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# Effect of three plants extract as a repellent substances on the Cowpea Beetle, *Callosobruchus maculatus* (Fabricius.) under the Laboratory Conditions

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## Abstract:

The cowpea beetle, *Callosobruchus maculatus* (Fabricius.),is global, ,attacks seed of cowpeas and related legumes in stores. This investigation was carried out in the plant protection department laboratory at Aswan University- Faculty of Agriculture and Natural Resources. .Three plants species belongs to two different families (Piperaceae, and Apiaceae), were used during these investigations against this weevil. The repellency effect of these plants was tested on the adults of *C. maculatus* which infested faba bean seeds . Data on the percentage of repellency (PR´s) of three (PE´s) with five concentrations showed that most PE´s were strongly repellent against *C. maculatus*, The most effective PE´s was Black Pepper fruits followed by Dill seeds and Cumin seeds. Data clear that acetone solvent concentration 250 mg/l. air recorded a highly significant numbers of repellent insects (65.56±8.68 and 68.89±7.29 ) in the first and fifth day after treated with black pepper and Dill , respectively. While cumin showed a highly percentage of insect ( 68.89 ±4.01) in the same concentration (250 mg/l. air ) after treated by petroleum solvent also in the fifth day of treated .This present study, revealed that these plants extracts enhanced its repellent efficacy to stored product insect, the cowpea beetle *Callosobruchus maculatus* (F.)

***Keywords*:** Cowpea beetle , *Vica Faba*, plant extract.

## 1- Introduction

Faba bean (*Vicia faba*) is considered one of the most important seeds foods especially in the third countries. Its contains amount of protein , vitamin and carbohydrate **(Mohammed 1996; Köpke and Nemeck 2010 ; El-Shamy and Abd El-Aty 2021).**

One of the most dangerous pests of stored goods in tropical nations is the cowpea beetle, *Callosobruchus maculatus* Fabricius (Coleoptera: Bruchidae), a cosmopolitan pest of legume seeds **(Kang, *et al.* 2013** ;**Massango, *et al.* 2017)**. However, because a particular host's availability varies greatly and because these adult insects can reside in hosts that are typically treated with pesticides **Gbaye, *et al.* (2012)**. Before determining where to lay its eggs, this insect may have to endure insecticidal sub-lethal exposures.

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In many storage systems, fumigants are the most economical and effective method of controlling pests in stored products. Not only can they eradicate a variety of pests, but they also quickly permeate materials and leave little residue behind. Phosphine is frequently used as a fumigant for these reasons. **(Mueller, 1990; Lee, *et al.* 2004**).

**Koul and Bhandari** (**2018** )**,** recommended that, botanical pesticides are thought to be safer for the environment and non-target creatures.

Also , **Kalpna and kumar** (**2022**)**,** reported that**,** development of integrated pest management systems that reduce the ecological effects of pest control techniques may be assisted by the possible effectiveness of plant extracts in controlling *C. maculatus*.

In line with sustainable agricultural principles, investigating plant extracts as possible biopesticides offers eco-friendly substitutes for synthetic chemical pesticides. This strategy aligns with the global movement towards environmentally friendly and sustainable pest management techniques. **(De Sousa *et al*.2023)**

**Rajendran and Sriranjini, (2008)** According to the report, researchers concentrated on creative approaches to managing insect pests in grain farms in order to preserve the ecosystem and avoid adverse environmental effects. They also focused on employing organic items, such as essential plant oils and pesticides ,. Additionally, plant products were used for fumigation since, in comparison to conventional fumigants, it is believed that plant extracts may have advantages such as minimal mammalian toxicity, quick breakdown, and local availability.

Several alternatives to fumigation have been studied for use in quarantined and stored products .T he development of safe substitutes that are practical, affordable, and easy to use is desperately ne eded in order to potentially replace the hazardous fumigants. **(Ayvaz *et al*. 2008).**

The use of natural materials to control pests in stored products is gaining a lot of interest since it may reduce risks to the environment and human health. An increasing number of people are using plant extracts to cure insect problems**. ( Akbar and Khan 2021).**

The essential oil fraction often has insecticide properties found in many plant spices, including herbs, and their preparations. **(Shaaya *et al.*, 1991)**.

