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USE OF *PETROSELINUM SATIVUM* OIL FOR THE PROTECTION OF WHEAT GRAIN AND MUNG BEAN SEEDS AGAINST THE RICE WEEVIL., *SITOPHILUS ORYZAE* L. AND THE COWPEA BEETLE, *CALLOSOBRUCHUS MACULATUS* (F.)

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Abstract

The effectiveness of treatment with *Petroselinum sativum* oil for the protection of wheat grain and mung bean seeds *Vigna radiata* (L.) against the rice weevil *S.oryzae* and the cowpea weevil, *C.maculatus* was determined through laboratory tests by coating grains and seeds with P.sativum oil at LC_{25}, LC_{50} and LC_{95} 's levels. S.oryzae adults were more sensitive to the oil than C.maculatus adults at LC50 and LC95's level (2.3 and 3.5, 13.5 and 19.1 ml/kg for *S.oryzae* and *C.maculatus*).

Oil treatment at three tested levels gave a severe reduction in egg deposition, hatchability and percentage of progeny, especially at LC_{95}'s level which was highly effective on the reproductive capacity of the two tested insects to the extent that no offspring was produced by the adults, and complete protection to wheat grains against S.oryzae and mung bean seeds against *C.maculatus* was achieved at this level (LC95's).

Oil treatments seem to have adverse effect on treated wheat grains and mung bean seeds germination, but the percentages of water absorbed did not vary consistently with the different concentration of oil applied (after 1,5 and 24 hr.).

Also, tested oil decreased the amount of total chlorophyll in case of wheat grains and mung bean seeds especially at LC95's level.

INTRODUCTION

The effectiveness of insecticides against stored product insects was studied by various investigators. Unfortunately, the side effects of the use of insecticides is causing concern among users and environment protection authorities allover the world. Also, synthetic insecticides are causing serious problems, such as harmful residues in the chain of food, risk of hazards and pollution of the environment, thus disruption of biological balance and destruction of the natural enemies of certain insect pest resistance.

Hence, a modern trend is tending again towards the old age practice of using indigenous plants as a source of natural insecticides. Every achievement to this respect would be of great value, especially to the developing countries, in solving their problems of crop and stored food protection by a possible cheap production of natural insecticides.

One of the possible alternatives to synthetic pesticides is the screening of plants in search for alternative pest control agents such as extracts of plant leaves, flowers, seeds, plant dusts, plant oils ... etc.

The bioactivity of several plant extracts, dusts and plant oils as pest control agents against stored product pests was studied by many investigators (Petterson et al., 1975; Jaipal et al., 1984; Su, 1985; Mahgoub and Ahmed, 1996).

The present work is mainly concerned with the bioactivity of Petroselinum sativum at different concentrations on mortality and reduction in F1 progeny of the rice weevil, Sitophilus oryzae L. and the cowpea beetle, Callosobruchus maculatus F.

MATERIALS AND METHODS

Test insects: The cowpea beetle, *Callosbruchus maculatus* F. was reared on mung bean seeds and the rice weevil, *Sitophilus oryzae* L. was reared on wheat grains, both at 27°C and 65 ± 5% R.H. Experiments were conducted under the same conditions.

Test oil: *Petroselinum sativum* oil was obtained from local oil refineries.

The insecticidal toxicity of the oil: Amounts of oil (dissolving in petroleum ether) estimated to give the tested concentrations were prepared. One ml of each prepared concentration was added to ten gms of mung bean seeds or five gms of wheat grains in glass jars and mixed thoroughly. Three replicates were carried out for each concentration.

Ten pairs of S.oryzae (1-2 weeks old) were introduced into glass tubes containing treated wheat grains or five pairs of C.maculatus (1-2 days old) were introduced into treated mung bean seeds.

Mortality counts were recorded after 48 hr. Percentages of insect mortality were corrected for the natural mortality by mean of Abbott's formula (1925). The corrected mortality percentages were statistically computed according to Finney (1952).

Bioassays: To determine the effect of LC25, LC50 and LC95% kill of the oil on the reproductive capacity of the two insects, 300 gm of cleaned wheat grains were mixed thoroughly with the concentrated oil (after dissolving in petroleum ether) at three tested levels (LC25, LC50 and LC95) in glass jars. The same was conducted with mung bean seeds which mixed at the same three levels. All jars were then left till the solvent was evaporated completely. Another untreated grains and seeds were served as controls.

