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Evaluation of Some Vegetable Oils Against Laboratory and Field Strains of Stored Grain Insects

By

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ABSTRACT

The present investigation aimed to evaluate vegtable oil ofNeem, Sesame and Sunflower oils against laboratory and field strains of the adult stage of stored grain insects, *Sitophilus oryza* and *Rhyzopertha dominica*. Aliquots of these oils were added to wheat grains in acetone to provide concentration of 10, 20, 40, 80, 160, 320, 640 and 1280 ppm and then infested with 20 adults of both laboratory and field strains of *S. oryza* and *R. dominica*. Mortalities were recorded after 72 hours. Wheat grain samples with acetone only were used as a control. Percentage of mortality was corrected to the percentage of the control.

The data showed that the laboratory strains were more susceptible than the field strains. Also, Neem oil was found to be the most effective than the other tested oils to the laboratory strains of *R. dominica* followed by Sesame oil, Corn oil and then Sunflower oil. Moreover, Field strains of *S. oryza* and *R. dominica* were more tolerant to the tested oils than the laboratory strains. The present results show that Neem oil may prove to be very useful as a grain protectant. Such an approach would have the added advantage of minimizing the use of synthetic insecticides thereby reducing possible deleterious side effects associated with their use on stored food product.

INTRODUCTION

Wheat and sorghum are the most important cereals in the world and a major staple food in the diets of the people in Asia and Africa (ICRISAT, 1992). Insect damage in stored grains and pulses may amount to 10-40% in countries where modern storage technologies have not been introduced. Larval feeding in sorghum grains has been found to adversely affect quality of minerals (Jood *et al.*, 1992), available carbohydrates Jood *et al.*, 1993a), protein and starch digestibility (Jood and Kapoor, 1992), and bioavailability of proteins (Jood *et al.*, 1993b). The measures to control pest infestation in grain and dry food products which depend heavily upon the use of various synthetic insecticides and fumigants to grain storage led to a number of environmental problems including the development of insecticide resistance in some stored grain insects (Champ and Dyte, 1976). Another concern is the accumulation of pesticide residues in treated grains (Snelson, 1987).

In the Yemen Republic, high losses of harvested cereal grain in traditional stores have occurred. there losses are caused by several pests, particularly the lesser grain borer, *Rhyzopertha dominica* (F.), the rice weevil, *Sitophilus oryza* (Geisthard 1992, and AL-Kirshi *et al.*, 1996). Thus, there is an urgent need to develop safe alternative that have the potential to replace the toxic chemicals.

Many plant species are known to possess insecticidal activity, which are frequently present in the essential oil fraction (Schmidt *et al.*, 1991 and Shaaya *et al.*, 1991)

The present investigation aimed to evaluate efficacy of some vegetable oils against field and laboratory strains of the adult stage of stored grain insects, *Sitophilus oryza* and *Rhyzopertha dominica*.

MATERIALS AND METHODS

A- Rearing Method for the Laboratory Strain.

Two laboratory strains of stored grains insects, *S. oryza* and *R. dominica* were reared separately in empty Jars (each glass 2L capacity) covered with muslin cloth. After two weeks, the insects were sieved out of the medium and transferred to another Jar. The insects were reared

under constant temperature (25±1°C) and 70±5% R.H.). Two field strains of *S. oryza* and *R. dominica* were collected from grains stores at Taiz and Al-Hoddeida Governorate. The adult stage were used for the experimental work.

B- Bioassay Technique.

Industrially extracted oils from Sunflower, *Helianthus annuus* (L.), Sesame, *Sesamum indicum* (L.), Corn, *Zea mays* (L.) and Neem, *Azadirachtin andica* and the malathion insecticide were obtained from locally supermarkets in Yemen Republic. It was stored at 4°C. Stock solutions of the oils were prepared in dark bottles using purified acetone. Aliquots of these solutions were added to 200 grams wheat grains to provide the concentration of 10, 20, 40, 80, 160, 320, 640 and 1280 ppm. The treated wheat grains were mixed thoroughly with a glass rod and divided into 20 equal portions. Six of the portions were placed in culture tubes 30 ml capacity for studies on insect mortality. Each portion was infested with 20 adults of either laboratory or field strains of *S. oryza* and *R. dominica*.

Mortalities were recorded after 72 hours. Wheat grain samples treated with acetone were used as a control. Percentage of mortality was corrected to the percentage of the control (Abbott, 1925). The LC_{50} values expressed as part per million (ppm) were determined directly from the log-concentration mortality regression line. Slope and confidence of LC_{50}'s were calculated according to Finney, (1925).

