American Journal of

Biochemistry and Molecular Biology

ISSN 2150-4210

Academic
Journals Inc.

www.academicjournals.com

American Journal of Biochemistry and Molecular Biology 3 (4): 356-368, 2013
ISSN 2150-4210 / DOI: 10.3923/ajbmb.2013.356.368

Efficacy of Some Plant Products and Two Conventional Insecticides and Their Residual Activities Against *Callosobruchus maculatus* (F.)

[1]Manal, A.A. Abd El-Razik and [2]Gamal, M.M. Zayed

[1]Department of Pesticides, Faculty of Agriculture, Minufiya University, Shebin El-Kom, Egypt
[2]Department of Stored Product Pests, Research, Plant Protection Research Institute Agriculture Research Center, Dokki, Giza, Egypt

Corresponding Author: Manal, A.A. Abd El-Razik, Department of Pesticides, Faculty of Agriculture, Minufiya University, Shebin El-Kom, Egypt

ABSTRACT

Callosobruchus maculatus (F.) (Coleoptera: Burchidae) is a primary pest of cowpea and other legumes worldwide, both in field and in stored seeds. Four botanical oils namely, groundnut, parsley, sunflower and nutmeg and the two conventional insecticides (Agrothion and malathion) 1% dust were evaluated as cowpea seeds protectants against *Callosobruchus maculatus* (F.). The tested compounds were applied in two ways (of mixing with media); preventive way and curative way. The results indicated that the mean number of laying eggs decreased in the preventive way with the increase of concentration of tested materials used. Also, the results showed reduction in F_1 progeny especially at the highest concentrations. The parsley oil was more effective than others tested materials used following by sunflower oil. The preventive manner was higher effective than the curative type for protecting cowpea seeds. Plant oils and chemical insecticides protected cowpea seeds for three months. The effect of plant oils for protecting cowpea seeds nearly equal that of the insecticides used through storage period. Consequently, it could be recommended to use the plant oils especially at the highest concentration in the present study to protect cowpea seeds against *C. maculatus* after further studies on the quality of treated seeds.

Key words: Efficacy, plant products, conventional insecticides, residual activities, *Callosobruchus maculatus*

INTRODUCTION

Callosobruchus maculatus (F.) (Coleoptera: Burchidae) is a primary pest of cowpea and other legumes worldwide, both in field and in stored seeds (Singh and Van Emden, 1979). Attack on stored grain by *C.maculatus* significantly reduces the quantity and quality of seeds destined for both human consumption and sowing purpose (Credland *et al.*, 1986). Substantial losses of revenue occur in storage, especially in rural areas of developing countries, where grain legumes are kept into old sacks or mud bins. No doubt that plant oils and plant powders are of low specific activity of protective property of physical nature rather than chemical one (Jilani *et al.*, 1988). It is an age-old practice of traditional farmers in the tropics to mix a local plant with the grain legumes. Using plants with insecticidal properties is therefore an attractive alternative to the more expensive synthetic pesticides (Yadav and Bhatnagar, 1987; Ayangar and Rao, 1989; Dixit and Saxena, 1990; Ketoh *et al.*, 2005; Hosny *et al.*, 2007; Udo *et al.*, 2011; Ziga *et al.*, 2012; El-Nagar *et al.*, 2012). Aly and Ahmed (2011) found that spearmint oil and powder had great effect as protectants to stored grain against number of stored grain insects.

The present study was carried out to evaluate four plant oils (groundnut, parsley, sunflower and nutmeg oils) and two chemical insecticides as seed protectants against *C. maculatus* beetle and one of the important aims to the present study is to minimize the usage of chemical control for stored cowpea beetles *C. maculatus*.

MATERIALS AND METHODS

Insect

Cowpea beetle, *Callosobruchus maculatus* (L.): Samples of cowpea seeds were obtained from local markets sieved and cleaned from dusts and inert materials. The cowpea seeds were placed in glass jar and sterilized by heating at 70°C for 1 h. The seeds were left to cool and reabsorb moisture. The sterilized seeds were distributed into other glass jars (500 mL each). Each jar was provided with 200-300 adults of *C. maculatus* and covered with muslin and kept in position by rubber band to avoid insect escape. The jars containing insects were incubated at 30+1°C and 70+5% RH for one week. Then, the parent adults were sieved out and discarded. Newly adult insects (0-1 day old) were used for tested experimental work according to Shawir (1988).

Chemical insecticides

Malathion

Common name: Malathion

Chemical name:

- O, O dimethyl-S-(1,2 dicarboxyethyl) ethylphosphorodi-thioate
- Molecular weight 330
- **Applied formulation:** Odorless malathion (dust 1% w/w)
- **Source:** Kafr El-Zayat pesticides and Chemical Co, Egypt

Agrothion

Common name: Malathion

Chemical name:

- O, O dimethyl-S-(1,2 dicarboxyethyl) ethylphosphorodi-thioate
- Molecular weight 330
- **Applied formulation:** Odorless malathion (dust 1% w/w)
- **Source:** Kafr El-Zayat pesticides and Chemical Co, Egypt

Were used at the concentrations of (0.04, 0.06, 0.08 and 0.1% w/w).

Plant oils: Plant oils used in the present study were those of nutmeg [*Monodora myristca* (L.)], ground nut (*Arachis hypogaea* (L.)), sunflower (*Helianthus annuus* (L.)) and parsley (*Petroselinum sativum* Hoffm) at the concentrations of (0.25, 0.5, 0.75 and 1% w/w). The oils used were purchased from the local market.

