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EFFICACY OF SOME SINAI'S FLORA EXTRACTS ON RICE WEEVIL *SITOPHILUS ORYZAE* L. AND BROAD BEAN BEETLE *BRUCHUS RUFIMANUS*

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ABSTRACT

This experiment was carried out during 2009 to 2012 in order to study the toxicological effect of petroleum ether, acetone and methanol extracts from some Sinai's Flora Ader *Artemisia monosperma* (whole plant), Neem *Azadirachta indica* (fruits), Lantana *Lantana camara* (whole plant) and Tobacco *Nicotiana glauca* (leaves + flowers) against adults of rice weevil *Sitophilus oryzae* and broad bean beetle *Bruchus rufimanus* at the Laboratory. Results indicated that all methanol extracts (polar solvent) achieved a high toxicity action against adults of rice weevil *S. oryzae* compared with petroleum ether (non-polar solvent) and acetone (Semi-polar solvent). Also, it can concluded that Tobacco tree (*Nicotiana glauca*) is one of the most potent plant at different solvents (petroleum ether, acetone and methanol) against adults of rice weevil *S. oryzae*.

Key words: Sinai's Flora, petroleum ether, acetone and methanol extracts, rice weevil *Sitophilus oryzae* L. and broad bean beetle *Bruchus rufimanus.*

INTRODUCTION

Sinai's Flora considers one of the most important alive resources in the environment of Egypt, and this is related to their role in the balance of ecosystem.

It includes medicinal plants, animal feed, food and fuel wood, with the addition to their economic and medical benefits and the therapeutic ones, where they are used in the treatment of many of the diseases.

The plants use for the purpose of finding new means for the control of the harmful insects and the carrier of the infections assuming that those means are distinguished by being a safe, and a cheap price, and with the efficiency of a high killing at the same time.

The rice weevil *Sitophilus oryzae* L. and broad bean beetle *Bruchus rufimanus* considered to be are one of the most dangerous pests of stored grain products in Egypt as well as other countries.

Beside great economic losses, insects also cause qualitative losses in raw materials and end-products **(Bodrože Solarov *et al.*, 2004)**.

At first the control of insect pests in storage is largely based on synthetic insecticides and fumigants (pirimiphos methyl and phosphine) which have led to the development of insecticide resistant strains, increasing cost of application, lethal effects on non-target organisms in addition to direct toxicity to users **(Champman and Dyte, 1976; Ignatowicz and Wesolowska 1994; Best and Ruthven 1995)**.

Also their adverse environmental effects and the need to maintain a sustainable environment have created the need for environmental-safe, degradable

and target specific insecticides. Because of this much effort has been focused on plants or their constituents as potential sources of commercial insect control agents **(Han *et al.*, 2006)**. Considerable effort have been focused on plant-derived materials, potentially useful as commercial insecticides.

Similarly they are recommended for use in residential premises with special precautions and care. In contrast, the products obtained from certain medicinal plants can be used without risk to non-target organisms. Additionally, consumption of extracts from some of the medicinal plants is even beneficial for human beings **(Nawaz 1999 and Saljoqi *et al.* 2006)**.

The present work aimed to study the toxicological effects of different Sinai's plant extracts against rice weevil *Sitophilus oryzae* and Broad bean beetle *Bruchus rufimanus* in laboratory.

MATERIALS AND METHODS

This experiment was carried out during 2009 to 2012 in order to study the Ecotoxicological effect of some Sinai's Flora Artemisia monosperma, Azadirachta indica, Lantana camara and Nicotiana glauca, against rice weevil Sitophilus oryzae and broad bean beetle Bruchus rufimanus at the Laboratory of Environmental Protection, Department of Environmental Protection, Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University, North Sinai Governorate, Egypt.

Insect rearing:

Insects were reared in accordance with the method prescribed by **(Anonymous, 2003).** Grains were dried up to 8% moisture content spread in the sun for about four hours so that any living stage of the insects could be destroyed. Afterward, cleaning of Grain was carried out by using an air blower, before its packing.