RESULTS AND DISCUSSION

The insecticidal activities of the tested plants oils against laboratory strain of adult stage of *S. oryza* and *R. dominica* are illustrated in Table 1. The data show that the laboratory strains were more susceptible than the field strains. Also, Neem oil was found to be the most effective than the other tested oils to the laboratory strains of *R. dominica* followed by Sesame oil, Corn oil and then Sunflower oil. The LC_{50} values were 11.89, 32.13, 53.34 and 192. 95 ppm, respectively, while the laboratory strains of *S. oryza* were more tolerant than *R.*

Table 1: Activity of Plant Oils to The Field and Laboratory Strains of Adult Stage of *S. oryza* and R. *dominica*.

Source of Oils	Time (hr) post treatment	*R. dominica* LC_{50}* (ppm)	Confidence Limits	Slope	*S. oryza* LC_{50}* (ppm)	Confidence Limits	Slope
Neem Oil	72	11.89	8.19-17.44	3.49	19.76	12.86-30.11	3.78
Sesame Oil	72	32.13	12.73-68.14	3.14	49.26	28.22-105.1	2.81
Corn Oil	72	53.34	42.47-96.85	1.98	79.39	62.31-188.1	2.00
Sunflower Oil	72	192.9	103.2-286.1	1.79	312.1	210.2-441.9	1.88
Malathion insecticide	72	0.09	0.04-0.18	3.20	0.70	0.46-1.10	1.49

* Calculated from the regression equation of the data after being converted to probits according to Finney (1952)

dominica in all cases. The LC_{50} values for the tested oils were 19.76, 49.26, 79.39 and 312.14 ppm, respectively. Field strains of *S. oryza* and *R. dominica* were more tolerant to the tested plant oils. The results are shown in Table 2. In general, the field strain of *S. oryza* was more tolerant to malathion insecticide than *R. dominica*. The LC_{50} values were 1.91 and 1.11, respectively. On the other hand, the Neem oil was found to be effective against the adult of *R. dominica* and *S. oryza* with LC_{50} values of 26.85 and 68.97 ppm, respectively, while Sunflower oil was the least effective one with LC_{50} of 349.19 and 405.92 ppm, respectively.

Vegetable oils have a high level of toxicity against adult bruchids and *S. oryza* (Hill and Schoonhoven, 1981 and Ivijaro, 1984). The present

results show that Neem oil may prove to be very useful as a grain protectant. Currently attention is drawn to the use of Neem-based botanical insecticide because of its specific short environmental persistence and minimal hazard to non-target organisms including humans (Stark and Walter, 1995). Such an approach would have the added advantage of minimizing the use of synthetic insecticides thereby reducing possible deleterious side effects associated with their use on stored food product.

Table 2: Susceptibility of Field Strains of Adult Stage of *S. oryza* and *R. dominica to* Plant Oils.

Source of Extract	Time (hr) post treatment	*R. dominica* LC_{50}* (ppm)	Confidence Limits	Slope	*S. oryza* LC_{50}* (ppm)	Confidence Limits	Slope
Neem Oil	72	26.8	18.90-39.16	2.23	68.9	40.99-162.15	2.26
Sesame Oil	72	42.9	20.46-59.14	3.66	79.3	62.31-102.60	2.19
Corn Oil	72	134.2	74.64-260.7	2.11	181.9	98.12-210.12	2.87
Sunflower Oil	72	349.2	236.8-502.1	2.40	405.9	299.83-898.13	1.88
Malathion Insecticide	72	1.11	0.82-2.00	3.27	1.91	1.12-2.46	2.83

* Calculated from the regression equation of the data after being converted to probits according to Finney (1952)

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الملخص العربى

تقييم كفاءة بعض الزيوت النباتيه ضد السلالات المعمليه والحقليه لحشرات الحبوب المخزونه

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استهدفت الدراسة الحاليه لتقييم كفاءة بعض الزيوت النباتيه ضد السلالات المعمليه والحقليه للحشرات الكامله لكل من *Rhyzoperthra dominica* , *Sitophilus oryza* وقد تم خلط هذه الزيوت بالحبوب لتحضير التركيزات التاليه: ١٠، ٢٠، ٤٠، ٨٠، ١٦٠، ٣٢٠، ٦٤٠، ١٢٨٠ جزء فى المليون ثم وضع ٢٠ حشرة كامله من السلاله المعمليه والحقليه لكل تركيز وتم تسجيل الموت بعد ٧٢ ساعه ثم حساب النسبه المئويه للموت بعد تصحيحها.

اوضحت النتائج ان السلالات المعمليه اكثر حساسيه عن نظيرتها الحقليه. كما وجد ان زيت النيم اكثر فعاليه عن الزيوت الاخرى ضد السلالات المعمليه من *R. dominica* يليه زيت السمسم ثم زيت الذره واخيرا زيت عباد الشمس.

ايضا اوضحت الدراسة ان كلا السلالات الحقليه لكلا الحشرتين اكثر تحملا للزيوت النباتيه عن السلالات المعمليه.

ويمكن القول بان زيت النيم يكون مفيد كمادة واقيه للحبوب المخزونه وبالتالى يمكن استخدام فى هذا المجال لتقليل استخدام المبيدات وبالتالى تقليل مخاطرها.