Comparative study of effect of chemical fertilizers or organic fertilizer on earthworm Eisenia foetida.

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Abstract: Today fertilizer has become essential to modern agriculture to feed the growing population. Chemical fertilizers are used extensively in modern agriculture, in order to improve crop yield. Urea is the most popular and widely used dry N fertilizer. The objective of the present study is to characterize the effect of fertilizers on the earthworm. The effects of soil fertilization with inorganic and organic fertilizers on earthworm rearing (populations, biomass, number of cocoons, juveniles etc.) were studied under different doses of the fertilizers for 60 days. When compared, marked changes were observed in the activity of Eisenia foetida in both type of fertilizers introduced. The present work indicates towards the deleterious effect of inorganic fertilizers on the survival of earthworm community in soil.

Introduction

Increased crop production largely relies on the type of fertilizers used to supplement essential nutrients for plants. Fertilizer application is required to replace cropland nutrients that have been consumed by previous plant growth with the ultimate goal of maximizing productivity and economic returns. Now a day, there is increased emphasis on the impact on soil environment due to continuous use of chemical fertilizers**.** Organic or inorganic plant foods, which may be either granular, used to amend the soil in order to improve the quality or quantity of plant growth. Fertilizers are compounds given to plants with the intention of promoting growth. Fertilizers can be organic (composed of organic matter that is carbon based) or inorganic (containing simple, inorganic chemicals. They can be naturally occurring compounds such as peat or mineral deposits, or manufactured through natural processes such as composting or chemical processes (such as the Haber process). Materials added to the soil or applied directly to crop foliage, to supply elements needed for plant nutrition. These materials may be in the form of solids, semisolids, slurry suspensions, pure liquids, aqueous solutions, or gases. The chemical elements nitrogen, phosphorus and potassium are macronutrients, or primary fertilizer elements which are required in greatest quantity. Sulfur, calcium, magnesium, called secondary elements are also necessary to the health and growth of vegetation, but they are required in lesser amounts compared to macronutrients. In literature, some researchers have concluded the chemical

fertilizers to be harmful for soil organisms but on the contradictory they have been supported too to be beneficial as far as their food supply is concern.

The acute toxicity of urea on E. foetida by using a simple paper contact method was studied, where the relative toxicity grade of urea was categorized as —very toxic‖ to E. foetida. According to reference , the inorganic fertilizers may also contribute indirectly to an increase in earthworm populations by increasing the quantity of crop residues returned to the soils, although the long-term use of inorganic nitrogen fertilizers may sometimes cause a decrease in earthworm abundance and biomass, particularly if it is ammonia-based . Other study, which measured earthworm activity in mineral fertilizer by considering casting frequency of the worm, found higher levels of casting activity in plots with inorganic fertilizers alone and with combination with organic matter than the control plots. It is widely believed that organic fertilizers support higher earthworm populations by providing a nutrient rich substrate for earthworm populations, whether they feed directly upon the organic matter or upon the microorganisms, which colonize the organic materials. Some researchers have reported in their studies that manure amendments supported higher earthworm densities and biomass than inorganic fertilizers after 5 years of soybean-corn-legume rotations. However, the application of mineral fertilizer on clay soils had been reported to have no significant effect on earthworm populations in another work . In long-term continuous cereal production, earthworm abundance and biomass was seen greatest in plots receiving a combination of manure and inorganic fertilizer.

METHODOLOGY

Experimental Model: Earthworms (E. foetida) were procured from the vermicomposting unit of Agricultural research centre o f Khudwani, Anantnag g Kashmir . They were maintained in the laboratory conditions and acclimatized for 15 days. The worms used in the experiment were approximately same body weight and body length.

CHEMICALS USED: 1) UREA (46% N): The inorganic fertilizer used in the experiment was Urea which was purchased from the local market. Once applied to the soil, urea is converted to ammonia, which reacts with water to form ammonium ions within two to three days (faster under warm conditions).

2) KALA SONA (Humic Acid 95%): Kala Sona is a unique soil conditioner, a naturally occurring organic substance consisting primarily of humic acid and minor levels of minerals, gypsum and clays. It eases organic material incorporation to the soil, accelerating its decomposition and nutrient utilization and eventually increases the carbon content of the soil. Preparations of soil beds: The experiment was conducted as per method given in reference [11]. Plastic tubs were used for preparations of soil beds. Dried soil (from nearby farmland) was crushed and filtered through a fine mesh sieve. One kg of fine soil was then poured in each plastic tub and then water was added to moistened the soil then 250gm dried powdered (3 week old) cow dung was also added to each plastic tub to avoid starvation.