Treatments

Effect on progeny: The tested materials were applied in two ways of admixing with seeds:

- **Preventive way:** As the materials were admixed with seeds before insect infestation (B)
- **Curative way:** As the materials were admixed with seeds after insect infestation (A)

For each treatment 20 g cowpea seeds were infested with 20 newly adults (10 females/10 males) of *C. maculatus* (0.1 day old) and put into glass jars (250 mL) for three days, then parents were discarded. Cowpea seeds containing immature stages were admixed with insecticides and plant oils at the different concentrations. Three replicates were done for each treatment and control and kept at 30+1°C and 70+5% R.H. The mean number of laid eggs was recorded before admixing with tested materials, the hatching percentage was calculated, the emerged percentage of adult was calculated and the reduction% in progeny was recorded and calculated.

The following parameters were determined; number of laid eggs, egg-hatched, percentages of hatchability, emergence and F_1 progeny reduction of *C. maculatus* for all compounds tested.

The effects of insecticides and plant oils to adult stage of cowpea beetles were measured according to the method advised by Ibrahim (2007). The tested insecticides at the concentration of (0.04, 0.06, 0.08 and 0.1% w/w) and plant oils at the concentrations of (0.25, 0.5, 0.75 and 1.0% w/w), were manually mixed with seeds 20 g for each treatment in glass jars (250 mL) and infested with 20 newly adult (10 females/10 males) (0-1 day old) *C. maculatus*. Three replicates were done for each treatment and control and kept at 30+1°C and 70+5% R.H., the mean of eggs lay on cowpea seeds, mean number of eggs hatched were counted and hatching percentages were calculated by the following equations:

$$\text{Percentage of hatching} = \frac{\text{Mean No. of eggs hatched}}{\text{Mean No. of eggs laid}} \times 100$$

The mean number of emerged adults were also counted, the emerged adult percentage were calculated by the following equation:

$$\text{Percentage of emergence} = \frac{\text{Mean No. of emerged adults}}{\text{Mean No. of eggs laid}} \times 100$$

and reduction percentage in progeny was recorded after 4 weeks post-treatment by the following equation:

$$\text{Reduction (\%)} = \frac{\text{Mean No. of emerged adults in control} - \text{Mean No. of emerged adults in treatment}}{\text{Mean No. of emerged adults in control}}$$

Residual activity: To study the residual activity of the pesticides and the tested plant oils, cowpea seeds were previously sterilized by drying at 50°C for 6 h to kill off any prior insect infestation. The seeds were treated with the above mentioned concentrations of the insecticides and plant oils and held 1, 2 and 3 months post-treatment under laboratory conditions. Treated seeds were infested with 20 newly adults (10 females/10 males) (0-1 day-old)/20 g seeds at the different periods. Three replicates were carried out for each treatment and control and were kept at 30+1°C and 70+5% R.H. The mean number of laid eggs on cowpea seeds after 10 days of infestation at the different periods, mean number of hatching eggs was counted and percentages of emergence were also calculated. The reduction percentage in progeny was estimated by the aforementioned equation.

Germination tests: The germination tests were accomplished on cowpea seeds of each treatment according to Qi and Burkholder (1981) with slight modification. Sixty seeds of each treatment were divided into three replicates, placed on Petri-dishes containing cotton layers (instead of filter paper) soaked with tap water and covered with tissue paper. Seed germination percentages were recorded four days after treatment for cowpea seeds after three months post treatment.

Weight loss: The weight loss of cowpea seeds due to infestation with *C. maculatus* was determined three months after treatment by sieving the dusts and insects from the seeds of cowpea seeds. The weight loss of cowpea seeds was calculated as dry weight loss according to the following equation of Harris and Lindblad (1978):

$$\text{Loss (\%)} = \frac{\text{Initial dry weight of seeds} - \text{Seeds dry weight after 3 months}}{\text{Initial dry weight of seeds}} \times 100$$

Data analysis: Data were statistically analyzed according to Duncan's Multiple Range test (Duncan, 1955).

RESULTS AND DISCUSSION

Insecticides dusts

Effect of chemical insecticides dusts on cowpea beetle, *C. maculatus*

Protective effect (B): The protective effect of two pesticide dusts, malathion and agrothion for cowpea seed against cowpea beetle *C. maculatus* was evaluated using different concentrations (0.04, 0.06, 0.08 and 0.1% w/w) on:

Eggs laying: The data in Table 1 showed that Agrothion was more toxic than malathion at the all different concentrations. The fecundity of the adult was highly inhibited by the highest concentration of agrothion pesticide where the number of eggs laid by 10 females was 5.0 compared to 340 in untreated control. Malathion pesticide was also significantly effective on female fecundity compared to control.

Table 1: Effect of pesticides on *C. maculatus* when admixed with cowpea seeds before and after insect infestation

		Mean No. of laid egg		Mean No. of egg hatching		Hatchability		Mean No. of emerged adults		Emergence (%)		Reduction (%)	
Tested materials	Conc. (% w/w)	B	A	B	A	B	A	B	A	B	A	B	A
Agrothion 1%	0.04	140^{c}	392^{a}	41^{c}	146^{b}	29.3^{c}	44.4^{b}	16^{c}	32^{c}	4.3^{d}	9.7^{c}	95.7^{c}	87.7^{f}
	0.06	86^{e}	361^{d}	16^{e}	126^{e}	18.6^{e}	34.9^{d}	0^{d}	28^{d}	0.0^{e}	7.8^{d}	100.0^{a}	89.3^{e}
	0.08	45^{g}	332^{h}	7^{g}	90^{g}	15.6^{y}	22.1^{f}	0^{d}	12^{f}	0.0^{e}	3.6^{f}	100.0^{a}	95.4^{c}
	0.10	5^{i}	319^{i}	0^{h}	38^{i}	0.0^{h}	11.9^{h}	0^{d}	5^{g}	0.0^{e}	1.6^{g}	100.0^{a}	98.0^{a}
Malathion 1%	0.04	150^{b}	347^{f}	50^{b}	141^{c}	33.3^{b}	42.1^{c}	14^{b}	36^{b}	9.3^{b}	10.4^{b}	94.4^{d}	86.2^{f}
	0.06	98^{d}	380^{b}	29^{d}	130^{d}	29.6^{c}	34.2^{e}	6^{c}	29^{d}	6.1^{c}	7.6^{d}	97.6^{b}	88.9^{e}
	0.08	52^{f}	369^{c}	12^{f}	98^{f}	23.1^{d}	26.6^{g}	0^{d}	19^{e}	0.0^{e}	5.1^{e}	100^{a}	92.3^{d}
	0.10	17^{h}	341^{g}	3^{h}	41^{h}	17.6^{f}	12.0^{h}	0^{d}	7^{g}	0.0^{e}	2.1^{g}	100^{a}	97.3^{b}
Control		340^{a}	352^{e}	275^{a}	282^{a}	80.9^{a}	80.1^{a}	250^{a}	261^{a}	90.9^{a}	92.6^{a}	-	-

