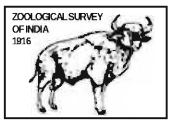

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A STUDY ON THE REARING OF *LAMPITO MAURITII* KINBERG (ANNELIDA : OLIGOCHAETA) IN VEGETABLE KITCHEN WASTES WITH SOME NOTES ON COCOON, HATCHING PATTERN, FECUNDITY AND GROWTH

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INTRODUCTION

An increase in human population and rapid urbanization has led to an increased accumulation of organic wastes. Time-immemorial it has been proved that earthworm plays an important role in recycling biodegradable organic wastes and in solving problems of deteriorating soil conditions. vermitechnology is the method of converting waste into useful products through the action of earthworm. This species is considered as a potential one for vermitechnology in Indian conditions (Dash and Senapati, 1986; Senapati and Julka, 1993; Bhattacharjee and Chaudhuri, 2002).

Bhal (1927) first studied reproductive biology of Indian earthworms. Stephenson (1930), Evans and Guild (1948a), Satchell (1967), Lakhani and Satchell (1970), Reynolds (1973), Vail (1974), Phillipson and Bolton (1977), Tomlin and Miller (1980), Reinecke and Visser (1981), Edwards (1988), Elvira *et al.*, (1996) studied the reproductive strategies of different lumbricid earthworm species. The most comprehensive studies of life cycles of non-lumbricidae earthworms are those of Lavelle (1971b; 1974; 1979), who studied a mixed population of Megascolecidae and Eudrilidae. Ecology of reproductive biology of Indian worms was reported by Senapati and Dash (1979), Senapati *et al.*, (1979), Dash and Senapati (1980, '82). Tembe and Dubash (1961), Sahu and Senapati (1986, '91), Sahu *et al.*, (1988), Kale *et al.*, (1982), Kale and Bano (1985), Kaushal and Bisht (1992), Kaushal *et al.*, (1995), Kaushal, Bora and Kandpal (1999), Bhattacharjee and Chaudhuri (2002) also worked on reproductive biology of Indian earthworms. Kale, Bano and Krishnomoorthy (1982), Kale and Bano (1985), Julka and Paliwal (1993), Ismail (1997), Kaushal and Bisht (1992), Kaushal *et al.*, (1995), Kaushal, Bora and Kandpal (1999), Bhattacharjee and Chaudhuri (2002), Chaudhuri, Pal, Bhattacharjee and Dey (2003) worked on different aspects of vermiculture in India.

Method of reproduction in *Lampito mauritii* Kinberg, is amphimictic, sexual and biparental (Gates, 1972). Observation has been mad that *Lampito mauritii* Kinberg, the selected species of earthworm, is successfully survive and reproduce in municipal waste disposal site of Kolkata and predominant earthworm species in that area. This study is intended to know whether this species is capable to survive, reproduce and grow in vegetable kitchen wastes (grows in West Bengal) medium, which is a prerequisite for successful vermicomposting.

MATERIALS AND METHODS

A. Method of Culture :

1. Earthen pot (upper dia.–25.4 cm., lower dia.–14 cm., height–19 cm.); 2. Broken brick; 3. Sand; 4. Soil; 5. Cowdung; 6. Vegetable wastes; 7. Jute cloth. The earthworms were collected from Dhapa, municipal waste disposal site of East Kolkata and kept for rearing in the laboratory of Zoological Survey of India, Kolkata. At first earthen pot is filled with broken bricks (4 cm) followed by sand (3 cm) and soil (5–6 cm). The soil used in this experiment was brought from the same site and precaution was taken so that no foreign cocoon could enter in the culture pot. Water was added to moistening the pot. Adult worms were introduced (20 in no. in each pot) and culture media was added on top. The pot is then wrapped with jute cloth. Regular watering was made to maintain moisture level 30%–35% with the temperature ranges from 25°C–28°C. Maintenance of moisture in the culture media is a key factor for obtaining good result, p^H is maintained within 6.5–7.5. Old culture media was replaced by the same amount of fresh media at fortnight intervals, for maintenance of optimum supply of food.

