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Comparative effect of different fertilizers on growth parameters of *Eisenia fetida*

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Abstract

The average growth rate of *Eisenia fetida* was measured in vermicompost prepared from different organic wastes i.e. cow dung + kitchen waste, cow dung alone, cow dung with mixture of different weeds and cow dung + congress grass. The maximum weight and length gain was observed in cow dung+ kitchen waste followed by cow dung alone. The earthworms did not exhibit much gain in weight and length when they were reared in cow dung with a mixture of different weeds and cow dung + congress grass. The weight gain by per earthworm was (1.54gm), (1.28gm), (0.75gm) and (0.65gm) in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively. Similarly the increase in length was (14.58cm), (11.20cm), (7.93cm) and (7.34cm), in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively. The experiment was conducted during the rainy season.

Keywords: *Eisenia fetida*, cow dung, kitchen waste, weeds and congress grass

1. Introduction

Earthworms are prominent invertebrates belonging to family lumbricidae and are dominant in the temperate and tropical soils. They are hermaphrodite but self-fertilization does not usually takes place. During laying eggs, the sexually mature worms exhibit distinctive epidermal ring shaped area called the clitellum, which has gland cells that secrete material to form a viscid, girdle like structure known as cocoon. The cocoons are small, with varying size according to species. The colour of the cocoon changes gradually as it develops from the freshly laid stage to the hatching stage. Though the number of fertilized ova in each cocoon ranges from one to twenty for lumbricid worms yet only one or two survive and hatch. Growth rate is very fast during initial 70 days life span. The mature worm can grow up to 1500 mg of body weight. Mature worm on average produce one cocoon every third day and one to three hatchlings emerge from each cocoon after three to four weeks of incubation. Though temperature tolerance range is good but they cannot withstand direct sunlight and temperature (Das *et al.*, 2002) [3]. During vermicomposting the number of adult worms, number of cocoons, weight gain, and worm population increased but vermicompost amount varied among different treatments (Kibatu *et al.*, 2015) [8]. Various organic wastes of different origin such as cow dung, kitchen waste, mixture of different weeds and congress grass was used as vermicompost for vegetable crop (Parveen Gill *et al.*, 2018) [10].

2. Material and Methods

Total four organic waste viz. kitchen waste, cow dung, parthenium, and mixture of different weeds were used as substrates for vermicomposting and 4 tubs of 70 liter capacity were taken for each treatment/organic waste under shady trees in the screen house area having a temporary shed made up of straw to prevent them from direct sunlight and rain fall. Kitchen waste was dried and crushed in to small pieces, Chaffed parthenium and mixture of weeds (<2.0 cm size) was weighed. The organic wastes were then mixed up separately with the cow dung in a ratio of 1:5, some water was added to the mixture for thorough mixing and subsequently 70 kg dry weight of the mixture was filled in each tub. Percent moisture in the mixture was calculated by keeping 1 kg of mixture in oven at 60 °C overnight. Cow dung alone was kept as control. One hundred healthy clitellated earthworms (*E. fetida*) were selected randomly, weighed and released in each tub, after 15 days. The tubs with different treatment were marked for the record. All these tubs were covered with gunny bags and sprinkled with water as and when required. The experiment was conducted for 90 days during the rainy season.

Various growth parameters like length, total number of the adult /cocoon and the total weight of earthworms were recorded.

2.1 Statistical Analysis

The standard statistical tools were used for analysis of data recorded in different experiments. The experimental design for screen house study was completely randomized block with four replicates (tubs). A critical difference (CD) was calculated between the treatments by CRD.

3. Result

Effect of different fertilizers on growth parameters of *Eisenia fetida* are shown in Fig.1, & 2 exhibiting the average growth of *E.fetida* in vermicompost prepared from different organic wastes. The maximum gain in weight and length was recorded in cow dung+ kitchen waste followed by cow dung alone. The earthworms did not show much gain in weight and length when treated with cow dung with a mixture of different weeds and cow dung + congress grass.

The weight gain by per earthworm was (1.54gm), (1.28gm), (0.75gm) and (0.65gm) in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively. The increase in length was (14.58cm), (11.20cm), (7.93cm) and (7.34cm), in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively.

