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Original Article

# Effect of Five Essential Oils as Repellents against the Cowpea Beetle, *Callosobruchus maculates* (F.)

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**ABSTRACT**

*In the world, Callosobruchus maculatus (F.) (Coleoptera: Chrysomelidae) is pest of cowpea grains. The aim of the current study was to evaluate the repellent activity of essential oils of Camphor (Eucalyptus globules) Castor (Ricinus communis), Cinnamon (Cinnamomum zeylanicum), Clove (Syzygium aromaticum) and mustard (Brassica rapa). The treatments, which contained essential oils at 0.01, 0.1 and 1% and acetone (control), were applied on half filter paper butted in the surfaces of Petri dishes. All the essential oils with 1% concentration repelled the adult C. maculates except the castor oil. The percentage of preference and repellence after 4 h was higher when filter paper treated with essential oil of cinnamon 1% compared with other essential oils and concentrations. Non significant repellent effect was found in 0.01% concentration in all tested essential oils. Based on our results, we can conclude that essential oils of camphor, Cinnamon, Clove and mustard have potential for use in the integrated management of adult C. maculates.*

***Keywords***: *botanical insecticides, cowpea beetle, essential oil, repellency.*

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## INTRODUCTION

The cowpea beetle, *Callosobruchus maculatus* (F.) is associated with cowpea storage, where it can attack the whole cowpea grains. Traditional organophosphates, such as malathion and pirimiphos-methyl are the most commonly used residual insecticides in stored grains [1, 2]. Chemical insecticides can cause pest resistance, environmental and food contamination and toxicity to non-target organisms [3, 4]. Plants produce secondary metabolites many of which can have insecticidal properties, as an alternative to synthetic insecticides [5]. Plant extracts and essential oils have traditionally been used to kill or repel stored product insects [6, 7, 8, 9]. The insecticidal constituents of many essential oils against stored product insects are mainly monoterpenoids such as limonene, linalool, terpineol, carvacrol and myrcene [10, 11]. Essential oils of several medical plant displayed considerable fumigant and repellent effects on adults of *C. maculates* [12, 13].

In this study, essential oils from five species of medical plants (Camphor (*Eucalyptus globulus*), Castor (*Ricinus communis*), Cinnamon (*Cinnamomum zeylanicum*), Clove (*Syzygium aromaticum*) and mustard (*Brassica rapa*) plants) were tested for repellent activity against *C. maculatus*.

## MATERIALS AND METHODS

Insect: Parent adults of Cowpea beetle, *Callosobruchus maculatus* were obtained from laboratory stock cultures maintained at the plant protection department, Faculty of Agriculture, Sohag University, Sohag, Egypt. They were reared in climatic chamber at 25 ± 2 °C, 70 ± 10% relative humidity (RH) and darkness. The food media used was whole Cowpea grains.

Essential oils: The essential oils were purchased from El Captain Campany (CAP PHARM), Obour City, Egypt: camphor (*Cinnamomum camphora*), Castor (*Ricinus communis*), Cinnamon (*Cinnamomum zeylanicum*), Clove (*Syzygium aromaticum*) and mustard (*Brassica rapa*).