1- Rice weevil *Sitophilus oryzae*:

Colonies of rice weevil, *Sitophilus oryzae* were reared on whole rice grains *Oryza sativa* initially 13 to 14% moisture content **(Chen, 2003)** in plastic container under the laboratory conditions at 28 ± 2°C, 75 ± 5% R.H. and L12:D12 **(Rahman and Talukder, 2006)**. The subcultures and the tests were carried out under the same conditions. 7 to 14 days old adult of *S. oryzae* were used to the experiments.

2- Broad bean beetle *Bruchus rufimanus*:

The broad bean beetle, *Bruchus rufimanus* (Boh.) were reared according to the method described by **Sabbour and Abd-El-Aziz (2007)**. The broad bean beetle were reared on broad bean seeds *Vicia faba* (L.) in plastic pots (20 x 20 x 17 cm) under laboratory conditions 28 ± 2 °C and 75 ± 5% R.H. Each pot was covered with muslin cloth to avoid escaping of adult beetles.

Plant material:

Fresh plants of Ader (*Artemisia monosperma*), Neem (*Azadirachta indica*), *Lantana camara* and Tobacco tree (*Nicotiana glauca*) were collected from the El-Maghara and El-Arish regions, North Sinai Governorate, Egypt (Table 1), during the winter seasons (November - February), washed and air-dried in the Glass Greenhouse. Dried plants were then ground to powder using an electric grinder. The powder, and extracts were used in this experiment. All plant extracts were prepared in the laboratory as described below.

Extraction of the Botanical:

Plant extracts were prepared according to the method described by **Talukder and Howse (1993)** with some modifications.

The powders of dried plants were extracted in the laboratory by a mixture of

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three solvents petroleum, methanol and acetone. 5 gram powder of whole plant of Ader (*Artemisia monosperma*), and Lantana (*Lantana camara*), leaves and flowers of Tobacco (*Nicotiana glauca*) and fruits of Neem (*Azadirachta indica*) mixed with 100 ml solvent and then left to stand for 24 hours overnight.

The mixture was then filtered through Whatman #1 paper. Six concentrations of 2.5%, 3%, 3.5%, 4%, 4,5% and 5% from final extracts were prepared using petroleum, methanol and acetone as a solvent to apply directly against rice weevil *Sitophilus oryzae* and broad bean beetle *Bruchus rufimanus* bioassays.

Total number of insects (dead and alive) were counted and the percent mortality was calculated which is a measure of plant extracts activity as compared to the control.

Data analysis:

For all treatments, the percentage of mortality was plotted against the different extract concentrations, then the data were corrected using Abbott's formula for the mortalities in the controls. Probit analysis was done to calculate lethal concentrations LC_{25}, LC_{50}, LC_{75} and LC_{90} and slope of the extract against two insects using the software **(Bakr 2007)** Ldp Line.

RESULTS AND DISCUSSION

The main criteria of toxicity such as regression lines, LC_{25}, LC_{50}, LC_{75} and LC_{90}, as well as slope values and toxicity index were used as parameters in comparison between all plant extracts.

1- Toxicity effects of Sinai's Flora extracts against *S. oryzae* L:

(1) Petroleum ether extraction:

The results in Table (1) illustrate that petroleum ether extract of *Nicotiana glauca* achieved acute toxicity against the adult of rice weevil *Sitophilus oryzae* after 5th days of exposure, followed by petroleum ether extract of *Azadirachta indica* at all lethal concentrations (LC_{25}, LC_{50}, LC_{75} and LC_{90} levels). On the other hand, petroleum ether extract of *Artemisia monosperma* gave the lowest toxicity effect against the adult of *S. oryzae*.

(2) Acetone extraction:

As shown in Table (1), the relative toxicity of acetone extracts of Some Sinai's Flora on the basis of the medium lethal concentration LC_{50} values and toxicity index obtained after 5th days of exposure against *S. oryzae*.

