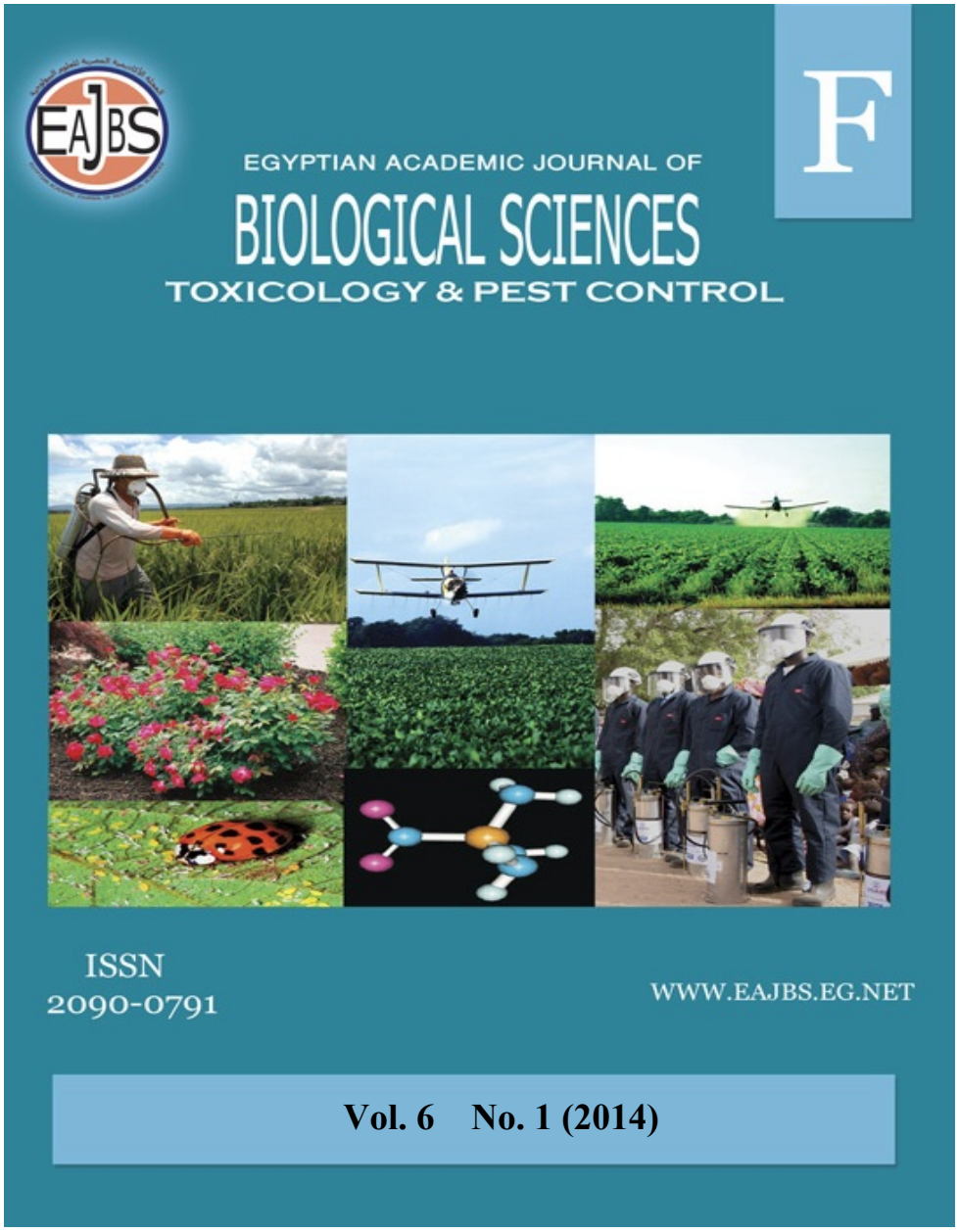

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Egypt. Acad. J. Biolog. Sci., 6(1): 65-71 (2014)

Egyptian Academic Journal of Biological Sciences
F. Toxicology & Pest control
ISSN :2090 - 0791
www.eajbs.eg.net

