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DETERMINATION OF TOXICITY OF DANITOL, METHOPRENE AND NEEM FORMULATION AGAINST STORED GRAIN PEST, *SITOPHILUS ORYZAE* L.

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ABSTRACT

Toxicity of a synthetic pymthmid (Danitol 10 EC.), methoprenc (J.H.A.) and nude neem extract formulation (RB-b +PBO +Tx) in synergestic form was determined in laboratory by contact method against adults of *Sitophilus oryzae.* Observations after 24 hours of treatment showed that 50% of the adults died at 0.39 µg/cm^2 of Danitol, 6.78 µg/cm^2 of neem formulation and 1856 µg/cm^2 of methopmne, the three products used in this experiment. Danitol was found more effective as compared to neem formulation and methoprene. It was found that the plant product formulation and a synthetic product are more effective than methopmne.

Introduction

Sitophilus oryzae is a major stored grain pest especially of rice in Pakistan and other tropical countries. It is preferable to use a pesticide for its control which is less toxic and it should not only kill the adults but also destroy their eggs. For this purpose entomologists have tried OP, OC, pyrethroids, growth regulators and plant products.

Plant products at higher concentration kill the insects and at lower concentration cause certain growth disturbance in various stages of the insect. Pertaining to J.H.A's very little work has been conducted on stored grain pests and other insects (Axtell *et al,* 1980; Retnakaran, 1980; Ahmed, 1983; Schwartz *et al,* 1985, Yasmeen *et al.,,* 1985; Rizvi *et al.,* 1986; Murtaza *et al,* 1990; Rizvi *et al.,* 1991).

In the recent years it has been demonstrated that various insect species are effected in their growth activity and metamorphosis by treatment with neem (Azadirachta indica AJuss) products (Sinha and Gulati, 1969; Saxena *et* at, 1974; Steel and Schmutterer, 1975; Roomi and Atiquiddin, 1977; Ketkar, 1987; Nagvi, 1987; Naqvi *et al,* 1989; Khan *et al,* 1991). The repellent effect of neem seed powder and neem oil in Tirbohum confffsum and Sitophilus *zeamais* was studied by Akou-Edi (1984). Naqvi *et al,* (1991) determined the toxicity, growth disturbance and enzyme (esterase) activity in *Callosobmchus analis.*

Danitol [Synthetic pyrethroid (fenpropathrene)] is being used since many years as a pesticide. Some workers have reported the toxic effect of pyrethroids on

several stored grain pests, and other insects (Bengeston, 1981; Robert *et al*, 1980; Brembong *et al*, 1983; Ishaaya *et al*, 1984; Gist and Charless, 1985; Punaki *et al.*, 1986; Harris and Turnbull, 1986). Danko], a standard pyrethroid and methoprene, a standard IGR were used for comparing the toxic and IGR properties of the new Deem formulation. This is an attempt to develop an indigenous pesticide.

Material and Methods

Rearing of sitophilus oryzae

Stock cultures of *Sitophitus oryzae* were reared in the insectary of Department of Zoology, University of Karachi, under controlled conditions. Insects were reared on rice, kept in jars and covered with (muslin) cloth by means of rubber bands. Bioassays were conducted under the same conditions and all experiments were carried with newly hatched adults of known age and male/ female as 1:1 ratio.

Preparation of test compounds

Danitol (10-E.C.) commercial grade was purchased from market and five different concentrations (0.003125%, 0.00625%, 0.0125%, 0.025% 0.05%) were prepared by diluting with distilled water for the determination of toxicity.

Different concentrations (0.03125%, 0.0625%, 0.125%, 0.25%, 0.5%) of methoprene, technical grade (100%), were prepared in acetone after preliminary experiments and were used for toxicity determination.

RB-b (Synergistic formulation) was made in 80% methanol with 0.01% of PBO (piperonyl butoxide) and 0.05% of Triton 100. Different concentrations were made by diluting the stock solution. RB-b was obtained by the courtesy of Dr. BS. Siddiqui of H.EJ. Research Institute of Chemistry, University of Karachi.

Method of treatment

Glass petridishes, 45cm in diameter, were used for the treatment of insects. Three sets with eighteen petridishes were taken. Each set was marked with concentration which was sprayed on them. After drying 20 adults of (female/male 1:1) Simphilus oryzae were released in each dish of the marked in set. After 24 hours number of alive and dead insects was counted. The value of it for experiments was 10 and the data was analyzed statistically.

