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INFLUENCE OF DIFFERENT ORGANIC WASTES ON THE LIFE ACTIVITIES OF THE EARTHWORM, *EUDRILUS EUGENIAE*

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ABSTRACT: Recently environmental problems are increasing due to dumping of organic wastes generated at both urban and rural areas, are not properly recycled and disposed. These organic wastes can be recycled properly to avoid problems like foul smell, environmental pollution, unhygienic conditions and infectious diseases. There are various methods (physical, chemical and microbiological) practicing for the disposal of solid organic wastes. Vermitechnology is one of the methods used for waste disposal and recycling of plant nutrients. Hence, the present study was undertaken to know the suitability and influence of different organic wastes such as Lawn Grass Waste (LGW), Cotton Residue Waste (CRW), Ashok Tree Waste (ATW), Parthenium Weed Waste (PWW) and Cattle Manure (CM) on the various life activities of the earthworm, *Eudrilus eugeniae.* The mean biomass of worm is almost same in all the organic wastes between (0.584 ± 0.001 to 5.90 ± 0.001) throughout the experimental period for 16 weeks. The growth rate during initial period was slow then it drastically increased at 9th week onwards in all the organic wastes, it was highest in ATW (9.11±0.04) and least in LGW (8.88±0.03). Sexual maturity of worms was observed from 6th week onwards with 60% in CRW and PWW and 40 % in LGW, ATW, and CM and it reached 100% at 9th week in all organic wastes. The cumulative cocoon number/ worm/ 16 weeks were maximum in CM (8.8) and PWW (8.2) and least in LGW (5.8). Based on these observations, it is revealed that *E. eugeniae* is a voracious feeder and breeder throughout the year proved to be an efficient worm in vermitechnology for organic waste management.

***KEY WORDS*:** Earthworm, *Eudrilus eugeniae*, Life activities, Organic wastes, Suitability.

INTRODUCTION

Environmental problems are increasing due to dumping of organic materials both in urban as well as rural areas. The organic wastes generated at urban areas are kitchen, household, market and municipal wastes that are increasing day by day as the population increases[1]. The agricultural residues of rural areas are also not properly recycled and disposed. These all wastes are the sources of creating foul smell, environmental pollution, unhygienic conditions and spreading of infectious diseases etc. All these problems can be avoided by recycling of organic wastes through various physical, chemical, biological and microbiological methods to get rid and disposal of all these wastes.

The use of earthworms in composting of various organic materials for the production of a better quality vermicompost as compared to those produced through traditional composting method[2,3]. The recycling of organic wastes through vermicomposting not only reduces the disposal problems, but it also gives

better alternative source of organic fertilizers and even it provides supplementary protein feed for the fish and poultry industries[4,5].

Vermicomposting of different kinds of wastes have been witnessed by many workers[6,7]. It has also been recommended by several workers that epigeic earthworms can be utilized for disposal and management of various organic wastes[8,9]. The most widely employed epigeic earthworm species for successful utilization and stabilization of different wastes is *E. fetida* [10,11]. Some others have also suggested that utilization of organic wastes along with cattle manure are suitable for vermicomposting[12,13,14]. The effective use of earthworms in organic waste management requires a detailed knowledge of the biology of potential earthworm species[15].

Hence, the present study was undertaken to assess the suitability and influence of various organic wastes on the biology such as growth, sexual maturity and reproduction of the African night crawler earthworm, *E. eugeniae.*

MATERIALS AND METHODS

Collection of Earthworms

The earthworm, *E. Eugeniae* was obtained from the University of Agricultural Sciences, Dharwad and were stock cultured in cattle manure in an uncontrolled laboratory conditions for multiplication.

Collection and Preparation of Earthworm food

Locally available various organic wastes such as Lawn grass waste, Cotton residue waste, Ashok tree waste, Parthenium waste and Control (Cattle manure) were collected and chopped into small pieces and allowed to dry under shade. The selection of organic wastes was based on the survey of their availability in large quantities. All four organic wastes were mixed with cattle manure in 10:1 proportion (v/v) so as to maintain C/N ratio. These mixed organic wastes including Cattle manure alone were sprinkled with tap water so as to maintain moisture content of about 70 to 80 % and allowed to stabilize for about 4-5 days in laboratory conditions for primary degradation (microbial).