Repellents may repel unwanted invaders through their taste or odor. or they can work locally or remotely, preventing an arthropod from flying to and landing on the largest under protection. **(Choochote *et al*., 2007)**. Insect repellents typically function by creating a vapor barrier that prevents arthropods from contacting the surface **(Brown and Hebert, 1997)**. Five plant extracts were used to treated the cowpea beetle **,** the results refers to , the conducted extracts had a toxic action against these beetle and its a safety methods to protect the farmers seeds from cowpea beetle **Ito EE and Ighere (2017).**

The aim of this investigation , is studying the effectiveness of repellents for the three plants extracts (Black pepper /fruits, Dill /seeds and Cumin/ seeds) prepared by Acetone, petroleum ether and chloroform extract, have been examined against the adults of C. *maculatus* with different concentrates and different exposure periods on faba bean seeds under the conditions of the laboratory.

### 2.1-Test Insect and Rearing Conditions.

*C. maculatus* was reared in controlled conditions at Aswan University and the Agricultural Research Center in Giza. The strain, collected in 2021 from Edfu traders, was maintained on pestfree cowpea seeds under specific temperature, humidity, and light conditions. Faba bean seeds were pre-stored at -18°C, and after egg-laying, females were removed, allowing eggs to develop until adult emergence.

**2.2-Plant Extracts:**

To assess plant extract repellence on *C. maculatus*, extracts from Piperaceae and Apiaceae species **(Table1)** were obtained from local shops in Aswan. Following **Helen (1985)**, plant materials were processed with solvents at 50°C. Diluted concentrations were mixed with seeds in glass jars, where 30 adults were introduced per jar with three replicates. Jars were maintained under rearing conditions.

**Table 1. The plants species were as follows:**

| Tested plants | Scientific name | Common name | Family Name | Used Part |
|---|---|---|---|---|
| Black pepper | *Piper nigrum* | Black pepper | Piperaceae | Fruits |
| Cumin | *Cuminum cyminum. L* | Cumin | Apiaceae | Seeds |
| Dill | *Anethum graveolens* | Dill | Apiaceae | Seeds |

**2.3-Preparation for repellency test:**

Ten grams of each plant extract were diluted in 50 ml of acetone, petroleum, or chloroform to obtain a 10% (w/v) stock solution. *C. maculatus* adults were exposed to doses ranging from 62.5 to 1000 mg/L air under controlled conditions (28±1°C, 60±5% RH, 12:12 h photoperiod). Repellency was recorded after 1, 2, 3, and 5 days, and data were analyzed using **Finney (1971)** method to determine the effect and required exposure duration.

**2.4-Repellency test:**

The repellent effect of plant extracts on *C. maculatus* was tested using a modified device by using **Helen (1985).** A plastic container was placed in the center of a Petri dish on filter paper saturated with solvents at concentrations of 125, 250, 500, and 1000 mg/L, with 10 g of treated seeds as a barrier. After two days, 30 insects were introduced per replicate, and jars were kept at 28°C and 65±5% RH. Each concentration had three replicates (90 insects/dose). Repellency was measured after 1, 2, 3, and 5 days using a choice bioassay, calculating the percentage based on insect movement between treated and untreated areas. The repellents was calculated by formula

$$\% \text{ Repellency} = \frac{\text{Number of repelled insects}}{30} \times 100$$

**2.5-Statistical analysis :**

The data was modified Using information from treatments and the control, following **Abbott's formula Abbott, (1925)** . Using SPSS (version 22), statistical analysis was performed using analysis of variance (one-way ANOVA) with three components at a significant level of 0.05 for all results. According to **Steel *et al.* (1997),** the data was processed as though complete randomized design.

