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# Comparative study of the effect of chemical fertilizer and organic fertilizer on *Eisenia foetida*

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**Abstract**
Earthworms are important soil organisms involved in organic matter decomposition, nutrient cycling, soil aeration and maintenance of soil fertility. The present study compares the effects of the chemical fertilizer urea and the organic fertilizer Kala Sona on the survival, biomass, length, activity and morphology of Eisenia foetida, together with histological examination of the clitellum region. Two experimental setups were conducted using different fertilizer concentrations and an untreated control. In the first setup, the project reported increasing mortality with increasing urea concentration, including 60% mortality at 1.5 g/kg after 20 days. In the second setup, 1.5 g/kg urea was reported as harmful and 3.0 g/kg as lethal by the trial-and-error procedure described in the project. Kala Sona-treated groups generally showed better survival, activity and biomass.

**Keywords:** *Eisenia foetida*, urea, Kala Sona, organic fertilizer, chemical fertilizer, clitellum, soil health

## Introduction

Earthworms are soil-dwelling invertebrates belonging to phylum Annelida and are described in the project as ecosystem engineers because they modify soil structure and contribute to nutrient cycling. They are important components of soil fauna and are associated with decomposition, humus formation, aeration and improvement of soil fertility.

Chemical fertilizers supply nutrients rapidly, but excessive use may affect soil organisms. Urea was selected as the inorganic fertilizer in this investigation. Kala Sona, described in the work as a humic-acid-rich organic soil conditioner, was selected as the organic fertilizer. Kala sona is high – concentration organic plant growth regulator and soil conditioner, predominantly containing 95% to 98% Humic acid. Chemical fertilizer mainly affects the clitellum region of the earthworm which leads to an improper reproduction.

The clitellum is a thick, glandular, saddle-shaped band found on the body of a sexually mature earthworm. It plays an essential role in reproduction. The clitellum is a glandular region of the body wall that secretes mucus during mating and forms the cocoon in which eggs are deposited and fertilized. Present on the 14th to 16th body segments in the common earthworm.

If the chemical fertilizers is used for long term then it will reduces the earthworm density (earthworm population) .Studies show earthworm population decline of 30-70% in intensively fertilized soils. Excessive use of chemical fertilizer can create toxicity and physiological stress on earthworm mainly the nitrogen rich fertilizers (eg.Urea). Continues use of fertilizer reduces the soil pH which makes it acidic which is unsuitable conditions for many earthworm species.

## Objective

The general recommendation for urea is 120kg/hectare in agricultural lands as per the Indian soil testing manual released in 2011 by the Department of Agriculture, Ministry of Agriculture, India. But Indian farmers overuse urea to achieve more productivity ignoring the negative effects on soil organisms particularly the earthworms. The objective was to compare the effects of urea and Kala Sona at different concentrations on *Eisenia foetida*, particularly survival, biomass, length, activity, morphology and mortality.

## Materials and Methods

### Preparation of experimental beds

The work describes beds containing 0.5 kg fine soil, 1 kg ploughed cow dung and 0.5 kg vermicompost, giving 2 kg total material in a 1:2:1 ratio. The beds were moistened and maintained with wet paper and regular watering.

### Experimental animals and setup

Ten mature earthworms of approximately similar age, body length and body weight were introduced into each plastic tub. One control set received no fertilizer. The first setup contained three urea treatments and two Kala Sona treatments. The second setup contained three urea treatments and three Kala Sona treatments, together with a control.

### Fertilizer doses

In the first setup, urea was used at 0.5, 1.0 and 1.5 g/kg, while Kala Sona was used at 0.5 and 1.0 g/kg. In the second setup, both fertilizers were used at 0.75, 1.5 and 3.0 g/kg.

### Measurements

Observations included number of surviving earthworms, biomass, length, activity, morphology and mortality. Length was measured using a thread and scale after the earthworm had stabilized.

## Results

### First experimental setup

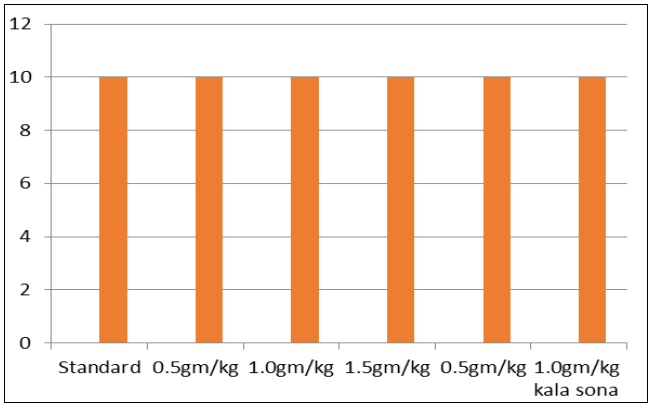
The work reports that all 10 earthworms remained alive in the control and both Kala Sona groups at day 20. At 0.5, 1.0

and 1.5 g/kg urea, 8, 7 and 4 worms remained alive, respectively. Thus, the 1.5 g/kg urea treatment showed 60% mortality. The work also reports slower movement and weakened condition in the higher-urea groups, whereas the Kala Sona groups showed healthier appearance, faster movement and greater biomass gain.