B. Media :

Vegetable kitchen wastes (like potato, banana, green leafy vegetables, cucurbita *etc*.) were collected from own and neighbouring families and stored in a plastic bucket, which contains holes for aeration. Cowdung was also added in the waste, in a ratio of 20 : 1 (wastes : cowdung) for primary decomposition. Sprinkle of water and mixing was done regularly to facilitate decomposition. Decomposition process continues for 15 days.

C. Sorting out of Cocoon :

Another pot containing earthworm and culture media with above composition was maintained. Cocoons were collected from this pot to study the incubation time, hatching pattern and juveniles. Cocoons were sorted out with great care from culture pot by wet sieving (0.5 mm mesh size) and hand sorting method. The size and weight of cocoons were measured. Before weighing the cocoons were washed gently in sterile water to remove debris and organic particles adhering to the sticky hull. Freshly laid cocoons were placed on wet blotting paper in a closed petridish (15 cm diameter) under ambient condition (30°C) and hatching of cocoons were observed until juvenile worms comes out from the cocoon. Sterile water was periodically added to the blotting paper to keep the paper moist.

OBSERVATIONS

A. Rearing :

It was observed that at regular interval of 30 days, up to 90 days the number of cocoons and juveniles were increased in pot–1, 2 and 3 (Table 1). It is revealed from Table 1, that the rate of hatching of cocoon was significantly high from 75% to 78.78%. It is also revealed that the mean hatchling production is 0.836 adult^{-1} month^{-1} (±SD : 0.063) (Table 2). There is a distinct increase in biomass (Avg. 1.6 times) (Fig. 1) and increase in population up to juvenile stage (Table 1).

Table 1. : Showing number of cocoons and juveniles of *Lampito mauritii* in vegetable kitchen waste in three culture pots in the laboratory. (P = pot, C = cocoon, J = juvenile)

Day	P – 1		P – 2		P – 3		Mean (±SD)	
	C	J	C	J	C	J	C	J
0	0	0	0	0	0	0	0	0
30	11	6	9	9	8	7	9.33 (1.24)	7.33 (1.24)
60	24	14	18	13	17	15	19.66 (3.09)	14 (0.81)
90	72	54	66	52	58	45	65.33 (5.73)	50.33 (3.85)

Table 2. : Showing different features of cocoon, hatchling and culture of *L. mauritii* in vegetable kitchen wastes (means ± SD).

Features	
Cocoons studied	25
Morphology	Ovoid, without ornamentation
Length (mm)	5.116 (0.367)
Breadth (mm)	3.338 (0.694)
Colour	Pale yellow
Fresh weight (mg)	21.072 (1.856)
Incubation time (days)	17.96 (1.754)
Hatching success (%) in pot	77.12 (1.577)
Hatching success (%) in blotting Paper	72
Hatchling per cocoon	One
Hatchling size (mm)	14.072 (0.951) ×
(Length × Breadth)	1.232 (0.25)
Fresh weight of hatchling	7.272 (0.741)
Cocoon adult^{-1}year^{-1}	13.24 (1.163)
Hatchling adult^{-1}month^{-1}	0.836 (0.063)
Increase in biomass (Avg.)	1.6 times

