Gurukul International Multidisciplinary Research Journal (GIMRJ)*with* International Impact Factor 8.357
Peer Reviewed Journal
https://doi.org/10.69758/GIMRJ/2505I5VXIIIP0048

e-ISSN No. 2394-8426
Monthly Issue
MAY-2025
Issue–V, Volume–XIII

Toxic effects of fertilizers onmortality of earthworms, *Eiseniafoetida*

Mr. Sumit S Wankhade[1], and Dr. Ashsish Ghaware[2]
sumitwankhade.14@gmail.com
[1]DepartmentofZoology,Mahatma Jyotibafule Commerce, Science and VitthalraoRaut Arts College Bhatkuli. Amravati 444602,India.
[2]DepartmentofZoology,Mahatma Jyotibafule Commerce, Science and VitthalraoRaut Arts College Bhatkuli. Amravati 444602,India

Abstract
Various researches carried out on effect of inorganic chemical fertilizers on earthworm *Eiseniafoetida* and findings revealed that there was significant variation between the treatments in terms of adult and juvenile earthworm mortality, ranging from 0.00 to 98%, when the food material was combined with different inorganic fertilizers. The urea at 10g/kg vermifeed had the noticeably highest mortality rate of 98%. MOP @ 10g/kg vermifeed (85.00%) comes next. The combination with single super phosphate (SSP) at 5g/kg vermifeed had the lowest mortality rate (30%). The adults of the *Eiseniafoetida* earthworm are comparatively moderately toxic to the complex fertilizers. When zinc (Zn) and iron (Fe), two of the micronutrients examined for toxicity at both tested dosages, were found comparatively more harmful to earthworm adults than other micro nutrients.
In the control treatment, there was no earthworm mortality (0.00%). Inorganic fertilizers were proven more harmful when added to earthworm food.
Keywords:,*Eiseniafoetida* earthworms, inorganic fertilizers, food materials, toxicity, mortality,dosage.

1.Introduction

Earthworms are the most significant members of the soil biota and crucial agents in in-situ vermiculation despite their lack of numerical dominance in soil, their size allows them to contribute significantly to the overall biomass. Their ability to consume organic matter, break it up, and mix it closely with mineral particles to create aggregates makes them crucial to the formation of soil. They are crucial to dynamic natural bioreactors that eliminate soil pathogens and take advantage of beneficial soil microflora. The degree to which the organic and inorganic components of soil mix depends on the species. Large volumes of soil are known to be moved by earthworms from the deeper strata to the surface.The amounts moved in this manner vary from 2 to 250 tonnes per hectare annually, which is the same as bringing a layer of soil that is 1 to 5 cm thick to the soil's surface each year, resulting in a layer free of stones. Through their burrowing activities, earthworms also influence soil structure by improving infiltration and aeration [1].
Numerous drawbacks have resulted from the careless use of inorganic fertilisers and other agricultural chemicals, including pollution of the environment, the loss of top soil as a result of fertiliser, weedicide, and pesticide poisoning, and the biomagnification of chemicals in food chains and food webs. The cost of producing crops and the need for chemical fertilizers could be reduced by making effective use of the available farm wastes through vermicomposting. Popularisingbiofertilizers and organic manure, as well as cost-effective production technologies, is therefore imperative.A 50–75% reduction in the need for inorganic fertilisers would result from the application of vermicompost at a rate of 1-2 tonnes per hectare to field crops (sorghum, potato, tomato and onion) and in situ vermiculture at a rate of 1-2 lakh worms per hectare in irrigated crops like sugarcane, mulberry and grape[2]. The toxicity of inorganic fertilisers to earthworms in the agricultural ecosystems has not been well studied. There is a great deal of room and

necessity to determine the acute and long-term toxicities to different inorganic fertilisers, given the great diversity of species, composition, and soil environment features.

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

Earthworm, Eiseniafoetida brought from commercial suppliers, Nursery Department of Forest, Wadali, Amravati and adopted as the test species, recommended by OECD guideline for carring out acute toxicity testson earthworm.