It is obvious that acetone extracts of *Nicotiana glauc* gave the highest toxic effect (Toxicity index= 1.51) which recorded lowest LC_{50} (2.85) compare with other acetone extracts, followed by acetone extracts of *Azadirachta indica* (Toxicity index = 1.09) at medium lethal concentration (LC_{50} was 3.96) against the adult of rice weevil *Sitophilus oryzae* after 5th days of exposure.

Whereas, acetone extracts of *Lantana camara* showed less effective of toxicity (LC_{50} was 4.31) in this respect.

(3) Methanol extraction:

Data given in the same table indicated that toxicity effect of methanol extracts on rice weevil *S. oryzae* L. at different concentrations at LC_{25}, LC_{50}, LC_{75}, and LC_{90} values. It's clear that methanol extracts of *Nicotiana glauca* gave the highest toxicity rates (1.37) against rice weevil based on LC_{50} value (2.71) compared with other methanol plant extracts on *S. oryzae*, followed by methanol extract of *Lantana camara* (toxicity index = 1.11). While, methanol extract of *Artemisia monosperma* showed low toxicity action against adults of rice weevil *S. oryzae* after 5th days of exposure.

Table (1): The Scientific name, Family, Common name, Arabic name, part used and harvested areas of investigated Sinai's Flora.

Scientific Name	Family	Common Name	Arabic Name	Part Used	Harvested areas
Artemisia monosperma	Compositae	Ader	العادر	Whole plant	Ber Lehfain, El-Arish, Godirate valley.
Azadirachta indica	Meliaceae	Neem	النيم	Fruits	Ber Lehfain
Lantana camara	Verbenaceae	Lantana	اللانتانا	Whole plant	Ber Lehfain- El-Arish
Nicotiana glauca	Solanaceae	Tobacco tree	النيكوتين	Leaves + Flowers	El-Maghara- El-Arish

These results go in line with those reported by **Hanem (2012)** , who found that nicotine and the related alkaloids nornicotine and anabasine are obtained from aqueous extracts of tobacco (*Nicotiana* spp.: Solanaceae).

They induce highly insecticidal effects as they are synaptic poisons that mimic the neurotransmitter acetylcholine.

Generally, it can observed that all methanol extracts (polar solvent) achieved a high toxicity action against adults of rice weevil *S. oryzae* compared with petroleum ether (non-polar solvent) and acetone (Semi-polar solvent).

Also, it can conclude that Tobacco tree (*Nicotiana glauca*) is one of the most potent plants at different solvents (petroleum ether, acetone and methanol) against adults of rice weevil *S. oryzae*.

2. Toxicity effects of Sinai's Flora extracts against *B. rufimanus:*

(1) Petroleum ether extraction:

Results presented in Table (2) revealed that the highest toxicity action was obtained when adults of broad bean beetle *B. rufimanus* treated with petroleum ether extract of *Azadirachta indica* (Toxicity index = 1.06) at medium lethal concentration (LC_{50} was 3.68), followed by petroleum ether extract of *Lantana camara* (Toxicity index = 1.05) at medium lethal concentration (LC_{50} was 3.72), respectively. On the contrary, petroleum ether extract of *Artemisia monosperma* showed the lowest toxicity action against adults of broad bean beetle *B. rufimanus* after 5th days of exposure.

(2) Acetone extraction:

Concerning, toxicity action effect of acetone extraction against adult of broad bean beetle *B. rufimanus* after 5th days of exposure (Table 5) based on LC_{25}, LC_{50}, LC_{75}, and LC_{90} as well as slope and toxicity index.

It's clear that the highest toxicity was achieved when adults of *B. rufimanus* treated with acetone extract of *Lantana camara* (Toxicity index = 1.11), followed by acetone extract of *Nicotiana glauca* (Toxicity index = 1.10) at all lethal concentrations (LC_{25}, LC_{50}, LC_{75} and LC_{90} levels), respectively.