# 3- Results and Discussion:

## 3.1- Repellence activity

### 3.1.1- Faba bean

### 3.1.2.1- Effect of Acetone Extract:

The results of repellency assays for tested acetone plant extracts (PE´s) on Faba bean seeds presented in **Table(2).** Data on the percentage of repellency (PR´s) of three plants extracts (PE´s) employed five concentrations to combat adults of *C. maculatus*.

As concentrations rose, the repellency rose as well and exposure period. Studies on repellency were carried out 1, 2, 3, and 5 days following treatment. The findings indicated that , Dill was strong repellent against *C. maculatus* at 250 mg/l air after 5-day exposure period (68.89±7.29). Also, black Pepper recorded great values (65.56±8.68) at 250 mg/l air after1 day exposure period, while Cumin recorded (63.33±3.33) at 1000 mg/l air after 1 day exposure period. The concentration used had a substantial impact on the PE´s' repellence activities, and it's important to note that extended exposure times additionally elevated the activity. When applied at all concentrations, the back pepper PEs appeared greater repellence activity against *C. maculatus*.

Dill and Cumin recorded the highest values repellency activity against *C. maculatus* adults at mean of different exposure days at a higher concentration (250 &1000 Conc. mg/l. air), (61.67±4.15 & 61.39±1.94) for abovementioned PE´s, respectively, **(Table, 2)**. The black Pepper recorded 51.39±3.49 after the exposure periods at 500 Conc. mg/l. air, The average repellency of the three PE´s at five test concentrations against *C. maculatus* adults differed significantly. The obtained results detected quite various for PE´s, the most effective PE´s was Back Pepper , Cumin , and Dill, which recorded 49.5±1.68, 44.17±2.19 and 44.11±2.67 respectively.

### 3.1.2.2- Effect of Petroleum Extract:

The results of repellency assays for tested petroleum plant extracts (PE´s) on Faba bean seeds presented in **Table (3).** Data on the percentage of repellency (PR´s) of three plant extracts (PE´s) with five concentrations against *C. maculatus* adults showed that most PE´s were mightily evictor against the beetle, and these ones bioactivities followed up clear dose-response relationships, and concentration-response analyses were significant. The repellency increased with increasing concentrations and exposure period. repellency tests were performed after 1, 2, 3, and 5 days of treatment. The findings suggested that Cumin was strong repellents of *C. maculatus* at 250 mg/l air after 5 days exposure periods, while Dill was the least effective after different exposure periods.

The concentration used had a significant effect on the PE´s' repellence activities, and it's important to note that extended exposure times also boosted the activity. Higher repellence activity against *C. maculatus* was demonstrated by the cumin PE , when applied at 250 mg/l air, recorded (71.11±2.22) repellency, followed by black pepper (55.56±5.97) at the 500 Conc. mg/l. air and Dill (37.78±2.94) (Table3) at the 125 Conc. mg/l. air after the exposure intervals .

The mean repellency of The three PE´s' against adults of *C. maculatus* differed substantially in the five tested concentrations. The obtained treatment results revealed very various for PE´s, the most effective PE´s was Cumin (seeds) , Black pepper (fruits) and Dill (seeds), which recorded 48.44±2.15, 42.89±2.68 and 28.94±2.14 respectively.

**Table (2): Effect of acetone extract of black pepper, Dill, and cumin on repellency of *C. maculatus* adults on Faba bean seeds .**

