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Effect of Sugarcane bagasse on growth and reproduction of earthworm, (*Eisenia fetida* Savigny, 1826)

Pooja Yadav[1] and Sudesh Rani[2]

[1]Department of Zoology, Maharshi Dayanand University,
Rohtak-124001 (India)
E mail**:** sudesh_zoology@rediffmail.com

Abstract

Accumulation of sugarcane bagasse can be a cause of serious problems for the environment if not treated properly. So this study was planned to feed this organic waste to the earthworm, *Eisenia fetida*, and observe its growth and reproduction. Hence, three treatments, T1, T2, and T3 were designed in a total of 15 pots and each has five replicates. For bedding soil, manure and sugarcane bagasse were used in different ratios. The soil-to- sugarcane bagasse ratio in T1 was 3:1, the soil-to-manure-to- sugarcane bagasse ratio in T2 was 1:2:1, and the soil-to-sugarcane bagasse ratio in T3 was 3:1. Maximum growth (Specific growth rate (SGR %), live weight gain, % gain in body weight and survivability) was recorded in T2 and T3. All these parameters were recorded, with minimal in T1, where soil and sugarcane bagasse were mainly used in treatment. Also, high reproductive potential was recorded in treatments T2 and T3 as compared to T1. Hence, the sugarcane bagasse is considered to be good food for *E. fetida*, which increased growth and reproduction of this worm and hence earthworm can act as a good agent to convert organic waste material into a useful one.

Key words : Earthworm, growth, reproduction, sugarcane bagasse.

Bagasse is an uncanny material which included nearly 30%-40% of pith fiber. Sugarcane bagasse can hold more water due to its lignified surface area[8] . Carbon: nitrogen ratios are present in high amounts in the sugarcane bagasse[16,21]. Vermicomposting is an achievable procedure to discard lignocellulosic waste while producing beneficial product. Vermicompost as a pulverized form having more potential to hold water and porosity.

Various researchers have tested earthworm-processed wastes, usually called vermicompost, in the horticulture and agriculture industries[1,2,3]. Nowadays, sugarcane bagasse is used with the cattle dung for its biodegradation and accelerating their desirability for *E. fetida* and improving

[1]Dissertation Student, [2]Associate Professor and Corresponding Author,

physico-chemical properties[9]. *E. fetida* species of earthworms belongs to the epigeic category that lives in organic wastes. For growth and development of *E. fetida* suitable quantity of organic waste moisture conditions and dark conditions are required[10,11]. The main aim of this paper is to investigate the effect of sugarcane bagasse on the growth and reproduction of the earthworm (*Eisenia fetida*).

The experiment was conducted in the Animal Behaviour and Pathology Research Laboratory (17) of the Department of Zoology, Maharshi Dayanand University, Rohtak, Haryana.

Organic waste :

Sugarcane bagasse was used as the composting material; it was collected from the sugarcane juice corner, Rohtak. It was dried for about two weeks approximately. After drying, the sugarcane bagasse, crushed with the help of a grinder then after it was used as feeding material for the earthworm.

Bedding :

Soil and manure were used for Bedding. Approximately four-week old cow dung (manure) was used, which was collected from the Botanical Garden at Maharshi Dayanand University, Rohtak, Haryana (Figure 1). Materials for bedding and feeding purposes were cut into small pieces before being applied in the experiment. The moisture content of 80%–85% was retained by sprinkling water daily on the bedding.

Design of experiment:

The experiment consists of three treatments T1, T2, and T3 according to the different compositions of soil, manure, and organic waste (sugarcane bagasse) in the following ratios:

Treatment	Organic waste	Ratio
T1	soil and sugarcane bagasse	3:1
T2	soil, manure, and sugarcane bagasse	1:2:1.
T3	manure and sugarcane bagasse	3:1.

Eisenia foetida

Manure

Soil

Sugarcane bagasse

Figure1. Materials used in Treatment

Culture of E. fetida :

Earthworms for culture were brought from Bhoojevan Organics Farm located in Najafgarh, New Delhi. Before introduction of earthworms in different treatments, they were cleaned properly and measurement in the form of length (cm) and weight (g) were taken. After then in 15 pots, 15 clitellated earthworms were introduced (Figure 2). The experiment lasted for one month. No extra materials were added during the experimental period.

Fig 2. Introduction of *E. fetida* in treatmen

Sampling :

Sampling was conducted after an interval of six days up to four weeks. Soil temperature (27 °C–28 °C), soil pH (7.4) and soil moisture (80%–85%) were recorded during the experimental period.

Moisture percentage in soil=Weight of wet soil -Weight of oven dried soil/Weight of oven dried soil x100

A soil sample was dried in an oven at a temperature of 105 to 110 degrees Celsius for 24 h[17].

Determination of growth performance:

The growth parameters in the experimental pots were calculated[18].

- Earthworm survivability% = Number of earthworms that survive/Total number of earthworms ×100
- Live Weight Gain (in gm) = Wf– Wi
- Specific Growth Rate (SGR) (% g d -1) = lnWf– lnWi/t ×100
- Growth% gain in body weight = Wf– Wi/ Wi ×100

(Here In is natural logarithm, Wf is final weight, Wi is initial weight and t is the time duration of the experiment).

Determination of reproduction performance:

Cocoon production was checked at the time of sampling. Appeared cocoons were taken out of the experimental pots and carefully washed and their numbers were recorded.

Success rate of hatching :

These cocoons from each pot were transferred to small boxes containing the experimental bedding material. These boxes were monitored daily as the hatchlings appeared. As soon as the hatchlings appeared separations of hatchlings were performed manually with a fine painting brush and counted.