2.2 Maintenance and Management

Organic wastes (dried leaves, sunflower stalks, and green leafy matter) and dung were used to prepare the food material needed for the experiments and for the survival of the earth worm species. A brick wall (aboveground) pit measuring 10 m x 1 m x 0.33 (L x W x H) was filled with dung and organic wastes in a 10:1 ratio, layer by layer. The dung layer was added to each layer. A thin layer of soil (1 cm) was used to seal the pit, and a layer of mulch (6–12 inches) was placed over it. Regular and adequate watering of the pit aided in the decomposition process. The decomposing organic matter was carefully combined, gathered, and kept in the lab for later use after 45 days [3].

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.

2.3 Evaluation of toxicity of chemical fertilizers to earthworms

Earthworm species were gathered from vermicompost pits where they had been mass multiplied in order to assess the toxicity of chemical fertilisers to earthworms. Plastic troughs measuring 60x45x30 cm were used for the studies. Five centimetres of vermibed red sand is placed in each trough, followed by 25 kg of vermifeed—a mixture of well-decomposed organic matter and dung (10:1)—and dried grass mulched on top. In the evening, 25 adults and 25 juvenile earthworms were released into each trough after it had been filled with vermifeed. Every treatment was duplicated twice.

To keep the mulch layer moist at all times and maintain the necessary level of bed moisture (40–50%) for worm activity, water was sprayed topically on the troughs on a regular basis.

3.Result and Discussion

Different chemical fertilisers, such as complex fertilisers, and straight fertilisers, are frequently used in the amravatiregion and are tested in lab to determine the effect on growth and development of the earthworms.

These fertilizers have been tested at two dosages. The findings then showed that the mortality rate for adult earthworms (*Eiseniafoetida*) varied between 0.00 and 100%. The treatment containing urea at 10g/kg vermifeed had the highest mortality rate of (98%) followed by murate of potash (MOP) at 10g/kg vermifeed (85%) The combination with single super phosphate (SSP) at 5g/kg vermifeed had the lowest mortality rate (30%). The adults of the *Eiseniafoetida*earthworm are comparatively moderately toxic to the complex fertilisers. At both tested dosages, zinc (Zn) and iron (Fe), two of the micronutrients examined for toxicity, were comparatively more harmful to earthworm adults. In the control treatment, there was no earthworm mortality (0.00%).The treatment containing urea at 10g/kg vermifeed and sulphate of potash (SOP) at 10g/kg vermifeed had a significantly higher mortality rate of (100%) juvenile(*Eiseniafoetida*) earthworms. Murate of potash (MOP) at 10g/kg vermifeed came in second

(98.00%).The single super phosphate (SSP) @5g/kg vermifeed treatment had the lowest mortality rate among the inorganic fertilisers (40.00%), followed by SSP @5g/kg vermifeed (48.00%).

The current research supports findings that indicate earthworms are commonly used as indicators of soil fertility, without which it is impossible to measure it directly. Using the paper contact method, an acute toxicity test of SP (super phosphate) to earthworms (Eiseniafetida) was conducted. The worms were exposed to a uniform deposit of SP on filter paper for 48 hours, and the mortality rate was noted. The recorded lethal concentration was 300µg/cm2, or 210 mg/5ml. The SP was categorised as "less toxic" to earthworms (E. fetida) based on the resulting LC50 value. The study's findings also show that when earthworms come into direct contact with inorganic mineral fertiliser, it can be toxic to them [4].

Adult earthworm mortality was 100% due to urea. The current results closely match the reports that showed fertilisers and pesticides contaminate groundwater systems and water bodies. Some beneficial soil microorganisms, such as earthworms, were being indirectly destroyed by the use of inorganic fertilisers and pesticides. The best example is that an earthworm will perish if it is placed in a beaker filled with urea solution. Therefore, the use of inorganic fertilisers is also to blame for the demise of farmer-friendly earthworms, and some beneficial microorganisms like bacteria that fix nitrogen also perish as a result of this kind of fertiliser[5].