Whereas, the lowest toxicity effect was obtained when adults of *B. rufimanus* treated with acetone extract of *Artemisia monosperma* after 5th days of exposure.

(3) Methanol extraction:

Generally, It can observed from table (2) that all methanol extracts (polar solvent) achieved a high toxicity action against adults of ***B. rufimanus*** compared with petroleum ether (non-polar solvent) and acetone (Semi-polar solvent).

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Also, it can conclude that *Azadirachta indica* is one of the most potent plants at petroleum ether and methanol solvents. While, acetone extracts of *Lantana camara* and *Nicotiana glauca* recorded a high toxicity action against adults of ***B. rufimanus***.

Data represented in Table (3) elucidated that toxicity actions at LC_{25}, LC_{50}, LC_{75}, and LC_{90} levels as well as toxicity index of some Sinai's Flora methanol extracts against adult of ***B. rufimanus***.

It's clear that the highest toxicity was achieved when adults of ***B. rufimanus*** treated with methanol extract of *Azadirachta indica* (Toxicity index = 1.20), followed by methanol extract of *Artemisia monosperma* at LC_{25}, LC_{50}, LC_{75} and LC_{90} levels, respectively. Whereas, the lowest toxicity effect was obtained when adults of ***B. rufimanus*** treated with methanol extract of *Nicotiana gluca* or *Lantana camara* after 5^{th} days of exposure.

DISCUSSION

The use of plant extracts for protecting stored grains against pests is going to be one of the best methods in storage pest management especially in small granaries. From the previous results, it can be deduced that all plant extracts used during the investigation have significant effects on the mortality of adults of *S. oryzae* and ***B. rufimanus***.

The rate of mortality was also observed to be effected by the polar solvent (methanol).

Thus, the high mortality rate observed among adults of *S. oryzae* and ***B. rufimanus***, reared on *N. glauca* and *A. indica*, respectively treated grains indicated that tobacco and neem trees are a promising control agent against *S. oryzae* and ***B. rufimanus***.

The same effect of natural extracts from tobacco and neem trees against insects' infestation was reported by **Hanem (2012) and Mihale *et al.*, (2009)** against *S. oryzae* and ***B. rufimanus***, respectively.

They reported that application of *Nicotiana glauca* and *Azadirachta indica* provided protection of grains against *S. oryzae* and ***B. rufimanus*** during storage.

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Table (2): Effect of Different Sinai's Flora petroleum ether, acetone and methanol extractions on *S. oryzae* L.

Extracts	Petroleum ether extraction						Acetone extraction						Methanol extraction					
	LC_{25}	LC_{50}	LC_{75}	LC_{90}	Slope	Toxicity index	LC_{25}	LC_{50}	LC_{75}	LC_{90}	Slope	Toxicity index	LC_{25}	LC_{50}	LC_{75}	LC_{90}	Slope	Toxicity index
A. monosperma	4.008	4.572	5.215	5.871	11.801 +/- 1.972	1.00	3.858	4.080	4.315	4.537	27.753 +/- 2.607	1.06	3.572	3.719	3.873	4.016	38.406 +/- 3.708	1.00
A. indica	3.776	4.209	4.692	4.480	14.30 +/- 1.88	1.09	3.723	3.957	4.205	4.442	25.515 +/- 2.343	1.09	3.407	3.666	3.944	4.213	21.196 +/-2.322	1.01
L. camara	3.809	4.379	5.034	5.707	11.143 +/- 1.83	1.04	4.046	4.306	4.582	4.846	24.977 +/- 2.797	1.00	2.912	3.345	3.843	4.354	11.196 +/- 1.501	1.11
N. gluca	3.709	4.044	4.408	4.764	17.994 +/- 1.957	1.13	2.504	2.846	3.234	3.628	12.146 +/- 1.119	1.51	2.314	2.707	3.167	3.648	9.898 +/- 1.367	1.37

* Toxicity index = high LC_{50} /other LC_{50}

Table (3): Effect of different Sinai's Flora petroleum ether, acetone and methanol extractions on *B. rufimanus*.