Each stabilized wastes were transferred to an earthen pots of size 7cm × 15cm height in triplicates in order to get accurate results for statistical authentication. To each pot, one week aged five juveniles of *E. eugeniae* were introduced after noting their weight. All experimental pots with about 70-80% of moisture content were kept in an uncontrolled laboratory conditions for 16 weeks. Observations were made with respect to increase in worm biomass, attainment of sexual maturity and cocoon production every week. Shortage of food was avoided by providing sufficient individual stabilized mixed organic wastes.

The growth rate of worms was calculated as per the formula given by Biradar *et al.*,[16] as given below:

$$Growth\ rate\ mg/day/gm = \frac{Weight\ of\ worm\ on\ the\ day\ of\ observation\ -\ Initial\ weight}{No\ of\ days\ on\ the\ day\ of\ observation} \times 1000$$

Statistical analysis was carried out by using ANOVA to test the significant difference between the life activities of the worm in different organic waste foods.

RESULTS

Biomass

Table1 and Fig1 represents the data and pattern of biomass increased in various organic wastes. The initial biomass of inoculated juveniles was between 0.006 to 0.009 gm/worm, the steady biomass increase was observed from the initial week up to 16th week in all organic wastes. There is a sudden increase in biomass from 7 to 8 weeks and reaches its maximum at 12 week onwards to the end of the experiment. The mean biomass of worms in Lawn grass waste, Cotton residue waste, Ashok tree waste, Parthenium waste and Control is 0.584, 0.585, 0.586, 0.585 and 0.590 gms respectively were observed. There is as such no significant difference in biomass of worms between and among different organic wastes as compared to Control

Table 1. Biomass (gm) of the earthworm, *E. eugeniae* in different organic wastes along with Control. Data are in Mean ± SE.

Weeks	Lawn grass waste	Cotton residue waste	Ashoka tree waste	Parthenium waste	Cattle manure (Control)
1	0.008 ± 0.001	0.007 ± 0.001	0.006 ±0.001	0.009 ± 0.001	0.009 ± 0.001
2	0.015 ± 0.001	0.016 ± 0.001	0.015± 0.001	0.017 ± 0.001	0.018 ± 0.001
3	0.026 ± 0.001	0.028 ± 0.001	0.030± 0.001	0.031 ± 0.001	0.032 ± 0.001
4	0.042 ± 0.001	0.045 ± 0.001	0.049± 0.001	0.042 ± 0.001	0.045 ± 0.001
5	0.080 ± 0.001	0.085 ± 0.001	0.089± 0.001	0.080 ± 0.001	0.090 ± 0.001
6	0.168 ± 0.001	0.171 ± 0.001	0.172± 0.001	0.172 ± 0.001	0.177 ± 0.001
7	0.308 ± 0.001	0.309 ± 0.001	0.310± 0.001	0.311 ± 0.001	0.312 ± 0.001
8	0.743 ± 0.001	0.743 ± 0.001	0.743± 0.001	0.744 ± 0.001	0.762 ± 0.001
9	0.889 ± 0.001	0.890 ± 0.001	0.891± 0.001	0.891 ± 0.001	0.924 ± 0.002
10	0.974 ± 0.002	0.972 ± 0.001	0.975± 0.002	0.975 ± 0.001	0.977 ± 0.002
11	1.000 ± 0.002	0.999 ± 0.002	1.000± 0.002	1.000 ± 0.001	1.002 ± 0.002
12	1.007 ± 0.001	1.007 ± 0.002	1.007± 0.002	1.007 ± 0.001	1.008 ± 0.002
13	1.015 ± 0.001	1.015 ± 0.001	1.015± 0.001	1.015 ± 0.001	1.015 ± 0.001
14	1.021 ± 0.001	1.021 ± 0.001	1.021± 0.001	1.021 ± 0.001	1.021 ± 0.001
15	1.024 ± 0.001	1.025 ± 0.002	1.025± 0.002	1.025 ± 0.002	1.025 ± 0.002
16	1.030 ± 0.001	1.031 ± 0.001	1.031± 0.001	1.032 ± 0.001	1.032 ± 0.001
Mean	**0.584 ± 0.001**	**0.585 ± 0.001**	**0.586± 0.001**	**0.585 ± 0.001**	**0.590 ± 0.001**

Figure 1. The biomass trend of *E. eugeniae* in different organic wastes along with Control

