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# EFFICACY OF SOME PLANT POWDERS AS WHEAT GRAIN PROTECTANTS AGAINST *SITOPHILUS ORYZAE* (L.) AND *RHIZOPERTHA DOMINICA* (F.)

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***Abstract***

In the present investigation, eleven medicinal plants (spearmint, dill, red sorrel, common spearmint, margoramm, anise, cumin, parsely, sweet basil, warm seed plant and caraway) were evaluated as possible grain protectants. They were evaluated at 1%w/w, to wheat grains against infestation by *Sitophilus oryzae* L. and *Rhizopertha dominica* F. The efficacy of these plants as powders were studied on adult mortality, F1 progeny, resultant weight loss (%) and damage (%). The results obtained showed that, the most effective powders against *S. oryzae* were margoram, anise, peppermint, dill and cumin while those of red sorrel, marjoram, anise and cumin were the most effective against *R. dominica* Margoram and anise were found the most effective against both insects. Also, the study specifies the previous powders as wheat grain protectants, since it affects adult mortality, and feeding compared to control. These powders are safer materials and could be removed easily by sieving and washing with water.

## INTRODUCTION

The annual post harvest losses caused y insect damage, microbial deterioration and other factors are estimated to be 10 - 25 % worldwide. Synthetic chemicals are currently the method of choice to protect grains from insect damage, however their continuous and widerspread use has led to the development of pest strains resistant and the problems of toxic residues (Ahmed *et al.* 1981; Zettler and Cuperus 1990). These problems created worldwide interest to develop alternative strategies including botanical insecticides as safer and effective protectants. Locally available plants and minerals have been widely used in the past to protect stored produce against insect pests (Golob and Webley, 1980). Active substances of plant origin affecting insects and mites of stored products are pyrethrum, incotine and ortenone.

The biological effectiveness of plants against stored products hs alreadybeen demonstrated by many workers (Malik and Naqvi 1984; Delobel and Melonga 1987; Su

1990; Jacob and Sheila 1993; Tiwari, 1994; Patel *et al.* 1993; Patel and Valand 1994; El-Lakwah *et al.* 1997; Al-Moajel and Abd El-Baki 2000 and Umoetok 2000).

The present work was carried out to evaluate eleven medicinal plants (mint, common spearmint, margoram, sweet basil, dill, anise, cumin, parsley, caraway, red sorrel and warm seed plant) against *Sitophilus oryzae* and *Rhizopertha dominica.*

## MATERIALS AND METHODS

**1. Test insects:** The tested insects were the rice weevil, *Sitophilus oryzae* (L.) (Coleoptera, Curculionidae) and the lesser grain borer, *Rhizopertha dominica* (F.) (Coleoptera, Bostrichidae). The two insects were reared in glass jars on wheat grains under laboratory conditions of 28 ± 1 ºC and 60 ± 5 % r. h. for several generations at Stored Grain Pests Division, Plant Protection Research Institute, ARC, Egypt.

**2. Sources of the test medicinal plants:** The tested medical plants were purchased from local supermarket. Their common, scientific, Arabic names, their plant families as well as the used part are entitled in Table 1. The used plant parts were grounded into a fine powder by an electrical blender for five minutes, sieved for obtaining very fine powders.

Table 1. General information about the tested medicinal plants ant its used parts.

| Scientific name | English name | Family | Arabic name | Part used |
|---|---|---|---|---|
| *Mentha piperita* (L.) | Mint (Peppermint) | Labiate | نعناع فلفلى | Leaves |
| *Mentha spicata* (L.) | Common spearmint | Labiate | نعناع بلدى | Leaves |
| *Majorana hortensis* | Margoram | Labiate | برداقوش | Seeds |
| *Ocimum asilicum* L. | Sweet basil | Labiate | ريحان | Leaves |
| *Antheum graveolens* (L.) | Dill | Umbelliferae | شبت | Seeds |
| *Pimpinella anisum* (L.) | Anise (Anise seed) | Umbelliferae | ينسون | Seeds |
| *Cuminum cyminum* | Cumin | Umbelliferae | كمون | Seeds |
| *Petroselinum sativum* Hoffm. | Parsley | Umbelliferae | بقدونس | Seeds |
| *Carum carvi* (L.) | Caraway | Umbelliferae | كراوية | Seeds |
| *Hibiscus sabdariffa* (L.) | Red sorrel | Malvaceae | كركدية | Flowers |
| *Artemisia herbaalpha* (L.) | Warm seed plant | Compositae | شيح بلدى | Flowers |

**3. Bioassay tests:** The tested plant powders were mixed with wheat grains at 1 % w/w. Ten replicates were made for each species, five were infested with each insect and the other ten replicates were left as control for comparison. About 20 g of the treated wheat grains has been infested with 25 adults of 0 - 1 week old *S. oryzae* and 40 unsexed adults of *R. dominica.* The replicates were placed inside incubator of 28 ± 1 °C and 60 ± 5 % r. h. The replicates were examined for adult mortality after two weeks later and then removed. The replicates were re-incubated again and 3 - 4 weeks later, they were examined daily for adult emergence. The emerged adults were counted and removed daily. After no adult emergence, weight loss was calculated through weight difference and its percentage calcultated. The percentage of damage was determined by withdrawing a random sample of one hundred grains and examined to count bored grains or those partially eaten and their means were calculated.

