Egyptian Journal of Biological Pest Control, 14(1), 2004, 155-163
Proceeding of 1st Arab Conference for Applied Biological Pest Control, Cairo, Egypt, 5-7 April 2004

Effect of Certain Plant Extracts and one Conventional Insecticide Pirimiphos-Methyl on Progeny, Ovicidal and Residual Activities of Two Stored Product Insect Pests

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ABSTRACT

Laboratory investigations were carried out on the efficiency of hexane and ethanol extract of *Eugenia aromatica* and *Pimpinella ansium* against *Sitophilus oryzae* (L) and *Callosobruchus maculatus* when mixed with wheat grains and cowpea seeds comparing with the recommended insecticide, Pirimiphos-methyl (Actellic 50% EC). The obtained results showed that, LC50 and LC90 concentrations of hexane and ethanol extracts produced high adult mortality and significant reduction of progeny (F1). With the N-hexane extract, the highest reduction percentage of (F1) was recorded with *E. aromatica* followed by *P. ansium* for their LC50 and LC90, respectively, compared to Pirimiphos-methyl. The tested plant extracts with ethanol and hexane had the same order of efficiency on *C. maculates.* As well as *S. oryzea.* Also, data obtained clearly showed that, the percentage of hatching eggs was significantly reduced compared to that of the control, especially with LC90 concentrations. The cowpea seeds and wheat grains were treated by plant extract at LC90 level and exposed to adults of *C. maculatus* and *S. oryzae* after various periods of storage (i.e. 7 days and 1,2,3,4 and 5 months post-treatment). The two plants extracts showed significant adult mortality and reduction of (F1) progeny of the two tested insect, species *C. maclatus* and *S. oryzae.* After three months post-treatment, the percent mortality and adult emergence were significantly reduced with pirimiphos-methyl as compared to the ethanol and n-hexane plant extracts against *S. oryzae* and *C. maclatus*). After 4 and 5 months, the reduction percentages of progeny recorded with ethanol extract of *E. aramatica* and *P. ansium* for *S. oryzae* were 66, 30.0 and 73, 38.5 % compared to pirimiphos-methyl which gave 47 and 20.0 % after the same periods. It was 67 and 27% after 4 and 5 months on *C. maculatus*, respectively while the correspondent reduction percentages of ethanol extracts compared on *P. ansium* and *E. aromatica* where the reduction percentage at the same period was 81.7, 61.0 and 70.3, 54.8 %, respectively. In the case of n-hexane extracts, the reduction percentage caused by the same plants was 63.0, 35.0 and 79.8, 58 % reduction of adult emergence, respectively, at 4 and 5 months.

Key Words: Plant extracts, conventional insecticide Pirimiphos-Methyl, residual activities, stored product insect pests

INTRODUCTION

Many species of insect pests cause extensive damage of stored products. The massive application of synthetic pesticides has created serious problems such as the build-up of pest resistance, upsetting of natural balance and hazards to man and animals. Investigations, concerning the toxic action of different plant products against certain pests has been reported by several investigators (El-Gayar *et al.,* 1975 and 1979; Abbassy *et al.,* 1981; Ahmed, 1985; Abo Arab *et al.,* 1998; Othman et al., 2000; Raja *et al.,* 2001 and Salwa, 2001). The use of different plant and mineral oils as protectants for stored grain for insect infestation is an ancient method (Yantal and Burkholder, 1981). Vegetable oils protected stored legumes and grains from bruchids and weevils attack for long periods of storage (Schoonhoven, 1978; Singh *et al.,* 1978; Shay and Ikan, 1980 and Pereira, 1983). Large numbers of plants have been screened for their biologically active chemicals and showed a good degree of success as protectants against a number of stored grain insect pests (Gill and Lewis, 1971; Ketker; 1976; Mahgoub and Ahmed, 1996 and Othman, 2000a& b).

The aim of the present study is to evaluate the biological activity of some plant extract compared with the organo-phosphorous conventional insecticide (Actelic 5090 EC) on progeny as well as ovicidal and residual activities against two of the main stored-product pests.

