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Laboratory evaluation of natural products and chemical compounds for controlling two stored grain pests

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ABSTRACT

The present study was carried out to evaluate the toxic activity of seven compounds, one organophosphorus (pirimiphos - methyl), two biocides (ivomic and *Bacillum thruingiensis*), two oils (K.Z mineral oil and Nitralo plant oil), one insect growth regulator (Cascade) and one organic acid (formic acid) against two important stored grain pests *Trogoderma granarium* and *Tyrophagus putrescentiae* by exposure to treated media. The effect of the mentioned compounds on the biology of tested pests, was also examined.

The results indicated that pirimiphos – methyl was the most toxic compound with LC_{50} 0.135 and 0.6 ug/gm for both *T.granarium* and *T.putrescentiae* at 24 hours post – treatment respectively. The least toxic compound was the mineral oil with LC_{50} values of 4300 and 210 ug/gm for *T.granasium*& *T.patrescentiae* respectively.There wase no signifigcant difference between the efficiency of the biocide ivomic and pirimiphos – methyl against *T.putrescentiae*. Cascade had more toxic effect on both tested species than the two different oils and formic acid. Results revealed that the same trend of toxicity was achieved for all tested toxicants against the larvae of *T.putrescentiae* . Results indicated that the mean number of larvae, pupae and emerged adults of *T.granazium* were highly affected by the different tested toxicants. Pirimiphos – methyl, ivomic and cascade had the same highest effect on the stages with reduction values of 100% Natrilo oil had the second rank with 83.78% reduction, while formic acid had the lowest effect with 45.9% reduction.

Also, results showed that the mean number of eggs laid, hatchability, progeny and the percentage of sterility highly affected by the different tested toxicants. All tested compounds had significant on all tested parameters compared with control.

INTRODUCTION

Stored products pests *Trophagus putrescentiae* (Schrank) and *Trogoderma granarium* (Everts) are considered of the major pest of economic importance causing serious injury to grains and other stored food products, (El-lakwah *et al*.,2000).One solution to this problem is to replace synthetic chemicals with natural compounds occunring in plants .In recent years much attention has been given to the control of storage pests that infest a large list of either stored grains or other materials and products.

So, stored product pests management is an important economic problem and strategies to control these pest ought to associate by chemical, physical and biological techniques. Recently the use of synthetic pesticides in crop protection resulted in potential hazards for mammals, disturbances of the environment, pest resistance to pesticides and lethal effects on non-target organisms, agroecosystems in addition to direct toxicity to users (Prakash and Rao, 1986, 1987). Therefore, now it has become necessary to search for alternative means of pest control with lower mammalian toxicity which can minimize the use of these synthetic chemicals. Use of botanical pesticides, natural plant products, in agroecosystems is now emerging as one of the prime means to protect crop produce and the environment from pesticidal pollution.

The use of different oils as Protectants including vegetable oils, essential oils and mineral oils, gave promising results (Abo – Arab *et al*., 1998 and Othman, 2000). Most of these chemicals are non-toxic, safe and *biodegradable* natural products and could be as insect growth regulations (Deschmukh and Renaparker, 1987) the pesticides referred to as microbial pest control agents or microbial insecticides are preparation based on disease – inducing organisms (entomopathogens) which normally infect or poison an insect or mite and ultimately cause its death. These pathogens and parasities are isolated and mass produced for use as commercial pesticides (Qudejans, 1991).

Juvenile hormone analogues (JHA), that have a very low toxicity for mammals have been considered as promising alternatives to the use of classical contact and fumigant insecticides in storehouses, being compatible with insect pest management programs (Staol, 1982 and Grenier and Grenier, 1993). These products have shown good biological activity in laboratory test against *I.castaneum*, even against strains resistant to pesticides (Thin and Edwards, 1986) or to fumigants (Vinuela *et al*., 1990), due to negative cross resistance.

Consequently, this study investigated the toxic activity of seven compounds on two pests, *T.granarium* and *T. putrescentiae*, and the effect of the mentioned compounds on the biology of tested pests.

MATERIALS AND METHODS

Pest culture techniques:

Tyrophagus putrescentiae:

Adults of *T. putrescentiae* obtained from a culture originally got from Romano cheese infested by the mentioned mite, was established under constant temperature of 29± 1C° and 70 ± 5R.H and feed on Baker's yeast. Individuals of mite were cultured in small plastic unit of 3 cm. in diameter and 4 cm. deep, where each was filled up to 0.7 cm by a binary mixture of plaster and charcoal (9:1) and tightly covered by a piece of glass slide, using a rubber band to tighten the cover with the used vial.