B: Before insect infestation, A: After insect infestation. Within the same column, data followed by the same letter are not significantly different (p = 0.05) Duncan (1955)

Hatchability: In general, hatching decreased when the concentration increased. Hatchability of deposited eggs was parameter that was highly affected by the pesticides where agrothion had a significant active as ovicide than malathion pesticide. The higher dose of the two pesticides 0.1% w/w gained 17.6 and 0.0% hatchability for malathion and agrothion, respectively in comparison with the untreated (control) (80.90%).

Adult emergence: The adult emergence percentage was significantly influenced with values of 0.0-9.3% for malathion according to the concentration of pesticide and 0.0-4.3% for agrothion compared to untreated control 90.9%.

Adult reduction: The percentage reduction in F_1-progeny was highly influenced by the two pesticides (94.4-100.0) and (95.7-100) for malathion and agrothion, respectively according to pesticides concentration (0.04 and 0.1).

Curative effect (A): The curative effect of two pesticides malathion and agrothion against *C. maculatus* using mixing with media method was indicated in Table 1. The same concentrations of the pesticides were used as in the above mentioned technique, 0.04, 0.06, 0.08 and 0.1% w/w to evaluate.

Eggs laying: It is clear that number of eggs laid by 10 females was not influenced by the tested concentration. The number of eggs laid ranged from 319 to 392 in comparison with control 352.

Hatchability: Egg hatchability is significantly influenced by pesticides treatments compared to control treatment. The hatching percentage (12.0-42.1 and 11.9-44.4%) was decreased as pesticide concentration increased (0.04-0.1%) for malathion and agrothion, respectively compared to 80.1 in untreated control.

Adult emergence: The adult percentage emergence was significantly influenced with values of 2.1-10.4% for malathion according to the concentration of pesticide and 1.6-9.7 for Agrothion compared to untreated control 92.6%.

Adult reduction: The percentage of reduction in F_1-progeny was highly influenced by the pesticides 86.2-97.3% for malathion and 87.7-98.0 for agrothion according to pesticide concentrations.

If the techniques (protective and curative) were compared in case of *C. maculatus*, the following points could be concluded.

- All common parameters are influenced by the two tested pesticides, since the concentrations of pesticides increased all parameters were relatively influenced
- The protective technique is more effective than curative one
- Agrothion pesticide was more effective than malathion one in general

The obtained results in Table 1 agree with Patil *et al.* (1994). They found that deltamethrin (12.5 ppm). Fenvalerate (75 ppm) and malation 50 ppm were the most effective treatments with greater adult mortlity, lower egg laying, lower number of adult emerged and no loss in grain

Table 2: Effect of botanical oils on *C. maculatus* when admixed with seeds before and after insect infestation

		Mean No. of laid egg		Mean No. of egg hatching		Hatchability		Mean No. of emerged adults		Emergence (%)		Reduction (%)	
Tested materials	Conc. (% w/w)	B	A	B	A	B	A	B	A	B	A	B	A
Groundnut oil	0.25	175^{b}	350^{f}	75^{d}	180^{e}	42.9^{de}	51.4^{e}	52^{d}	92^{e}	29.7^{e}	26.3^{e}	80.2^{j}	66.8^{i}
	0.50	150^{c}	365^{c}	60^{f}	176^{f}	40.8^{de}	48.2^{f}	14^{f}	76^{g}	27.3^{ef}	20.8^{g}	84.4^{h}	73.4^{g}
	0.75	107^{e}	346^{g}	42^{g}	106^{m}	39.3^{def}	30.6^{L}	27^{h}	61^{j}	25.2^{f}	17.6^{j}	89.7^{f}	78.7^{e}
	1.00	86^{fg}	356^{e}	22^{i}	82^{o}	25.6^{fg}	23.0^{n}	17^{j}	52^{kl}	19.8^{gh}	14.6^{k}	93.5^{d}	81.8^{d}
Parsley oil	0.25	79^{g}	372^{a}	23^{i}	150^{i}	29.1^{fg}	40.3^{h}	17^{j}	73^{h}	21.6^{g}	19.6^{h}	93.5^{d}	74.5^{f}
	0.50	58^{h}	368^{b}	15^{j}	136^{j}	25.9^{fgh}	36.9^{i}	11^{k}	53^{k}	18.9^{h}	14.4^{k}	95.8^{c}	81.5^{d}
	0.75	41^{i}	365^{c}	5^{L}	128^{k}	12.2^{hi}	35.1^{j}	3^{L}	40^{m}	7.3^{j}	10.9^{m}	98.9^{b}	86.0^{c}
	1.00	0^{j}	357^{e}	0^{L}	47^{q}	0.0^{i}	13.2^{p}	0^{L}	28^{o}	0.0^{k}	7.8^{o}	100.0^{a}	90.2^{a}
Sunflower oil	0.25	136^{d}	362^{d}	39^{g}	192^{d}	28.7^{fg}	53.0^{d}	35^{fg}	98^{d}	25.7^{f}	27.1^{d}	86.6^{h}	65.7^{j}
	0.50	95^{f}	364^{cd}	22^{i}	162^{h}	23.2^{gh}	44.5^{g}	20^{ij}	67^{i}	21.1^{gh}	18.4^{i}	92.4^{e}	76.6^{f}
	0.75	69^{g}	371^{a}	10^{k}	122^{L}	14.5^{hi}	32.9^{k}	8^{L}	51^{L}	11.6^{i}	13.7^{L}	96.9^{c}	82.2^{d}
	1.00	0^{j}	355^{e}	0^{L}	57^{p}	0.0^{i}	16.1^{o}	0^{L}	36^{n}	0.0^{k}	10.1^{n}	100.0^{a}	87.4^{b}
Nutmeg oil	0.25	183^{b}	362^{d}	121^{b}	216^{b}	66.1^{b}	59.7^{b}	80^{b}	141^{b}	43.7^{b}	38.9^{b}	69.5^{L}	50.7^{k}
	0.50	161^{c}	365^{c}	101^{c}	201^{c}	62.7^{bc}	55.1^{c}	62^{c}	102^{c}	38.5^{c}	27.9^{c}	76.3^{k}	64.4^{j}
	0.75	136^{d}	349^{f}	66^{e}	171^{g}	48.5^{e}	48.9^{f}	46^{e}	86^{f}	33.8^{d}	24.6^{f}	82.4^{i}	69.9^{h}
	1.00	110^{e}	357^{e}	31^{h}	96^{n}	28.1^{fgh}	26.9^{m}	30^{g}	62^{j}	27.3^{ef}	17.4^{j}	88.5^{g}	78.3^{e}
Control		360^{a}	365^{c}	301^{a}	310^{a}	83.6^{a}	84.9^{a}	262^{a}	286^{a}	72.8^{a}	78.4^{a}		