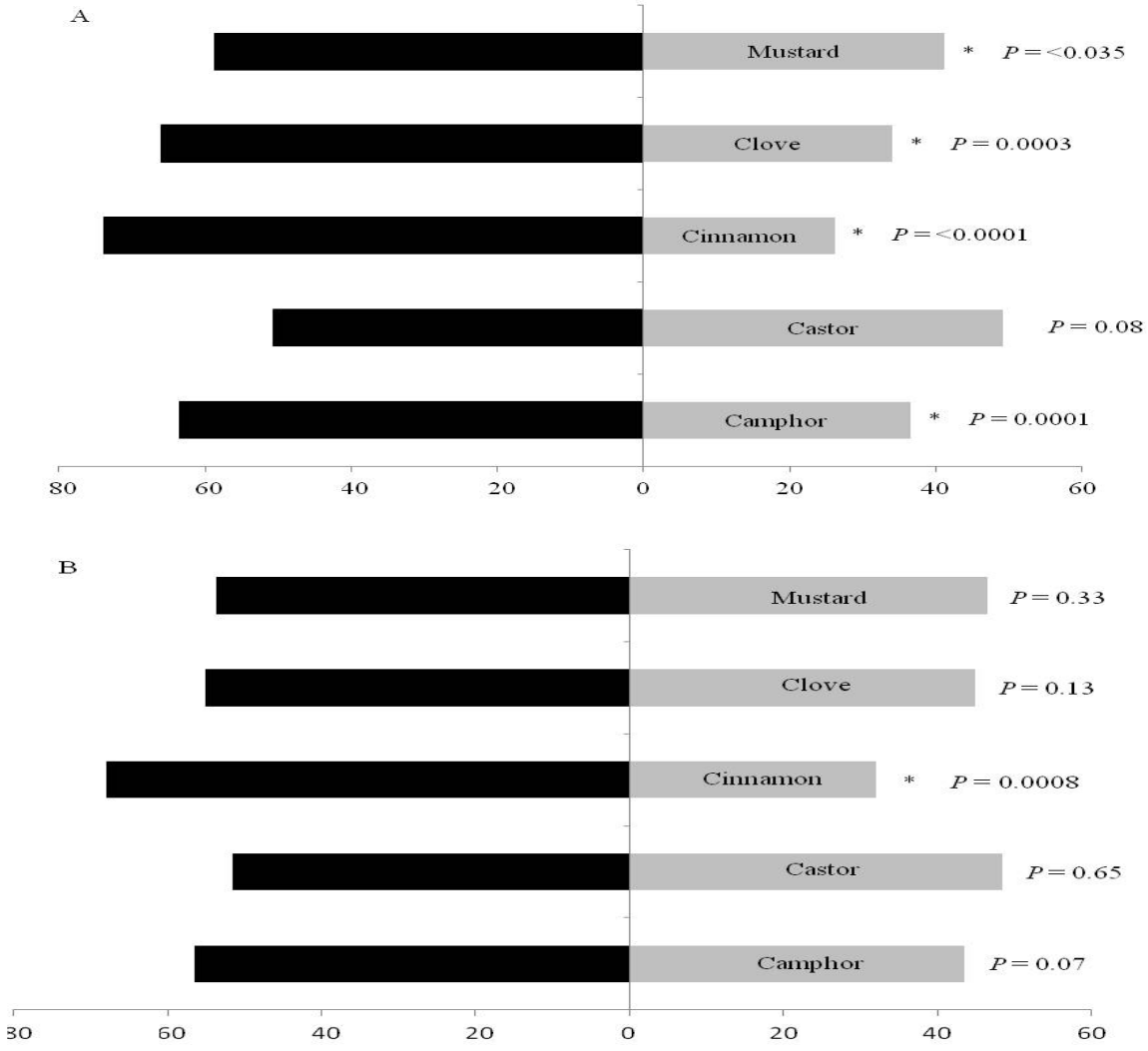
Experiment: The repellency tests were done in Petri dishes (9 cm diameter), containing filter papers inside (Whatman Nº 1) in the dimension of the dishes. Solutions were prepared at concentrations of

0.01, 0.1 and 1 %, %), in a logarithmic series (Robertson and Preisler 1992). On one half of filter paper, uniformly, 0.5 mL of each concentration of the essential oils was applied, and on the other half only acetone was applied. The treated and control half-discs were left at 10 minutes for the solvent to evaporate. On the center of each dish, 20 adults of *C. maculatus*, unsexed were placed. The treatments were repeated twenty times. The number of beetles present in the control half (NC) and the treated half (NT) were recorded after 4 hours (h) [14]. The repellency assay was placed in an environmental-controlled room (25 ± 2 ºC, 70 ± 10% RH and darkness).

Statistical Analysis: The results were compared by the paired t-test at 5 % probability using SAS software [15]. The percentage of repellency (PR) values were classified into classes of repellency 0, I, II, III, IV or V, where, class 0 (PR ≤ 0.1 %), class I (PR = 0.1 – 20 %), class II (PR = 20.1– 40 %), class III (PR = 40. 1 – 60 %), class IV (PR = 60. 1 – 80 %) and class V (PR = 80. 1 – 100 %), and negative PR values were treated as zero [16, 17, 18].

## RESULTS AND DISCUSSION

Percentage of preference and repellence (PR) values are shown in Figure 1 and Table 1, respectively. Four essential oils exhibited repellent activity against *C. maculates* after 4 h. Data in Figure 1 showed that Cinnamon oil had generally a more effective repellent (47.5%) against adults *C. maculates*. Moreover, the statistical analysis revealed a significant difference between this oil and the other oils with 0.1% concentration. However, Castor oil had less PR values in all concentrations been used. The rest of essential oils had a moderate repellent action. A non significant difference showed between the essential oils with 0.01% concentration against *C. maculates*. In generally, the efficacy in respect of the repellency followed in the order: cinnamon > clove > camphor > Mustard > castor after 4 h after treatment.