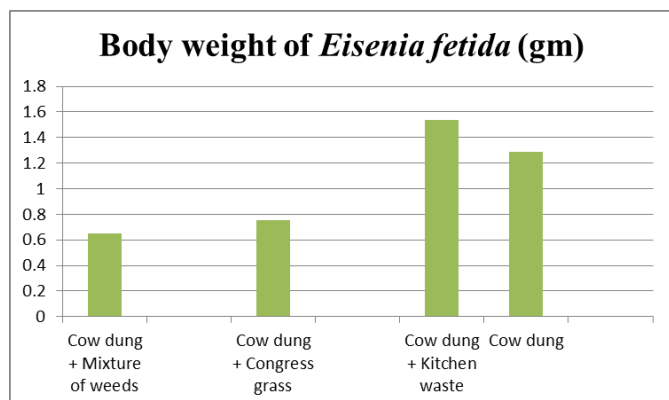


Fig 1: Average body weight of *Eisenia fetida* in different organic waste

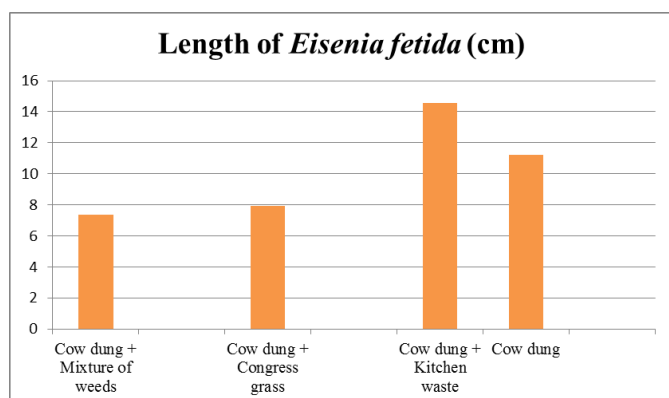


Fig 2: Average length of *Eisenia fetida* in different organic waste

Fig. 3 & 4 show the average reproductive biology of *E. fetida* in different organic wastes. The maximum number of cocoon and adult were observed in cow dung with kitchen waste followed by cow dung, cow dung with congress grass and a mixture of different weeds. Number of cocoon and adult in all the four treatments were found significantly different.

The total number of cocoon were (381.25), (349.25), (274.50) and (171.75) in kitchen waste, cow dung, congress grass and mixture of different weeds respectively. Similar observations were for the number of adult worms and they were (322.75), (233.75), (202.75) and (120), in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively.

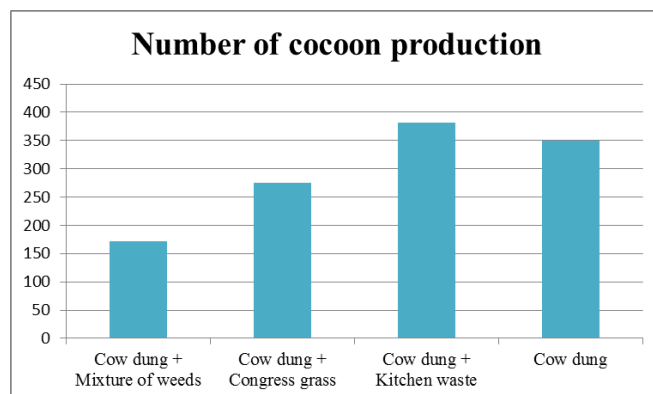


Fig 3: Average No. of cocoon produced by *Eisenia fetida* in different organic waste

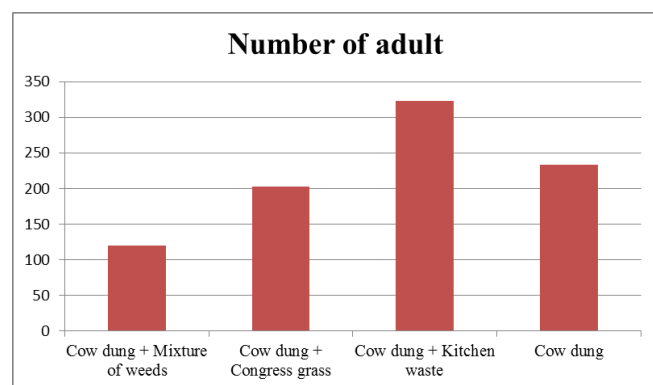


Fig 4: Average No. of adult (*E. fetida*) in different organic waste

4. Discussion

The Growth was observed in terms of biomass increase of earthworm in each treatment whereas the reproduction potential was determined by counting cocoon and the number of adult.

4.1 Survivability of adults

The 100 earthworms were incubated in each tubs having cow dung with different organic wastes (kitchen waste, cow dung, congress grass and mixture of different weeds) and the result showed the maximum survivability of worms in cow dung with kitchen waste followed by cow dung, cow dung+ congress grass and cow dung + mixture of different weeds.