Trogoderma granarium:

T.gramarium adults tested in this study were continuously reared free of any insecticidal contamination for several years at 30± 2 C° and 70 ± 5 R.H at Department of stored product pests, Plant Protection Research Institute, Sakha Agriculture Research Station. The subculture was maintained under the same conditions, 200 – 400 adults from the previous culture were added in 850 ml glass jars containing 400 gm crushed and whole wheat grain (*Triticum aestivum* L.) (Variety of Sakha 69 initial moisture content of 14%) as a culture medium, the jars were covered with muslin cloth to be tightly closed it was ringed by rubber bands. Newly emerged adults (0-24 hours old) were used in the experiments.

Tested Compounds:

All tested compounds were in the formulated form and dosages were calculated on the basis of ppm of active ingredient:

1- Pirimiphos – methyl: (0-2 diethyl amino – 6 – pyrimidin – 4 – yl – 0,0-dimethyl phosphorothioate)
2- Insect growth regulators (IGR) : 1- [4- [2- chloro – 4- (trifluormethyl) phenoxy] 2- flouorophenyl] -3- (2.6 - difluorbenzoyl) urea.
3- Natural oil (Natrilo): Natural vegetable oil 93% (w/v)
4- Kz: Emulsifiable mineral oil, Essential mineral oil (95%) (w/v).
5- Ivomic 1% w/v ivermerctin and 10% w/v clorsulon in a sterile solution.
6- B.t. (*Bacillus thuringiensis*) var. kurstaki, 32,000 international units of potency per mg. (14.52 Billion International units per pound) 6.4%
7- Formic acid 60% .

Bioassay of the tested compounds:

Baker's yeast method:

According to Dike *et al.* (1953), mite individuals [10 adults (5 male & 5 females) or larvae] of *T. putrescentiae* were confirmed in small glass tube and exposed to Treated (Series of concentrations) or untreated (treated with distilled water) small piece of Baker's yeast (0.2 gm each), placed on filter paper (2x2 cm). The adults were divided into groups each of which containing 3 replicates. The last groups were treated by distilled 0.2 ml water. All treatments and control examined at two different intervals (24 & 48 hrs) and Kept at the same mentioned temperature degree before counts. Mortality was recorded after 24 and 48 hours. All results were corrected accreted according to Abbott's formula (1925) as follow:

$$\text{Mortality \%} = \frac{\text{Mortality\% of treatment} - \text{mortality \% of control}}{100 - \text{mortality \% of control}} \times 100$$

Data were statistically analyzed by Litchfield and Wilcoxon (1949). Toxicity index of tested compounds were determined according to Sun (1950) as follows.

$$\text{Toxicity index} = \frac{LC_{50} \text{ of the most effective compound}}{LC_{50} \text{ of a tested compound}} \times 100$$

Mixing with media:

Mixing with media using different concentrations:

The desired considerable concentrations of each tested compound were diluted with water except ivomic which diluted with acetone. 20 gm sample of wheat grain was placed in small glass jar (11.5 by 6 cm diameter), one ml of each concentration placed on each glass jar above the surface of grain using micropipette. The jars were shaken by hand to mix the grain with the tested concentration. The treated samples were left on jars for a convenient time until the solvent evaporated, each concentration replicated three times. Other jars were left without toxicants to serve as control treatment. Ten of newly emerged adults of *T. granarium* were transferred to each jar, covered with muslin cloth and kept under laboratory conditions. Mortality counts were recorded after 24 and 48 hrs. All results were corrected according to Abbott's formula (1925).

Biological effects of the tested compounds:

T. putrescentiae:

Baker's yeast method of Dike *et al*. (1953) was carried out. In this procedure mite individuals were confined in small glass tube and exposed to LC_{50} s treated or untreated (treated with distilled water) small pieces of Baker's yeast (0.2 gm each), placed on filter paper (2x2 cm). The adults were divided into groups each of which containing 3 replicates. The last groups were treated by distilled 0.2 ml water and kept at the same pre-mentioned temperature. Mortality counts were recorded after 24 and 48 hours.

All results were corrected according to Abbott's formula (1925). Survival progeny were discarded after 3 days. The number of eggs, larvae, nymph and adults was recorded. Reduction percentage of all stages, sterility and hatchability compared with untreated check was calculated according to the following equations.

C-T / C X 100

Where:

C = Number of control stage.