B: Before insect infestation, A: After insect infestation. Within the same column, data followed by the same letter are not significantly different ($p = 0.05$) Duncan (1955)

weight, up to 12 weeks. Non of insecticidal treatments had an adverse effect on germination. Giga and Zvoutete (1990) mentioned that pirimiophos methyl, chloropyrifos methyl, fentrothion and malathion were effective in controlling *Sitophilus zeamais* and *Tribolium castaneum* on maize.

Plant oils

Effect of botanical oils against *C. maculatus*

Protective effect: The protective effect of four plant oils, groundnut, parsley, sunflower and nutmeg for cowpea seeds against cowpea beetle *C. maculatus* was evaluated using different concentrations (0.25, 0.50, 0.75 and 1.0% w/w). The results in Table 2 showed that parsley oil and sunflower had higher effect than other two oils (groundnut and nutmeg) with all tested treatments.

Eggs laying: The fecundity of the adults was highly inhibited by increasing the dose concentration with all tested oils used compared with untreated control.

The numbers of eggs laid with the highest concentration 1.0 w/w% were 86.0, 0.0, 0.0 and 110.0 for groundnut, parsley, sunflower and nutmeg oils, respectively compared to untreated control 360.0. In general, this effect increased as the concentration of four botanical oils increased.

Hatchability: Data also exhibited that hatchability of eggs laid was parameter that was highly affected by the highest concentration 1.0 w/w% for four oils was 25.6, 0.0, 0.0 and 28.1 for groundnut oil, parsley oil, sunflower oil and nutmeg oil, respectively in comparison to untreated control 83.6.

Adult emergence: The emergence percentage for four oils with highly concentration (1.0 w/w%) were 19.8, 0.0, 0.0 and 27.3 for groundnut oil, parsley oil, sunflower oil and nutmeg oil, respectively in comparison to untreated control 72.8. In general, this effect increased with the increase of concentration of four soils.

Adult reduction: The reduction percentage of F_1 progeny ranged from 80.2 to 93.5; 93.5 to 100; 86.6 to 100 and 69.5 to 88.5 for groundnut oil, parsley oil, sunflower oil and nutmeg oil, respectively. In general, the parsley oil was the most effective compared to the remained oils.

Curative effect (A): The curative effect of the four botanical oils on cowpea seeds against *C. maculatus* was indicated in Table 2 which included the following criteria.

Eggs laying: The same concentrations of the soils were used as the above technique (protective) 0.25-1.0% w/w.

It is clear that number of eggs laid was not slightly influenced by this method.

Egg hatchability: Eggs hatchability is significantly influenced by oil treatments compared to control treatment. This parameter was decreased as oil concentration increased as follows (23.0-51.4), (13.2-40.3), (16.1-53.0) and (26.9-59.7) for groundnut oil, parsley oil, sunflower oil and nutmeg oil, respectively in comparison with untreated control 84.9.

Adult emergence: The adult emergence percentage significantly influenced with values of (14.6-26.3), (7.8-19.6), (10.1-27.1) and (17.4-38.9) for groundnut oil, parsley oil, sunflower oil and nutmeg oil, respectively compared to untreated control 78.4.

Adult reduction: The reduction percentage in F_1 progeny highly influenced by the four oil treatments and ranged from (66.8-81.8), (74.5-90.2), (65.7-87.4) and (50.7-78.3) for the same mentioned oils, respectively.

If the protective and curative techniques were compared in case of *C. maculatus*, the following points could be concluded:

- As the concentrations of oils increased, all parameters were relatively influenced
- All the common parameters are influenced by the four oils
- Parsley and sunflower oils were most effective than groundnut and nutmeg oils
- The protective technique is more effective than curative one

The results in Table 2 agree with those reported by Doherty *et al.* (1988) who used coconut, groundnut, sesame and mustard oils against *C. maculatus* and *C. chinensis*. Adults of *C. maculatus* did not oviposit on treated seeds with 1.0% w/w which prevented emergence of both species and sesame oil prevented the emergence of *C. chinensis* for one month after oviposition. El-Sayed *et al.* (1989) found that maize oil at 2.5 and 5 mL kg^{-1} reduced the progeny of the bruchid to 1.3 and 0.25 adults, respectively after one month of treatments as compared with 158 adults for control. There was no progeny when coconut oil was used. Don-pedro (1989) reported that vegetable oils reduce development of *C. maculatus* on cowpea seeds and that the main toxic action of these oils was against eggs. Khaire *et al.* (1992) reported that no adults emerged up to 66 days with the castor oil at rate of 0.75 and 1.0% w/w. These oils significantly reduced oviposition of *C. maculatus*.

