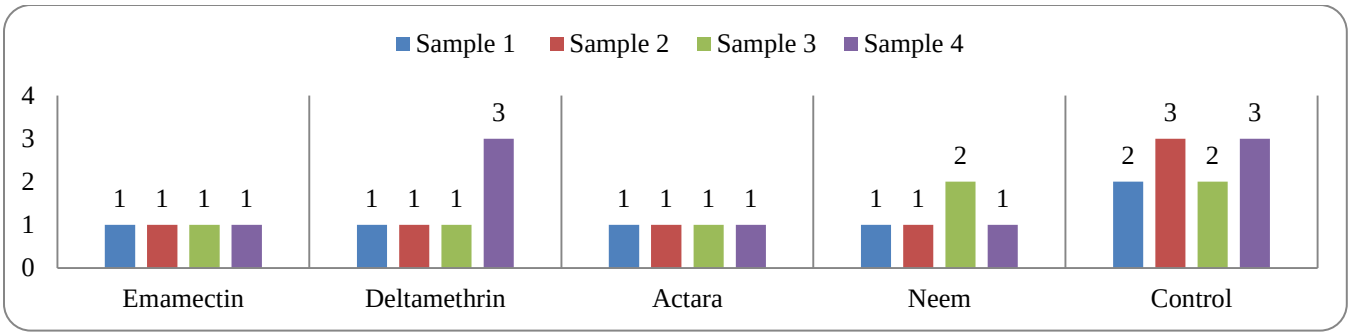

Figure 6: *C. psylla* population after 1 month of spraying.

Figure 7 showed that the population of citrus psylla in all samples of cypermethrin and bifenthrin (1, 2, 3 and 4) was recorded (1%, 1%, 1% and 1%) respectively. As follow by indoxacarb (1%, 1%, 1% and 3%) in sample 1, sample 2, sample 3 and sample 4.

Than the graph also containing data about Neem, the maximum of toxicity was showed by sample 4 while the less toxicity was showed by sample 1, sample 2 and sample 3. The figure indicated too control, the maximum of population was observed in control of sample 2 and sample 4 while the minimum of population was observed by sample 1.

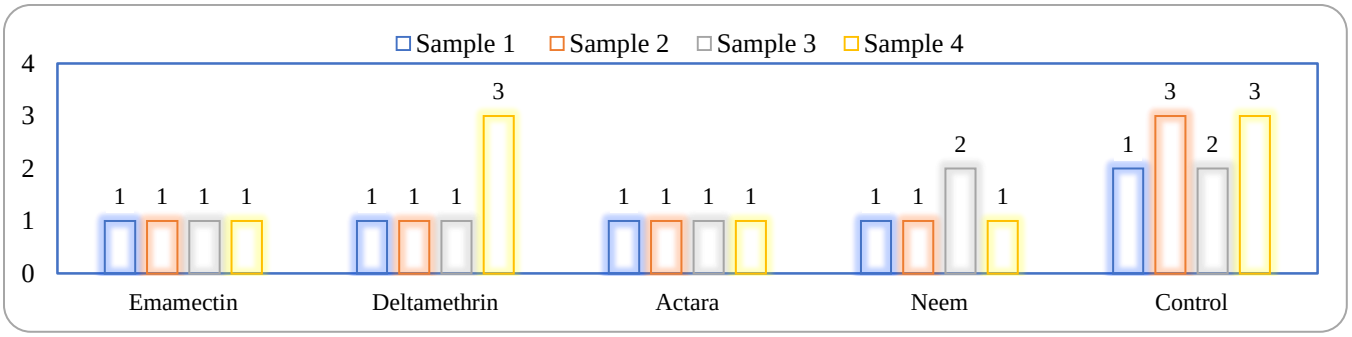

Figure 7: Comparison of *C. psylla* population after more than 1 month of spraying.

