VOLUME 8 ISSUE 2 2022

ISSN 2454-3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 8, No. 2, 130-135 (2022)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Influence of Autumn Leaves on Growth and Reproductive Performance of Earthworms (*Eisenia foetida*)

Yadav Priya and Rani Sudesh*

Animal Behaviour and Pathology Laboratory, Department of Zoology, Maharshi Dayanand University, Rohtak 124001, Haryana, India

**Corresponding Author*

Received: 12th June, 2022; **Accepted:** 20th July, 2022; **Published online:** 28th July, 2022

https://doi.org/10.33745/ijzi.2022.v08i02.016

Abstract: The present study evaluated the effect of autumn leaves as a food source on the growth and reproductive performance of *Eisenia foetida*. Three treatments, A, B, and C, each having five replicates, were designed in a total of 15 pots. For bedding soil, manure and autumn leaves were used in different ratios. The soil-to-leaf ratio in Treatment (A) was 3:1, the soil-to-manure-to-leaf ratio in Treatment (B) was 1:2:1, and the manure-to-leaf ratio in Treatment (C) was 3:1. Treatment C showed the most growth (Specific Growth Rate %, live weight gain, % gain in body weight and survivability) and was followed by Treatment B. All these parameters were recorded, with minimal in Treatment A, where soil and autumn leaves are mainly used in bedding. Also, high reproductive potential was recorded in treatments C and B as compared to A. Hence, the autumn leaves are good for the growth and reproduction of *E. foetida* provided the bedding has all the other nutritional requirements like manure and nutritive soil.

Keywords: Growth, Reproduction, Earthworm, Autumn leaves, Specific growth rate, *Eisenia foetida*

Citation: Yadav Priya and Rani Sudesh: Influence of autumn leaves on growth and reproductive performance of earthworms (*Eisenia foetida*). Intern. J. Zool. Invest. 8(2): 130-135, 2022.
https://doi.org/10.33745/ijzi.2022.v08i02.016

Introduction

Nearly 700 million tonnes of organic waste are generated annually in India, including leaves, husks, sawdust, peeling of stems, flowers, and other materials, which are either burned or dumped on land (Bhiday, 1994). One sort of organic waste that is handled by earthworms is leaf waste. When these are left on the soil surface in large quantities, they pose issues such as unpleasant odour and mosquito production. In Indian cities, dry leaves from avenues and fruit trees are typically burned to keep the environment clean, but at the same time, litter burning also contributes to air pollution (Abbasi and Ramasamy, 1999). So, vermicomposting is a more effective way to address these issues. It is one method for reducing organic waste, and it has been used successfully all over the globe. Vermicomposting is a low-cost technology that

converts agricultural waste into organic fertilisers by allowing earthworms and microorganisms to engage throughout the worm gut (El-Haddad *et al.*, 2014). Earthworms perform well in aerobic ecosystems, but their activity is limited in anaerobic ecosystems (paddy fields) (Zorn *et al.*, 2008; Schutz *et al.*, 2008), affecting their character as ecosystem engineers. *E. foetida* is an epigeic species that commonly feeds on plant debris and tolerates higher temperatures than other species (Senthil *et al.*, 2013), which allows it to thrive in warmer climates (typically above 43 °C) and those with cooler soil temperatures (often below 5 °C). Further, it is the best species for vermicomposting because of its short life cycle and high rate of reproduction and regeneration (Bhattacharjee and Chaudhuri, 2002; Banik and Chaudhuri, 2017). The present study evaluated the effect of autumn leaves as a food source on the growth and reproductive performance of *Eisenia foetida*.

Materials and Methods

The experiment was conducted in the Animal Behaviour and Pathology Research Laboratory of the Department of Zoology, Maharshi Dayanand University, Rohtak, Haryana, India. Autumn leaves were used as composting material, which were collected from the University Campus. Collected leaves were chopped into small pieces so that they could be easily ingested by earthworms during the process.

Bedding:

Bedding was done with soil and manure. Approximately four-week old cow dung (manure) was used, which was collected from the Botanical Garden at Maharshi Dayanand University, Rohtak, Haryana. The pH of manure was 7.9 (determined by the use of a pH meter). Autumn leaves were mainly used as feeding material. The experiment consists of three treatments (A, B and C) according to the different compositions of soil, manure, and organic waste (autumn leaves) in the following ratios:

Treatment (A): soil and leaves in a 3:1 ratio.

