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ANALYSIS

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REPRODUCTION INFLUENCE OF THE EARTHWORM, *EISENIA FETIDA* CULTURED IN DIFFERENT MEDIA OF GREEN GRAM WASTE

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ABSTRACT

The rate of cocoon production and weight gain / loss of the epigeic earthworm, *Eisenia fetida* kept in different substrate medium containing, partly decomposed greengram waste with soil for 5 weeks. The worms kept in different media showed a gradual increase in their body weight until the termination of this study except 10 PSR, where a gradual decline after third week was noticed. The worms kept in the same media (10, 25, 50, 75, and 100 PSR) showed an increased value in their body weight over their respective initial weight. On the contrary, all the worms kept in 0 PSR (soil alone) medium showed a gradual decline in their body weight from II week onwards. The worms kept in soil alone for 35 days showed 100% survival value, but lesser cocoons were laid during the course of study due to less organic matters present in the medium. The worms kept in other PSR media (10, 25, 50, 75, and 100) for 35 days produced relatively more cocoons than the control, but the worms in 100 PSR media produced relatively more cocoons than the worms kept in 10, 25, 50, and 75 PSR media. Among the five greengram waste media studied, the worms kept in 100 PSR, produced the maximum of cocoons and were hatched out into a maximum of youngones with the hatching rate of 0.9 hatchling / cocoon and hatching success of 91.7% after a period of 29 to 32 days incubation time.

Key words: Green gram waste, *Eisenia fetida*, Cocoons, Incubation and hatchling.

INTRODUCTION

Earthworms have been successfully introduced into areas where they are absent and have found to increase the yield of crops. The long –term benefits of encouraging earthworms can be translated into dollars. Researchers have estimated that for every dollar invested in earthworms on New Zealand sheep farms, the farmer can expect a return of 3.34 and an increase in carrying capacity of 2.5 stock units/hectare or an increase in productivity of 25-30 per cent (Crump, 1969). Earthworms are excellent bioindicators of the relative health of soil ecosystem (Kuhle, 1983). Because of the fact that they are large, numerous, easy to sample, widely distributed, relatively immobile and are in full contact with the substrate in which they live and consume large volume of this substrate they can be used for biomonitoring of terrestrial ecosystem. Earthworms derive their nutrition from organic materials, living microorganisms and by decomposing animals. Surface living earthworms feed on food material selectively while deep soil living worms ingest soil as such. The type and amount of material available influence the size of earthworms, population, species diversity, growth rate and cocoon production.

The pulse plant, greengram (*Vigna radiata*) is cultivated in Cauvery delta region after paddy harvest as a short term crop. A bulk amount of greengram wastes was dumped along the road sides during its harvests. Sometime the dumped waste is burnt as a whole as and some of them may be used as Fuel materials. But nobody knows the utility value of this material as a rich source of organic content and as a raw material for vermiculture practices there by a huge production of vermicompost. Having a good knowledge about the bulk production of greengram waste and its utility value in mind, the presents study was undertaken to utilize the same for the culture practices of earthworm. The proposed work plan comprises the following aspect.1.Effect of greengram waste on the production of cocoon and growth of adult earthworms, *Eisenia fetida*.

MATERIALS AND METHODS

PROCUREMENT AND MAINTENANCE OF EARTHWORMS

Species of adult earthworm, *Eisenia fetida* were purchased from a Periyar maniyammai University at Vallam (Thanjavur). The worms were kept in large trays with substrate medium, containing 50% partly decomposed cowdung and 50% soil and maintained under the laboratory condition (temperature range, 31-36^{o}c) for 30 days. Adult worms with the size, 6-13 cm in length and 0.13-0.92 gm in weight were used for the present study.

COLLECTION OF SOIL

Dry soil was taken from the Avoor village (Valangaiman TK, Thiruvarur District), for the present study. It was manually powdered using stone mortar.

COLLECTION OF GREENGRAM WASTE

The waste materials of greengram (*Vigna radiata*) were collected from Avoor village, Valangaiman TK, Thiruvarur District.

