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EFFICACY OF AZADIRACHTIN OIL AS PROTECTANT OF WHEAT AGAINST THE RICE WEEVIL,*SITOPHILUS ORYZAE* (L.) (CURCULIONIDAE, COLEOPTERA)

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ABSTRACT

Five concentrations of azadirachtin oil (1%) were tested to evaluate its effect as protectant of wheat grains against the rice weevil, *Sitophilus oryzae* (L.) infestation. These concentrations wer10, 50, 100, 500 and 1000 ppm, the assay set up on parent adults and the progeny which resulted from them. The results showed that, the percentage of adult mortality in parent adults increased by increasing the concentration of azadirachtin oil through 12 days after treatment compared to untreated control. The used concentrations did not affect on the life span of parent adults. The number of emerged adults (progeny) was greatly affected by the different used concentrations compared to untreated control.. The developmental period of progeny from egg laying to adult emergence on treated wheat significantly longed compared to untreated control. The re was greatly reduction in adult emergence on treated wheat compared to untreated wheat. The percentage of weight loss in untreated wheat (control) was 22% compared with the treatments which were 15.33, 9.33 , 8.5, 6.0 and 4.66% at 10, 50, 100, 500 and 1000 ppm of azadirachtin, respectively. The azadirachtin oil gave a good protection to wheat against the rice weevil.

INTRODUCTION

Many insects are unable to infest certain plants because of the presence of particular noxious substances (Fraenkle, 1969). The neem tree (*Azadirachta indica* A. Juss.) is known to be rarely infested by insects and to have repellent or antifeedant effects (Ruscoe, 1972). Neem has been used as an effective post-harvest protectant for many crops and it has been demonstrated to reduce insect populations in stored products through its toxic and growth-disrupting and other effects on the pests (Jenkins *et al.,* 2003). It has been an age old practice in rural areas of the whid country to mix dried neem leaves with grain meant for storage for long periods. Active components have been isolated from neem and these include the triterpenoids, azadirachtin (Butterworth and Morgan, 1971) and melantriol (Lavie *et al.*, 1967), both of which suppress feeding. Azadirachtin has proved to be one of the most promising active ingredient obtained from the seed kernels of neem as grain protectant (Sunita, 2006). Some works were carried out to assess the effects of various neem products on storage pests, Makanjuola, 1989; Reddy and Singh, 1998; Elhag, 2000; Musabyimana *et al.*, 2001; Jenkins *et al.,* 2003; Tripathi *et al.*, 2003 a & b; Athanassiou *et al.*, 2005 and Sunita, 2006 .

The present study was set up to test the efficacy of azadirachtin oil as protectant of wheat grains against the rice weevil, *Sitophilus oryzae* (L.) infestation.

MATERIALS AND METHODS

Rearing of insects:

Rice weevil, *Sitophilus oryzae* (L.) was selected to carry out this study. It reared on wheat grains under laboratory conditions 27 ± 2 °C and 65 ± 5% R.H.. Experiments were conducted using unsexed one week old adults.

Application with azadirachtin oil:

New harvested wheat grains obtained from the market which were sterilized at 65 °C for 4 hours to avoid any pre-harvest infestation. Azadirachtin oil 1% was used in all treatments. Five concentrations of azadirachtin were prepared for treatments. These concentrations were 10, 50, 100, 500 and 1000 ppm. The experimental unit was 50 gm wheat (replicate) which was put in glass jar and 10 pairs of one week old adults were put in each jar which covered by a piece of cloth and secured using rubber bands. Grains treated with distilled water were used as untreated control. The weevils were leaved in jars for one week for egg laying then separated using an appropriate sieve and transmitted to other jars contained uninfested wheat grains till it died.

Experimental design and statistics :

Number of dead parent adults, number of adults emerging (F_1) and the developmental period (from treatment to adult emergence) were recorded. All emerging adults were removed from jars daily to prevent further mating and egg laying in order to prevent the overlap of generations. Assessment of adult emerged was continued until the 32 days of bioassay. The wheat in each treatment was weighted to assess the weight loss in all treatments and untreated control. The percentage of reduction in emergence was calculated by using the formula:

% Reduction in emergence = $\frac{y - x}{y} \times 100$. Where,

y = number of emerged adults in untreated control.

x = number of emerged adults in treatment.

