MIXING EFFECT OF NEEM SEED OIL (*AZADIRACHTA INDICA* A. JUSS.) WITH SOME WHEAT VARIETIES FOR THE CONTROL OF THE KHAPRA BEETLE, *TROGODERMA GRANARIUM* EVERTS

MOHAMED S. FOUAD

Plant Protection Dept., Fac. Agric. Minia Univ. , Minia, Egypt.

(Manuscript received 14 October 2005)

Abstract

The effect of mixing neem seed oil at different rates (1, 2, 4 and 8 ml/kg grain) with some wheat varieties (Sids, 1,4; Giza 164, 168 and Beni-suef 1,3) for the control of *T. granarium* was determined.

Results showed that, wheat varieties of Giza 164 and Giza 168 were the least susceptible to infestation with the *T. granarium* (characteristics by the longest developmental period, the lowest mean percentage of adult emergence, the least percent of weight loss and the least value of susceptibility index). Also, neem seed oil (NSO) was effective in protecting the grains of various wheat varieties against *T. granarium*, however the different rates of NSO interacted with wheat varieties resistance and significantly increased larval mortality and reduced the percentage of adult emergence.

Moreover, NSO at different rates was significantly increased the developmental period of the different stages of this insect reached 28-39 days at 8 ml/kg grain as compared to the check (21.5-34.0days) in the different wheat varieties.

In addition, NSO at different rates caused a significant reduction of the percentage of weight loss of the different grain wheat varieties as well as reduced the weight loss from over 20% in the control to less 5% in the different wheat varieties.

INTRODUCTION

The Khapra beetle, *Trogoderma granarium* Everts, is a major pest of cereal grains and their products in Egypt. This species infests a wide range of stored commodities, which become contaminated with numerous cast larval skins and feces, however the damage is caused by larval stage. The adults do not feed and lay eggs in locations which favour the ready access of larvae to their accustomed food (Ismail *et al.*, 1989).

Control of these insects by using insecticides has serious drawbacks, such as the development of resistant strains, toxic residues hazards to workers and increase of

costs. In recent years, attention has been given to the control of stored grain pests with vegetable oils. One of the promising natural plant compounds for insect control is neem oil. Azadirachtin, a tetranortriterpenoid isolated from the seeds of the neem tree, *Azadirachta indica*, has insect growth regulating activity and inhibits feeding and disrupts growth and development of a variety of insect species (Schmutterer and Ascher, 1984 and Salem, 1996). Also, among the different means to reduce the use of insecticides in stored grains is the development of varieties, which are resistant to attack by stored grain insects.

Therefore, the present study was conducted to determine the effect of mixing neem seed oil with six wheat varieties for the control of *T. granarium*

MATERIALS AND METHODS

Adults of *T. granarium* (collected from infested wheat) were successful reared on pre-sterilized and conditioned wheat grains at 30°C and 70±5 % R.H. Deposited eggs were collected and kept under the same conditions, newly hatched larvae were obtained and reared on the wheat grains till the beginning of the fourth instar (Mostafa, 1993).

Wheat varieties of Sids 1,4; Giza 164, 168 and Beni-suef 1, 3 were supplied by the Agricultural Research Centre, Giza- Egypt.

Combining effect of neem seed oil with the previous wheat varieties was tested. Neem seed oil was applied at the dosages of 1,2,4 and 8 ml/kg grain. The desired quantity of neem oil was dissolved in 20 ml of petroleum ether to allow uniform application on the surface of the grains. Oil solution was pipetted on samples of 500 g (from each wheat variety) grains in one liter wide-mouth jars. The grains were then mixed manually and thoroughly for five minutes to insure complete coverage (adopted by Khaire *et al* 1992). Treated grains were exposed to air for 24 hours to get rid of the petroleum ether. Grains of each wheat variety were treated with petroleum ether alone in the same procedure were used as control. For each treatment, 10 g sample (with four replications) was infested with 5 pairs of the 4^{th} instar larvae of *T. granarium* and kept in small glass jars, one day after oil treatment. Then after the jars were covered with muslin cloth and all jars were kept under the same conditions of 30°C and 70±5% R.H. (Mostafa, 1993).