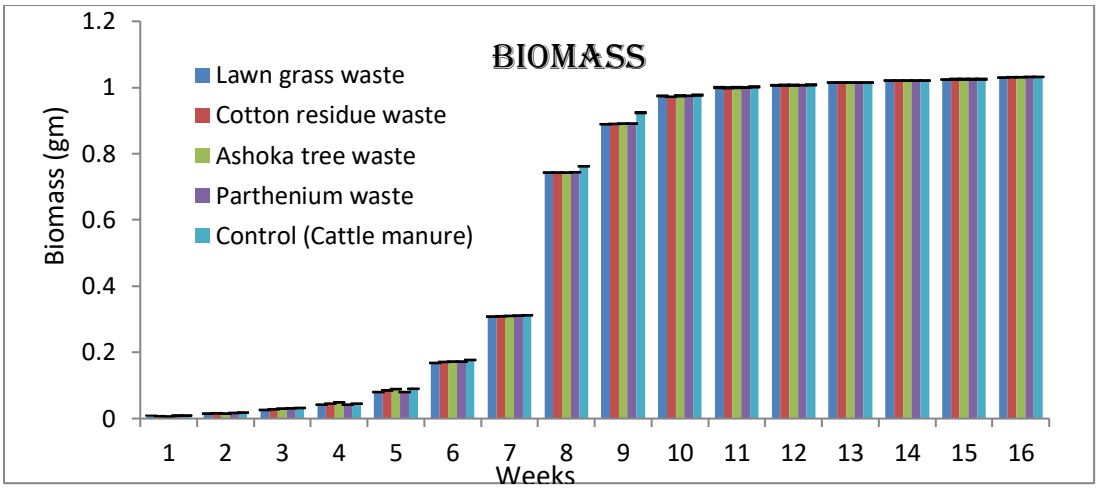
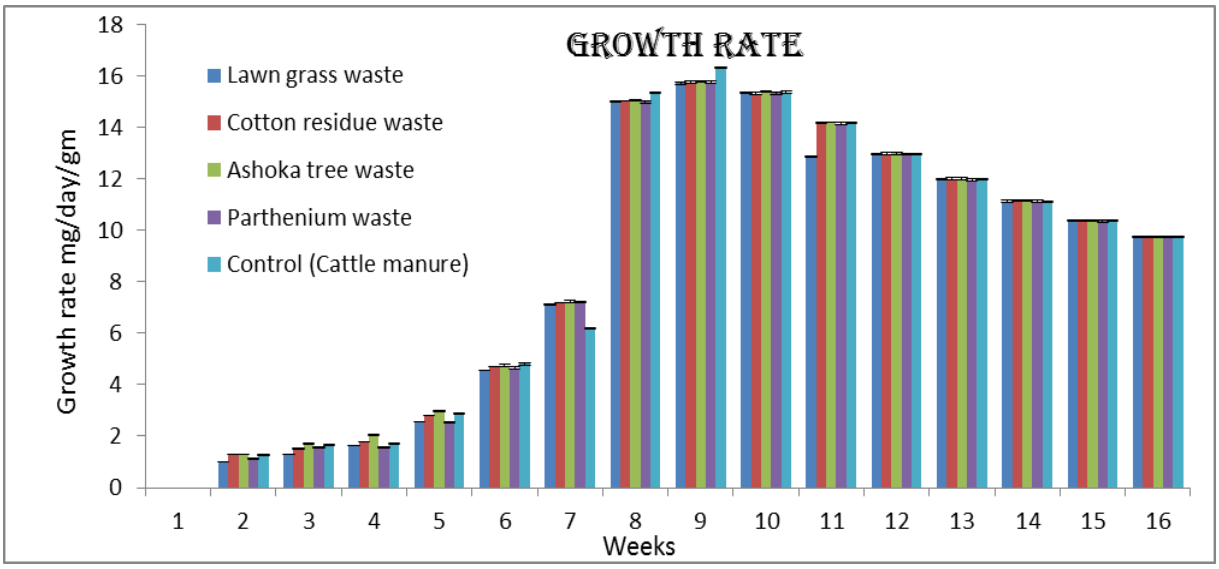


Table 2. Growth rate (mg/day/gm) of the earthworm, *E. eugeniae* in different organic wastes with Control. Data are in Mean ± SE

