IRAQI Academic Scientific Journals
Samarra Journal of Pure and Applied Science
SJPAS
مجلة سامراء للعلوم الصرفة والتطبيقية
www.sjpas.com
p ISSN: 2663-7405
e ISSN: 2789-6838

The biological effect of some plant oils on the life of the *Callosobruchus maculates* (Fab) (Coleoptera : Bruchidae)

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Article Information
Received: 05/08/2022
Accepted: 14/08/2022
Keywords:
Callosobruchus maculatus, plants oil, Avocado, Siwak, Wandering Jew.

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Abstract
In this study three vegetable oils has been used with different concentrations (1.5, 3, 4.5 ml per 20gm/grain), the treatment that does not use any vegetable oils is served as a control. Ten *C. maculatus* insects are released into a Petri dish containing 20g of cowpea beans with appropriate vegetable oil concentration. After closing, leave at room temperature. Records are kept of seed weight loss, egg laying, adult emergence, and death. No significant differences are observed when increasing the concentrations of vegetable oils. Cereals treated with siwak oil recorded the highest mortality rates, reaching 52.91% after 96 hours of treatment at a concentration of 4.5 ml. It is observed that the laying of eggs decreases with the toothpick oil, as it reached 75 eggs at a concentration of 4.5 ml. The lowest percentage of weight loss was with the toothpick oil at a concentration of 4.5 ml, which amounted to 4.5%. It is noted in the emergence of adults that the highest percentage of appearance was with the oil of the Wandering Jew, which amounted to 31 insects. It is also noted that the killing increases with increasing concentration and increasing the duration of exposure.

Introduction

The legume family is the second most important plant family in the world. It contains protein (20-40%) and carbohydrates (50-60%) and is also a good source of thiamine, niacin, calcium and iron [1,2] Cowpea (*Vigna unguiculata* (L.) walp is a staple legume in food crops of important economic and nutritional importance worldwide [3]. *Vigna unguiculata*, pods and fresh leaves are consumed as green vegetables in many parts of the world, especially in tropical and subtropical regions, while the rest of the plant is used after harvesting the pods as fodder for livestock [4].

The use of chemical pesticides and fumigants in storage insect pest control is limited due to insecticide resistance and hazardous residues in food and the environment management. As a result, natural insecticide is being sought widely affordable, environmentally friendly, and non-target safe organisms that have no negative impact on organoleptic and commercial value it is unavoidable that the quality of stored grains deteriorates. As far as plant products go, in general, biodegrade quickly, are less harmful to mammals and may be recycled. Be

easily and economically produced by farmers and small-scale producers. Extracts that are crude, somewhat purified, or purified are used in industries [5]. Insect pests are a sever danger to cowpea production and storage in tropical and subtropical poor nation, including Iraq. The cowpea beetle, *Callosobruchus maculatus* (Fab.) (coleopteran: Bruchidae), is a significant pest of stored legume seeds, particularly cowpea *Vigna unguiculata* [6]. They can be used to preserve grain that has been stored. Many plant powder, extracts, and essential oils, such as paper, clove, and sweet flag, have been shown to have insecticidal properties against various stored grain insect pests [7,8,9,10].

Various ways of applying plant oils to protect grains against insect pests have been tried in the past [11]. tested plant essential oils against *C. chinensis* by thoroughly combining 2.5 ml kg of Legume instead of pea seeds [12]. where did Ranjeet et al. (2020)[13] investigated the insecticidal effectiveness of four essential oils and their combinations against *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.) in wheat under laboratory setting, with the adults exposed to oils soaking on a blank mat [14]. Stated that a sweet flag composition might be used to coat the surface of various packing materials to protect them against storage insect. Green gram could be better protect against pulse beetles for more than 120 days if a piece of plywood soaked whit clove oil is placed on the grain surface.

In view of the great damage caused by the southern cowpea beetle *C. maculatus* to food crops, especially in the cowpea plant, as well as the damage of chemicals used in the fight to humans, and from this point of view came the idea of the research, which is the use of three vegetable powders, namely, toothpicks (siwak), avocado and the Wandering Jew, and to examine their effectiveness in the life of an insect.

