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A STUDY ON LIFE CYCLE OF EARTHWORM *EISENIA FOETIDA*

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ABSTRACT

The Chinese epigeic earthworm Eisenia foetida is a surface feeding earthworm. In the present study the Eudrilus eugeniae were grown in cow dung and their life cycle were studied in different days of intervals like 15, 30,45 and 60 days. The important parameters such as Cocoon production, Hatchlings, Total Biomass and Length of earthworms were measured. The cocoon production was started at after 30 days and hatchlings were released after 45 days.

Key words: *Eisenia foetida,* Life cycle, Cow dung.

INTRODUCTION

Earthworms are a group of soil macrofauna well known for their considerable contribution in organic matter recycling. The worms have long been associated with productive soils. They modify soil structure, fertility, improve plant growth and are important in sustaining productivity (Buckerfield, 1998). Earthworm is one which has always interested to mankind, it is nature's own tiller, aerator, crusher, composter, moisture builder of the top soil and above all is soil's intimate friend and benefactor (Watanabe, 1975 and Lal, 1988). Earthworms play a vital role in soil fertility through the influence on water regime, aggregation, litter incorporation, soil organic dynamics and microbial activity (Briones et al., 1998). The Chinese epigeic earthworm *Eisenia foetida* is a surface feeding earthworm (Graff, 1974 and Tsukamoto and Watanabe, 1977). The life cycle has been thoroughly investigated and reported by Venter and Reinecke (1988). The compost worm*E. foetida* is widely studied as an organic decomposer (Hartenstein and Bisesi,

1989). *E. foetida* lives mainly on dead plant material (Neuhauser et al., 1980). *E. foetida* is dark brown in colour with yellow colour in the tip of the tail. The adult worms are about 5-7 cm in length, 3-5mm in diameter and 500-600mg of biomass (Venter and Reinecke, 1988). It has a temperature tolerance of 29^{o}C and high level of moisture. The worms initially grow very slowly during the first 30 days, and then the growth rate of the worm increased steadily and reaches a mean growth rate of 2.5mg/worm/day after 600 days, (Venter and Reinecke, 1988).

In*E. foetida* the first indication of clitellum development appeared 50 days after hatching. It started producing cocoon at the mean age of 55 days. The rate of cocoon production was 0.35/worm/day. The newly formed cocoon is usually light while in colour and immediately the colour changed into light brown (Venter and Reinecke, 1988). The length of the cocoon is 3.2-4.0mm, diameter 2.0-2.7mm and mean biomass of 12.65mg. The cocoon is oval in shape and is sharply pointed with fibrous tips at the ends. A mean production of 1.6 cocoons/worm/day was observed by Viljoen and Reinecke (1994). The mean incubation period of *E. foetida* was 23 days. The average hatching success was 73%. The number of hatchlings/coccon varied from 1-9 with a mean of 2.7/cocoon (Venter and Reinecke, 1988). The hatchlings were red in colour, with the hinder most segments still not fully differentiated. The importance of earthworms in the breakdown of organic matter and the release of the nutrients that it contains has been known for a long time (Darwin, 1881). It has been demonstrated clearly that some species of earthworms are specialized to live in decaying organic matter and can degrade it into fine particulate materials, rich in available nutrients, with considerable commercial potential as plant growth media or soil amendments (Edwards and Bohlen, 1996). For instance, earthworms are able to process sewage sludges and solids from wastewater; brewery wastes; processed potato wastes; from poultry, pigs, cattle, sheep, goats, horses, and rabbits; as well as horticultural residues from dead plants, yard wastes, and wastes from the mushroom industry.(Edwards and Neuhauser, 1988).