Evaluation the effectiveness of orange oil for controlling cowpea seed beetle *Callosobruchus maculates* (Fabricius) (Coleoptera: Bruchidae)

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ARTICLE INFO
Article History
Received: 25/8/2014
Accepted: 27/9/2014:

Key words:
Callosobruchus maculates
Coleoptera
Bruchidae
Orange oil

ABSTRACT

The cowpea seed beetle *Callosobruchus maculates* (Fab.) (Coleoptera: Bruchidae) is considered one of the most important pests attacking various cowpeas species in stores, causing serious damage and great loss of the crop.

The present study aimed to evaluate the efficiency of the orange oil against the adults of this pest under laboratory conditions. Experiments were carried out using four concentrations of orange oil (5, 2.5, 1.25 and 0.12 mg/l).The obtained results showed that, the tested concentrations were highly effective against the adults cowpea seed beetle, and there is a positive relationship between the concentration of the oil and the percentage of mortality of the adults. Data show very high mortality rates at all concentrations after 6 days from treatment. The mortality percentage reached 50% and 80% after 3 and 6 days from treatment, at the highest concentration (5mg /L.), respectively.

INTRODUCTION

Cowpea, *Vigna unguiculata* is considered one of the major and cheapest sources of vegetable protein in the human food, in most tropical and subtropical regions of the world (Rachie, 1985).

The cowpea seed beetle, *Callosobruchus maculates* (Fab.) is considered as the most worldwide insect pest infesting various *Vigna* species seeds in storage. Severe infestation resulting serious damage and noticeable reduction in quantity and quality of the crop, may reach 50 – 100% loss within several months from storage (Jood *et al*., 1993; Singh, 1978, Seck *et al*., 1991and Tanzubil, 1991). It is also one of the most important pests attacking various legumes in the Kingdum of Saudi Arabia (Mostafa *et al*., 1981).

Therefore, it is necessary to find out alternative efficient and safe control methods which are effective as pesticides without any problems in application and are friendly of the environment for controlling this pest away of the use of insecticides (Zettler and Cuperus, 1990 and White, 1995).

The effect of several plant extracts as pest control against some stored product pests were studied by many investigators (Afifi *et al*, 1988 and El Lakwah *et al*, 1992, 1993, 1995 and 2000).

The present work was carried out in order to evaluate the effectiveness of orange oil as natural component against cowpea seed beetle and to contribute to the possibility of using natural oils and plant extracts as alternatives of pesticides in controlling such pests.

MATERIALS AND METHODS

Cowpea seeds (*Vigna unguiculata*) were selected for this study as it is one of the most legumes preferable by the cowpea seed beetle (*C. maculates*) to feed, oviposite a large number of eggs, and the larvae develop faster on it, compared with other legume seeds (Decelle, 1981; Giga and Smit, 1987, Ogunwocu and Idowu, 1994 and Raja *et al*., 2001).

Seeds were brought from the local market , purified from damage seeds and/or other impurities, then washed, dried and maintained in suitable jars for at least three weeks to insure free of insect infestation (Rajapakze *et al*., 1998).

The experiment was carried out in the insect laboratory, faculty of science, princes Nora University, Riyadh, Saudi Arabia.

Method of Mahdy and Hamoudy, 1984 was followed, with some simple modification in seed treatment, where orange oil was used. Clean and not infested cowpea seeds were prepared and sterilized at 60°C for 20 minutes and were divided into equal parts in plastic bags.

Four treatments, each with three replicates at rates (5, 2.5, 1.25 and o.12 cm^3/ Kg. seeds). Oil was added to the bags using pipette and then shaken well in order to encapsulate the seeds with oil. All bags were left in a place away from any source of infestation for 15 days to the oil to get inside the seeds.