Materials and Methods

Culturing of Insects

Southern cowpea beetle is collected from local markets in Kirkuk city / Iraq and the insect is classified by the Research Center and Natural History Museum / Department of Insects and Invertebrates / University of Baghdad. The insect is cultured in a Petri dish and its mouth is covered with a perforated cloth for the purpose of respiration of the insect. 5 pairs of the insect are added to it with 20 gm of cowpea for feeding purpose and kept in an incubator at a temperature of 25 ± 2 °C and a relative humidity of 70 ± 5%. Uses newly emerging future generations in subsequent experiments, taking into account the continuous renewal of the colony.

Plants collection

Four types of plants are used, cowpea (*Vigna unguiculata*) Fabales : fabaceae, Wandering Jew (*Tradescantia fluminensis*) Commelinales : Commelinaceae, toothpick (*Salvadora persica*) Brassicales : Salvadoraceae, avocado (*Persea Americana*) Laurales: Lauraceae. The wandering Jew leaves from home gardens, toothpicks, avocado and cowpea seeds are collected from local markets in Kirkuk city / Iraq.

Preparation of vegetable oils

Preparation of plant extracts in the table in the laboratory of the College of Agriculture / University of Kirkuk based on the method [14] by cleaning the plant part from all impurities and leaving it to dry at room temperature for three days and then crushing it into a fine

powder by an electric grinder And we put 200 g of each plant part into the extraction container (Extraction thamble), and each part of the plant alone, and then extracted through the Soxhlet extractor 500 ml, By using a mixture of organic solvents 200 ml Dichloro methane at a concentration of 99.99% and 200 ml of ethanol at a concentration of 99.99% and heating began by means of a textile heater for 4-6 hours at a temperature of 70 ° C, depending on the type of the plant part until the color of the vegetable powder is gone. By evaporating the organic solvent under low pressure and at a temperature of 77° C using a rotary evaporator in the Chemistry Laboratory / College of Education for Pure Sciences / Kirkuk University and obtaining a viscous substance, Add the chloroform solvent to the material and leave for 25-30 minutes at room temperature. To get rid of the solvent, keep the sample at 4 °C in the refrigerator in opaque glass vials until use.

Table 1: Botanical powder that are employed in the research

Common name	Scientific name	Family	Used part
Wandering Jew	*Tradescantia fluminensis*	Commelinaceae	Paper
Siwak	*Salvadora persica*	Salvadoraceae	Root
Avocado	*Persea Americana*	Lauraceae	Seeds

The effect of vegetable oils on the life of the southern cowpea beetle

Three different concentrations of vegetable oil were used which are 1.5, 3 and 4.5 ml of vegetable oil / kg of cowpea from cowpea. 5 virgins were added daily from the breeding environment) of the southern cowpea beetle *C. maculatus*. Then the samples are incubated in the incubator at a temperature of 25 ±2ºc and a relative humidity of about 70±5% , then the killing rate of insects is estimated after three days.

a- Calculate the number of eggs laid by females and the ejection percentage (the percentage of egg laying prevention).

According to Abbott's equation (1925)

$$\text{Percentage of parcel ratio} = \frac{\text{The number of eggs laid on the seeds is controlled} - \text{The number of eggs laid in the treatment}}{\text{The number of eggs laid on the seeds is controlled}} \times 100$$

b- Calculate the percentage of killed adults of an insect

$$\text{To kill percentage} = \frac{\text{number of dead insects}}{\text{The total number of insects}} \times 100$$

c- Effect of plant extracts on the number of budding insects and the percentage of reduction of first generation individuals (F1)