| Plants extract | Conc. (mg/l. air) | Exposition period (day) | | | | Mean |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 5 | |
| Black pepper (fruits) | 1000 | 46.67±3.85$^{cB}$ | 53.33±1.93$^{cA}$ | 51.11±4.44$^{bAB}$ | 53.33±5.09$^{bA}$ | 51.11±1.89$^{b}$ |
| | 500 | 40.00±3.85$^{dC}$ | 50.00±1.92$^{bB}$ | 61.11±4.44$^{aA}$ | 54.44±10.6$^{bB}$ | 51.39±3.49$^{b}$ |
| | 250 | 65.56±8.68$^{aA}$ | 44.44±4.84$^{dC}$ | 51.11±6.19$^{bB}$ | 33.33±5.77$^{cD}$ | 48.61±4.48$^{b}$ |
| | 125 | 45.55±4.01$^{cA}$ | 40.00±5.09$^{dB}$ | 35.55±4.01$^{cC}$ | 23.33±1.93$^{dD}$ | 36.11±2.98$^{c}$ |
| | 0 | 53.33±1.93$^{bB}$ | 61.11±2.22$^{aA}$ | 63.33±5.09$^{aA}$ | 63.33±1.93$^{aA}$ | 60.28±1.81$^{a}$ |
| | Mean | 50.22±3.01$^{A}$ | 49.78±2.36$^{AB}$ | 52.44±3.21$^{A}$ | 45.55±4.56$^{B}$ | 49.5±1.68 |
| Dill (seeds) | 1000 | 27.78±4.57$^{cA}$ | 26.66±8.56$^{cA}$ | 24.45±3.10$^{dA}$ | 24.45±7.78$^{eA}$ | 25.83±6.9$^{c}$ |
| | 500 | 34.44±4.84$^{bA}$ | 21.11±7.78$^{dB}$ | 32.22±4.01$^{cA}$ | 32.22±8.01$^{dA}$ | 30.00±3.15$^{c}$ |
| | 250 | 56.67±13.88$^{aC}$ | 62.22±8.68$^{aB}$ | 58.89±4.01$^{aBC}$ | 68.89±7.29$^{aA}$ | 61.67±4.15$^{a}$ |
| | 125 | 37.78±6.19$^{bB}$ | 42.22±8.89$^{bB}$ | 50.00±9.62$^{bA}$ | 41.11±4.84$^{cB}$ | 42.78±3.53$^{b}$ |
| | 0 | 53.33±1.93$^{aB}$ | 61.11±2.22$^{aA}$ | 63.33±5.09$^{aA}$ | 63.33±1.93$^{aA}$ | 60.28±1.81$^{a}$ |
| | Mean | 42.00±4.72$^{A}$ | 42.67±6.06$^{A}$ | 45.78±5.04$^{A}$ | 46.00±5.88$^{A}$ | 44.11±2.67 |
| Cumin (seeds) | 1000 | 63.33±3.33$^{aA}$ | 61.11±4.44$^{aA}$ | 62.22±4.01$^{aA}$ | 58.89±5.56$^{aA}$ | 61.39±1.94$^{a}$ |
| | 500 | 31.11±4.01$^{cB}$ | 41.11±5.88$^{bA}$ | 43.34±8.82$^{bA}$ | 41.11±7.78$^{bA}$ | 39.17±3.26$^{b}$ |
| | 250 | 32.22±2.94$^{cB}$ | 44.44±5.88$^{bA}$ | 33.33±7.70$^{cB}$ | 28.89±9.10$^{cB}$ | 34.72±3.39$^{b}$ |
| | 125 | 24.44±2.94$^{dB}$ | 34.45±4.01$^{cA}$ | 23.33±5.77$^{dBC}$ | 18.89±4.01$^{dC}$ | 25.28±2.51$^{c}$ |
| | 0 | 53.33±1.93$^{bB}$ | 61.11±2.22$^{aA}$ | 63.33±5.09$^{aA}$ | 63.33±1.93$^{aA}$ | 60.28±1.81$^{a}$ |
| | Mean | 40.89±4.13$^{B}$ | 48.44±3.39$^{A}$ | 45.11±4.88$^{AB}$ | 42.22±5.12$^{B}$ | 44.17±2.19 |

a, b & c: There is no significant difference (P>0.05) between any two means for each extract, within the same column have the same superscript letter; A, B & C: There is no significant difference (P>0.05) between any two means, within the same row that have the same superscript letter.

