**Annals of Agric. Sci., Moshtohor** **ISSN 1110-0419**
**Vol. 50(1) (2012), 69– 74** **http://annagricmoshj.com**

# Certain Plant Dusts As Stored Grain Protectants Compared To Malathion Dust

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**Abstract**

In this study four plant dusts namely, mustard (*Brassica orvensis*) seeds, turmeric (*Curcuma longa*) rhizomes, anise *(Pimpinella anisum*) seeds and black pepper (*Piper nigrum*) seeds and malathion 1% dust, which included in this study as a standard reference were evaluated as grain protectants against, rice weevil, *Sitophilus oryzae* (L.)., lesser grain borer, *Rhizopertha dominica* (F.) and red flour beetle, *Tribolium castaneum* (Herbst) which attack wheat grain during storage. The results showed that the mortality percentages increased with the increasing of the concentration and period of exposure. The number of emerged offspring decreased with increasing concentrations. Results also indicted that *T. castaneum* was less sensitive to the tested plant and malathion dusts (1%) than the other two insect species. All treatments had significant desired effects on the percentages of wheat weight loss and germination of grains compared to malathion dust which has no an effect on the germinated grains but, plant dusts slightly reduced the germination. Consequently, it could be recommended to use the plant dusts in this study especially the highest concentration to protect wheat grains against stored grain insects in this investigation.

**Key words:** wheat grains against stored, germination of grains, *Sitophilus oryzae* (L.) , *Tribolium castaneum*

## Introduction

Wheat is one of the most important cereal crops in many countries of the world. In Egypt it is main diet for Egyptian population. Plant products are receiving greater attention as prophylactic measures against stored product pests because they are frequently safe to non-target organisms, and are used for human food.

Neem (*Azadirachta indica*) products including leaf, kernel and seed powders, seed extracts and oil have been reported as effective protectants against several stored products pests (**Girish and Jain** 1974; **Singh and Srivastava**, **1980**; **Saxena 1989** and **Schmutterer**, **1990**).

Many investigators proved that plant materials were highly effective against different stages of many stored grain insects (**El- Aidy and Helal 1997**) (**Bekela** *et al*., **1997**; **Obeng** *et al*, **1998**, **keita** *et al*., **2000**, **2001**; **Ketoh** *et al* **2005**; **Zayed 2005**, **Rajapakse**, (**2006**), **Hosny**, *et al*., **2007**, and **Epidi** *et al*., (**2008**).

The widespread use of synthetic insecticides posses a serious hazard to both man and wildlife because of adverse effects on the environment. The detrimental effects on the ecosystem are well demonstrated when benefical insects, predators and parasites died, but often insect pests develop resistance to the chemicals used. (**Prakash and Rao**, **1986** & **1987**).

The current study was carried out: to test the efficiency of some plant dusts, mustard, turmirc, black pepper and anise and one synthetic insecticide, malathion dust against *sitophilus oryzae*, *Rhizopertha dominica* and *Tribolium castaneum*. To study the effect of those materials on biology of the tested insects. To estimate the % reduction in wheat weight loss.

## Materials and methods

### Insects

The considered insects in the current investigation, rice weevil; *Sitophilus oryzae* (L.); lesser grain borer *Rhizopertha dominica* (F.); and red flour beetle, *Tribolium castaneum* (Herbst). They were reared at 28 ± 1°c and 65- 70 % R.H (relative humidity) at the Laboratory of Stored Product Pests Department, Plant Protection Research Institute, Sakha Agricultural Research Station. Grains of Sakha 69 wheat grains for *S. oryzae* and *R. dominica* and crushed wheat grain for *T. castaneum*, were used.

### Insecticide:

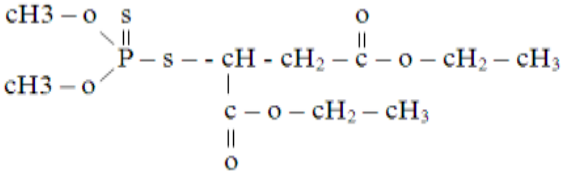
### Malathion

Common name: Malathion

### Chemical name:

O, O dimethy l-S- (1,2 dicarboxyethyl) etthylphosph- orodithioae

### Structure formula:



Molecular weight: 330

### Plant dusts

Plant dusts used in the present study were seeds of mustared (*Brassica orveniss*), anise (*Pimpinella anisum*), black pepper (*Piper nigrum*) seeds and turmeric (*Curcuma longa*) rhizomes which were purchased from the local market.

