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Anti-Whitefly Effect Using Maclura Leaf Extract as a Botanical Insecticide

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Abstract

For the purpose of studying the antibacterial effect of maclura leaves as an insecticide of plant origin against whitefly, a laboratory experiment was carried out using four concentrations of alcoholic extract of maclura plant, which were 0.5, 10, 1.5 and 2.0 g/l in controlling the whitefly in adults and nymph's phases. and through the results obtained from the experiment, which showed the concentration of 2 g/l was significantly superior to the other concentrations achieving a percentage killing rate of 91% in adult's phase and 95% in nymph's phase, in adult's phase. In this experiment, the number of live insects before spraying decreased from 100 insects to 9 insects after spraying after 72 hours, with an increase in the efficiency of killing rate over the other concentrations, amounted to 16.66%, 42.18% and 65.89%, respectively in adult's phase, while in nymphs phase the number insects decreased from 100 live insects before spraying to 5 live insects, while the lowest effects for the concentrations, it was to the concentration 0.5 g/l , which achieved the lowest rates in the relative killing efficiency rate compared to other concentrations were used in the experiment. Tests to detect the content of the plant extract from the active substances showed the presence of many compounds, including: tannins, glycosides, phenols, Resins, carbohydrates, saponins, alkaloids and terpenes. This study evaluated the efficacy of maclura plant extracts against whitefly and study impact of the plant extract on phases of life this insect also tested under experimental conditions.

1. Introduction

The use of chemical pesticides in combating economically harmful insects had a positive effect in reducing their damage and risks, and contributed to raising agricultural production at high rates and meeting the requirements of the growing global need for food. However, this expansion in the production and uses of chemical pesticides has led to many negative environmental and health effects, due to the high toxicity these pesticides contain and the merits of their long stay in the soil and plants, which leads to the possibility of poisoning with these pesticides either through direct exposure to them or through eating fruits and vegetables that have been contaminated. Insect control in it, as well as pollution of water sources, especially groundwater [1].

use of plant extracts in the process of producing safe and environmentally friendly insecticides was the most appropriate solution in the face of the dangerous effects caused by industrial chemical pesticides, as these pesticides are characterized by their longevity. The short time in the soil, which does not exceed twenty days, as well as its non-toxicity to humans and animals, in addition to its rapid oxidation in the soil due to heat, light and moisture [2].

On the other hand, the reduced stability of pesticide plants means that the health of consumers is at less risk due to reduced exposure to bioactive compounds from plants that degrade into harmless natural products unlike synthetic pesticides that continue to remain on plants for weeks or in the soil for months or years. This means that crops can be harvested without the risk of residue remaining due to the rapid decomposition of naturally occurring compounds when exposed to UV radiation and soil/water microorganisms. another benefit for small holder farmers is that it allows production to higher value organic markets and for export [3, 4].

Also, the high content of the plant of active substances such as alkaloids, flavonoids and phenols, is the reason for making these active substances in the plant more harmful and toxic to the target insects of various kinds through two types of poisoning: infectious poisoning and contact poisoning, as contact poisoning has the ability to penetrate from through the outer cover of the insect or the shell of its eggs to reach the inner tissues, and some of the latter reaches through the external respiratory openings [5]. As for the infectious poisoning pesticides, they are the pesticides whose effect occurs after the insect eats it in its food. Moreover, it has not been shown that the insect strains have shown resistance against the action of the natural pesticide. The main reason for it is due to the fact that the compounds and complexes in plant materials give an electoral pressure with multiple factors, which in turn reduce the development of resistance in insects, as they inhibit and reduce the effectiveness of their immune system, which contributes to combating and killing them [6].

The white fly *(B.tabaci*) has several characteristics and capabilities that made it a dangerous pest in cropping systems, among which its large number is specialized in attacking multiple types of economic agricultural crops and a large number of wild plants, which number about 600 plant families that include various types of grain and vegetable crops. Fruit trees, vegetables, ornamentals and industrial crops, in addition to their great ability to mate and produce huge numbers of flies during one season, where one pair can produce 184 insects per generation under temperatures up to 29 degrees Celsius, and the whitefly is characterized by its high ability to absorb plant juice Without stopping, even if she lays eggs or mates, as she does not leave her host except in the event of the death of the fly or the death of the host [7, 8].

The Maclura tree, *Maclura pomifera*, belongs to the mulberry family Moraceae, native to North America and Eurasia. It is a distinctive tree with its large green and spherical fruit that resembles an orange, its diameter ranges from 8-14 cm and it is greenish-yellow containing inside it a large number of spindle-shaped seeds. The height of the tree is from 7-20 m. Its leaves are deciduous, oval, dark green, tapering at the top with full edges, and it is drought tolerant. Its flowers are white and its bark is coppery with straight slits. It is also considered a bi-dwelling plant and its branches have thorns, and there are no dangerous diseases or pests that affect it [9]. It also has many benefits and uses, especially in the field of medical preparations to treat various diseases such as gout, rheumatism and arthritis, as well as skin diseases, in addition to its use as insecticides [10].

