Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(6): 1135-1137

Received: 09-09-2017
Accepted: 11-10-2017

Shruthi N
Department of Agricultural Entomology College of Agriculture, Vijayapur University of Agricultural Sciences, Dharwad, Karnataka, India

AP Biradar
Department of Agricultural Entomology College of Agriculture, Vijayapur University of Agricultural Sciences, Dharwad, Karnataka, India

Syed Muzammil
Department of Agricultural Entomology College of Agriculture, Vijayapur University of Agricultural Sciences, Dharwad, Karnataka, India

Correspondence
Shruthi N
Department of Agricultural Entomology College of Agriculture, Vijayapur University of Agricultural Sciences, Dharwad, Karnataka, India

Toxic effect of inorganic fertilizers to earthworms (*Eudrilus eugeniae*)

Shruthi N, AP Biradar and Syed Muzammil

Abstract
Studies on effect of inorganic chemical fertilizers to *Eudrilus eugeniae* Kinberg earthworms. The results revealed that, when the food material was incorporated with various inorganic fertilizers, there was wide variation among the treatments with respect to mortality of adult and juvenile earthworms ranging from 0.00 to 100 per cent. Significantly highest per cent mortality of 100 % was recorded with urea @10g/kg vermifeed Followed by MOP @ 10g/kg vermifeed (95.00%). The lowest mortality was found in mixed with single super phosphate (SSP) @ 5g/kg vermifeed (28%). The complex fertilizers cause relatively moderate toxicity to the adults *E. eugeniae* earthworm. Among the micro nutrients tested for their toxicity, Zinc (Zn) and Iron (Fe) were relatively toxic to earthworm adults at both tested dosages. Zero mortality of earthworms was noticed in the control treatment (0.00%), respectively. Among inorganic fertilizers were more dangerous to earthworms when incorporate in to food material of earthworms.

Keywords: *Eudrilus eugeniae*, earthworms, inorganic fertilizers, food materials, toxicity

1. Introduction
Earthworms are the important agents in *in-situ* vermiculturing and most important members of the soil biota, although, they are not numerically dominant in soil, their large size makes them one of the major contributors to total biomass. They are extremely important in soil formation principally through their activities in consuming organic matter, fragmenting and mixing it intimately with mineral particles to form aggregates. They play an important role of dynamic natural bioreactors exploiting useful soil micro flora and destroying soil pathogens. Different species contribute in different degrees to the mixing up of organic and inorganic components of soil. The earthworms are known to move large amounts of soil from the deeper strata up to the surface. The amounts moved in this way range from 2 to 250 tons per hectare per annum, which is equivalent to bringing a layer of soil between 1 mm to 5 cm thick to the surface every year creating a stone free layer on the soil surface. Earthworms also affect soil structure through their burrowing activities which facilitates better aeration and infiltration [1].
Indiscriminate use of inorganic fertilizers and other agro chemicals has lead to many limitations such as loss of top soil due to poisoning of it by fertilizers, weedicides and pesticides, bio magnification of chemicals in food chains and food webs and environmental pollution. By efficient utilization of the available farm wastes, through vermicomposting, the demand for chemical fertilizers and crop production cost could be minimized. Therefore, the need of the hour is to popularize organic manure and bio fertilizers along with the cost effective production technologies. Application of vermicompost at the rate of 1-2 ton per hectare to field crops (sorghum, potato, tomato and onion) and *in situ* vermiculture at the rate of 1-2 lakh worms per hectare in irrigated crops like sugarcane, mulberry and grape would substitute the requirements of inorganic fertilizers to an extent of 50 to 75 per cent [2]. Little information has been generated on the toxicity of inorganic fertilizers to earthworms in sugarcane and agricultural eco-system. Taking into account the wide variability of species, composition and characteristics of the soil environment, there is ample scope and need to work out acute and chronic toxicities to various inorganic fertilizers.

2. Materials and methods
The toxicity of different inorganic fertilizer to earthworms was tested by incorporation of fertilizers in to food material (vermifeed).

2.1 Collection and maintenance of different earthworm species

For conducting studies under laboratory, the species of earthworm (*Eudrilus eugeniae* Kinberg*)* required for the study were collected from vermiculture unit, Department of Agricultural Entomology, Regional Agricultural Research Station, College of Agriculture, Vijayapur, University of Agricultural Sciences, Dharwad (Karnataka).

2.1.1 Maintenance

Food material required for experimentation as well as for the maintenance of earth worms species, culture was prepared by using organic wastes (dried leaves, sunflower stalks and green leafy matter) and dung. Organic wastes and dung were mixed in the proportion of 10:1 and were arranged in a brick wall (aboveground) pit of size 10m x1mx0.33 (L x W x H) in layer wise. Each layer was altered with dung layer. The pit was closed with a thin layer of soil (1 cm) and covered with 6-12″ mulch layer. The pit was watered sufficiently and regularly to enhance the decomposition process. After 45 days, the decomposed organic matter was thoroughly mixed, collected and stored in the laboratory for further use [3].