**Treatments (Bioassay methods):**

**- Mixing with media:**

The insecticide malathion dust 1% was mixed with whole or crushed wheat grains at the different concentrations of (0.04, 0.06, 0.08 and 0.1 % w/w), while plant dusts were mixed at the concentrations of (0.5, 1.5, 2.5 and 4% w/w). Weight of 20g of treated whole or crushed wheat grains was infested with 20 newly emerged adults (1-2 weeks-old) of *S. oryzae*, *R. dominica* and *T. castaneum* in glass jars (250 ml), separately.

Mortality was recorded after one and two weeks post-treatment, and corrected according to **Abbott's Formula (1925)** the parents were removed after twenty days and the number of emerged adults was recorded after 60 days post-treatment .The reduction of the progeny was calculated according to **EL-Lakwah** *et al*. (**1992**)

$$\% \text{ Reduction} = \frac{\text{Mean No. of emerged adults in control - Mean No. of emerged adults in treatment}}{\text{Mean No. of emerged adult in control}} \times 100$$

The loss % in wheat weight was also calculated after 3 months post- treatment according to Harris and Lindbled (**1978**).

$$\frac{\text{Initial dry weight of seeds} - \text{Seed dry weight after 3 months}}{\text{Initial dry weight of seeds}} \times 100$$

Three replicates were done for each treatment and control and kept at 28 ± 2 °C and 65 – 70 R.H. The germination test was accomplished on seeds of each treatment for wheat grains according to **Qi and Burkholder (1981)** with slight modification where sixty seeds of each treatment were divided into three replicates, placed on petri – dishes containing cotton layer (instead of filter paper) soaked with tap water and covered with tissue paper, seed germination percentages were recorded four days after treatment for wheat grains.

**Data analysis**

Statistical analysis of all data was carried out according to Duncan's multiple range **(Duncan, 1955)**.

**Results and Discussion**

**1 Malathion activity:**

**1.1 Toxic effect against *S. oryzae*, *T. castaneum* and *R. dominica*.**

The results in Table (1) demonstrated differences in mortality percentages between the control and other treatments, as well as within the treatments with all insects tested.

The percentages of mortality were increased with the increase of concentration or period of exposure. Results indicated that malathion 1% dust provided the most effective control against *S. oryzae*, *R. dominica* and *T. castaneum*, respectively, where concentration at 0.1% w/w gave 88.0 and 96.6 mortality with *S. oryzae* at one and two weeks exposure periods, respectively, while percents mortality was 78.3 and 88.3% with *T. castaneum* at the same exposure periods, respectively, as well as gave 83.3 and 95.0 % mortality with *R. dominica* at the same mentioned exposure periods, respectively.

**1.2 Effect on progeny**

Data summarized in table (1) revealed that the reduction of progeny significantly increased with the increasing of concentration. Malthion had the highest reduction with the highest concentrations where reduction reached to 98.3, 91.0 and 96.3 with *S. oryzae*, *T. castaneum* and *R. dominica* at 0.1 % w/w, respectively, while % reduction ranged from 32.4 – 45.2, 16.9 – 28.31 and 31.1 – 49.7% with mustard, turmeric, black pepper and anise against the three tested insects at 0.5% wt/wt, respectively tables (2 to 4).

**Table 1.** Effect of malathion dust admixed with wheat or crushed wheat grains on *S. oryzae*, *T. castaneum* and *R. dominica*.

| Treatments | Concent. W/W % | *S. oryzae* | | | | | |
|---|---|---|---|---|---|---|---|
| | | % mortality after | | N. of emerged adults progeny | % Reduction in progeny | % R. in weight loss | % germination of wheat grains after 3 months |
| | | 1 week | 2 week | | | | |
| Malathion 1% dust | 0.04 | 54.0 | 76.6 | 510 | 42.7 f | 79.4 d | 96.0 ab |
| | 0.06 | 68.3 | 90.0 | 281 | 68.4 g | 83.3 e-g | 97.0 ab |
| | 0.08 | 85.0 | 91.6 | 110 | 87.6 d | 87.6 hi | 95.0 b |
| | 0.1 | 88.0 | 96.6 | 15 | 98.3 a | 92.7 k | 96.0 ab |
| | control | - | | 891 | | | 98.0 a |
| | | *T. castaneum* | | | | | |
| | 0.04 | 38.3 | 61.6 | 365 | 29.2 l | 57.8 d-f | 96.0 ab |
| | 0.06 | 46.6 | 70.0 | 230 | 55.4 i | 67.8 gh | 97.0 ab |
| | 0.08 | 56.6 | 80.0 | 91 | 82.3 f | 85.6 jk | 95.0 b |
| | 0.1 | 78.3 | 88.3 | 46 | 91.0 c | 92.8 k | 96.0 ab |
| | control | | | 516 | | | 98.0 a |
| | | *R. dominica* | | | | | |
| | 0.04 | 43.3 | 68.3 | 396 | 47.4 g | 74.1 de | 96.0 ab |
| | 0.06 | 48.3 | 85.0 | 251 | 66.6 H | 79.4 fh | 97.0 ab |
| | 0.08 | 61.6 | 90.0 | 101 | 86.6 e | 87.5 ij | 95.0 b |
| | 0.1 | 83.3 | 95.0 | 27 | 96.3 b | 94.7 k | 96.0 ab |
| | control | | | 735 | | | 98.0 a |