Six earthworm species have been identified as potentially the most useful species to break down organic wastes. These are*E. foetida* (and the closely-related *Eisenia andrei*), *Dendrobaena veneta*, and *Lumbricus rubellus* from temperature regions and *Eudrilus eugeniae*, *Perionyx excavates*, and *Perionyx hawayana* from the tropics. Other species can be used but these species are the commonest. The survival, growth, mortality, and reproduction of these species have been studied in detail in the laboratory, in a range of organic wastes, including pig,

cattle, duck, turkey, poultry, potato, brewery, paper, and activated sewage sludge. All of the species tested could grow and survive in a wide range of different organic wastes, but some were much more prolific, others grew more rapidly, and yet others attained a large biomass quickly; those were all characters contributing in different ways to the practical usefulness of the earthworms in producing vermicompost or being used as animal feed protein. However there were many species-specific differences in the biology and ecology of these earthworms. Vegetable waste are one of the major sources of municipal waste, recycling of wastes through vermitechnology reduces the problems of non-utilization of wastes, alternative to chemical fertilizer, locally available organic wastes of anthropogenic and natural products were used as bio fertilizers after employing earthworms as decomposer, for degradation and recycling to enhanced the production (Bakthvathsalam and Ramakrishnan, 2004). In recent times, morphological characters still are used to characterize earthworm species. Stephenson (1930) reported that the genital system is much more conservative and resistant to evolutionary change than the somatic system.Population dynamics, productivity and energy flow in earthworms cannot be fully understood unless the life cycle of the earthworm is known. Studies on the life cycles of earthworms are also necessary for effective vermiculture. Hence the present study is aimed to study the life cycle pattern of the earthworm *Eisenia Fetida*using cow dung as a substrate.

MATERIALS AND METHODS

Collection of cow dung:

The cow dung was collected from the Faculty of Agriculture and Animal Husbandry Gandhigram Rural Institute Deemed University, Gandhigram, Tamil Nadu, India. The cowdung was separated from the soil and individually subjected to predecomposition for 10 days in plastic trays sprinkling water.

Collection of earthworms:

Then the mature clitellate earthworms *Eisenia Fetida* were collected from Vivekananda College, Trivedakam near Sholavandhan, Madurai District, Tamil Nadu, India.

Experimental setup:

The mature earthworms were introduced in the trays contain predecomposed cow dung. The moisture content maintained between 50-70% throughout the study by sprinkling adequate quantities of water. During the experiment the aeration was given to vermibeds twice in a week.

Observation of growth rate of *Eiseniafetida*:

The increase in growth rate such as number of earthworms, cocoon production and weight of earthworms were observed.

RESULT

Growth (length and biomass) reproduction (cocoon and hatchling production) of *Eiseniafetida*cultured in cow dungs at different time intervals like 15,30, 45 and 60 days are represented in Figures 1 to 4.