PARTIAL DECOMPOSITION OF GREENGRAM WASTE

A rectangular brick work cement tank with size, 90×35×45cm free from earthworm invasion was constructed and used for the decomposition of greengram waste. The tank was filled with dry greengram waste and poured with sufficient water. The tank was closed with polythene sheets to avoid water evaporation and a possible release of foul smell during decomposition. Water was poured regularly in the tank after removing the polythene sheets and the tank was closed again with the same polythene sheets for proper decomposition. Once in three days, the decomposing materials were thoroughly mixed by using a wooden rod to ensure uniform decomposition. About 50 kg of partly decompost greengram waste material were obtained after 50 days of decomposition.The greengram powder was sieved separately using a sieve with size 1mm^2 to obtain a medium with a particle size less than 1mm as suggested by Reinecke and Venter (1985). Reduced particle size of the culture medium was found to be favorable for raising growing worms and also provides more surface area per volume of culture medium which facilitates microbial activities as well as moisture availability (Reinecke and Venter,1985).

PREPARATION OF SUBSTRATES FOR COCOON PRODUCTION STUDY

Six sets of five media with per cent substrate ratios (PSR), 100,75,50, 25, and 10 were prepared using powdered greengram waste and dry soil with volume by volume basis and mixed well. Four liters of substrate in each per cent ratio was taken in an earthen pot and sufficient volume of water was added it into it to ensure optimum

moisture condition as suggested by Martin (1982). To assess the rate of cocoon production in the above said media, 10 adult earthworms were introduced into each pot. Six sets of control (soil alone as substrate) experiments with 10 adult earthworms in each were also maintained simultaneously along with these media. Regular watering is a must for this culture study to provide optimum moisture condition to the earthworms. Cocoons produced by earthworms were collected and recorded once in seven days for a period of 35days (01.12.2014 - 04.01.2015). The body weight is recorded during cocoon collection.Survival of earthworms were also observed in the above said media during the course of study. Rate of cocoon production was calculated at daily as well as at monthly basis.

HATCHINGS GROWTH STUDY

The medium used in the cocoon production study after 35 days were renewed with fresh partly decomposed greengram waste for incubation time, hatching success and hatchling growth study. Cocoons collected at 7 days interval for 35 days from the earthworm, *Eisenia fetida* exposed to different PSR media were placed separately in plastic cups containing the same PSR medium and observed their incubation time and hatching ability daily until all the cocoons were hatched out into hatchings.

STATISTICAL ANALYSIS

The rate of cocoon production by earthworms was calculated and statistical comparisons were made between control and experimental data.

RESULT AND DISCUSSION

COCOON PRODUCTION STUDY

The rate of cocoon production and weight gain / loss of the epigeic earthworm, *Eisenia fetida* kept in the substrate medium containing 0, 10, 25, 50, 75, and 100 per cent substrate ratio (PSR) prepared from partly decomposed greengram waste with soil for 5 weeks were given in Table 1. The worms kept in 10, 25, 50, 75, and 100 PSR media showed a gradual increase in their body weight until the termination of this study except 10 PSR, where a gradual decline after third week was noticed. However the worms kept in the same media (10, 25, 50, 75, and 100 PSR) showed an increased value in their body weight over their respective initial weight and the respective body gain values were 42, 255, 294,389, and 358%. On the contrary, all the worms kept is 0 PSR (soil alone) medium showed a gradual decline in their body weight from II week onwards and the per cent weight loss value after V week was 35 (Table 1).

The worms kept in soil alone for 35 days though showed 100% survival value, only 26 cocoons were laid during the course of study due to less organic matters present in the medium. Though the worms kept in other PSR media (10, 25, 50, 75, and 100) for 35 days produced relatively more cocoons than the control, but the worms in 100 PSR media produced relatively more cocoons (0.3 cocoon /day/worm) than the worms kept in 10,25, 50, and 75 PSR media (0.079 to 0.259 cocoon /day /worm) (Table 1). The values of incubation time and hatching success of cocoons collected from the earthworm, *Eisenia fetida* exposed to 10, 25, 50, 75, and 100 PSR media of partly decomposed greengram waste were given in Table 2. Among the five greengram waste media studied, the worms kept in 100 PSR produced a maximum of 630 cocoons and were hatched out into a maximum of 597 youngones

with the hatching rate of 0.9 hatchling / cocoon and hatching success of 91.7% after a period of 29 to 32 days incubation time.

