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Growth and Reproduction of Earthworm (*Eisenia fetida*) in Different Organic Media

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Abstract.- The study was designed to evaluate the growth and reproduction of *Eisenia fetida* on different locally available organic manures, i.e., cow manure, sheep/ goat manure and dry leaves. The growth and reproduction of *Eisenia fetida* was measured by studying parameters, such as, gain in body weight, number of cocoons produced and number of hatchlings emerged. These worms were grown in these organic manure for about six months. The growth rate of *Eisenia fetida* was significantly higher ($P<0.05$) in cow manure as compared to dry leaves, sheep/goat manure and simple soil. Sheep/goat manure showed mortality after about tenth week of inoculation. The cocoon production was significantly greater ($P<0.05$) in cow manure than in dry leaves. Cocoon production was not observed in sheep/goat manure and simple soil. Hatchlings production was also significantly higher ($P<0.05$) in cow manure i.e., 120 hatchlings as compared to dry leaves with 73 hatchlings produced during this experiment. It has been concluded that cow manure is a better medium for growth and reproduction of *Eisenia fetida*.

Key words: Organic manures, cocoon production, earthworm, organic media for earthworm, *Eisenia fetida*.

INTRODUCTION

Earthworms are the soil dwelling invertebrates, which have great agricultural importance. They influence the soil structure by ingestion, which leads to the break down of organic matter and its ejection as a surface or subsurface cast (Nijhawan and Kanwar, 1952; Edwards and Lofty, 1977). One of the most promising worms for vermicomposting is *Eisenia fetida*. Its biology and main environmental requirements have been extensively reported (Kaplan *et al.*, 1980; Hartenstein *et al.*, 1981; Reinecke and Venter, 1987; Edwards, 1988). *E. fetida* is an earthworm which grows rapidly (Neuhauser *et al.*, 1980), reproduces prodigiously (Hartenstein *et al.*, 1979), is potentially deployable for management of wastes rich in microbial biomass (Hartenstein, 1981), and is possibly more efficient on a time-space scale for production of animal protein (meat, in contrast to eggs and milk) than any other organism husbanded at present (Hartenstein, 1981).

E. fetida is a manure worm, which is used at commercial scale to produce compost for use in agriculture. The hardy nature of this worm can help tolerate wide fluctuation of temperature and

humidity. This enables easy culturing of this species. Growth rate is very fast and its duration is 70 days. The mature worm can grow up to 1500 mg of body weight. Mature worm, on the average, produces one cocoon every third day and one to three baby worms emerge from each cocoon on hatching after three to four weeks of incubation. Though temperature tolerance is good, it cannot withstand direct sunlight and temperature (Das *et al.*, 2002).

MATERIALS AND METHODS

Experiment was conducted in Vertebrate Pest Control Laboratory, PMRP/IPEP at National Agricultural Research Center, Islamabad during the period from 30 October 2002 to 14 May 2003, where the stock of *E. fetida* is being maintained for the past 8 years.

Cultivation

Three organic manures, i.e., cow manure, sheep/goat manure and dry leaves were tested for culturing of *E. fetida*. Simple soil was taken as control. All the materials were ground, separately dried and sieved through mesh size of 3.35 mm. The pH values of these organic manures were noted to check the suitability of these media for culturing of *E. fetida*.

Five replicates of each medium were taken in

twenty containers, five for each of the three media and control group. Each container was filled up to the level so that each medium occupied a depth of 6cm. All the containers were weighed before and after filling. The moisture content was adjusted in each medium by adding water, and it was different for each medium *i.e.*, cow manure 150%, leaves 50%, sheep/goat manures 200%, and simple soil 20%. These containers with media were subsequently left for five days indoor at laboratory temperature and adjusted moisture contents for stabilization of these media before the start of experiment.

Inoculation

Forty preclitellate specimens of *E. fetida* were collected from stock culture. A pair of preclitellate worms was weighed for recording its biomass and then was placed in each of the twenty containers of different organic media. All the containers were covered with pieces of smooth cotton cloth held by rubber bands to prevent earthworms from escaping.

