# Bio-insecticide effect of Some Aromatic Plant Extracts on the Granary Weevil *Sitophilus granarius* L. (Coleoptera: Curculionidae)

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**Abstract**

*Seed and leaf extracts of parsley, Petroselinum crispum; rocket, Eruca vesicaria and thyme, Thymus vulgaris, were used in the experiment to evaluate for their effect on productivity against granary weevil, Sitophilus granarius. According to results, all the plant extracts had effects on productivity of the granary weevil. The reduction of* $F_1$ *adults was highest in thyme for granary weevil. Effect on productivity of both leaf and seed extracts are similar. Acetone extracts showed highest effect on productivity followed by methanol, ethanol and water extracts. Effect on productivity increased proportionally with the concentration of the plant extracts.*

**Key words:** Granary weevil, *Sitophilus granarius*, aromatic plant extract.

## 1. INTRODUCTION

Seed parasites deposit eggs on or in a seed and the progeny immature stage is completed within the same seed. Thus the resources available to the larva are determined by the behaviour of the female parent and the quality of the seed on which the egg was deposited (Yıldırım et al., 2001).

Three species of *Sitophilus* (*Sitophilus granarius* L., *Sitophilus oryzae* L. and *Sitophilus zeamays* Mots) are seed parasites of cereal crops such as wheat, oat, barley, rice and sorghum and are important economic pest species in stored grain. The species share the same life history but do have a number of differences in their seed exploitation strategies (Longstaff, 1986).

*Sitophilus granarius* is highly destructive and cosmopolitan pest insect all over the world. The wheat weevil *S. granarius* (also known as the grain weevil or granary weevil) can cause significant damage to harvested grains that are being stored and may drastically decrease yields (Jacobs and Calvin, 2001).

Application of different insecticides as a chemical control method, contribute to a stable supply of agricultural production, but their continuous use causes soil, air and water pollution, health hazards to all living organisms and pesticides resistance, on the other hand, synthetic insecticides are expensive (Franzen, 1983).

In contrast, the low toxicity of aromatic botanical insecticides makes the processing and application of the product inexpensive. In many cases, the botanical materials are locally available and affordable (Childs et al., 2001). Botanicals insecticides have generated extraordinary interest in recent years as potential sources of natural insect control agents.

The use of locally available plants and their products as a bio-degradable component in the control of the storage pests is an ancient technology in many parts of the world. There is an urgent need for safe effective and bio-degradable pesticides with no toxic effects on non-target organisms. This has created a world wide interest in the development of alternative insect control strategies including the search for new types of insecticides (Shaaya et al., 1997).

The main goal of the present study was to evaluate the insecticidal and biological effects of some plant extracts to control of granary weevil, *S. granarius* in wheat.

## 2. MATERIALS AND METHODS

### 2.1. Insect Culture

The granary weevil, *Sitophilus granarius* L. was reared in a 1 L wide-mounted glass jars containing soft wheat grains. Mouth of the jars covered with a fine mesh cloth for ventilation and to prevent escape of the weevils. Cultures were maintained in an incubator at 27 ± 1 °C and 60 ± 5 % relative humidity. Insects used in all experiments were 1 to 7 day old adults (Figure 1). All experimental procedures were carried out under the same environmental conditions as the cultures.

### 2.2. Plant Materials

In this study, bio-insecticide effect of aromatic extracts from parsley, *Petroselinum crispum* (Mill.) Nyman ex A. W. Hill; rocket, *Eruca vesicaria* Mill. and thyme, *Thymus vulgaris* L. were tested against granary weevil, *S. granarius*. Parsley and rocket were obtained from a local market of Ankara while thyme was collected from Central Anatolian Region (Figure 2).

### 2.3. Preparation of Plant Extracts

Leaves and seeds of parsley, rocket and thyme were washed in water after collection and then air-dried under the shade. The air-dried seeds and leaves were then oven-dried at 60 °C. The dried material were ground manually and passed through a 25-mesh sieve to obtain fine dust. Twenty gram of fine dust of each plant extracts were separately mixed with 250 ml of each solvent (acetone, ethanol, methanol and water). The mixture was then stirred for 30 minutes in a magnetic stirrer and left to stand for next 24 hours. The mixture was then filtered through a fine cloth and again through the Whatman No.1 filter paper. The filtrate was then boiled for solvent in a water bath to a constant volume. For water extract at 80 °C and for chemical extracts at 70 °C. After the evaporation the condensed extracts were preserved in tightly corked labelled bottles and stored in a refrigerator for further use. Before using in experiment each solution was diluted with distilled water to prepare different concentration of plant extract.

### 2.4. Reproductivity Test

Ten-gram of wheat grain was treated with different plant extracts at the concentration of 30, 60, 90 and 120 mg/ml along with a control treatment and kept in the Petri dishes (9 cm diameter). After 24 hours, 10 pairs of 5-7 day-old adult granary weevils were released at the centre of Petri dishes containing food material and covered with lid for next 7 days to allow them to oviposit. The adults were then sieved out and removed from the Petri dishes. In this experiment, the numbers of progeny of granary weevils, from day 35 to day 45, were recorded. The observed data were statistically analysed by completely randomized design. Mean values were adjusted by Duncan's multiple range test.

