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Research Article

BIOLOGICAL RESPONSE OF EARTHWORM *LAMPITO MAURITII* TO MONOCROTOPHOS (ORGANOPHOSPHORUS) INSECTICIDE KEPT IN DIFFERENT SUBSTRATES

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ABSTRACT

The present study has investigated the toxic effect of monocrotophos on the Earthworm *L. mauritii* kept in different substrates by laboratory experiments. The LC_{50} value and their lower and upper confidence limits for four different substrates such as dry soil (control), cow dung, saw dust, dry coir waste and tea waste mixed with monocrotophos have been worked out in the earthworm, *Lampito mauritii*. It is important to note that the worms exposed to monocrotophos mixed with different substrates experience the behavioral changes noted as initial symptoms. The mortality differences observed between I hr – LC_{50} and 144 hr – LC_{50} and in the toxicity values of monocrotophos mixed with substrates may be due to difference observed in the feeding activity of the animal in the respective substrate at different periods. The results suggest the substrate tea waste, saw dust and coir waste can be used as good manure to any crop which requires more monocrotophos to *Lampito mauritii*.

Keywords: *Lampito mauritii*, Monocrotophos, Toxicity, Different substrates, Biological response.

INTRODUCTION

Earthworms are common soil organisms in most environments and play an important role is improving structure and fertility of soil ecosystem (Bartlett *et al.*, 2010). They modify soil organic matter both chemically and physically, mix leaf little with the soil, facilitate the formation and stabilization of soil aggregates and improve soil porosity (Lavelle and Spain, 2001). It has been indicated that earthworms may represent up to 60-80% of the total animal biomass in soil (Ouellet *et al.*, 2008; Jouquet *et al.*, 2010) unlike many other soil organisms that are protected by thick cuticle on the exterior of their bodies, earthworms are particularly susceptible to soil chemicals (Lanno *et al.*, 2004; Nahmani *et al.*, 2007). The bioaccumulation of insecticides in earthworms may not lead to significant effects to the animal itself, but may produce series damages to high tropic levels (Darling and Thomas, 2005; Hobbelen *et al.*, 2006; Van Gestel *et al.*, 2011). Therefore, earthworms are suitable bio indicators of soil contamination and can be used to provide safety thresholds for insecticide application (Suthar *et al.*, 2008, Lourenco *et al.*, 2011). They are used as bio indicator of soil quality and they serve as model organisms in toxicity testing. Earthworms are characterized by high ability to cumulate a lot of pollutants from soil. It is important to understand the harmful effects that pesticides have on organisms, especially when changing environmental conditions occur. Earthworms have been studied as a readily available, easily maintainable and cheap test species for assessing chemical pollution. The present study is aimed at to know the impact of different artificial substrates such as coir pith, tea waste, saw dust, and farm yard manure (used as good medium for vermiculture) on the toxicity of monocrotophos to the earthworm, *Lampito mauritii*.

MATERIALS AND METHODS

Collection and Maintenance of Earthworms

L. mauritii were collected from agricultural farm field in Kidarankondan, Thiruvarur, Tamil Nadu, India. They were maintained in the laboratory conditions kept in large trays with a substrate medium, 50% farmyard manure and 50% soil (vol/vol) for two weeks at 28 ± 20 C with 50 – 60% moisture. Adolescent worms of 10 to 12 cm in length and 2 to 3 mm in width, with pink undifferentiated clitella were used for the present study. The experimental setups were made for this project for *L. mauritii*. The media units, plastic trays (30 x 30 x 30 x 30 x 30 cm) were filled with

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pre-processed cow dung, saw dust coir pith, tea dust are mixed with soil as in the ratio 1:1 (v/v) and soil as a control keeping the setup in moisture conditions whenever needed add water. The each substrate was added to 1 ml of monochrotophos in all trays, ten exotic indigenous earthworms *L. mauritii* were added to the respected medium. The experiments by regular noted, and assess the effect of herbicides on *L. mauritii*.

Chemical

Monocrotophos insecticide commercially available, in the trade name of Monostar monocrotophos supplied by Pesticides India Ltd, Mumbai, was used for the present study. It was purchased from local pesticide agency.