MATERIALS AND METHODS

1- Plant material and extract methods:

Two plant species (*Eugenia aromatica* and *Pimpinella ansium*) were collected from Aswan, Upper Egypt. The flower buds of *E. aromatica* and *P. ansium* of the collected plants were extracted by n-hexane and ethanol. The plant parts used were dried naturally on laboratory benches at room temperature for 7 days, until they became crisp dry. Further drying was carried out in the oven at 40°c for 24 hours, and then the plant parts were crushed to fine powder using a laboratory grinder. 150 gram from the dried powder

of the tested plant organs were successively extracted with n-hexane and ethanol solvents according to Hussein *et.al,* 2002 method. The recommended organophosphate insecticide Pirimiphos-methy (Actelic50% EC): O-2-diethylamin-6-methyl–Pyrimidin-4-ylo-, Odimethylphosphorothioate was used for comparison.

2- Insects used:

The rice weevil, *Sitophilus oryzae* and Cowpea weevil, *Callosobruchus maculatus* used in this study were continuously reared for several years at 30 ± 2°c and 70 ± 50% relative humidity (R.H.), at the Department of Stored Product Pests, Plant Protection Research Institute. The culture was maintained under the same conditions in glass jars each containing 200-400 adults in the case of rice weevil and 100-200 adults in the case of cowpea weevil. The jars were covered with muslin and kept in the incubator.

3- Bioassay Techniques:

3.1. Seed Treatment.

For seed treatment, concentrations of each tested plant materials or pirimiphos-methyl were diluted with aceton, 20g of grains or cowpea seed were placed in small cylindrical glass jars (11.5 x 6 cm). One ml of each concentration was placed in each jar above the surface of wheat grains or cowpea seeds using micropipette. The jar was shaken by hand to mix the grains and cowpea seeds with the extract. The treated grains and cowpea seeds were left on jars for a suitable time until the solvent evaporation. Each concentration was replicated three times. The jars only with acetone were served as control. Ten pairs of newly emerged adults of *S. oryzae* and five males and females of *C. maculates* (0-24 hrs old) were transferred to each jar, covered with muslin and kept under laboratory conditions. Mortality counts were recorded after 1, 3, 5, and 7 days. All results were corrected with Abbott's formula (1925) and data statistical analyzed to determine the LC 50 and 90 values and the slope of the toxicity lines according to Finney (1971). The LC_{50} and LC_{90} values after 5 days from the treatments were used and alive insects were allowed complete their life cycle for 30 days to determine the reduction in the progeny by the following equation:

$$\text{Percent reduction of progeny} = \frac{\text{Mean No. of adults emerged in control - mean No. of adults in treatment}}{\text{Mean No. of adults emerged in the control}} \times 100$$

All emerged adults were recorded for five weeks starting from the first emergence.

3.2. Ovicidal activity:

To determine the ovicidal activity of the tested materials, two concentrations were used, i.e. LC_{50} and LC_{90} values. Ten adults of (0-24 hrs old) *C. caculatus,* five males and five females were released in glass petridishes (9cm diameter) containing 20g of cowpea seeds for 3-days which were allowed to lay eggs. On the fourth day the adults were removed. Then the laid eggs on cowpea seeds were treated with the LC_{50} and LC_{90} of each tested material by spraying the seed surface using glass atomizer-one ml acetone solution of each dilute concentration was applied to 20g seed sample. The petri-dishes containing seeds treated only with acetone were served as control. Each concentration was replicated three times 9-days after treatment, the number of hatched eggs were recorded, and then the percentage hatched eggs were calculated.

3.3. Bioassay of the residual activity:

To study the residual activity of the tested plant materials, wheat grains and cowpea seeds were previously sterilized by drying at 50°c for 6 hrs to kill off any prior insect infestation. The seeds were treated with the test materials and exposed to *S. oryzae* or *C. maculatus* after different periods of storage i.e. 7days and 1, 2, 3, 4 and 5 months post-treatment. In this test, 2 Kg of wheat grains or cowpea seeds were taken in a 4-liter glass jar in which 100 ml solvent containing the plant extract or pirimiphos-methyl at LC 50 value were added into the glass jars above the surface of the seeds, shacked by hand to mix the seeds with tested materials and kept of the laboratory conditions to evaporate the solvent then stored till used for testing. The samples treated only with acetone served as control. For testing the residual activity, sample of 20g treated seeds was taken after the previously mentioned periods of storage in small glass jars and exposed to five males and five females of *S. oryzae* and *C. maculatus.* The jars were covered with muslin with elastic bands and left in the laboratory. Each concentration was replicated three times. The percentage moralities were recorded after different periods of infestation; i.e. 1, 3 and 5 days. After 14 days of treatment, the parent adults were removed to prevent mixing them with the first generation (F1) off spring. The total number of eggs laid on the wheat or cowpea seeds by females during the 14-days was examined under bionocular microscope and number of hatched and non hatched eggs was recorded to determine the reduction of the progeny under the experimental conditions described above. All the fertile eggs were hatched during 9 days

(but no mature adults survived for more than 10 days after the first days of oviposition). The unhatched (or unfertilized) eggs appeared transparent, whereas viable eggs were opaque. Emerging adults were recorded for 3 weeks.

