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## Research Article

# Effect of some plant oils to control pest insects of Rusty flour beetle, *Tribolium castaneum* and Small grain borer, *Rhyzopertha dommica*

Feryal H. SADIQ[1], Fayhaa Abbood Mahdi AL-NADAWI[*2]

[1]*Department of Plant Protection, College of Agricultural Engineering Science, University of Baghdad, Baghdad, Iraq.*
[2]*Department of Sciences, Basic Education College, Mustansiriyah University, Baghdad, Iraq.*
[*]*Email: lneadawi@uomustansiriyah.edu.iq*

**Abstract**
This study was carried out to investigate the effect of four kinds of plant oils to control insects *Tribolium castaneum* and *Rhyzopertha dommica*. *Heliantjus annus* and *Communis ricinus* oils were used aginst *T. castaneum* and *Olea europea* and *Nucifera cocos* oil aginst *R. dommica.* The plant oils were used in three concentrations of 2.5, 5, and 7.5ml/kg. The results showed different effects of the used oils and concentration, however, all oil had effective role in decreasing number of larvae and pupae, and adult pest's Coconut oil was also more effective than the others at 2.5, 5, and 7.5ml/kg.

**Keywords:** Plant oil, Olive, Coconut, Protection.

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## Introduction

Pests are among the main problems damaging 10-40% of the stored grains and other food products. In adult and larval stages, Rusty flour beetle Tribolium cataneum infect grains, legumes, and museum specimens (Via 1999; Weston, & Rattingourd 2000). This insect is characterized by a high ability to reproduce and cause rapid infection if the environmental conditions are appropriate. It causes a loss of 15-10% of the stored materials in one season. In addition, contamination of the rest of food materials become unsuitable for human and animal use due to the unacceptable odours or their damage. The flour infected with the rusty flour beetle has a mouldy smell and taste bad due to the insect's secretions (Quanin) and changes in the chemical composition of the infested grains (Walkil et al. 2003). Fogliazza & Pagon (2003) mentioned that the rusty flour beetle is one of the most influential insects in the rubberiness of the infested dough made of infested wheat flour, thus having a negative impact on the quality of bread.

Small grain borer, *Rizopertha dominica* (Bostrichidae: Coleoptera) is one of the most important pests globally. It infects various cereals, especially wheat grains, and causes great losses because it has strong jaws that burrow into the grains (Al-Azzawi & Mahdi 1983; Zarzis 1993). Its larvae enter the grain and feed on its contents and only the peel remains, and it consumes more than its need because of its ability to pierce dry grains (Al-Azzawi & Mahdi 1983).

Many methods are used to control warehouse insects, and the difficulty of controlling them is that they are present with stored food materials. The use of pesticides as one of the control methods pollutes these food materials. In addition, the repeated use of pesticides leads to the emergence of resistance in

insects. Recent research has shown that methyl bromide has a toxic effect leading to genetic mutations (Danse & others 1984). Temperatures were also used as one of the methods of controlling pests. The appropriate temperatures for insect activity generally fall between 20-30°C, and the lower temperature (-15) is deadly for most insects. This method is considered one of the safe and effective methods in controlling pests and preventing their recurrence. Many researchers recommended cold storage as an alternative to chemical methods in controlling warehouse insects (Durel 1905; Summous & Carsol 1924). Salt (1963) studied the effect of temperature (-15) in controlling rusty flour beetles.

The use of natural products such as plants has shown successful and effective natural control because of their desirable qualities, being quick decomposing compounds with high effectiveness against harmful insects and little harm to humans and the environment (Petrson & Others 2000). Therefore, many studies used plants as inhibitors for feeding insects, repellents or growth regulators (Muostafa 2000). Also, researchers conducted many studies to control pest insects using plant powders (Khalaf & Aylan 1999; Farhan 2002; Al-Farmani & Khalaf 2009).

Vegetable oils were also used as one of the methods to control stored material against insect pests (Donepedro, 1989). Vegetable oils have a toxic effect on insect eggs as they kill the fetus and have a fatal and repellent effect on the adults of the insect. Therefore, this study aimed to find an effective method against the rusty flour beetle and the small grain borer using some plant oils.

## Materials and methods

Four types of vegetable oils, including sunflower oil, *Heliantjus annus*, castor oil, *Communis ricinus*, olive oil, *Olea europea*, coconut oil, *Nucifera cocos* were used in this study. These vegetable oils were obtained from local markets. Two types of natural foods i.e. wheat seeds and wheat groats, were considered as infection media for insects. The mentioned materials were sterilized in an electric oven at a temperature of 60°C for two hours. Sunflower oil and castor oil were added to the wheat groats, olive oil and coconut oil to the wheat seeds. The oils were then added in concentrations of 2.5, 5, and 7.5ml per kg of food and mixed well with food items. Oil was mixed with food using ordinary nylon bags to obtain a homogeneous mixture of oils and seeds i.e. the bags were manually moved and shaken. The oiled seeds were transferred to an airtight place for two weeks to saturate the seeds with oil (Mahdi & Hamoudi 1984). Small vials were used so that each vial contained 10g of oiled seeds. Three replicates were used for each treatment, and the refiner was expressed as one vial. For the comparison, bottles of untreated seeds consisting 10g were used. The bottles were placed in an incubator. The number of larvae and pupae, adults and remaining food was calculated every two weeks. at a temperature of 32±2°C and relative humidity of 70±5%.

