

Variations in the Cocoon Production and Hatching Ability in Earthworm *Eisenia fetida* During Different Season Fed with Different Organic Wastes

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Abstract

Variations in the cocoon production and hatching ability of earthworm *Eisenia fetida* in different season and with different organic waste were recorded fed ad libitum on stabilized cattle dung (T₁), press mud (T₂), banana waste (T₃) and a combination of T₁, T₂ and T₃ in equal proportions (T₄). The study revealed that the average cocoon production ranged from 13.0 to 16.0 per worm during rainy season, 24.5 to 29.0 during winter season and 7.0 to 9.5 cocoons during summer season. The cocoon production was highest during winter season, which gradually decreased during rainy season and the production was least during summer season irrespective of the feed. The average rate of hatching ability per cocoon varied from 0.5 to 1.9 hatchlings per cocoon. The overall hatching ability reduced comparatively during summer season.

Key words : *Eisenia fetida*, Cocoon, Hatchlings, Cow dung, Press mud.

The life cycle of *E. fetida* is simple with only juvenile and adult stages. There are no distinguishing characters between different age groups. After hatching the worms undergo rapid growth for a period of 5 to 6 weeks. Clitellum develops at the end of sixth week. Clitellum appears as a thick muscular band at the 1/3 region of the anterior portion of the body indicating sexual maturity. Adult worms cannot be differentiated into age group depending on the external characters. However, they can be maintained separately and age determined and classified into adult I, adult II and adult III, depending as length and weight of the worm.

Earthworms face feeding constraints depending on external abiotic parameters (1, 2), and relatively poor nutritive resources in the soil systems (3,4), movements in compact soil strata and also unfavorable climatic conditions and ultimately determined by their internal digestive capacity (5). Cattle dung fed to earthworms gives high growth and rate of reproduction (6,7). Moreover the temperature in the laboratory or field is suitable for continual activity of *E. fetida* fed on Cattle dung (8). The worms reached sexual maturity between three and seven months with breaks in cocoon production (9). The energy budgets for

individual organisms, different stages and their population studies have been well documented (10).

It is epigeic, litter dweller and feed on high organic matter content with an energy rich diet. Growth occurs at an optimum temperature of 20 to 28°C and hatching at 25°C. Hatching occurs about 3 weeks after cocoons (egg cases) were deposited. When fed *ad libitum* with sufficient space it grows a maximum of about 1.5 gram (present study). After 8 to 10 weeks of growth, it declines in size and suffer mortality till about 12 weeks to sometimes 17 weeks. Therefore, the present investigation was carried out with a view to find out the seasonal variations in the cocoon production and hatching ability of earthworm *Eisenia fetida* fed with different organic waste.

Methods

The epigeic earthworm *Eisenia fetida* was cultured under laboratory conditions. Fed *ad libitum* on cattle dung (decomposed and stabilized) at room temperature with 70 to 80% humidity/moisture maintained by sprinkling of required amount of tap water.

Cattle dung was collected from the nearby cattle farm and left in the specially constructed beds for the

microbial activities to take place and it was allowed to stabilize for 15 days to 20 days or till the warmth subsides. Press mud was collected from sugar factory. It is the by-product in sugar mills with the residue obtained from sedimentation of the suspended materials such as fiber, wax, ash soil and other particles from cane juice. Banana waste was collected from banana farm. It included the leaf, stem and tuber. It was left to decompose by keeping it moist for few days or till the warmth subsides.

The different feed substance were decomposed and stabilized before being used for the study. Earth worm *Eisenia fetida* were reared under laboratory condition fed ad libitum on stabilized cattle dung (T_1 – control feed), press mud (T_2 – experimental feed), banana waste (T_3 – experimental feed) and T_4 – experimental feed with combination of T_1 , T_2 and T_3 in equal proportions (1 : 1 : 1), during different seasons (rainy, winter and summer season) with 75 to 80% moisture throughout the study period. Three replicates (10 worms/replicate) of earthworms were exposed to different experimental feed (T_1 , T_2 , T_3 and T_4). Cocoon production and hatching ability were recorded for the above replicates. Cocoons were isolated and incubated till the juveniles were hatched to know the hatchability and the above observations were subjected for different season.

Results and Discussion

During rainy season at $28 \pm 2^\circ\text{C}$ E. *fetida* requires 80 to 100 days for the completion of growth period. After attaining the maximum weight it lost weight as a function of age. As the age progressed cocoon production reduced along with diminished feeding activity. Immature, pre-reproductive period, lasted 20 days from hatching. The next 20 days reproduction starts, by way of production of cocoons and can be called pre-reproductive stage/immature period through the worms produce cocoons. It can be referred to as initiated reproductive period. *E. fetida* produced cocoons from the initiated reproductive period (after day 20) to day 40, 60 and 80 and even after day 80 to day 100 in some cases. The average cocoon production ranged from 13.0 to 16.0 per worm during rainy season with different feed T_1 , T_2 , T_3 and T_4 .

