

## INSECTICIDAL ACTIVITY OF ROCKET SEEDS *EURCA SATIVA* EXTRACTS AGAINST SOME STORED GRAIN INSECTS AND ITS RESIDUAL EFFECT DURING STORAGE

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### Abstract

The present work concerned the effect of plant extracts, seeds of Rocket *Eurca sativa* in three solvents, hexane, acetone and methanol on three imported stored grain insects, adults of *Rhizopertha dominica* and *Tribolium castaneum* and *Trogoderma granarium*. All experiments carried out under laboratory conditions of 30±2 and 65±5 R.H. to calculate the percentage of mortality and reduction of F-1progeny for the three insects. Data was calculated after 1,3,5,7,14 and 21 days from treatment, hexane extract has the most mortality effect on the three insects, the mortality percentage ranged 30-100% with 0.25%-2% concentrations on *R. dominica* with reduction in F-1progeny ranged 77.78-100%. For *T.castanium* mortality values were in range 10.43±2 -77.9±9.29% and the reduction in F1-progeny ranged 64-100%. Mortality percentage ranged 10.22±1.52-100% for *T. gnarium* with 100% reduction in F1-progeny at 2% conc. While the other concentrations merely proved changes in the sex ratio.

The residual effects of the tested planet hexane extracts was experimented to evaluate their efficiency during storage. Throughout six months, the toxic of the *Eruca sativa* hexane extract was tested every two weeks.

### INTRODUCTION

Stored grains are considered one of the most important sources of human food and therefore it was necessary to study the pest which attack them causing many harms in the crops leading to decrease the yield and high economic losses.

This work aimed to study the use non traditional alternative aid (seeds of *Eurca sativa* Mill Family: Brassicaceae) to control three of the most abundant stored grain pests, khapra beetle *Trogoderma granarium* (Everts) Coleoptera: Dermestidae red flour beetle *Tribolium castaneum* (Herbst) Cooleoptera :Teneberiondae and lesser grain borer *Rizopertha dominica* (Fabricius) Coleoptera: Bostrichidae as a safe methods to reduce their population. The effect of several plant extracts as pest control against some stored product pests has been studied by many investigators Su(1985). Darwish (1992 and 1997) and El-Lakwah et.al.(1992, 1993, 1994, 1996, 1998).

## MATERIALS AND METHODS

### Insects cultures:-

Laboratory strain of the three insects were used in the experiments reared until the 5<sup>th</sup> generation, the suitability insects were put in glass jars each of approximately 250ml containing about 100gm of each insects feeding, and covered with muslin cloth and fixed by rubber bands. About 100 adults were introduced into the jars for laying eggs and then kept in an incubator at  $30 \pm 2$  C° and 65%R.H. After two days, all insects were removed from the media and the jars were kept again at the last controlled condition to obtain adults of the same age needed for tests. The khapra beetle, *Trogoderms granarium* and lesser grain borer, *Rizopertha dominica* were reared on wheat kernels, but red flour beetle, *Tribolium castaneum* (Herbest) was reared on wheat flour or crushed wheat under the same laboratory conditions for several generations at the stored product laboratory, Plant Protection Research Institute, Mansoura Branch.

Wheat grains and wheat flour were sterilized by freezing at -18c for two weeks to free the materials from any previous infestation.

Mixed population of *Trogoderma granarium* (Everts), *Tribolium castaneum* (Herest) and *Rizopertha dominica* (Fabricius) was obtained from Stored Products Department, plant Protection Research Institute, Agriculture Research Center for rearing in the laboratory.

### Plant seed extracts studies:-

Seeds of *Erucca sativa* Mill {Family: Brassicaceae (Cruciferae)} were

Obtained from herb shop. Seeds of *Eruca sativa* was grounded in an electric mill into fine powder. According their polarity, three solvents were hexane, acetone and methanol. The ground plant material was shaken for one hour in a shaker and its content was filtered. The solvent was evaporated at 50 C° under reduced pressure using a rotary evaporator as described by Su (1985). The extract in the form of crud was weighted and dissolved by the same solvent to get 10%(w/v) stock solution. Concentration of 2,1,0.5, and 0.25%(w/w) were prepared by diluting the solution in the solvent.