T = Number of treated stage.

$$\% \text{ Hatchability} = \frac{\text{No. of larvae}}{\text{No. of eggs}} \times 100$$

$$\% \text{ Sterility} = 100 - \left[\frac{a \times b}{A \times B} \times 100 \right]$$

Where:

a = Number of eggs laid / female in treatment.

b = % of hatchability of treatment

A = Number eggs laid / female in untreated control.

B = % of hatchability in untreated control.

The data obtained were subjected to statistical analysis according to Duncan's multiple range tests (1955) which was applied whenever possible.

T- granarium:

LC_{50} concentration of the tested compounds were diluted with water except ivomic which diluted in acetone. 20gm wheat grain were placed in small glass jars (11.5 by 6 cm diameter), one ml of each concentration placed on each glass jar above the surface of grain using micropipette. The jars were shaken by hand to mix the grain with the compound. The treated samples left on jars for a convenient time until the solvent evaporated, each treatment was replicated three times. Other jars were left to serve as control treatment. Five pairs of newly emerged adults of *T-granarium* were transferred to each jar covered with muslin cloth and kept under laboratory conditions. Mortality counts were recorded after 24 and 48 hrs. All results were corrected according to Abbott's formula (1925). Survival of parent insects was removed. The number of larvae, pupae and adults were counted.

Reduction percentage of the studied stages compared with untreated check was calculated as mentioned before.

RESULTS AND DISCUSSION

Toxic activity of the tested compounds:

Toxicity of seven compounds: one organophosphorus; pirimiphos-methyl. One insect growth regulator; cascade, two oils; mineral (KZ) and plant oil (Natrilo), two biocides; ivomic and *Bacillus thuringiensis* and one organic acid; formic acid were studied against two of important stored grain pests, *T. granarium* adult and *T. putrescentiae* by exposure to treated media method.

Exposure to treated media for both *T. granarium& T. putrescentia* :

The toxic activity of the tested compounds was evaluated against *T. granarium* and *T putrescentiae* laboratory strains. Adults of both species were exposed to wheat grains for *T. granarium* and small pieces of Baker's yeast for*T. putrescentiae* were admixed with the desirable concentrations of the tested compounds. LC_{50} values with their confidence limits and slope values are tabulated in Tables (1). Data indicated that pirimiphos-methyl was the most toxic compound with LC_{50} (0.135 & 0.6 ug/g) for both *T. granarium and T. putrescentiae* at 24 hours post- treatment, respectively. The least toxic compound was the mineral oil with LC_{50} values of (4300 & 210 ug/g) for *T. granarium* and *T. putrescentiae*, respectively. Based on the LC_{50} values there was no significant difference between the efficacy of the biocide ivomic and pirimiphos- methyl against *T. putrescentia* (Table 1). Wherever the potency of ivomic followed the effect of pirimiphos- methyl on *T. granarium* (Table 4). Data obtained in tables (1 & 4) cleared that cascade had a higher toxic effect on both tested species than the two different oils and formic acid. As a conclusion, pirimiphos- methyl was the most effective compound on the two tested species followed by the biocide, (ivomic) , insect growth regulator, (cascade), formic acid and oils. In addition, the *T putrescentiae*, was more susceptible than *T. granarium* against all tested compounds (except for pirimiphos- methyl) . The effect of *B. thuringiensis* did not appear before 48 hrs, after treatment against both of *T. grana*rium and *T*. *putrescentiae,* the LC_{50} values were (320 & 600) for the two species mentioned before, respectively (Tables 3& 5). Data showed that the LC_{50} decreased when the time of exposure increased for *T. granarium* (Table 5) after 48 hrs, of treatment the *B. thuringiensis* had the highest effect against *T. granarium* compared to the tested oils and formic acid where the LC_{50} values were (320, 470 1700 and 1900) for *B. thuringiensis*, formic acid, Natrilo oil and KZ oil, respectively. The results in table (2) revealed that the same trend of toxicity was achieved for all tested toxicants against the larvae of *T. putrescentiae* where the potential rank was as followed, pirimiphos- methyl (1.1), ivomic (1.9), cascade (16) formic acid (190) and KZ (200 ug/g) after 24 hrs of treatment. Concerning the tested OP compound, these findings are in good agreement with Zettler and Jones (1977) who found that pirimiphos - methyl was the most toxic to both the susceptible and malathion resistant strain of *T.*

castamemeum and was more toxic than malathion. The potencies of plant extract were confirmed by many authors as stored product protectants (Jotwrni and Sircar, 1965; Pereira, 1983; *Arnason et al., 1989;* El- Aidy and Helal, 1997; *Abo- Arab et al., 1998, Lopez et al 2008* and Nerio *et al* 2009. Su *et al.* (1991) studied the toxic action of 12 citrus oils extracted from peels of citrus fruits and one conventional insecticide, (pirimiphos- methyl) to adults of *S. oryzae* using residue thin film technique, they found that pirimiphos-methyl with the LC_{50} 0.01 ug/cm ^{2} was the most toxic compound comparable to the tested citrus Oils.