Observations of mortality, growth and metamorphosis were made at 3-day intervals for a period of six weeks after treatment to determine the number of dead larvae and adults emerged.

To study the developmental period of *T. granarium*, 50 larvae (1-2 day old) were added to 100 g of each wheat variety treated with oil. The infested grains were kept under the respective conditions till the offspring started to emerge the progeny produced were counted daily (Ismail *et al.*, 1989).

During the course of the trials, each infested sample of wheat grain was weighed at the beginning of the experiment and at the end of experiment after all the insects and all the dust they created had been removed. Uninfested samples were also weighed and the change in weights was used to correct the initial changes in weight of the corresponding trial samples, and the percentage loss in weight was calculated (Fouad, 1995).

The susceptibility index of each variety was assessed based on emerging adults (F_1) and the length of developmental period (Dobie, 1974).

All the obtained data were estimated and subjected to the analysis of variance according to Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

The effect of neem seed oil (NSO) mixed with different wheat varieties of Sids 1, 4; Giza 164, 168 and Beni-suef 1,3 on the mean percentage mortality of *T. granarium* larvae are presented in Table 1. Wheat varieties treated with neem seed oil (NSO) (8 ml/kg grain) gave the high mortality (45-65%). Meantime higher larval mortality occurred in Giza 164 and Giza 168 grains treated with 8 ml NSO than other tested varieties. Moreover, percentage larval mortality was not significantly different among the varieties, but showed significantly higher mortality in grains treated with the different rates of NSO. The combination of wheat varietal resistance with different rates of NSO had a significant interaction effect on the percentage of dead larvae (Table 1). Jvbijaro (1990) resulted that neem oil protected grains against stored product pests as antifeedant, reduced egg hatch and emergence. Also, the plant extracts are known to be caused a significant mortality of *T. granarium* larvae when used to protect grains against stored product pests (Lale, 1995).

Data in Table (2) show that the mean percentage of adult, emergence was significantly higher in untreated wheat varieties of Sids 1,4 and Beni-suef 1,3 ranging

from (65-78%) as compared to Giza 164, 168 (35-48%). Meanwhile, all ratios of NSO significantly reduced the percentage of adults emerging at different wheat varieties as compared to the control. The least percentage of adults emerging were observed in Giza 164 and Giza 168 (3 and 8%, respectively) when mixed with neem oil at the rate of 8 ml/kg grain. With an exception, suppression of adult emergence was dose dependent, decreasing with increasing dose (Fouad, 2000).

As for the average developmental period (Table 3), untreated Giza 164 variety showed a significant prolonged period (34.0 days) as compared to the other untreated varieties (ranging from 21.5-27 days). Meanwhile, the developmental period of *T. granarium* was longer in all wheat varieties mixed with NSO under all different ratios of NSO, it was significantly increased to 35 and 39 days in Giza 168 and Giza 164, respectively as compared with other treated varieties (28-33 days) when mixed with NSO at 8 ml/kg grain. Azadirachtin has insect growth regulating activity and inhibits feeding and disrupts growth and development of insect species (Salem, 1996).

It could be expected, the percentage loss in weight followed a similar pattern which paralells the mean number of progeny. Data in Table (4), clearly indicated that the percentage loss in weight was significantly lower on Giza 164 and Giza 168 varieties (5.5 and 7.5%, respectively), compared to all untreated tested varieties (ranged from 17.0 to 20.5%). The different rates of NSO application were also caused a significant reduction in percentage of loss in weight caused by *T. granarium*. In all wheat grain varieties treated with NSO at 4 ml/kg or more were significantly less infested than untreated grains. However, treatment of grains at 8 ml/kg grains of NSO had reduced damage from 5.5-20.5% to less 4.5% in all tested varieties. The present investigation has shown integration neem seed oil (NSO) and partial resistance that caused significantly increase the percentage of grains of different wheat varieties protected against damage by *T. granarium* (Xu *et al.*, 1993 and Lale and Mustapha, 2000).