RESULTS AND DISCUSSION

1- Effects on progeny:

Data summarized in Table (1) revealed that ethanol *Eugenia aromatica* and *Pimpinella ansium* plant extracts had the strongest adversal action on adult off-springs among the used extracts, since they at the LC_{50} levels reduced the emerged progeny of *C. maculatus* and *S. oyzae* by 50.6 and 48.5% and 50.5 & 46.6% for *S. oyzae* as compared to the control, respectively. Both of the two extracts had an effect similar to that of pirimiphos-methyl (53.6%), where there is no significant difference between their effects and that of pirimiphos-methyl. At the LC_{90} level the ethanol extracts had the same order of efficiency; there were significant differences between control and the ethanol extract, where both of the used extracts significantly reduced the emerged progeny.

Plant extracts with hexane at LC_{50} and LC_{90} levels caused a significant reduction in the progeny of *C. maculatus* and *S. oryzae* when compared with the control. Based on the reduction percentage of progeny of *C. maclatus* and *S. oryzae,* the used hexane extracts at LC_{50} and LC_{90} level had the following effects in a descending order: *E. aomatica* and *P. ansium* in which concentration increasing the emerged progeny decreased with increasing the concentration. Also, results showed that hexane plant extract had an effect lower than that of the ethanol extracts at LC_{90} level. The different effects between hexane and ethanol extracts may be due to the plant species and the amount of different extracted materials with the two different solvents and concentrations used.

The above mentioned findings are in good agreement with those of Saxena *et.al* (1992) who stated that petroleum ether and methanol extracts of aerial parts of *Lantana camara* at 5% concentration caused complete feeding deterrent action and caused reduction of progeny of *C. maclatus.* Mahgoub *et al.,* (1998) found similar remarkable reduction in the average number of progeny emerged from wheat grains and cowpea seeds treated with LC_{25}, LC_{50}, and LC_{75} of *Petreselinum sativum* oil while no adult emergence was revealed at LC_{90}.

It is well known that chemical pesticides have the property of poisoning with more low concentration. In this study, the chemical insecticide pirimiphos-methyl, at low concentration levels, had the highest adversal effect against all the tested insects at all periods of experiment with low concentrations compared to all tested plant extracts. These results are in agreement with those of El-Aidy and Helal (1997), Helal (1998) and Abo Arab *et.al.* (1998).

2- Ovicidal activity:

The susceptibility of eggs of *C. maculatus* (1-3 day-old) to the tested plant extracts and pirimiphos-methyl at the LC_{50} level was determined according to egg hatchability percentage (Table 2). Based on LC_{50}, statistical analysis indicated that *E. aromatica* and *P. ansium* extracts had the most effects, which gave 21.3 and 17.4 % 13.2 and 25.9% hatching with ethanol and n-hexane extracts, respectively.

At all levels of tested ethanol and n-hexane plant extracts, there were significant differences found between control and these extracts which significantly reduced the number of hatching eggs. At LC_{50} with ethanol extracts significant differences were found between pirimiphos-methyl and the all tested plant extracts. *P. ansium* and *E. aromatica* had the same effect on egg hatching of *C. maculatus*. There is no significant difference between n-hexane extract of *E. aromatica* and pirimiphod-methyl, while a significant difference was found between *E. aromatica* and *P. ansium.* At LC_{90} level all extracts and pirimiphos-methyl significantly reduced the number of hatching eggs of *C. maculatus* compared to the control (check).

N-hexane extracts pirimiphos-methyl was the most effective among the tested materials with percent productivity index 7.0 followed by *E. aromatica* and *P. ansium* with percent productivity indices of 14.5, 20.0, respectively. The different effects between organophosphate insecticide pirimiphos-methyl and the plant extracts may be due to the mechanism of action, the penetration rate of each toxicant introduced to eggs or the type and amounts of extracted active ingredients by the two different solvents used. In general all tested extracts significantly reduced the number of hatching eggs of *C. maculatus* at either LC_{50} or LC_{90} level. *E. aromatica* and *P. ansium* markedly increased the reduction percentage of hatching eggs and their number. Therefore, the two extracts were selected to conduct further experiments. The progressive findings are in agreement with those of Pereira (1983) who indicated that the oils of Neem kernel, karate, groundnut, palm

kernel, and palm exhibited significant ovicidal activity on *C. maculatus* eggs at a rate of above 3 mg oil/kg cowpea seeds.