Extracts	Petroleum ether extraction						Acetone extraction						Methanol extraction					
	LC_{25}	LC_{50}	LC_{75}	LC_{90}	Slope	Toxicity index	LC_{25}	LC_{50}	LC_{75}	LC_{90}	Slope	Toxicity index	LC_{25}	LC_{50}	LC_{75}	LC_{90}	Slope	Toxicity index
A. monosperma	3.546	3.921	4.335	4.745	15.472 +/- 1.853	1.00	3.756	4.300	4.923	5.560	11.488 +/- 1.812	1.00	3.345	3.731	4.161	4.591	14.225 +/- 1.863	1.07
A. indica	3.182	3.684	4.265	4.866	10.602 +/- 1.105	1.06	3.749	4.177	4.654	5.129	14.374 +/- 1.868	1.03	2.853	3.321	3.867	4.435	10.209 +/- 1.129	1.20
L. camara	3.388	3.723	4.104	4.481	15.926 +/- 2.069	1.05	3.458	3.875	4.341	4.809	13.661 +/- 1.803	1.11	3.512	3.982	4.514	5.054	12.375 +/- 1.766	1.00
N. gluca	3.437	3.780	4.156	4.527	16.358 +/- 1.922	1.04	3.472	3.913	4.410	4.910	12.994 +/- 1.782	1.10	3.693	3.967	4.263	4.547	21.643 +/- 2.109	1.00

* Toxicity index = high LC_{50} /other LC_5

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الملخص العربى

فعالية مستخلصات بعض نباتات سيناء البرية على سوسة الأرز *Sitophilus oryzae* L. وخنفساء الفول الكبيرة *Bruchus rufimanus.*

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١. قسم حماية البيئة ـ كلية العلوم الزراعية البيئية بالعريش- جامعة قناة السويس ـ مصر.

٢. قسم وقاية النبات ـ كلية الزراعة بالإسماعيلية

أجري البحث خلال الفترة من ٢٠٠٩ وحتى ٢٠١٢ من أجل دراسة تأثير السمية لمستخلصات البترواليوم إيثر، والأسيتون والميثانول لبعض النباتات البرية في سيناء (النبات الكامل للعادر، ثمار النيم، النبات الكامل للانتانا، أوراق وأزهار النيكوتين) على بعض آفات الحبوب المخزونة (سوسة الأرز، خنفساء الفول الكبيرة) تحت ظروف المعمل، وأظهرت النتائج أن جميع مستخلصات الميثانول (المذيبات القطبية) حققت سمية عالية ضد الحشرات البالغة من سوسة الأرز وخنفساء الفول الكبيرة مقارنة مع المذيبات من البترواليوم إيثر(مذيب غير قطبي)، والأسيتون (مذيب شبه قطبي)، وأوضحت النتائج أن مستخلص أوراق وأزهار النيكوتين أعطى أعلى سمية ضد حشرة سوسة الأرز في جميع المذيبات المستخدمة (بترواليوم إيثر، أسيتون، و وميثانول)، يليه نبات النيم بعد خمسة أيام من المعاملة و بالنسبة لخنفساء الفول الكبيرة أعطى مستخلص البترواليوم إيثر والميثانول لنبات النيم أعلى سمية ضد حشرة خنفساء الفول الكبيرة، في حين أعطى مستخلص الأسيتون من نباتات اللانتانا والنيكوتين أعلى سمية ضد حشرة خنفساء الفول الكبيرة بعد خمسة أيام من المعاملة.

الكلمات الاسترشادية: مستخلصات البترواليوم إيثر، سوسة الأرز، وخنفساء الفول الكبيرة، نبات اللانتانا ، نبات النيكوتين