Weeks	Lawn grass waste	Cotton residue waste	Ashoka tree waste	Parthenium waste	Cattle manure (Control)
1	-	-	-	-	-
2	1.00± 0.01	1.28± 0.00	1.28± 0.03	1.14± 0.02	1.28± 0.02
3	1.28± 0.00	1.50± 0.03	1.71± 0.04	1.57± 0.02	1.64± 0.03
4	1.61± 0.00	1.80± 0.00	2.04± 0.03	1.57± 0.03	1.71± 0.03
5	2.57± 0.00	2.78 ± 0.00	2.96± 0.04	2.53± 0.04	2.89± 0.03
6	4.57± 0.00	4.68 ± 0.00	4.74± 0.06	4.65± 0.03	4.80± 0.03
7	7.14± 0.04	7.19 ± 0.00	7.23± 0.03	7.19± 0.02	6.18± 0.01
8	15.00± 0.04	15.02 ± 0.00	15.04± 0.03	15.00± 0.05	15.36± 0.02
9	15.73± 0.05	15.76 ± 0.04	15.80± 0.03	15.75± 0.03	16.33± 0.04
10	15.33± 0.03	15.31 ± 0.06	15.38± 0.02	15.33± 0.04	15.36± 0.03
11	12.88± 0.03	14.17 ± 0.03	14.20± 0.04	14.15± 0.04	14.18± 0.02
12	12.97± 0.03	12.98 ± 0.03	13.00± 0.03	12.96± 0.03	12.97± 0.02
13	11.98± 0.03	12.00 ± 0.05	12.01± 0.03	11.96± 0.05	11.97± 0.03
14	11.13± 0.03	11.14 ± 0.02	11.15± 0.02	11.12± 0.03	11.12± 0.03
15	10.36± 0.02	10.38 ± 0.02	10.39± 0.03	10.36± 0.04	10.36± 0.03
16	9.73± 0.02	9.75 ± 0.04	9.76± 0.02	9.74± 0.03	9.74± 0.02
Mean	**8.88± 0.03**	**9.04± 0.03**	**9.11± 0.04**	**9.00± 0.03**	**9.05± 0.02**

Figure 2. Growth rate trend of *E. eugeniae* in different organic wastes along with Control



Growth Rate

The growth rate of *E. eugeniae* in different organic wastes for a period of 16 weeks is given in Table 2 and Fig 2. The growth rate worm is calculated as mg/day/gm. During initial weeks, the growth rate was slow, there after, it increased steadily and reached its maximum at 8th week in all organic wastes. Comparatively very least and highest growth rate was observed in Lawn grass and control respectively. The maximum growth rate at 8th week is 15.73, 15.76, 15.80, 15.75 and 16.33 mg/day/gm was observed in Lawn grass waste, Cotton residue waste, Ashok tree waste, Parthenium waste and Control respectively. In all organic wastes, gradual decline in growth rate was observed after 11th week onwards till the end of the 16th week. The mean growth rate was 8.88, 9.04, 9.11, 9.00 and 9.05 in Lawn grass waste, Cotton residue waste, Ashok tree waste, Parthenium waste and Control respectively. There is as such no significant difference was observed in growth rate of worms between and among different organic wastes and with control too.

Sexual Maturity

Table 3 and Fig 3 represents the percent sexual maturity of *E. eugeniae* in different organic wastes including control. Worms get started maturing from 6th week onwards in all organic wastes such as Lawn grass waste (40%), Cotton residue waste (60%), Ashok tree waste (40%), Parthenium waste (60%) and Control (60%). The percent sexual maturity increased gradually from 7th week and it reached 100% on 8th week in Ashoka tree waste and Parthenium waste, whereas, in all other organic wastes

such as Lawn grass waste, Cotton residue waste and control, it reached on 9th week. After the attainment of sexual maturity, the adult worm was about 15-20 cm in length, 5-7mm in diameter and consists of about 200-250 metameric segments. The maximum weight was 2-3 gms/worm is observed in our studies.

Table 3. Percent attainment of sexual maturity (%) of *E. eugeniae* in different organic wastes along with Control

Weeks	Lawn grass waste	Cotton residue waste	Ashok tree waste	Parthenium waste	Cattle manure (Control)
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	40.00%	60.00%	40.00%	60.00%	40.00%
7	60.00%	80.00%	80.00%	80.00%	60.00%
8	80.00%	80.00%	100.00%	100.00%	80.00%
9	100.00%	100.00%	100.00%	100.00%	100.00%
10	100.00%	100.00%	100.00%	100.00%	100.00%
11	100.00%	100.00%	100.00%	100.00%	100.00%
12	100.00%	100.00%	100.00%	100.00%	100.00%
13	100.00%	100.00%	100.00%	100.00%	100.00%
14	100.00%	100.00%	100.00%	100.00%	100.00%
15	100.00%	100.00%	100.00%	100.00%	100.00%
16	100.00%	100.00%	100.00%	100.00%	100.00%