The hatchling obtained from (0.5 to 0.9 hatchling / cocoon) the above studies (all PSR media) did not follow the findings of Dash and Senapati (1980) and Bakthavathsalam and Ramakrishnan (2004), where they observed usually one or very rarely two juveniles from each cocoon on hatching. Further the hatchling obtained from the present study were found to be very less (0.5-0.9) when compared to other species such as *Perionyx excavatus* with 1.1 and *Pheritima hawayana* with 1.2 (Loehr *et al*., 1985), *Eisenia fetida* with 2.7 (Venter and Reinecke, 1988) and *Eudrilus eugeniae* with 2.63 hatchling / cocoon (Ramalingam, 1997). However the present study follows the findings of Bakthavathsalam and Geetha (2004a), where they found 0.9 to 1.0 and 0.7 to 1.0 hatchling /cocoon on hatching while using the earthworm, *Lampito mauritii* exposed to decomposed paddy chaff and weed plants material respectively. But a contradictory observation was noted in the current study with regard to cocoon incubation period as observed by Dash and Sanapati (1980),Reinecke *et al*.,(1992), Ramalingam (1997) and Bakthavathsalam and Geetha (2004a), where they found 28-30 days, $\pm$ 23 days, 27.33$\pm$ 0.42 days and 26-54 days respectively for tropical earthworms, *Eisenia fetida,* and *Lampito mauritii.* In spite of good health condition and 100% survival value observed in the adult earthworms kept under different media, it is important to note here that the production of cocoons from lower PSR to higher PSR showed an increasing trend, but it was relatively very lesswhen compared to the studies made by Ramalingam (1997) in the earthworm, *Lampito mauritii* cultured under press mud medium where he found $\pm$ 0.4 cocoon /worm/ day. The earthworm culture study made by Subramaniyan (2008) using paddy straw waste showed relatively very low cocoon production value (0.126 cocoon/ worm/day) over our present study with greengram waste. The current results proved beyond any doubt that the culture medium containing greengram waste was the best one as far as cocoon production and growth of earthworm are concerned. The reduction in the earthworm body weight observed in the current reproductive study with 0 PSR medium may be due to low level of nitrogen and carbon (presence of poor organic content) present in the above medium as reported by jena *et al*., (2002) since the earthworms need nitrogen for their cellular protein synthesis and is also essential for cocoon production. The organic matters selected for the current study are considered as good raw material for the preparation of culture medium to raise earthworm for biomass production in order to meet the protein requirements of food industry peotaining to fish, poultry and pigs.

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TABLE-1

Values showing the body weight (gm) and cocoon production by the earthworm, *Eisenia fetida* fed with different per cent substrate ratio (PSR) of partly decomposed greengram waste for 5 weeks.

Period	**PSR**					
	0	10	25	50	75	100
Initial	0	0	0	0	0	0
	25.9	25.5	26	25.9	25.6	25.2
I-week	0	0	6	5	6	10
	26.5	32.3	37.7	41.3	62.6	50.7
II-week	3	6	12	19	25	30
	22.5	39.8	45.4	53.2	93.2	72.5
III-week	6	31	89	112	124	147
	20.1	46.4	61.2	70.2	113.2	102.7
IV-week	9	71	113	137	182	213
	19.8	40.3	71.2	80.3	120.4	107.8
V-week	8	59	97	123	208	230
	10.5	36.4	92.3	102.3	125.2	115.6
Total cocoon produced	26 (0.012)	167 (0.079)	317 (0.150)	396 (0.188)	545 (0.259)	630 (0.3)
Per cent weight change over initial	-59	+42	+255	+294	+389	+358

Upper row values indicate the total number of cocoon produced by 60 earthworms ; Lower row values indicate the total weight of 60 earthworms. Values in parenthesis indicate the production of cocoon/ worm/day.

TABLE-2

Values showing the incubation time and hatching success of cocoons collected from the earthworm, *Eisenia fetida* fed with different PSR of partly decomposed greengram waste under laboratory condition.

PSR	Total cocoon produced by 60 earthworm	Incubation time (days)	Total hatchlings obtained	Hatchling/ cocoon	Hatching success (%)
0	26	18-21	14	0.5	53.8
10	167	21-25	121	0.7	72.4
25	317	25-29	270	0.8	85.1
50	396	29-32	345	0.8	87.1
75	545	29-32	493	0.9	90.4
100	630	29-32	578	0.9	91.7

FIG 1. SHOWS THE GREENGRAM WASTE, BEFORE AND AFTER COMPOST.

(A) BEFORE COMPOST

(B) AFTER COMPOST

FIG 2. SHOWS THE DIFFERENT GREENGRAM WASTE MEDIA USED DURING THIS STUDY.

S – Soil
PD – Partly Decompost

FIG 3. SHOWS THE SAMPLE OF EARTHWORM *EISENIA FETIDA*.

FIG 3. SHOWS THE SAMPLE OF AN AN EARTHWORM *EISENIA FETIDA*.