

BIOLOGICAL ACTIVITY OF NEEMAZAL POWDER AND KATELSOUS DUST AGAINST *TROGODERMA GRANARIUM* EVERTS ADULTS (DERMESTIDAE : COLEOPTERA)

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(Manuscript received 14 September 1998)

Abstract

The biological activity of the botanical insecticide neemazal (contains 10% azadirachtin) and the inert dust Katelsous (84% rock-phosphate and 16% sulphur) was studied against the adults of *Trogoderma granarium* Everts, infesting cereal grains and their products especially in hot and sub-hot countries.

Neemazal powder and katelsous dust were applied to wheat grains as surface treatment, at rates of 4000, 1000, 500, 250 and 125 ppm for neemazal and at rate of 1% for katelsous dust. The high dosage (4000 ppm) of neemazal showed high significant effect on adults mortalities (90%), compared with 25% in katelsous and 3.33% in control. After 4 days post exposure, all dosages of neemazal as well as katelsous, proved high toxic effect on adults (93.33-96.67% mortalities) in comparison with 23.33% in control. Males were more sensitive to all rates of neemazal used as well as katelsous than females that is obviously indicated 1 day post exposure.

Both the high dose of neemazal (4000 ppm) and katelsous 1% were significantly highly active in reducing the F1 progeny. Reductions of 92.62% and 92.08% in F1 progeny were obtained for both, respectively, after one month. Dosages 1000, 500, 250 ppm also proved high protective value to wheat grains (86.07-81.14%). After a storage period of two months for the treated grains with all dosages of neemazal and katelsous, no offspring was produced at any treatment compared with average no. of 61.63 insect produced in control. All treatments of neemazal powder and katelsous dust, showed no hazards effect on seed germination of treated wheat grains, with exception of the high dosages (4000 and 1000 ppm) of neemazal which reduced the percentage of seed germination to 88% and 92%, respectively.

INTRODUCTION

The effectiveness of many plant products against grain insects had been reviewed by Macanjuola (1989) and Taheya & Hammood (1993), as alternatives to insecticides for grain protection. Other investigators studied the effect of inert dusts as safe and effective insect control agents (Wigglesworth, 1944; Verma et al., 1976; Mostafa & Al-Moagel, 1989).

This study aims to evaluate the potential use of neemazal (botanical powder containing 10% azadirachtin), and katelsous (an inert dust) for the suppression of the populations of *Trogoderma granarium* Everts, a serious insect pest of common cereals.

MATERIALS AND METHODS

1. Insecticidal activity: The botanical insecticide neemazal-W (a powder containing 10% azadirachtin), provided by Trifolio-M-GMBH Company, Germany, was admixed thoroughly with wheat grains at concentrations of 4000, 1000, 500, 250 and 125 ppm. Three replicates (100 g each) were specified for every treatment. Another three replicates of wheat grains were treated with katelsous dust (16% sulfur and 84% rock phosphate) produced by Kafr El-Zayat Company, Egypt, at a rate of 1%. A third group of 3 similar replicates were left untreated as control.

Ten pairs (10 males and 10 females) of newly emerged *T.granarium* adults (0-24 hrs. old), obtained by sexing the pupae of a standard stock culture fed on wheat grains, were liberated into the jars of each replicate, then incubated at $30\pm 1^{\circ}\text{C}$ and $65\pm 5\%$ R.H. Mortality of adults (males and females) was recorded 1, 2, 4, 7 and 14 days after exposure, then corrected mortality percentages were calculated according to Abbott's formula (Abbott, 1925).

Data obtained were statistically analyzed using F-test, T-test and L.S.D.

II. Effect on reproduction Jars were kept for two months and counts of offspring produced were made one and two months after storage, then examined for F1 development.