Parameters

The growth and reproduction of *E. fetida* in different organic media were tested by measuring alteration in biomass, number of cocoons produced and number of hatchlings emerged out of these cocoons on weekly basis. All the hatchlings produced were taken out of the media to save them from extreme diverse conditions in these containers.

Replacement of media

After every ten weeks, organic manures were replaced fifty percent twice during six months period.

RESULTS AND DISCUSSION

Effect of different organic manures on biomass of earthworm

Worm pairs were added in each of twenty containers of different organic manures. High growth was observed in cow manure after sixteen weeks of inoculation. Figure 1 shows the growth rate in dry leaves and simple soil. Comparison of these results showed that weight gain by worms in cow manure was significantly higher than that in dry

leaves ($F_{1-52} = 69.017$, $P=0.0000$) and simple soil ($F_{1-52} = 335.83$, $P=0.0000$). Growth rate in dry leaves was significantly higher than that in simple soil ($F_{1-52} = 419.45$, $P=0.0000$). Sheep/goat manure showed continuous mortality after the replacement of medium due to its acidity *i.e.*, pH of 6.0 (Table I), hence it was excluded. It was concluded that cattle manure could serve as excellent food source for *E. fetida*.

Table I.- pH values of different culturing media used in experiment.

Organic manures	pH values
Cow manure	8.5
Dry leaves	7.4
Sheep / goat manure	6.0
Simple soil	7.2

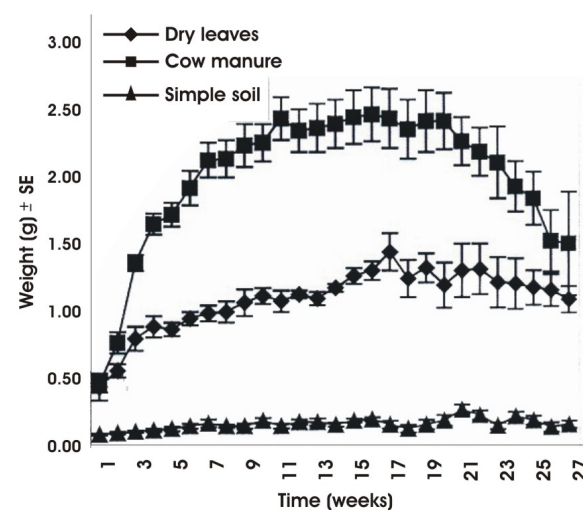


Fig. 1. Effect of different organic manures on biomass of earthworm, *Eisenia fetida*.

The present study showed that if high growth and reproduction rates were to be achieved, regular feeding of the worms was required. Neuhauser *et al.* (1980) found a relationship between growth and population density of *E. fetida* in cow dung, horse dung or activated sludge. When incubated individually worm masses increased to levels as high as 2 g. When population densities were 10 and 53 worms/liter maximum worm masses amounted to 0.08 and 0.3 g/worm, respectively. The present

study also confirmed this finding because when earthworms were incubated in pair, they attained the maximum biomass of 2.5 g in cow manure and 1.4 g in dry leaves. Control group showed no marked variation in biomass. According to Neuhauser *et al.* (1980) this difference can be attributed to cocoon production (individually incubated worms do not produce cocoons), competition for food and the toxicity of worm excreta.

When conditions were unfavorable the size was reduced. This being the case in the culturing of *E. fetida* at the end of experiment when temperature exceeded the optimal value.

Cocoon production in different organic media

Cocoon production was observed only in cow manures and dry leaves. In cow manure, premature worms started producing clitella after two weeks and after the third week, the cocoons were observed first time. At that time worm pairs attained the average weight of about 1.69 g. The cocoons production increased till the end of experiment and showed peak after twenty-seven weeks of inoculation (Fig. 2.). A total of 210 cocoons were produced over a period of six months in all the five replicates.