Data illustrated in Fig. (1) show the susceptibility index of different wheat varieties mixed with NSO. It was cleared that the untreated varieties Giza 164 and Giza 168 had the least susceptibility index (3.7 and 5.8, resp.) as compared to untreated wheat varieties (7.7-9.2). Tested wheat varieties mixed with NSO (8 ml/kg grain), the susceptibility index completely reduced in Giza 164 and Giza 168.

It could be concluded that, the combination of application of neem seed oil and resistance wheat varieties appears to have great potential for the management of this beetle in stored wheat varieties.

REFERENCES

1. Dobie, P. (1974): The laboratory assessment of the inherent susceptibility of maize varieties to post-harvest infestation by *Sitophilus zeamais* Motsch. (Coleoptera, curculionidae). J. Stored Prod. Res., 10: 183-97

2. Fouad, M. S. (1995): Correlation between certain nutritional constituents of some wheat varieties and infestation by *Sitophilus granarius* L. (Coleoptera: Curculionidae). J. Egypt.Ger. Soc Zool., Vol 16(E), Entomology, 171-182.

3. Fouad, M. S. (2000): Protection of stored broad beans and mungbeans against the cowpea weevil, *Callosobruchus maculatus* (F.) by using certain plant and citrus oils. J. Egypt. Ger. Soc. Zool., Vol. 31 (E), Entomology, 183-195.

4. Ismail, I.I.; T.S. Mostafa and B.B. EL-Keridees (1989): Effect of food and light on reproductive capacity and rate of infestation of *Trogoderma granarium* Everts. Bull. Soc. Ent. Egypte, 68: 159-168.

5. Jvbijaro, M.F. (1990): The efficacy of seed oils of *Azadirachta indica* A. Juss and *Piper guinense* Schum and Thonn on the control of *Callosobruchus maculatus* F. Insect Sci. Appl. 11: 149-152.

6. Khaire, V.M.; B.V. Kachare and U.N. Mote (1992): Efficacy of different vegetable oils as grain protectants against pulse beetle, *Callosobruchus chinensis* in increasing storability of pigeonpea. J. Stored Prod. Res., 28: 153-156.

7. Lale, N.E.S. (1995): An overview of the use of plant products in the management of stored product coleoptera in the tropics. Postharvest News and Information, 6; 69-75.

8. Lale, N.E.S. and A. Mustapha (2000): Potential of combining neem (*Azadirachta indica* A. Juss) seed oil with varietal resistance for the

management of the cowpea bruchid, *Callosobruchus maculatus* (F.) J. Stored Prod. Res., 36: 215-222.

9. Mostafa, T.S. (1993): Effect of certain plant extracts on body weight and biochemical aspects of the Khapra beetle, *Trogoderma granarium* Everts. Bull ent. Soc. Egypt Econ. Ser., 20; 77-85.

10. Salem, H. (1996): Neem-Based insecticide as a repellent and growth inhibitor against the red flour beetle, *Tribolium castaneum* (Coleoptera: Tenebrionidae). Bull ent. Soc. Egypt, Econ. Ser., 23: 78-85.

11. Schmutterer, H. and K.R.S. Asher (1984): Natural pesticides from the neem tree (*Azadirachta indica* A. Juss) and other tropical plants. Proceeding of the second international neem conference, Rauischolzhausen, 1983; Germany Agency for Technical cooperation, Eschborn, Germany.

12. Snedecor, G.W. and W.G. Cochran (1980): Statistical methods. (6th ed.) Iowa State Univ. Press, Iowa, USA pp.: 255-269.

13. Xu, H.H., S.F. Chiu, F.Y. Jiang and G.W. Huang (1993): Experiments on the use of essential oils against stored product insects in a storehouse. J. South China Agric. Univ. 14, 42-47.

Table (1): Effect of neem seed oil mixed with different wheat varieties on the mean percentage mortality of *T. granarium* larvae.