4.2 Cocoon and number of adults

The maximum number of cocoon and adult was observed in cow dung with kitchen waste followed by cow dung, cow dung + congress grass and cow dung + mixture of different weeds.

The earthworm starts cocoon production at the age of 6 weeks and continues till the end of 6 months. One pair of earthworms can produce 100 cocoons in 6 weeks to 6 months under favorable conditions. The average incubation period of a cocoon is roughly about 3-5 weeks but in temperate worms it ranges between 3-30 weeks and 1-8 weeks in tropical worms (Ismail, 1997) [6]. Reinecke *et al.*,1992 [12] reported that

E. fetida had a wider tolerance range for temperature in comparison to the *Eudrilus eugeniae* and *Perionyx excavatus*. It can tolerate as high as 42°C as well as a low soil temperature upto 5°C.

Similar results were recorded about the reproduction efficacy of *Eisenia fetida* by some other researchers. The number of adults and cocoon in the present study were same in cow dung + congress grass and mixture of different weeds and cow dung (Joshi and Chohan, 2010 & Shivakumar. S, 2009) [7, 14]. The results were also similar for average production of one cocoon every third day by mature worm and one to three hatchlings emerge from each cocoon after three to four weeks of incubation.

The reproduction efficiency and total number of cocoon recorded in cow dung with kitchen waste were similar as observed by (Bharadwaj. A, 2010) [1], (Tripathi, G. *et al.*, 2004) [17]. Edwards *et al.*, 1998 [4] concluded that the important difference between the rates of cocoon production in the two organic wastes must be related to the quality of the waste material. The average rate of cocoon production was 7.23 worms /week in the monsoon season (Biradar *et al.*, 1999) [2]. The waste decomposition and the earthworm production were associated strongly with the quality of the substrate especially with the chemical as well as the biological composition of the substrate (Surendra Suthar, 2006) [16]. The difference for cocoon production rate in present and the past studies could be related to the quality of the substrate. The maximum rate of cocoon production by *E. fetida* 3.8 cocoons per week at 25 °C, and maximum number of 10.4 cocoons per week at 20 °C by Edwards, 1988 [5] and Rodriguez *et al.*, 1986 [13] recorded seven cocoons per earthworm per week at 30 °C.

4.3 Growth of earthworms

The maximum weight and length gain was observed in cow dung with kitchen waste followed by cow dung alone, but in case of cow dung with mixture of different weeds and parthenium the earthworms showed least gain in weight and length.

The mean weight was observed (1.54gm), (1.28gm), (0.75gm) and (0.65gm) in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively and mean length was (14.58 cm), (11.20cm), (7.93cm) & (7.34cm), in kitchen waste, cow dung, congress grass, and mixture of different weeds respectively.

The observation on weight and length gain by earthworms in case of cow dung with kitchen waste were similar as observed by (Tripathi, G. *et al.*, 2004 and Bharadwaj, A. 2010) [17, 1]. Maximum mean weight of the adult earthworms was achieved in winter at the lowest temperature, but these large-sized earthworms showed the lowest mating activity. *E. fetida* can reach nearly 1.6 g in laboratory conditions. (Venter and Reinecke, 1988) [18]. The weight gain by earthworms in cow dung matched with observations taken by Siddique, J. *et al.*, 2005 [15]. The loss in weight and length of earthworms in case of cow dung with mixture of different weeds or parthenium were similar to the observations by Raipat. B.S. 2010 [11] and Shivakumar, S.2009 [14]. Reproduction potential and growth rate in the present investigation was possibly due to depression of food intake and utilization of major proportion of the absorbed food energy in to the metabolism as observed by Lett *et al.*, 1976 [9].

5. Conclusion

The maximum number of cocoons 381, were observed in cow dung+ kitchen waste followed by 349, 274 and 171 in cow dung, congress grass +cow dung and cow dung + mixture of different weeds respectively. The maximum number of adult 322, were observed in cow dung+ kitchen waste followed by 233, 202 and 120 in cow dung, congress grass +cow dung and cow dung + mixture of different weeds respectively. The maximum weight gain 1.54gm was observed in cow dung+ kitchen waste followed by 1.28gm, 0.75gm, and 0.65gm in cow dung, congress grass +cow dung and cow dung + mixture of different weeds respectively. The maximum gain in length 14.58cm was recorded, in cow dung+ kitchen waste followed by 11.20cm, 7.93cm, and 7.34cm in cow dung, congress grass +cow dung and cow dung + mixture of different weeds respectively, so kitchen waste was best for various growth parameters of *Eisenia fetida* among all the treatments .

6. Acknowledgement

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