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Acute toxicity of Diammonium phosphate to earthworm (*Eudrilus eugeniae*)

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Abstract

In the agriculture, soil works as a store house of nutrients required for terrestrial ecosystem but today to meet the demands of increasing population agriculture totally depends on the agrochemicals. Intensive use of agrochemicals definitely caused soil pollution. Among soil biota earthworms play a more significant role in soil ecosystem by taking part in organic matter cycle and modifying the soil structure. Earthworms are also used as an indicator species to diagnose environmental pollution in soil ecosystem. In present study an experiment was conducted to find out the eco-toxicity of Diammonium phosphate on earthworm *Eudrilus eugeniae*. Different doses of DAP were mixed with soil and the mortality of earthworm *Eudrilus eugeniae* were recorded. The experiment found that for 96 hours all the earthworms thrived at the dose 100 mg/kg. and LC₅₀ were recorded at the exposure of 400 mg/kg. So it is concluded that earthworms were affected by the use of Diammonium phosphate. So proper care should be taken when DAP is used in agricultural field.

Keywords: Soil, agrochemicals, *Eudrilus eugeniae*, DAP, Acute toxicity

1. Introduction

With the advent of the Green Revolution, there has been a quantum leap in the use of synthetic herbicides, pesticides and fertilizers throughout the world to sustain high yielding crop varieties. Long term continuous use of these fertilizers in high doses cause deterioration in soil physical, chemical and biological properties and soil health. [1-3]. Earthworms are major component of soil fauna involved directly or indirectly in biodegradation, stabilization through humus formation and various soil processes [4, 5]. Earthworms are also well known for their significant contribution to improve soil fertility by adding their castings rich in NPK [6, 7]. They are also regarded as one of the most suitable biomarker in ecological risk assessment [8]. A number of toxicity studies were conducted on the effect of agrochemicals on the earthworm. Most of studies conducted on effect of pesticides on earthworm [9, 10] but very few studies were conducted on the effect of fertilizers on the earthworms. So, in this study different doses of Diammonium phosphate fertilizer were added to the experimental sets. Ten healthy gut evacuated earthworms were added to five replicates for each concentration of fertilizer. On the other hand, control group was also set with only water and same number of earthworms. Thus, the present investigation was undertaken to access the potential risk of Diammonium phosphate on earthworm *Eudrilus eugeniae*.

2. Materials and Methods

2.1 Earthworms: The earthworm *Eudrilus eugeniae* (Annelida, Oligochaeta, Eudrilidae) were purchased from vermiculture unit of Nasik and cultured in vermicomposting plant of the Kotecha college at Bhusawal. Bhusawal is located on the bank of Tapi river and has an average elevation of 209 metres. It is the biggest Taluka of Jalgaon district situated on National Highway 6. The earthworms were collected from the plant acclimatized for one month in laboratory conditions. At the time of experiment gut of earthworms were cleaned by keeping them in glass beaker having filter paper soaked with 25 ml of tap water for 24 hours at 25 ± 2 °C.

2.2 Fertilizer: Diammonium Phosphate (DAP) is the world's most widely used phosphorus fertilizer. It is highly soluble excellent source of Phosphorus (P) and nitrogen (N) for plant nutrition.

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2.3 Experimental set-up

Ten mature earthworms with evacuated gut were added to each plastic trough separately with respect to different doses of fertilizers and a diet of 10% organic matter (cow dung and leaf litter) and air dried soil. Test soil was collected from a non-irrigated land which has no record of input of agrochemicals. Control was set with only soil and water. The troughs were covered with wet muslin cloth to maintain moisture level and also it will prevent earthworms to crawl out of the trough. One control and five replicates were used

for each dose and kept in laboratory for 96 hours. Number of deaths in each set with respect to different doses was recorded to find out toxicity of fertilizers. The experiment was maintained at 25±2 °C

3. Results and Discussion

There is a wide variation of toxicity of Diammonium phosphate on adult earthworms. Details of toxicity with respect to doses and replicates are mention here as table1.

Table 1: Mortality of adult *Eudrilus eugeniae* at different concentrations of Diammonium Phosphate after 96 hours.