I. Effect on reproduction

A. Sitophilus oryzae

1. Number of deposited eggs / female : Five grams of wheat grains treated with oil at (LC25, LC50 or LC95) with ten couples of two-week old adults were placed in glass tubes. After seven days insects were removed and the number of deposited eggs in the grain were calculated according to Frankenfeld (1948) and Howe (1952). Four replicates were made for each concentration, beside four replicates of untreated grains were used as control.

2. The *S.oryzae* percentage of emergence : Ten couples of two-week old *S.oryzae* adults were placed in glass tube containing five gm of wheat treated with LC_{25}, LC_{50} or LC_{95} of tested oil. After seven days insects were removed, and the total number of the emerged adults was recorded after six weeks.

B. *Callosobruchus maculatus*

Number of deposited eggs, hatchability and progeny of adults: Ten of the above treated mung bean seeds (with LC25, LC50 or LC95 levels) were placed in glass tubes. Five couples of newly emerged adults were placed in each tube and covered with muslin. After one week, all dead insects were discarded and the seeds were examined for the number of eggs laid. Hatchability of eggs were indicated when they turned white showing that larvae had penetrated the seeds. Infested seeds were kept till the emergence of offspring which was counted. Tests were all carried out under controlled conditions of 27^{o}C and 65±5% R.H.

II. Seed germination and water absorption

Seed germination by *Petroselinum sativum* oil were examined. Wheat grains and mung bean seeds (*Vigna radiata* (L.) were treated with oil at LC25, LC50 and

LC95 levels. Germination was tested 2 days after oil treatments in petri dishes, four dishes (9 cm) were lined with two layers of filter paper soaked with 4 ml water and then, 25 grains or seeds were placed on the paper. Germination was recorded 7 days later.

Oil treatments and control were weighed and submerged in water. Moisture absorption was measured after 1, 5and 24hr as percentage of weight increase after drying the seeds with paper towels.

III. Determination of chlorophyll

An accurate weight of shoot sample (1gm) was ground in cold aqueous acetone (80%). The paste was filtered under suction through a Whatman No. 2 filter.

The concentrations of chlorophyll a, b and total chlorophyll were determined colourimetrically by measuring the optical density of the 80% acetone chlorophyll extracts at the wave lengths 645, 663 and 652 µm, respectively.

The obtained reading was then calculated by the following equation of Mackinney (1941) :

$$\text{Chlorophyll (a)} = 20.2 \times \Delta 645 \times \frac{\text{volume of the extract}}{1000 \times \text{weight of sample}}$$

$$\text{Chlorophyll (b)} = 8.02 \times \Delta 663 \times \frac{\text{volume of the extract}}{1000 \times \text{weight of sample}}$$

$$\text{Total Chlorophyll} = \frac{\Delta 652 \times 1000}{34.5} \times \frac{\text{volume of the extract}}{1000 \times \text{weight of sample}}$$

RESULTS AND DISCUSSION

A comparison based on LC25 values of tested oil given in Table 1 shows that 0.06 ml of the oil applied mung bean seeds as surface treatment resulted in 25% mortality to exposed C.maculatus adults after 48 hr, while larger amount (0.12 ml/kg wheat grains) of the oil gave the same mortality (25%) to exposed *S.oryzae* adults. The corresponding trend was registered at LC_{50} level, while marked (2.3 ml/kg) in *S.oryzae* and (3.2 ml/kg) in *C.maculatus*. This means that LC_{50} level, the oil was relatively more toxic to *S.oryzae* than *C.maculatus*. However, a comparison based on LC95 values indicates *S.oryzae* to be more sensitive to oil (13.5 ml/kg) than *C.maculatus* (19.1 ml/kg).

The slopes of regression lines obtained 48hr after treatment, Table 1 are 0.920 for *C.maculatus* and 2.186 for *S.oryzae*. These results agree with Taheya et al., (1995) with *Nigella sativa* seeds which affected the reproductive capacity of *S.oryzae and C.maculatus.*

Table 1. LC25, LC50 and LC95 values and slopes of regression lines for *Petroselinum sativum* oil against *Sitophilus orzyae* and *Callosobruchus maculatus* adults, 48 hr after treatment.

Test insect	LC25 (ml/Kg)	LC50 (ml/Kg)	LC95 (ml/Kg)	Slope
S.oryzae	1.2	2.30	13.5	2.186
C.maculatus	0.6	3.20	19.1	0.920

Results in Table 2 indicated that exposing *S.oryzae* adults to the LC25, LC50 and LC95 levels of the tested oil resulted a great reduction in the mean number of eggs/5 females which marked 9.00, 4.00 and 1.76 eggs, respectively. Besides, highly reduction in average number of progeny emergence at the two first levels. No adult emergence was noticed at LC95 level. The same trend was noticed when exposing adults of *C.maculatus* to the tested levels (LC25, LC50 or LC95), the mean number of eggs was severely affected, very few number of eggs were deposited (21.8, 2.86 and 0.14 eggs) as compared with that of control (140 eggs).