Insect growth regulators were widely used for controlling many various insects of stored grains (Ketoh *et al.,* 2005 and Nerio *et al., 2009*) Cakmakci *et al.* (1987) tested *B. thuringiensits* isolated from different sources in Turkey; they found that some of isolates were more effective than others, giving 84–100% mortality against larvae of pyralid *Ephestia kuehniella.* They also mentioned that extension of the use of microbial preparations would results in a considerable reduction of the side effects of chemical insecticides.

Table (1):Toxicity of the tested toxicants to adults of *T putrescentiae* by exposure to treated media (after 24 hours).

Toxicant	LC_{50} ug/g	Confidence limits		Slope	Toxicity index
		Lower	Upper		
Organophosphorus					
Pirimiphos-meyhyl	0.6	0.37	0.96	1.4	100
Biocide					
Ivomic	0.66	0.55	0.79	5.0	90.91
Insect growth regulator					
Cascade	18	13.8	23.4	2.5	3.33
Organic acid					
Formic acid	52	29.5	91.5	1.3	1.2
Oil					
Plant oil (Natrilo)	170.0	117.2	246.5	2.2	0.35
Mineral oil (KZ)	210.0	150.0	294.0	2	0.28

Table (2):Toxicity of the tested toxicants to Larvae of *T. putrescentiae* by exposure to treated media (after 24 hours)

Toxicant	LC_{50} ug/g	Confidence limits		Slope	Toxicity index
		Lower	Upper		
Organophosphorus					
Pirimiphos-meyhyl	1.1	0.8	1.4	2.5	100
Biocide					
Ivomic	1.9	1	3.6	1.04	57.9
Insect growth regulator					
Cascade	16.0	6.7	38.4	0.8	6.9
Organic acid					
Formic acid	190	135.7	266	1.7	8.57
Oil					
Mineral oil (KZ)	200	153.8	260	2.5	0.55

Table (3): Toxicity of the tested toxicants to *T. putresceniae* by exposure to treated media (after 48 hours)

Toxicant	Adults				Larvae			
	LC_{50} µg/g	Confidence limits		Slope	LC_{50} µg/g	Confidence limits		Slope
		Lower	Upper			Lower	Upper	
Oil								
Natrilo	-	-	-	-	200	142.9	280	2.5
Biocide								
B. thuringiensis	600	461.5	780	2.5	900	642.9	1260	2

Table (4):Toxicity of the tested toxicants to adults of *T.granarium* by exposure to treated media (after 24 hours)

Toxicant	LC_{50} mg/g	Confidence limits		Slope	Toxicity index
		Lower	Upper		
Organophosphorus					
Pirimiphos-meyhyl	0.135	0.105	0.175	2.5	100
Biocide					
Ivomic	0.95	0.680	1.33	2	14.2
Insect growth regulator					
Cascade	290	207.100	406	2	0.05
Organic acid					
Formic acid	850	531.250	1360	2.5	0.016
Oil					
Plant oil (Natrilo)	4000	1904.8	8400	0.8	0.0034
Mineral oil (KZ)	4300	2866.665	6450	1.7	0.0031

Table (5):Toxicity of the tested toxicants to adults of *T. granarium* by exposure to treated media (after 48 hours)

Toxicant	LC_{50} mg/g	Confidence limits		Slope	Toxicity index
		Lower	Upper		
Biocide					
Bacillus thuringiensis	320	246.155	416	2	100
Organic acid					
Formic acid	470	188	1175	3.3	68.1
Oil					
Plant oil (Natrilo)	1700	944.445	3060	1.1	18.8
Mineral oil (KZ)	1900	1357.145	2660	2.5	16.8

Kheir and Alahmed (2003) investigated the effect of ivermectin and vermisantel complex against *Hyalomma dromedaril.* Ivermectin showed high acaricidal activity with rabbits treated twice at a dose of 800 µg/kg which caused 100% larval mortality and significant reductions in adult engorgement weight; number and hatchability of eggs laid. However, no significant differences were obtained when ticks were exposed to vermisantel complex treated and control rabbits. Abo-Arab and El-Hamady (1998) studied efficiency of ivermectin as a protectant against certain stored grain insects using the technique of exposure to treated feeding media, ivermectin exhibited considerable toxicity nearly equal to that of malathion. Many researchers studied the effect of formic acid on varroa mite (Shawer *et al.,* 1993; Ghoniemy, 1998; Abou El-Enain *et al*., 1999; Calderon *et al.,* 2000; Mansour, 2003, and Serag El-Dien and Eissa, 2003). Results obtained showed that bee keepers can use formic 60% safety during winter and summer season for controlling varroa mite.