**Table (3): Effect of petroleum ether of black pepper, Dill, and cumin on repellency of *C. maculatus* adults on Faba bean seeds .**

| Plants Extract | Conc. (mg/l. air) | Exposition period (day) | | | | Mean |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 5 | |
| Black pepper (fruits) | 1000 | 18.89±4.44$^{dA}$ | 18.89±4.44$^{cA}$ | 18.89±4.44$^{dA}$ | 18.89±4.44$^{eA}$ | 18.89±1.89$^{d}$ |
| | 500 | 55.56±6.76$^{aA}$ | 55.56±5.68$^{aA}$ | 55.56±5.68$^{aA}$ | 55.56±5.68$^{bA}$ | 55.56±5.97$^{a}$ |
| | 250 | 30.00±6.94$^{cC}$ | 41.11±3.52$^{bA}$ | 40.00±2.62$^{c}$0$^{AB}$ | 35.56±0.6$^{dBC}$ | 36.67±4.96$^{c}$ |
| | 125 | 43.33±8.39$^{bC}$ | 53.33±1.71$^{aA}$ | 48.89±6.14$^{bAB}$ | 47.78±5.55$^{cBC}$ | 48.33±5.78$^{b}$ |
| | 0 | 50.00±1.92$^{aC}$ | 46.67±5.77$^{bC}$ | 55.55±4.01$^{aB}$ | 67.78±2.94$^{aA}$ | 55.00±2.94$^{a}$ |
| | Mean | 39.56±4.26$^{B}$ | 43.11±5.48$^{AB}$ | 43.78±5.78$^{AB}$ | 45.11±6.17$^{A}$ | 42.89±2.68 |
| Dill (seeds) | 1000 | 14.44±4.44$^{cA}$ | 14.44±4.44$^{dA}$ | 16.67±3.85$^{dA}$ | 15.56±4.84$^{cA}$ | 15.28±1.90$^{d}$ |
| | 500 | 15.55±4.01$^{cAB}$ | 11.11±2.94$^{dB}$ | 20.00±1.92$^{dA}$ | 15.55±2.22$^{cAB}$ | 15.56±1.55$^{d}$ |
| | 250 | 30.00±1.92$^{bA}$ | 23.33±5.77$^{cB}$ | 28.89±2.94$^{cA}$ | 22.22±2.94$^{bB}$ | 26.11±1.87$^{c}$ |
| | 125 | 35.56±4.84$^{bA}$ | 37.78±2.94$^{bA}$ | 36.67±0.00$^{bA}$ | 21.11±6.19$^{bB}$ | 32.78±2.72$^{b}$ |
| | 0 | 50.00±1.92$^{aC}$ | 46.67±5.77$^{aC}$ | 55.55±4.01$^{aB}$ | 67.78±2.94$^{aA}$ | 55.00±2.94$^{a}$ |
| | Mean | 29.11±3.80$^{A}$ | 26.67±4.02$^{A}$ | 31.56±3.87$^{A}$ | 28.44±5.53$^{A}$ | 28.94±2.14 |
| Cumin (seeds) | 1000 | 40.00±5.77$^{bB}$ | 46.67±6.94$^{bA}$ | 47.78±5.55$^{cA}$ | 41.11±4.01$^{cB}$ | 43.89±2.62$^{c}$ |
| | 500 | 32.22±2.94$^{cA}$ | 26.67±3.33$^{cB}$ | 20.00±1.92$^{dC}$ | 24.45±7.78$^{dBC}$ | 25.83±2.36$^{d}$ |
| | 250 | 47.78±8.68$^{aC}$ | 55.55±7.78$^{aB}$ | 68.89±4.01$^{aA}$ | 71.11±2.22$^{aA}$ | 60.83±3.94$^{a}$ |
| | 125 | 51.11±5.88$^{aC}$ | 54.44±7.29$^{aBC}$ | 57.78±7.78$^{bB}$ | 63.33±1.71$^{bA}$ | 56.67±3.85$^{ab}$ |
| | 0 | 50.00±1.92$^{aC}$ | 46.67±5.77$^{bC}$ | 55.55±4.01$^{bB}$ | 67.78±2.94$^{abA}$ | 55.00±2.94$^{b}$ |
| | Mean | 44.22±2.84$^{C}$ | 46.00±3.68$^{BC}$ | 50.00±4.79$^{AB}$ | 53.56±5.43$^{A}$ | 48.44±2.15 |

a, b & c: There is no significant difference (P>0.05) between any two means for each extract, within the same column have the same superscript letter;