Several experiments were carried out to study the effect of plant extracts in controlling the whitefly, including [11], indicated that the use of 10% alcoholic extract of al-Masbahah in the control of aphids when calculating the death rates after 24 and 48 hours achieved a killing rate of 66.6 and 100%, respectively, compared to the extracts of castor and zig plants, which had killing rates of 83.33 and 76.60%, respectively, and at the same time dates.

In an experiment to study the effect of several aqueous and alcoholic extracts of some plants in controlling the whitefly, [12] found that the use of a concentration of 10 mg / ml from alcoholic extract of Al-Saad plants reduced the rate of infestation with this insect by about 36.3% and 33.3%, respectively.

Taaban (2022) found that the use of alcoholic Moringa extract in the control of whitefly and aphids with concentrations of 0.5, 1, 2, and 3% achieved significant results with a killing rate of 95% and 91% for whitefly in the nymphs and adults, while the killing rate of aphids at the same phases were 93 and 90% for all both [13].

Lafta (2017) found that when studying the evaluation of the efficiency of water extracts of yarrow, eucalyptus and henna in combating an insect from the faba bean, the aqueous extract of the plant outperformed the other species, achieving the highest death rate of 90% ,96% and 99% when treating first-stage nymphs at a concentration of 15 mg / ml after 24 and 48 hours, respectively [14]. Plant extracts are safe, eco-friendly and more compatible with environmental components compared to synthetic pesticides and this study supports use pant extract as insecticide.

2. Experimental Procedure

The alcoholic extract of the maclura plant was prepared by some steps that included in the beginning collecting the leaves of plant, from the botanical complex in the national park of the Ministry of Agriculture and classified by the Iraqi National Herbarium Department of the Ministry of Agriculture. It was dried after being cleaned in laboratory conditions and ground with an electric mill, using the method followed by [15, 16], as 20 g of leaf powder was placed separately in a thimble extraction tube and then placed in a soxhelt extractor, then adding 200 ml of 70% ethyl alcohol for 24 hours and then the sample was concentrated in a rotary evaporator at a temperature not exceeding 70 degrees Celsius. the sample was kept in the refrigerator until use.

The plastic Petri dishes in size (9 mm) were prepared and a filter paper moistened with distilled water was placed inside each of them, then plant leaves were placed on them and each dish was sprayed with the concentrations used in the experiment separately, which are 0.5, 1, 1.5, and 2 g/l. The control treatment was sprayed with distilled water and then the insects were transferred to the dishes at a rate of 20 insects in each plate and in 5 dishes for each treatment. The experiment was repeated at a rate of 3 times for each concentration of the plant extract. The dishes were left in the laboratory at a temperature of 25 ± 1 ℃ and a relative humidity of 60 + 10. The percentage of deaths was calculated after 24, 48 and 72 hours of treatment. The percentages of deaths were corrected according to the equation of orell and Schneider to the following equation [17]:

$$\textbf{The corrected mortality precentage} = \frac{A-B}{100-B} \times 100$$

Where A: The mortality precentage of treatment, B: The mortality precentage of precentage of control treatment.

Detection of Active Ingredients

A set of qualitative disclosures was conducted to identify the chemical components in the extracts of the maclura plant, where many effective compounds were found, the details of which are listed in Table (1). The active substances in the extract of the leaves of the maclura plant were detected by chemical method and according to the methods were used in [18, 19, 20].

Statistical Analysis

The design of the randomized complete sectors RCBD was followed with three replications in distributing pesticides treatments and the least significant difference test L.S.D was adopted to ensure the significance of differences between the rates of different treatments under the 0.05 probability level to compare the results. The statistical analysis program spss was used to analyze the experiment and results data.

Table (1). the content of the alcoholic maclura extract of the active substances.