Wheat varieties	Dosage of neem seed oil (NSO) (ml/kg)					
	0.0	1 ml	2 ml	4 ml	8 ml	mean
Sids 4	15	48	45	45	45	39.6
Giza 164	45	48	58	60	65	55.2
Beni-suef 1	25	40	50	48	50	42.6
Sids 1	15	35	40	53	58	40.2
Giza 168	40	48	48	45	60	48.2
Beni-suef 3	8	43	43	58	55	41.4
Mean ± s.e.	24.7±6.22	43.7±2.25	47.3±2.63	51.5±2.72	55.5±2.99	
L.S.D.	at 5%				at 1%	
Dosage of NSO	11.4				15.2	
Wheat variety	–				–	
Interaction	27.9				37.1	

Table (2): Effect of neem seed oil mixed with different wheat varieties on the mean percentage of adult emergence of *T. granarium*.

Wheat varieties	Dosage of neem seed oil (NSO) (ml/kg)					
	0.0	1 ml	2 ml	4 ml	8 ml	mean
Sids 4	75	40	40	35	35	45
Giza 164	35	28	18	15	3	19.8
Beni-suef 1	65	48	20	23	20	35.2
Sids 1	75	50	40	33	23	44.2
Giza 168	48	35	28	20	8	27.8
Beni-suef 3	78	28	20	15	15	31.2
Mean ± s.e.	62.7±7.28	38.2±3.98	27.7±4.23	23.5±3.63	17.3±4.75	
L.S.D. Dosage of NSO	at 5% 12.1				at 1% 16.1	
Wheat variety	13.3				17.6	

Table (3): Effect of neem seed oil mixed with different wheat varieties on the developmental period (days) of *T. granarium*.

Wheat varieties	Dosage of neem seed oil (NSO) (ml/kg)					
	0.0	1 ml	2 ml	4 ml	8 ml	mean
Sids 4	22	25.3	28	28.3	33	27.3
Giza 164	34	35.3	36	36.3	39	36.1
Beni-suef 1	21.5	25.5	26.5	33.0	33	27.9
Sids 1	26	27.5	31	30.8	31	29.3
Giza 168	27	27	30.5	33	35	30.5
Beni-suef 3	25.3	26	27	28.5	28	27.0
Mean ± s.e	26±1.88	27.8±1.58	29.8±1.47	31.7±1.28	33.2±1.55	
L.S.D. Dosage of NSO	at 5% 5.0				at 1% 6.6	
Wheat variety	5.4				7.2	

Table (4): Mean percentage of loss in weight of different wheat varieties grains treated with neem seed oil (NSO) against *T. granarium* infestation.

Wheat varieties	Dosage of neem seed oil (NSO) (ml/kg)					
	0.0	1 ml	2 ml	4 ml	8 ml	mean
Sids 4	19.5	13.1	5.6	4.4	4.4	9.4
Giza 164	5.5	3.1	2.5	1.3	0.6	2.6
Beni-suef 1	18.5	7.5	5.6	6.9	3.8	8.5
Sids 1	20.5	6.3	4.4	3.1	3.1	7.5
Giza 168	7.5	5.0	6.9	3.1	1.3	4.8
Beni-suef 3	17.0	10.0	9.4	5.0	3.8	9.0
Mean s.e	14.8±2.72	7.5±1.5	5.7±0.97	4.0±0.80	2.8±0.64	
L.S.D. Dosage of NSO	at 5% 3.6				at 1% 4.8	
Wheat variety	4.0				5.3	