Treatment (B): soil, manure, and leaves in a ratio of 1:2:1.

Treatment (C): manure and leaves in a ratio of 3:1.

Materials for bedding and feeding purposes were cut into small pieces before being applied in the experiment. The moisture content of 75%–85% was retained by sprinkling water daily on the bedding.

Culture of E. foetida:

The experiment was conducted in the Wet Laboratory no. 17 of the Department of Zoology at Maharshi Dayanand University, Rohtak, Haryana. Three treatments (A, B and C), each having five replicates were used. Earthworms for culture were brought from Bhoojevan Organics Farm located in Najafgarh, New Delhi. In 15 pots, 15 clitellated earthworms were inoculated. Before inoculation in the pots the earthworms were cleaned properly, and measurement of length (cm) and weight (g) were taken. The experiment lasts for one month. No extra materials (soil, manure, leaves) were added during the experimental period.

Sampling:

Sampling was conducted after an interval of six days up to four weeks. The soil quality parameters such as soil temperature (26 °C–28 °C) , soil pH (7.6) and soil moisture (75–85%) were recorded during the experimental period. Soil sample was dried in an oven at a temperature of 105 to 110 °C for 24 h (Peace, 1983). The soil moisture was calculated as follow:

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

Determination of growth performance:

The weight of earthworms from the experimental pots were measured after an interval of six days for the growth parameters. The following growth parameters were calculated (Sogbesan and Ugwumba, 2006):

Earthworm survivability % = number of earthworms that survived/total number of earthworms ×100

Live Weight Gain (g) = Wf– Wi

Specific Growth Rate (SGR) (% g d $^{-1}$) = lnWf– lnWi/t ×100

Growth % gain in body weight = Wf– Wi / Wi ×100

Where Wf is final weight, Wi is initial weight, ln is natural logarithm and t is time duration of experiment.

Determination of reproduction performance and hatching success:

Cocoon production was checked at the time of sampling. Cocoons were taken out of the experimental pots and carefully washed and their numbers were recorded. For analysis of the success rate of hatching, cocoons from each pot were transferred to small boxes having the experimental bedding material. These boxes were monitored daily as the hatchlings appeared. For determination of the hatching success, separations of hatchlings were performed manually with a fine painting brush, they were separated and counted.

Statistical analysis:

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

Results

Growth performance and Reproductive performance of E. foetida:

Growth parameters, live weight gain, percentage gain in body weight, SGR, and survivability of *E. foetida* were initially increased for three weeks before declining in all treatments (Fig. 1). However, mean values for all of these parameters were significantly ($P < 0.05$) higher in Treatments B and C than in Treatment A. Among treatments B and C, all growth parameters (Mean) remained high as compared to treatment A (Fig. 2). The total cocoon production rate in autumn leaves was also examined. As mature clittellate earthworms were introduced into different treatments, cocoon production was observed on the 6th day in Treatments B and C only. When cocoon production begins, it continues until the 18th day of the experiment in both Treatments B and C. The cocoon production was observed to be significantly high ($P < 0.05$) in Treatment C (141 cocoons) and no cocoons were found in Treatment A till the completion of the experiment. The reproductive potential of earthworms in Treatments B and C was 0.34± 0.07 and 0.46±0.05, respectively (Table 1).

The number of hatchlings (incubation period of earthworms) was completed in 18 days. The highest total number of hatchlings (141), which comprised 6 hatchlings/cocoon, was observed in Treatment C followed by 123 hatchlings, comprised 7 hatchlings/cocoon, in Treatment B. Hatchling success in Treatment C and in B was 15 and 11%, respectively. The least or no incubation period was observed in set up A as no cocoon production was occurred (Table 1).

Discussion

At the time of experiment termination, decreased growth parameters were observed. This might be because of the depletion of food (Bhat *et al.*, 2016; Sonia *et al.,* 2016). Weight loss in earthworms is also related to sexual maturity as the earthworm utilises maximum energy for reproduction purposes (Jesikha and Lekeshmanaswamy, 2013). The specific growth rate is the most acceptable comparative index to compare the growth of different organic wastes (Meharaj and Manivannan, 2015). In the present study, *E. foetida* was allowed to grow in Treatment C (manure and leaves, 3:1), B (soil, manure and leaves, 1:2:1), and A (soil and leaves, 3:1) showed a sequence of maximum, moderate, and minimum growth parameters, respectively. In addition, the earthworm growth rate also depends upon the type and quality of organic waste (Jayakumar, 2018).