### Bioassay test:

10 gm of wheat for *T. granarium* and *R. dominica* and crushed wheat for *T. castaneum*, were put into glass jars of 50ml volume mixed with 1ml of the plant extract left for 24 hr. for dryness. Then 30 adult insects of each *R. dominica* and *T. castaneum*, and 3<sup>rd</sup> instar larvae of *T. granarium* were confined to treated wheat grains. Three replicates were used for each concentration and three for the solvent only with the grains as control replicates. Jars were covered with rubber bands and kept in the incubator at  $30 \pm 2$  c and  $65 \pm 5$  %R.H.

Mortality data were recorded after 1,3,5,7,14 and 21 days. Mortality corrected was calculated using Abbot's formula(1925).

$$T-C \times 100 \quad T---\text{mortality in treatment}$$

$$C---\text{mortality in control}$$

After 21 days, adults of *R. dominica* and *T. castaneum* were removed from all replicates and keep the jars in the incubator for 45 days to inspect the number of F1-progeny. For *T. granarium* the replicates were tested after 30 days to inspect adult males and females. The reduction rate of progeny was calculated using the following equation.

$$\% \text{reduction} = \frac{\text{F1-emerged in control} - \text{F1-emerged in treatment}}{\text{F1-emerged in control}} \times 100$$

The correct mortality percentage of each extract was statistically computed according to Finney (1971). From which the corresponding probit lines (Lc-p lines) were estimated in addition to determine 35, 50 and 90% mortalities, slope values of tested compounds were estimated. In addition, the efficiency of different compounds was measured by comparing the tested extract with the most effective extract by using the following equation: Toxicity index = Lc50of the tested extract x 100( Sun 1950).

#### **Residual efficiency:-**

A sample of 500gm. Clean wheat was used for the plant extract at Lc90 concentration. The used weight was the lowest value of Lc90 of the extract with the three insects, if was 3.95%. Mixing was manually done in one liter glass jar and kept at the laboratory condition. The obtained quantities(10gm.)were divided into several groups each placed into glass vials. Each group consists of three replicates for different each period . Each replicate was infested with 30 insects of adult, *T.castaneum* and *R. dominica* and 3r instar larvae of *T. granarium* and kept in the laboratory conditions of 30 C° ±2 and 65±5% R.H. Abdel-aziz (2007).

Mortality counts were recorded after 7 days. Lived insects were removed and noticed emergency adults F1-progeny after 45 days for each treatment for *T. castaneum* and *R. dominica* and 3 days for *T. granarium*.

## RESULTS AND DISCUSSION

Data showed a positive correlation between mortality percentage of the pests and concentration of each extracts i.e., increasing of concentration of each extract caused increasing in mortality percentage.

### 1- Toxicity of rocket extracts on *R. dominica* :-

Results concerning the bioactivity of the hexane against *R. dominica* shown in (Table1) indicated that, after 21 days, there were high mortality percentage about 100% with 2% concentration while the percentage of mortality was 30% for 0.25% concentration of hexane extract. In respect to acetone extract, the mortalities were 81.33%, 14.7, 14.7 and 0 with 2, 1, 0.5 and 0.25% concentrations, respectively. About methanol extracts, the mortality percentage was very low even after 21 days from treatment at all tested concentrations.

Reduction in F1-progeny as illustrated in fig.(1) ranged from 77.78- 100%, 33- 99.23% and 10.43- 40.3% with rocket hexane, acetone and methanol at various conc., respectively. The obtained results indicate clearly that rocket hexane extract has the highest efficacy on *R. dominica* in the mortality percentage and reduction in F1-progeny compared with methanol extract of the same part which has the lowest effect.

### 2- Toxicity of rocket extracts on *T. castaneum*:-

Result in Table (2) showed that mortalities increased with increasing concentration and exposure time. It was apparent that low mortalities percentage was recorded after one day from treatment. After 21 days from treatment, mortality values were in rang from  $10.34 \pm 2$ ,  $77.9 \pm 9.29\%$ ,  $0-7.77 \pm 1.52\%$  and  $10 \pm 2.64- 22.22 \pm 4.04\%$  at various concentrations for hexane, acetone and methanol extracts respectively.