**Statistical analysis:** SAS (System – SAS 2012) program was used to analyze the data to study the effect of different factors on the studied traits according to a complete random design (CRD). The significant differences between the means were compared with the LSD test.

## Results and discussion

In sunflower oil treatments, the results showed the highest rate of the rusty flour beetle larvae as 6.8 in the control group (oil-free groats), and the lowest rate as 0.6 in 7.5ml/kg treatments (Table 1). The results also showed the highest number of pupae as 5.4 in the control group, and the lowest in 0.6 at 7.5ml/kg treatments. The highest rate of the adults was 8.8 in the control group and the lowest 0.0 in 7.5ml/kg treatment.

The results showed that castor oil had a significant effect on the studied characteristics of the rusty flour beetle. The highest number of larvae was recorded in the control group, while the lowest rate was 0.6 in 7.5ml/kg treatment. The highest number of pupae

**Table 1.** Shows the average (larvae, pupae, and adults) of food remaining for the rusty flour beetle treated with different concentrations of sunflower oil.

| The rest of the food | Adult rate | Pupal rate | Larval rate | concentration | Sample collection date |
|---|---|---|---|---|---|
| 9.88 | 9 | 8.6 | 8.3 | 2.5 | 17-3-2017 |
| 9.90 | 8.3 | 7.3 | 7.3 | 5 | |
| 9.88 | 7.6 | 6.6 | 7 | 7.5 | |
| 9.83 | 8 | 7 | 7.3 | 2.5 | 31-3-2017 |
| 9.82 | 6.6 | 6 | 7 | 5 | |
| 9.76 | 5.3 | 5.3 | 6 | 7.5 | |
| 9.78 | 7 | 6.6 | 6.3 | 2.5 | 14-4-2017 |
| 9. 78 | 5.6 | 4.6 | 5.3 | 5 | |
| 9.70 | 3.6 | 4 | 4.6 | 7.5 | |
| 9.67 | 5.3 | 5.6 | 5.3 | 2.5 | 28-4-2017 |
| 9.76 | 3.6 | 3.6 | 4 | 5 | |
| 9.65 | 1.6 | 3 | 3 | 7.5 | |
| 9.52 | 3.3 | 3.6 | 3.3 | 2.5 | 12-5-2017 |
| 9.70 | 1.6 | 1.3 | 1.6 | 5 | |
| 9.60 | 0 | 0.6 | 0.6 | 7.5 | |
| | 8.8 | 5.4 | 6.8 | Control | |
| | 3.148 | 2.667 | 2.913 | ------- | LSD |
| | | | ($P$<0.05 ) | | |

**Table 2.** Shows (larvae, pupae and adults) and the remaining food for the rusty flour beetle treated with different concentrations of castor oil.

| The rest of the food | Adult rate | Pupal rate | Larval rate | concentration | Sample collection date |
|---|---|---|---|---|---|
| 9.97 | 8.6 | 8 | 8 | 2.5 | 17-3-2017 |
| 9. 97 | 7.3 | 7 | 6.6 | 5 | |
| 9.98 | 6 | 5.6 | 5.6 | 7.5 | |
| 9.90 | 7.3 | 7.3 | 7 | 2.5 | 31-3-2017 |
| 9.95 | 6 | 6 | 5.3 | 5 | |
| 9.95 | 5 | 4 | 4.3 | 7.5 | |
| 9.82 | 5.6 | 6 | 6 | 2.5 | 14-4-2017 |
| 9.95 | 4.6 | 5.3 | 4 | 5 | |
| 9.88 | 2.6 | 2.3 | 3 | 7.5 | |
| 9.77 | 4.3 | 4.6 | 5 | 2.5 | 28-4-2017 |
| 9.90 | 2 | 3 | 2 | 5 | |
| 9.86 | 1 | 0 | 0.6 | 7.5 | |
| 9.70 | 2.3 | 2 | 3.3 | 2.5 | 12-5-2017 |
| 9.87 | 0.3 | 3 | 0 | 5 | |
| 9.84 | 0 | 0 | 0 | 7.5 | |
| | 8.6 | 5 | 7.2 | Control | |
| NS | 2.714 | 2.081 | 2.539 | ---------- | LSD |
| | | | ($P$<0.05) | | |

was 5, while the lowest rate was recorded in 7.5ml/kg treatment (0.0) (Table 2). These results agree with the findings of Mondal & Akhtal (1994) who reported that both castor oil and caffeine have an inhibitory effect on the rusty flour beetle. The results also agreed that Swidan (2005) concluded that garlic oil had a real effect against the rusty flour beetle.