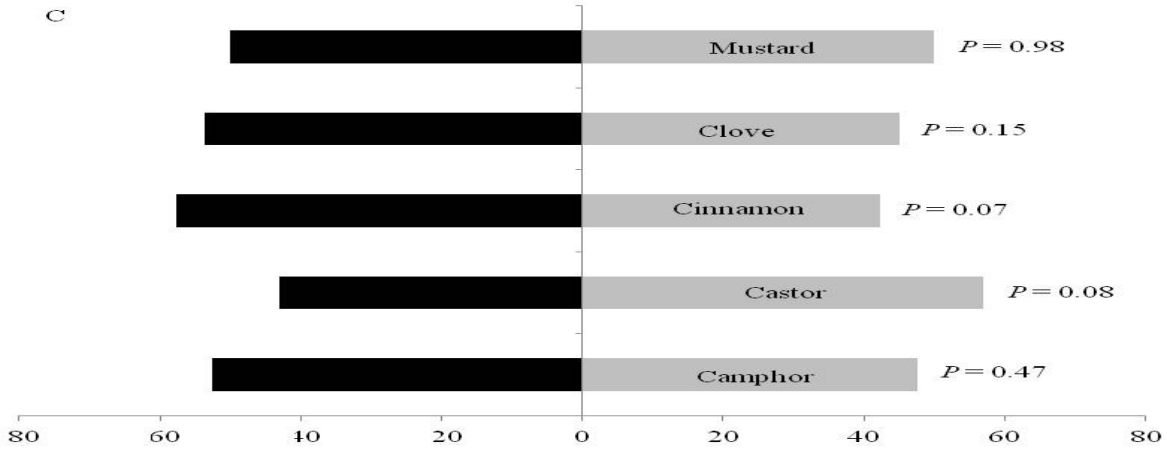



**Figure 1:** Preference (%) of *Callosobruchus maculatus* for a half filter paper treated or not with five essential oils with concentrations (A) 1%, (B) 0.1% and (c) 0.01 after 4 h, in free choice test. * Significant values at 5 % probability by t-paired test ($p < 0.05$).

The classes of repellency were higher with the essential oil of *C. zeylanicum* at 1 % (classes III) compared with those from essential oils and other essential oils at 0.1 and 0.01% (classes II and I) (Table I).

**Table I. – Mean percent repellency (PR) values for five essential oils tested on adults of *Callosobruchus maculates* in free-choice test**

| Concentrations<br>Essential oils | 0.01 % | 0.1 % | 1 % |
|---|---|---|---|
| Camphor | 5 I | 13 I | 27 II |
| Castor | 0 | 3 I | 1.5 I |
| Cinnamon | 15.5 I | 36 II | 47.5 III |
| Clove | 8.75 I | 10 I | 32 II |
| Mustard | 0 | 7.25 I | 17.5 I |

Classes of Repellency: class I (PR = 0.1-20 %), class II (PR = 20.1-40 %), class III (40.1-60 %).
Negative PR values were treated as zero

Cinnamon powder also was showed generally a more repellent effective on adults of *Sitophilus granarius*. *Rhyzopertha dominica* and *T. castaneum* [19]. The powders of *Piper nigrum*, *Capsicum annuum* and *C. zeylanicum* (Cinnamon plant) showed a repellent effect on *Sitophilus zeamais* [20]. The clove oil had repellent activity on three important stored grain insect pests, *R. dominica*, *Sitophilus oryzae* and *T. castaneum* [21]. The monoterpene camphor might have broad insecticidal activity against stored–product insects and act as the fumigant in *Asplenium haussknechtii* oil. Camphor from several Artemisia species reported that is toxic against stored–product beetles [22, 23, 24]. Quintai and Yongcheng [25] proved repellent efficacy of camphor in the control of *T. castaneum*. Effect of mustard oil also has been reported on *Callosobruchus chinensis* [26] and *S. zeamais* [27].

## CONCLUSION

Based on the present study, it could be concluded that essential oils of cinnamon, clove, camphor and mustard pose potential repellent activity against adults *C. maculates*. The study demonstrates that these essential oils can play an important role in protection of cowpea grains from *C. maculates*.

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