Table (1): Percent reduction of progeny (F1) of *C. maculatus* and *S. oryza* adults from cowpea seeds and wheat grains treated with LC_{50} and LC_{90} values after five days of treatment.

Tested materials	*C. maclatus*							
	Ethanol extraction				Hexane extraction			
	LC_{50} mg/kg	R%*	LC_{90} mg/kg	R%*	LC_{50} mg/kg	R%*	LC_{90} mg/kg	R%*
Eugenia aromatica	8.7	48.5	40.5	86.6	6.5	49.6	37.2	93.6
Pimpinella ansium	6.8	50.6	15.3	91.6	14.9	46.7	52.5	87.6
Pirimrphos-methyl	0.0021	53.6	0.0044	96.6	0.0021	53.6	0.0044	96.6
Tested materials	*S. oryzae*							
	Ethanol extraction				Hexane extraction			
	LC_{50} mg/kg	R%	LC_{90} mg/kg	R%	LC_{50} mg/kg	R%	LC_{90} mg/kg	R%
Eugenia aromatica	6.95	46.6	43.27	88.5	3.52	48.3	19.8	96.0
Pimpinella ansium	5.29	50.5	15.20	98.4	12.0	43.6	44.7	82.3
Pirimrphos-methyl	0.0012	50.6	0.0051	100.0	0.0012	50.6	0.0051	100.0

* % R = percent reduction in the F1 progeny

Table (2): Hatchability percentage of *C. maculatus* eggs (1-3 days old) after surface spraying with ethanol and n-hexane plant extracts using LC_{50} and LC_{90} values (mg/kg which was calculated after 5 days in seed treatment).

Tested materials	Ethanol extractions					
	LC_{50} (mg/kg) Cowpea seeds	% hatch	% productivity index	LC_{90} (mg/kg) Cowpea seeds	% hatch	% productivity index
Eugenia aromatica	8.7	21.3	27.3	40.3	11.9	15.3
Pimpinella ansium	6.8	17.4	22.3	15.3	9.0	11.5
Pirimrphos-methyl	0.0021	11.0	14.0	0.0044	5.6	7.2
Control	-	77.9	-	-	77.0	-
Tested materials	Hexane extraction					
	LC_{50} (mg/kg) Cowpea seeds	% hatch	% productivity index	LC_{90} (mg/kg) Cowpea seeds	% hatch	% productivity index
Eugenia aromatica	6.5	13.2	16.7	37.8	11.3	14.5
Pimpinella ansium	14.9	25.9	33.2	52.5	15.6	20.0
Pirimrphos-methyl	0.0021	11.0	14.0	0.0044	6.5	72.0
Control	-	77.9	-	-	77.9	-

$$\% \text{ Productivity index} = \frac{\% \text{ egg hatching in treated}}{\text{egg hatching in control}} \times 100$$

Our results also indicated that, the ethanol and hexane plant extracts of *E. aromatica* (Flower buds) and *P. ansium* (seeds) gave the high effects on the tested insect species by 3 different methods of applications. These results suggest that these plants may be a good source for naturally occurring phyto-chemicals with the potential of protecting stored product from attack of pests. Therefore we selected these two mentioned plants to carry out some further phyto-chemical experiments to clarify and insure these findings.

Also, the effectiveness of the various plant extracts in suppressing the oviposition and percent eggs hatching has been recorded by several authors. Makanjuola (1989) found that, extracts of Neem leaves and seed has significantly reduced oviposition, percent hatched eggs and percent adult emergence of *C. maculatus* on treated cowpeas. He also concluded that Neem not only acting as an oviposition deterrent but also as an ovicide. Ferial (1985) also reported that citrus oils, navel orange, sweet orange and grape fruit significant reduced the oviposition. Furthermore all oils reduced total deposited eggs on seeds and egg hatchability percentage. Othman (2000 b) found that the mortality of potato tuber moth, *Phthorimaea Opereulella* eggs fumigated by vapors of Tagetes minuta oil for 6, 12 and 24 h periods of exposure was dose dependent and the longer exposure to vapors, the higher effects obtained. In the case of *P. Opereulella* larvae exposed in infested tubers the ability of oil vapors to penetrate a mass of commodity and persist for long time to kill insects hidden inside the tubers or living in the interstitial space of a commodity was indicated.