Reduction in F1-progeny was much higher than mortality values at all concentration (0.25-2%). It ranged from 64-100% with hexane extract, while methanol extract gave 85.71-90.5%.

### 3- Toxicity of seed rocket extracts on *T. granarium*:-

The pesticidal activity of the three obtained botanical extract against *T. granarium* at different concentrations and was illustrated in (Table3). Data showed that, the highest conc.2% caused complete mortality of the 3<sup>r</sup> larval instar of the pest just after the third day of exposure to hexane extract, also this con. Cause complete reduction in F1-progeny to the pest. Even the lower conc. Cause only  $10.22 \pm .52\%$  in the mortality of the larvae but it able to change the sex ratios from 1:1 in the control 2 males: 1 females

In contrast, the acetone extract proved high mortality percentage with the highest conc. (2%). It reached  $20 \pm 2\%$  after one day only and increased with the increasing of exposure period till became 100 after 21 days with complete reduction in the progeny. While the other concentration 1, 0.5 and 0.25% also Caused mortality effect on the larvae  $84.65 \pm 8.18$ ,  $30.57 \pm 1$  and  $24.74 \pm 0.57$  % respectively.

Table 1. Toxicity of rocket extracts on the adult of *R. domenic*a and reduction (%) of Fi-progeny at 30± 2 °C and 65±5 %R.H. with different concentrations.

Rocket seeds extract in	Cone. (w/w) %	% Adult mortality after indicated days						Fi-progeny after 45 days	% Reduction in Fi-progeny
		1	3	5	7	14	21		
Hexane	2%	26.66±5.56	60±2.29	80±4.35	92±2	94.44±2	100	0	100%
	1%	12.22±3.66	35.55±4.6	60±4	15±5	85.55±4.5	91.11±2.51	0	100%
	0.5%	4.44±0.57	5.55±0.57	16.66±0	8.6±0.57	26.66±1	32.22±1.52	2.33	92.93%
	0.25%	1.11±0.57	5.55±1	7.77±2.64	4.3±3.46	14.44±2.08	30±2.64	7.33	77.78%
Control		0	0	0	0	0	0	33	
Acetone	2%	6.6 ±2.64	11.1±3.21	17.76 ±4.16	41.1±13-57	52.93±11	81.33±7.5	0.66	99.23 %
	1%	1.1±0.57	3.33±1	4.43 ±1.52	7.83±3	10±3.05	14.7±3.6	1.33	97.18%
	0.5%	1.1±0.57	1.1±0.57	3.3±1	3.3±1.52	5.63±1.73	14.7±4.04	8.6	81.18%
	0.25%	0	1.1 ±0.57	3.3±1	0±0.57	0±0.57	0±0.57	31.66	33%
Control		0	0	0	0	0	0	47.3	
Methanol	2%	0	1.1±0.57	1.1±0.57	3.3±1.52	4.53±1.73	9.22±0.57	13.33	40.3%
	1%	0	1.1±0.57	2.2±0.57	3.3±1.15	4.54 ±1	8.05±1.52	19	14.9%
	0.5%	0	0	0	3.3±0.57	3.4±0.57	8.07±1.52	19.66	11.95%
	0.25%	0	1.1 ±0.57	2.2±0.57	2.2 ±1	3.4±0.57	6.89±1	20	10.43%
Control		0	0	0	0	0	0	20.33	

Data showed that the methanol extract of rocket seeds did not have lethal effect on the larvae even with the highest concentration.

Hexane extract caused 100% reduction of F1-progeny at 2% conc. While the other concentrations merely proved changes in the six ratios. High conc. Only of acetone extract of rocket showed also complete inhibition in the F1-progeny. Changes in the six ratios between males and females of the adult occurred with 1% and 0.5% produced adults in a ratio of 4 female and 13male and 8.66female for concentration 2%, 1%, .0.5 and 0.25%, respectively, while control produced 12male :14female Fig.(3).

The result indicate that hexane extract of rocket seeds has a strong pesticidal effect on the three stored grain beetle when used in proportion ranging from 0.25 to 2.0 percent for *R.dominica*, while at 2.0% *T. cataneum* and *T. granarium*, respectively.

