

**EFFECT OF WHEAT GRAINS TREATMENT WITH DILL,  
ANETHUM GRAVEOLENS AND PARSLEY, APIUM SATIVUM  
SEED POWDERS ON THE POPULATION OF  
THE RICE WEEVIL, SITOPHILUS ORYZAE**

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**Abstract**

Experiments were conducted in the laboratory at  $26 \pm 1^\circ\text{C}$  and  $65 \pm 5\%$  R. H. to study the effect of adding 0.8, 0.4, and 0.2% dill, *Anethum graveolens* or parsley, *Apium sativum* powders to the wheat grains on the mortality and population growth of *Sitophilus oryzae* (L.). Mortality results recorded during the first two weeks period of exposure are concentration and time dependent.

Meanwhile average mortality values of the period from the first to the third month of treatment, revealed that addition of *Apium sativum* powder to the food of *S. oryzae*, obviously increased adult mortalities at all concentrations compared with dill powder. However *S. oryzae* was susceptible to the dill powder at high concentration, 0.8% than 0.4 and 0.2%, but the *Apium sativum* powder was more effective against *S. oryzae*. Results concerning addition of the seeds powder of dill and parsley to the diet at 0.8, 0.4, and 0.2% concentrations showed also marked decline in the adult populations during the first period of rearing of *S. oryzae* compared with untreated. The rate of growth of *S. oryzae* was smaller in the media at the two high concentrations of the plant powders than the other media.

At the same time, *Apium sativum* seed powder gave satisfactory protection to wheat grains against this insect species up to 6 months.

**INTRODUCTION**

Dill, *Anethum graveolens* L. family Apiaceae is a herb which originated in Europe and was introduced all over the globe by the early part of the 19<sup>th</sup> century. It was first used for culinary and medical purposes. Parsely, *Apium sativum* L., also is used as a condiment for flavoring salads and sauces (Darwish, 1992).

Stored product pests do a great deal of damage to many grains in the storage. For this and other reasons new compound with fewer side effect, less hazardous to man and environment and low liability for insects to develop resistance are very desira-

ble. Many plants contain highly toxic materials, which could be extracted and used against insects. Such compounds may have less effect in environment and could be used safely to control pests. Using of plant extracts and their powders to control and protect stored product from pests becomes a necessity to reduce and overcome the hazards caused by pesticides and poisonous gases. There have been numerous studies of the uses of plant parts such as leaves, fruits, roots, flower and seeds to control stored product insects (Jotwani & Sircar, 1967; Ahmed, 1983; Ivbijaro 1983; & 1984 Sighamony *et al.*, 1985; Shukla, *et al.* 1988; Su & Sondengam, 1980; Su 1985; Darwish, 1992 and EL-Lakwah *et al.*, 1997, 1999a and 1999b).

In this study, the effect of diet treatment with dill, *A. graveolens*, L. and parsely, *A. sativum* seed powders on the population of *Sitophilus oryzae* (L.) was investigated.

## MATERIALS AND METHODS

**Insects used :** Laboratory strains of the rice weevils *S. oryzae* reared on wheat kernels were used in this study.

Experiments were conducted at  $26 \pm 1$  °C and  $65 \pm 5\%$  RH. in an incubator condition at the laboratory of Plant Protection Department, Faculty of Agriculture, Moshtohor Zagazig Univ.

**Materials and toxicity test:** Dill, *A. graveolens* seeds contain 3 – 4% volatile oil, which contain as carvone from 43 – 63% (Trease and Evans, 1978 and Evans, 1994).

Parsely, *A. sativum* contains 2 to 3% volatile oil and some fixed oils, which contains limonene and about 55% of carvone (Frankish and Rao, 1997). The seeds of dill and parsely were bought from the local market, dried at room temperature for two weeks and grinded into fine powder in an electric mill. The powders was mixed with wheat grains to give the prober concentration (i.e. 0.2, 0.4 and 0.8% w/w).

