The repellent and attractive effect of hexane extract and plant powder of Ocimum basilicum against the southern cowpea beetle, Callosobruchus maculatus

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Abstract

The experiment was conducted in the laboratories of Al-Musaib Technical College, Al-Furat Al-Awsat Technical University in March 2024 for the purpose of testing the effect of hexane extract and plant powders on the flowers and leaves of the basil plant, Ocimum basilicum, at concentrations (0.25, 0.50, 0.75%, 1) % and weights (0.25, 0.50, 0.75, 1) g in the percentage of repulsion and attraction against adults of the southern cowpea beetle Callosobruchus maculatus for hexane extract and plant powders of Ocimum basilicum flowers and leaves using a chemotropism device. The results showed that the repulsion rate was 90 and 80% compared to the attraction rate, which amounted to 10 and 20% for the flowers and leaves of the plant, respectively at a concentration of 1%. As for the powders, the repulsion rate was 73.33 and 66.67% compared to the attraction rate, which amounted to 26.67 for both flowers and the leaves of the plant at a weight of 1 g. The results showed that there is a direct proportionality in increasing the expulsion rate with increasing concentrations and weights.

Keywords: hexane extracts, Ocimum basilicum, Callosobruchus maculatus

Introduction

The cowpea plant (Vigna sinensis L.) is considered one of the most important legume crops, especially in third world countries, where it has the ability to grow in soils that lack organic materials in addition to its cheap prices compared to other legumes, which makes it one of the important foodstuffs in the food consumption tables of poor countries [2,1]. The southern cowpea beetle, Callosobruchus maculatus , is one of the most important insect pests in the Coleoptera order, which belongs to the Chrysomelidae family. It is an insect that infects the seeds of leguminous plants in most parts of the world, including Iraq [3]. Many plants contain substances that are toxic, repellent, or attractive to species of arthropods [4,5]. It was indicated that there are 1005 species of plants that have a toxic effect on insects and 384 There are 279 species that inhibit feeding, 279 species that have an insect repellent effect, 31 species that inhibit growth, and 5 species that cause sterility in insects. Botanical pesticides, such as extracts and powders, play a crucial role as natural products produced by plants. They function by reducing insect populations, repelling them, preventing mating, inhibiting the egg-laying process, and inhibiting larval development [6]. The current study aims to evaluate the effectiveness of the plant's compounds in repelling and attracting the southern cowpea beetle, C. maculatus .

Materials and methods

Collecting plant samples and diagnosing them :

Plant samples of flowers and leaves for Ocimum were collected from their home country, Babylon province, in order to benefit from them in the experiment. The Natural History Museum at the University of Baghdad identified the plant samples collected at the start of the flowering season in May 2023. Concentrations and weights were used (0.25%, 0.50%, 0.75%, 1%), (0.25 g, 0.50 g, 0.75 g, 1 g) respectively The data were also analyzed using a completely randomized design.

Collection and breeding of Callosobrachus maculatus:

We obtained a colony of Callosobruchus maculatus from infected seeds in local markets. We placed healthy cowpea seeds in the freezer for two days to ensure they were free of infection. We placed approximately 100 g of insect-infected seeds in each bottle, which is equivalent to 50 g of healthy seeds. We covered the nozzle of the bottle with a milling cloth cover and tied it with a rubber band to prevent adult insects from emerging. We also wrote information on it, including the date of adding the insect-infected seeds and the insect type. This is for the purpose of monitoring and following up on the generations of the insect, and it was used to provide the experiments with the different insect stages of the studied insect. The bottles were placed in the incubator at a temperature of 30 ± 2 C°, a humidity of $70 \pm 5\%$, and complete darkness, and these are the same conditions in which the experiments were conducted. In it, the colony continued to be renewed in order to ensure its sustainability after each generation, as it was provided with cowpea seeds (food) whenever its food was exhausted [7.]

The attractive and repellent effect of hexane extracts on adults of Callosobruchus maculatus using a chemotropism device :

He used the chemotropism device based on [8], which is a box made of wood, 48 cm long and 20 cm high, with a movable lid and two openings facing each other through which a 100 cm long glass tube passes. Its diameter is 3 cm. In the middle of it there is an opening for the purpose of inserting insects. The tube is divided into centimeters. Both ends of the tube are closed with a piece of cotton. The pieces of cotton on the right side of the tube were treated with concentrations of the raw hexane extracts of the leaves and flowers of the basil plant, each separately. As for the piece of cotton in The other side was treated with hexane and distilled water, which was considered a control treatment. 10 adult insects were placed in the middle of the tube and waited for 20 minutes to then count the number of individuals attracted and repelled by the substance for a distance of 20 cm. The experiment was conducted under the normal conditions of the laboratory, with the tube cleaned between Each treatment of the female workers was repeated in three repetitions, and then the results were calculated according to the following equations: [9,10.]