Effect of the tested compounds on progeny:

Ten adults of *T. granarium* and *T. putrescentiae* were exposed to feeding media treated with LC_{50} values of the tested compounds to study the effect of these materials on the number of eggs laid, hatched eggs, larvae, pupae, progeny and the percentage of progeny reduction.

Effect of the tested compounds on *T. granarium* progeny:

Data in Table (6) indicated that the mean number of larvae, pupae and emerged adults of *T. granarium* were highly affected by the different tested toxicants. Results in Table (7) are distinguished into four groups based on the percentage of reduction of the immature stage and adults. There were significant differences between the efficiency of used compounds against the tested stages of *T. granarium* compared to control. Pirimiphos – methyl, ivomic and cascade had the same highest effect on all stages of the tested insect with reduction values of 100%. Natrilo oil had the second rank with 83.78% reduction value. Formic acid had the lowest effect with 45.90% reduction. These result agree with that of several investigators. (Zayed, 2005 and Demissie *et al*., 2008).

Table (6): Analysis of variance for the number of larvae, pupae and adults of *T. granarium* resulted in the tested toxicants.

SV	DF	MS			% Reduction
		Larvae	Pupae	Adults	
REP (R)	2	3.0398512	4.0849336	4.0224086	0.75653
Treat (T)	7	47.9772529**	55.1026693**	55.1026693**	5503.74223**
Error	14	0.8585932	2.5735812	1.8567991	2.55478

Table (7): Percentage of reduction and mean numbers of offspring, in different stages of *T. granarium* for the tested toxicants.

Treatment	Mean			% Reduction
	Larvae	Pupae	Adults	
Control	11.33 e	12.33 d	12.33e	0.00 f
Pirimiphos - methyl	0.00 a	0.00 a	0.00 a	100.00 a
Ivomic	0.00 a	0.00 a	0.00 a	100.00 a
Cascade	0.00 a	0.00 a	0.00 a	100.0 a
Natrilo	2.00 b	2.00 ab	2.00 ab	83.78 e
KZ	3.00 b	3.00 ab	3.00 bc	75.67 d
B. thurinogensis	4.67 c	4.67 bc	4.67 cd	62.12 c
Formic acid	6.67 d	6.67 c	6.67 d	45.90 b

Mean followed by the same letter in the column are not significantly different ($p<0.05$)

Effect of the tested compounds on *T. putrescentiae* progeny:

Result in Table (8) showed that the mean number of eggs laid, hatched eggs, progeny and the percentage of sterility were highly affected by the different tested toxicants. There were significant difference, between all treatments and control. The results in Table (9) had the same trend. According to meran of progeny pirimiphos – methyl, ivomic and cascade were the most effective compounds followed by Natrilo oil compared to the remaining toxicants. Percentage of sterility, indicated the same trend. In conclusion, all tested compound had significant effect on all tested parameters compared with control. These results are in agree with that of several investigators (Abo – Arab *et al*., 1998; Kim-Soonil *et al*., 2003; Cosimi *et al*., 2009 and Nerio *et al*., 2009).

Table (8): Analysis of variance for the number of eggs laid, hatched eggs, percentages of hatching, number of offspring anfd sterility of *T. putrescentiae*.

SV	DF	MS						
		Total eggs	Egg / female	N. hatching	Hatchability	Adults	%progeny	%sterility
REP (R)	2	12.121254	0.04103750	3.069029	1.061553	3.477554	0.00101	8.41526
TREAT (T)	7	488.078760 **	2.26887560 **	509.328871 **	6829.07135 **	533.801918 **	741232845* *	3597.01301 **
Error	14	1.982697	0.04741845	3.222839	1.67781	4.592768	2.28702	2.51783

Table (9):Means of hatched eggs, progeny, sterility, of *T. putrescentiae*.