Maclura plant	
The result	Detection type
+	Tannins
+	Carbohydrates
+	Glycosides
+	Phenols
+	Resins
_	Flavonoids
+	Saponins
+	Alkaloids
_	Protein
_	Coumarins
+	Terbines
_	Steroids

3. Results and Discussion

The results are shown in Table (2) when studying the effect of using four alcoholic concentrations of maclura plant extract in the control of the whitefly insect, the concentration of 2 g/l achieved the highest killing rate for the target insect, at a rate of 91 insects and after 72 hours of treatment with this concentration of maclura plant extract, as this extract had a gradual toxic effect with the passage of time, when decreased The number of insects from 100 insects before spraying (control treatment) to 49 live insects after 24 hours, 26 live insects after 48 hours, and only 9 live insects after 72 hours of treating the insect with this plant extract**.**

The results showed statistically that the concentration of 2 g/l was significantly superior to the other three concentrations used in the average percentage killing rates, in addition to the killing rates of the targeted insects over time with an increase of percentages amounting reached to 16.66%, 42.18%, and 65.89%, respectively, for the concentrations of 0.5, 1, and 1.5 g/l.

Table (2). Effect of alcoholic maclura extract in controlling whitefly adults (*B.tabaci*).

Concentrations gm /l	Number of insects before spraying (control)	Number of dead insects after 24 hours	Number of dead insects after 48 hours	Number of dead insects after 72 hours	Kill percentage
0.5	100	15	35	58	58
1	100	27	52	64	64
1.5	100	39	63	78	78
2	100	51	74	91	91
L.S.D 0.05	10				

The results are shown in Table (2) when studying the effect of using four alcoholic concentrations of maclura plant extract in the control of the whitefly insect, the concentration of 2 g/l achieved the highest killing rate for the target insect, at a rate of 91 insects and after 72 hours of treatment with this concentration of maclura plant extract, as this extract had a gradual toxic effect with the passage of time, when decreased The number of insects from 100 insects before spraying (control treatment) to 49 live insects after 24 hours, 26 live insects after 48 hours, and only 9 live insects after 72 hours of treating the insect with this plant extract**.**

The results showed statistically that the concentration of 2 g/l was significantly superior to the other three concentrations used in the average percentage killing rates, in addition to the killing rates of the targeted insects over time with an increase of percentages amounting reached to 16.66%, 42.18% and 65.89%, respectively, for the concentrations of 0.5, 1, and 1.5 g/l.

The results also showed that the concentration of 1.5 g/l in turn achieved a significant superiority over the concentrations 1 and 1.5 g/l in control treatment and the rate of killing efficiency with an increase rate of 21.18% and 34.48%, respectively. The results also showed that the concentration of 0.5 g/l achieved the lowest results in the use of the plant extract in controlling the whitefly, with a killing percentage of 58% compared to the other concentrations that achieved higher killing rates than this concentration.

Table (3). Effect of alcoholic maclura extract in controlling whitefly nymphs (B.tabaci).

Concentrations g/l	Number of insects before spraying (control)	Number of dead insects after 24 hours	Number of dead insects after 48 hours	Number of dead insects after 72 hours	Kill Percentage %
0.5	100	25	38	5°	5°
1	100	30	57	69	69
1.5	100	42	67	80	80
2	100	55	83	95	95
L.S.D 0.05	7.4				

The results in Table (3) indicate that the concentration of 2 g/l achieved the best results for the use of alcoholic maclura plant extract in controlling the whitefly nymphs that represent the pre-transformation stage to adults, as this concentration achieved a killing rate reached to 95% after 72 hours of spraying the botanical insecticide compared to the other concentrations that achieved lower relative killing rates of 80, 69 and 55%, respectively. This superiority in the relative killing rates of the insects targeted at the concentration of 2 g/l has achieved superior rates on the concentrations of 1.5, 1, and 0.5 g/l, which amounted to 18.75, 37.76, and 72.72%, respectively.

The results also showed in Tables (2 & 3) that the cumulative effect of killing increases with the time when treating the target insect with the plant extract. in the vital activities inside the body of the insect over time, which causes the occurrence of insect poisoning through the effect of the extract reaching the respiratory system, which leads to its disruption and the occurrence of cases of suffocation, in addition to the fact that the pesticide causes paralysis and slowness in the movement of the insect and on the first day. The toxic effect of the pesticide in combating the target insect may be attributed to the plant pesticide's containment of toxic active substances such as glycosides, phenols and alkaloids that penetrate the respiratory and nervous systems in the insect's body Which leads to her death later [21, 22].

4. Conclusions

The experiment concluded that the use of alcoholic maclura plant extract belonging to the mulberry family achieved an effective toxic effect in controlling the whitefly insect, and that the concentration of 2 g/l achieved the best results compared to other concentrations were used in the experiment. The results of this research showed the feasibility of using the extract of the maclura plant in the fight against sucking and piercing insects, which can constitute a key factor within the concepts of exploiting plant extracts, which are among the cheap, effective and environmentally friendly natural resources in the production of pesticides that contribute to the control of these harmful and dangerous insects and that it is possible to develop experiments that include the use of combinations of extracts of several plants, including local ones, with different concentrations in pest control, and within field experiments or in protected greenhouses.

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