Fig 1. Number of Cocoon produced by *Eisenia foetida*

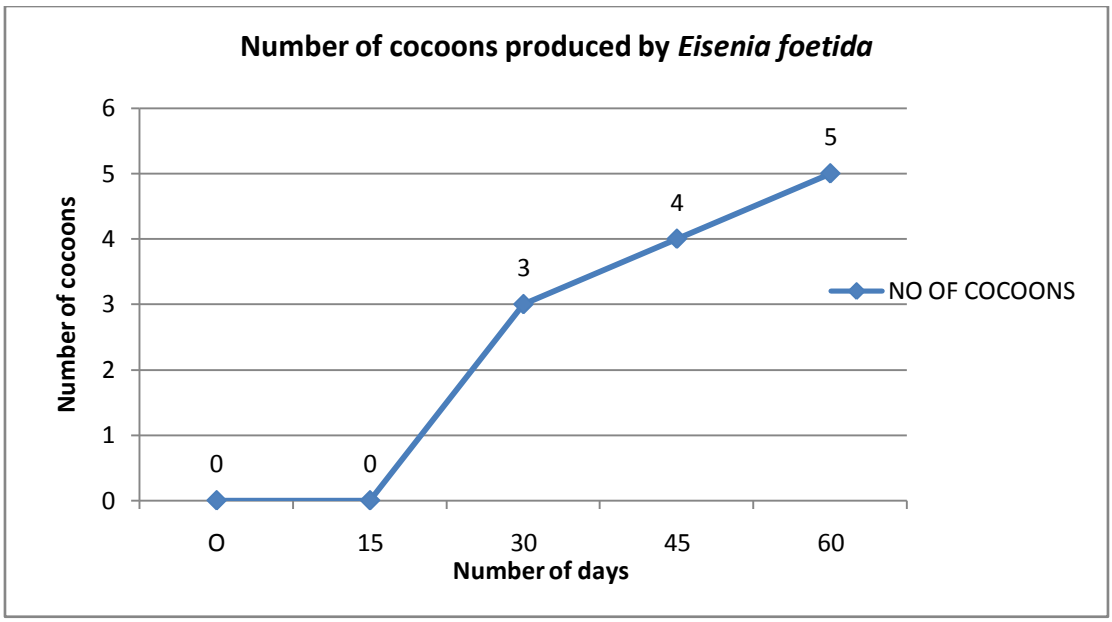


Fig 2. Number of Hatchlings produced by one Cocoon of *Eisenia foetida*

