Evaluation of the effectiveness of some components of the aqueous and alcoholic extract of black cumin Nigella sativa on the larvae and adults of the fruit fly Carpoomya Vesuviana

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Abstract

A laboratory experiment was conducted in the graduate studies laboratory at Al-Musaib Technical College in the Department of Biocontrol Technologies for year 2024-2025 on the effect of alcoholic and aqueous extracts of the black cumin plant and their effect on the stages of the pest Carpoomya vesuvius. The results of the study showed that the concentrations of the alcoholic extract (25%-50%-75%) of black cumin and the highest mortality rate of the adult insect for the black cumin extract reached 9.33 at a concentration of (75%), while the lowest mortality rate was 1.58 after a week of treatment at a concentration of (25%). As for the larval stage, the highest mortality rate was 6.58 at a concentration of (75%) and the lowest mortality rate was 1.17 at a concentration of (25%). As for the aqueous extract of black cumin, the highest mortality rate of the adult was 10.00 at a concentration of (75%), and the lowest mortality rate of the adult was 1.33 for the concentration (25%), while for larvae, the highest mortality rate was 6.22 also at the concentration (75%), and the lowest rate was 1.67 at the lowest concentration (25%), indicating the possibility of incorporating alcoholic and aqueous extracts of black cumin into bio control program to control the fruit fly, Carpoomya vesuvian, which infects fruit trees and reduce its damage.

Keywords: Carpoomya vesuvius, black cumin, Nigella sativa

Introduction

Jujube (Ziziphus spina-christi) is a plant belonging to the Rhamanaceae family. It is widely distributed in temperate regions, relatively dry lands, and warm-climate regions of the hemisphere, including Iraq [8]. Jujube is a blessed tree with many benefits. Its fruits are eaten because they are sweet and highly nutritious. It is considered a distinguished fruit, as every 100 grams of fresh fruit contains 80% carbohydrates (glucose and fructose), 0.9

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g of fat, 3 grams of iron, 140 mg of thiamin (B1), 0.13 g of riboflavin (B2), 3.7 mg of niacin (B3), and approximately 30 mg of vitamin C, the concentration of which varies depending on the ripeness of the fruit [6]. Jujube seeds contain 18.6% protein and 28.5% fat, and are rich in sulfur amino acids. Its leaves are rich in calcium (1270 mg) and iron (100 g) [9]. The jujube plant has received significant international attention as an underutilized fruit tree with a promising future [11]. The fruit fly (Ceratitus vesuvius) is one of the most dangerous pests affecting jujube trees, as it poses a challenge to its cultivation worldwide [10]. There are more than 4,000 species of fruit flies around the world, 250 of which pose a threat to agricultural production. Fruit fly species attack the fruits of many trees such as peaches, palm trees, jujube, citrus fruits, and many cucurbit vegetables [8], causing direct losses due to the females laying eggs inside healthy fruits, and indirect losses due to the entry of microorganisms that cause fruit rot. Pests are an important and determining factor in increasing jujube production, which necessitated the use of various chemical pesticides to limit their impact (Keier et al., 2020). However, the negatives associated with these materials and the resulting environmental risks, such as the emergence of resistance, the killing of natural enemies, and the occurrence of poisoning cases among control workers, forced researchers to search for environmentally safe alternatives. And for humans, biological enemies and animals (Shah et al., 2020). The research aims to study the effect of the aqueous and alcoholic extract of black cumin in controlling the larval and adult stages of the fruit fly Carpoomya Vesuvian.

Materials and Methods

1- Collecting and preparing the fruit fly (Carpoomya vesuvian) colony.

The insect colony was obtained by placing infected fruits in 50 ml plastic containers with a capacity of 5 cm and a height of 5 cm. The containers were tightly sealed with a piece of mallet and placed in an incubator at 25 ± 2 °C. After the larvae emerged, 10 larvae were placed in perforated plastic containers at the top for the purpose of treating with extracts. Three replicates were performed for each treatment, in addition to a control treatment for each concentration [4].

2- Collecting and preparing extracts from the black cumin plant (Nigella sativa)

2-1- Collecting and preparing samples of the black cumin plant (Nigella sativa).

Black cumin seeds were obtained from local markets in Babylon province/Al-Mahawil District. The seeds were ground in an electric grinder, turned into a fine powder, and placed in plastic bags in the refrigerator.