Table 3: Residuals activity of pesticides against *C. maculatus*

Tested materials	Conc. (%w/w)	Mean No. of eggs laid after months			Hatchability (%)			Emergence (%)			Reduction (%)		
		1	2	3	1	2	3	1	2	3	1	2	3
Agrothion	0.04	129^{b}	145^{e}	176^{b}	32.6^{b}	35.9^{b}	57.9^{a}	11.6^{b}	26.9^{bc}	47.2^{cd}	93.8^{d}	83.6^{f}	64.8^{j}
	0.06	82^{e}	96^{e}	140^{d}	25.6^{c}	32.3^{d}	52.1^{a}	8.5^{c}	28.1^{b}	44.3^{d}	97.1^{c}	88.7^{d}	73.7^{e}
	0.08	42^{g}	62^{g}	131^{f}	0.0^{f}	29.0^{e}	45.8^{a}	0.0^{e}	19.4^{d}	32.1^{f}	100.0^{a}	94.9^{b}	82.2^{c}
	0.10	7 i	27 i	102^{h}	0.0^{f}	25.9^{f}	40.2^{a}	0.0^{e}	7.4^{e}	27.5^{g}	100.0^{a}	99.2^{a}	88.1^{a}
Malathion	0.04	140^{b}	168^{b}	170^{e}	32.9^{b}	35.1^{b}	57.6^{a}	11.4^{b}	25.0^{c}	48.2^{c}	93.4^{d}	82.4^{f}	65.3^{j}
	0.06	102^{d}	109^{d}	136^{e}	24.5^{d}	33.9^{c}	61.0^{a}	7.8^{c}	28.4^{b}	51.5^{b}	96.7^{b}	86.9^{e}	70.3^{f}
	0.08	49^{f}	66^{f}	122^{g}	22.4^{e}	31.8^{d}	57.4^{a}	4.1^{d}	27.3^{bc}	46.7^{cd}	99.1^{b}	92.4^{c}	75.8^{d}
	0.10	19^{h}	32^{h}	98 i	0.0^{f}	26.3^{f}	61.1^{a}	0.0^{e}	6.3^{e}	28.8^{e}	100.0^{a}	91.6^{c}	83.9^{b}
Control		346^{a}	357^{a}	364^{a}	78.0^{a}	76.6	78.3^{a}	70.0^{a}	66.7^{a}	64.8^{a}			

Within the same column, data followed by the same letter are not significantly different (p = 0.05) Duncan (1955)

Udo (2011) reported that groundnut oil inhibit progeny emergence of *C. maculatus* at 20 mL treatment and in general it reduce the damage caused by *C. maculatus*.

Residual effect

Residual effect of pesticides against *C. maculatus*

Eggs laying: Results obtained in Table 3 showed that Agrothion had achieved reduction percentage in off-springs of *C. maculatus* (F.) higher than malathion at all different exposure periods. There are significant differences between control and pesticides treatments in the mean number of egg laying at the different exposure periods. Also, there is significant difference within the pesticides treatments.

At the concentration 0.08 and 0.1% w/w with the Agrothion and malathion the laying eggs were (42 and 7), (62 and 27), (131 and 102) and (49 and 19), (66 and 32), (122 and 98) compared with untreated control (346, 357, 364) after exposure periods 1, 2 and 3 months post-treatment, with agrothion and malathion, respectively.

Hatchability: The hatching percentages showed significant differences between the control and pesticides treatments. At the highest concentration 0.1% w/w, 0.0, 25.9, 40.2 and 0.0, 26.3, 16.1 with agrothion and malathion, respectively compared to untreated control 78.0, 76.6, 78.3 after 1, 2 and 3 months after treatment.

Adult emergence: The emergence percents were (0.0, -7.4, 27.5) and (0.0, 6.3, 28.8) for agrothion and malathion, respectively compared with untreated control (70.0, 66.7, 64.8) after exposure periods 1, 2, 3 months.

Adult reduction: The reduction percentage in F_1 progeny showed significant differences between the agrothion and malathion with all tested concentration after exposure periods 1, 2 and 3 months. At the highest concentration 0.1% w/w the reduction percentage was 100.0, 99.2 and 88.1% and 100.0, 91.6 and 83.9 for agrothion and malathion, respectively. The agrothion and malathion pesticides at 0.1% w/w nearly provided the complete protection of the seeds against *C. maculatus* for 3 months.