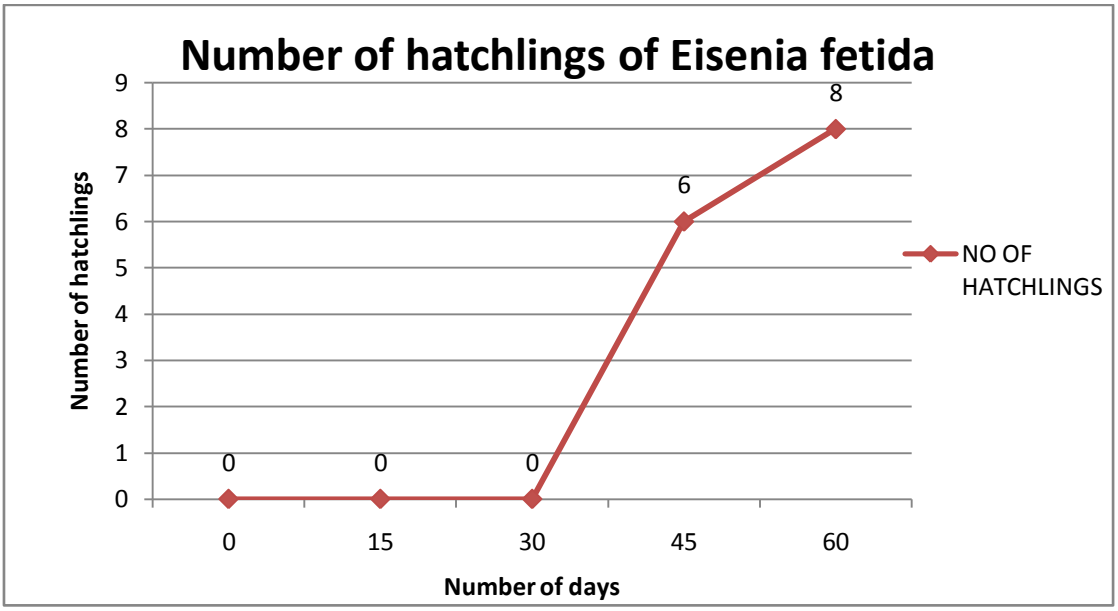


Fig. 3: Total Biomass of Earthworm *Eisenia foetida*

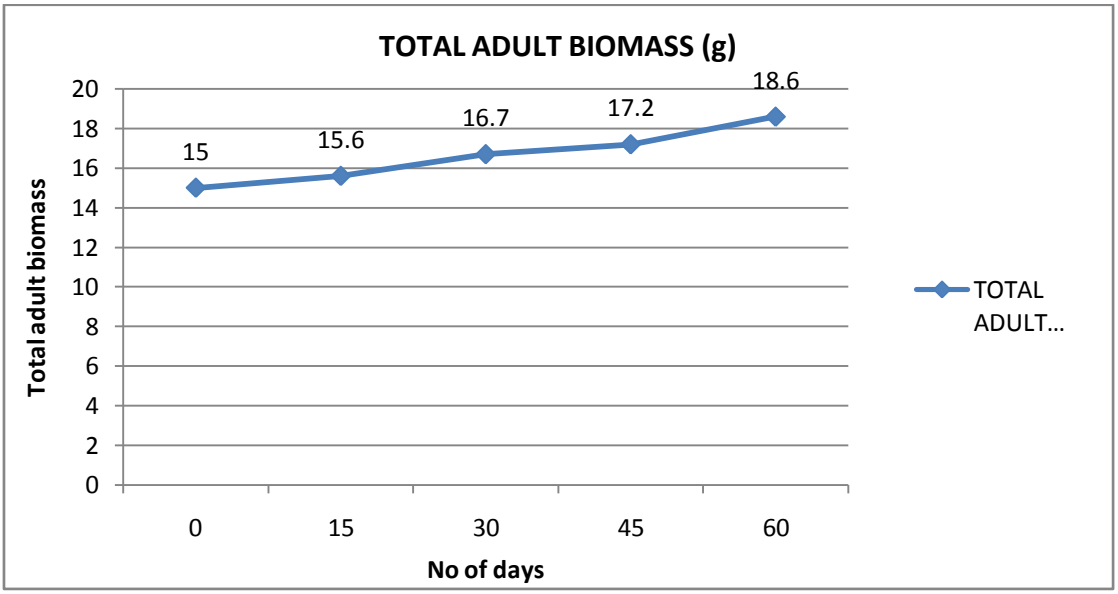
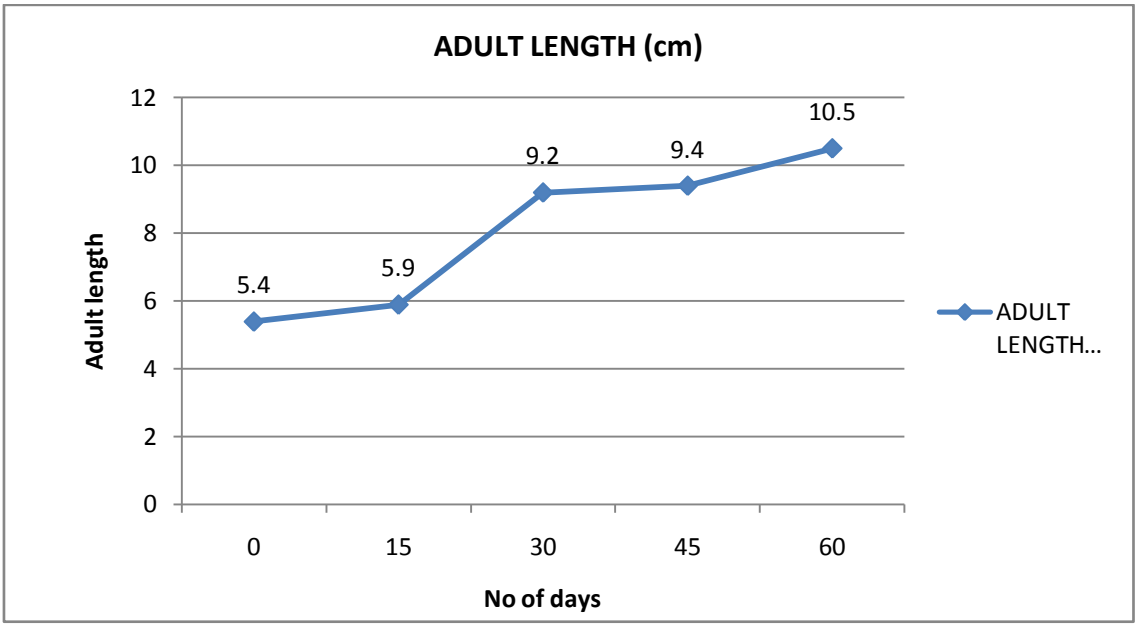