Statistical analysis :

The data were analyzed with a One way ANOVA including Turkey HSD.

Growth :

Live weight gain and growth % gain in body weight in T1 were firstly increased and then became constant. However,

Table-1. Growth of *E. fetida* under different treatments

Parameters	Treatments		
	T1	T2	T3
Live weight gain	0.02±0.02	0.05± 0.06	0.02±0.04
Specific growth rate (SGR)	0.5±0.30	0.45±0.52	0.26±0.40
Growth % gain in body weight	16.25±9.86	17.5±17.99	9.57±12.13
Survivability percentage	94.75±1.75	95.00±5.00	100±0.00

All the values are ±S.E. The results are significant at $p < 0.05$.

maximum values for both these parameters were observed in T2. On second and third sampling, live weight gain was recorded to be decreased in T2 and T3. But further at the time of termination of experiment i.e. after one month-increased values for this parameter were observed in T2. The same pattern for Specific Growth rate in was recorded in all treatments. Survivability was recorded maximum in T3 followed by T2 (Table. 1)

Reproduction :

The effect of feeding substrate was examined on total cocoon production rate. As a mature clitellated earthworms were used in experiment so on 6th day in T2 cocoon production were recorded and no Time to cease cocoon production was observed as it remained continued until termination of the experiment. While in T3, no cocoon production took place during the experimental period. Cocoon production was recorded significantly ($p < 0.05$) high in T2 than in T1. Cocoon production/Worm, reproductive potential and total no. of hatchlings emerged remained significantly ($p < 0.05$) higher in T2 than in T1 and T3 (Figure 3).

Decrease in growth parameters might be because of the depletion of food as due to reproduction number of earthworms increased[4,19]. Also for reproduction maximum energy is utilized by earthworm which becomes a reason for weight loss[13]. Specific growth rate plays an important role in comparing the growth of different organic wastes[15]. In addition to this, the type and quality of organic waste also important as far as the earthworm growth rate is concerned[12]. In this study, *E. fetida* was allowed to grow in T1 (soil and sugarcane bagasse, 3:1), T2 (soil, manure, and sugarcane bagasse, 1:2:1), and T3 (manure and sugarcane bagasse, 3:1) showed a sequence of moderate maximum and minimum growth and reproduction, respectively.

In present experiment as matured clitellated earthworm were used so cocoon production was seen after 6 days. In another study the cocoon production in different organic wastes started after 30 and 35 days[5,22]. Variation in the cocoon production under different compositions of the organic waste due to alteration of the Nutritional value[6,7].

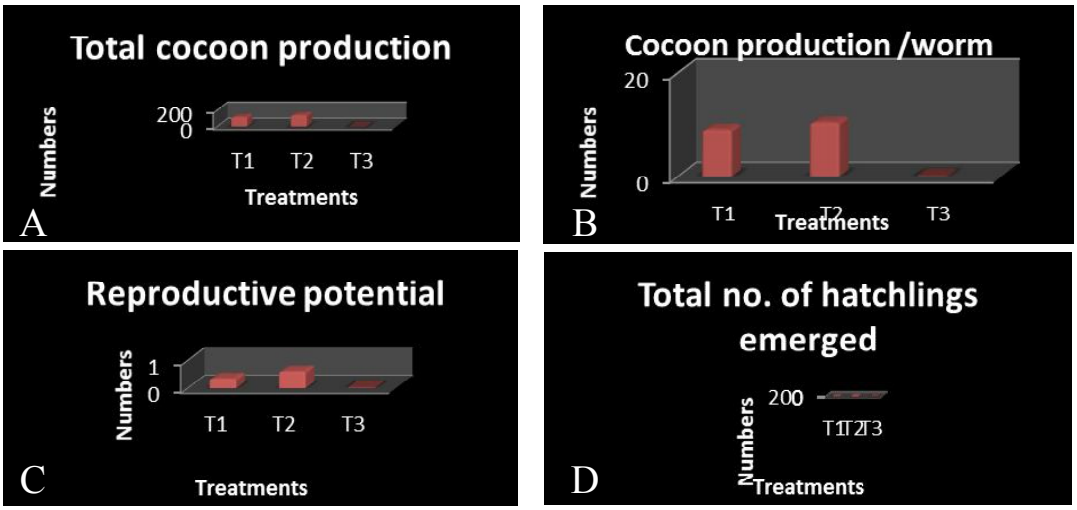

Figure 3. Reproduction of earthworm (*Eisenia fetida*) in sugarcane bagasse.
A. Maximum cocoon production in T2
B. Cocoon production/worm high in T2 and T1
C. Reproductive potential maximum in T2
D. Total number of hatchling emerged out remained high in T2

Also, during this study not even a single cocoon was seen in T3. In previous study 0.15–0.23 cocoons/worm/day production rate in different organic wastes were reported[20]. These results also bear a resemblance to present study. The organic matter and N content of the soil are critical for the growth and reproduction of earthworms[14]. The hatching success of *P. excavates* in response to N-content in the substrate was found to be very high[7]. In another study hatching success of 48.05%–67.24% was reported in the earthworm species *Perionyx excavatus* cultured in different organic wastes[5]. In present experiment, growth and reproduction were recorded as very poor in T3, where manure and sugarcane bagasse was taken in a ratio of 3:1. This may be because N-content in this substrate is not up to mark, which is necessary for the growth and reproduction of earthworm.

The sugarcane bagasse was found to be appropriate for the growth and reproduction of the earthworm *E. fetida* if incorporated into culture in a particular ratio along with other organic wastes. Hence, use of earthworm in the conversion of organic waste into useful manure is an environmentally friendly work.

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