## 3. RESULTS AND DISCUSSION

Laboratory exercises made on effects of different solvent extracts of seeds and leaves of parsley, rocket and thyme on the reproductivity adult emergence of *S. granarius* presented in Table 1-3. It was found that all the treated plants significantly ($p<1$ %) reduced the reproductivity adult emergence of *S. granarius* in comparison to control and the effects, in general, was concentration dependent. Thyme was the most effective. Rocket was the more effectively than parsley. There was no significant difference between leaf and seed extract (Table 2). For solvents, methanol extract was highly effective in the reduction of reproductivity adult emergence of *S. granarius* followed by ethanol, acetone and water extract.

The present study revealed that the reduction of $F_1$ adult emergence of granary weevil by using the leaf and seed extract of parsley, rocket and thyme agreed with the previous findings.

Yılmaz and Kansu (1990) studied that biological activities against different stage of *S. granarius* on the seed that are treated with oil were different. The protective action of vegetable oils (sunflower, popy, rape seed) on grain stored for 2 months was determined against different biological stage of *S. granarius*.

Solarov et al. (2008) investigated that the insecticidal activities of different doses of plant extracts obtained from *Piper nigrum, Carum carvi* and *Sesamum indicum* against rice weevil *Sitophilus oryzae* L. As a result, the extract of *P. nigrum* was found to be the most efficient causing the highest mortality rate.

Ebadollahi (2011) studied that essential oils from summer savory and fennel could be applicable to the management of stored product insects to decrease ecologically detrimental effects of utilization synthetic insecticides.

Shikder and Shanjahan (2011) studied that the effect on fecundity increased proportionally with the concentration of the plant (bonkalmi, eucalyptus, nishinda) leaf and seed ectracts.

Hamza et al., (2016) showed that the fumigant toxicity of the volatile oils was tested against 1 week old adults of *Sitophilus granarius*. The results demonstrated that the mortality increased with increases in concentration and exposure periods. As a result, the three volatile oils could be applicable to the management of populations of *S. granarius*.

## CONCLUSION

The reduction of $F_1$ adult emergence of granary weevil by using the aromatic plant extracts can control easily. Aromatic plant extracts will be very economic, its preparation and usage will be too much familiar to the growers, and environment will remain safer. Considering cost effectiveness, easy preparation, easy usage technology and environment friendly advantages plant extract can be the most important component of integrated pest management in controlling granary weevil of storage.


**Figure 1.** Test insect: *Sitophilus granarius* with soft wheat grains.

**Figure 2.** Test plants: Left, *Petroselinum crispum*; middle, *Eruca vesicaria*; right *Thymus vulgaris*.

**Table 1.** Reproductivity rate of *S. granarius* treated with extracts of different plants.

| **Test Plants** | **$F_1$-adults (n)** | | | | |
|---|---|---|---|---|---|
| | **Concentrations (mg/ml)** | | | | |
| | 0 | 30 | 60 | 90 | 120 |
| ***E. vesicaria*** | 161.4$^a$ | 76.88$^c$ | 76.64$^e$ | 63.71$^{gh}$ | 54.54$^j$ |
| ***T. vulgaris*** | 161.4$^a$ | 80.43$^c$ | 74.40$^e$ | 64.36$^h$ | 51.76$^j$ |
| ***P. crispum*** | 161.4$^a$ | 87.61$^b$ | 80.26$^d$ | 71.92$^f$ | 60.14$^i$ |

Results are significantly different at 1% level by Duncan's Multiple Range Test

**Table 2.** Reproductivity rate of *S. granarius* treated with extracts of different plant parts.

| Test Plant Parts | $F_1$-adults (n) | | | | |
|---|---|---|---|---|---|
| | **Concentrations (mg/ml)** | | | | |
| | 0 | 30 | 60 | 90 | 120 |
| **Leaf** | 161.7 | 72.1 | 63.4 | 51.2 | 40.3 |
| **Seed** | 161.6 | 69.7 | 63.1 | 50.8 | 40.9 |

**Table 3.** Reproductivity rate of *S. granarius* treated with plant extracts of different solvents

| Solvents | $F_1$-adults (n) | | | | |
|---|---|---|---|---|---|
| | **Concentrations (mg/ml)** | | | | |
| | 0 | 30 | 60 | 90 | 120 |
| **Acetone** | 161.3[a] | 78.2[b] | 69.6[d] | 59.4[g] | 47.6[k] |
| **Ethanol** | 161.1[a] | 74.9[c] | 64.6[f] | 55.1[i] | 46.6[k] |
| **Methanol** | 161.6[a] | 75.0[c] | 60.1[g] | 50.2[j] | 40.5[l] |
| **Water** | 161.6[a] | 79.4[b] | 67.4[de] | 57.7[h] | 47.9[k] |

Results are significantly different at 1% level by Duncan's Multiple Range Test

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