Fig. 4: Length of adult Earthworm *Eisenia foetida*



Discussion

The feasibility of using earthworms for waste management is dependent on a fundamental knowledge of the basic parameters like the survival, growth and reproduction of earth worm species. Environmental conditions and population density are known to affect growth and reproduction of earthworm. The temperature (Reinecke and Kriel, 1981) and moisture content (Evans and Guild, 1948; Reinecke and Venter, 1987) of the waste are the two most important environmental factors in vermicultre. Earthworm`s growth , maturation, cocoon production and reproduction potential are not only influenced by environmental conditions alone but also are strongly affected by the quality and availability of food (Evans and Guild 1948; Neuhauser et al., 1979; Reinecke and Viljoen, 1990; Elvira et al., 1998) . It is also reported that the kind and amount of food materials available influence the size of the earthworm population, species diversity, Growth and fecundity. Earthworms have been shown to require food rich in nitrogen, cellulose and microorganisms for growth and reproduction (Ranganathan and Parthasarathi,1999).

Earthworm`s continue to grow throughout their lives with enlargement of their body segments following emergence from the cocoons, but the rate of their growth declines following sexual maturity (Edwards and Bohlen, 1996) growth, reproduction. Life cycle and environmental

requirements of *Eudrilus eugeniae* were studied by Neuhauser et al., (1979). Further, the growth and population dynamics of *P.escavatus, E.eugeniae and E. fetida* were investigated using pressmud (Kale *etal*., 1994) and cattle dung (Loehr *etal*., 1985). Parthasarathi and Ranganathan (2000) on *E.eugeniae* and *L.mauritii* using pressmud, Karmegam and Daniel (2000c) on *E.eugeniae* using leaf litter and Chaudhuri *et al.,* (2002) on *Excavates* using kitchen wastes in India enormous amount of disposable sugarcane byproducts like pressmud (20 million tons/ annum), trash (40 million tons/ annum) and bagasse (60 million tons / annum) – all rich in organic nutrients are produced. It is intended to test whether these wastes could be used for vermiculture and vermicomposting. The objectives of the present study was to determine the best mixture combinations of these waste that would support the maximum production of cocoon, hatchlings, vermicast recovery and growth in epigeic and anecic worms like *E. eugeniae* and *E. fetida.*

The quality and quantity of feed and various physico-chemical parameters influenced earthworm`s and fecundity (Reinecke and Venter,1987; Venter and Reinecke, 1988 ; Reinecke and Viljoen, 1990; Kale and Bano, 1991 ; kale et al., 1992). Murchie (1960) proved experimentally the existence of a significant relationship between weight increase and substrate type, which may reasonably be attributed to nutritional quality of the substrate. Such correlation between increased growth rate and various organic wastes used as feed was reported in a variety of earthworms; *E.eugeniae, E.fetida and P . excavates* on cattle dung (Reinecke et al., 1992), *L.maurittii* on cowdung (Kale and Bano, 1992), *E.eugeniae* on sugar factory refuse (Kale *etal* ., 1994) and *E. Andrei* on sludge from paper and pulp industries (Elvira *et al.*,.,1998). Growth and reproduction of earthworms require OC, N, P and cellulose which are obtained from litter, grit and microbes (Edwards and Bohlen, 1996; Parthasarathi and Ranganathan, 2000).