These results are in agreement with those of Borai (2007) who used petroleum ether and acetone extracts of rocket on *Callosobruchus maculatues* under laboratory condition of  $28\pm 2c$  and 65%R.H. and found that, the 1% concentration caused 100% mortality percentage on the pest after 7 days exposure period. Also, hexane extract of rocket proved complete reduction in F1-progeny Of *T. granarium* ,*R. dominica* and *T. castaneum*. These results are Similar to those of Borai (2007) who obtained the same result with petroleum ether and acetone extracts of rocket on *Callosobruchus maculatute*. Comparing with these results, Al- Moajel (2004) tested powders from *E.sativa* against *Trogoderma granarium* adults and larvae, no significant effect was observed in *E. sativa* on adult and larval mortality and F<sub>1</sub>.

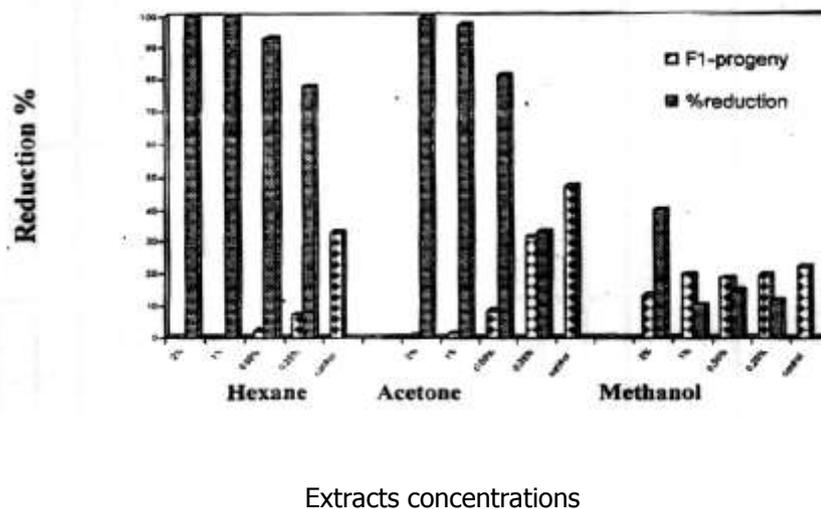
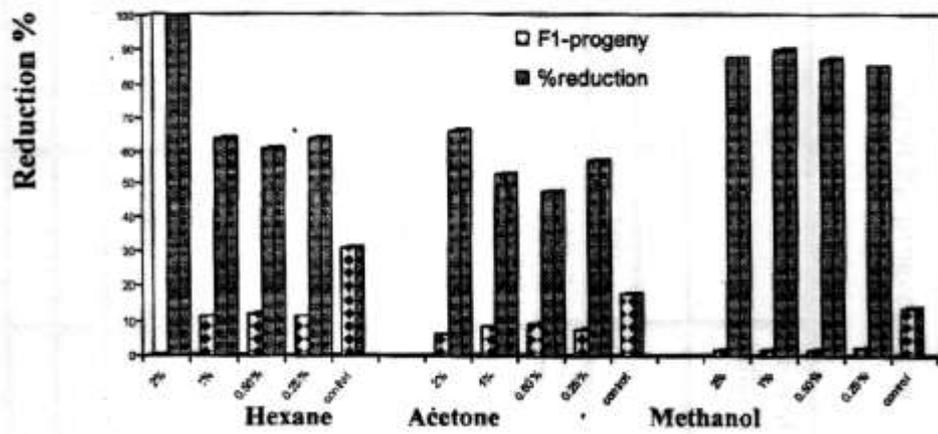
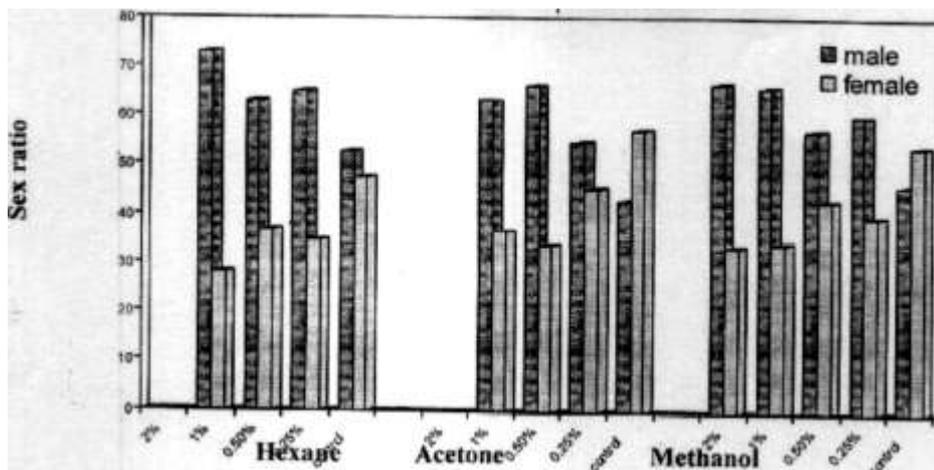