The percentages of loss in weight was calculated by the "count and weight" method described by Harris and Lindblad (1978) applying the following equation:

$$\% \text{ Weight loss} = \frac{(Wu \times Nd) - (Wd \times Nu)}{Wu\,(Nu + Nd)} \times 100.$$ Where,

Wu = weight of undamaged grains.

Wd = weight of damaged grains.

Nu = number of undamaged grains.

Nd = number of damaged grains.

All treatments replicated three times.

RESULTS AND DISCUSSION

1- Effect on parent adults:

As shown in Table (1), the percentage of adult mortality in parent adults increased by increasing the concentration of azadirachtin oil. At the 6th day after treatment the percentage of mortality ranged between 6.7% with lowest concentration (10 ppm) and 19.9% with highest concentration (1000 ppm). The percentage of mortality increased gradually where, it reached to 100% at the 11th day with 10 and 50 ppm. The two concentrations 100 and 500 ppm gave 100% mortality after 10th day while the highest concentration (1000 ppm) gave this percentage after 9th day. The percentage of mortality in untreated control was 6.7% at 6th day and increased gradually and reached to 15.8% after 12th day.

Table (1): Effect of azadirachtin on parent adults of *Sitophilus oryzae*.

Concent-ration (ppm)	Percentage of mortality after indicated days							Avg. life span (days) ±S.E.
	6	7	8	9	10	11	12	
Control	3.7	5.4	8.4	10.1	12.8	13.7	15.8	9.29±0.18
10	6.7	16.7	40.0	50.0	50.0	100	-	7.33±0.14
50	10.0	20.0	30.0	66.7	70.0	100	-	6.43±0.15
100	13.3	23.3	30.0	66.7	100	-	-	6.86±0.11
500	16.6	29.9	33.2	76.7	100	-	-	6.73±0.16
1000	19.9	29.9	90.0	100	-	-	-	6.40±0.15

$L.S.D._{(0.05)}$=1.78

Data in Table (1) also show that, there was no effect of the used concentrations on the life span of parent adults. It ranged between 6.4 days at 1000 ppm to 7.33 days at 10 ppm compared with 9.29 days for untreated control. No significant differences between treatments but the difference is significant between untreated control and the treatments.

These results are agree with Athanassiou *et al.* (2005) who reported that, azadirachtin at 100 ppm concentration or more was effective against *S. oryzae* on whole rye and oats, where mortality was 100% after 7 and 14 days of exposure, respectively.

2- Effect on progeny and weight loss:

The emerged adults from treated and untreated wheat grains throughout 32 days were recorded as shown in Table (2). The number of emerged adults (progeny) was greatly affected by the different used concentrations.

The total number of emerged adults was 700 resulted from treated wheat with lowest concentration (10 ppm) decreased to 371, 296, 198 and 115 adults when the concentration increased to 50 , 100 , 500 and 1000 ppm, respectively. The total emerged adults were 1053 resulted from untreated control. Makanjuola (1989) found a significant difference in the number of emerging *S. oryzae* between the respective treatments and their control. Also, Athanassiou *et al.* (2005) stated that, significantly less progeny of *S. oryzae* was recorded in the treated rye and oats grains than in the untreated grains.

Table (2): The progeny produced by 30 pairs of *Sitophilus oryzae* on wheat grains treated with different concentrations of azadirachtin.

Concentration (ppm)	Days					Total ±S.E.
	0-7	7-14	14-21	21-28	28-32	
Control	173	161	456	112	151	1053±80.13
10	163	95	248	112	82	700±45.49
50	162	35	90	45	39	371±36.56
100	165	28	50	39	14	296±30.43
500	90	8	64	22	14	198±17.05
1000	69	15	12	12	7	115±13.49

Table (3) reveals that, the developmental period of progeny from egg laying to adult emergence on treated wheat ranged between 69.31 days with 10 ppm concentration to 72.24 days with 1000 ppm concentration compared to 66.73 days with untreated control. The differences were insignificant between various treatments but it significant between treatments and untreated contrl. Makanjuola (1989) reported that, no significant difference in the developmental period between treatments and controls. In contrast, Sunita (2006) found that, treatment with neem was effective in disturbing growth and development of *S. oryzae* compared to the untreated control.

Table (3): Effect of azadirachtin on progeny of *Sitophilus oryzae* resulted from 30 pairs on treated wheat and weight loss.