III. Effect on percentage of germination: Sets of samples of 100 surface disinfected wheat kernels (in four replicates, 25 each) treated with each of the tested concentrations; 4000, 2000, 1000, 500, 250 and 125 ppm of neemazal powder, 100 kernels treated with katelsous dust at rate 1% and 100 kernels kept untreated as control. Kernels of each replicate were kept on moistened filter paper in a Petri-dish for 7-10 days at room temperature ($25-28^{\circ}\text{C}$) and the number of normal sprouts was counted, then the percentages of germination was calculated (Anonymous, 1959).

RESULTS AND DISCUSSION

I. Insecticidal activity:

Table 1 shows the effect of neemazal powder and katelsous dust on the mortality of *T.granarium* adults at $30\pm 1^{\circ}\text{C}$ and $65\pm 5\%$ R.H. Corrected percentages of mortality are further shown in Table 2. Adult beetles were highly affected by the high dose of neemazal (4000 ppm) 1 day after exposure (43.33% mortality). Whereas katelsous at dose of 1% gave a very low rate of mortality (1.66%), neemazal doses of 1000 to 125 ppm gave nearly similar rates of mortality (18.33-23.33%).

For all treatments, males were significantly more affected than females 1 day after exposure (F test).

At 2 days post-treatment, neemazal at doses ranging 4000-250 ppm, gave satisfactory mortalities (85-90%) compared to katelsous (25%) and the control (3.33%).

Four days after exposure, katelsous and neemazal at the high doses caused considerably high mortality (95%). For all treatments of neemazal and katelsous, 100% kill was obtained within 7 days exposure. The corrected percent kill (after excluding the natural mortalities) are shown in Table 2.

The above results indicate that mixing the wheat grains with the inert dust katelsous at rate 1% can be equally effective against *T.granarium* infestation as mixing them with the botanical insecticide neemazal at the doses of 4000-250 ppm. However, neemazal induced a more rapid toxic effect. Chaterjee (1954) and Verma *et al.* (1976) stated similar results.

Su (1985) and El-Lakwah *et al.* (1993b) referred to the toxic effect of neemazal powder on other grain insects.

II. Effect on reproduction: Data presented in Table 3 indicate that after one month of exposure to wheat grains treated with neemazal powder at a dose of 4000 ppm and katelsous dust at rate of 1%, *T.granarium* female adults produced significant low offspring (0.90 ± 0.711 and 0.96 ± 0.011), respectively. Most of larval mortalities occurred as 1st and 2nd instars compared to control females that produced an offspring of 12.20 ± 1.071 individuals (alive larvae, pupae and adults) after the same period. Such results indicate that wheat grains treated with the two tested materials produced less than 8% of the offspring produced by adults reared on untreated grains.

Lower concentrations of neemazal (1000-125 ppm) produced significantly lower offspring (1.60 ± 0.215 - 3.16 ± 0.641) than the control. The high dose of neemazal (4000 ppm) as well as katelsous at rate 1% reduced offspring by 92.62% and 92.08%

in F1 progeny, Table 4.

Lower concentrations of neemazal (1000-250 ppm) caused relatively high protection (81.14-86.89%) to wheat grains as compared with control, since non of the offspring produced from the mentioned treatments could develop. All died in early stages.

No offspring was produced from all tested treatments after two months of storage, whereas a mean of 61.63 insects were produced by each parent female in the control.

The effect of katelsous and other inert dusts on stored grain insects was investigated by Verma *et al.* (1976), and Mostafa & El-Moagel (1989). The effect of neemazal on F1 progeny of stored grain insect pests, was also mentioned by Macanjuola (1989), Mostafa & Al-Moagel (1989), and El-Lakwah *et al.* (1997).

III. Effect on percentage of germination: Table 5 shows that doses of 500-125 ppm of neemazal powder or katelsous dust 1% had no effect on the percentage of wheat-seed germination (95 to 97%), compared to 98% for the control. Higher doses of neemazal 1000 and 4000 ppm reduced seed germination to 92 and 88%, respectively. But, not reached the significant level.