Plastic boxes ca. 6 x 4 cm were used, in each box an equal quantity of treated seeds were put. All replicates were weighted and fixed. Ten newly emerged adult beetles were added to each box and the boxes were covered with punched plastic cover. All boxes were incubated under controlled conditions (25C and 70% R. H.), suitable for grow and developing insects (Al-Jaberry and Abul Karem, 1987) and left for new adult emergence from seeds. Mortalities of adult insects were counted and recorded after 3 and 6 days from the treatment and the LC_{50} and LC_{90} were calculated using the probit analysis method. Comparisons were made on the basis of the slops of the probit (Finny, 1971).

RESULTS

Four concentrations of orange oil were tested for the control of adult cowpea seed beetle *Callosobrucus maculates* (Fab.). Data are tabulated in the following Tables:

Results in Table (1) indicated that the mortality percentage after 3 and 6 days from treatment increased with the increase of the concentration of the orange oil. The percentage ranged between 50% at the highest concentration (5 mg/l) and 20% at the least concentration (0.12%) after 3 days from treatment (Table 2). After 6 days the percentage increased in all concentrations, reached 80% at the highest concentration (5 mg/l), where as it was 70% at the lowest one, (Table 3).

Table 1: The effect of orange oil on adult *C. maculates* after three and six days from treatment.

Concentration Mg/L	replicates	Total no. insects	After 3 days from treatment		After 6 days from treatment	
			Dead	alive	dead	alive
5	1	10	5	5	9	1
	2	10	6	4	8	2
	3	10	4	6	7	3
2.5	1	10	3	7	9	1
	2	10	5	5	6	4
	3	10	2	8	8	2
1.25	1	10	4	6	8	2
	2	10	3	7	7	3
	3	10	1	9	7	3
0.12	1	10	4	6	7	3
	2	10	2	8	6	4
	3	10	0	10	8	2

It is also clear from Table (2) and Fig. (1) that, the value of LC_{50} equal 11. 907 mg/l, where as the value of LC_{90} equal 6367.559 after 3 days from treatment. After 6 days the value of LC_{50} reached 0.0002 mg/l and the value of LC_{90} was 2799.662 mg/l, (Table 3, Fig. 2). The slope was 0.47 and 0.179 after 3 and 6 days from treatment, respectively.

The x2 counted value was 1.402, whereas the tabulated value was 6 after three days from treatment. The x2 counted value was 0.11, whereas the tabulated value was 6 after six days from treatment.

Table 2: Response of *C. maculatus* adults to the tested orange oil concentrations after three days from treatment

No.	Treated	Concentration	Observed	Linear	Log	Linear
		10	Responded %	Responded %	Conc. 10	Probit
1	30	1.2	20	17.4242	0.079	4.062
2	30	12.5	26.667	32.2859	1.097	4.54
3	30	25	33.333	37.5125	1.398	4.682
4	30	50	50	42.9768	1.699	4.823

		slope	0.47	+/- 0.21
X2	1.402	Tabulated 6		

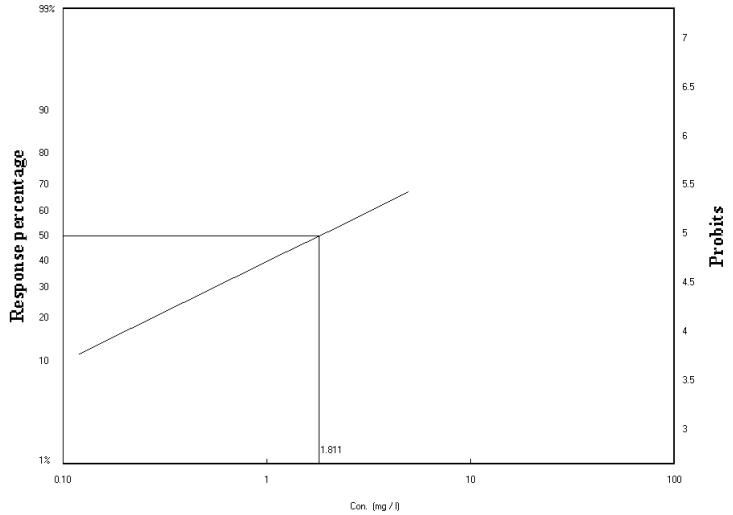

Fig. 1: Probit line showing response of *C. maculatus* adults to the different concentrations of orange oil after three days from treatment