**Population studies:** Adults (7–14 days old) of insects were used in the experiments. Three replicates of a 100 gm wheat grain mixed with dill or parsely seed powders to achives concentrations of 0.8, 0.4, and 0.2 gm / 100 gm grains/jar. Three replicates of control experiment were also conducted. Sixteen adults of *S. oryzae* were

taken from the culture and introduced to each jar. Glass jars containing the media and the initial number of the adult insects were kept under controlled condition of  $26 \pm 1^\circ\text{C}$  and  $65 \pm 5\%$  RH. To investigate the toxic effect of dill and parsley powders on the adults of the insect species, mortality was assessed after 2, 3, 5, 7, and 14 days. Another experiment was conducted for 6 and 5 months. During that period, the alive and dead adults were counted monthly and recorded. The rate of population growth was calculated according to the following formula, (Birch, 1948) :

$$dN / dt = r \text{ No.}$$

$$N_t = N_0 e^{rt}$$

Where  $N_0$  = number of animals at time zero,

$N_t$  = number of animals at time  $t$ .

$r$  = intrinsic rate of increase/day.

Carrying capacity; assessed using the following equation:

$$= \frac{A + B + C}{3}$$

where :  $A$  = number alive of insect above the maximum  $N_0$ .

$B$  = Maximum numbers of alive insect.

$C$  = Number alive insect under the maximum  $N_0$ .

**Apium sativum persistence and weight loss of grain:** Persistence of *A. sativum* powder as protectant as conducted after 5 months for treatment and was examined after 15, 30 and 60 days for 0.8 and 0.4% concentration of *A. sativum* treatment.

Weight loss of grain was also estimated 5 month after treatment. It was assessed by the following equation:

$$\% \text{ weight loss} = \frac{\text{weight of uninfested grains} - \text{weight of infested grains}}{\text{weight of uninfested grains}} \times 100$$

The weight loss was estimated for each treatment in relation to the control and the data were transformed to arcsine units and subjected to analysis of variance (Snedecore and Cochran, 1967).

## RESULTS AND DISCUSSION

### Toxic effect of dill, *A. graveolens* and parsley, *A. sativum* powders

Results concerning the effect of, *A. graveolens* and *A. sativum* powders treatments on mortality of *S. oryzae* during the first fourteen days period of rearing are presented in Table 1. Mortality of *S. oryzae* increased as dill powder concentration increased. At 0.8% concentration, mortalities were 16, 30, 40, 65 & 75% after 2, 3, 5, 7 and 14 days for *S. oryzae* respectively. Lower mortalities were noticed at 0.4 and 0.2% concentration for this insect. Mortalities were 0 & 0, 15 & 5, 25 & 5, 25 & 15, and 45 & 19 for *S. oryzae* at 0.4 & 0.2% concentrations after 2, 3, 5, 7 and 14 days respectively. A negligible mortality were achieved for control .

Table 1. Effect of different concentrations of dill and parsley powders on mortality of *Sitophilus sryzae* during the first tow weeks of exposure.

Powder type	Days	As % Adult mortality			
		Concentration of powder			
		0.80%	0.40%	0.20%	Control
Dill	2	16 ± 3	0 ± 0	0 ± 0	0 ± 0
	3	30 ± 6	15 ± 5	5 ± 2	0 ± 0
	5	40 ± 4	25 ± 3	5 ± 0	3 ± 0
	7	65 ± 5	25 ± 6	15 ± 6	0 ± 0
	14	75 ± 8	45 ± 6	19 ± 7	3.3 ± 1
Parsely	2	19 ± 4	6 ± 3	1 ± 1	0 ± 0
	3	34 ± 4	32 ± 12	21 ± 6	0 ± 0
	5	59 ± 6	46 ± 9	12 ± 4	0 ± 0
	7	80 ± 10	77 ± 13	48 ± 15	2 ± 1
	14	93 ± 9	89 ± 9	81 ± 6	9 ± 1

Mortality of *S. oryzae* adults increased as *A. sativum* powder concentration increased. Also, mortalities increased with time lapse. After 2 days from treatment, mortalities were 19, 6 and 1% at 0.8, 0.4 and 0.2% concentration respectively. These values increased to reach 93, 89% and 81% after two weeks from treatment.

It was obvious from the above results that higher concentrations produced higher percentage of mortalities. However *S. oryzae* was more susceptible to the *A. sati-*

*vum* powder than *A. graveolens*.

The obtained results are in harmony with the findings of EL-lakwah *et al.*, 1999 b, who, studied the effect of diet treatment with black pepper seed powder on the populations of *S. oryzae* and *T. castaneum*.

#### **Effect of dill powder concentrations on population of tested insects**

Fig. 1 presents the population growth of *S. oryzae* adults at various treatment with dill seeds powder compared with the control.