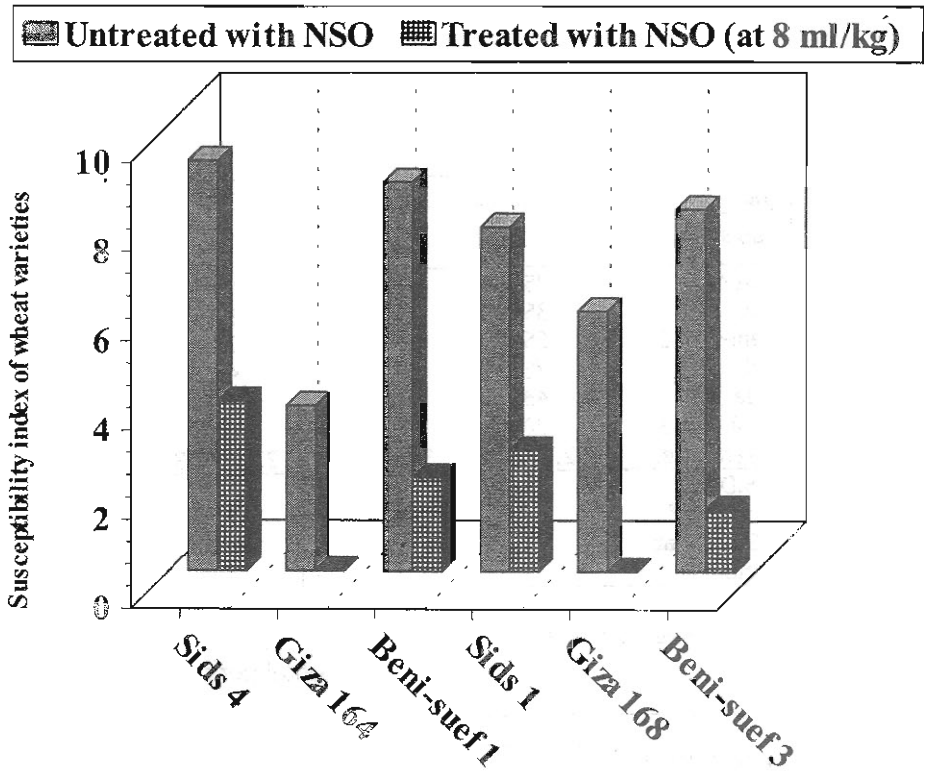

Fig. (1): Susceptibility index of different wheat varieties treated with neem seed oil (NSO) against *T. granarium* infestation.

تأثير خلط زيت بذرة النيم مع بعض أصناف القمح لمكافحة حشرة خنفساء الصعيد

محمد سمير فؤاد

قسم وقاية النبات – كلية الزراعة – جامعة المنيا – المنيا – مصر

- تمت دراسة مدى تأثير خلط زيت بذرة النيم (بمعدلات ١، ٢، ٤، ٨ مل/كجم حبوب) مع بعض أصناف القمح (سدس ١، ٤ ، جيزة ١٦٤، ١٦٨ وبنى سويف ١،٣) لمكافحة حشرة خنفساء الصعيد.
- أظهرت النتائج أن صنفى جيزة ١٦٤ وجيزة ١٦٨ كانت أقل الأصناف المختبرة حساسية للإصابة بهذه الحشرة حيث أتضح أنه كانت أكثرها إطالة لفترة نمو الحشرة وسجلت أقل عدد من النسل الناتج و اقل نسبة مئوية للفقد الناتج فى وزن الحبوب نتيجة الإصابة بهذه الحشرة كما سجل هذان الصنفان أقل قيمة لدليل الحساسية Susceptibility index
- وقد دلت النتائج أيضا أن زيت بذرة النيم كان ذو كفاءة عالية فى حماية حبوب أصناف القمح المختبرة ضد الإصابة بخنفساء الصعيد حيث وجد أن خلط زيت بذرة النيم بمعدلاته المختلفة مع أصناف القمح المختلفة أدت إلى زيادة معنوية فى النسبة المئوية لموت اليرقات وخفضاً فى النسبة المئوية لخروج النسل الجديد لهذه الآفة .
- أدى استخدام زيت بذرة النيم بمعدلاته المختبرة إلى زيادة معنوية فى طول فترة نمو الأطوار المختلفة لحشرة خنفساء الصعيد حيث تراوحت ما بين ٢٨-٣٩ يوما عند المعاملة بمعدل ٨ مل /كجم حبوب بالمقارنة ٢١,٥-٣٤ يوما فى أصناف القمح المختلفة الغير معاملة .
- وجد ان زيت بذرة النيم بمعدلاته المختلفة لها القدرة على حماية حبوب القمح حيث أحدثت انخفاضاً معنوياً فى النسبة المئوية للفقد فى وزن الحبوب للأصناف المختلفة حيث وصلت إلى اكثر من ٢٠% فى (بدون معاملة) إلى اقل من ٥% فى أصناف القمح المختلفة نتيجة الإصابة بهذه الحشرة .