According to another reaearch, earthworms are generally regarded as indicators of soil fertility, without which it is impossible to measure it directly. Using a straightforward paper contact method suggested by the OECD (Organisation for Economic Cooperation and Development), an acute toxicity test of urea to earthworms (E. fetida) was conducted. This is a straightforward screening test to determine the chemical's potential for toxicity to earthworms. According to the resulting LC50 value, urea was classified as "very toxic" to earthworms, with a lethal concentration of 28µg/cm2 [6]. The study's findings show that when inorganic fertilisers come into direct contact with earthworms, they can also be toxic.

Monitoring the application of fertiliser dosage on agricultural lands, especially urea, is therefore imperative[7].By observing the lowest number of cocoons/earthworms, another study found that chemical fertilisers, specifically phosphorus and potassium, had a negative impact on the biological activity of earth worms, E. euginae, in guava ecosystems. They also concluded that simple fertilisers are more detrimental than complex fertilisers[8].

Table no 1 and 2 Shows the outcomes of the experiments..

S. No	Treatments/inorganicfertilizers	Dosage(g\kgvermifeed)	*Percent mortalityadults ofearthworms
1	Urea	5	94.00(75.82)^{bc}
2	Urea	10	98.00(90.00)^{a}
3	Singlesuperphosphate(SSP)	5	30.00(31.94)^{m}
4	Singlesuperphosphate(SSP)	10	37.00(37.46)^{l}
5	Diammoniumphosphate (DAP)	5	46.00(42.71)^{k}
6	Diammoniumphosphate (DAP)	10	52.00(46.15)^{j}
7	Complexfertilizer(19:19:19)	5	62.00(51.94)^{i}
8	Complexfertilizer(19:19:19)	10	68.00(55.55)^{h}
9	Complexfertilizer(12:32:16)	5	73.00(58.70)^{g}
10	Complexfertilizer(12:32:16)	10	82.00(64.93)^{e}
11	Murate ofPotash(MOP)	5	82.00(64.90)^{e}
12	Murate ofPotash(MOP)	10	85.00(77.07)^{b}
13	SulphateofPotash(SOP)	5	91.00(72.57)^{d}
14	SulphateofPotash(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}

Gurukul International Multidisciplinary Research Journal (GIMRJ)*with* International Impact Factor 8.357
Peer Reviewed Journal
https://doi.org/10.69758/GIMRJ/2505I5VXIIIP0048

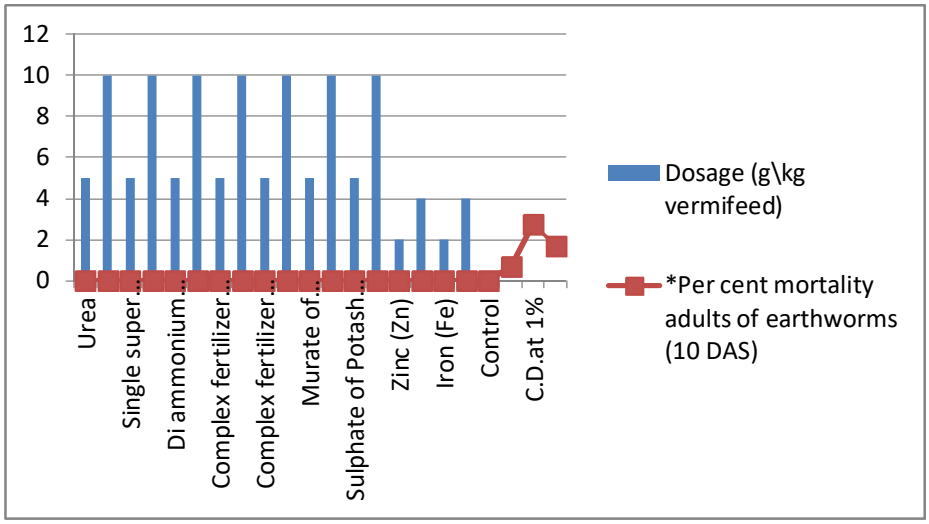
e-ISSN No. 2394-8426
Monthly Issue
MAY-2025
Issue–V, Volume–XIII