Treatment	Means						
	Total eggs	Egg / female	N. hatching	Hatchability	Adults	%progeny	%sterility
Control	40.00 e	2.70 e	39.00 c	100.00 d	40.00 c	100.00 c	0.00 a
Pirimiphos – methyl	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	0.01 a	100.00 e
Ivomic	0.02 a	0.02 a	0.05 a	0.02 a	0.02 a	0.02 a	100.00 e
Cascade	12.00 b	0.56 b	0.01 a	0.01 a	0.02 a	0.02 a	100.00 e
Formic acid	21.00 d	1.40 d	7.00 b	100.00 d	7.00 b	100.00 c	48.00 b
Natrilo	17.00 c	1.10 cd	4.00 b	70.60 b	4.00 b	70.60 b	71.20 d
KZ	14.00 b	0.90 bc	3.67 b	78.60 c	4.67 b	100.00 c	73.80 d
B. thuringensis	19.00 cd	1.30 d	6.33 b	100.00 d	6.33 b	100.00 c	52.00 c

REFERNCES

Abbott. W.S. (1925): A method of comparing effectiveness of an insecticide. J. Econ Entomol. 18: 265- 267 .

Abo- Arab. R.B. and Sh.E.E El- Hamady (1998). Invermectin: as a protestant against Stored grain insects. Alex. Sci. Exch. 19 (3): 419-427.

Abo- Arab; R.B; R.M.Y. Helal and A. El- Aidy, Nadia (1998). Bioresidual activity of certain oils and plant extracts on some stored grain insects in relation with a validity of wheat grain.j. Agric. Sci. Mansoura Univ., 23 (12): 5641-5653.

Abou El- Enain, H.T.; S.M. Abou-Lila and S.A. Mahmoud (1999). Efficiency of the natural products and chemical compounds for controlling *varroa jacobsoni* Oud. J.Agric. Sci. Mansoura Univ.; 24(1): 247-254.

Arnason, J.T.; B.J.R. Philogene and P. Morand (1989). Insecticides of plant origin. ACS Symposium Series 387, Washington, 213pp.

Calmakci, L.;A. Bosgelmez; B. Gurkan; O.Z.Soylu and H. Butlut (1987). A study of *Bacillus thuringiensis* production and the determination of its effects against some Lepidopterous larvae causing damage of agricultural importance.Doge-Turk- Tarim-Ve- Ormancillk- Dergisi, 11(1): 94-104.

Calderon; R.A.; R.A. Ortiz; H.G. Arce; J.W. Van veen and J.Quan (2000) Effectiveness of formic acid on mortality in capped brood cells of Africanized honey bees.j. Agric. Res. 39(3-4): 177-179.

Cosimi, S.; E. Rossi; P. L. Cioni and A. Canale (2009). Bioactivity and qualitiative analysis of some essential oils from Mediterranean plants against stored-product pests – evaluation of repellency against *Sitophilus zeumais* Motschulsky, *Crptoletes ferrugineus* (Stephens) and *Tenebrio moliter* (L.). J. stored prod. Res. 45 (2): 125-132.

Demissie, G.; T. Tefera and A. Tadesse (2008). Efficacy of silicosec, filter cake and wood ash against the maize weevil, *sitophilus zeamais* Motschulsky (Coleoptra: Curculionidae) on three maize genotypes. J. stored prod. Res. 44 (3): 227-231.

Deschmukh, P.D. and D.M. Renapaker (1987). Insect growth regulator activity of some indigenous plant extracts. Insect Sci.8 (1): 81-83.

Dike, R.J.; K.D. Ihde and W.V. price (1953) Chemical control of mites. J. Econ.Entomol; 46(5): 844+849.

Duncan. D.B. (1955). Multiple Range and Multiple F Tests. Biometrics, 11: 1-42.

El-Aidy, Nadia. A. and R.M.Y Helal (1997). Efficiency of four natural materials as protectans for stored wheat grains against *sitophilus oryzae* L. and their effects on quality of grains. J. Agric. Sci. Mansoura Univ., 22 (12): 4217-4227.

El Lakwah, F.A., Sanaa, M. Mahgoub and Salwa, M. Mohamed (2000). Effectt of Maize hush ash and mustard seeds powder as grain protectants on some stored product insects – Annuals of Agric Sci. Moshtohor. 38 (1): 565-571.

Ghoniemy, H.A. (1998). A comparison between different techniques for controlling *Varroa jacobsoni* (using formic acid) under Fayoum conditions. J. Agric. Sci., Mansoura Univ., 23(7): 3411-3418.

Grenier. S.and A.M. Grenier (1993). Fenoxycarb, fairly new insect growth regulator: A review of its effects on insects. Ann. Appl..Biol. 122:369-403.