**4. Statistical analysis:** The obtained data were analyzed statistically by analysis of variance test and the different means were compared by multiple range test (Duncan, 1959) using a computer program of SASS Institute methods. As well as, the standard error of the means was calculated.

## RESULTS AND DISCUSSION

The efficacy of the different medical plant plowders at 1% w/w on the rate of infestation and multiplication of on *S. oryzae* and *R. dominica* are given in Tables 2 and 3. Results indicated that all tested powders exerted a harmful effect on the behavior and reproduction of *S. oryzae* and *R. dominica* when admixed with wheat grains and none of the tested powders enhanced any insect character. In respect to efficacy on the rice weevil, Table 2, the results showed significant differences among the tested plant powders and the control on the adult mortality, number of F1 progeny and its reduction, weight loss (%), and damage (%). The powders of margoram, dill, cumin, peppermint and spearmint were the most effective plant powders.

While, those of red sorrel, parsely, sweet basil and caraway were the least effective on *S. oryzae* compared to control. Margoram and dill resulted in higher adult mortality (70.7 and 64 %) leading to a lowest values of progeny (69.3 and 82), weight loss (%) (6.7and 7.2 %) and damage (17.0 and 17.3 %) and reduction in adult progeny (72.8 and 67.8 %), respectively. Those of caraway and sweet basil caused 44 and

30.7 % mortality and lowest values of F1 progeny (136.3 and 145.7), weight loss (%) of 9.3 and 11.3 % and percentage damage reached 31.3 and 39 % so resulting to a lowest values of reduction in adult progeny.

The effects on *R. dominica* is given in Table 3. All powders were more effective compared to control, although some powders exerted a harmful effect on the feeding and f1 progeny, whereas some were less effective. For example, wheat treated with margoram, parsely and common spearmint, red sorrel and anise seed were the most effective on adult mortality, feeding and F1 progeny of *R. dominica* and so inhibiting progeny production and both damage and weight loss. Some as caraway, warm seed plant and cumin were the least effective. The most effective powders on *R. dominica* were margoram and dill. Margoram caused a higher reduction in progeny (73.5%), reduced values of weight loss (3.76 %), and damage (10.7 %). While, the least effective powders was caraway, which caused a reduction reached 25.9 % in adult progeny, weight loss (9.87 %) and damage (22 %). Among the tested plant powders, margoram and dill were the most effective as it completely inhibited feeding and breeding of *S. oryzae* and *R. dominica* when mixed with wheat grains at 1 %.

The powders were found to be toxic to the adults of both insect species and the reasons could be either stomach or contact toxicity (Ferial *et al.* 1989) as well as the powders effectively reduced the productivity of both insects on wheat. This could be due to disturbance in eggs hatch or larval development or both resulting in reproduction inhibition. So these powders could be used for the protection of the stored wheat against *S. oryzae* and *R. dominica*. Sieving and washing of grain with water may leave the grain free from any residues of the plant powders (Tiwari, 1994) and so make these plant powders safe as grain protectants.

The present investigation indicated that powders of margoram, anise seed, cumin and parsley were effective on both insects and so could be used as grain protectants. These plant powders should also be used against other stored grain insects so enabling us to extract and formulate a common grain protectant. The promising plant powders found herein, must be reselected for other final evaluation at 3 - 4 rates or concentrations. These plant powders, so therefore might be a good source of naturally occurring effective insecticides as has been mentioned by Arnason *et al.* 1989.

Table 2. Bio-efficacy of some medicinal plant powders mixed with wheat grains at 1% w/w against *Sitophilus oryzae* (L.) infestation.

| Test Plant | Adult mortality (%) /2 weeks | Progeny number | Progeny reduction (%) | Weight Loss (%) | Grain Damage (%) |
|---|---|---|---|---|---|
| *Margoram* | 70.7±6.7abc | 69.3±7.5f | 72.9 | 6.7±0.4d | 17.0±0.6d |
| *Dill* | 64.0±4.0abc | 82.0±7.2ef | 67.8 | 7.2±0.7d | 17.3±3.8d |
| *Peppermint* | 45.5±3.2bc | 89.3±3.8def | 65.0 | 8.0±0.5cd | 24.0±3.8bcd |
| *Cumin* | 45.3±4.7bc | 85.0±6.3ef | 67.7 | 7.7±1.0cd | 17.7±2.4cd |
| *Caraway* | 44.0±2.3bc | 136.3±11.6bcde | 46.5 | 9.3±0.3bcd | 31.3±6.2bcd |
| *Common spearmint* | 34.7±4.8bc | 92.3±10.5def | 63.8 | 8.5±1.04cd | 26.7±5.4bcd |
| *Warm seed plant* | 34.7±6.7bc | 143.3±3.9bcd | 43.8 | 12.7±2.2abc | 31.3±7.3bcd |
| *Parsley* | 34.7±7.1bc | 152.0±4.5bc | 40.4 | 9.7±3.2bcd | 47.5±1.9ab |
| *Sweet basil* | 30.7±6.7bc | 145.7±9.1bcd | 42.9 | 11.3±2.7bcd | 39.0±0.6b |
| *Anis seed* | 32.0±6.9bc | 102.0±12.5cdef | 60.0 | 7.6±0.9cd | 25.0±2.0bcd |
| *Red sorrel* | 29.3±1.9bc | 173.0±13.7b | 32.2 | 13.7±2.7ab | 39.3±4.3b |
| Control | 10.7±2.7c | 225.0±7.7a | 00.0 | 16.8±1.9a | 64.3±1.2a |

- Data was analyzed statistically by analysis of variance and means separated by Duncans multiple range test. Different symbols after standard error indicates a significant difference.