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2-2- Preparation of the alcoholic extract of Nigella sativa

[7] method was followed to prepare alcoholic extracts. 10 grams of dry powdered material from each of the seeds of the Nigella sativa plant was placed in a Soxhlet extractor. 200 ml of ethyl alcohol was added to the extract. The extraction process continued for 24 hours at a temperature of 45°C. The extracted sample, which contained the raw extracted plant materials, was concentrated. The process was repeated several times to obtain a sufficient quantity. The material was then dried in an electric oven at a temperature of 40-45°C. The dry residue was then placed in tightly sealed glass containers with a known weight and stored in the refrigerator until use. The basic solution was prepared by dissolving (5) grams of the crude alcoholic extract in (5) ml of ethyl alcohol with a concentration of (99.7)%, adding 3 ml of the spreading agent, Tween 20, and making up the volume to 100 ml with distilled water. The solution concentration became (5)%, or the equivalent of (50) mg/ml. From this, concentrations of (0.25, 0.50, 0.75)% were prepared. The control treatment was (5) ml of ethyl alcohol, and the volume was made up to 100 ml with distilled water. [2].

2-3- Study of the effect of different concentrations of the alcoholic extract of black cumin on the mortality of the larval stage of the fruit fly, Carpoomya vesuvian.

Ten larvae were placed in three replicates of the larval stage in perforated plastic containers for ventilation from the top. They were treated with concentrations of (0.25, 0.50, 0.75%) at 0.5 ml for all treatments and left to dry for 2 minutes, and then the previously prepared food was added. The control treatment was treated with distilled water and 5 ml of alcohol. These replicates were then transferred to an incubator at 25 ± 2°C, and the number of dead larvae was taken after (1, 3, 5, 7) days of treatment. [5]

2-4- Study of the effect of different concentrations of alcoholic extract of black cumin on the mortality of the fruit fly Carpoomya vesuvian.

10 larvae, three replicates of the larval stage and the adults, were placed separately in plastic containers perforated for ventilation at the top. They were treated with concentrations of (0.25, 0.50, 0.75%), each separately, at a rate of 0.5 ml for all treatments. They were left to dry for 2 minutes, and then the previously prepared food was added. The control treatment was distilled water and 5 ml of alcohol. These replicates were then transferred to an incubator at a temperature of 25 ± 2 °C, and the numbers of the deceased adults were taken after (1, 3, 5, 7) days of treatment. [5]

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2-5- Preparation of the aqueous extract of the black cumin plant (Nigella sativa)

The aqueous extract of the black cumin plant was prepared according to the method of [3], adapted from [7]. 10 grams of black cumin powder was taken and placed in a 500 ml glass beaker containing 200 ml of distilled water. The plant material was mixed in a magnetic mixer for 15 minutes, then left for 24 hours (to obtain better extraction) after tightly covering the container to avoid the entry of impurities. The solution was filtered using Whatman No. 1 filter paper, and the filtrate was placed in a centrifuge at 3000 rpm for 10 minutes to remove suspended matter. The filtrate was taken and placed in an oven at 45°C to obtain the dry residue, which was then stored in small, tightly sealed glass bottles. Record its weight when empty and store it in the refrigerator until use.

2-6- Studying the effect of different concentrations of aqueous extract of black cumin on the larval mortality of the fruit fly, Carpoomya vesuvius.

Ten larvae were taken for each concentration, with three replicates. The control treatment consisted of 10 larvae placed in each replicate of plastic containers, then sprayed with the extract at concentrations of (0.25, 0.50, and 0.75) mg/ml. The larvae were then fed with pre-prepared jujube fruit. The control treatment consisted of distilled water and 5 ml of alcohol. The number of dead insects was then counted after 1, 3, 5, and 7 days of treatment.

2-7 - Studying the effect of different concentrations of aqueous extract of black cumin on the mortality of adult individuals of the fruit fly Carpoomya vesuvius.

Ten larvae and ten adults were taken separately for each concentration, with three replicates, along with the control treatment. 10 larvae and 10 adults were placed in each replicate of plastic containers, then sprayed with the extract at concentrations of (0.25, 0.50, and 0.75) mg/ml, and fed with previously prepared jujube fruit. The control treatment was distilled water and 5 ml of alcohol. Mortality rates were then calculated after 1, 3, 5, and 7 days of treatment.

- Statistical Analysis

The results were analyzed using the statistical analysis program (Genstat 2015) using a completely randomized design (CRD) according to the factorial model. Significance was tested using the least significant difference (LSD) test. D) Least significant difference) at a probability level of 0.05 to indicate the significance of the result (Al-Rawi and Khalaf Allah, 2000). The percentage of insect mortality was calculated and corrected using the Abbott equation [1].

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Results and Discussion

1- Testing the effect of concentrations of alcoholic and aqueous extracts of black cumin on the larval stage of the fruit fly, Carpoomya vesuvian.

Alcoholic extract of black cumin for the larval stage. Aqueous extract of black cumin for the larval stage.

Table (1) indicates the effect of concentrations of alcoholic extract of black cumin and the time period on the mortality rate of the larval stage of the fruit fly. The highest mortality rate for the larval stage was 6.58, while the lowest mortality rate was 1.17. The effect of the concentrations of the aqueous extract of black cumin and the time period on the mortality rate of the larval stage of the insect. The mortality rate of the larval stage reached 6.92, while the lowest mortality rate was 1.67. From Table (1), a significant effect was found for the aqueous extract at a concentration of (0.75 - 0.50) with the time period. The concentration had a clear significant effect in the days after (1 day, 3 days, 5 days, 7 days).

