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LABORATORY FUMIGATION TESTS OF PHENYL ISOTHIOCYANATE AGAINST FOUR LABORATORY-REARED INSECTS

Saleem A. Qureshi, Shams Mohiuddin and B.A. Khan

PCSIR Laboratories, Karachi 39

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The knockdown effectiveness of phenyl isothiocyanate individually and in combination with propylene oxide, terpentine, 100-octane and CCl_4 was tested on *Musca domestica* (L). In order to obtain the same KD_{50}, in a range of 8–17 min, the required quantity of phenyl isothiocyanate was approximately 73, 38 and 31 times lower than propylene oxide, terpentine and 100-octane respectively.

The addition of the above-mentioned fumigants decreased the knockdown value of phenyl isothiocyanate.

The order of fumigation toxicity for *Tribolium confusum* (Duv) at lethal level is DDVP > phenyl isothiocyanate > *o*-xylene > methanol. *Tribolium confusum* (Duv) seemed to be more susceptible to the vapours of phenyl isothiocyanate than *Bruchus chinensis* (L). The mustard compound (phenyl isothiocyanate) proved to be extremely toxic to *Schistocerca gregaria* (Forskal) nymphs at 1 mg/l dose; producing complete kill after 5-hr exposure.

INTRODUCTION

Thiocyanates are known to have knockdown effect similar to that of pyrethrins or carbamates [1]. Some of them have been used alone or in combination against soil and crop nematodes [2,3] while certain aliphatic thiocyanates have been tested against various insects as fumigants [4–6]. The literature survey showed that the fumigation and knockdown effectiveness of aromatic isothiocyanates were comparatively less studied. The present paper reports a study of the knockdown activity of phenyl isothiocyanate against the laboratory-reared *Musca domestica* (L) and its vapour toxicity against *Tribolium confusum* (Duv), *Bruchus chinensis* (L) and *Schistocerca greagaria* nymphs.

The results have been compared with other fumigants. The data on the knockdown effectiveness of phenyl isothiocyanate alone and in combination with propylene oxide, terpentine, 100-octane and CCl_4 are also given.

MATERIAL AND METHODS

The laboratory stock cultures of the insects from which the test insects were obtained have been reared continuously for years in the insectory. Three-day-old houseflies (20/ batch) were exposed to the vapours of the fumigants at atmospheric pressure in 10-litre glass jars fitted with glass-stoppers to note their knockdown effectiveness at room temperature. The required quantity of the fumigants was delivered by the microsyringe on a piece of filter paper which was placed at the bottom of the fumigation jar. Time required for 50 and 90 KD was recorded at $30^{o}\pm3$ and 65% R.H. Late 4th instar nymphs of the desert locust, *Schistocerca gregaria* (Forskal) were exposed for 5 hr to note the knockdown activity of phenyl isothiocyanate. They were transferred to clean jars and fed, and mortality counts were made in 24 hr.

Twenty-five adult *Tribolium confusum* (Duv) and *Bruchus chinensis* were exposed to the various concentrations of phenyl isothiocyanate (0.11 to 5.67 mg/l), propylene oxide (8.29 to 24.87 mg/l), *o*-xylene (8.78 to 21.95 mg/l) for 24 hr in cylindrical test cages, 2 in long x 1 in dia, covered at both ends with 60 mesh screen lids and the toxicity induced was compared with DDVP (93% FC) at the rate of (0.01 mg/l a.i.) and methanol (39.64–79.28 mg/l). The insects were removed from the food and placed in test cages 2 hr before fumigation so that they could recover from the effects of handling before treatment. The test cages containing the insects were suspended in the centre of each jar and postfumigation mortality was assessed 2 hr after the completion of the treatment. Insects that showed any movement when touched or when placed under the light of a 60 W bulb were recorded as survivors. Each treatment was repeated at least 3 times and the means for insect mortality were calculated. The mortality was corrected by Abbott's formula [7].

No attempt was made to determine the length of time taken for the vapour evolution from the fumigants, nor to measure their actual concentration in (mg/l) inside the jars.

Table 5. Comparative study of knockdown effectiveness (KD_{50} and KD_{90} in min) of phenyl isothiocyanate individually and in combination with other fumigants against *Musca domestica* (L).

Composition	Dose applied (mg a.i./l)	Alone (min)		in mixture (min)	
		KD_{50}	KD_{90}	KD_{50}	KD_{90}
Phenyl isothiocyanate	0.567	18	22	–	–
100-octane	35.16	15	20	–	–
Phenyl isothiocyanate + 100-octane (1:3)	1.055	–	–	26	36
Terpentine	43.05	17	25	–	–
Phenyl isothiocyanate +	0.567				
Terpentine (1:3)	1.292	–	–	23	26
Propylene oxide	82.9	15	20	–	–
Phenyl isothiocyanate +	0.567				
Propylene oxide (1:1)	0.414	–	–	24	27
CCl_4	39.725	33	48	–	–
Phenyl isothiocyanate +	0.567				
CCl_4 (1:1)	0.794	–	–	25	30

Data include readings where the time for KD_{50} and KD_{90} ranged from 15–48 min.

mortality after 24 hr is many times that of phenyl isothiocyanate which was kept constant. As the rate of volatilization of phenyl isothiocyanate and the solvents used is different; it was not possible to calculate the actual quantity of individual fumigant in vapour form within 15–48 min. It was also not possible to furnish sufficient information regarding the antagonistic effect of the mixtures because of different rate of action of phenyl isothiocyanate and other solvents mixed with it. According to Bond [13] the toxicity of mixture of some fumigants may be additive and complement the effectiveness of each other, the action of others may be antagonistic to reduce the overall toxicity. According to him hydrogen cyanide, a respiratory depressant, can reduce the toxicity of methyl bromide to *Sitophilus granarius* (L).

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