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PESTICIDE EFFECTS ON TROPICAL EARTHWORMS: CURRENT STATUS, TRENDS AND FUTURE

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Expansion of agriculture in tropical regions is heavily relying on the use of pesticides. Pesticides, however, are generally also toxic to non-target soil organisms and as a consequence may hamper proper functioning of the soil. Sustainability of tropical agriculture, therefore, requires information on the effects of pesticides on beneficial soil organisms like earthworms, which play an important role in the soil ecosystem. Nevertheless, pesticide toxicity under tropical conditions is only rarely assessed and understanding the effects in such conditions remains a priority. In addition, tropical risk assessments often rely on data generated under temperate conditions. This approach is rather questionable mainly due to different climatic conditions. Therefore, it is essential to understand pesticide toxicity and the consequent ecological effects under tropical conditions.

Temperature and soil type may act as critical factors that modify pesticide toxicity. The higher activity of earthworms at higher temperatures may trigger a higher uptake of pesticides causing larger effects on survival under representative tropical conditions. However, sub-lethal endpoints, such as growth and reproduction, do not show clear differences between the tested temperatures and varied with different soil types indicating that the nature of the pesticide and soil type were more important than temperature. Temperature may also influence the stability of the pesticides and its degradation kinetics, resulting in a lower toxicity at higher temperatures. Therefore, temperate data should only be used with caution in tropical risk assessment and pesticide regulation. Tropical risk assessment and tests using earthworms currently uses data generated with the temperate compost worms *Eisena fetida* and *Eisena andrei*. These species are less ecologically relevant as they are rarely found in natural soils. One good alternative is to use indigenous species specific to tropical regions. Recent results indicate that the local species *Perionyx excavatus is* more sensitive than the standard species *Eisenia andrei*. However, it should be noted that differences in sub-lethal effects in sensitivity were relatively small. In addition studies show that *Perionyx excavatus* may be used as a good alternative test species under tropical conditions in future studies, applying the available standard test guidelines for *Eisenia* sp. The effects of both pure compounds and formulated products on tropical earthworms and the estimation of possible added toxicity of formulated products have often been neglected in toxicity studies. Very few studies indicate that the toxicity of formulated products was higher than that of the pure compounds. In general, it can be also suggested that the toxicity of formulated products may be masked by interactions with the soil resulting in more or less similar toxicities of formulations and the pure compounds. Lack of cost-effective tests with short duration often hampers the risk assessment of pesticides under tropical conditions. Recently the earthworm avoidance test has been considered a good alternative in toxicity studies. Simple experimental design and short duration of the test makes it ideal for an initial screening test in pesticide regulation in tropical countries like Sri Lanka. Comparison with literature data showed that endpoints generated through earthworm avoidance tests are generally less sensitive than reproduction but more sensitive than survival and, therefore, could be used in the initial risk assessment to facilitate pesticide regulation in tropical regions.

The standard test guidelines for earthworm toxicity testing often use the OECD artificial soil, which is composed of sand, kaolin clay and sphagnum peat. Development of a tropical artificial soil is a timely need due to increasing costs, non-availability and environment concerns associated with sphagnum peat. The suitability of locally available, environmentally friendly substrates such as coco peat (composted and non-composted), saw dust and paddy husk has been investigated and modified artificial soil has been invented by

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substituting sphagnum peat in the standard artificial soil. It is learnt that composted coco peat is a good alternative for sphagnum peat and being used in tropical ecotoxicology. The extrapolation of laboratory studies to real time filed situations still remains a challenge. As an example effects of pesticides on structural properties (species diversity, abundance, biomass) and functions (organic matter breakdown, nutrient cycling) of soil ecosystems have rarely been studied in the field under tropical conditions, hence future experiments based on litter bag test and earthworm field test that have been introduced and standardized by the OECD should be encouraged under tropical conditions. In addition, it should be noted that incorporation of generated scientific information into policy decisions still remains very poor, and effective mechanism is urgently needed.