Jotwarni, M.G. and P. Sircar (1965). Neem seed as protectant against stored grain pests infesting wheat seed. Ind. J. Ent. 27 (2): 160 -164.

Ketoh, G. K.; H.K. Koumaglo and I.A. Glitho (2005). Inhibition of *Callosobruchus maculates* (E.) (Coleoptera: Bruchidae) development with essential oil extracted from *Cymbopgon schoenanthus* L. Spreng. (poaceae), and the wasp *Dinarmus basalis* (Rondani) (Hymenoptera: pteromalidae). J. stored prod. Res. 41 (4): 363-371.

Kheir, M.S. and Alahmed M. A. (2003). Acaricidal efficacy of ivermectin and vermisantel complex against *Hyalomma dromedaril* (Acri: Ixodidae) infesting rabbits. (*Oryctolagus spp.*). Alex. J. Agric Res. 48 (1): 123 – 127.

Kim-Soonil, R. O.; H. Jungyeon; K.I.M. Dohyoung; L.E.E. Hanseung; A.H.N. Young; S.I.Kim; J.Y.Roh; D.H. Kim; H.S. Lee and Y. J. Ahn (2003). Insecticidal activities of aromatic plant extracts and essential oils agaisnt *sitophilus oryzae* and *callosobruchus chinesis.* J. stored prod. Res. 39 (3): 293-303.

Litchfield, J.T. and F. Wilcoxon (1949). "A simplified method of evaluation dose – effect experiments". J. Pharmacol. Exp. Thero., 95: 99 – 113.

Lopez, Maria, D.; Maria, J. Jordan and Maria, J. Pascual-villalobos (2008). Toxic compounds in essential oils of coriander, Caraway and Basil active against stored rice pests. J. stored prod. Res. 44 (3): 273-278.

Mansour, H.M. (2003). Efficiency of some compounds against the mite *Varroa jacobsoni* on honeybee. J. Agric. Sci. Mansoura Univ.; 28 (9): 7067 – 7072.

Nerio, L.S.; J. olivero-verbal and E.E. Stashenko (2009). Repellent activity of essential oils from seven aromatic plants grown in Colombia against *Sitophilus Zeamais* Motschulsky (Coleoptera). J. Stored prod. Res. 45 (3): 212-214.

Othman, K. S. A. (2000). Insecticidal potential of essential oils of plant origin as protectants in stored grains. J. Egypt. Ger. Soc. Zool., 32: 91 – 103.

Pereira, J. (1983). The effectiveness of six vegetable oils as protectants of cowpeas bermbara groundnuts against infestation by *Calosobruchus maculatus* (F.) (Coleotpera: Bruchidae). J. Stored Prod. Res. 19, 57 – 62.

Prakash, A. and J. Rao (1986). Evaluation of plant products as antifeedants against the rice storage insects. Proc. Symp. Resid and Environ. Pollution, pp. 201 – 205.

Prakash, A; and J. Rao (1987). Use of chemicals as grain protectants in storage ecosystem and its consequences. Bull. Grain Tech. 25 (1): 65 – 69.

Qudejans (1991). Agro – pesticdies and functions in integrated crop protection. Economic and Social Commission for Asia and the Pacific (ESCAP). U. N. Bangkok, pp. 329.

Serage El-Dien, F. H. and A. A. Eissa (2003). Efficiency of some natural oils and chemical substances against the mite, *Varroa jacobsoni* (Oud.) infesting honeybee in different localities in Egypt. J. Agric. Sci. Mansoura Univ., 28 (111): 6921 – 6925.

Shawer, M. B.; H. A. Borae; R. El – Sufty and H. A. M. Mansour (1993). Effectiveness of substances used for the control of varroatosis in Egypt. J. Agric. Res. Tanta Univ., 19 (4).
Staol, G. B. (1982). Insect control with insect growth regulators: resistance and the future. In Pest Resistance to Pesticides (Edited by Georghiou and Saito), pp. 615 – 668, plenum press, New York.
Su, H. C. F.; R. D. Speirs and P. G. Mahany (1991). Toxicity of citrus oils to several stored-product insects. Laboratory evaluation. J. Econ. Entomol. 84 : 1438 – 1441 .
Sun, V. P. (1950). Toxicity index an improved method of comparing the relative toxicity of insecticides. J. Econ. Entomol; 43 (1): 45 – 53.
Thin, B. B. and J. P. Edwards (1986). Laboratory evaluation of the juvenile hormone analogue fenoxycarb against some insecticide susceptible and resistant stored product beetles. J. Stored. Prod. Res. 22: 235 – 241.
Vinuela, E.; A. Gobbi; P. Del Estal and F. Budia (1990). Evaluation del organofosforado malathion Y del regulador crecimiento de los insects fenoxycarb. Sobre una Poblacion de Campoy Otra de Laboratorio de *T. castaneum* Invest. Agr. Pred. Veg. 5: 145 – 155.
Zayed, G. M.M. (2005). New approaches for controlling stored grain insects. Ph. D. thesis, Kafr El-Sheikh, Agric. Tanta Univ.
Zettler, J. L. and R. D. Jones (1977). Toxicity of seven insecticides to malathin – resistant red flour beetle. J. Econ. Entomol. 70 (5): 536 – 538.