DISCUSSION

Different kinds of pests are present in citrus industry which produces 25 % yield losses and Asian citrus psylla has a major share more than 80% lose in this industry. The Asian citrus psylla was firstly reported in Tiawan and then in Indo Pakistan with wide distribution in Asian countries. It produces defoliation by sucking of cell sap with a fatal disease called citrus greening (Khan et al., 2015). The chemical substances used to control pests are called as pesticides. The loss of food is on upward scale in third world countries. The loss of food is done during harvest, cultivation and post-harvest activities. Scientists are trying to develop different types of pesticides which have natural origin because the synthetic pesticides contain chemicals and non-biodegradable nature with toxic metals. These residues combine in water and food producing a great threat for human beings (Agboola et al., 2022).

Our study compared the effectiveness of synthetic pesticides and neem extract against each other and with control to kill citrus psylla on citrus plants. Our study concluded that both synthetic pesticides and bio extract of neem leaves was effective in controlling the number of pests. A significant difference was observed in the mortality of both pesticides and bio extract when compared to controls ($p<0.05$), as indicated in table 1. The results were similar to another study conducted by Ahmad *et al.* in 2018 that compared the effect of neem based biopesticide on control of Aphids and potato leaf hoppers. The study concluded that both neem oil and bifenthrin were significantly more effective than control to reduce the number of aphids and potato leaf hoppers (Ahmad et al., 2012).

When compared with each other, the SEM of % mortality of pests with Bifenthrin was significantly better than cypermethrin and indoxacarb as shown in table 1, ($p<0.05$). The results were similar to the research conducted by Qasim and Hussian (2014), who compared the efficacy of different synthetic pesticides against citrus psylla. He concluded that Bifenthrin was more effective than Polytrin-C and Actara. He found the lethal time of Bifentherin to be from 4-5 hours

at a concentration of 500ppm. However they did not find any difference in the efficacy of Bifenthrin and Iidacloprid, another synthetic pesticide. Another field experiment in Faisalabad found bifenthrin was better than lambdacyhalothrin for control of 2 major pests of okra (Qasim and Hussian, 2014).

Our study found the neem extract to be significantly better at killing *C. psylla* than cypermethrin and indoxacarb, denoting that neem can extract can be a potentially effective biopesticide against *C. psylla*. Similar results were obtained with the use of Neem oil against Aphids and potato leaf hoppers in Nowshehra, Pakistan (Shahzad et al., 2019). Different pesticides are getting less effective because of pests developing resistance. It is one of the factors that go against the use of synthetic pesticides favoring the use of biopesticides, besides the latter being environmentally better than the other one. A molecular study done by Chen *et al.* in 2018 in Florida found out a moderate to high resistance against thiamethoxam in *Citrus syllid*. However, No or very low resistance against bifenthrin denoting its superiority against imidacloprid and cyantraniliprole (Chen et al., 2018).

The strengths of our study included a Randomized complete block design and reactively long term follow up for assessment of pesticide effectiveness. Weakness of our study included the measurement at less frequent interval with the first measurement at 24 hours and using only one dose of pesticides. Further studies should be done to compare the effectiveness of other biopesticides and neem extract at different concentrations. Furthermore, toxic or harmful effects on the crops should also be evaluated.

CONCLUSION

It is concluded that the bifenthrin was to be the most effective in controlling the *C. psylla*, followed by indoxacarb, cypermethrin, and the botanical extract of neem seed. *C. psylla* population observed after the 72 hours of treatment showed that neem extract was lit bit toxic compared to other treatments. Our study found the neem extract to be significantly better at killing *C. psylla* than cypermethrin and indoxacarb, denoting that neem can extract can be a potentially effective biopesticide against *C. psylla*. However, the field experiment confirmed the superiority of bifenthrin over the botanical extract.

CONFLICT OF INTEREST

There is no conflict of interest.

AUTHOR'S CONTRIBUTION

All authors contribute equally.

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