Results

Toxicity determination

The LC_{50} of Danitol, neem formulation (RB-b + PBO + Tx) and methoprene was determined against rice weevil Sitophilus *oryzae.* Probit mortality graph (Fig. I) indicates $_{LC50}$ as 039 pg/cm^2 for Danitol, 628 µg/cm^2 for neem formulation and 18.85 µg/cm^2 for methoprene. Statistical analysis of the data is presented in Table 1-3.

Discussion

In the present work LC_{50} (24 hours) of Danitol, neem formulation and methoprene was found to be 0.39 µg/cm^2, 628pg/cm^2, and 18.85 µg/cm^2 respectively as shown in Fig. 1-3. Several workers have found the toxicity of Danitol pyrethroid alone and synergized with piperonyl butoxide for females of *Anopheles quadrimaculatus* and Psomphora colwnbiae. They reported that pyrethroids were effective and their toxicity was enhanced when used with piperonyl butoxide. In the present finding, efficacy of a synthetic pyrethroid, Danitol 10 EC. (fenpropathrion) was compared with neem formulation (in synergestic form) and methoprene. The compounds were applied by contact method and it was observed that Danitol 10 E.C. was more toxic than the neem formulation and methoprene.

According to Bremboog *et al* (1983), fenpropathrion along with other pyrethroids had a lower infection toxicity toward *Pseudalatia separate* larvae than the topical toxicity.

In the present studies topical application of pyrethroid caused highest toxicity as much as 78%. It means that the compound penetrates through the insect body which leads to death after 24 hours.

Bengeston (1981) suggested that pyrethroids are responsible for the control of *Sitophilus oryzae, Rhyzopertha dominica* and *Tribolium castaneum* by paper impregnation method. LC_{50} values were 0.19, 0.18 and 1.2% respectively. In the present finding the LC_{50} value of pyrethroid is 039µg/em^2 which is very low and may be due to the different active ingredients.

Steets and Schmutterer (1975) found that feeding of adult Mexican bean beetles for first 5 days on bean, sprayed with 50 ppm azadirachtin increased the mortality of the beetles. In the present investigation it was found that the mortality of *Sitophilus* increased with the increase in concentration. The highest mortality was