A concentration of 100 µl/L of air space and exposure of 72 hours was enough to obtain 100% kill of all the insects living inside tubers in space treatment.

3- Residual activity:

The residual activity of the tested plant extracts was evaluated. The effectiveness on adults as percent mortalities and progeny emergence were used as criteria. Progeny emergence (F_1) of both tested insects was calculated. All results obtained were recorded in Table (3-5).

3.1. Effects on mortality percentage and progeny of *S. oryzae*:

Data summarized in Table (3) showed that ethanol extracts at 7 days date, *P. ansium* had the remarkable effect with 46.6, 83.6 and 94.2 % mortality compared to *E. aromatica* which caused 43.3, 56.6 and 89.6 % mortality. At 1, 2, 3, 4, and 5 months, the 5 days of exposure *P. ansium* proved highest potency. The mortality percentage were 90, 90, 83.3, 66.6 and 30.0%, respectively, compared to *E. aromatica* which produced 86.6, 80.0, 75.6, 63.3 and 20% mortality at the same mentioned dates. Results indicated that the *P. ansium* exhibited the longest residual effect (up to 5 months) in comparison with the recommended reference insecticide pirimiphos-methyl which remarkably lost its effect at 5 months date of storage, where it caused 0, 0 and 8% mortality after 1, 3 and 5 days of exposure, respectively. Also, the obtained results showed that both tested extracts had longer residual effects than that of pirimiphos-methyl. On the other hand, the potency n-hexane extract of *E. aromatica* higher than that of *P. ansium* at all storage periods.

In general, both tested plant extracts exhibited a longer residual activity than that of pirimiphos-methyl either with ethanol or other solvents. However, pirimiphos-methyl had initial effect at 7-days of storage higher than that of both tested extracts. These findings agree with those of Abd El-Kawy (1992), who treated yellow meal corn with the plant oils cotton seed, sesame, peanut and paraffin oils at rates of 1, 3 and 5 ml g/kg. All oils caused highly significant adult mortality of *S. oyzae* which increased by increasing the period of exposure to treated seeds. From the obtained results it would be suggested, there was a positive relationship between the type of solvent, concentration of plant extract, exposure period and its insecticidal activity.

Table (3): Mortality percentage of insect treated with LC_{90} values of plant extracts compared to pirimiphos-methyl against *S. oryzae* after indicated different period post treatment.

Tested materials	Conc. LC_{90} (mg/kg grains)	Exposure time (in days)	% mortality after indicated intervals					
			7 days	Months				
				1	2	3	4	5
Ethanol extracts								
E. aromatica	43.3	1	43.3	36.6	30.0	16.6	8.3	0.0
		3	56.6	50.0	46.6	36.6	30.0	10.0
		5	89.6	86.6	80.0	75.6	36.0	20.0
P. ansium	15.2	1	46.6	38.3	38.3	28.3	10.0	0.0
		3	83.6	76.6	73.3	45.0	26.6	26.6
		5	94.2	90.0	90.0	83.3	66.6	30.0
n-hexane extracts								
E. aromatica	43.3	1	58.3	46.6	36.6	30.0	23.3	10.0
		3	83.3	80.0	66.6	43.3	38.3	16.6
		5	96.0	90.0	86.6	80.0	52.6	26.6
P. ansium	15.2	1	36.6	23.3	18.3	8.3	0.0	0.0
		3	66.6	58.3	46.6	26.6	26.6	0.0
		5	83.3	76.6	70.0	56.6	43.3	13.3
pirimiphos-methyl	0.0051	1	50.0	46.6	46.6	33.3	16.6	0.0
		3	83.3	80.0	80.0	63.3	23.3	0.0
		5	100	96.6	90.0	86.6	30.0	8.0

Based on the reduction percentage of progeny (F_1) of *S. oryzae* extract of ethanol *E. aromatica* and *P. ansium* and pirimiphos-methyl were significantly reduced the emerged adults of *S. oryzae* at all storage intervals compared with control, except with pirimiphos-methyl at 5 month date. Although there were no significant differences between both ethanol extracts and pirimiphos-methyl, *P. ansium* exhibited higher reduction percentage than that of *E. aromatica* and pirimiphos-methyl at 2, 3, 4 and 5 months intervals of storage (Table 4). *P. ansium* gave 100, 93.5, 87, 80, 73 and 38.5% while *E. aromatica* produced 100, 89.7, 83, 73.3, 66 and 30% reduction in progeny at 7 days and 1, 2, 3, 4 and 5 months, respectively. On

the other hand, with n-hexane extracts results (Table 4) cleared that *E. aromatica* was the effective extract with reduction percentage higher than that of *P. ansium* and pirimiphos-methyl at 3, 4, and 5 months intervals, although there were no significant differences between the tested materials used in this respect. The fluctuations found between the effect of hexane and ethanol plant extracts may be due to the different isolated materials by the two solvents, while the different effects between both extracts and pirimiphos-methyl might be due to the mode of action and the residual half life of each material.