Addition of Urea: The Urea dose being practically applied in the local agricultural lands for the Kharif crop was found to be 174 kg/ hectare of land area. Here, in our experimental set up the soil bed contained 1 kg of soil and cow dung mixture made in the ratio of 1:1. Therefore, the calculated value of Urea for the soil bed was 3.48gm/ kg of soil. In addition to the dose being practiced by the farmers i.e. 3.48gm/ kg, three more doses of Urea were set viz. 0.75gm/ kg, 1.5gm/ kg, and 2.25gm/ kg.

Addition of Kala Sona: The dose of Kala Sona being used by the farmers was 4.5 kg/ hectare and so for our experimental set up the calculated dose of this organic fertilizer was 0.45gm/ kg of soil. One more dose of Kala Sona 0.9gm/ kg was set as the experimental dose.

Experimental set-up : 15 Mature earthworms (same age group) were added to each plastic tub. The tubs were covered with wet muslin cloth, so that the moisture level needed by the worms is maintained and it will prevent them to crawl out of the tub. Thus, one control set and five experimental set were prepared. 3 replicates were used for each set. To maintain up-to 70 percent moisture level water was supplied regularly. After 15, 30, 45 and 60 days the changes were observed in activity, morphology, growth of earthworms as well as the number of cocoons and juveniles were also counted.

