ECOTOXICOLOGICAL ASSESSMENT OF SOME SELECTED WEEDICIDE FORMULATIONS ON *Eisenia Andrei* UNDER TROPICAL CONDITIONS

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INTRODUCTION

Intensified agriculture, to meet demands for high crop production, has led to a long-term accumulation of agrochemicals in soil. The continuous dependence on these agrochemicals has brought great concern of potential hazards on soil fauna and soil functions. Continuous application, poor management practices and direct application to the soil surface may lead to the retention of weedicides in the soil ecosystem that can cause harmful effects on soil organisms. For a proper assessment of pesticide risks to soil ecosystems, data on their toxicity to soil organisms is needed (De Silva, 2009). Earthworms are considered to be good model organisms to evaluate soil contamination due to their role in decomposition, nutrient cycling and soil structuring processes. Earthworms have shown to be susceptible to pesticides. Over the last 10 years, some data on the toxicity of pesticides to earthworms has been obtained and it has been shown that results of laboratory toxicity tests may provide a reasonable prediction of field effects. Satunil60 (Thiobencarb+Propanil) and Supereon (Propanil) are among the commonly used weedicides that is used in Sri Lanka. No studies have been performed with soil organisms using these chemicals and the toxicity of these chemicals on beneficial soil organisms such as earthworms is unknown. Therefore, we study the toxicity of these weedicides under tropical conditions as an initial risk assessment.

METHODOLOGY

Satunil60 (Thiobencarb+Propanil) and Supereon (Propanil) samples were obtained from the local market. Adult earthworms (*Eisenia andrei*, 450-600 mg) from synchronized cultures in the laboratory were selected and acclimatized in natural soil collected from the upper most soil layer at a site near Dickwella in Matara, and sieved in the laboratory to be used as a homogeneous substrate. This soil had a pH of approx. 6.5, 3.7% organic matter and 5.6% clay. In addition, OECD artificial soil was used (OECD, 1984) as a test substrate. Toxicity tests were performed according to the ISO guideline 11268-2 (1998) and OECD (1984). In the tests, earthworms were exposed to a series of nominal concentrations (1, 3, 10, 30, 100, 300 and 900 mg a.i /kg dry soil) of the test chemicals, homogeneously mixed in with the test soil. The control soil was moistened only with chlorine-free water. Mortality after 28 days and behavioral effects were observed as the end points. Soil was returned into the test containers for another 4 weeks to allow cocoons to hatch. At the end of the 8-week test period, the number of juveniles produced was determined. The LC 50 and 95% confidence limits were calculated by the Trimmed Spearman Kärber method (Hamilton et al, 1977). The model for a logistic response was used for the calculation of EC_{50} and 95% confidence limits. The Lowest Observed Effect Concentrations (LOEC) and the No Observed Effect Concentrations (NOEC) was determined using ANOVA and Dunnett's test by SPSS version 16.0.

RESULTS AND DISCUSSION

Acute toxicity of the two formulations is given in Table 1. The highest toxicity was recorded with Satunil60, which was a combination of the active ingredients of Thiobencarb and Propanil, than with Supereon, which contains only Propanil. Hypersensitivity, secretion of mucus and a loss of mobility of earthworms were observed even in lower concentrations. No observed recovery of behavioral effects suggests that any recovery after the exposure was not

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possible. The toxicity of both formulations in the natural soil was higher than in te OECD artificial soil. Natural soil contained lower organic matter content compared with OECD soil. Generally, organic matter tends to retain contaminants resulting in lower bioavailability, and is therefore one of the main reasons behind lower toxicity of these formulations in OECD soil.

The EC50 values for earthworm reproduction are also given in Table 1. The lowest EC50 value for reproduction compared with the controls was recorded with Supereon in natural soil, which indicates that the used formulation was highly toxic to earthworms. This is followed by recording in natural soil, Satunil60 in OECD soil and Supereon in OECD soil, respectively. It was also noted that chronic toxicity of these two formulations was higher in natural soil than OECD soil. This could be linked with the presence of higher organic matter that resulted in lower bio-availability. In general terms, all recorded LC50 values and EC50 values were less than 50 mg a.i/kg dry soil except two occasions in OECD soil, which indicated high toxicity of these two formulations on tested earthworm species.

CONCLUSIONS / RECOMMENDATIONS

Satunil60 (Thiobencarb + Propanil) can be considered as the most toxic and Propanil has recorded the least toxic of the two tested weedicides. Nevertheless, the low LC_{50} values of both weedicide formulations indicate high toxicity on earthworms. It also revealed that the toxicity of these formulations in natural soil is always higher than in OECD soil, and hence their application under realistic field conditions should be done with caution. Further, studies with pure compounds and field studies with the above formulations will also be beneficial in further risk assessment of weedicides.

Table 1: Toxicity of formulated products of Satunil60 and Supereon to the earthworm *Eisenia andrei* in natural soil and OECD soil. The LC_{50} values (28 days) for the effects on survival and EC_{50} values for the effects on reproduction are given with corresponding 95% CI (in parenthesis). All values are expressed in mg a.i kg^{-1}dry soil

Formulation	Soil type	LC50	EC50 (Reproduction)
Satunil60 (Thiobencarb+Propanil)	Natural Soil	17.32 (nd)	12.3 (8.37-16.22)
	OECD Soil	51.71 (47.76-55.98)	16.92 (9.48-24.35)
Supereon (Propanil)	Natural Soil	44.78 (38.99-51.42)	3.06 (2.38-3.74)
	OECD Soil	191.84 (173.52-210.52)	121.45 (40.15-202.80

REFERENCES

De Silva, P. M. C. S**.** (2009). Pesticide effects on earthworms: A tropical perspective. Ipskamp drukkers. Netherlands.

Hamilton M. A., Russo R. C., and Thurston R. V. (1997). Trimmed Spearman -Karber method for estimating median lethal concentrations in toxicity bioassays. *Environment Science and Technology 11(7)*. 714-719.

International Standardization Organization. (1993). Soil quality - effects of pollutants on earthworms (*Eisenia fetida*), Part 1: Determination of acute toxicity using artificial soil substrate. *ISO 11268-1*. International Standardization Organization, Geneva.

Organization for Economic Co-Operation and Development. (1984). *Guideline for testing of chemicals No 207, Earthworm Acute Toxicity Test*. Paris.

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