The numbers of alive insects for *S. oryzae* at 0.8, 0.4, and 0.2% concentrations reached their peaks after 45, 105 and 105 days, where the numbers were 20, 174 and 1293 at 0.8, 0.4 and 0.2% concentration, respectively and declined there after. However, the peak of alive insects in case of control was recorded after 90 days as (1720) and declined there after.

These values were achieved after 45 and 105 days from starting the experiment. Meanwhile, the population maximum was 1720 adults for the control and reached after three moths, Table 2.

From the initial time to 120 days the number of the survival was slightly decreased in the treated diet. On the other hand, during this period the survival number was gradually increased in the control.

The carrying capacity level, were recorded during the 1.5<sup>th</sup> to 3.5<sup>th</sup> month period for the treated media and form the 2<sup>sc</sup> to 3<sup>rd</sup> month for the control, was 12, 98, 626, and 842 adults for the media at 0.8, 0.4, 0.2% and the control, respectively, Table 3. The values indicate that the adults population size of the media at 0.2% was markedly greater than other media.

From the 4<sup>th</sup> month, the adult population slowed down and reached a lower level after 6 months in the treated and untreated media.

The rapid drop of the population during the period from the 4<sup>th</sup> to 6<sup>th</sup> month in the various media was due to the influence of the ecological factors, which affect the population density of the insects, such as food shortage, over crowding effect ... etc.

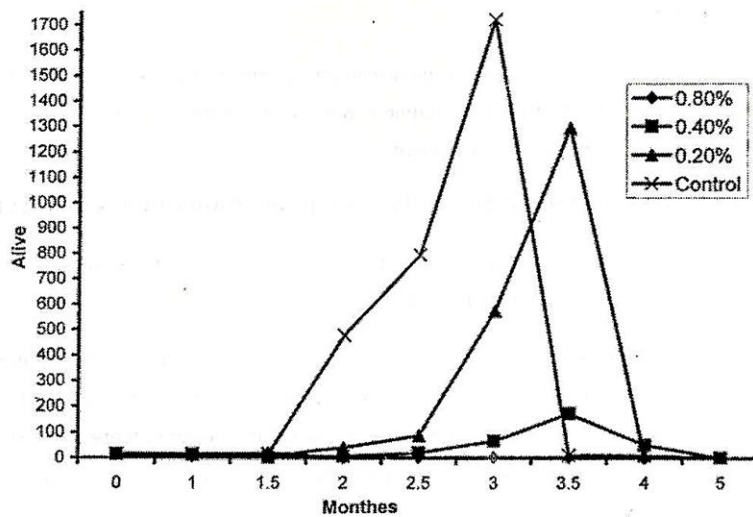


Fig. 1. Alive population of *S. oryzae* adults after treatment with *Anethum graveolens* L. powder.

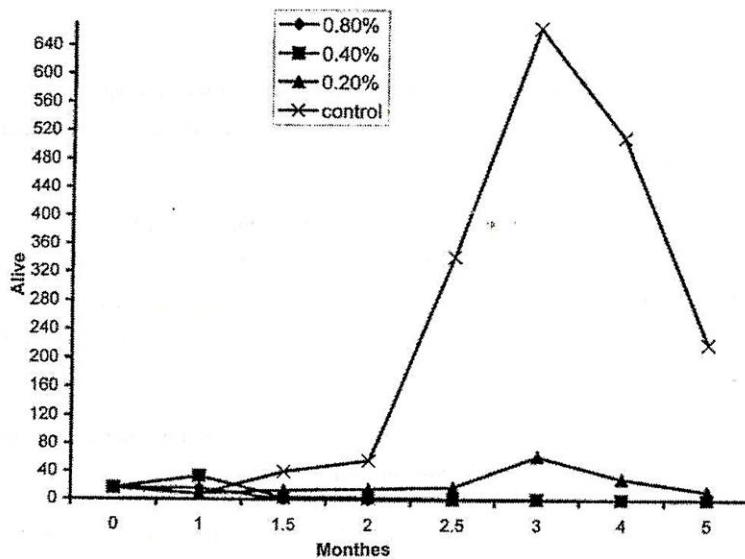


Fig. 2. Alive population of *S. oryzae* adults after treatment with *Apium sativum* L. powder.