التقييم المعملي للنواتج الطبيعية والمركبات الكيماوية لمكافحة نوعين من آفات الحبوب المخزونة

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أجريت الدراسة الحالية لتقييم النشاط الإبادي لسبع مركبات (مركب فوسفوري عضوي (بريميفوس ميثيل)، وكذلك نوعين من المبيدات الحيوية وهي (أيفوميك، بكتيريا باسيلس ثيورنجنسيس) ونوعين من الزيوت أحداهما معدني (Kz) والآخر زيت نباتي (نانيرلو) ومنظم نمو حشري (كاسكيد) وكذلك حمض عضوي وهو (الفورميك) وذلك ضد نوعين من الآفات الهامة للحبوب المخزونة وهما خنفساء الصعيد *T. granarium* (الحشرة الكاملة) والنوع الآخر أحد أنواع الأكاروسات وهو *T.putrescentiae* (الحيوان الكامل) وذلك بطريقة التعريض للبيئة المعاملة. وأيضاً دراسة تأثير هذه المواد على عدد البيض والفقس وعدد اليرقات والنسبة المئوية للتعذير والنسبة المئوية للذرية وأخيراً النسبة المئوية للخفض في التعداد للآفات المختبرة.

أظهرت النتائج أن البريميفوس ميثيل كان المركب الأشد سمية حيث كانت الجرعة اللازمة لقتل 50% هي0.135، 0.6 ميكروجرام/ جرام بالنسبة لحشرة خنفساء الصعيد *T.granarium* وأكاروس *T. Putrescentiae* بعد 24 ساعة من المعاملة على الترتيب. أما المركب الأقل سمية فكان الزيت المعدني (KZ) حيث كانت الجرعة القاتلة لـ 50% من الأفراد المعاملة 4300، 210 ميكروجرام بالنسبة لخنفساء الصعيد *T. granarium* وأكاروس *T. Putrescentiae* على الترتيب.

وأوضحت النتائج أنه لم يكن هناك فروق معنوية ما بين المبيد الحيوي أيفوميك والمبيد الكيماوي (بيرويميفوس ميثيل) ضد الأكاروس المستخدم *T. putrescentiae* حيث كانت حدود الثقة لكلا المركبين واحدة.

وأوضحت النتائج أن منظم النموكاسكيد كان تأثيره السام أعلى على الحشرة المختبرة والحيوان المختبر من نوعي الزيوت المستخدمة وحامض الفورميك.

كما أظهرت النتائج أن نفس اتجاه السمية حدث مع المواد المختبرة ضد يرقات الأكاروس موضوع البحث.

وأظهرت النتائج أيضاً أن متوسط عدد اليرقات والعذارى والذرية الناتجة لحشرة خنفساء الصعيد تأثرت بشدة بجميع المركبات المختبرة، وأظهرت مركبات البريميفوس ميثيل وأيفوميك وكاسكيد نفس التأثير على الأطوار المختبرة للحشرة حيث أظهرت نسبة خفض في التعداد 100%، أما زيت ناتيرلو فقد احتل المركز الثاني في الترتيب بنسبة خفض في التعداد 83.78% وجاء في المركز الأخير حمض الفورميك بنسبة خفض للتعداد 45.9%.

بالنسبة للأكاروس *T.Putrescentiae* أظهرت النتائج أن متوسط عدد البيض الموضوع ونسبة الفقس والنسبة المئوية للعقم قد تأثرت بشدة على مستوى جميع المركبات المختبرة، وأظهرت النتائج وجود فروق معنوية ما بين المعاملات من ناحية والكنترول من ناحية أخرى وبصفة عامة يمكن القول بأن كل المركبات المختبرة كان لها تأثير معنوي على كل المعايير المدروسة مقارنة بالكنترول.

قام بتحكيم البحث

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