**1.3Effect on weight loss**

All treatments significantly increased the reduction of wheat weight loss at the all different concentrations compared to the control. The highest reduction in weight loss achieved with the highest concentration against the all tested insect species. The percent reduction in weight loss ranged from 57.8 – 79.4 at 0.04% and from 92.7 – 94.7% at 0.1% concentration for the three tested insects.

**1.4Effect on germination**

The results showed that malathion had no significant effect on the germination compared the control at the all tested concentrations after 3 months post treatment. These results are in agreement with those of **El-Aidy** and **Abdel-Shafi** (**1995**), **El-Hamady** *et al*. (**1999**) and **Abo-Arab** *et al*. (**2004**), who reported that the gerimantion percentages due to the good protective effect of pesticidal treatments of malathion during storage did not affect the seeds germination.

The obtained results in Table (1) agree with those of **Giga** and **Zvoutete** (**1990**) **Khawaja** *et al*. (**2000**), **Ali** *et al*. (**2003**), **Athanassia** *et al* (**2004**) and **Abo-Arab** *et al*. (**2004**), mentioned that malathion, was effective in controlling *S. zeamais* and *T. castaneum* on maize.

**2.Plant dusts effect against *S. oryzae, T. castaneum* and *R. dominica***

**2.1Toxic effect**

The results in Tables (2, 3, and 4) demonstrated differences in mortality percentages between control and the other treatments as well as within the treatments with the all insects tested, the percentages of mortality increased with the increasing of concentrations or exposure periods. Results showed that Turmeric was the most effective toxic agent against *S. oryzae*, *R. dominica* and *T. castaneum*, respectively where concentration of 4% w/w gave 94.7, 91.6 and 88.3 mortality percentages, respectively while mustard dust nearly had the lowest effect against the tested insect species.

**Table 2.** Effect of some plant dusts admixed with wheat grains on *S. oryzae*

| Treatments | Concent. W/W % | % mortality after | | No. of emerged adults after 2 months | % Reduction in progeny after 2 months | % R. in loss of grain weight |
|---|---|---|---|---|---|---|
| | | 1 week | 2 week | | | |
| Mustard | 0.5 | 16.7 | 33.3 | 570 b | 36.0 L | 77.2cd |
| | 1.5 | 42.3 | 58.3 | 389 d | 56.3 J | 79.3de |
| | 2.5 | 69.7 | 75.9 | 171 f | 80.8 f | 82.0ef |
| | 4.0 | 81.3 | 92.6 | 68 h | 92.3 c | 89.6ni |
| Turmeric | 0.5 | 28.3 | 38.3 | 488 c | 45.2 k | 80.2 f |
| | 1.5 | 45.8 | 62.6 | 312 e | 64.9 i | 88.9 hi |
| | 2.5 | 71.3 | 82.0 | 146 g | 83.6 d | 93.3 j |
| | 4.0 | 81.0 | 94.7 | 22 I | 97.6 a | 96.1 k |
| Black pepper | 0.5 | 6.0 | 28.3 | 602 b | 32.4 N | 73.7 b |
| | 1.5 | 36.7 | 48.7 | 490 d | 45.0 k | 78.5 d |
| | 2.5 | 54.0 | 61.6 | 232 f | 73.9 h | 87.4 g |
| | 4.0 | 63.2 | 76.3 | 156 H | 82.5 | 91.3 ij |
| Anise | 0.5 | 10.0 | 25.0 | 586 c | 34.2 m | 75.7 bc |
| | 1.5 | 36.6 | 58.8 | 397 e | 55.4 J | 79.6 ef |
| | 2.5 | 61.3 | 74.3 | 190 g | 78.6 g | 81.9 ef |
| | 4.0 | 70.7 | 87.6 | 53 i | 94.0 b | 89.3 hi |
| control | | | | 891 a | | |

**2.2Effect on progeny**

The results in Tables (2, 3, and 4) revealed that the reduction in progeny increased with the increasing of concentration . All plant dusts had the highest reduction in progeny at concentration of 4% for turmeric, mustard, anise and black pepper, respectively against the three tested insect species. In general the turmeric had the highest adversed effect on progeny of all insects tested while the black pepper had the lowest one on progney of all insects tested. The *T. castaneum* had less susceptibility to the all plant dusts treatments compared to the other two insect species, while *S. oryzae* was lower tolerant than the other two tested insects.