Birundha (2013) and Tran (2016) studied the cocoon production in different organic wastes which started after 30 and 35 days. In the present experiment, as the clitellated earthworms were introduced into culture, cocoon production was seen on the 6th day, and this ceased after four weeks in treatments B and C. There was not even a single cocoon seen in Treatment A. The fluctuations in the cocoon production may be because of the different composition of the organic

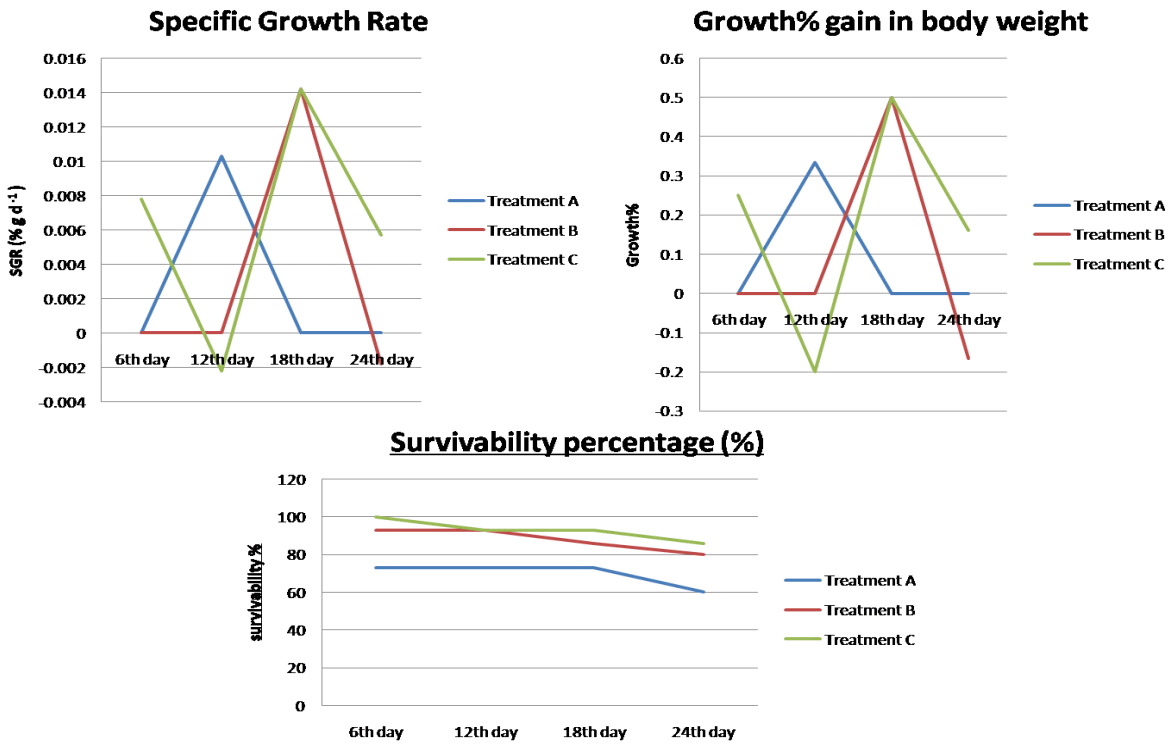

Fig. 1: Growth and survivability of *E. foetida* during experimental days.