Repulsion rate = Number of insects against the tested substance and cut off 25 cm from the center / total number of insects x 100

Attraction percentage = Number of insects expelled heading towards the tested material and cutting 25 cm from the center / Total number of insects x 100

Balance percentage = Attraction percentage - Repulsion percentage .

The attractive and repellent effect of plant powders on Callosobruchus maculatus adults using a chemotropism device :

The same steps were followed as in paragraphs 2–3, except for replacing the plant powders with hexane extract, as well as replacing the concentrations with the required weights.



Figure 1. The chemotropism device

Results and discussion

Study of the attractive and repellent effect of hexane extracts on adults of C.maculatus using a chemotropism device :

The results in Table (1) showed that the hexane extract was superior in increasing the rate of repellent and decreasing the attraction at a concentration of 1% (90, 80) and (10, 20) for Ocimum flowers and leaves, respectively, after 20 minutes of treatment using a chemotropism device. There is a direct proportion between the repellent effect and the concentration of the extract, and there are significant differences as a result of the effect of hexane extracts on the rates of repulsion and attraction. This is consistent with [6], who evaluated the effect of extracts (hexane, ethyl acetate, and ethyl alcohol) of the rhizomes of the Cyperus rotundus plant on the rate of repulsion, attraction, and balancing of adults of C. maculatus at a concentration of 2.5%. It also agreed with [11], who knew the attractive and repellent effects of vegetable oils on C.maculatus using a chemotrophometer device. It was noted that the highest repellency rate was when using cumin oil at a concentration of 8%, where it reached 76.66, 23.33, and 53.33 for the rates of repulsion, attraction, and balancing, respectively.

Extract type		Extract concentration	Percentage	
			Repellent effect	Attractive effect
Hexane extract	flower	0.25 %	46.67	33.33
		0.50%	63.33	26.67
		% 0.75	80.00	20.00
		% 1	90.00	10.00
Hexane leaf extract		% 0.25	40.00	40.00
		% 0.50	56.67	33.33
		% 0.75	73.33	26.67
		% 1	80.00	20.00

Table (1) The attractive and repellent effect of hexane extracts on adults of C.maculatus using a chemotropism device.

The LSD value for the type of extract is 3.53, for the concentration of the extract is 4.99, and for the interaction is 7.06

Study of the attractive and repellent effect of plant powders on adults of C. maculatus using a chemotropism device :

The findings in Table (2) showed that the flower powders were superior in increasing the rate of repellent and decreasing the attraction at a weight of 1 g (73.33, 66.67) and (26.67, 26.67) for both the flowers and leaves of the plant, respectively. There is a direct proportion between the repellent effect and the weight of the powder, and there are significant differences as a result of the effect of powder weights on the rates of repulsion and attraction. This agrees with the findings of [12], who employed four plant powders, Pimpinella anisum, Datura inoxia, Thymus vulgaris, and parsley (Petroselinum crispum). All of these powders demonstrated a repellent effect, except for the thyme plant powder, which attracted the adults of the hairy grain beetle .

Douvdor type	Doudor weight	Percentage		
Powder type	Powder weight	Repellent effect	Attractive effect	_
Elemennewden	0.25 g	50.00	40.00	_
	0.50 g	53.00	33.33	
Flower powder	0.75 g	66.67	33.33	
	1 g	73.33	26.67	
	0.25 g	43.33	46.67	_
Leaves powder	0.50 g	53.33	40.00	
	0.75 g	60.00	33.33	
	1 g	66.67	26.67	

Table (2) The attractive and repellent effect of plant powders on adults of *C.maculatus* using a chemotropism device.

The LSD value for the powder type is 4.33, for the powder weight is 6.12, and for the interference is 8.65.

Conclusions

Hexane extracts and powders demonstrated effective repellent and attractive effects. In terms of these effects, the hexane extract of flowers was superior. Moreover, the percentage of repellent and attractive effects increases proportionally with the concentration.

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