Acute toxicity test

For assessing acute toxicity, the preparation of selected test medium of each substrate 1 kg of dry substrate was taken. The test doses are expressed as ml active in gradient monocrotophos /kg dry substrates weight. For assessing the toxicity of each of the selected doses (based on exploratory test) of monocrotophos mixed with different substrates. The mortality rate of earthworm was observed after 1, 3, 6, 12, 24, 36, 48, 72, 96, 120 and 144 hours of exposure. The LC_{50} value was calculated by Probit analysis method (Finney, 1971) and the number of survivors was also noted at each exposure period. Earthworms were considered dead if they did not respond to a gentle mechanical stimulus.

RESULTS

The acute toxicity values and their lower and upper confidence limits of the earthworm, *L. mauritii* exposed to five different substrates mixed with monocrotophos (1 ml/kg substrates) have been worked out for different time intervals. The toxic range between 1 hr-LC_{50} and 144 hrs – $LC_{50}$was 8.81 – 0.40, 10.29 – 2.60, 7.46 – 1.75, 7.23 – 1.00 and 10.81 – 1.50 ml (Figure 1-4) active ingredient of monocrotophos kg/dry substrate weight for the earthworm exposed to the substrates 1,2,3,4 and 5 respectively. While the constructing acute toxicity curves for the earthworm LC_{50} and different time periods, asymptote was reached in all case during 144 hours. Similar trend is also reported in other organophosphates pesticide by a number of previous workers (Bakthavatchalam and Rajaraman, 2003, Bharathi and Subha Rao, 1984) reported 96-h LC_{50} of carbofuron, phosphamidon, monocrotophos and dichlorvos on *L. mauritii* in artificial soil. (Parnaik and Dash, 1990) exposed earthworms to different concentrations of pesticide monocrotophos.