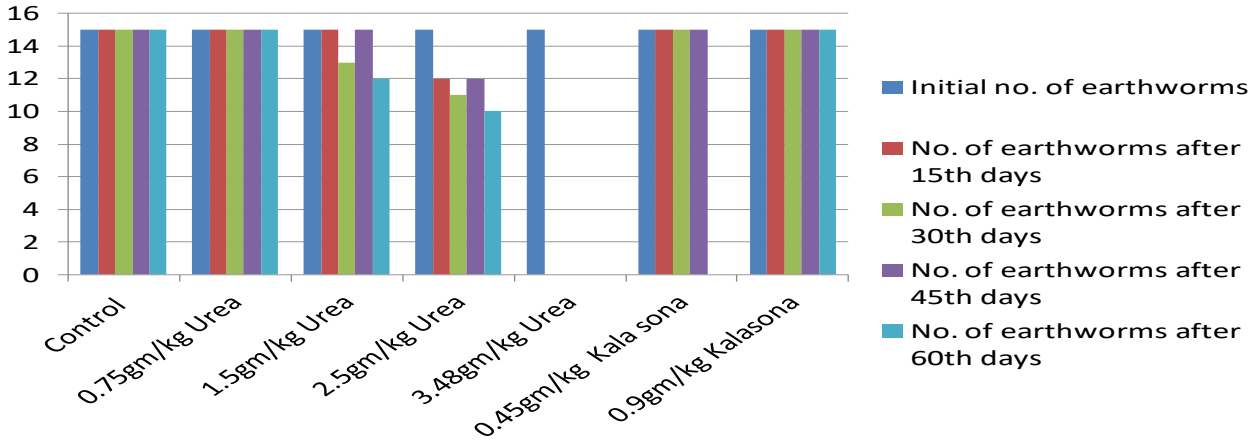
III. OBSERVATION

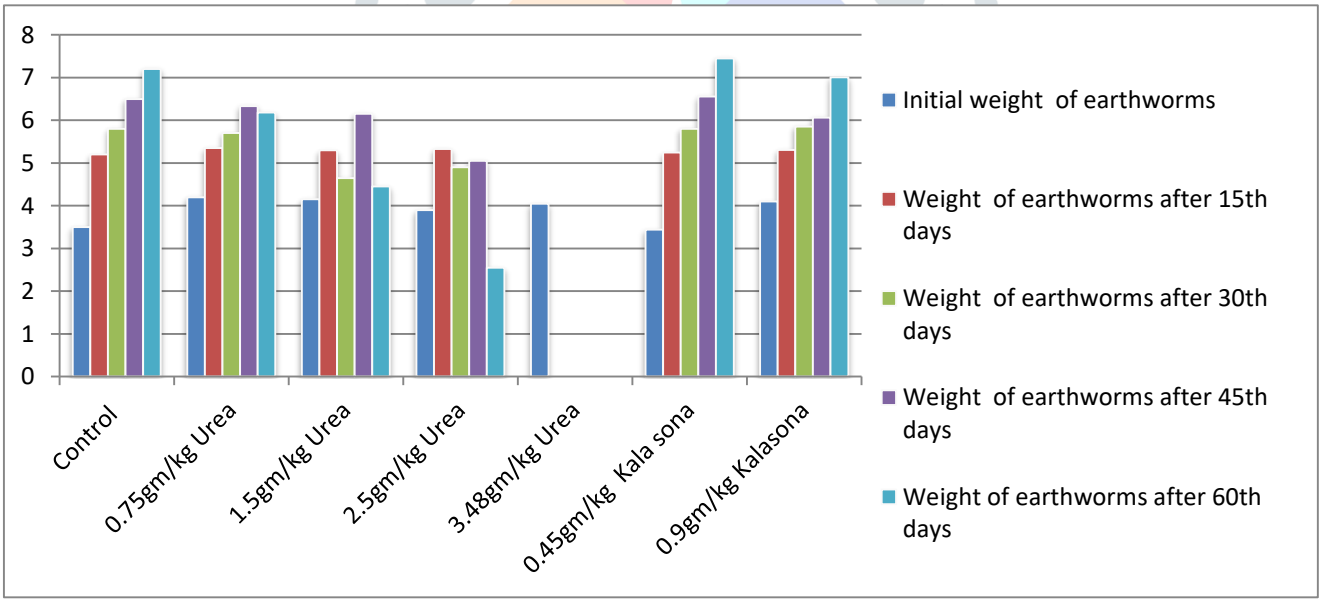
The chemical fertilizer urea was found to be fatal for the earthworm population when the dose reached more than 1.5gm/kg soil. A parallel control experiment set was also set to compare the changes in the behavior and morphology. The morphological change observed in the different sets of our experiment has been discussed below. The initial number of earthworms in all the set up along with the control set was 15. At the end of 60th day, all the 15 earthworms were alive in the control set up and in both the organic fertilizer soil bed. In addition, under the dose of 0.75gm/kg urea, the earthworms were also safe. However, as the dose increased from *0.75gm/kg to 1.5gm/kg ,2.25gm/kg, and 3,28gm/kg mortality among the test animal is seen.*