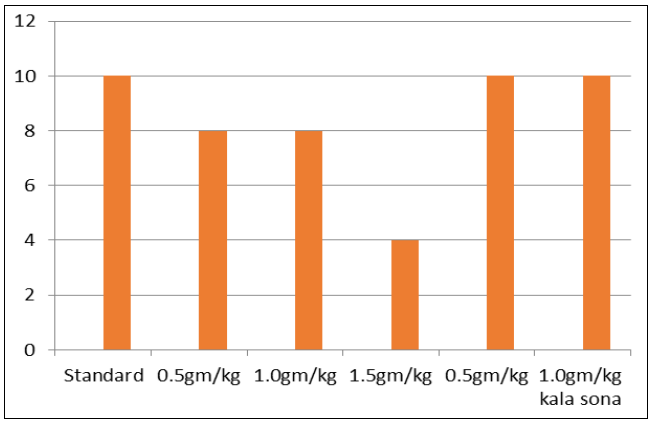
| Day | Parameter | Control | Urea 0.5 | Urea 1.0 | Urea 1.5 | Kala Sona 0.5 | Kala Sona 1.0 |
|---|---|---|---|---|---|---|---|
| 1 | Number | 10 | 10 | 10 | 10 | 10 | 10 |
| 1 | Biomass | 4.0 g | 2.0 g | 2.0 g | 3.0 g | 8.0 g | 8.0 g |
| 1 | Length | 6–7.5 cm | 4–5.5 cm | 4–5.5 cm | 4–5.5 cm | 10–11 cm | 10–11 cm |
| 10 | Number | 10 | 8 | 8 | 4 | 10 | 10 |
| 10 | Biomass | 5.0–5.5 g | 3.0 g | 3.0 g | 2.0 g | 9.0 g | 9.5 g |
| 10 | Length | 7–9 cm | 4.9–6.7 cm | 4.3–7.0 cm | 5.1–6.0 cm | 11–12 cm | 11–12.5 cm |
| 20 | Number | 10 | 8 | 7 | 4 | 10 | 10 |
| 20 | Biomass | 5.5–7.0 g | 4.0 g | 3.0 g | 2.0 g | 10.0 g | 10.5 g |
| 20 | Length | 7.5–9.5 cm | 5.0–7.8 cm | 8.0–9.0 cm | 5.6–6.4 cm | 11–12.5 cm | 11.2–12.9 cm |

**GRAPHS from the first experimental setup:**

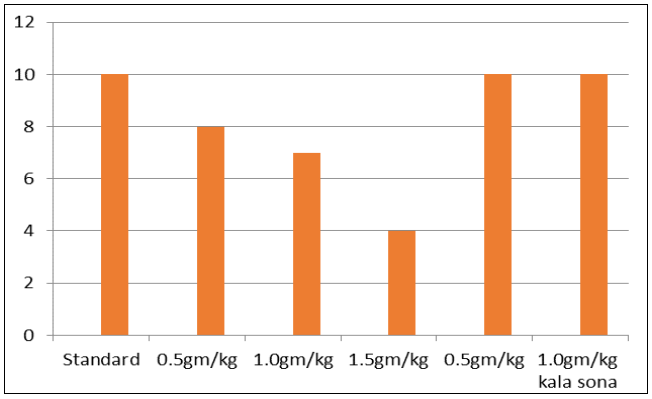
On 1st day the number of earthworm on y axis and concentration is on x axis.




On 10th day the number of earthworm on y axis and concentration is on x axis.




On 20th day the number of earthworm on y axis and concentration is on x axis.



**Second experimental setup**

The second setup produced a stronger dose-related response. On day 10, six worms remained in the 1.5 g/kg urea group and none remained in the 3.0 g/kg urea group, which the project labels a lethal dose. The project also records ten worms in the 0.75 g/kg urea group. For Kala Sona, ten worms remained at 0.75 and 1.5 g/kg, while the 3.0 g/kg group was recorded as a harmful dose with zero worms on day 10.In this experiment, the result states that the excessive concentration of any kind of fertilizer will be harmful for the earthworm.

| Day | Parameter | Control | Urea 0.75 | Urea 1.5 | Urea 3.0 | Kala Sona 0.75 | Kala Sona 1.5 | Kala Sona 3.0 |
|---|---|---|---|---|---|---|---|---|
| 1 | Number | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 1 | Biomass | 6 g | 5 g | 5 g | 6 g | 7 g | 5 g | 4 g |
| 1 | Length | 6–6.5 cm | 5.7–6.5 cm | 6.5–7.5 cm | 6–7.4 cm | 6.3–7.0 cm | 6.3–7.2 cm | 5.5–7.5 cm |
| 10 | Number | 10 | 10 | 6 | 0 (lethal) | 10 | 10 | 0 (harmful) |
| 10 | Biomass | 7 g | 6 g | 3 g | 0 | 8 g | 6 g | 0 |
| 10 | Length | 6.2–7.0 cm | 6.0–7.0 cm | 6.5–7.5 cm | – | 6.5–7.2 cm | 6.5–7.5 cm | – |

**Discussion**

Across the two experimental setups, the project reports a stronger adverse response to increasing urea concentrations than to Kala Sona. The response included reduced activity, lower biomass and mortality at higher urea concentrations. The organic fertilizer groups were generally described as healthier, more active and better nourished. The second setup strengthened the observed dose-related pattern, with the project reporting no survivors at 3.0 g/kg urea by day 10. And this dose is considered as the lethal dose.

**Conclusion**

The present investigation indicates that urea was more harmful to *Eisenia foetida* than Kala Sona (organic fertlizer) under the tested conditions. Increasing urea concentration was associated with increased mortality and reduced biological performance, while Kala Sona treatments showed comparatively favorable survival and biomass. This study may be useful to evaluate ecological risk from agricultural activities such as the application of agrochemicals, and to avoid ecological damage from inappropriate application of chemical fertilizers. Therefore, it is advised that the use of nitrogenous fertilizer like urea should be within ecologically safe limits and it is advised to use organic fertilizer in the place of inorganic fertilizer.

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