Results achieved from the current experiments lead to the anticipation that mixing wheat grains with 1% katelsous dust or neemazal at a dose of 125 ppm proved high protective agents to the grains against *Trogoderma granarium* infestation, through both increasing mortalities and reduction of F1progeny by killing the early stages instars (1st and 2nd). Use of such materials at the mentioned doses may be encouraged, taking into consideration their qualities as an non-toxic materials.

ACKNOWLEDGEMENT

This work was carried out in the frame of the National Project of Integrated Pest Management for Postharvest pests, financed by EEC-Counterpart Funds. The valuable contribution of this project is gratefully acknowledged.

Table 1. Effect of neemazal powder and kateisous dust on the mortality of *T. granarium* Events adult beetles at $30 \pm 10^\circ\text{C}$ & $65 \pm 5\%$ R.H.

Material	Dose	Adult mortality (days after treatment)																			
		1			2			4			7			14							
		No. of males	No. of females	Total c.m.* %	No. of males	No. of females	Total c.m.* %	No. of males	No. of females	Total c.m.* %	No. of males	No. of females	Total c.m.* %	No. of males	No. of females	Total c.m.* %					
neemazal	4000 ppm	18	8	26	43.33	11	17	28	90	3	4	96.67	0	2	2	100	0	0	0		
	1000 ppm	10	1	11	18.33	20	20	40	85	6	6	95	0	3	3	100	0	0	0		
	500 ppm	11	2	13	21.67	19	20	39	86.67	6	6	96.67	0	2	2	100	0	0	0		
	250 ppm	8	6	14	23.33	19	20	39	88.33	2	4	95	1	2	3	100	0	0	0		
	125 ppm	8	3	11	18.33	16	11	27	63.33	5	13	18	93.33	1	3	4	100	0	0	0	
kateisous	1%	1	0	1	1.66	12	2	14	25	15	27	43	95	2	1	3	100	0	0	0	
control		1	0	1	1.66	1	0	1	3.33	8	4	12	23.33	16	16	32	76.67	4	10	14	100

L.S.D.1% for sex = 0.933

F=74.535

c.m. : Commulative mortality.

Table 2. Corrected per-cent kill of *T.granarium* adult beetles after different periods of exposure to neemazal and katelsous dust at $30\pm 1^{\circ}\text{C}$ and $65\pm 5\%$ R.H.

Material	Dose	Percentage corrected kill of adults after			
		1 day	2 days	4 days	7 days
neemazal	4000 ppm	42.37	89.65	95.65	100
	1000 ppm	16.95	84.48	93.48	100
	500 ppm	20.35	86.21	95.65	100
	250 ppm	22.04	87.93	93.47	100
	125 ppm	16.95	62.06	91.30	100
katelsous	1%	0.00	22.42	93.48	100

Table 3. Offspring of *T.granarium* adult females exposed to wheat grains treated with neemazal powder and katelsous dust at $30\pm 1^{\circ}\text{C}$ and $65\pm 5\%$ R.H.

Material	Dose	Months after treatment		
		One		Two
		Mean no. of F_1 / female \pm S.E.	% Progeny to control	Mean no. of F_1 / female \pm S.E.
neemazal	4000 ppm	0.90 \pm 0.711	7.38	0
	1000 ppm	1.60 \pm 0.215	13.11	0
	500 ppm	1.70 \pm 0.431	13.93	0
	250 ppm	2.66 \pm 0.427	18.86	0
	125 ppm	3.16 \pm 0.641	25.96	0
katelsous	1%	0.96 \pm 0.011	7.92	0
Control		12.20 \pm 1.071	-	61.63 \pm 0.431

L.S.D. for neemazal concentration = 2.676.

"F" = 48.533

L.S.D. at 5% for katelsous concentration and control = 5.225

"F" = 85.583

Table 4. Relative protection of wheat grains treated with neemazal powder and katelsous dust against *T.granarium* Everts adults.