Table 2. Effect of Petroselinum sativum oil on *S.oryzae* adults exposed to surface treated wheat grains .

Concentration (ml/kg grains)	Mean no. of eggs/10 pairs	Mean no. of progeny emergence
1.2 (LC25)	09.00	02.67
2.3 (LC50)	04.00	00.67
13.5 (LC95)	01.76	00.00
Control	48.76	32.00

Besides, a great reduction in hatchability of the produced eggs at the two first levels (LC25 and LC50). In case of LC90, no hatching was noticed. On the other hand, the percentage of progeny was severely affected which marked 56.0 and 1.0 adult at LC25 and LC50, but at the higher concentration (LC95 level), no progeny could emerge or 100% relative protection was achieved to mung bean seeds from *C.maculatus* infestation at this level, Table 3.

Table 3. Effect of *Petroselinum sativum* oil on *C.maculatus* adults exposed to surface treated mung bean seeds .

Concentration (ml/kg grains)	Mean no. of eggs/5 pairs	Hatchability	% progeny emergence
0.6 (LC25)	21.8	63.22	56.0
2.3 (LC50)	2.86	59.20	01.0
19.1 (LC95)	0.14	00.0	00.0
Control	140.0	91.8	84.0

These findings are in agreement with earlier reports of Mahgoub (1987) with castor oil which prevented emergence of *C.maculatus* and *S.oryzae*. Also, Mahgoub and Ahmed (1996) found that extracts of *Ricinus communis* seed gave a good protection to wheat grains and seeds against *S.oryzae* and *C.maculatus* up to 12 weeks approximately. Also, these findings are in agreement with Singh et al. (1978) with groundnut oil at 5 ml/kg cowpea seeds which prevented emergence of *C.maculatus* progeny.

Table 4. Germination of wheat grains after *Petroselinum* sativum oil treatments and water absorption for 1, 5 and 24 hr.

Concentration (ml/kg)	Germination %	Water absorption %		
		1 hr	5 hr	24 hr
1.2 (LC25)	89.0	16.1	27.0	50.2
2.3 (LC50)	85.0	16.5	28.4	51.8
13.5 (LC95)	72.0	16.6	30.1	52.3
Control	97.0	13.6	27.0	56.7

Seed germination and water absorption

Wheat grains was affected by oil treatments, Table 4. The reduction in germination was the most apparent at the high concentration (LC95 level). These results agree with Mital (1971) who found that cowpea treated with groundnut oil lost its viability. Water absorption of grains and seeds influences cooking quality. The percentage of water absorbed did not vary consistently with the amount of oil applied. In addition, differences between concentrations were relatively small, Table 5. These results agree with those reported by Yuntai and Burkhobler (1981). The same trend was noticed in mung bean seeds.

Table 5. Germination of wheat grains after *Petroselinum sativum* oil treatments and water absorption for 1, 5 and 24 hr.

Concentration (ml/kg)	Germination %	Water absorption %		
		1 hr	5 hr	24 hr
0.6 (LC25)	82.0	07.80	32.8	100.0
2.3 (LC50)	80.0	11.80	32.10	100.3
19.1 (LC95)	75.0	08.00	28.90	103.1
Control	91.0	07.00	32.20	104.7

Table 6 showed that *P.sativum* oil decreased the amount of both chlorophyll a, b in wheat grain and consequently total chlorophyll who showed slight reduction in LC25, LC50 concentrations (3.9% and 7.8%, respectively), but more reduction in LC95 (19.4%). In case of mung bean seeds, results showed that *P.sativum* oil decreased the amount of both chlorophyll a,b and total chlorophyll, which showed reduction of 19.98% and 62.03% at LC_{25}, LC_{50} and LC_{95}, respectively, Table 7.

Table 6. Effect of Petroselinum sativum on chlorophyll content of germinated wheat grains.

Concentration (ml/kg grains)	Chlorophyll content		
	Chlorophyll (a)	Chlorophyll (b)	Total
1.2 (LC25)	0.348	0.180	0.562
2.3 (LC50)	0.333	0.174	0.540
13.5 (LC95)	0.313	0.165	0.514
Control	0.263	0.145	0.453

Table 7. Effect of Petroselinum sativum on chlorophyll content of germinated wheat mung bean seeds.