2.1.2 Natural enemies and their management

Ants and termites were the main natural enemies encountered in experimental troughs/beds. Apparently, due to the thick layer of mulch cover on the top of feed layer and around the pit coupled with sufficient watering repelled /killed the ants and termites.

2.2 Evaluation of toxicity of chemical fertilizers to earthworms.

For the evaluation of toxicity of chemical fertilizers to earthworms (*E. eugeniae*), earthworm species were collected from vermicompost pit where they have been mass multiplied. The studies were carried out in plastic troughs of 60x45x30 cm size. Each trough was provided with five centimeter thick bedding of red sand as vermibed, over which 25 kg of well decomposed organic matter and dung (10:1) (vermifeed) was put and the top was mulched with dried grass. After filling the trough with vermifeed, 25 adults and 25juveniles earthworms were released to each trough during evening hours. Each treatment was replicated two times.

The troughs were kept wet by sprinkling water topically regularly to keep the mulch layer wet all time to maintain the required amount of bed moisture (40-50%) for the activity of worms.

3. Result and Discussion

The results of experiments can be seen in table 1 to 2. Different chemical fertilizers *viz.,* straight fertilizers, complex fertilizers and micro nutrients are being used commonly in sugarcane ecosystem, are tested knowing the effect of growth and development of *E. eugeniae* earthworm under laboratory condition. These fertilizers have been tested at two dosages.

Then the results revealed that, the mortality of adult *E. eugeniae* earthworm ranged from 0.00 to 100%. The highest mortality of (100%) *E. eugeniae* earthworm was noticed in the treatment mixed with urea @ 10g/kg vermifeed this was followed by Murate of potash (MOP) @ 10g/kg vermifeed (95%). The lowest mortality was found in mixed with single super phosphate (SSP) @ 5g/kg vermifeed (28%). The complex fertilizers cause relatively moderate toxicity to the adults *E. eugeniae* earthworm. Among the micro nutrients tested for their toxicity, Zinc (Zn) and Iron (Fe) were relatively toxic to earthworm adults at both tested dosages. Zero mortality of earthworms was noticed in the control treatment (0.00%), respectively. The significantly higher mortality of (100%) juveniles *E. eugeniae* earthworm was noticed in the treatment mixed with urea @ 10g/kg vermifeed and sulphate of potash (SOP) @ 10g/kg vermifeed, this was followed by Murate of potash (MOP) @ 10g/kg vermifeed (98.00%).Among the inorganic fertilizers, less mortality recorded in the treatment single super phosphate(SSP) @5g/kg vermifeed (40.00%) and was followed by SSP @ 5g/kg vermifeed (48.00%).

The present findings corroborates with findings, who reported that, earthworms are typically inferred as soil indicators without which soil fertility cannot be measured directly. An acute toxicity test of SP (super phosphate) to earthworms (*Eisenia fetida*) was performed using paper contact method the worm was exposed to the deposit of SP kept uniform on filter paper for 48 h and the mortality was recorded. The lethal concentration was recorded as 210mg/5ml (i.e. 300µg/cm2). Based on the resulting LC50 value, the SP was classified as "less toxic" to earthworm (*E. fetida*). The result of this study further demonstrates that the inorganic mineral fertilizer can also be toxic to earthworms when contacted directly [4].

Urea caused mortality to adult earthworms 100 per cent. The present findings are in close agreement with the reports revealed that**,** the pesticide and the fertilizers pollute the water bodies and ground water system. The application of the inorganic fertilizers and pesticide were indirectly destroying some useful soil microorganism like earthworms. The best example if we put an earthworm in a beaker containing urea solution then it will die. So the application of the in inorganic fertilizers is also responsible for the death of farmer friend earthworm and some helping microorganism such as nitrogen fixing bacteria also die due to this type of fertilizer [5]. Another person who reported that, earthworms are typically inferred as soil indicators without which soil fertility cannot be measured directly. An acute toxicity test of urea to earthworm (*E. fetida*) was performed using a simple paper contact method proposed by OECD (Organization for Economical Cooperation and Development) and this is a simple screening test to identify the toxic potential of the chemical to earthworm the lethal concentration was recorded as 28µg/cm2, based on the resulting LC50 value, urea was categorized as "very toxic" to earthworm [6]. The result of this study demonstrates that inorganic fertilizers can also be toxic to earthworms when contacted directly. Thus there arises an unavoidable need for monitoring the usage of fertilizer dosage on agricultural lands, particularly the urea [7] another report revealed that in guava ecosystem chemical fertilizers viz., phosphorus and potassium had an adverse effect on the biological activity of earth worms *E. euginae* by recording the minimum number of cocoons/earthworms and they also opined that, straight fertilizers are more harmful than complex fertilizers [8].