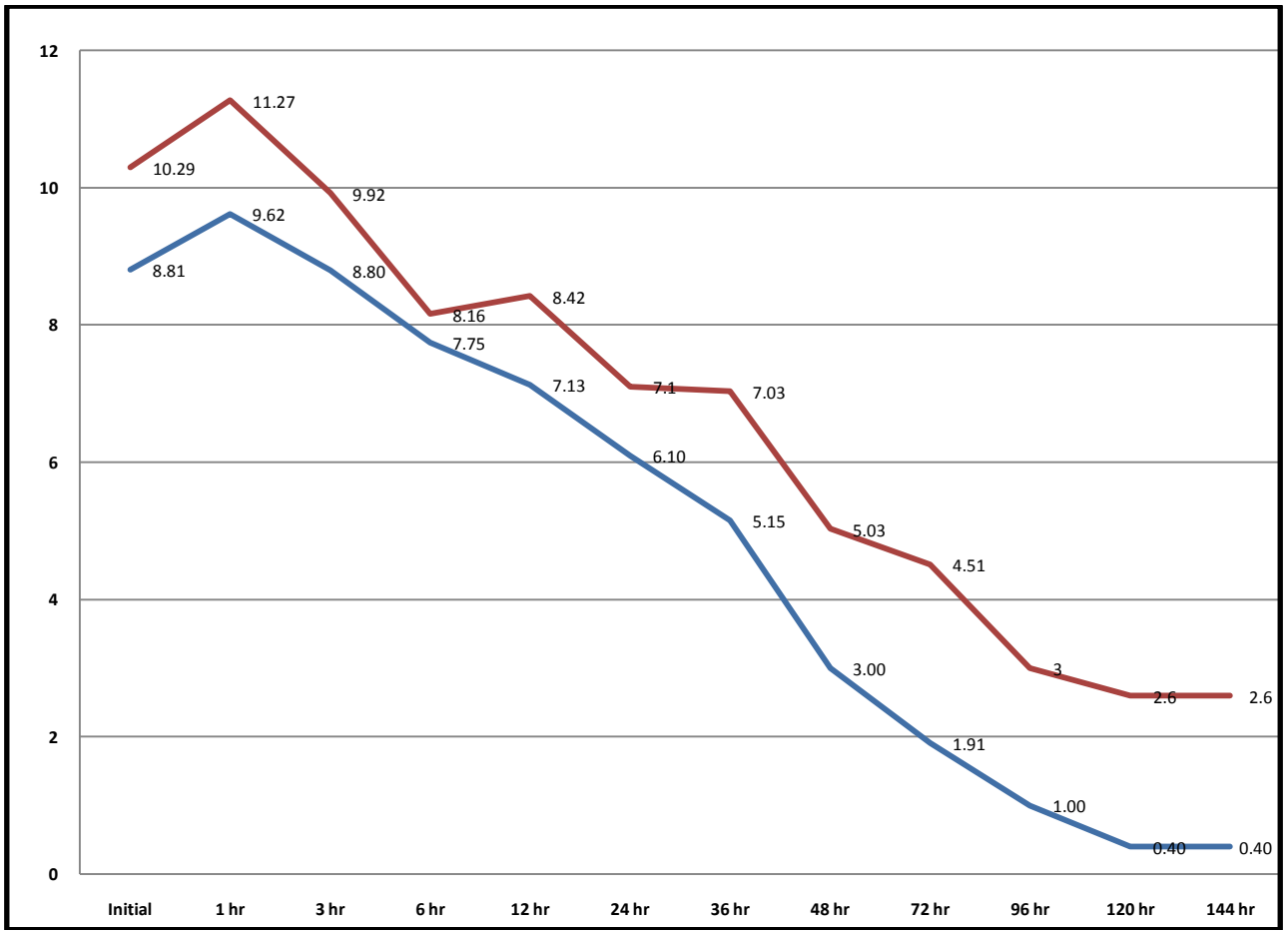

Figure 1. Comparative toxic impact of monocrotophos (ml/kg) concentration on *Lampito mauritii* in control and cow dung.

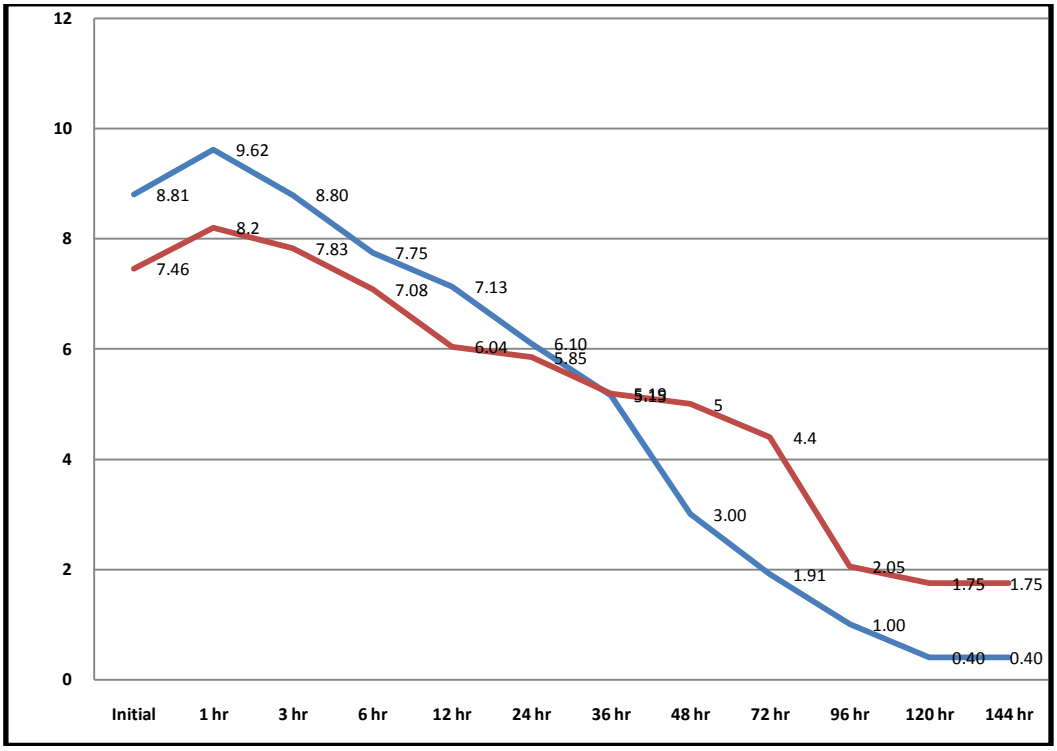

Figure 2. Comparative toxic impact of monocrotophos (ml/kg) concentration on *Lampito mauritii* in control and coir pith.