Concentration (ml/kg seeds)	Chlorophyll content		
	Chlorophyll (a)	Chlorophyll (b)	Total
0.6 (LC25)	0.530	0.261	0.906
2.3 (LC50)	0.495	0.221	0.725
13.5 (LC95)	0.417	0.165	0.598
Control	0.232	0.090	0.344

REFERENCES

1 . Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18 (2) : 265-276 .

2 . Finney, D.F. 1952. Probit Analysis. Cambridge University Press, 256 pp.

3 . Frankenfeld, J.C. 1948. Staining methods for detecting weevil infestation in grains. U.S.D.A., Ent. Bur., Et-256, p.4.

4 . Howe, R.W. 1952. The biology of the rice weevil Calandra oryzae. Ann. App. Biol. 39 (2): 168-180.

5 . Jaipal, S., Z. Singh and O.P. Malik. 1984. Insecticidal activity of various neem leaf extracts Rhizopertha dominica a stored grain pest. Neem Newsl., 1: 35-36.

6 . Mackinney, G. 1941. Absorption of light by chlorophyll solution. J. Biol. Chem., 140 : 315-322 .

7 . Mahgoub, S.M. 1987. Studies on the rice weevil, *Sitophilus oryzae* L. and the cowpea beetle, *Callosobruchus maculatus* F. Ph.D. Thesis, Fac. Agric., Cairo Univ.

8. Mahgoub, S.M. and S.M.S. Ahmed. 1996. *Ricinus communis* seed extracts as protectants of wheat grains against the rice weevil, *Sitophilus oryzae*. Annals of Agric. Sci., Ain Shams Univ., Cairo, Egypt. 4 (1) : 483-491.

9. Mital, H.C. 1971. Protection of cowpea from insect infestation with the aid of fixed oil. J. West Afr. Sdi. Assoc. 16 : 45-48.

10. Patterson, B.D. 1975. Plant-insect interaction. Biological and phytochemical evaluation of selected plants. Lioydia 38 (5) : 391-402.

11. Singh, S.R., K. Leuschner and D. Nangta. 1978. Groundnut oil treatment for control of Callosobruchus maculatus. J. Stored Product Res. 14 : 77-80.

12. Su, H.C.F. 1985. Laboratory evaluation of biological activity of *Cinnamomum cassia* to species of stored product insects. J. Ent. Sci. 20: 247-253.

13. Taheya, S.M., M.S. Salwa, and M.M. Sanaa. 1995. Evaluation of *Nigella sativa* seed extract for the control of *Callosobruchus maculatus* and *Sitophilus oryzae*. Egypt. J. Appl. Sci., 10 (8) : 7-21.

14. Yuntai, Q. and Burkhobler. 1981. Protection of stored wheat from the granary weevil by vegetable oils. J. Econ. Entomol. 74: 502-505.

استخدام زيت البقدونس كوسيلة لحماية حبوب القمح وبذور فول المونج ضد حشرتي سوسة الأرز وخنفساء اللوبيا

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أجريت دراسات معملية لزيت بذور نبات البقدونس كمادة واقية لحبوب القمح وبذور فول المونج من الاصابة بسوسة الأزز وخنفساء اللوبيا. وقد تم تحديد الجرعات التى تسبب موت LC25 وكذلك الجرعات الوسطية المميتة LC50 وايضا الجرعات التى تسبب موت LC95 من كلتا الحشرتين وقد اوضحت النتائج الاتى:

كانت حشرة خنفساء اللوبيا اكثر حساسية بالتركيز القاتل LC25 وكذلك التركيز القاتل LC50 من سوسة الارز حيث أن الجرعة التى تسبب الموت كانت اقل من مثيلتها من سوسة الارز والعكس صحيح عند اجراء المقارنة على اساس التركيز الأعلى LC95

كما تسبب الزيت بتركيزاته المختبره لكل من الحشرتين فى خفض الكفاءة الانتاجية انخفاضا شديدا عن حشرات المقارنة.

وكذلك لم تنتج اى خلفة نهائيا من الحشرات المعرضة لتركيز LC95 لكلتا الحشرتين مما أدى لحماية الحبوب والبذور حماية كاملة ضد الحشرتين.

كما تسبب الزيت بتركيزاته المختبرة الثلاث الى خفض حيوية البذور المعاملة. أما امتصاص الماء فلم يكن له اى تأثير بالمقارنة بالبذور غير المعاملة.

كان للزيت المختبر تأثير كبير على تكوين الكلوروفيل فى أوراق النبات حيث قلت كمية الكلوروفيل المتكونة فى نبات القمح و فول المونج خصوصا على مستوى ٩٥ ٪ بالمقارنة بالبذور غير المعاملة.