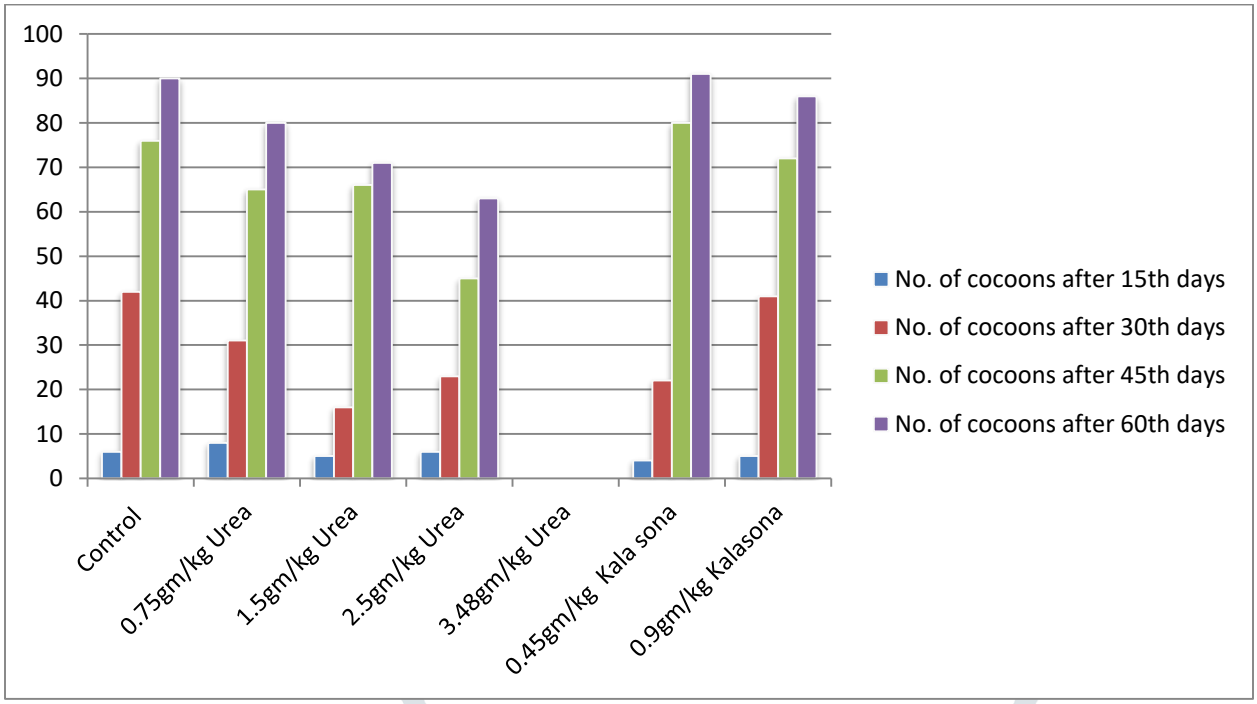
DAYS	Parameters	Control set	0.75gm/kg Urea	1.5gm/kg Urea	2.5gm/kg Urea	3.48gm/kg Urea	0.45gm/kg Kala sona	0.9gm/kg Kalasona
Ist day	Number	15	15	15	15	**15**	15	15
	Biomass of alive worms (gm)	3.5	4.2	4.15	3.9	4.05	3.44	4.1
	Biomass/individual (gm)	0.14	0.17	0.16	0.15	0.15	0.14	0.16
0n 15th day	Number	15	15	15	12	0	15	15
	Biomass(worms)	5.2	5.35	5.3	5.33	NA	5.25	5.31
	Biomass/individual(gm)	0.24	0.25	0.24	0.31	NA	0.15	0.17
	cocoons	6	8	5	6	NA	4	5
0n 30th day	Number	15	15	13	11	0	15	15
	Biomass (gm)	5.8	5.7	4.65	4.9	NA	5.8	5.85
	Biomass/individual(gm)	0.3	0.3	0.31	0.28	NA	0.3	0.31
	cocoons	42	31	16	23	NA	22	41
	juveniles	5	3	4	2	NA	3	2
On45thday	Number	15	15	15	12	NA	15	15
	Biomass(worms)	6.5	6.33	6.15	5.05	NA	6.56	6.6
	Biomass/individual(gm)	0.34	0.33	0.27	0.25	NA	0.35	0.36
	cocoons	76	65	66	45	NA	80	72
	juveniles	10	6	3	2	NA	12	9
0n 60th day	Number	15	15	12	10	NA	15	15
	Biomass (gm)	7.2	6.18	4.45	2.55	NA	7.45	7.1
	Biomass/individual(gm)	0.38	0.37	0.32	0.3	NA	o.39	0.4
	cocoons	90	80	71	63	NA	91	86
	juveniles	19	16	13	10	NA	24	21