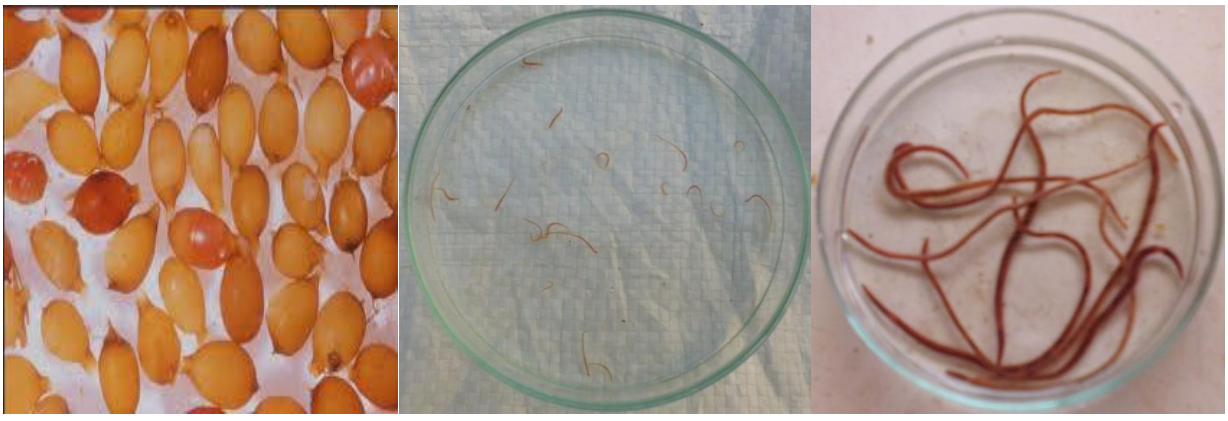
The growth rate of earthworm varies between different earthworm species and in different organic wastes; *E.eugeniae,P.excavates* and *E.fetida* cultured on cowdung for total period of one year increased at the rate of 12mg/worm/day; 3.5mg/worm/day and 7mg/worm/day, respectively (Reinecke et al., 1992); *E.eugeniae* and *L.mauritii* on pressmud (for total period of one year) increased 15 mg/worm/day and 4 mg/worm/day (Ramalingam, 1997), *E.andrei* (for total period 70 days) on sledges from paper and pulp industries increased 8.4 mg/ worm/day (Elvira et al., 1998) and *P.excavates* (for total period of 1045 days) on kitchen wastes increased 2.5 mg/worm/day (Chaudhuri et al., 2002).

Like the growth rate the mean cocoon production rate varies between different earthworm species and different organic wastes: *E. eugeniae* cultured on cattle manure for one year had been shown to produce 1.3 cocoons/worm/day (Viljoen and been shown to produce 1.3 cocoons/worm/day (Viljoen and Reinecke, 1994), on sludge (for one year) 0.1 cocoons/worm/day respectively (Ramalingam, 1997) and *E. andrei* on sludges from paper and pulp industries (for 70 days) produces 0.22 cocoon/worm/day (Elvira et al., 1998) . in the present study among different ptb mixtures, worms cultured on 8:1:1 ptb mixture (for60 days) was found to show increased cocoon production i.e., 0.29 cocoons/*E. eugeniae*/day and 0.04 cocoons /*E. fetida*/day, respectively.

Hatchability rates of different species of earthworms cultured on different organic wastes show wide fluctuations: 2.7 in *E. foetida* on cattle manure (Ventre and Reinecke, 1988), 2.2 in *E.eugeniae* on cattle manure (Viljoen and Reinecke, 1994), *E. eugeniae* and *L.mauritii* with 2.63 and -3.15 on pressmud (Ramalingam) and *P. excavatus* with 2.45 on cowdung and *P.excavatus* with 1.37 on kitchen wastes (Chaudhuri et al., 2002). In general, in the present study the results indicated that the rate of increase of biomass, cocoon production and hatchling production of *Eisenia foetida*were significantly increased from 0^{th} day to 60^{th} day.In the present study, the analyses of the results indicated that a gradual increase of growth rate was observed during 15 - 60 days.

FIGURES

Fig 5: Life cycle of Earthworm *Eisenia foetida*



CocoonHatchlings **Adult Earthworms**

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