**2.3Effect on weight loss:**

All plant dusts tested at all concentrations significantly reduced the weight loss with the all tested insects where, the percent reduction in loss ranged from 55.6% at 0.5 % w/w concentration of anise dust with *T. castaneum* (table 3) to 96.1% at 4.0% w/w concentration of turmeric dust with *S. oryzae* (Table 2).

The obtained results are in agreement with **Gharib**, **2004** who mentioned that some medicinal plants (common, dill, anise and other plants) were used against *S. oryzae* on wheat grains, they increasd adult mortality and reduced insect feeding compared to untreated control. (**Hosany** *et al*. 2007) mentioned that plant oils and plant dusts were used against *Collosobruchus maculatus* and *T. granarium* on (cowpea and wheat) seeds, respectively they increased adult mortality and reduced progeny, the loss of seed weight was lesser compared to control. **Shabnam** and **Nouraddin** (2010) found that black pepper and red pepper powders against *R. dominica* and *S. granarius* produced complete mortality at 5% w/w concentration and complete reduction in progeny.

**Udo** *et al* (2011) reported that root, bark and leaf powders of *Dracaena arborea* against *S. zeamais* and *C. maculatus* increased adult mortality and reduced progeny, the loss of grains weight was low compared with untreated control.

### 2.4 Effect on germination

Results in Table (5) revealed that except the concentration of 4.0% w/w of anise there were significant differences between the all treatments at all concentrations and control where the percent germination ranged from 47% to 92% with the all tested dusts at the all tested concentrations compared to control which had 96.0% germination. Anise dust had the least detrmintal effect on germination at 4% w/w compared to black pepper at 0.5% w/w which had the highest harmful one. In general malathion had the highest detrimental effect where it increased mortality, reduced progeny as well as decreased the weight loss of wheat grain compared to the all treatments and although, plant dusts have many advantages where they are relatively safe on mammals, environment and have no effect on resistance development and could be removed easily by sieving and washing with water compared to the synthetic chemical insecticide malathion which has the opposite of mentioned advantages.

**Table 3.** Effect of some plant dusts against *T. castaneum*.

| Treatments | Concent W/W % | % mortality after 1 week | % mortality after 2 week | N. of emerged adults after 2 months | % Reduction in progeny after 2 months | % R. in loss of grain weight |
|---|---|---|---|---|---|---|
| Mustard | 0.5 | 8.3 | 13.3 | 386 b | 25.2 m | 65.6 c |
| | 1.5 | 25.0 | 35.0 | 218 d | 57.8 I | 77.4 d |
| | 2.5 | 48.3 | 68.6 | 102 f | 80.3 d | 87.8 fg |
| | 4.0 | 70.0 | 78.3 | 64 h | 87.6 b | 93.7 gh |
| Turmeric | 0.5 | 16.6 | 33.3 | 37 c | 28.3 L | 70.0 c |
| | 1.5 | 48.0 | 65.0 | 197 e | 61.8 g | 81.5 de |
| | 2.5 | 62.0 | 73.3 | 89 g | 82.8 c | 88.5 fg |
| | 4.0 | 76.0 | 88.3 | 41 i | 92.0 a | 94.8 h |
| Black pepper | 0.5 | 6.0 | 18.3 | 403 c | 21.9 N | 56.7 b |
| | 1.5 | 26.6 | 48.0 | 291 e | 43.6 J | 70.4 c |
| | 2.5 | 41.3 | 61.6 | 157 g | 69.6 f | 78.9 d |
| | 4.0 | 58.0 | 73.3 | 91 i | 82.4 c | 88.5 fg |
| Anise | 0.5 | 18.3 | 26.3 | 429 b | 16.9 o | 55.6 b |
| | 1.5 | 37.6 | 54.0 | 310 d | 39.9 k | 70.7 c |
| | 2.5 | 52.6 | 68.0 | 201 f | 61.0 H | 77.0 d |
| | 4.0 | 63.3 | 76.0 | 118 H | 77.1 E | 85.2 ef |
| control | | | | 516.0 | | |