Table 4: Residuals activity of botanical oils against *C. maculatus*

Tested materials	Conc. (%w/w)	Mean No. of eggs laid after months			Hatchability (%)			Emergence (%)			Reduction (%)		
		1	2	3	1	2	3	1	2	3	1	2	3
Groundnut oil	0.25	270^{e}	280^{c}	298^{b}	74.4^{b}	75.7^{cd}	87.6^{a}	50.4^{c}	57.5^{c}	61.7^{b}	54.4^{o}	38.5^{n}	22.0^{m}
	0.50	209^{f}	209^{g}	262^{cd}	55.0^{g}	70.3^{g}	72.1^{g}	42.9^{d}	51.2^{de}	56.1^{cd}	67.5^{j}	59.2^{j}	37.7^{k}
	0.75	142^{L}	141^{k}	185^{f}	50.7^{i}	60.5^{i}	65.9^{i}	30.3^{f}	46.1^{f}	38.4^{h}	82.7^{e}	75.9^{f}	69.9^{e}
	1.00	97^{m}	97^{m}	106^{h}	37.1^{k}	50.5^{i}	62.3^{j}	24.7^{gh}	34.0^{i}	31.1^{j}	90.5^{c}	87.4^{c}	74.6^{d}
Parsley oil	0.25	203^{g}	222^{f}	260^{cd}	68.9^{e}	73.4^{de}	76.2^{e}	49.3^{c}	54.0^{d}	50.8^{f}	59.4^{k}	53.8^{k}	44.1^{j}
	0.50	186^{i}	197^{h}	236^{e}	52.2^{h}	57.9^{gh}	59.7^{k}	36.0^{e}	40.1^{h}	32.6^{jk}	73.1^{h}	69.8^{h}	67.3^{f}
	0.75	142^{L}	152^{j}	199^{f}	36.6^{k}	51.3^{i}	53.3^{n}	22.5^{h}	31.6^{ij}	32.8^{jk}	87.1^{d}	81.7^{d}	79.2^{b}
	1.00	22^{f}	48^{o}	96^{n}	31.8^{L}	33.3^{k}	48.9^{o}	0.0^{j}	25.0^{k}	38.5^{h}	100.0^{a}	95.4^{a}	84.3^{a}
Sunflower oil	0.25	223^{e}	260^{d}	281^{bc}	72.6^{c}	77.3^{bc}	80.8^{c}	56.5^{b}	52.7^{de}	55.9^{cd}	49.4^{m}	47.7^{m}	33.5^{L}
	0.50	198^{h}	207^{g}	251de	71.7^{c}	73.4^{de}	76.9^{d}	37.9^{e}	43.0^{g}	36.3^{hi}	69.5^{i}	66.0^{i}	61.4^{h}
	0.75	173^{k}	169^{i}	182^{fg}	46.8^{j}	56.8^{h}	66.5^{h}	27.2^{g}	30.8^{j}	34.0^{ij}	81.1^{f}	80.2^{e}	73.7^{d}
	1.00	32^{o}	67^{n}	102^{h}	37.5^{k}	40.3^{j}	56.9^{m}	6.3^{i}	32.8^{i}j	54.9^{de}	97.9^{b}	91.6^{b}	76.3^{c}
Nutmeg oil	0.25	297^{b}	297^{b}	212^{ef}	70.0^{d}	79.6^{ab}	81.7^{b}	47.1^{c}	64.6^{b}	62.8^{b}	46.9^{n}	23.1^{o}	16.3^{n}
	0.50	240^{d}	240^{e}	282^{bc}	69.3^{de}	75.0^{cd}	76.6^{de}	49.3^{c}	50.4^{e}	58.2^{c}	57.4^{L}	51.4^{L}	37.9^{k}
	0.75	180^{j}	208^{g}	230^{e}	57.6^{f}	68.8^{f}	74.8^{f}	39.0^{e}	39.4^{h}	44.8^{y}	74.7^{g}	72.2^{g}	56.3^{i}
	1.00	85^{n}	120^{L}	162^{g}	54.1^{g}	55.0^{h}	57.6^{L}	49.4^{c}	52.5^{de}	53.1^{ef}	83.1^{e}	75.9^{f}	63.6^{g}
Control		346^{a}	351^{a}	347^{a}	79.8^{a}	82.3^{a}	80.6^{c}	72.0^{a}	74.6^{a}	68.0^{a}			

Within the same column, data followed by the same letter are not significantly different (p = 0.05) (Duncan, 1955)

These findings are in agreement with Giga and Zvoutete (1990) who mentioned that malathion was effective in protecting maize grains against *S. zeamais* and *T. castaneum* for 90 days of treatment.

Residual effect of botanical oils against *C. maculatus*

Eggs laying: Results in Table 4 showed that, oils at the all rates significantly reduced the egg laying compared with control at the different exposure periods, where, the mean numbers of egg laying at the concentration 1% w/w with the groundnut, parsley, sunflower and nutmeg oil, were (97, 97 and 106), (22, 48 and 96), (32, 67 and 102) and (85, 120 and 162) after 1, 2 and 3 months, respectively compared with untreated control 346, 351 and 347 after 1,2 and 3 months, respectively.

Hatchability: The hatching percentages showed significant differences between the oil treatments and control at the highest concentration 1% w/w were (37.1, 50.5, 62.3), (31.8, 33.3, 48.9), 37.5, 40.3, 56.9) and (54.1, 55.0,57.8) for groundnut, parsley, sunflower and nutmeg oils, respectively compared to control 79.8, 82.3, 80.6 after 1, 2, 3 months, treatment.

Adult emergence: The emergence percentages strongly influenced by the oil treatments at the highest concentration were 1% w/w (24.7, 34.0, 31.1), (0.0, 25.0, 38.5), (6.3, 32.8, 54.9) and (49.4, 52.5, 53.1) for groundnut, parsley, sunflower and nutmeg oils, respectively compared to control (72.0, 74.6, 68.0) after 1, 2, 3 months treatments.

Adult reduction: The percent of adult reduction ranged between 46.9 and 100%, 23.1, 95.4, 16.3 and 84.3 with the all tested rates of oils at 1, 2 and 3 months, respectively post treatment (Table 4).

Singh *et al.* (1978) found that groundnut oil at 5 mL kg^{-1} of cowpea seeds caused complete protective against *C. maculatus* up to 180 days. Shukla *et al.* (1988) mentioned that coconut, sesame, rape, soybean, groundnut, mustard, palm and maize oils were effective in protecting cowpea seeds against attack by *C. maculatus*. Sharma (1999) recorded that neem oil at 2% completely protected maize grains against *S. oryzae*, *S. cerealella*, *R. dominica* and *T. cataneum* for up to 9 months. Raghvani and Kapadia (2003) used 8 vegetable oils (coconut, groundnut, mustard, sesame, castor, been neem, koranj and sunflower) against *C. maculatus*. the neem and coconut oils at 10 mL kg^{-1} seed provided the complete protection of seeds against *C. maculatus* for 6 months and other oils at the concentration 10 mL kg^{-1} seeds or 5 mL kg^{-1} seeds gave more than 94% protection up to 4 months storage.