Table . 1 shows the effect of the concentrations of the aqueous and alcoholic extracts of black cumin on the larval stage of the fruit fly Carpoomya vesuvian.

Alcoholic extract of black cumin for larval stage						Aqueous extract of black cumin for larval stage					
concentration%	1day	3 day	5day	7day	average	concentration%	1day	3 day	5day	7day	average
0	0.67	0.67	1.33	2.00	1.17	0	0.67	2.00	2.00	2.00	1.67
0.25	0.67	2.00	4.00	6.67	3.33	0.25	1.33	2.33	3.33	5.00	3.00
0.50	1.67	4.33	6.33	7.67	5.00	0.50	2.00	4.00	4.67	8.00	4.67
0.57	3.33	5.67	7.33	10.00	6.58	0.75	4.33	5.33	8.00	10.00	6.92
average	1.58	3.17	4.75	6.58		average	2.08	3.42	4.50	6.25	
LCD0.05	concentration period interaction 1.905 0.953 0.953					LCD0.05 concentration period interaction 1.780 0.892 0.890					

This study agrees with what was stated by (Khalaf et al., 2008) to know the effect of plant powders of black cumin and black pepper on the life of the bean beetle, as the

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study showed that these powders had a clear effect on reducing the rate of laying the laid eggs, as black cumin powder was superior in reducing the rate of the number of eggs laid on the seeds. The effect of these powders may be due to their content of alkaloids, phenolic compounds, terpenes, glycosides, and active ingredients that act as anti-feeding or repellents, leading to the death of insects due to starvation or causing a hormonal imbalance, inhibiting egg-laying, hatching, or molting of the insect's larvae.

2- Testing the effect of concentrations of alcoholic and aqueous extracts of black cumin on the adult fruit fly, Carpoomya vesuviana.

Table (2) indicates the effect of concentrations of alcoholic extracts of black cumin and the time period for the death rate of adult fruit fly, Carpoomya vesuviana. The highest death rate for adult fruit fly, C. vesuviana, was 9.33, while the lowest was 1.58. The effect of concentrations of aqueous extracts of black cumin and the time period for the death rate of adult fruit fly, C. vesuviana, was 10.00, while the lowest was 1.33. From Table (2), a significant effect was found for the aqueous extract at a concentration of (0.75 - 0.50) with the time period. The concentration had a clear significant effect on the days after (1 day, 3 days, 5 days, and 7 days).

2- Testing the effect of the concentrations of the alcoholic and aqueous extracts of black cumin on the adult fruit fly, Carpoomya vesuviana.

Table (2) indicates the effect of the concentrations of the alcoholic extract of black cumin and the time period on the mortality rate of the adult fruit fly, Carpoomya vesuviana. The highest mortality rate for adult fruit fly, C. vesuviana, was 9.33, while the lowest mortality rate was 1.58. The effect of the concentrations of the aqueous extract of black cumin and the time period on the mortality rate of the adult fruit fly, Carpoomya vesuviana, was 10.00, while the lowest mortality rate was 1.33. From Table (2), a significant effect was found for the aqueous extract at a concentration of (0.75 - 0.50) over the time period. The concentration had a clear significant effect over the following days (1 day, 3 days, and 5 days).

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Table (2) shows the effect of the concentrations of the alcoholic and aqueous extracts of black cumin on the adult fruit fly, Carpoomya vesuvian.

Alcoholic extract of black cumin for complete role						Aqueous extract of black cumin for the role of completes					
concentration%	1day	3 day	5day	7day	average	concentration%	1day	3 day	5day	7day	average
0	1.00	1.00	3.00	3.33	2.08	0	0.67	2.33	1.67	0.67	1.33
0.25	2.33	5.33	10.00	10.00	6.92	0.25	6.67	6.67	8.67	10.00	8.00
0.50	4.67	6.67	10.00	10.00	7.83	0.50	8.67	8.67	10.00	10.00	9.33
0.57	7.33	10.00	10.00	10.00	9.33	0.75	10.00	10.00	10.00	10.00	10.00
average	3.83	5.75	8.52	8.52		average	6.50	.6.92	7.58	7.67	
LCD0.05 concentration period interaction						LCD0.05 concentration period interaction					
1.247 0.624 0.624						0.513 1.136 0.513					

This is consistent with (EI-Lakwah et al., 1989). Their study results showed that black cumin led to a decrease in the number of adult beetle offspring. The effect of these powders may be due to their content of alkaloids, phenolics, terpenes, glycosides, and active ingredients that act as anti-feeding or repellents, leading to the death of insects due to starvation or disrupting hormonal balance, inhibiting egg-laying, hatching, or molting of the insect's larval stages.

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