Regarding olive oil, the results showed that the highest rate of the number of small grain borer larvae was 7 in the control treatment (oil-free wheat seeds), and the lowest rate as 0.3 was found in the concentration of 7.5ml/kg (Table 3). The results also showed that the highest number of pupae was 5.2 in the control and the lowest pupae as 0.0 in 7.5ml/kg group. In addition, the highest adult insects were 9.2 in the control group the lowest rate (0.3) in 7.5ml/kg treatment.

The results revealed that coconut oil had a significant effect on the studied characteristics of the small grain borer (Table 4). The highest average

**Table 3.** Shows the rate of (larvae, pupae and adults) and the food remaining of the small grain borer beetle treated with different concentrations of olive oil.

| The rest of the food | Adult rate | Pupal rate | Larval rate | concentration | Sample collection date |
|---|---|---|---|---|---|
| 9.88 | 8.3 | 8.6 | 8 | 2.5 | 17-3-2017 |
| 9.90 | 7.3 | 7.3 | 7.6 | 5 | |
| 9. 97 | 6.3 | 7 | 6.6 | 7.5 | |
| 9.96 | 7.6 | 7 | 7.3 | 2.5 | 31-3-2017 |
| 9.88 | 7 | 7 | 6.6 | 5 | |
| 9.96 | 5.3 | 5.3 | 5.6 | 7.5 | |
| 9.85 | 6.3 | 6.3 | 5.6 | 2.5 | 14-4-2017 |
| 9.73 | 5.6 | 5.6 | 5.3 | 5 | |
| 9.93 | 4.3 | 4.3 | 4.6 | 7.5 | |
| 9.85 | 5 | 5.6 | 5 | 2.5 | 28-4-2017 |
| 9.76 | 4.3 | 4 | 4.3 | 5 | |
| 9.87 | 3.3 | 2.3 | 3.3 | 7.5 | |
| 9.80 | 2.3 | 3.3 | 3 | 2.5 | 12-5-2017 |
| 9.54 | 0.6 | 1.3 | 1.6 | 5 | |
| 9.80 | 0.3 | 0 | 0.3 | 7.5 | |
| | 9.2 | 5.2 | 7 | Control | |
| NS | 3.426 | 2.558 | 3.178 | -------- | LSD |

**Table 4.** Shows the rate of (larvae, pupae and adults) and the remaining food for the small grain borer insect treated with different concentrations of coconut oil.

| The rest of the food | Adult rate | Pupal rate | Larval rate | concentration | Sample collection date |
|---|---|---|---|---|---|
| 9.98 | 8.6 | 8.6 | 8.3 | 2.5 | 17-3-2017 |
| 9.98 | 8 | 7.3 | 7.6 | 5 | |
| 9.98 | 6.6 | 6.6 | 6.3 | 7.5 | |
| 9.97 | 7.6 | 7 | 7.3 | 2.5 | 31-3-2017 |
| 9.97 | 6.6 | 6 | 6 | 5 | |
| 9.93 | 5 | 5.3 | 5.3 | 7.5 | |
| 9.97 | 6.3 | 5.6 | 6 | 2.5 | 14-4-2017 |
| 9.95 | 5.3 | 4 | 4.3 | 5 | |
| 9.93 | 2.6 | 3 | 2.6 | 7.5 | |
| 9.95 | 4 | 4 | 4.3 | 2.5 | 28-4-2017 |
| 9.95 | 2.3 | 1.3 | 1.3 | 5 | |
| 9.91 | 0.3 | 1.6 | 0 | 7.5 | |
| 9.93 | 1 | 0 | 1.6 | 2.5 | 12-5-2017 |
| 9.92 | 0 | 0 | 0 | 5 | |
| 9.90 | 0 | 0.6 | 0 | 7.5 | |
| | 9.6 | 4.6 | 6.8 | Control | |
| NS | 3.861 | 2.437 | 2.861 | --------- | LSD |

number of larvae was 7.2 in the control group and the lowest rate as 0.0 at 5 and 7.5ml/kg treatments. The results also indicated that the highest pupae (4.6) were in the control group while the lowest in the 5 and 7.5ml/kg groups (0.0). The results showed that the highest number of adults was (9.6) in control one, while the lowest (0.0) in 5 and 7.5ml/kg treatments (Table 2).

Based on the results, the number of larvae, pupae and adults of both insects decreased significantly in the grits and wheat seeds treated with the vegetable oils. The best-used oil was coconut oil, however the four vegetable oils have given protection to natural foods from infection by the studied two insects, especially coconut oil gave complete protection to wheat seeds. This finding is in agreement with Sangappa (1976) and Kaire et al. (1992), that reported complete protection for field pistachios from infection by the Chinese cowpea beetle *Callosobruchus chinensis* after treating them with vegetable oils (neem, mustard and, olive oils).

The vegetable oils used (sunflower, castor, olive, and coconut) in this work have significantly affected the larva, pupa and adult of the rusty flour beetle and

the small grain borer. The physical properties of these oils may make food items cause a change in the surface tension and cause lethal action to develop embryos or larvae of these insects during early age (Messina & Renwick (1993). The effective activity of vegetable oils is the triglycerides and fatty acids oleic acid caus (Hill & Schoonhoven 1981) that obstruct the bronchi and then the death of insects (Hewlet 1975).

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