A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

### 3. 1.2.3- Effect of Chloroform Extract:

The results of repellency assays for tested chloroform plant extracts (PE´s) on Faba bean seeds presented in **Table( 4).** Data on the percentage of repellency (PR´s) of three plant extracts (PE´s) with five concentrations against beetles infested adults were tested. Data clear the significant and the relationships between concentrations and exposure periods.

Results showed that the Dill (seeds) and Black pepper (fruits) (seeds) PE´s were strong repellent of *C. maculatus* (70.00±5.09 and 58.89±4.44 after (5 & 1) days exposure period, at (125 & 1000 mg/l air) for abovementioned PE´s, respectively, while, Cumin recorded (56.67±8.82) after 2 day exposure period at 1000. mg/l air.

The concentration used had a substantial impact on the PE´s' repellence activities, and it's important to observe that extended exposure times also boosted the activity. When applied, the Dill PE exhibited the strongest repellence activity against *C. maculatus*, followed by cumin and black pepper.

The repellence activities of the PE´s were significantly influenced by the concentration applied and, interestingly, the activity was also increased when insects were exposed for a longer time. Dill (seeds) PE´s, showed higher repellence activity to *C. maculatus*, when applied at all used concentrations, which recorded (54.17±2.23) repellency as mean of different exposure days, followed by Cumin and black pepper PE´s (53.17±1.54 & 42.94±2.03) against *C. maculatus* adults, respectively.

**Table (4): Effect of chloroform extract of black pepper, Dill and cumin on repellency of *C. maculatus* adults on faba bean seeds .**

