

Toxicity of the Pyrethroid Insecticides Cypermethrin and WL85871 to the Earthworm, *Eisenia foetida* Savigny

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A considerable research effort has been dedicated to investigating the effects of pesticides on earthworms, both in laboratory tests (eg Cathay, 1982; Karnak and Hamelink, 1982; Lebrun *et al.*, 1981) and under field conditions (Black and Neely, 1975; Cook and Swait, 1975; de Medts, 1981; Lofs-Holmin, 1982). The aim of the present study was to assess the laboratory toxicity of the pyrethroid insecticides cypermethrin (RIPCORD¹: (RS)- α -cyano-3-phenoxybenzyl (1RS)-*cis,trans*-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane-carboxylate and WL85871 (FASTAC¹: a mixture of the (1R *cis*)S and (1S *cis*)R isomers of cypermethrin) to the earthworm, *Eisenia foetida*.

The experimental procedure used here has been accepted for inclusion in the OECD and EEC guidelines for testing chemicals (Anon, 1982; Edwards, 1983). The method involves maintaining worms for fourteen days in a soil-like medium with which concentrations of the test compounds have been mixed. In order to standardize the results, water, organic solvent and positive control (chloracetamide) treatments were included in the test. Chloracetamide has been proposed as a suitable reference substance for such studies in both the OECD and EEC protocols.

MATERIALS AND METHODS

The worms used in this study were two-to-three months old, sexually mature *Eisenia foetida*, each weighing between 300-600 mg. Before being used in the experiments they were acclimated for several days at $20 \pm 1^\circ\text{C}$ in a medium of sand, clay, peat and horse manure.

The test medium was prepared by thoroughly mixing industrial sand, kaolinite clay (English China Clay GTY powder) and sphagnum peat ('Shamrock' Irish moss peat) in the weight ratio 7:2:1. The pH was adjusted to 6.5 by adding calcium carbonate and 680 g quantities of soil were placed in shallow plastic bowls.

Cypermethrin and WL85871 were tested as technical grade materials dissolved in acetone. Deionized water was used as the solvent

¹ RIPCORD and FASTAC are Shell registered trade names

for chloracetamide. For the insecticides and the acetone control, 5 ml of test solution was sprayed onto the soil using a Brinkman TLC hand-held sprayer (Camlab Ltd., Cambridge, U.K.). The solution was mixed with the soil to ensure a uniform distribution of chemical throughout the medium. After evaporation of the solvent, deionized water was mixed into the medium giving a weight of 750 g of soil with a moisture content of 20% (dry-weight basis). For the chloracetamide, 5 ml of test solution was added to 65 ml of deionized water which was then mixed with the soil. Preparation of the water controls involved mixing 70 ml of deionized water with the soil. In both cases, these procedures gave 750 g of soil with 20% moisture content. All the batches of soil were then transferred to 150 mm diameter x 75 mm high glass crystallizing dishes.

The doses of chemical used in this test were expressed in terms of mg of compound per kg (dry weight) of soil. All three chemicals were tested at 0.1, 1.0, 10 and 100 mg kg⁻¹. Four replicates were prepared for each concentration of the three chemicals and for the water and acetone controls. Ten healthy worms were placed on the soil surface of each dish. The dishes were then covered with perforated plastic film and left in continuous light at 20 ± 1°C. After seven days the moisture content of the dishes was re-adjusted to 20% and any dead worms were discarded. After a further seven days, the number of live worms in each dish was recorded.

RESULTS AND DISCUSSION

Table 1 - Mortality of worms in artificial soil test

Treatment	Dose (mg kg ⁻¹)	Mean weight of worms (mg)	Mortality (%)
Cypermethrin	0.1	330	5.0
	1.0	330	7.5
	10	340	5.0
	100	330	5.0
WL85871	0.1	360	2.5
	1.0	360	5.0
	10	340	2.5
	100	350	5.0
Chloracetamide	0.1	340	0
	1.0	350	0
	10	350	0
	100	360	100
Acetone control	-	350	0
Water control	-	350	2.5

Note: Forty worms were tested at each dose

The results summarized in Table 1 show that neither cypermethrin nor WL85871 caused significant mortality at concentrations up to 100 mg kg⁻¹. Chloracetamide had a fourteen day LC₅₀ value of about 30 mg kg⁻¹ (by graphical interpolation). The same value was recorded for this chemical in another series of earthworm toxicity tests (Inglesfield, unpublished data).

Both cypermethrin and WL85871 proved to be non-toxic to the worms in these tests. This lack of toxicity can probably be partly ascribed to the fact that for many compounds, including pyrethroids, adsorption onto the organic matter portion of the soil particles renders part of the dose unavailable to the worms. The maximum dose used - 100 mg kg⁻¹ with no toxic response - corresponds to a concentration of about 750 g ai ha⁻¹ in the top 1 mm of soil following direct overspraying. Since this value is many times greater than the maximum recommended dose for either compound, it is concluded that neither cypermethrin nor WL85871 would have adverse effects on natural populations of earthworms when used under normal commercial conditions.

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