Concentration (ppm)	Developmental period (days) ±S.E.	% Reduction in adult emergence	% weight loss
Control	66.73±0.48	-	22.0
10	69.31±0.85	33.52	15.33
50	71.03±1.08	64.77	9.33
100	71.02±1.07	71.89	8.5
500	72.78±0.46	81.19	6.0
1000	72.24±0.88	89.08	4.66

$L.S.D._{(0.05)}$= 3.66

Also, Table (3) shows that, the reduction in adult emergence on treated wheat compares to untreated wheat was 33.52% at 10 ppm of azadirachtin concentration. This percentage increased to 64.77, 71.89, 81.19 and 89.08% by increasing the azadirachtin concentration to 50 , 100 , 500 and 1000 ppm, respectively.

These results are agree with findings by Elhag (2000) who stated that, the progeny production of cowpea bruchid, *Callosubrichus maculates* was significantly reduced where, only 11.9% of the eggs deposited reached adulthood when chickpea seeds were treated with 1% crude extract of neem seeds. Also, Sunita (2006) found that, treatment with neem was effective in reducing population of *S. oryzae* compared to the untreated control.

Based on the weight loss in treated and untreated wheat (Table, 3) it is obvious that, the azadirachtin gave a good protection to wheat against the rice weevil. The percentage of weight loss in untreated wheat (control) was 22% compares with the treatments where, it decreased to 15.33, 9.33 , 8.5, 6.0 and 4.66% at 10, 50, 100, 500 and 1000 ppm of azadirachtin concentrations, respectively.

The results of this investigation suggest that, the azadirachtin oil has potential to be used for protecting stored grains from insect attack. It is further evident that if the grains are sprayed with a suitable concentration of azadirachtin, even on infestation, the rice weevil will fail to consume stored grains and the reproduction will be inhibited and the chances of further build up of their population will be eliminated.

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كفاءة زيت الأزاديراختين كمادة واقية للقمح من الإصابة بسوسة الأرز *SITOPHILUS ORYZAE* (L.) (CURCULIONIDAE, COLEOPTERA)

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لدراسة كفاءة زيت الأزاديراختين(١%) كمادة واقية للقمح من الإصابة بسوسة الأرز، تمت المعاملة لحبوب قمح خالية من الإصابة بخمسة تركيزات منه(١٠، ٥٠، ١٠٠، ٥٠٠، ١٠٠٠ جزء فى المليون) . تم وضع حشرات كاملة من سوسة الأرز عمر أسبوع على القمح المعامل و غير المعامل فى أوعية زجاجية وذلك لمدة أسبوع لوضع البيض ثم تم فصل الحشرات عن القمح و وضعها على قمح غير معامل فى أوعية زجاجية أخرى . أظهرت النتائج أن نسبة الموت فى الحشرات الكاملة (جيل الآباء) زادت بزيادة التركيز حيث بلغت ١٠٠% فى اليوم التاسع بعد المعاملة بالتركيز ١٠٠٠ جزء فى المليون. لم تتأثر مدة حياة الطور الكامل للآباء معنويا فى حالة القمح المعامل بالتركيزات المختلفة إلا انها كانت معنوية بالمقارنة بها فى حالة القمح غير المعامل. كان تأثير المعاملة على النسل الناتج من جيل الآباء فى حالة القمح المعامل واضحا ، حيث انخفض عدد النسل الناتج من البيض الموضوع على القمح المعامل بنسبة كبيرة جدا عنه فى حالة النسل الناتج من البيض الموضوع على القمح غير المعامل (١١٥ حشرة فى حالة القمح المعامل بتركيز ١٠٠٠ جزء فى المليون مقابل ١٠٥٣ حشرة فى حالة القمح غير المعامل). لم تتأثر مدة التطور (من وضع البيض إلى خروج الحشرات الكاملة) للنسل الناتج من جيل الآباء معنويا بإختلاف التركيز بينما زادت معنويا فى المعاملات عنها فى المقارنة. بلغت نسبة الفقد فى الوزن الناتجة عن تغذية الحشرات على القمح غير المعامل ٢٢% إنخفضت فى حالة التغذية على القمح المعامل بالتركيزات المختلفة (٤,٦٦% فى حالة القمح المعامل بتركيز ١٠٠٠ جزء فى المليون).