| Plants extract | Conc. (mg/l. air) | Exposition period (day) | | | | Mean |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 5 | |
| Black pepper (fruits) | 10 | $58.89\pm4.44^{aA}$ | $53.33\pm1.93^{aB}$ | $40.00\pm3.85^{bC}$ | $37.78\pm2.94^{bC}$ | $47.50\pm3.05^{b}$ |
| | 5 | $35.55\pm9.09^{cA}$ | $35.56\pm7.29^{cA}$ | $35.56\pm7.29^{bA}$ | $34.45\pm6.19^{bA}$ | $35.28\pm3.22^{c}$ |
| | 2.5 | $36.67\pm1.93^{cA}$ | $27.78\pm2.22^{dB}$ | $24.44\pm1.11^{cB}$ | $24.45\pm4.01^{cB}$ | $28.33\pm1.86^{d}$ |
| | 1.25 | $42.22\pm11.6^{bA}$ | $45.56\pm5.88^{bA}$ | $37.78\pm5.55^{bB}$ | $33.33\pm5.77^{bB}$ | $39.72\pm3.54^{c}$ |
| | 0 | $57.78\pm4.84^{aC}$ | $57.78\pm2.94^{aC}$ | $63.33\pm1.93^{aB}$ | $76.67\pm1.93^{aA}$ | $63.89\pm2.69^{a}$ |
| | Mean | $46.22\pm3.86^{A}$ | $44.00\pm3.43^{AB}$ | $40.22\pm3.81^{B}$ | $41.33\pm5.15^{B}$ | 42.94±2.03 |
| Dill (seeds) | 10 | $17.78\pm5.88^{cC}$ | $34.45\pm2.22^{bB}$ | $31.11\pm4.01^{eB}$ | $45.55\pm9.09^{dA}$ | $32.22\pm3.9^{c}$ |
| | 5 | $51.11\pm2.37^{bC}$ | $58.89\pm14.95^{aB}$ | $51.11\pm10.6^{dC}$ | $63.33\pm8.39^{cA}$ | $56.11\pm5.28^{b}$ |
| | 2.5 | $58.89\pm7.78^{aA}$ | $61.11\pm5.88^{aA}$ | $54.45\pm2.22^{cdB}$ | $60.00\pm3.85^{cA}$ | $58.61\pm2.41^{b}$ |
| | 1.25 | $48.89\pm9.10^{bC}$ | $62.22\pm4.44^{aB}$ | $58.89\pm2.94^{bcB}$ | $70.00\pm5.09^{bA}$ | $60.00\pm4.48^{ab}$ |
| | 0 | $57.78\pm4.84^{aC}$ | $57.78\pm2.94^{aC}$ | $63.33\pm1.93^{aB}$ | $76.67\pm1.93^{Aa}$ | $63.89\pm2.69^{a}$ |
| | Mean | $46.89\pm5.13^{C}$ | $54.89\pm4.62^{B}$ | $51.78\pm3.61^{B}$ | $63.11\pm3.67^{A}$ | 54.17±2.23 |
| Cumin (seeds) | 10 | $51.11\pm5.88^{bBC}$ | $56.67\pm8.82^{aA}$ | $48.89\pm5.88^{bC}$ | $54.44\pm5.88^{bAB}$ | $52.78\pm3.01^{b}$ |
| | 5 | $52.22\pm4.01^{bA}$ | $45.56\pm9.87^{bB}$ | $42.22\pm4.84^{cB}$ | $52.22\pm10.6^{bA}$ | $48.06\pm3.61^{b}$ |
| | 2.5 | $44.44\pm5.88^{cC}$ | $54.45\pm7.78^{aAB}$ | $51.11\pm4.01^{bB}$ | $57.78\pm2.94^{bA}$ | $51.94\pm2.77^{b}$ |
| | 1.25 | $54.45\pm4.01^{abA}$ | $44.45\pm2.22^{bB}$ | $42.22\pm5.88^{cB}$ | $55.55\pm11.76^{bA}$ | $49.17\pm3.46^{b}$ |
| | 0 | $57.78\pm4.84^{aC}$ | $57.78\pm2.94^{aC}$ | $63.33\pm1.93^{aB}$ | $76.67\pm1.93^{aA}$ | $63.89\pm2.69^{a}$ |
| | Mean | $52.00\pm2.23^{B}$ | $51.78\pm3.07^{B}$ | $49.55\pm2.74^{B}$ | $59.33\pm3.75^{A}$ | 53.17±1.54 |

a, b & c: There is no significant difference (P>0.05) between any two means for each extract, within the same column have the same superscript letter;
A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

**Discussion**

The repellency of the three PE´s at five test concentrations against with acetone at five test concentrations against *C. maculatus* adults differed significantly. The findings showed significant differences for PE´s, the most effective PE´s was Back Pepper , Cumin and Dill, respectively. Also ,The most effective PE´s were cumin (seeds), followed by black pepper (fruits) and dill (seeds), according to the average repellency of the three PE´s in five tests concentrations towards petroleum solvent . Dill (seeds) PE´s, indicated higher repellency activity to *C. maculatus,* when applied at each concentrations, followed by Cumin and black pepper PE´s, respectively, when applied with Chloroform plant extracts (PE´s) on Faba bean seeds.

**Tembo and Murfitt**, **(1995)** indicated that anoxia was the cause of the death. This is supported by the results showing that fumigant toxicity was considerably increased when plant oils were employed in conjunction with controlled atmosphere treatment .The controlled environment is known to help insects regulate two physiological and biological aspects of stress. **Donahaye and Navarro, (2000)** One is the decrease in O2 concentration, which causes anoxia or hypoxia; the other is the rise in CO2 concentration, which causes hypercarbia, or both. In China, plants having insecticidal properties, like pyrethrum (Tanacetum cinerariifolium (Trevir.) Schultz-Bip.), tobacco (*Nicotiana tobacum* L.), and neem (*Azadirachta spp.*), have long been employed to manage agricultural pests.