Table 3: Response of *C. maculatus* adults to the tested orange oil concentrations after six days from treatment

No.	Treated	Concentration	Observed	Linear	Log	Linear
		10	Responded %	Responded %	Conc. 10	probit
1	30	1.2	70	69.1908	0.079	5.501
2	30	12.5	73.333	75.2716	1.97	5.683
3	30	25	76.667	76.9421	1.398	5.737
4	30	50	80	78.5406	1.699	5.791

Slope	1.79	+/- 0.201
X2	0.11	Tabulated 6

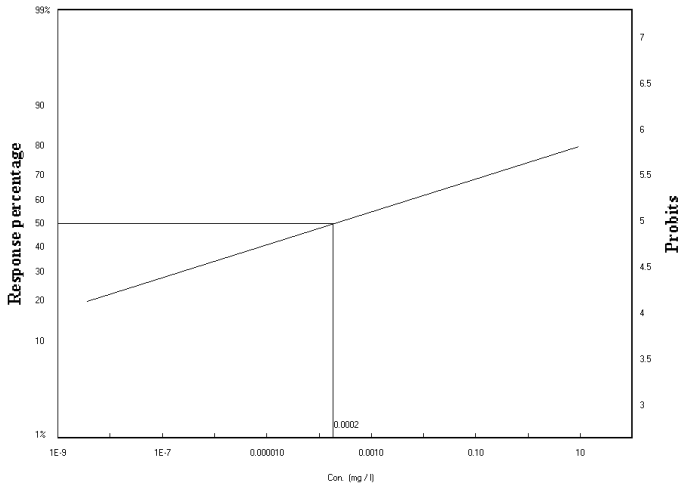

Fig. 2: Probit line showing response of *C. maculatus* adults to the different concentrations of orange oil after six days from treatment

Fig. (3) show comparison between the two toxicity linears for the used oil after 3 and 6 days from treatment and illustrate the value of LC_{50} of both periods.

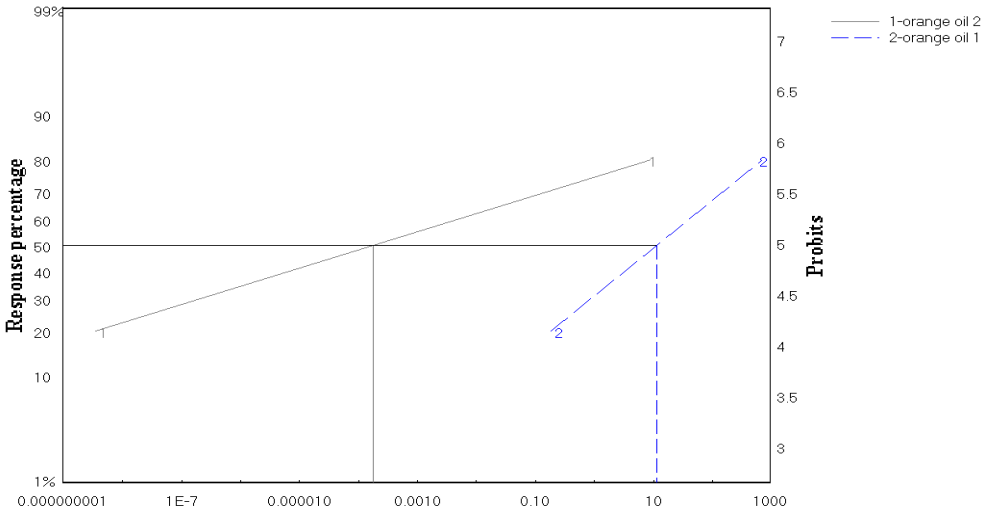

Fig. 3: Probit lines and LC values of orange oil on *C. maculatus* adults after three and six days from treatment under laboratory conditions

DISCUSSION

Current experiment indicated that the orange oil gave different rates of mortality differs according to the concentrations used on adults of *Callosobruchus maculatus*. High rates of mortality obtained with high concentrations after 3 and six days from treatment.