According to Tabu formula [15]

$$\text{Reducing Percentage (F1)} = \frac{\text{The number of emerging insects in control} - \text{The number of emerging insects in the treatment}}{\text{The number of emerging insects in control}} \times 100$$

d- Knowing the percentage of seed weight loss after 3 months of storage

e- The effect of attractant and repellent of plant extracts on insect life

$$\text{Attraction percentage} = \frac{\text{The number of insects that headed towards the tested material and traveled a distance of 25 cm}}{\text{The total number of insects}} \times 100$$

$$\text{expulsion percentage} = \frac{\text{The number of insects that went against the tested material and traveled a distance of 25 cm}}{\text{The total number of insects}} \times 100$$

Equilibrium Ratio = Attraction Ratio - expulsion Ratio

Results and Discussion

Effect of three plant essential oils on oviposition, The number of emerging insects, and weight loss

In (Table 2), it is noted the effect of vegetable oils with different concentrations on the number of eggs lay by *C. maculatus*. Is noted that the highest number of eggs lay by the insect during its lifespan was with the oil of the Wandering Jew plant at a concentration of 1.5 ml, which amounted to 153 eggs, and less The number of eggs was with the siwak plant oil at a concentration of 4.5 ml, which amounted to 75 eggs. When looking at the average effect of each concentration, it is noted that the relationship is inverse with the number of eggs laid and the increase in concentration The average effect of the plant is (214, 127.3, 139.3, 105.7) eggs, respectively, which is consistent with the study [15] where 5 plant oils were used against the southern cowpea beetle. *C. maculatus* are *Aframomum melegueta*, *Ficus exasperate*, *Tetrapleura tetraptera*, *Annona muricata*, *Eucalyptus globules* at concentrations (1, 3, 5) ml and the average number of eggs is (125, 91, 92.67) eggs (155.67, 140.33, 129.33) eggs (103.67, 105.67, 105.67) eggs (143.67, 120.67, 117.67) eggs (107.33, 115.33, 85.67) eggs respectively for each oil compared to the control where it is (180.33, 160.00, 165.67, 152.33, 159.33) eggs respectively for each plant.

As for the emergence of adults of the southern cowpea beetle, Table 2 the effect of vegetable oils on the number of emerging insects of the (southern cowpea beetle) *C. maculatus*. The highest percentage of the emerging insects was with Wandering Jew plant extract, where the number of emerging insects is 31 at a concentration of 1.5 ml and less The number of emerging insects is with the miswak plant extract, where the number of emerging insects is 7 at a concentration of 4.5 ml compared with the control group, where the number of emerging insects is 151 insects. When looking at the average effect of each plant, it is noted (18, 29,15). It is noted that the inverse relationship between the number of emerging insects and the increase in concentration, and this is consistent with the study [16], where he reached a conclusion that the increase in concentration decreases the number of emerging insects, Plants act as repellents and inhibitors of feeding as they form an insect wall and its movement prevents its death, as well as for the presence of alkaline, sulfur and phenolic substances clearly on insects [17].

At Table 2, the percentage of weight loss for *Vigna unguiculata* treated with vegetable oils before *C. maculatus* during a period of 3 months, and it is found that the highest weight loss is with Wandering Jew plant oil, which recorded 30.32% at concentration 1.5 ml and the lowest percentage is with the Siwak plant oil, where it recorded 5.4% in concentration 4.5 ml at concentrations (1.5, 3, 4.5) ml respectively, and this is consistent with the study [18] when treating oils of 5 plants which are mustard, neem, poppy and pumpkin seeds to protect Cowpea, where no weight loss is recorded, as the result is 0.00% at all concentrations (0.5, 1, 1.5, 2) ml.

Table 2: Effect of some plant oils on the oviposetion, adult emergence and weight loss of inset *callosabrocus maculatus*

Botanicals	Dose (ml)	Oviposition	Adult emergence	Weight loss (%)
Persea Americana	0	214	151	64.32
	1.5	150	23	28.43
	3	127	20	24.58
	4.5	105	11	15.32
Average		127.3	18	68.33
Tradescantia fluminensis	0	214	151	64.32
	1.5	153	31	30.32
	3	137	29	27.67
	4.5	128	27	20.34
Average		139.3	29	26.11
Salvadora persica	0	214	151	64.32
	1.5	141	21	14.32
	3	101	17	11.28
	4.5	75	7	5.4
Average		105.7	15	10.3

	Ho	d.f	Xo^2	P-value	Sig
Oviposition	There are no significant differences between the increase in concentration and the number of eggs	4	6.123	0.190	Not sig.
Adult emergence	There is no significant difference between the increase in concentration and the number of emerging insects	4	0.183	0.898	Not sig.
Weight loss (%)	There are no significant differences between the increase in concentration and the percentage of weight loss	4	1.138	0.881	Not sig.