**Ileke and Oni, (2011)** tested effectively toxic plant extract against storage insect *C. maculatus*. The mortality could be attributed to the toxic effects of the chemicals in the tested plant species.

**Ito EE and Ighere (2017)** reported that used plants extracts were be one of the most safety methods , The interaction of plant substances and solvent effects may be the cause of the cowpea beetle's death.

**Elgizawy, *et al.*, (2019)** determined The chemical structure of the essential oil extracted from *Litsea cubeba* (Lauraceae) fruits Furthermore, in order to assess the essential oil's contact and fumigant toxicity as well as its repellent properties against the adults of two stored grain insect pests—the red flour beetle, *Tribolium castaneum* (Herbst.) and the rice weevil, *Sitophilus oryzae* (L.)—in the lab, the results indicated that the essential oils citral and dlimonene had higher fumigation toxicity on the same insects, 4.44, 4.89, and 16.68 μg/l, respectively.

**Madavi *et al.* (2022)** studied the effect of plant extracts as a repellency substances black pepper , sweet flag and clove were recommended as a repellency plants against stored grain..

**Alhadidy, (2023)** investigated the effects of steeping chickpea *seeds (Cicer arietinum* L.) Using ethanolic and aqueous extracts of the *Oleander Nerium oleander, Basil Ocimum basilicum, Chinaberry Melia azedarach*, and *Natgrass Cyperus rotundus* leaves on certain biological aspects of the cowpea beetle *Callosobruchus maculatus* (Fab.). The results of this investigation demonstrated the advantage of aqueous extracts over ethanolic extracts, as well as the superiority of oleander and chinaberry leaf extracts over basil and nutgrass leaf extracts.

**Gupta, *et al.*(2023)** investigated The chemical structure of seven essential oils (EOs) . The obtained results showed that every EO combination exhibited synergistic effects. *A. calamus* shown greater repellence against *C. maculatus* and *C. chinensis* in the repellency assay (RC50 = 53.98 and 118.91 µL/L) respectively

**Michael, *et al*. (2023)** recommended that, effectiveness of *A. wilkesiana* extracts in defending cowpea seeds against *C. maculatus* can be utilized as a sustainable alternative to chemical insecticides. Also, **Akbar, *et al* . (2024)** evaluated the effectiveness of five plant extracts against *Callosobruchus maculatus* L.: *Nicotiana tabacum* L., *Nicotiana rustica* L., *Azadirachta indica A. Juss*., *Thuja orientalis* L., and *Melia azedarach* L. results revealed that, The efficacy of *A. indica* was highest, In contrast, *T. orientalis* was found to be the least effective against *C. maculatus*, With increasing dosage and duration, the repellency of *C. maculatus* on plant extracts rose to its maximum

**Alhoqail, (2025)** examined The bioefficacy of plant extracts *(Melia azedarach* L., *Nicotiana rustica* L., *Azadirachta indica* L., *Nicotiana tabacum* L., and *Thuja orientalis* L.) against *Callosbruchus maculatus* . The effectiveness of *A. indica*, *N. rustica*, and *N. tabacum* in controlling *C. maculatus* was highlighted.

**Muhammad, (2025)** indicated that, the concentration of the plant extract and the duration of time spent against adults varied in the proportions of attraction and repellency.

## 4- Conclusion :

The results of this investigation show that three plant extracts' repellent properties against the adult *C. maculatus* varied significantly. The percentage of repellency (PR´s) of three plants extracts (PE´s) with five concentrations against *C. maculatus* adults showed that most PE´s were mightily bouncer against *C. maculatus*, and these bioactivities followed up clear dose-response relationships, and the concentration-response analyses were significant, As concentrations rose, the repellency rose as well and exposure period.

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