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

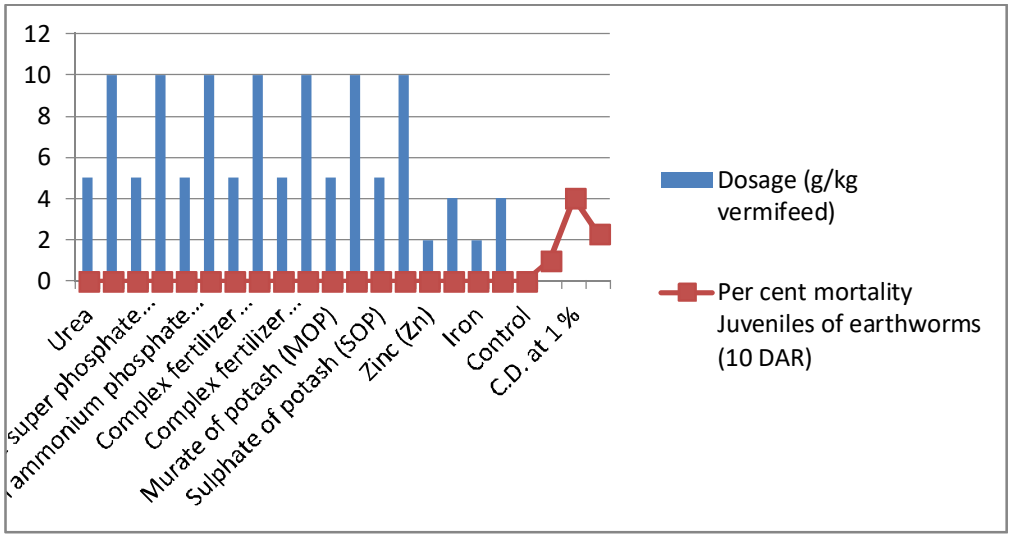
Table 1: Effect of chemical fertilizers on adults *of* earthworms (*Eiseniafoetida*), when incorporated (mixing) in to food material

S. No	Treatments\inorganicfertilizers	Dosage(g/kgvermifeed)	*Percent mortality Juveniles of earthworms
1	Urea	5	96.00(78.46)[c]
2	Urea	10	100.00(90.00)[a]
3	Singlesuperphosphate(SSP)	5	40.00(39.22)[k]
4	Singlesuperphosphate (SSP)	10	48.00(43.85)[j]
5	Diammoniumphosphate (DAP)	5	52.00(46.15)[j]
6	Diammoniumphosphate (DAP)	10	60.00(50.77)[i]
7	Complexfertilizer(19:19:19)	5	68.00(55.56)[h]
8	Complexfertilizer(19:19:19)	10	80.00(63.46)[f]
9	Complexfertilizer(12:32:16)	5	82.00(64.93)[f]
10	Complexfertilizer(12:32:16)	10	90.00(71.56)[d]
11	Murateofpotash(MOP)	5	90.00(71.56)[d]
12	Murateofpotash(MOP)	10	98.00(82.14)[b]
13	Sulphateofpotash(SOP)	5	95.00(77.14)[c]
14	Sulphateofpotash(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

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



Effect of chemical fertilizers on adults *of* earthworms (*Eiseniafoetida*), when incorporated (mixing) in to food material



Effect of chemical fertilizers on juveniles of earthworms (*Eiseniafoetida*), when incorporated (mixing) in to food material.

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 (*Cakkustephuschinensis*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 *Eiseniafetida*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 Eiseniafetida 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.