Table 1: Effect of chemical fertilizers on adults *of Eudrilus eugeniae* earthworms, when incorporated (mixing) in to food material

S. No	Treatments / inorganic fertilizers	Dosage (g\kg vermifeed)	*Per cent mortality adults of earthworms (10 DAS)
1	Urea	5	94.00 (75.82)^{bc}
2	Urea	10	100.00 (90.00)^{a}
3	Single super phosphate (SSP)	5	28.00 (31.94)^{m}
4	Single super phosphate (SSP)	10	37.00 (37.46)^{l}
5	Di ammonium phosphate (DAP)	5	46.00 (42.71)^{k}
6	Di ammonium phosphate (DAP)	10	52.00 (46.15)^{j}
7	Complex fertilizer (19:19:19)	5	62.00 (51.94)^{i}
8	Complex fertilizer (19:19:19)	10	68.00 (55.55)^{h}
9	Complex fertilizer (12:32:16)	5	73.00 (58.70)^{g}
10	Complex fertilizer (12:32:16)	10	82.00 (64.93)^{e}
11	Murate of Potash(MOP)	5	82.00 (64.90)^{e}
12	Murate of Potash(MOP)	10	95.00 (77.07)^{b}
13	Sulphate of Potash (SOP)	5	91.00 (72.57)^{d}
14	Sulphate of Potash (SOP)	10	93.00 (74.70)^{c}
15	Zinc (Zn)	2	67.00 (54.93)^{h}
16	Zinc (Zn)	4	72.00 (58.05)^{g}
17	Iron (Fe)	2	77.00 (61.34)^{f}
18	Iron (Fe)	4	79.00 (62.73)^{f}
19	Control	-	0.00 (0.00)n
	S.Em.±		0.68
	C.D.at 1%		2.75
	C.V.		1.69

* - Figures in the parentheses are arc sin transformations, DAS- days after release

Table 2: Effect of chemical fertilizers on juveniles of *Eudrilus eugeniae* earthworms, when incorporated (mixing) in to food material

S. No	Treatments\inorganic fertilizers	Dosage (g/kg vermifeed)	*Per cent mortality Juveniles of earthworms (10 DAR)
1	Urea	5	96.00 (78.46)^{c}
2	Urea	10	100.00 (90.00)^{a}
3	Single super phosphate (SSP)	5	40.00 (39.22)^{k}
4	Single super phosphate (SSP)	10	48.00 (43.85)^{j}
5	Di ammonium phosphate (DAP)	5	52.00 (46.15)^{j}
6	Di ammonium phosphate (DAP)	10	60.00 (50.77)^{i}
7	Complex fertilizer (19:19:19)	5	68.00 (55.56)^{h}
8	Complex fertilizer (19:19:19)	10	80.00 (63.46)^{f}
9	Complex fertilizer (12:32:16)	5	82.00 (64.93)^{f}
10	Complex fertilizer (12:32:16)	10	90.00 (71.56)^{d}
11	Murate of potash (MOP)	5	90.00 (71.56)^{d}
12	Murate of potash (MOP)	10	98.00 (82.14)^{b}
13	Sulphate of potash (SOP)	5	95.00 (77.14)^{c}
14	Sulphate of potash (SOP)	10	100.00 (90.00)^{a}
15	Zinc (Zn)	2	73.00 (58.70)^{g}
16	Zinc (Zn)	4	80.00 (63.46)^{f}
17	Iron	2	79.00 (62.73)^{f}
18	Iron	4	86.00 (68.02)^{e}
19	Control	-	0.00 (0.00)l
	S.Em.±		1.00
	C.D. at 1 %		4.05
	C.V.		2.28

* - Figures in the parentheses are arc sin transformations, DAR- days after release

4. References

1. Bhatnagar RK, Palta RK. Vermiculture and vermicomposting. Kalyani publishers. First edition. 1996, 341-343.
2. Kulakarni M. Effect of vermiculturing on growth and yeild of China aster (*Cakkustephus chinensis* Nees). M.Sc. (Agri). University of Agricultural Sciences, Dharwad. 1994, 94-96.
3. Mahanthaswamy MV. Studies on toxicity of pesticide to earthworm. *M. Sc. (Agri) Thesis*, University of Agricultural Sciences, Dharwad. 1999, 237-240.
4. Abbiramy KS, Pankiras R, Jyothi PP. Assessment of acute toxicity of superphosphate to *Eisenia fetida* using paper contact method. Asian journal of plant science and research. 2013; 3(2):112-115.
5. Upadhyay M. Organic farming: A new hope for protection from adverse health effects of exposure to inorganic pesticides and fertilizers. International Journal of Biology, Pharmacy and Allied Sciences. 2012; 1(9):1356-1367.
6. Abbiramy KS, Pankiras R. Determination of an acute toxicity of Urea to *Eisenia fetida* by a simple paper contact method. International Journal of Science, Environment and Technology. 2013; 2(5):886-891.
7. Roberts BL, Dorough HW. Relative toxicities of chemicals to the earthworm *E. fetida*, Environmental Toxicology and Chemistry. 1984; 3:67-78.
8. Anonymous. Improved package of practices for higher yields. UAS, Dharwad, Karnataka. 2012, 382-388.