Effect of plant extracts on adults of *C. maculatus*

At Table 3A, it is noted the effect of exposure periods and concentrations of vegetable oils on the killing rate of *C. maculatus* wholes. For avocado oil extract, the highest killing rate is at a concentration of 4.5 ml after an exposure period of 96 hours, which amounted to 41.87%, and the lowest killing rate was at a concentration of 1.5 ml After a period of exposure of 24 hours, which amounted to 14.44%, and there were no significant differences between the other exposure periods and the increase in concentration. When looking at the average effect of time, it is noted that the relationship is direct between the increase in concentration and the increase in the exposure period, as it recorded (17.8, 22.6, 26.4, 35.97%) after periods of exposure after (24, 48, 72, 96) hours, respectively, compared to the control, which recorded (0.00, 0.00, 0.00, 4.65%) respectively.

As for the Wandering Jew oil, the highest killing rate is at a concentration of 4.5 ml after a 96-hour exposure period, where it has scored 39.87%, and the lowest percentage at a concentration is 1.5 ml after a 24-hour exposure period, where it has recorded 11%. There are no significant differences between the increase in concentration and the percentage of killing and when Looking at the average effect of time, it is noted that there is a direct relationship between the increase in concentration and the rate of killing, as it is recorded (15.95, 21.3, 29.03, 36.50) % at exposure periods (24, 48, 72, 96) hours, respectively, compared to the control.

As for the Siwak oil, the highest killing rate is at a concentration of 4.5 ml after a 96-hour exposure period, where it recorded 57.87%, and the lowest killing rate is at a concentration of 1.5 ml after a 24 hour exposure period, where it has recorded 19.91%, and there are no significant differences between the increase in concentration and the increase in exposure periods and when looking at To the average effect of time, it is noted that the direct relationship between the increase in concentration and the increase in exposure periods recorded (22.85, 31.55, 44.3, 52.91)% after exposure periods (24, 48, 72, 96) hours compared to the control group. The effect rate of the concentration is the highest percentage with Siwak oil, which amounted to 41.34% at a concentration of 4.5 ml, and the lowest percentage with avocado oil, which amounted to 21.62% at a concentration of 1.5 ml compared to the control, which amounted to 1.16%.

This is in agreement with the study [19] where *E. baplearaoides* extract is used at concentrations of 2.5, 6.5, 7, 10 µL/ml against adult *T. granarium*, and the highest lethal concentration is reached after 6 days of exposure treatment, which recorded 51.41% At a concentration of half-killer 4.12 µL/ml, the relationship is positive with increasing concentration and exposure treatment time. This is in agreement with the study of [18], where he used 5 different vegetable oils and obtained the results (3.33, 92.5, 98.33, 99.17, 100.00) % at concentrations of (0.5, 1, 1.5, 2) ml respectively.

Table 3: Killing percentages of plant extracts with different time periods and concentrations on the wholes of the southern cowpea beetle *C. maculatus*

Plant extract	Concentration ml/kg	Transaction after \ hour				Effect rate of each concentration
		24	48	72	96	
Avocado	1.5 ml	14.44	18.32	22.35	31.37	21.62
	3 ml	16.54	23.43	26.31	34.67	25.24
	4.5 ml	22.34	26.13	30.43	41.87	30.19
average time effect		17.7	22.6	26.4	35.9	
Wanding jew's	1.5 ml	11	17.32	26.32	33.89	22.13
	3 ml	17.54	21.23	28.43	35.76	25.74
	4.5 ml	19.33	25.43	32.34	39.87	29.24
average time effect		15.9	21.3	29.03	36.5	
Siwak	1.5 ml	19.91	27.32	42.21	48.98	34.61
	3 ml	23.87	31.95	43.34	51.87	37.76
	4.5 ml	24.76	35.38	47.34	57.87	41.34
average time effect		22.85	31.55	44.3	52.91	
Control		0.00	0.00	0.00	4.65	1.2
Average overall time effect		14.11	18.86	24.9	32.49	