**Table 4.** Effect of some plant dusts against *R. dominica*.

| Treatments | Concent. W/W % | % mortality after 1 week | % mortality after 2 week | N. of emerged adults progeny | % Reduction in progeny | % R. in loss of grain weight |
|---|---|---|---|---|---|---|
| Mustard | 0.5 | 18.3 | 26.6 | 420 b | 44.0 g | 73.0 d |
| | 1.5 | 36.6 | 43.3 | 292 d | 61.2 d | 78.5 e |
| | 2.5 | 53.3 | 65.0 | 151 f | 79.9 c | 85.3 gh |
| | 4.0 | 71.6 | 88.3 | 36 h | 95.2 a | 90.6 hi |
| Turmeric | 0.5 | 33.3 | 40.0 | 397 c | 49.7 ef | 79.4 ef |
| | 1.5 | 46.6 | 53.0 | 264 e | 64.9 d | 84.1 fg |
| | 2.5 | 71.6 | 78.3 | 136 g | 81.9 bc | 89.4 hi |
| | 4.0 | 80.0 | 91.6 | 30 i | 96.0 c | 92.4 i |
| Black pepper | 0.5 | 10.0 | 30.0 | 519 b | 31.1 h | 60.0 b |
| | 1.5 | 36.6 | 46.6 | 401 d | 46.7 ef | 65.6 c |
| | 2.5 | 58.3 | 61.6 | 286 f | 62.0 d | 72.9 d |
| | 4.0 | 68.3 | 81.6 | 102 h | 86.5 gh | 88.2 hi |
| Anise | 0.5 | 20.0 | 33.3 | 446 c | 40.7 gh | 62.9 bc |
| | 1.5 | 36.7 | 46.6 | 306 e | 59.4 ef | 78.8 e |
| | 2.5 | 61.6 | 78.3 | 141 g | 81.3 bc | 86.5 gh |
| | 4.0 | 75.0 | 90.0 | 46 i | 93.9 ab | 92.0 i |
| control | | | | 753 | | |

**Table 5.** Effect of tested plant dusts on germination% of wheat after three months.

| Conc. w/w | Treatments | | | | |
|---|---|---|---|---|---|
| | Mustard | Turmeric | Black pepper | Anise | control |
| | | | Germination % | | |
| 0.5 | 81.0 e | 90.0 b-d | 47.0 J | 90.0 b-d | 96.0 a |
| 1.5 | 75.5 f | 91.0 d | 61.0 h | 86.0 cd | |
| 2.5 | 61.0 h | 87.0 bc | 66.0 g | 88.0 cd | |
| 4.0 | 57.0 i | 76.0 f | 74.0 f | 92.0 ab | |

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## استخدام مساحيق نباتية معينة كمواد واقية للحبوب المخزونة مقارنة بمسحوق الملاثيون

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في هذه الدراسة تم استخدام أربعة مساحيق نباتية هي الخردل والكركم والفلفل الأسمر والينسون مقارنة بمبيد الملاثيون مسحوق 1٪ كمرجع أساسي وكان الهدف الرئيسي هو دراسة تأثير المساحيق النباتية في حماية حبوب القمح اثناء التخزين ضد حشرات سوسة الأرز وثاقبة الحبوب الصغرى وخنفساء الدقيق الصدئية، وقد أظهرت نتائج الدراسة زيادة النسبة المئوية للموت بزيادة التركيزات وكذلك فترة تعرض الحشرات للمواد المختبرة وكذلك انخفاض أعداد الحشرات الخارجة (الجيل الأول) بزيادة التركيزات المستخدمة وأظهرت النتائج أن خنفساء الدقيق الصدئية كانت أقل حساسية للمساحيق النباتية والملاثيون عن سوسة الأرز، وثاقبة الحبوب الصغرى.

احدثت جميع المعاملات تأثير معنوياً في نسبة الفقد في الحبوب حيث انخفضت نسبة الفقد في المعاملات مع المساحيق النباتية والمبيد مقارنة بالكنترول، وكذلك أدت المساحيق النباتية إلي خفض النسبة المئوية للإنبات عند كل التركيزات ما عد الينسون عند تركيز 4% مقارنة بالكنترول، بينما وجد أن مسحوق الملاثيون لم يؤثر علي النسبة المئوية للإنبات مع كل التركيزات مقارنة بالكنترول.

ويتضح من هذه الدراسة إمكانية استخدام المساحيق النباتية خاصة التركيزات المرتفعة لحماية حبوب القمح من الحشرات المدروسة بدلاً من الملاثيون.