It seems from the results given in Table 3 and 4 that all tested materials drastically reduced the adult progeny of *C. macultus* emerged from treated seeds previously stored at the different periods with the highest concentration used with all tested materials. After one, two and three months of treated seeds storage almost complete protection were achieved with agrothion, malathion and one month for parsley and sunflower oil. After two months tested materials at the highest concentration gave a good protection for seeds storage with the reduction values of 99.2, 95.4, 91.6, 91.6, 87.4 and 75.9 for the agrothion, parsley, malathion, sunflower, groundnut and nutmeg tested materials, respectively.

The results in Table 5 showed significant differences for seed germination between oil treatments and control and within concentrations. The germination percentages decreased with increasing the concentration and exposure period. The germination percentages at concentration 1% w/w was decreased from 98% for control after three months to (54, 92, 64 and 52%) in groundnut, parsley, sunflower and nutmeg oil treatments, respectively. The obtained results agree with those of Qi and Burkholder (1981) who found that the cowpea seeds germination was reduced from 100% in the control to 30, 27.5, 32.5 and 52% in cotton seed, soybean, maize and peanut oil treatments, respectively at concentration 1% after 2 months.

Abo-Arab *et al.* (1998) found that the wheat grain germination was reduced from 97 and 90% at the exposure period 24 h and 6 months in the control to (85 and 62.5%) and (38.8 and 40.0%) with *N. sativa* and *L. usitatissimum*, respectively at the concentration 16 mL kg^{-1}. The effect of pesticides dusts on cowpea seed germinations after three months treatments is shown in Table 5. The obtained results showed no significant differences between the control and treatments, between treatments or within concentration. The obtained results agree with Ayad and Alyousef (1986), El-Aidy *et al.* (1995) and El-Hamady *et al.* (1999) who reported that the germination percentage improving may be due to the protective effect of malathion which did not affect the germination of seeds during storage. The loss of weight cowpea seeds in Table 5 showed significant differences between the control and other treatments oils and pesticides or between concentrations of tested materials used oils or pesticides.

These results agree with those reported by many researchers. Cruz and Cardona (1981) used soybean and maize oils against *C. chinensis* in stored seeds of cowpea. The treatments protected the cowpea seed and decrease their weight loss. Raghvani and Kapadia (2003) used (coconut, groundnut, mustard, castor and sunflower) oils against *C. maculatus*. Oils completely protect the grains against *C. maculatus* for 6 months at the concentration 10 mL kg^{-1}.

Table 5: Effect of treating cowpea seeds with botanical oils and pesticides on germination and the weight loss of cowpea seeds after three months post treatment

Tested materials	Conc %w/w	Germination of seeds (%)	Weight loss of seeds
Groundnut oil	0.25	92^{b}	14.0^{e}
	0.50	98^{a}	9.0^{g}
	0.75	76^{c}	6.0^{i}
	1.00	54^{d}	2.1^{k}
Parsley oil	0.25	97^{a}	11.2^{f}
	0.50	95^{a}	7.6^{h}
	0.75	96^{a}	3.2^{j}
	1.00	92^{b}	1.6^{k}
Sunflower oil	0.25	86^{b}	22.0^{c}
	0.50	90^{b}	16.0^{d}
	0.75	67^{d}	8.3^{g}
	1.00	64^{cd}	3.7^{j}
Nutmeg oil	0.25	72^{c}	26.0^{b}
	0.50	62^{e}	16.0^{d}
	0.75	49^{f}	9.3^{g}
	1.00	52^{f}	5.4^{i}
Malathion	0.04	96^{a}	17.0^{d}
	0.06	97^{a}	12.2^{f}
	0.08	95^{a}	7.9^{h}
	0.10	98^{a}	3.3^{j}
Agrothion	0.04	98^{a}	16.2^{d}
	0.06	96^{a}	8.0^{h}
	0.08	97^{a}	4.2^{j}
	0.10	96^{a}	1.7^{k}
Control		98^{a}	36.2^{a}

The different effects between plants oils used in the present study may be due to the type of plant, the part of plant used the active groups in each plant and finally the manner of bioassay of tested plant oils or insecticides. In conclusion, there were deterioration effects on the all tested parameters by using of both botanical oils and chemical insecticides.

REFERENCES

Abo-Arab, R.B., R.M.Y. Helal and N.A. El-Aidy, 1998. Bioresidual activity of certain oils and plant extracts on some stored grain insects in relation with quality of wheat grain. J. Agric. Sci. Mansoura Univ., 23: 5641-5653.

Aly, S.D. and S. Ahmed, 2011. Oils and powder of spearmint as an alternative to *Sitphilus oryzae* chemical control of wheat grains. J. Plant Protect. Res., 51: 145-150.

Ayad, F.A. and Alyousef, 1986. Biological persistence of some insecticides and their influence on germination rate and early seedling growth of the chickpeas, *Cicer arietinum*. Bull. Int. Soc. Egypt. Econ. Ser., 25: 95-103.

Ayangar, G.S.G. and U.J. Rao, 1989. Neem extracts as larval repellant and ovipositional deterrents to *Spodoptera litura* (Fabr.). Indian J. Entomol., 51: 121-124.

Credland, P.F., K.M. Dick and A.W. Wright, 1986. Relationship between larval density, adult size and egg production in cowpea seed beetle, *Callosobruchus maculatus*. Ecol. Entomol., 11: 41-50.

Cruz, C. and E. Cardona, 1981. Control of dry seed weevils with cooking oil. J. Agric. Univ. Puerto Rico, 65: 295-298.