Cocoon Production

The production of cocoons by *E. eugeniae* in various organic wastes is shown in the Table 4 and Fig 4. The worms started producing cocoons, a week after their maturity (6th week) i.e. from 7th week onwards in all organic wastes (Fig.4). Cocoon production trend was in a zig zag fashion, the mean cumulative cocoon number/worm was 5.8, 6.0, 7.4, 8.2 and 8.8 in Lawn grass waste, Cotton residue waste, Ashok tree waste, Parthenium waste and Control respectively. The maximum cocoon production/worm/week was observed in Control (1.4) and Parthenium waste (1.4) and it was least in Lawn grass waste (1.1). No significant difference was assessed or noticed in cocoon production among and between different organic wastes and control.

Figure 3. Per cent sexual maturity of *E. eugeniae* in different organic wastes along with control

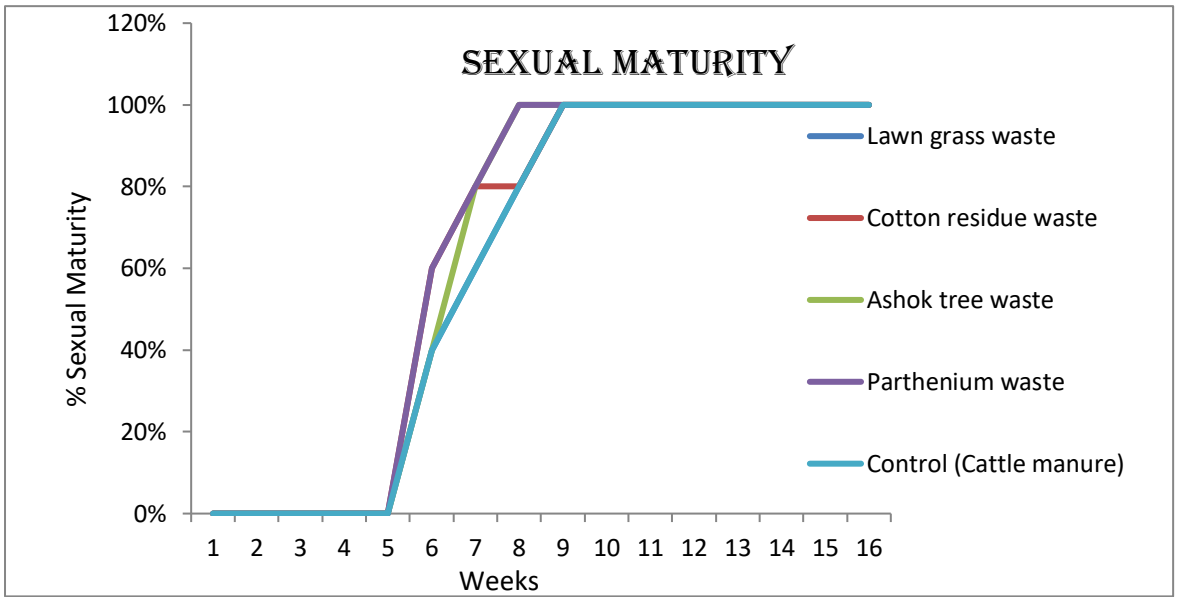


Table 4. Rate of cocoon production /worm/week by *E. eugeniae* in different organic wastes including Control

Weeks	Lawn grass waste	Cotton residue waste	Ashok tree waste	Parthenium waste	Cattle manure (Control)
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	0.8	0.8	1.4	1.4	1.0
8	0.6	1.2	1.4	0.6	1.4
9	1.0	1.0	0.8	1.4	1.0
10	1.0	0.6	1.0	1.0	1.4
11	0.6	0.6	0.6	0.8	0.4
12	0.8	1.2	0.4	0.6	1.0
13	0.4	0.6	0.4	0.8	0.6
14	0.4	-	0.8	0.6	0.8
15	0.2	0.6	0.4	0.4	0.8
16	-	-	0.2	0.6	0.4
Mean cumulative cocoon number	**5.8**	**6.0**	**7.4**	**8.2**	**8.8**

Figure 4. Cocoon production by *E. eugeniae* and its trend in different organic wastes including Control