Table (4): Percent reduction of progeny (%R) of (F_1) on *S. orayzae* adults exposed to wheat grains treated at the LC_{90} concentration level of tested materials at various intervals post treatment.

Tested materials	Conc. of LC_{90} (mg/kg) of wheat grains	Storage periods post-treatment											
		7- days		1 month		2 month		3 month		4 month		5 month	
		Mean adult emerged	% R*	Mean adult emerged	% R	Mean adult emerged	% R	Mean adult emerged	% R	Mean adult emerged	% R	Mean adult emerged	% R
Ethanol													
E.aromatica	43.3	0.0 b	100	6.3 b	89.7	12.3 b	83	26.3 b	73.3	41.6 b	66	96.6 b	30.0
P.ansium	15.2	0.0 b	100	4.3 b	93.5	9.6 b	87	20.0 b	80	32.6 b	73	85.0 b	38.5
n-hexane													
E.aromatica	19.8	0.01 c	100	3.6 b	93.5	12.3 b	83.0	20.0 c	80	44.3 c	55.0	88.3 b	36.0
P.ansium	44.7	10.0 b	80	13.0 b	79	23.3 b	68	50.0 b	49.0	80.0 b	34.0	120.0 ab	13.2
pirimiphos-methyl	0.051	0.01 c	100	4.3 b	94.0	10.6 b	85.0	23.3 c	77	57.6 c	47	110.3 ab	20.0
Control	-	55.6 a		62.0 a		73.0 a		98.6 a		122.0 a		138.3 a	

* Percent reduction in the F1 progeny

Means followed by the same letter are not significantly different at the 5%level by DMRT (Duncan Multiple Range Test, Duncan, 1955).

Our results agreed with those done by several researchers, Zidan *et al.* (1993), evaluated four plant extracts namely *Mentha longifolia, Eugenia aromatica, Sapinds aponaria* and *Prunus ameniaca* against the adults of *S. orzae* on treated wheat grains. *Mentha longifolia* and *E. aromatica* exhibited great efficiency in controlling *S. oryzae* in wheat grains. The same results were found with post treatment periods. Similarly plant oils, cotton seed, sesame, paraffin and peanut oils were mixed with yellow meal corn at rates of 1, 3 and 5mg/kg by Abd El-Kawy (1992). The results reported that, all used oils significantly reduced the number of adults' progeny. After 135 days of exposure to cotton seed, sesame, peanut and paraffin oils at the rate of 1 mg/kg the reduction percentages of adults progeny reached 94.1, 92.7, 92.1 and 95.8%, respectively. The same trend was noticed when wheat grains treated with *Petroselinum sativum* oil at three levels (LC_{25}, LC_{50}, and LC_{59}) (Mahgoub *et al.*, 1998). They recorded significant reduction in average the number of progeny emergence at LC_{25} and LC_{50} levels, while no adults' emergence was noticed at LC_{95} level. Taheya *et al.* (1995) *Nigella sativa* seeds affected the reproductive capacity of *S. oryzae.* Mahgoub and Ahmed (1996), Methanol and petroleum ether extract gave good protection to wheat grains against *S. oryzae* up to, approximately 12 weeks storage.

3.2. Effects on mortality percentage and progeny of *C. maculates:*

Results summarized in Table (5) show the mortality percentages of *C. maculatus* adults when exposed to cowpea seeds prior treated with LC_{90} (mg/kg of cowpea seeds) of n-hexane and ethanol extracts of *E. aromatica* and *P. ansium* and a conventional insecticide pirimiphos-methyl and stored for 5 months at laboratory condition. Percent mortality was recorded at 1, 3 and 5 days of exposure at the different periods of storage. At periods of storage, n-hexane of *E. aromatica* extract had the most effect compared to the ethanol *E. aromatica* at 1, 3 and 5 days of exposure. There was a fluctuation between the effects of the mentioned extracts at all periods of storage. However ethanol *P. ansium* extract had the highest effect compared to that of n-hexane one at almost all periods of storage. In general extracts of *E. aromatica* had high residual effect compared to that of *P. ansium.* Results showed that percentage mortality increased with the increasing of time elapse. The residual of tested extracts as well as pirimiphos-methyl decreased when the periods of storage increased. Ethanol extracts of either *E. aromatica* or *P. ansium* had higher residual potency than that