Material	Dose	Relative protection %*	L.S.D. at 5% level	L.S.D at 1% level
neemazal	4000 ppm	92.62**	0.7831	0.9090
	1000 ppm	86.89**	0.9641	1.4027
	500 ppm	86.07**	1.0940	1.6116
	250 ppm	81.14**	1.7870	2.0912
	125 ppm	74.04**	2.0131	2.9899
katelsous	1%	92.08**	0.7016	0.8916

* Estimated on the base of reduction in F_1 progeny as % of control.

** Significant reduction in F_1 progeny.

Table 5. Percentages of seed germination of wheat grains treated with neemazal powder and katelsous dust.

Treatments	Percentage of seed germination
neemazal	
4000 ppm	88
1000 ppm	92
500 ppm	95
250 ppm	97
125 ppm	95
katelsous1%	96
Control	98

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الكفاءة البيولوجية لمسحوق النيمازال والقاتلسوس علي حشرة *Trogoderma granarium Everts* خنفساء الصعيد

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معهد بحوث وقاية النباتات - مركز البحوث الزراعية، الدقى ، الجيزه .

تم دراسة الكفاءة البيولوجية لمسحوق النيمازال (مادة مصنعة من نبات النيم تحتوي علي ١٠٪ أزاديراختين Azadirachtin) والقاتلسوس (مادة صخرية تؤثر علي الحشرات بخواصها الطبيعية، تحتوي علي ٨٤٪ صخر فوسفات، ١٦٪ كبريت) ضد الحشرات الكاملة لخنفساء الصعيد *Trogoderma granarium Everts* من عائلة خنافس الجلود Fam. Dermestidae ورتبة غمدية الأجنحة Ord. Coleoptera وهي إحدى حشرات الحبوب والمواد المخزونة صعبة المكافحة.

تمت معاملة حبوب قمح سليمة نظيفة خالية من أي إصابات سابقة سطحياً بمسحوق النيمازال بتركيزات ٤٠٠٠، ٢٠٠٠، ١٠٠٠، ٥٠٠، ٢٥٠، ١٢٥ جزء في المليون، وبمسحوق القاتلسوس بتركيز ١٪ وكانت النتائج كمايلي:

- كانت نسبة موت الحشرات الكاملة عند التركيز العالي جداً للنيمازال ٩٠٪ بعد يومين من التعريض، بينما وصلت هذه النسبة إلي ٢٥٪ في الحشرات المعرضة لمسحوق القاتلسوس مقارنة بنسبة الموت الطبيعي بعد نفس المدة (٣، ٢٢٪).

- بعد أربعة أيام من المعاملة تراوحت نسبة الموت في كل تركيزات النيمازال بين ٩٦، ٦٧ و ٩٢، ٢٢٪، بينما بلغت النسبة ٩٥٪ لمسحوق القاتلسوس و ٢٢، ٢٢٪ لحشرات المقارنة.

- كانت الحشرات الكاملة للذكور أكثر تأثراً من الإناث بكلا المسحوقين بعد يوم واحد من التعريض.

- بعد شهر من المعاملة أظهر مسحوق القاتلسوس كفاءة عالية في خفض خلفه الجيل الأول (F1) من الحشرات الأبناء التي تعرضت له (٩٢، ٠٨٪) وتمائل في ذلك مع التركيز العالي جداً من النيمازال (٤٠٠٠ جزء في المليون).

- بعد فترة تخزين مدتها شهرين لم توجد أي حشرات في جميع المعاملات المختبرة (أي أن حشرات الجيل الأول توقفت عن النمو وإعطاء خلفه جديدة) في حين كانت خلفه الجيل الأول في المقارنة ٦١، ٦٢ حشرة/أنثى.

- لم يكن لمسحوق القاتلسوس (١٪) ولا التركيزات المنخفضة من النيمازال (٥٠٠ إلي ١٢٥ جزء في المليون) تأثير سئ على نسب الإنبات التي تراوحت بين (٩٥ - ٩٧٪)، بينما أدت التركيزات العالية من النيمازال (٤٠٠٠، ١٠٠٠ جزء في المليون) الي خفض نسب الإنبات إلي ٨٨، ٩٢٪ علي التوالي.