Fig. 1. Reduction (%) in F<sub>1</sub>- progeny in adults of *R. dominica* with rocket hexane, acetone and methanol extracts with different concentrations progeny of treated adults.



Extracts concentrations

Fig. 2. Reduction (%) of in F<sub>1</sub> progeny *in* adults of *T. castaneum* with rocket hexane, acetone and methanol extracts with different concentrations,



Extracts concentrations

Fig. 3. showed high sensivity of the three Stored grain pests, *T. castaneum*, *T. granarium* and *R. domonica* to the plant extract rocket.

In relation to the efficiency of rocket against three tested pests, *T. granarium* was the most sensitive and gave LC<sub>50</sub> value of 0.97% followed by *R. domonica* and *T. castaneum*, they were 1.01 and 2.41 %, respectively. The corresponding LC<sub>90</sub> reached 4.70, 3.59 and 8.59 %, respectively. The toxicity index was 95.93 and 40.09 % for *R. domonica* and *T. castaneum* based on LC<sub>50</sub> of *T. granarium* 100.00%', respectively.



Table 3. Toxicity of rocket extracts on 3<sup>rd</sup> instar larvae of *T. granarium* wheat and reduction (%) of Fi-progeny at 30± 2 °C and 65±5 %R.H. with different concentrations,

Rocket seeds extract in	Cone. (w/w) %	% larvae mortality after indicated days						Fi-progeny after 30 days	% Reduction in Fi-progeny
		1	3	5	7	14	21		
Hexane	2%	46.66±9.6	100	100	100	100	100	0	100%
	1%	7.77±0.57	23.33±2.64	44±2.3	31.83±2.64	35.62±2.08	44.18±1	12 ♂ +4.66 ♀	72.99: 28.34%
	0.5%	5.55±1	15.55±0.57	19.33±0.57	21.6±1	25.27±2	30.23±3.21	10.3♂+6.3♀	63: 37%
	0.25%	4.44±1.15	8.88±2.51	9±2.51	10.22±2	10.22±2	10.22±1.52	12.33♂+6.66♀	64.92: 35%
Control		0	0	0	0	0	0	13.33♂+12♀	57.62: 47.37%
Acetone	2%	20±2	57.77±1.15	71.26±2.51	80.43±3.78	93±2	100	0	100
	1%	12.22±2.5	36.66±4.35	40.24±6.42	48.29±6.55	60.93±8.23	84.65±8.18	4♂ + 2.33♀	63.19:36.8
	0.5%	8.88±1.52	18.8±1.52	17.26±2	19.53±1.52	27.61±1	30.57±1	11♂ + 5.6♀	66.26:33.73
	0.25%	1.11±0.57	2.22±0.57	0	0	6.92±3.5	24.74±0.57	10 ♂+ 8.33♀	54.55:45.44
Control		0	0	0	0	0	0	6♂+9♀	42.85: 57.14
Methanol	2%	0	0	0	0	0	0	13.33♂ +6.66♀	66.68: 33.332
	1%	0	0	0	0	0	0	15.66♂ +8♀	65.93: 34.07
	0.5%	0	0	0	0	0	0	12 ♂+9♀	57.14: 42.85
	0.25%	0	0	0	0	0	0	13♂ +8.66♀	60: 39.98
Control		0	0	0	0	0	0	12♂ +14♀	46.15: 53.84

Table 4. sensitivity of three stored grain insects to rocket seed hexane extracts.

