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Research Article

Toxicity assessment of Aluminium on vermicomposting ability of Eudrilus eugeniae (Kinberg) on leaf litter

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Abstract

Vermicomposting technology is one of the best options available for the treatment of organics-rich solid wastes. In which earth worm converts biodegradable garbage into high quality manure and plays a key role in soil biology and they serve as versatile natural bioreactors to harness energy and destroy soil pathogens. The worms feed voraciously on all biodegradable wastes. There is an instance of chemical toxicity among non target organisms like earthworms etc, in agricultural lands due to pollution of chemical companies and factories. In the present investigation vermicomposting ability of earthworms *Eudrilus eugeniae* were measured experimentally by exposing in moist leaf litter with Aluminium. The morphological changes observed during the exposure of animals were observed in laboratory conditions and appears to impair the different stages of reproductive cycle of the worms thereby resulting in the onset of reduced vermicomposting ability of the earthworm.

Key words: *Eudrilus eugeniae*, vermicomposting, toxicity, aluminium, exposure.

Introduction

Vermicomposting is the best biotechnology to reduce the load on the treatment and disposal of biodegradable agro waste. Earthworms have ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are essential for maintaining soil productivity [1]. Vermicompost is the microbial composting of organic wastes through earthworm activity to form organic fertilizer which contains higher level of organic matter, organic carbon, total and available N, P, K and micronutrients. It also promotes microbial and enzyme activities, in the soil [2].

The vermicompost contains humified organic matter characterized by high molecular weight and an enzymatically active humic faction which stimulates plant germination and growth [3][4]. Use of earth worms for biodegradation of organic wastes curbs the organic pollution caused by solid waste from agricultural lands, animal husbandry and agro based industries. The microbial activity and residual levels of nutrients have been found to be enhanced upon using vermicompost as manure to the fields [5].

Earthworms, on the other hand, have been used as biomarkers for assessing environmental pollution [6]. There is an increasing concern about soil contamination due to the wide spread use of agro pesticides [7]. Among them, organo phosphoric compounds have been indicated to cause reproductive damage. Commercial parathion, a highly toxic organophosphate, is used in Latin America, and its application endangers the environment and the public health [8] [9].

There are numerous instance of metal toxicity in agricultural. Toxic amounts of Cu, Zn, or Ni have accumulated in soils from fungicides, unneeded fertilizers, and sewage sludge, or have occurred naturally. Most toxicity has occurred under intensive agricultural practices, in orchards, vineyards, and vegetable fields and can be quite expensive to alleviate [10].

Materials and methods

Selection and collection of test animals

A bulk sample of exotic, epigeic earthworm, *Eudrilus eugeniae* was obtained from M/S. Kamali farms, Kanuvai, Coimbatore, brought to the laboratory and maintained in glass tanks in vermicompost mixture supplied by the farm. The worms were acclimatized to the laboratory condition for 10 days.

Preparation of pre-digested leaflitter-cowdung mixture

Leaf litter was periodically collected at different points in Coimbatore Racecourse and brought to laboratory. The leaves were sun dried and chopped into 4 to 5cm pieces. Organic mixture of leaf litter and dried cow dung was prepared at the ratio of 1:1 w/w sprinkled with minimum quantity of pollutant-free tap water and kept in large PVC tanks for days 21predigestion [11]. For better pre decomposition regular mixing and turning of the leaflitter-cowdung mixture were followed. After 21 days of pre digestion, required quantity of the predigestion, required quantity of the pre-digested organic mixture was used for mixing with the toxicant for further investigation.

Selection of aluminium concentrations

For exposure of earthworms to different concentrations of aluminium (Al), aluminium sulphate [Al_2 (So_4)$_3$ .6H_2o] was used. The selection and the range of Al concentrations were based on the direction given in Dir 88/303/EEC (OIL 133, 1988). The Al concentrations selected for the study were 500ppm, 1000ppm, 1500ppm, 2000ppm, 2500ppm and 3000ppm, respectively under T_1, T_2, T_3, T_4, T_5 and T_6 test conditions.

Exposure of worms to Al concentrations

Corresponding amounts of [Al_2 (So_4)$_3$ .6H_2o] for each test Al concentration was weighed, dissolved in 100ml of toxicant free-tap water (uniformly for all test concentrations) and sprinkled with 2kg of pre-digested leaf litter- cow dung organic mixture. Aluminium added pre-digested mixtures of different concentrations were kept in individual trays (45cm × 30cm × 15cm) and were thoroughly mixed. Into each tray, 10 clitellate *Eudrilus eugeniae* were introduced. 2kg of pre-digested leaf litter- cow dung organic mixture (without

aluminium as control) was also kept in similar tray and introduced with ten worms were maintained under laboratory conditions (28 ± 1°C) and at 60 to 70 percent of moisture by regular sprinkling with tap water every day. The trays were individually covered with thin cotton cloth in order to prevent the escape of the worms and also to provide darkness for the worms to work on the mixture. The worms were kept in aluminium- treated conditions for a maximum period of 90 days.