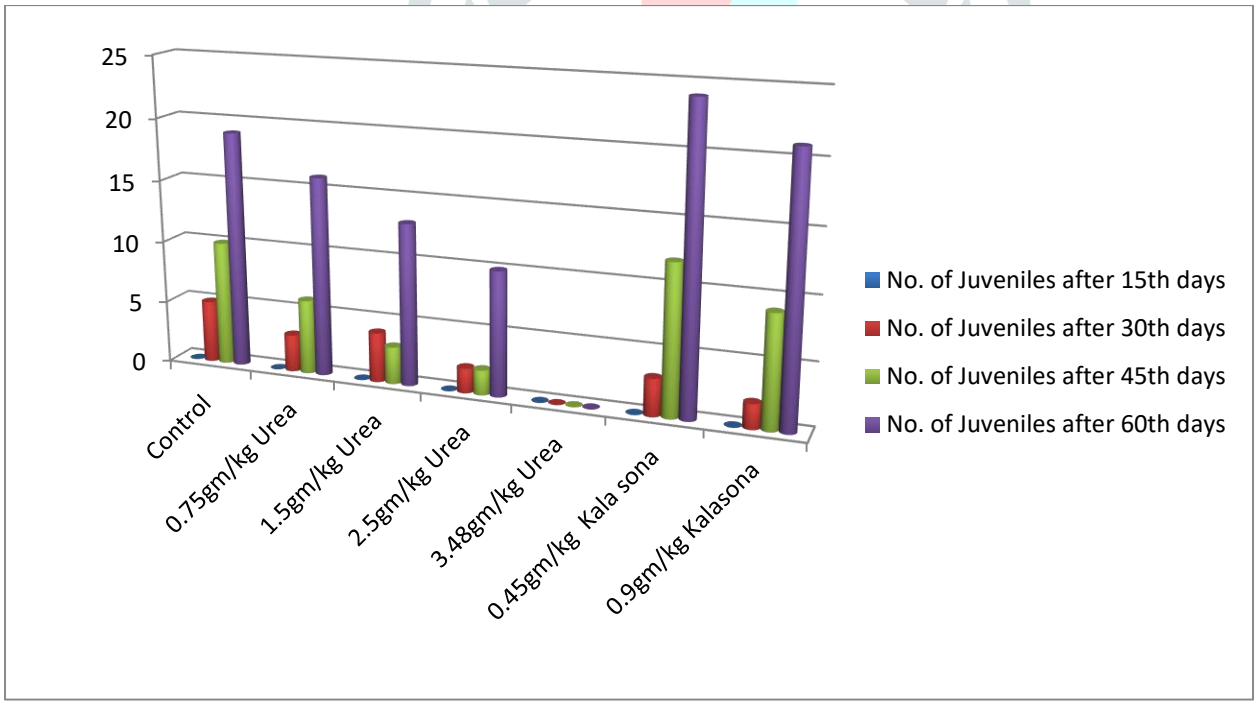
Apart from the observed mortality among the test animal, the changes in weight was noticed in the worms which were able to survive throughout the study period under the higher doses of urea than 0.75gm/kg. The weight of the

earthworms was found to be increasing in the starting days of the experiment but after one month a steady pattern of weight gain was observed in urea dose of 2.25gm/kg and also the earthworms in this set was seen weakened in the later days. The initial increased weight of earthworms in this set from rest of the sets can be due to swelling of earthworm's body. On the other hand, there was found appreciable weight gain of the worms under both the organic fertilizer _Kala Sona' set during the whole study than the control set.









RESULTS AND DISCUSSION

Urea is the most commonly used nitrogen fertilizer worldwide. The overused urea in agricultural fields may affect the soil organisms especially, the earthworms which are known well for their role in soil fertility .The experiment conducted during this investigation revealed many interesting facts. The chemical fertilizer Urea was found to be quite toxic to the earthworms. Different doses of Urea was administered to the soil and simultaneously one organic fertilizer _Kala Sona'was also used at two doses to conduct a perfect comparison

of the two types fertilizer on the earthworm activity. A control set up was run parallel to the experimental set up. There were significant changes in the mortality and weight of tested earthworms after exposure to Urea. There was a positive correlation between earthworm mortality and the concentration of Urea added to soil. The mortality reached 100% when the dose of Urea reached 3.48gm/kg which is the actual dose being practiced by the farmers in the agricultural land. The weight of earthworms exposed to Urea decreased steadily with the increase in the dose of Urea. The loss in body weight changed with increased exposure time. The sharp decrease in weight of earthworms revealed that the high concentration of urea was very toxic to the worms or it could be lethal for the total population. However, at the low concentration of urea there was no significant change in morphology except reduction in body weight. The major effects on the earthworms could be seen in terms of the number of adult worms, their biomass and cocoon production which clearly indicates the general health of earthworms. The counting of the number of cocoons and juveniles was also done to estimate the harmful effects on their reproductive activity in the two types of fertilizers. The Juvenile and immature worms were also found to be influenced by urea application. In our experiment, mortality of all the 15 earthworms were seen in the dose of urea which is practically been applied in the agricultural land by the farmers i.e. 3.48gm/kg soil. The deleterious effects of urea on earthworm were found under this dose within 24hrs in the form of all dead worms with lesions and separation of the posterior body parts. Urea had a strong toxic effect on the earthworm Eisenia foetida; this can be as it exerted its toxic action by way of skin infiltration.

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