The population growth rate of *S. oryzae* was greater for the control than various treated diet, Table 2. Results revealed that addition of dill seeds powder to the diet of *S. oryzae* at various concentrations did not induce higher mortalities during the 1<sup>st</sup> to 3<sup>rd</sup> month of rearing in comparison to the untreated media. The results was similar with the finding of EL-Lakwah *et al.* (1999a). He revealed that addition of African chili fruits powder to diet of *S. oryzae* at 0.8, 0.4 and 0.2% concentrations did not induce higher mortalities during the first to the three months of rearing in comparison with the control.

These values show clearly that addition of dill seeds powder at 0.8% to the diet of *S. oryzae* induced higher mortality value during the period from the 1<sup>st</sup> to 5<sup>th</sup> month of rearingn comparison to other treatments as well as control.

In summary the results indicated that *S. oryzae* was more sensitive to treatment with dill seed powder. The population of *S. oryzae* declined sharply after it reached its peak but the decline was slow in case of control, Fig. 1. *S. oryzae* alive number was smaller than control at 0.8% after 4 month from the treatment. However by the end of experiment the alive insect number was very higher in control than treatment. *S.oryzae* insect mortality increased at 0.8% and did not increased at other treatments during the 1<sup>st</sup> to 3<sup>rd</sup> month after the addition of dill powder to food.

The numbers of *S. oryzae* alive insects at 0.8, 0.4 and 0.2% concentrations reaches its peak after 1.5, 3.5 and 3 month, respect., this peak in case of control was recorded after 3 months, also. The dead adult's insect peak number was observed after 4 months for all treatments including control. The insect growth was followed by a decline in their number after it reached peaks. The number of dead adults was fluctuated for all treatment and at all concentrations.

The population rates of growth of *S. oryzae* were - 0.023, 0.016, 0.040 and 0.052, for the diet at 0.8, 0.4 and 0.2% concentrations, as, well as untreated diet, respectively.

It could also concluded that the lower concentration of dill powder had an activation effect upon the population growth rate in both insects and this rate was higher in *T. castaneum* than *S. oryzae*. In a study on the effect of fenugreek seed flour on *T.*



*castaneum* and *S. oryzae*. By EL-Lakwah *et al.*, 1989, the found that the rate of population growth was higher in case of *T. castaneum* than *S. oryzae*. But in general, the obtained results are in harmony with the findings reported by EL- Lakwah *et al.*, 1989 on the population of the two insects species under study for diet, treated with. The *Melia azederach* fruit powder as well as for insect media treated with African chili fruits powder (EL – Lakwah *et al.*, 1995 and 1999a).

Table 2. Rate of growth for *Sitophilus oryzae* adults in presence of dill and parsely powders.

	Concentration of powder	Initial number (No.)	Number after 90 days (N)	Intrinsic rate of increase (r)
Dill	0.8%	16	2	-0.023
	0.4%	16	67	0.016
	0.2%	16	574	0.040
	Control	16	1720	0.052
Parsely	0.8%	16	0	-0.133
	0.4%	16	1	-0.030
	0.2%	16	62	0.015
	Control	16	666	0.041

#### Effect of parsely powder concentrations on the populations of the tested insect

The population growth of *S. oryzae*, adults at various treatments with *Apium sativum* powder compared with the control is showed in Figure 2.

Results indicated that the initial number of alive insects was obviously reduced after one month from treatment for the various treated media as compared with the control. Then, the number of alive adults increased rapidly after 60 days post-treatment to reach 62 and 666 adults after 3 months from rearing for 0.2% concentrations and untreated diet, respectively. However the peak of alive adults was decreased sharply after one month for the treated media at 0.8% and 0.4% concentration respectively. After 5 months of rearing the number of alive adults declined to zero, zero, 12 and 220 for the various media, respectively.



The population growth curves of *S. oryzae* reared in the various media, Fig. 2 showed following one month of a stationary phase rapid increase from the 1<sup>st</sup> to the 3<sup>rd</sup> month. From the 3<sup>rd</sup> to the 5<sup>th</sup> month the number of survival decreased slowly for the media at 0.2% concentration and untreated and was decreased sharply for the other media. The recorded carrying capacity level during the period from the 1<sup>st</sup> to the 3<sup>rd</sup> month of rearing was 11, 17, 37 adults for the media at 8.4 and 2% Meanwhile, it was 506 adults for the control, Table 2.