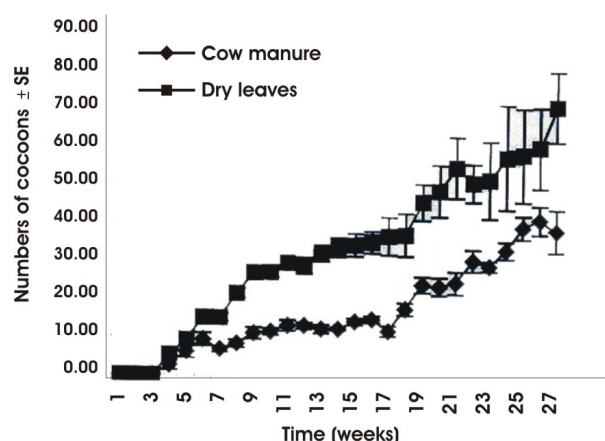


Fig. 2. Effect of different organic manures on production of Cocoons of an earthworms, *Eisenia fetida*.

Cocoons were produced in dry leaves after third week, but the number of cocoons were less as compared to those in cow manure (Fig. 2.). Average biomass of worm pairs was about 0.92 g, when they

started producing cocoons. Size of cocoons was also less but normal growth occurred. In total, 116 cocoons were produced in all the five replicates of dry leaves over the period of entire study. Comparison of these results showed that cocoon production was significantly greater in cow manure than in dry leaves ($F_{1,52} = 12.745$, $P = 0.00077$).

In sheep/goat and control group, no cocoons were observed throughout the experiment. In simple soil, the only variation that occurred on weekly basis was alteration in paired worm's biomass, which was affected by climatic changes, *i.e.*, temperature variation and moisture content. There was marked increase in biomass and cocoon production with time till the end of experiment. This contrasts with the findings, where cocoon production and cocoon viability tend to decrease with age after motivation (Venter and Reinecke, 1987).

Bostrom (1988) mentioned that the quality of the food source might influence cocoon production. In our studies, earthworms were fed on different food sources but in each treatment the food source remained unchanged. Figure 2 shows the rate of cocoon production in cow manure and dry leaves. These results showed that high cocoon production was observed in cow manure than in dry leaves.

Production and growth of hatchlings

Hatchlings production was observed in cow manure and dry leaves. Results showed greater hatchlings production in cow manure as compared to dry leaves. In cow manure a total of 120 hatchlings were produced from 219 cocoons over the time of six months in all the replicates. In case of dry leaves 73 hatchlings emerged from 115 cocoons, remaining cocoons did not hatched during six months period. Figure 3 also illustrates that high number of hatchlings was observed in cow manure.

The hatchlings were continuously produced till the end of experiment. But the comparison of these results showed no significant difference for hatchlings production in cow manure and dry leaves ($F_{1,52} = 2.44$, $P = 0.12$). In sheep/goat manure and simple soil, no cocoon was observed, they showed no hatchling production. During the present study it has been observed that the use of food by earthworms is influenced by various factors such as

available moisture, particle size and the organic content of the substrate (Neuhauser *et al.*, 1980; Reinecke and Venter, 1987). These factors were kept constant in the experimental groups and therefore, could not have affected the results.

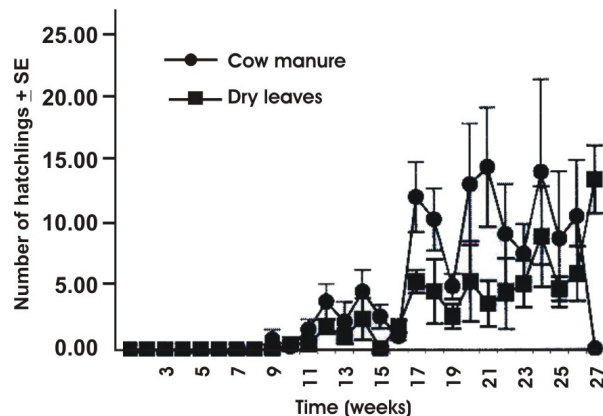


Fig. 3. Effect of different organic manures on hatchling production of an earthworm, *Eisenia fetida*.

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