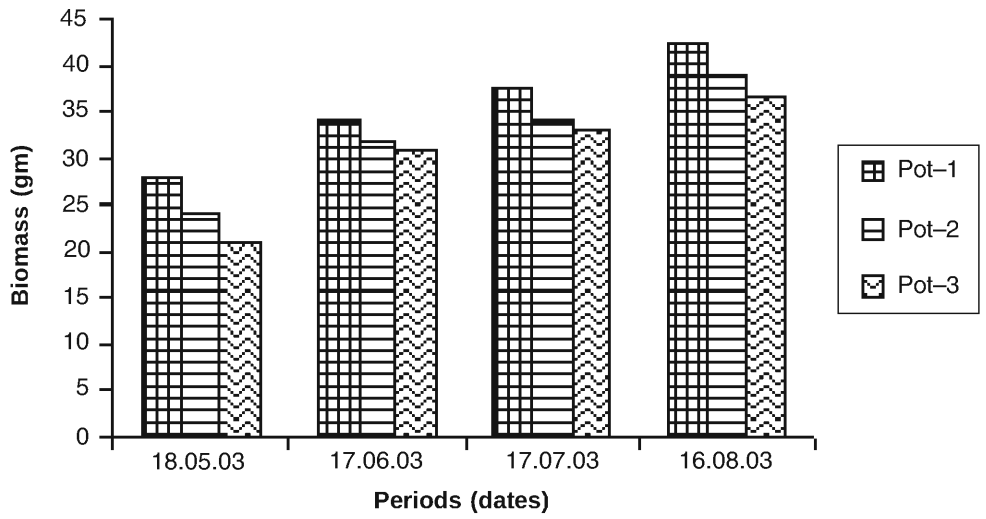

Fig. 1. : Showing the conversion rate of vegetable kitchen waste into biomass (gm) by *L. mauritii* with time.

B. Shape and Size of Cocoons :

Each cocoon is ovoid in shape with out any ornamentation. The two poles are tapered and blackish in colour. Freshly laid cocoons are soft gelly like, transparent and translucent yellow in colour. Colour changes from light green to brownish with the progress of development and texture finally becomes hard. Size varies between 4.5–6 mm in length (Mean : 5.116, ±SD : 0.367) and 2.5–5 mm (Mean : 3.388, ±SD : 0.694) in breadth (across the widest part). Mean fresh weight varies between 18.5–23.5 mg (Mean : 21.072, ±SD : 1.856).

C. Incubation Time :

Development time of cocoons varied between 15–20 days (Mean : 17.96, ±SD : 1.754).

D. Hatching of cocoons :

All the cocoons were under close observation and at 11.30 p.m. (18-07-03) first cocoon were found to hatch. Initially the cocoon started shaking vigorously before it hatched, there after the hatchling started to come out from the cocoon shell by making a slit on the terminal end of the cocoon (Plate I). The hatchling came out with wriggling movement that took about 1–2 minutes to come out from cocoon. It was observed that the hatchling retreat back into their shells when disturbed at the time of emergence. Hatchling starts moving quickly after emergence (Plate II). Altogether 25 cocoons were under keen observation of which 18 cocoons were hatched. The estimated hatching success was 72%. Only one hatchling was hatched from each cocoon.

E. Juveniles :

The hatchlings measures about 12.6–15.3 mm in length (Mean : 14.072, ±SD : 0.951) when relaxed and 0.9–1.5 mm in breadth (Mean : 1.232, ±SD : 0.250). Fresh weight of hatchlings varies between 6–8.2 mg (Mean : 7.272, ±SD : 0.741). The colour was whitish red. Within 3–4 weeks, length 40 mm and fresh weight 80 mg of juveniles were recorded.