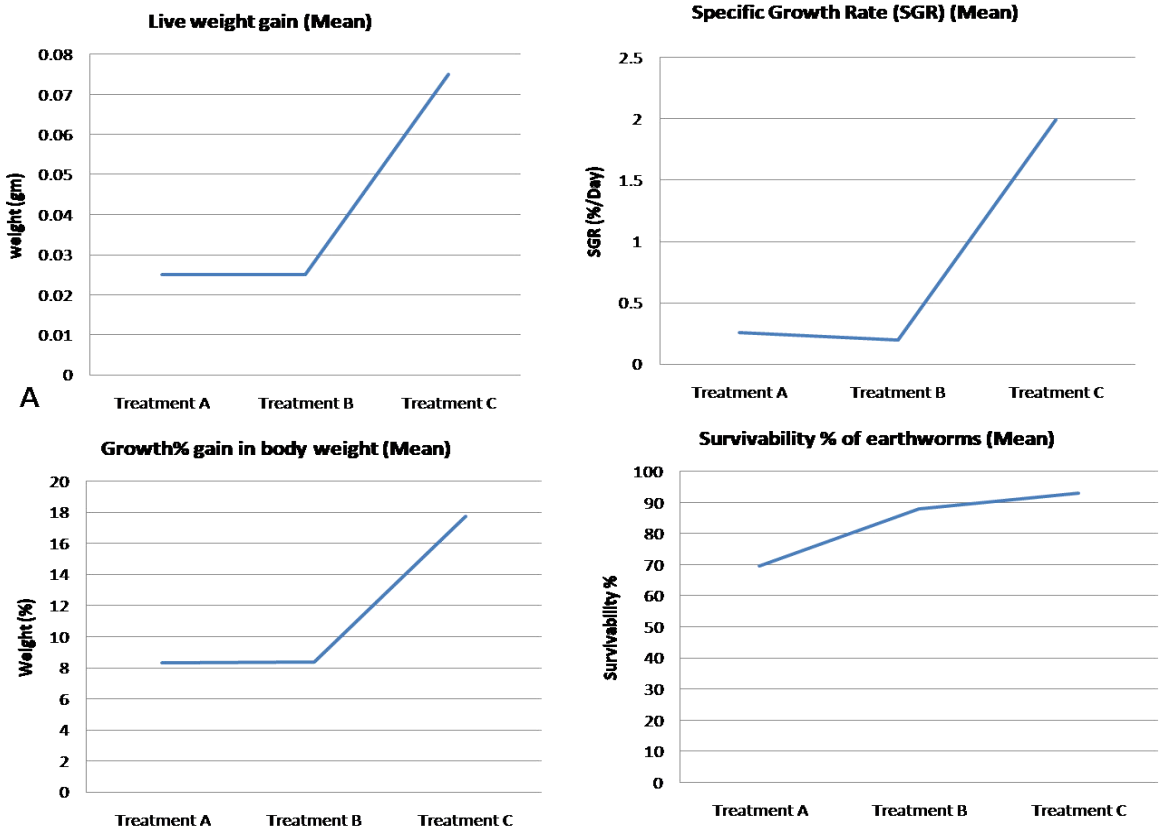

Fig. 2: Live weight gain, SGR, Growth % gain body weight, and survivability of *E. foetida* in different treatments.

Table 1: Reproductive performance of *E. foetida* under different treatments

Parameters	Treatment A	Treatment B	Treatment C
Cocoon production	×	6th day	6th day
Total no. of cocoon produced	×	123.8±0.37	142.6±0.68
Cocoon production/worm	×	9.0± 0.45	10.6± 0.40
Cocoon production/worm/day (Reproductive potential)	×	0.34±0.07	0.46±0.05
Time to cease cocoon production	×	18th day	18th day
Total no. of hatched cocoons	×	14±0.71	22±0.68
Hatching success	×	11%	15%
Total no. of hatchlings emerged	×	85.2±0.58	130.6±0.40
Hatchlings/Cocoon	×	6.6±0.40	5.6±0.40

The results are significant at P < .05

waste, which may alter the nutritional value (Degefe and Tamire, 2017; Coulibaly, 2019). Suthar (2006) reported 0.15–0.23 cocoons/worm/day production rate on different organic wastes. These results support the present study. A significant difference in the cocoons' hatching success was observed in different treatments. The emergence of hatchlings in the present experiment was significantly higher in treatment C than in treatments B and A. Birundha *et al.* (2013) reported hatching success of 48.05%–67.24% in the earthworm species *P. excavatus* cultured in different organic wastes. Degefe and Tamire (2017) observed that the hatching success of *P. excavates* in response to N-content in the substrate was very high. The growth and reproduction of earthworms directly depends upon the organic matter and N content of the soil (Kabi *et al.* 2020). In the present study, growth and reproduction were recorded as very poor in Treatment A, where soil and autumn leaves were taken in a ratio of 3:1. It may be that this soil is not rich in nutrition.

Conclusion

The autumn leaves were found to be appropriate for the growth and reproduction of the earthworm *E. foetida.* As a result, using autumn leaves, which are a rich organic waste, in vermicomposting and earthworm production is environmentally friendly. The quality of the soil is also important for *the* growth and reproductive performance of earthworm species.

Acknowledgements

The authors are thankful to the Head of Department of Zoology, Maharshi Dayanand University, Rohtak, Haryana, for providing facilities to carry out this study.