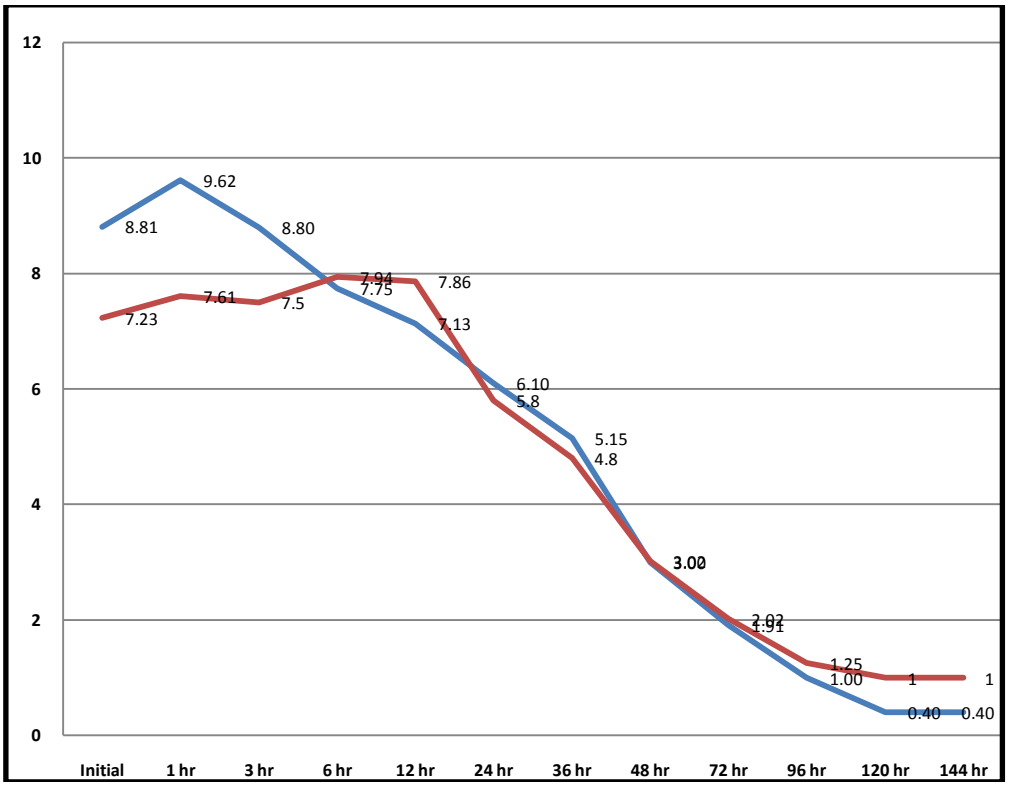

Figure 3. Comparative toxic impact of monocrotophos (ml/kg) concentration on *Lampito mauritii* in control and saw dust.