Plant oil	Ho	d.f	Xo^2	p-value	sig
Avocado	There are no significant differences between the increase in concentration and the percentage of weight loss	6	0.222	1.000	Not sig.
Wanding jew	There are no significant differences between the increase in concentration and the percentage of weight loss	6	1.604	0.965	Not sig.
Siwak	There are no significant differences between the increase in concentration and the percentage of weight loss	6	0.384	0.99	Not sig.

Consolation

According to the study's findings, the evaluated oils can be used to control *C. maculatus* in grains of stored cowpea. The highest measured oil concentrations (i.e., 4.5 ml) had the greatest impact on reducing oviposition raising mortality, and improving repellency. Siwak oil has superior results at preventing the growth of *C. maculatus.* It is advised that small-scale farmers and grain storage facilities utilize natural materials that are safe for the environment and for human health. The agriculture sector of underdeveloped nations will benefit from additional research to increase the efficacy of plant-based products as pesticides.

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IRAQI Academic Scientific Journals
Samarra Journal of Pure and Applied Science
SJPAS
مجلة سامراء للعلوم الصرفة والتطبيقية
www.sjpas.com
p ISSN: 2663-7405
e ISSN: 2789-6838

التأثير الحيوي لبعض الزيوت النباتية في حياتية خنفساء اللوبيا الجنوبية *Callosobruchus maculates* (Fab) (Coleoptera : Bruchidae)

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معلومات البحث:

تأريخ الاستلام: 2022/08/05

تأريخ القبــول: 2022/08/14

الكلمات المفتاحية:

خنفساء اللوبيا الجنوبية، الزيوت النباتية، الافوكادو، السواك، اليهودي الزاحف

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الخلاصة:

يتم استهلاك البقوليات في جميع أنحاء العالم وخاصة في البلدان الآسيوية. بسبب احتوائها على الألياف الغذائية والبروتينات والمعادن والفيتامينات. بعد الحصاد، يتم الاحتفاظ بحبوب اللوبيا وتستهلك حتى المحصول التالي. ومع ذلك، تغزوها الكثير من الآفات المخزنية، وخاصة *Callosobruchus maculatus*. استخدمت الدراسة ثلاثة زيوت نباتية بتراكيز مختلفة (1.5 ، 3 ، 4.5 مل لكل 20غم\حبوب)، المعاملة الذي لا يستخدم أي زيوت نباتية كانت بمثابة عنصر تحكم للسيطرة. تم إطلاق عشرة حشرات من نوع *C. maculatus* في إطباق بتري تحتوي على 20 جم من حبوب اللوبيا مع تركيز الزيت النباتي المناسبة. بعد إغلاقها، تُركت في درجة حرارة الغرفة. تم الاحتفاظ بسجلات عن فقدان وزن البذور، ووضع البيض، وظهور البالغين، والموت. لوحظت عدم وجود فروق معنوية عند زيادة التراكيز للزيوت النباتية. سجلت الحبوب المعالجة بزيت السواك أعلى معدلات الوفيات إذ بلغت 52.91% بعد 96 ساعة من المعاملة عند تركيز 4.5مل. لوحظ أن وضع البيض يقل بزيت السواك إذ بلغت 75 بيضة عند تركيز 4.5مل. وكانت اقل نسبة فقد في الوزن مع زيت السواك عند تركيز 4.5مل إذ بلغت 4.5% ولوحظت في ظهور البالغات أعلى نسبة ظهور كانت مع زيت اليهودي الزاحف إذ بلغت 31حشرة كما لوحظ أن القتل يزداد بزيادة التركيز وزيادة مدة التعرض.