References

Abbasi SA and Ramasamy EV. (1999) Biotechnological methods of acids derived from earthworm-processed organic wastes on plant growth. Bioresour Technol. 84: 7-14.

Banik D and Chaudhuri PS. (2017) Regeneration ability in seventeen top soil and sub soil earthworm

species. J Environ Biol. 38(3): 393-399

Bhat SA, Singh J and Vig AP. (2016) Effect on growth of earthworm and chemical parameters during vermicomposting of press mud sludge mixed with cattle dung mixture. Procedia Environ Sci. 35: 425-434.

Bhattacharjee G and Chaudhuri PS. (2002) Cocoon production, morphology, hatching pattern and fecundity in seven tropical earthworm species--a laboratory based investigation. J Biosci 27: 283-294.

Bhiday MR. (1994) Earthworms in agriculture. Indian Farming 43(12): 31-34.

Birundha M, Paul JJ and Mariappan P. (2013) Growth and reproduction of *Perionyx excavatus* in different organic wastes. Int J Curr Microbiol Appl Sci. 2(2): 28-35.

Coulibaly SS, Ndegwa PM, Ayiania M and Zoro IB. (2019) Growth, reproduction, and life cycle of *Eudrilus eugeniae* in cocoa and cashew residues. Appl Soil Ecol. 143: 153-160.

Degefe G and Tamire G. (2017) Growth and reproductive performance of *Eisenia foetida* in three varieties of flower (rose, carnation and hypericum) leftovers. Entomol Nematol. 9(4): 29-35.

El-Haddad ME, Zayed MS, El-Sayed GAM, Hassanein MK and Abd El-Satar AM. (2014) Evaluation of compost, vermicompost and their teas produced from rice straw as affected by addition of different supplements. Ann Agric Sci. 59(2): 243-251.

Jayakumar V, Murugan SS and Manivannan S. (2018) Biodyanamics of epigeic earthworm *Eudrilus eugeniae* and *Eisenia fetida* during recycling of poultry waste amended with different organic food sources. Int Arch Appl Sci Technol. 9(4): 46-51.

Jesikha M and Lekeshmanaswamy M. (2013) Effect of pongamia leaf medium on growth of earthworm (*Eudrilus eugeniae*). Int J Sci Res Publ. 3(1): 1-4.

Kabi F, Kayima D, Kigozi A, Mpingirika EZ, Kayiwa R and Okello D. (2020) Effect of different organic substrates on reproductive biology, growth rate and offtake of the African night crawler earthworm (*Eudrilus eugeniae*). Org Agric. 27: 1-3.

Meharaj I and Manivannan S. (2015) Influence of poultry waste amended with different organic food sources on growth and reproduction performance of indigenous earthworms *Lampito mauritii* (Kinberg) and *Perionyx excavatus* (Perrier). Eur J Exp Biol. 5(6):1-6..

Schütz K, Nagel P, Dill A and Scheu S. (2008) Structure and functioning of earthworm communities in woodland flooding systems used for drinking water production. Appl Soil Ecol. 39: 342-351.

Senthil K, Satheesh KV, Uthaya K and Anbuganapathi G. (2013) Impact of biofertilizers on growth and reproductive performance of *Eisenia fetida.* Ann Rev Res Biol. 3(4): 574-583.

Sogbesan OA, Ugwumba AAA and Ibiwoye TII. (2006) Growth performance and nutritional of semi-arid zone earthworm (*Hyperiodrilus euryaulos*; Clausen, 1967) cultured in some organic wastes as fish meal supplement. Nigeria J Tropical Agricult. 8(3): 255-262.

Sonia V, Felix S and Antony C. (2016) Comparative study of growth and reproduction of earthworm *Eudrilus eugeniae* in different organic substrate. IRA Int J Appl Sci. 4(1): 61-68.

Suthar S. (2007) Nutrient changes and biodynamics of epigeic earthworm *Perionyx excavatus* during recycling of some agriculture wastes. Bioresour Technol. 98(8): 1608-1614.

Tran HD. (2016) Vermicomposting of spent mushroom compost using perionyxexkavatus and artificial nutrient compound. Int J Environ Agric Res. 2: 101-109.

Zorn MI, Van Gestel CAM, Morrien E, Wagenaar M and Eijsackers H. (2008) Flooding responses of three earthworm species, *Allolobophora chlorotica*, *Aporrectodea caliginosa* and *Lumbricus rubellus*, in a laboratory-controlled environment. Soil Biol Biochem. 40: 587-593.