Treatments		lc <sub>35</sub> %	lc <sub>50</sub> %	lc <sub>90</sub> %	Slope	Toxicity index (%)
Tested compounds	Insects					
Rocket	<i>T. castaneum</i>	1.65	2.41	18.59	2.32±0.27	40.091
	<i>T. granarium</i>	0.60	0.97	4.70	1.78±0.19	100.00
	<i>R. domonica</i>	0.67	1.01	3.95	2.16±0.18	95.93

$$\text{Toxicity index} = \frac{\text{LC}_{50} \text{ of the most effective pesticide}}{\text{LC}_{50} \text{ the tested pesticide}} \times 100$$

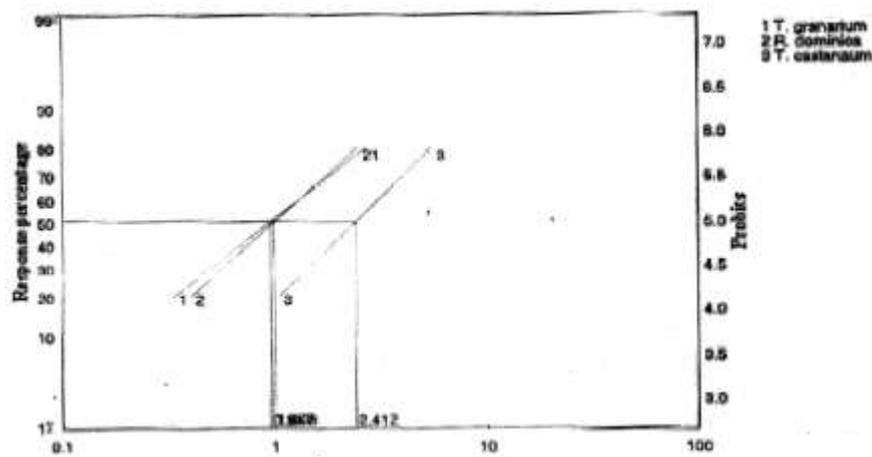


Fig. 4. Toxicity lines of rocket hexane extract against three stored grain pests.

## 2- Residual effect:-

Results indicated that, rocket hexane extract has a high persistent where it caused a mortality 100% till 10 weeks for *R. domonica* then this percentage decreased with varied changes till reached 84.44% after six months. About *T. castaneum*, this extract gave high mortality 68.88% till 6 weeks then it declined to become 1.11% after the tested period. *T. granarium* larvae were sensitive 'to rocket hexane extract for about 8 weeks with mortality 63.33% after that it diminished to be 6.66% after six months.

As for the insect progeny was gained in case of *R. domonica* and *T. castaneum*, but a few numbers of adults appeared for *T. granarium*.

These results are supported by Doharey et al. (1990) who tested the effect of 0.5% (w/v) of (*Eruca sativa*) (L.) oil applied to green gram reduced F<sub>1</sub>-emergence of *Callosobruchus chinensis* by 88% and *C. maculatus*, by 75 %, when parent insects were added six months after treatment. Compatible to that found Jood et al, (1993) when they used neem (*Azadirachta indica*) oil and powders of neem leaf and neem kernel, citrus (*Citrus limon*) leaf, garlic (*Allium A|astium*) bulb, and poina (*Mentah spicata*) leaf in maize kernels at 1 and 2 % level (w/w) against larvae of *T. granarium* Everts. Neem kernel powder and oil

provided complete protection to grains for 6 months, whereas substantial insect infestations (7-19%) were noticed after 3 months in other treatment, Infestation increased progressively and reached as high as 35 (neem leaf and podina), 43 (citrus), and 62% (garlic) after 6 months, for 6 months,

Table 5. Corrected mortality percentage of *R. dominka*, *T. castaneum* and *T. granarium* after 7 days of exposure to wheat treated with LC<sub>90</sub> of rocket hexane extract and reduction (%) of Fr progeny for different periods under laboratory conditions.