Observation of worms during Al exposure period

At an interval of every 30 days, worms in each tray (control and treatments) were observed for the morphological changes (if any) due to aluminium treatment. Care was taken to observe the worms with minimum disturbance. At the end of the maximum period of 90 days, the compost mixture in all the trays were separately analysed and obtained data were recorded used for further analysis. The compost mixtures in each tray(C and T1 to T6) were observed for the extent of compost worked by the worm and the texture of the compost mixture. The compost mixture in all the trays were also photographed for a comparative understanding on the vermicomposting ability of the worms under Al treatment after 90 days.

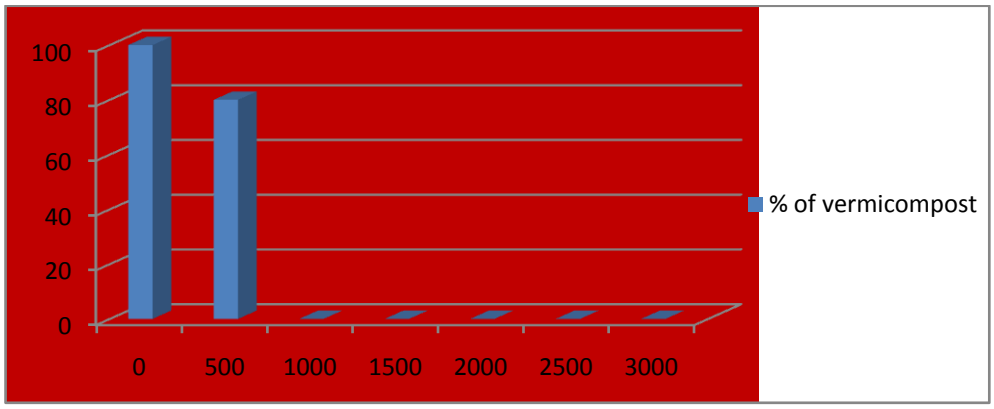
Results

Plate 1 Bulk sample of *Eudrilus eugeniae* and an adult clitellated worm

Plate 2 Experimental set up of Al treated earth worm with control

Plate 1 shows the bulk sample of *Eudrilus eugeniae* along with an adult clitellate worm. Plate 2 showed treatments with different concentrations of Al and provides the compost of *Eudrilus eugeniae* under control and Al concentration treatments following 90days of exposure. From Plate 1, it could be observed that the epidemic adult earthworm, *Eudrilus eugeniae* showed mass aggregation. The adult *Eudrilus eugeniae* measured about 15±1.25cm.

Figure 1 Vermicomposting ability of *Eudrilus eugeniae* in of Al treatment



The texture of control and worm worked mixture in Al treatments from T1 to T6(500ppm to 3000ppm) after 45 days; it could be observed that T1 and T2 mixtures exhibited comparatively more granules of worm cast compared to the treatments T3 to T6. Even the texture of the mixture appeared to be changed in T1 and T2 whereas; T3 to T6 mixtures more or less remained similar to that of the worm- unworked pre-digested control mixture following 90 days of Al treatment (Plate 4). It could be observed that the worm exhibited severe morphological abnormalities under Al – treatment when compared to normal worms. Abnormal bulging of clitellar region and over all emancipation of the size of the body could be observed to be more severe particularly in T4 to T6 treatments showed in figure 1.

Discussion

Earthworms, as soil dwelling organisms, are known to be very much influenced by the chemicals present in the terrestrial environment [12]. Hence, it was believed to be of interest to analyse the effect of xenobiotic substances on the general and reproductive parameters of earthworms as indicators of soil pollution.

In the present study, *Eudrilus eugeniae,* exposed to concentrations of aluminium ranging from 500ppm to 3000ppm (T1 to T6 treatments), exhibited severe morphological abnormalities compared to control (Plate 2).The abnormal bulging of clitellar region and severe emancipation of the size of the body leads to less production of vermicompost could be observed in worms under higher concentration of aluminium treatments (T4 to T6). The observed toxicological symptoms such as clitellar bulging and general emancipation of the worm body in *Eudrilus eugeniae* under Al treatment together with similar pathological symptoms reported in different species of earthworms exposed to various toxicants [13] [14] [15]. The reproductive ability of *Darwida willisi* at elevated concentrations of Zn resulted in a delay in completion of the life cycle and a decline in the total population [16]. In the present study possible reduction in the reproductive potential of *Eudrilus eugeniae* under toxic conditions might result in the impairment of vermicomposting ability of worms as well.

Conclusion

Vermicomposting technique converting decomposable organic wastes into valuable vermicompost through earthworm activity is a faster and better process when compared with the conventional methods of composting. The accumulation of toxic chemicals and its effects on t he growth, reproduction and life cycle of a dominant earthworm species was described by many researchers in Indian crop fields. Hence in the present study it could be concluded that *Eudrilus eugeniae* exhibited severe toxic effects of aluminium by way of showing pathological symptoms such as bulging of clitellar region and emancipation of general body size under toxic conditions. It is concluded that the heavy metal aluminium appears to impair the different stages of reproductive cycle of the worms thereby resulting in the onset of reduced vermicomposting ability of the earthworm.

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