However, after the 4<sup>th</sup> month, the number of the alive insects decreased slowly and was 30 and 511 adults to reached 12, 220 adults after 5 months at 0.2% and control but, in the treated diet at 0.8% and 0.4% the number of survivals declined rapidly and diminished at the 6<sup>th</sup> month of rearing.

The high drop of the population during the period from the 3<sup>rd</sup> to 5<sup>th</sup> month in the concentration 2% and untreated diet was due to influence of the ecological factor, which affect the population density of the insects, such as food shortage overcrowding effect etc., but, this high drop of the population at 0.8% and 0.4% concentrations due to the fact that these plants contain terpenoids, glycosides or similar substances which possess antifeedant, repellency or led to a molting disturbance which is often lethal (Champagne *et al.* 1989).

The carrying capacity level of the various media and the population maximum of alive adults were obviously very lower for the media at 0.8% and 0.4% concentrations than the treated media at 0.2% and control, Table 3.

Also, the rate of population growth for *S. oryzae* was high lower at 0.8% and 0.4% concentration as compared with the treated diet at 0.2% and the control (Table 2). Mean mortality values recorded during the 1<sup>st</sup> to the 3<sup>rd</sup> month of rearing, Table 3 revealed that addition of *Apium sativum* powder to the diet of *S. oryzae* at various concentration did induce higher mortalities in comparison to the untreated diet.

Results revealed clearly that the addition of *Apium sativum* powder to diet of *S. oryzae* at various concentration, especially 0.8% and 0.4% concentrations showed on obvious very decline in the adult population during the first months of rearing compared to the untreated food. This result is similar to the findings achieved with Fenugreek

Table 3. Carrying capacity level of the media, population maximum of alive adults and number of dead adults for *S. oryzae*.

Media	Dill				Parsely			
	Carrying capacity Level of the media	Population maximum		Mortality % The 1 <sup>st</sup> to 3 <sup>rd</sup> Month	Carrying capacity Level of the media	Population maximum		Mortality % The 1 <sup>st</sup> to 3 <sup>rd</sup> Month
		No.	Recorded at months			No.	Recorded at months	
100 gm grain + 0.8 g herp seed powder	12	20	1.5	92	11	16	1.0	100
101 gm grain + 0.4 g herp seed powder	98	174	3.5	29	17	33	2.0	97
102 gm grain + 0.2 g herp seed powder	626	1293	3.5	3.20	37	62	3.0	38.6
Control	842	1720	3.0	32.1	506	666	3.0	1.2

seed flour and black pepper powder for the same insect species (EL – Lakwah *et al.*, 1989).

In this respect, EL-Lakwah *et al.*, (1999b) mentioned that addition of 0.8% black pepper powder to the food of *S. oryzae* caused an obvious decline in the population during the first three months of rearing. Also, addition of Chinaberry tree fruit dust to the diet of *S. oryzae* showed an obvious decline in the adult population during the first five months of rearing (EL – Lakwah *et al.* 1995).

The obtained results showed clearly that powder of *Apium sativum* at various concentration gave complete protection to grains against pest species, this might be due that *Apium sativum* an adverse effect on egg deposition, hatchability, progeny percentage or acted as repellency material.

These findings are in agreement with earlier reports of Mahgoub *et al.* (1997) who, use *Petroselinum sativum* oil against *S. oryzae* and *C. maculatus* adults after 48 h. from treatment, a great reduction in hatchability of the produced eggs at the two first levels (LC<sub>25</sub> & LC<sub>50</sub>), in case of LC<sub>90</sub>, no hatching noticed, also. The percentage of progeny was severely affected which 56 and 1 adults at LC<sub>25</sub> and LC<sub>50</sub>, but the higher concentration (LC<sub>95</sub>), no progeny could emerge or 100% relative protection was achieved to mung seeds from *C. maculatus* infestation at this level.

#### **Persistence of *Apium sativum* powder activity on *S. oryzae* adult**

Table 4 further indicates that, for any tested concentration adult mortality of *S. oryzae* after storage was greater than or equal to the initial mortality, i.e. no decrease in the material powder activity was noted. In this respect Abd-Kway and El-khayat (1998) stated that no decrease in insecticidal activity was noticed on *R. dominica* by *B. thuringiensis*. Also, this data, as it is, of obvious results to Mahgoub *et al.* (1997).