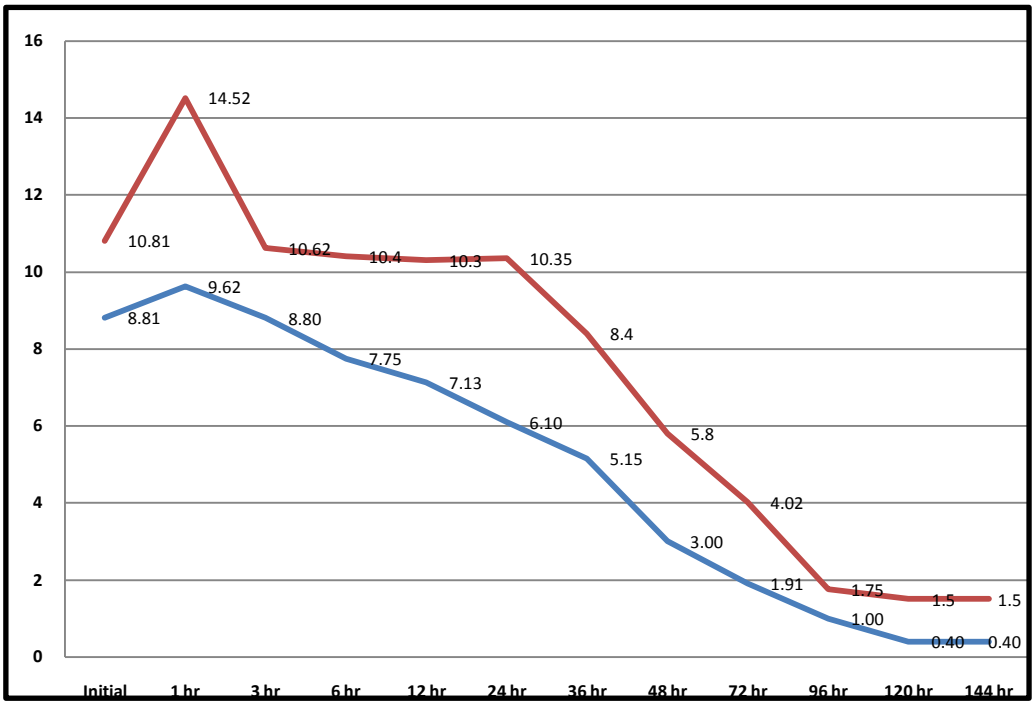

Figure 4. Comparative toxic impact of monocrotophos (ml/kg) concentration on *Lampito mauritii* in control and tea waste.

DISCUSSION

Acute toxicity of earthworm is an efficient tool in assessing ecological risks of contaminated soils (Lukkari *et al.*, 2005; Hemibach, 1985) and the end point is mortality (Karnak and Hamelink, 1982; Dean-Ross, 1983; Ellis *et al.*, 2007). In this present experiment, Monochrotophose showed no mortality at the recommended agricultural dose The toxic range between 1 hr – LC_{50} and 120 6 hr – LC_{50} for the earthworm kept in substrate 1 (control) was found to be 9.62 – 0.40 ml active ingredient of monocrotophos /kg dry substrate weight. The worms kept in substrate 2, (Cow Dung), the same toxic range was found to be 11.27 – 2.60 ml active ingredient of monocrotophos /kg dry substrate weight. In the case of substrates 3 (Coir Pith) the similar toxic ranges was found to be 8.20 – 1.75 ml active ingredient of monocrotophos / kg dry substrate weight. The worms kept in substrate 4 (Saw Dust) and 5 (Tea Dust Waste) the respective toxic range was found to be 7.61 – 1.00 and 14.52 – 1.50 ml active ingredient of monocrotophos/kg dry substrate weight. In all the cases, asymptote was reached in the acute toxicity curve during 144 hours at the concentrations 0.40, 2.60, 1.75, 1.00 and 1.50 ml active ingredient of monocrotophos/kg dry substrate weight due to the attainment of equilibrium in the insecticide medium.

It is important note that the worms exposed to monocrotophos mixed with different substrates experience the following as initial symptoms: swelling in the segments of clitellum and posterior region, oozing out of the mucous substances from the body surface, deep constriction at certain parts of the body, rolling of body surface, colour change and fragmentations of body segments due to autotomy. Marginal weight gain at 1 hr revealed was by swelling of body surface. But in subsequent hours of exposure the worms showed remarkable reduction in their body weights as revealed by oozing of mucous substances from the body surface.

CONCLUSION

From the results, it is inferred that even the concentration now used as non-lethal, would cause drastic change in the body weight as revealed by low uptake of substrate and hence the concentration cannot be considered as safe for the worm. Out of four substrates (except control) used, the substrates 5, 3 and 2 abile to reduce the toxicity of monocrotophos to *L. mauritii* better than once viz.

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