It is clear that the percentage of mortality of adult beetles positively correlated with the concentration of the oil in both periods and in all treatments.

The current results agree with those of Ali *et al*. (1983) who tested a number of plant oils (Neem oil, *Melia azaderach*; Coconut oil, *Cocos nucifera* ; Turnip oil, *Brassica* sp.; Sesame oil, *Sesanum indicum* and Palm oil, *Elaeis guineensis*) on adults of the cowpea seed beetles breading on chickpea plant which were used at concentrations 0.05 and 1ml/100 gm. seeds. They found that both neem and coconut oils caused high rates of mortality could reach 100% after three days from treatment at 1ml.

Also, the results agree with the finding of Ivbijara *et al*., 1985 who found that the mixture of coconut oil, ground nut oil and African palm oil with maize at concentration of 5 and 10 ml/kg. caused mortality rate of 67 – 100% for adult rice weevil *Sitophilus oryza* after 24 hours from exposure. Moreover, the oils at 1ml/kg. Caused the same mortality rate, but after 7 days.

The results also agree with Zewar (1987) who stated that, some plant oils (castor, olive, paraffin and maize) are efficient against adults of cowpea seed beetle *Callosobruchus maculatus*. And that when exposing adult insects of higher concentration 12ml / kg seeds caused death of 100% after two days of exposure to grains treated with castor and paraffin oils, whereas in the case of maize, oil caused 90% death at the same concentration.

The results also agree with the findings of Chaubey (2008), where he isolated the principle oil of seven kinds of spices, and studied their effect on oviposition, egg hatching and larval development of pulse beetle, *Callosobruchus chinensis*. These oils were: Black seed oil (*Nigella sativa*), Dill (*Anethum graveolens*), Cumin (*Cuminum cyaminum*), Star anise (*Illicium verum*), black pepper (*Piper nigrum*), Nutmeg (*Myristica fragrant*) and Ajwain (*Trachyspermum ammi*). All these oils caused death for adult insects. The most efficient oil was the oil of black seed (*Nigella sativa*) against all stages of the insect, followed by black pepper oil (*Piper nigrum*) then Nutmeg oil (*Myristica fragrant*), other oils were less effective.

The present study recommended orange oil against the cowpea seed beetle, *Callosobruchus maculatus*, especially when using high concentration 5 mg/L.

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ARABIC SUMMERY

تقييم فعالية زيت البرتقال فى مكافحة خنفساء اللوبيا (*Callosobruchus maculatus* (Fabricius (رتبة غمدية الاجنحة : فصيلة بروكيدى)

البندري فهد اليوسف

قسم الأحياء، كلية العلوم، جامعة الأميرة نوره بنت عبدالرحمن

المملكة العربية السعودية

تعتبر خنفساء اللوبيا من أهم الأفات واسعة الانتشار التى تهاجم الأصناف المختلفة من اللوبيا فى المخازن مسببة أضرارا خطيرة وفقد كبير فى البذور.

هدفت الدراسة الحالية الى تقييم فعالية زيت البرتقال فى مكافحة الحشرات الكاملة لخنفساء اللوبيا *Callosobruchus maculatus* (Fab.) تحت الظروف المعملية المنضبطة. أجريت التجارب باستخدام أربعة تركيزات من زيت البرتقال (٥ ، ٢.٥ ، ١.٢٥ ، ٠.١٢ ملجرام / لتر).

أوضحت النتائج المتحصل عليها ان التركيزات المستخدمة كانت عالية الكفاءة على الحشرات الكاملة لخنفساء اللوبيا وكانت هناك علاقة موجبة بينها وبين نسبة موت الحشرات الكاملة فى جميع المعاملات المستخدمة بعد ثلاثة ايام وستة ايام من المعاملة، حيث بلغت نسبة موت الحشرات عند أعلى تركيز (٥ ملجرام / لتر) بعد المعاملة بثلاثة أيام ٥٠% ، بينما بلغت ٨٠% بعد المعاملة بستة أيام عند نفس التركيز.