#### **Weight loss in wheat grains**

As shown in Table 5 *Apium spp* powder had a significant effect on the feeding behavior of *S. oryzae* adults. Treatment of wheat grains with *Apium sativum* powder decreased food consumption of adults and consequently, reduced insect feeding damage. A correlation existed between increase of material powder concentration of *Apium sati-*

*vum* and decrease of weight losses of wheat grains. With *S. oryzae* adult decrease in grain weight was 61% in the control compared to zero and 7.04% in grains treated with 0.8% and 0.4% after 150 days of storage. After the same storage period, decrease in weight for *S. oryzae*. This result in respect of Abd El – Kawy and EL – Khayat (1998) presented that weight loss of wheat grains treated with *B. Thuringiensis* Vri. Kurstuki, due to infestation with both species *R. dominica* and *S. granarius* was evidently less than untreated grains.

The above results lead to the conclusion that *Apium sativum* powder may help reducing deterioration of stored wheat grains and inhibiting the development and reproduction of *S. oryzae* on them.

It is concluded that these plant powder can be successfully used for reducing the weight losses caused certain stored grains insect species in addition to their efficiency they are safe and easy to use.

Table 4. persistence of *Apium sativum* powder activity on *S. oryzae* re-reared on wheat grains stored after 5 month at  $26 \pm 2^\circ\text{C}$  and  $65 \pm 5\%$  RH.

Concentration W / W	Average No. of adults within certain after storage of infected wheat grains after exposure periods		
	15 days	30 days	60 days
0.8%	$65 \pm 6$	$32 \pm 3$	$22 \pm 6$
0.4%	$50 \pm 2$	$21 \pm 6$	$20 \pm 1$
Control	$0 \pm 0$	$0 \pm 0$	$0 \pm 0$

Table 5. Weight loss caused by *S. oryzae* wheat grains treated with *Apium sativum* 5 months after treatment.

Concentration W / W	weight loss (g) $\pm$ S.D	% weight loss of grain
0.8%	$300 \pm 0$	0
0.4%	$279.17 \pm 4$	7.04
0.2%	$139.6 \pm 2$	53.5
Control	$117.3 \pm 2$	61.0

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## تأثير معاملة حبوب القمح بمسحوق بذور كل من الشبث والبقدونس على تعداد سوسة الأرز

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أجريت هذه الدراسة معملياً على درجة حرارة ٢٦ م ورطوبة نسبية ٦٥٪ لمعرفة تأثير إضافة تركيزات مختلفة (٠،٢، ٠،٤، ٠،٨) من مسحوق بذور كل من الشبث والبقدونس إلى حبوب القمح على نسب الموت ومنحنيات النمو لسوسة الأرز.

ولقد أظهرت النتائج أن نسب الموت المسجلة خلال فترة اسبوعين من معاملة الحبوب كانت تتوقف على التركيز المستعمل ومدة التعريض حيث ارتفعت بزيادتها.

ووجد أن إضافة مسحوق بذور البقدونس إلى غذاء حشرة سوسة الأرز أدى إلى زيادة واضحة فى متوسط الموت الناتجة خلال ١-٢ شهر من المعاملة مع جميع التركيزات المخدمة مقارنة بمعاملة مسحوق الشبث.

وتبين أن الحشرات الكاملة وسوسة الأرز كانت أكثر حساسية لمسحوق بذور الشبث بالمقارنة بالكنترول، مع أنه اتضح أن مسحوق بذور البقدونس كان الأكثر تأثيراً على هذه الحشرة.

وأظهرت نتائج تأثير المسحوق النباتى على تعداد الحشرات عند إضافة مسحوق البقدونس إلى غذاء سوسة الأرز قد أدى إلى انخفاض واضح فى أعداد الحشرات الكاملة خلال فترات التربية الأولى على غذاء يحتوى على ٠،٢، ٠،٤، ٠،٨٪ من هذا المسحوق النباتى مقارنة بمسحوق الشبث.

وقد انخفض تعداد الحشرات الكاملة لسوسة الأرز عند تربيتها فى بيئة تحتوى على أعلى تركيزين وهما ٠،٤، ٠،٨٪ من مسحوق بذور النباتين مقارنة بالمعاملات الأخرى وفى نفس الوقت فإن إضافة مسحوق بذور البقدونس أعطى حماية كاملة لحبوب القمح خلال ستة أشهر ولذلك يمكن التوصية باستخدامه للوقاية من الإصابة الحشرية خلال فترات التخزين.