of pirimiphos-methyl at 4 and 5 months periods of storage with mortality percentages of 65.6, 36.6 and 60.0, 46.6 and 58.6 and 23.3% for ethanol extracts of *E. aromatica, P. ansium* and pirimiphos-methyl at the two mentioned periods of storage, respectively. These findings are in agreement with those of Mahgoub (1995) who tested the effects of leaves extracts and powder of neem plant on adults of *C. maculatus.* Chloroform extract gave 83.3% mortality at 1% concentration after 3-days of exposure. The 30% Neem leaf powder gave 100% mortality at the same periods. Neem seed oil *A. indica* and of *Piper guineese* remarkably protected cowpea seeds from damage. At 2 and 3 mg/kg mortality of *C. maculates* adults reached 100% after 24 h with piper seed oil while it was 65-100% at 3-5 days with neem oil.

Table (5): Mortality percentage of LC_{90} values of plant extracts compared to pirimiphos-methyl on *C. maculatus* after different period post-treatment

Tested materials	Conc. LC90 (mg/kg)	Exposure time	7 days	Time (month)				
				1	2	3	4	5
% mortality								
Ethanol extracts								
E. aromatica	40.5	1	43.3	36.6	28.6	23.3	20.0	20.0
		3	63.3	63.3	53.3	36.6	30.0	23.3
		5	92.5	92.5	83.5	76.6	65.6	36.6
P. ansium	15.3	1	46.6	43.3	36.6	23.3	10.0	3.3
		3	76.6	56.6	50.0	46.6	36.	10.0
		5	92.8	86.5	76.6	76.6	60.0	46.6
n-hexane extracts								
E. aromatica	37.8	1	50.0	46.6	40.0	30.0	26.6	0.0
		3	83.3	80.0	56.6	43.3	36.6	26.6
		5	93.3	92.0	80.6	73.3	56.8	40.6
P. ansium	52.5	1	23.3	23.3	20.0	16.6	10.0	0.0
		3	56.6	46.6	40.6	36.6	23.3	16.6
		5	81.1	76.6	76.6	70.0	50.0	26.6
Pirimiphos-methyl	0.0044	1	56.6	53.3	46.6	36.6	20.0	6.6
		3	83.3	83.3	76.6	63.3	50.0	23.3
		5	100	92.0	89.6	78.3	58.6	23.3

Results obtained in Table (6) showed that *E. aromatica* extracted with n-hexane had achieved reduction percentage in off-springs of *C. maculatus* (F_1) higher than that of ethanol *E. aromatica* extract had more residual potency than that of same extract with n-hexane. There were no significant differences between n-hexane extracts of both *E. aromatica* and *P. ansium* at the remaining periods of storage. At the same time the n-hexane extracts of both tested plans had reduction percentage ratios higher than that of pirimiphos-methyl at the periods of 3, 4 and 5 months. Ethanol extract of *P. ansium* at 3, 4 and 5 months and *E. aromatica* at 5

Table (6): Percent reduction of progeny (%R) of (F_1) on *C. maculatus* adults exposed to cowpea seeds treated with LC_{90} levels of tested materials after different periods post-treatment

Tested materials	mg/kg Con / Time	Storage periods post-treatment											
		7- days	% R	1 month	% R	2 month	% R	3	% R	4	% R	5	% R
		Mean adult emergence		Mean adult emergence		Mean adult emergence		Mean adult emergence		Mean adult emergence		Mean adult emergence	
Ethanol													
E. aromatica	40.5	12.6 b	92.3	20.3 b	89.7	28.3 b	87	30.0 bc	84.1	65.3 b	70.3	93.3	54.8
P. ansium	15.3	7.8 c	96.6	18.0 b	90.8	18.6 b	91.3	20.3 c	89.4	39.9 c	81.7	79.3	61.6
n-hexane													
E. aromatica	37.8	13.3 b	94.2	16.6 b	91.9	20.3 b	90.5	23.6 b	87.5	57.7 b	79.8	86 c	58.2
P. ansium	52.5	17.3 b	92.8	22.6 b	88.2	26 b	87.9	37.6 b	80.1	81.3 b	63	132 b	35.6
Pirimiphos. methyl	0.0044	0.0 c	100	11.2 b	94.3	23.6 b	88.8	46.4	75.6	72.3 b	67.1	149.6 b	27.1
Control		232.0 a		196.0 a		216 a		189.3 a		219 a		206 a	

Means followed by the same letter are not significantly different at the level 5% by DMRT (Duncan Multiple Range Test, Duncan, 1955).