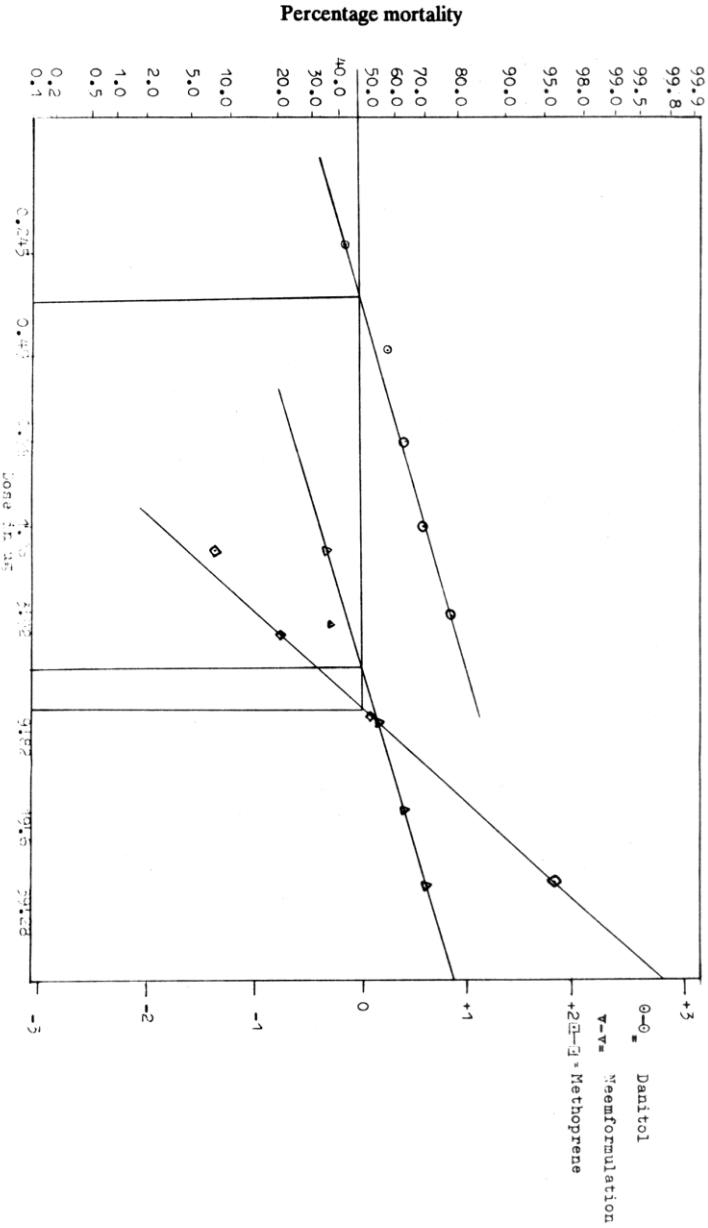

Figure 1. Determination of toxicity of danitol, methoprene and neem formulation against *Sitophilus oryzae*

Table 1

Statistical analysis of the toxicity of Danitol against *Sitophilus oryzae*

Concentration $\mu g/cm^2$	Mortality (Mean ± S.E.)
Ct	- -
0.245	44 ± 7.15
0.490	58 ± 8.32
0.982	64 ± 2.45
1.960	68 ±11.25
3.920	78 ± 3.74

Table 2

Statistical analysis of the toxicity of neem formulation against *S. oryzae*

Concentration $\mu g/cm^2$	Mortality (Mean ± S.E.)
Ct	2 ± 2.005
Ch	6 ± 4.010
2.45	36 ± 2.450
4.90	34 ± 3.580
9.82	54 ± 2.005
19.60	54 ± 3.580
39.28	72 ± 4.680

Table 3

Statistical analysis of the toxicity of methoprene, against *S. oryzae*

Concentration $\mu g/cm^2$	Mortality (Mean ± S.E.)
Ct	5 ± 2.880
Ch	10 ± 3.170
04.90	8 ± 2.005
09.82	20 ± 9.820
19.64	52 ± 2.005
39.28	62 ± 2.005
78.59	96 ± 2.005

72% at 3926 µg/cm^2 and lowest 36% at 6.28 µg/cm^2. The difference in lethal concentration (LC50) is because they used pure form of azadirachtin where as RB-b used in the present work is in synergistic form that contains azadirachtin along with other components of neem.

According to Ketkar (1986) among non-edible oils 25, 5.0, 73;10.0 m1/kg of neem oil on cowpea seed against *Callosobmchus mandarin* (F) proved to be the best surface protectant for cowpea seeds. It produced 89.7% mortality of the insects. In the present experiments also high percentage of mortality was obtained, for example 72% at 39.28 µg/cm.^{2}

Many workers reported the toxic effect of methoprene against different insect spp, for example, Axtell et al. (1980) reported that dimilin, methoprene and flit MIA, when applied in the field against *Aedes*, gave good results, i.e. 100% mortality by the application of 0.01/lb (llg/ha) of dimilin and 0.04/lb (45g /ha) of methoprene. In the present findⁱng 96% mortality of *Sitophilus oryzae* was obtained at 78.56 µg/cm^2 by the contact method after 24 hours' of treatment. Similar results were reported by Retnakaran (1980) and Yasmeen *et at* (1985). It means that the result obtained in our experiments is in accordance with the previous reports. Ahmad (1983) repoted that initial stages, i.e. 1st and 2nd Star of *D.* koenigii showed high mortality against methoprene. He found that the mortality was gradually reduced in later Stars, *i.e.* 3rd, 4th and 5th one. LD_{50} and LD_{90} were calculated as 10.0 and 21.0 mg/nymph. Rizvi *et al.* (1986) studied the lethal effect of methoprene against Oxyrhachis *tamnda* (Fabr.) and reported LD50 as 45 µg/adult.

Rizvi *et al* (1990) reported 1.4 mg/insect as LD_{50} of methoprene for fourth Star nymph of *D. koenigii* and Murtaza *et al* (1990) reported 6.8 µg/insect against adults of same genus and species. In the present work the LC_{50} of methoprene was 18.85 µg/cm.^{2} This difference in values as compared to those of previous workers may be due to different types of insects, method of application and also due to different levels of tolerance.

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