Table 3. Bio-efficacy of some medicinal plant powders mixed with wheat grains at 1% w/w against *Rhizopertha dominica* (L.) infestation.

| Test Plant | Adult mortality (%) /2 weeks | Progeny number | Progeny reduction (%) | Weight Loss (%) | Grain Damage (%) |
|---|---|---|---|---|---|
| *Margoram* | 95.8±2.7a | 35.0±4.1e | 73.5 | 3.67±0.2cde | 1.07±1.5bc |
| *Dill* | 90.0±2.9a | 47.3±8.4de | 64.2 | 6.80±0.6bc | 12.3±0.6bc |
| *Peppermint* | 95.0±2.9a | 51.0±4.1de | 61.5 | 6.70±1.9bc | 14.7±6.5c |
| *Cumin* | 92.5±4.3a | 60.7±1.7de | 54.1 | 6.37±1.0cde | 14.3±0.3bc |
| *Caraway* | 95.8±2.2a | 98.0±5.2b | 25.9 | 9.87±0.3b | 22.0±3.1b |
| *Common spearmint* | 100±0.0a | 40.0±1.8de | 69.8 | 4.83±0.4cd | 12.0±1.0bc |
| *Warm seed plant* | 100±0.0a | 68.3±6.8cd | 48.4 | 9.37±0.6b | 19.7±2.2b |
| *Parsley* | 95.8±3.0a | 42.3±3.5ce | 68.0 | 4.17±1.5cde | 9.7±2.4bc |
| *Sweet basil* | 97.5±2.55a | 46.7±8.4de | 64.7 | 7.02±0.6bc | 11.7±1.9bc |
| *Anis seed* | 95.8±0.8a | 41.7±1.6dg | 68.6 | 5.67±1.3c | 12.0±2.5bc |
| *Red sorrel* | 85.0±7.7a | 30.3±9.4c | 77.0 | 5.17±1.2cd | 7.0±2.2bc |
| Control | 14.0±1.8b | 132.3±3.8a | 00.0 | 14.0±1.6a | 39.7±5.5a |

- Data was analyzed statistically by analysis of variance and means separated by Duncans multiple range test. Different symbols after standard error indicates a significant difference.

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# فعالية مساحيق بعض النباتات كمواد واقية للقمح ضد حشرتى سوسة الأرز وثاقبة الحبوب الصغرى

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يعتبر القمح محصولاً إستراتيجياً هاماً، ويتم استيراده بالعملة الأجنبية الصعبة لمواجهة الزيادة السكانية الكبيرة، لأن كمية المنتج المحلى لا تكفى لسد كمية الإحتياجات. وتتعرض حبوب القمح للإصابة بحشرة سوسة الأرز وثاقبة الحبوب الصغرى محدثة به خسائر كبيرة، لأن القمح يمثل عائل أساسى لهما. ونتيجة لذلك تم تنفيذ الدراسة الحالية لتقييم فعالية مساحيق بعض النباتات الطبية المتاحة والمتوفرة فى مصر ضد كلا الحشرتين. وقد تم استخدام مساحيق النعناع الفلفلى والشبت والكركديه والنعناع البلدى والبرداقوش والينسون والكمون والبقدونس والريحان والشيح البلدى والكراوية عند تركيز ١٪. وتم تقييم الفعالية على نسبة موت الحشرات الكاملة بعد أسبوعين، وعدد الحشرات الخارجة من المعاملات ونسبة الانخفاض فى نسبة الخروج، بجانب نسبة الفاقد فى الوزن والضرر الناتج. أظهرت النتائج أن مسحوق البرادقوش والينسون والنعناع الفلفلى والشبت والكمون كانت أكثر المساحيق فعالية ضد سوسة الأرز بينما كان مسحوق الكركدية والنعناع البلدى والبرادقوش والينسون والبقدونس هى أكثر المواد فعالية ضد ثاقبة الحبوب الصغرى. كما أظهرت الدراسة أن البرادقوش والينسون هى الأكثر فعالية ضد كلا الحشرتين. وتوصى الدراسة الحالية باستخدام مساحيق المواد السابقة كمواد واقية للقمح ضد كلا الحشرتين لأنها مواد آمنة بجانب سهولة فصلها بالنخل أو غسيلها بالماء قبل طحنها. كما توصى الدراسة الحالية بتقييم هذه المساحيق ضد الحشرات الأخرى التى تصيب القمح.