Sr. No.	Dose (mg/ kg soil)	No. of earthworms used in each replicate	Mortality in different replicates					Average (Total)	(%) Mortality	Remark
			1	2	3	4	5			
1	100	10	0	0	0	0	0	0	0%	Non Toxic
2	150	10	0	1	1	1	2	1	10%	Non Toxic
3	200	10	1	1	2	1	2	1.4	14%	
4	250	10	2	0	2	4	3	2.2	22%	
5	300	10	3	4	3	4	3	3.2	32%	
6	350	10	4	4	3	5	4	4.0	40%	
7	400	10	5	6	5	5	4	5.0	50%	
8	450	10	7	8	7	6	7	7.0	70%	
9	500	10	7	8	8	9	7	7.8	78%	
10	550	10	8	9	9	9	9	8.8	88%	
11	600	10	9	10	9	10	10	9.6	96%	
12	650	10	10	10	10	10	10	10	100%	100% mortality

No mortality of adult earthworms was recorded at 100mg/kg exposure of DAP. Mortality begins with the exposure to 150mg/kg. of DAP. A distinct variation in mortality was found with respect to different concentrations in different replicates. (Table1, figure1) On an average 1% (average 1.0) mortality was recorded in each replicate at the exposure of 150mg/kg. Mortality gradually increases with the increase in the dose of fertilizer. Mortality of *Eudrilus eugeniae* at the exposure of 200mg/kg, 250mg/kg, 300mg/kg, 350mg/kg, 400mg/kg, 450mg/kg, 500mg/kg, 550mg/kg and 600mg/kg of DAP to the soil was 14% (average 1.4), 22%, (average 2.2), 32% (average 3.2), 40%, (average 4.0), 50% (average 5.0), 70% (average 7.0), 78% (average 7.8), 88% (average 8.8), and 96% (average 9.6) respectively. Mortality at the exposure of 650 mg/kg of DAP to the soil was recorded 100%. Results show 100mg/kg. and 150mg/kg. of DAP to the soil was

nontoxic whereas 650mg/kg was highly toxic to earthworms *Eudrilus eugeniae*. In an earlier study positive impacts of NPK fertilizer treatment on earthworm, population was recorded [11] while [12] of the opinion that long-term application of inorganic fertilizers may adversely affect earthworm populations due to soil acidification. One researcher [13] have found that there was no mortality of adult earthworms *Drawida willsi* was found when they were exposed to superphosphate up to dose of 100 mg/kg. A comparative study on earthworm population in grass land and chemical fertilized land was done by the researcher [14] their result stresses that the total biomass and number of earthworms in non - cultivated land was more than the cultivated land. This may be due to application of chemical fertilizers like urea and Diammonium phosphate.

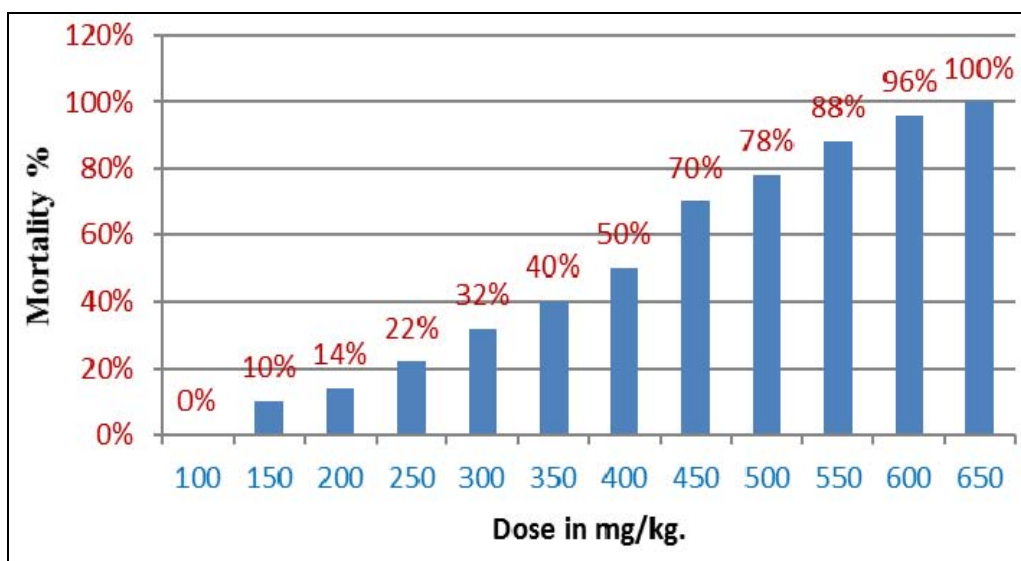


Fig 1: Mortality % of earthworm *Eudrilus eugeniae* after 96 hours exposure to DAP

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