Period (weeks)	<i>R. dominka</i>		<i>T. castaneum</i>		<i>T. granarium</i>	
	Mortality (%)	Reduction (%)	Mortality (%)	Reduction (%)	Mortality (%)	Reduction (%)
2	100	100	88.88	100	96.66	100
4	100	100	73.33	100	93.33	100
6	100	100	68.88	100	68.88	100
8	100	1(H)	36.66	100	63.33	95
10	100	100	35.55	100	43.33	80.4
12	%.66	100	35.55	100	22.22	74.5
14	84.44	100	27.77	100	28.88	65
16	83.33	1s00	14.44	100	26.66	62.8
18	71.11	100	16.66	100	23.33	52.4
20	71.11	100	10	100	17.77	41.2
22	70.55	100	2.22	100	8.88	41.1
24	56.66	100	1.11	100	6.66	[212

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## النشاط الابادي لمستخلص بذور نبات الجرجير *Eruca sativa* ضد بعض حشرات المواد المخزونة وتأثيرها الباقي أثناء التخزين

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2- قسم علم الحيوان. كلية العلوم. جامعة المنصورة

لقد تمت هذه الدراسة لتقييم الكفاءة الابادية لبعض المستخلصات النباتية لبذور الجرجير *Eruca sativa* ضد الحشرة البالغة من خنفساء الدقيق الصديئة وثاقبة الحبوب الصغرى وكذلك العمر اليرقي الثالث من حشرة خنفساء الصعيد (الخبرة). حيث تم إستخلاص هذا النبات بثلاث مذيبات هي الهكسان والاسيتون والميثانول. ولقد تم دراسة نسب الموت للحشرات وكذلك الانخفاض في الجيل الاول منها إن وجد. حيث تم عمل أربع تركيزات مختلفة من كل مستخلص لكل نبات وهي 0.25% و 0.5, 1, 2, 1, 0.5 ومعالجة حبوب القمح بها وحساب نسب الموت بعد 21 و 14 , 7 , 5 , 3 , 1 يوما لكل حشرة.

1- دراسة التأثير السام لبذور نبات الجرجير على حشرة ثاقبة الحبوب الصغرى:-

أوضح مستخلص الهكسان تأثيراً ابادي تام عند التركيز الأعلى (2%) وحوالي 30% عند التركيز الأقل (0.25%) أما مستخلص الاسيتون فكانت نسب الموت 14,14,7,81,33 وصفر للتركيزات 2 , 1 , 0.5 , 0.25% على التوالي مقارنة بمستخلص الميثانول الذي لم يوجد له تأثير سام ملحوظ مع جميع التركيزات.

أما عن نسب الانخفاض في الجيل الاول فتراوحت بين 100 : 77.78% لمستخلص الهكسان 99.23 : 33% لمستخلص الاسيتون و 3 : 40.3 : 11.95% لمستخلص الميثانول.

2- دراسة التأثير السام لبذور نبات الجرجير على خنفساء الدقيق الصديئة:-

بعد 21 يوما من المعالجة تراوحت نسب الموت من

29±2,77,9±10,34±1,52,7,77±2,0:17.77±0 لمختلف التركيزات لكل من مستخلص

الهكسان والاسيتون والميثانول على الترتيب.

3- دراسة التأثير السام لبذور الجرجير على خنفساء الصعيد (الخبرة):

تم اختبار سمية المستخلصات على العمر الثالث لليرقات وكانت نسب الموت 10.33 – 100% و 24.74 – 100% لكل من الهكسان والاسيتون أما مستخلص الميثانول فلم يكن له نفس التأثير على الحشرة النتائج السابقة تؤكد فاعلية مستخلص الهكسان لبذور الجرجير على الحشرات الثلاثية للتركيزات من 2-0.25% لثاقبة الحبوب الصغرى و 2% لكل من خنفساء الدقيق الصديئة وخنفساء الصعيد

4- الأثر المتبقي:-

تم في هذه التجربة خلط حبوب القمح بأقل قيمة  $LC_{50}$  لمستخلص الهكسان لبذور نبات الجرجير مع الحشرات الثلاثة وقد أوضحت النتائج أن الأثر المتبقي لمستخلص الهكسان لبذور الجرجير سببت إبادة كاملة لحشرة ثاقبة الحبوب الصغرى لعشرة أسابيع كاملة ثم بدأت في الانخفاض التدريجي حتى 56.66% بعد ستة أشهر مع عدم ظهور أي حشرة من الجيل الأول للحشرة الأولى طوال 6 أشهر و 6 أسابيع للحشرة الثانية مع خفض عدد أفرادها مقارنة بالكنترول