DISCUSSION

The present study deals with 60 example of *Lampito mauritii* Kinberg for studying the biology in ambient laboratory condition. From the available literature it has been found that the shape, size, weight, incubation time, hatching success and production of cocoons differ greatly among earthworm species. Satchell (1967) reported *Aporrectodea caliginosa*, *A. longa* and *Octolasion cyaneum* produced between 3 and 13 cocoons year^{-1}, *Allolobophora chlorotica* produced 25–27 and *Lumbricus rubellus*, *L. castaneus* and *Dendrodrilus rubidus* 42–106 cocoons year^{-1}. Edwards (1988) reported that *Dendrobaena veneta* could produce 84 cocoons year^{-1}; *Eudrilus eugeniae*, 188; *Eisenia foetida*, 198 and *Perionyx excavatus*, 1014 cocoons year^{-1}. In field condition Dash and Senapati (1980) observed that the number of cocoons produced by *Lampito mauritii* Kinberg was 14.25 adult^{-1} year^{-1}. In the present study under laboratory culture this species shows an average cocoon production is 13.24 adult^{-1}yr^{-1} (Table 1). The slight decrease in number might be due to the change in microclimatic condition in laboratory. According to Bhattacharjee and Chaudhuri (2002), values of cocoon production for this species are at the rate of 43 adult^{-1} year^{-1}, which is much higher than the present investigation. This low rate in this experiment may be due to the higher parent worms density. Senapati and Sahu (1993) postulated that, considering both temperate and tropical species, the size of the worms bears a negative relationships with cocoon production; but worm diameter to cocoon diameter, worm biovolume to cocoon biovolume, worm dry weight to cocoon dry weight all bear significant positive correlation. Lee (1985) correlated the higher risk of mortality in early life with higher rate of cocoon production. According to Satchell (1967) there is a clear relationship between the number of cocoons produced and their location in the soil profile. Those species living near the surface and facing adverse conditions produce many more cocoons. A relationship between reproductive strategies and ecological categories in tropical earthworms was proposed by Lavelle *et al.*, (1998) and Barois *et al.*, (1999). They distinguished four groups of earthworms. According to their classification *Lampito mauritii* falls within group 3: small, mainly polyhumic endogeic species with intermediate fecundity (10–68 cocoons adult^{-1} yr^{-1}) and usually one hatchling per cocoon (Bhattercharjee and Chaudhuri, 2002). In the present observation only one hatchling emerge out from each cocoon (n = 25). But Bhattacharjee and Chaudhuri (2002) observed 53% of the cocoons produced more than one hatchling (2, rarely 3). Dash and Senapati (1980) observed, cocoons on hatching usually give rise to one and very rarely to two juveniles, in this species.

The development time of cocoons varies considerably among earthworm species. Hallatt *et al.*, (1990) observed mean incubation period was 18.7±0.26 days in *Perionyx excavatus*. Kaushal *et al.*, (1999) observed mean incubation period of 31.9±1.2 days in *Metaphire houletti* in different culture media. Edwards (1988) reported that the time that cocoons of *E. foetida* took to hatch was 32–73 days; *E. eugeniae* 13–27 days; *P. excavatus*, 16–21 days and *D. veneta*, 40–126 days. Bhattacharjee and Chaudhuri (2002) observed 15 days incubation period in pot culture, Ismail (1997) observed incubation period for 18 days in artificial culture, Sahu and Senapati (1991) observed 28 days in field condition, Dash and Senapati (1980) observed 28–30 days incubation period during October-December for *Lampito mauritii*. In this experiment mean incubation period of 17.96 (SD : ± 1.754) days is observed. So, incubation period is shorter in laboratory culture than to the field condition. Soil moisture and temperature both have considerable effect on cocoon incubation and emergence pattern of juveniles. In complete hydric conditions and in very dry condition (< 5% soil moisture) cocoons never hatch (Dash and Senapati, 1980).

Bhattacharjee and Chaudhuri (2002) observed 60% hatching in this species, on the contrary in the present investigation 77.12% (SD : ± 1.577) hatching observed within the culture pot and 72% hatching in moist blotting paper. Hatching success is significantly higher may be due to the inhabitation of the species on the topsoil environment. Kaushal *et al.*, (1999) observed 100% hatching success in *Metaphire houletti*, when kept in moist filter paper. Hallatt *et al.*, (1990) observed mean hatching success of all the cocoons produced from parental worms of different ages was only 63.4% in *Perionyx excavatus*.

High fecundity, short incubation period, high hatching success in anecic (Dash and Senapati, 1980 : Ismail, 1997) or top soil endogeic (Bhattacharjee and Chaudhuri, 2002) worm *Lampito mauritii* is probably adaptive strategies of '*r*' selected worms (Sahu and Senapati, 1991) to enable them to survive drastic environmental changes in top soil.

According to Evans and Guild (1948), Satchell (1967), Lee (1985), Edwards and Bohlen (1996) cocoon production, time of incubation varies with species, population density, age structure and with different environmental parameters *viz*. temperature, moisture and the energy content of the available food.

Growth in biomass (Fig. 1) clearly indicates that vegetable kitchen waste serves as a good food source for the present studied species. It can be concluded from the present study that this may be used as a good vermicomposting species from vegetable kitchen waste.

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