Dixit, O.P. and R.C. Saxena, 1990. Insecticidal action of *Premina integrifolia* against *Callosobruchus chinensis*. Pesticides, 24: 29-31.

Doherty, R.B., R.N. Kantar and K.M. Singh, 1988. Effect of edible oils in protection of green gram, *Vigna radiata* seeds from pulses beetle, *Callosobruchus chinensis* L. Indian J. Agric. Sci., 58: 151-154.

Don-pedro, K.N., 1989. Effects of fixed vegetable oils on oviposition and adult mortality of *Callosobruchus maculatus* (F.) on cowpea. Int. Pest Cont., 31: 34-37.

Duncan, D.B., 1955. Multiple range and multiple F test. Biometrics, 11: 1-42.

El-Aidy, A. Nadia and A.M. Abdel-Shafi, 1995. Effect of pesticide concentration and storage period on pesticide residue, chemical composition, viability and vigor of wheat seed. J. Agric. Sci. Mansoura Univ., 20: 3171-3179.

El-Hamady, S.E.E., R.B.S. Abo-Arb, F.A.A. El-Zeir and E.A. Amer, 1999. Storage of pesticides-treated maize seeds effect on insect infestation viability of seed and the safe utilized of redundant seeds as poultry feed. Proceedings of the 2nd International Conference of Pest Control, July 1999, Mansoura, Egypt, pp: 76-88.

El-Nagar, T.F.K., H.M. Abdel Fattah, A.S. Kholed and S.A. Aly, 2012. Efficiency of pepper mint oil fumigation cowpea seeds. Life Sci. J., 9: 375-383.

El-Sayed, F.M.A., A.A.M. Etman and M. Abdel-Razik, 1989. Effectiveness of natural oils in protecting some stored products from two stored product pests. Bull. Fac. Agric. Univ. Cairo, 40: 409-418.

Giga, D.P. and P. Zvoutete, 1990. The evaluation of different insecticides for the protection of maize against some stored product pests. Int. Pest Control, 32: 10-13.

Harris, K.L. and C.J. Lindblad, 1978. Postharvest Grain Loss Assessment Methods a Manual of Methods for the Evaluation of Postharvest Losses. The American Association of Cereal Chemist, UK., pp: 95-99.

Hosny, A.H., A.A. Salama, R. Ismail, R. Abo-Arab and S.I.A. Ibrahim, 2007. Botanical products as stored grain protectants. J. Agric. Res. Kafrelsheikh Univ., 33: 873-886.

Ibrahim, S.A., 2007. Atmospheric modification as a new approach for controlling stored grain pests. Ph.D. Thesis, Faculty of Agriculture, Kafrelsheikh University.

Jilani, G., M.I. Khan and A.L. Ghiasuddin, 1988. Studies on insecticidal activity of some indigenous plant materials against the pulse weevil *Callosobruchus analis* (F.). Pak. J. Entomol. 3: 21-32.

Ketoh, G.K., H.K. Koumaglo and I.A. Glitho, 2005. Inhibition of *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) development with essential oil extracted from *Cymbopogon schoenanthus* L. Spreng. (Poaceae) and the wasp *Dinarmus basalis* (Rondani) (Hymenoptera: Pteromalidae). J. Stored Prod. Res., 41: 363-371.

Khaire, V.M., B.V. Kachare and U.N. Mote, 1992. Efficacy of different vegetable oils as grain protectants against pulse beetle, *Callosobruchus chinensis* L. in increasing storability of pigeon pea. J. Stored Prod. Res., 28: 153-156.

Patil, P.K., R.N. Nawale and U.N. Mote, 1994. Efficacy of synthetic pyrethroids as seed protectants of pigeon pea against pulse beetle, *Callosobruchus maculatus* Fab. Indian J. Ent., 56: 51-57.

Qi, I.T. and W.E. Burkholder, 1981. Protection of stored wheat from the granary weevil by vegetable oils. Econ. Entomol., 74: 502-505.

Raghvani, B.R. and M.N. Kapadia, 2003. Efficacy of different vegetable oils as seed protectants of pigeon pea against *Callosobruchus maculatus* (Fab.). Ind. J. Plant Prot., 31: 115-118.

Sharma, R.K., 1999. Efficacy of neam products against storage pests in maize. Ann. Agric. Res., 20: 198-201.

Shawir, M.S., 1988. Studies on the control of stored product insect pests. Ph.D. Thesis, Chemistry of Pesticides, Faculty of Agriculture Alexandria University, Egypt.

Shukla, R.M., V.K. Singh and M.L. Saini, 1988. Effectiveness of some edible oils for protecting cowpea against the attack of *Callosobruchus maculatus* (F.). Plant Protec. Bull. Faridabad, 40: 4-6.

Singh, S.R., R.A. Luse, K. Leuschaer and D. Nangojia, 1978. Groundnut treatment for the control of *Callosobruchus maculatus* F. during cowpea storage. J. Stored Prod. Res., 14: 77-80.

Singh, S.R. and H.F. Van Emden, 1979. Insect pest of grain legumes. Ann. Rev. Entomol., 24: 225-278.

Udo, I.O., 2011. Protectant effect of plant oils against cowpea weevil *Callosobruchus maculatus* on stored cowpea (*Vigna unguiculata*). J. Agric. Biol. Sci., 6: 58-61.

Udo, I.O., T.T. Epidi and J.A. Osakwe, 2011. Comparative efficacy of root, bark and leaf powder of *Drocoenea arborea* for the control of two storage insect pests. Sci. Res. Essays, 6: 1473-1478.

Yadav, S.R.S. and K.N. Bhatnagar, 1987. A preliminary study on the protection of stored cowpea grains against pulse beetle by indigenous plant products. Pesticides, 21: 25-29.

Ziga, L., V. Matai and T. Stanislav, 2012. Efficacy of four essential oils against *Sitophilus granarius* (L.) adults after short-term exposure. Afr. J. Agric. Res., 7: 3175-3181.