The average cocoon production during winter

Table 1. Mean cocoon production and hatchability in *Eisenia fetida* fed ad libitum different feed T_1 (Cattle dung), T_2 (Pressmud), T_3 (banana waste) and T_4 (mixed food) during different seasons.

Season	Food	Age Group	Cocoons/ age	Cocoons/ worm	Hatchlings/ cocoon	
Rainy season	T_1	Adult ₁	7.5	16.0	1.6	
		Adult ₂	8.5			
	T_2	Adult ₁	7.0	14.5	1.3	
		Adult ₂	7.5			
	T_3	Adult ₁	6.0	13.0	1.4	
		Adult ₂	7.0			
	T_4	Adult ₁	6.5	15.5	1.7	
		Adult ₂	9.0			
	Winter season	T_1	Adult ₁	8.5	29.0	1.9
			Adult ₂	10.0		
		T_2	Adult ₁	8.0	25.5	1.6
			Adult ₂	8.5		
T_3		Adult ₁	8.0	24.5	1.6	
		Adult ₂	8.5			
T_4		Adult ₁	8.5	27.5	1.8	
		Adult ₂	9.0			
Summer season		T_1	Adult ₁	4.0	8.5	1.0
			Adult ₂	4.5		
		T_2	Adult ₁	3.5	7.5	0.5
			Adult ₂	4.0		
	T_3	Adult ₁	3.5	7.0	0.6	
		Adult ₂	3.5			
T_4	Adult ₁	4.5	9.5	1.3		
		Adult ₂	5.0			

season ranged from a minimum of 24.5 with T_3 feed and a maximum of 29.0 with T_1 feed per worm. The average cocoon production during summer season ranged from a minimum of 7.0 cocoons with T_3 feed and a maximum of 9.5 cocoons with T_4 feed. The cocoon production was highest during winter season, which gradually decreased during rainy season, and the production was least during summer irrespective of the type of feed (Table 1).

In the present study the cocoons were incubated for 25 ± 2 days and the hatchlings were isolated after the incubation period (Table 1). The average rates of hatchling per cocoon during rainy season (T_1 –1.6, T_2 – 1.3, T_3 –1.4 and T_4 – 1.7), minimum of 1.3 hatchlings with T_2 feed and maximum of 1.7 hatchlings with T_4 feed. The rate of hatching increased during winter season with (T_1 –1.9, T_2 – 1.6, T_3 –1.6 and T_4 – 1.8)

minimum of 1.6 hatchlings per cocoon with T_2 and T_3 feed and maximum of 1.9 hatchlings with T_1 feed. The overall hatching ability reduced comparatively during summer season ($T_1-1.1$, $T_2-0.5$, $T_3-0.6$ and $T_4-1.3$) minimum with 0.5 hatchlings per cocoon with T_2 feed and maximum of 1.3 hatchlings per cocoon with T_4 feed. During rainy, winter and summer season with all the feed types T_1, T_2, T_3 and T_4 the mean cocoon weight ranged between 24.8 mg to 27.8 mg with the mean cocoon moisture of 71.2 to 79.7%.

References

1. Laverack M. S. 1961. Tactile and chemical perception in earthworms II. Responses to acid pH solutions. *Comp. Biochem. Physiol.* 2 : 22—34.
2. Bayne B. L. and J. Widdows. 1978. The physiological ecology of two populations of *Mytilus edulis* L. *Oecologia* 37 : 37—62.
3. Wei-xing Zhu and M. Carreiro Margaret. 1999. Chemoautotrophic nitrification in acidic forest soil along an urban to rural transect. *Soil. Biol and Biochem.* 31 : 1091—1100.
4. Lee K. E. 1959. *The earthworm's fauna of New Zealand.* N. Z. Dep. Sci. Indust. Res. Bull. 130.
5. Lofty J. R. 1974. Oligochaetes. In C. H. Dickenson and G. J. F. Pugh. (eds). *Biology of plant litter decomposition.* Volume 1. Academic Press, N Y, USA.
6. Reinecke A. J., and S. A. Viljoen. 1990. The influence of feeding patterns on growth and reproduction of the vermicomposting earthworm *Eisenia fetida* (Oligochaeta). *Biol. and Fert. Soils* 10 : 184—187.
7. Biradar P. M. 2000. *Biology of epigeic earthworm, Eisenia fetida (Savigny 1826) in semiarid region of Karnataka and its role in biodegradation of organic wastes.* Ph. D. thesis. Gulbarga Univ. India. 140 pp.
8. Kale R. D. and K. Bano. 1984. Time and space relative population growth pattern of earthworm *Eudrilus eugeniae*. *Nat. Symp. on soil pest and soil organism.* 29—31 Oct. BHU, Varanasi, India. 24—25 pp.
9. Kale R. D., and R. V. Krishnamoorthy. 1982. Cyclic fluctuations in the populations and distribution of three species of tropical earthworms in a farmyard garden in Bangalore. *Rev. Biol. Soil* 19 : 63—71.
10. Vernberg F. J. and W. B. Vernberg. 1975. Adaptations to extreme environments. In F. J. Vernberg (ed). *Physiological ecology of estuarine organisms.* Univ. South Carolina Press, Columbia.