Percent reduction of progeny =

$$\frac{\text{Mean No. of adults emerged in control} - \text{mean No. of adults emerged in treated}}{\text{Mean No. of adult emerged in the control}} \times 100$$

months period, had high significant reduction percentage than that of pirimiphos-methyl with percentage ratios of 89.4, 81.7 and 61.6 with *P. ansiu* and 54.8% with *E. aromatica* compared to 75.7, 67.1 and 27.1

with pirimiphos-methyl at the same mentioned periods of storage, respectively. Generally at all periods of experiment there were significant differences between all used materials and control. Also, results indicate that the extracts used had achieved long residual action on progeny (F_1) compared with pirimiphos-methyl.

Based on the reduction percentage of progeny of *C. maculatus* the order of residual effect almost, was as follow *P. ansium* ethanol extracts *E. aromatica* n-hexane and ethanol extracts and finally n-hexane of *P. ansium*. These findings are in agreement with those of Ivbijaro (1990). Othman (2000a) evaluated the insecticidal potential of some plant extracts, *Cymbopogon proximus, Thymns vulgaris* and *Tagetes minuta* against adults of *Sitophilus granarins* (L) in laboratory seed treatments at a rate of 2, 4 and 6 ml of each oil/kg of wheat grains. With the highly active cymbopogon oil, the percent mortality of adults was 84.2% as well as the percent reduction in the number of weevils emerging from oil-treated wheat grains which was 63.0%. These values were 67.7 and 61.2% for thymus and 61.5 and 61.2% for tagetes oil, applied at 6 ml oil/kg of wheat grains.

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تأثير بعض المستخلصات النباتية ومبيد البريمفوس-ميثيل على تعداد الآفة ونسبة فقس البيض والأثر الباقى لنوعين من آفات الحبوب المخزونة

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أجرى هذا البحث بهدف دراسة تأثير فاعلية بعض المستخلصات النباتية وهى نباتات القرنفل والينسون المستخلصة بنوعين من المذيبات مقارنة بالمبيد الكيماوى الموصى به وهو البريميفوس-ميثيل على تعداد الآفة ونسبة فقس البيض والأثر الباقى على حشرتى سوسة الأرز وخنفساء اللوبيا. وقد أوضحت النتائج المتحصل عليها أن التركيزات النصفية (LC_{50}) والتركيزات المميتة (LC_{90}) اظهرت إنخفاضاً ملحوظاً فى التأثيرات على عدد الحشرات الناتجة فى الجيل الأول سواء حشرة سوسة الأرز أو خنفساء اللوبيا ولاسيما تركيزات (LC_{90}) حيث أن نسبة الإنخفاض تزداد مع زيادة تركيزات جميع المستخلصات المستخدمة. أما بالنسبة للمبيد الكيماوى فقد أظهر نسبة عالية من الإنخفاض. وفى حالة معاملات البيض أوضحت النتائج أن مستخلص نبات الينسون والقرنفل سجلا انخفاضاً معنويا فى نسبة البيض الفاقس مقارنة بالكنترول وخاصة تركيزات (LC_{90}). أما فى حالة اختبار الاثر الباقى فقد أوضحت النتائج نسبة موت ملحوظة مع المستخلصات النباتية سواء مع خنفساء اللوبيا أو سوسة الأرز وكذلك نسبة انخفاض ملحوظ فى عدد الحشرات الناتجة (الجيل الأول) وكانت النسب مرتفعة فى المبيد مقارنة بالمستخلصات. وبعد الشهر الرابع والخامس كانت نسب الانخفاض فى التعداد بالنسبة لحشرة سوسة الأرز مع مستخلص الإيثانول لنبات الينسون والقرنفل عالية مقارنة بمبيد البريميفوس-ميثيل. أما بالنسبة لمستخلصات الهكسان فكانت نسبة الإنخفاض عالية أيضاً بالنسبة لمستخلص نبات القرنفل والينسون وكانت نسبة الإنخفاض بعد الجيل الأول بالنسبة لحشرة خنفساء اللوبيا فى نفس الترتيب بالنسبة لسوسة الأرز