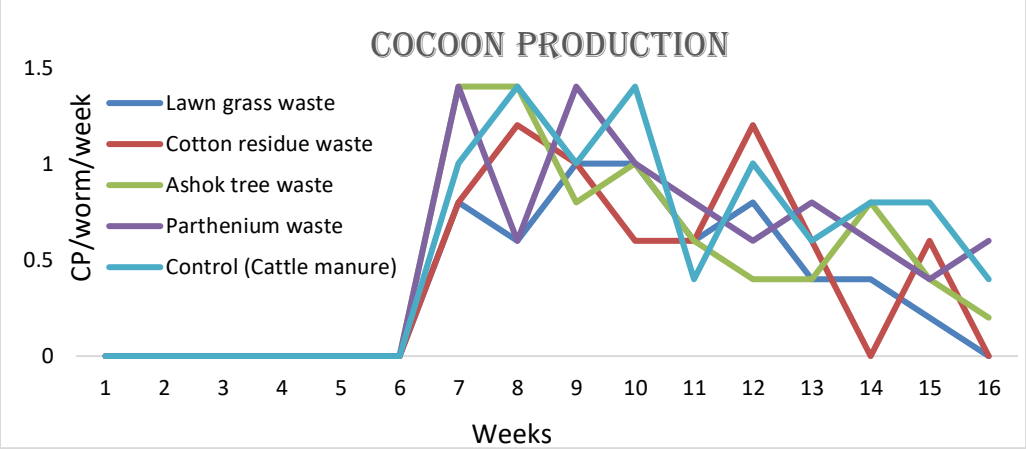


Table 5. The potentials of the earthworm, *E. eugeniae* in various organic wastes *for* vermiculture practice

Sl No.	Organic waste foods	Mean biomass	Mean growth rate	Mean cocoon production
1	Lawn grass waste	0.584±0.001	8.88±0.03	0.64
2	Cotton residue waste	0.585±0.001	9.04±0.03	0.74
3	Ashok tree waste	0.586±0.001	9.11±0.04	0.74
4	Parthenium waste	0.585±0.001	9.00±0.03	0.82
5	Cattle manure (Control)	0.590±0.001	9.05±0.02	0.88

Table 6. Statistical analysis with respect to biomass, growth rate and cocoon production

Sl No.	Life activities		Waste foods		
		DF value	Mean squares	F value	Significance
1	Biomass	Between groups=4 Within groups=75	0.000 0.210	0.000	1.000
2	Growth rate	Between groups=4 Within groups=75	0.104 32.540	0.003	1.000
3	Cocoon production	Between groups=4 Within groups=75	0.090 0.224	0.404	0.805

DISCUSSION

The life activities of the earthworm, *E. eugeniae* in various organic wastes were somewhat similar throughout the experiment. The slight variation in the biomass and growth rate of worms was observed in different organic wastes that might be due to preferential feeding habits of the earthworm, *E. eugeniae*. Biradar *et al.*,[16] and Kale and Krishnamoorthy[17] have also been reported that type of food also influences the life activities of earthworms.

The increase in biomass and growth rate pattern of this worm is similar with respect to different organic wastes may be due to the voracious feeding and breeding habit of *E. Eugeniae*[18]. This clearly suggests that minimum dietary requirement of the worms was fulfilled by all the organic wastes provided to this worm.

The increased growth rate of this worm from 7th week onwards in all wastes may be due to enhanced feeding activities in the early stages to get more energy for the cocoon production. Similar observation was also reported by Haynes *et al.,*[19] that more compost was produced during pre-clitellar stage rather than the post-clitellar stage. Loehr *et al.,*[20] was also reported that *Perionyx excavatus* reached its maximum biomass after approximately 100 days grown in sewage sludge. Reinecke *et al.,*[21] Were also observed the maximum biomass (5600mg/worm) of *E. eugeniae* in their studies

The occurrence of early and late maturity by the earthworm *E. eugeniae* may be due to preference and quality of food provided to the worms[22]. The difference in rate of cocoon production in different organic wastes may be again correlated or dependent on quality and preference in type of food by the *E. eugeniae*. Neuhauser *et al.,*[23] and Edwards[24] were also noticed that the quality of food or preferred food determines the time taken for sexual maturity and reproduction.

STATISTICAL ANALYSIS

The statistical analysis revealed that there is as such no significant difference with respect to biomass, growth rate, and cocoon production (Table 6) grown in different organic wastes along with control cattle manure.

CONCLUSION

Based on the observation with respect to worm biomass, growth rate, formation of clitellum (maturity) and cocoon production (Table 5) in various organic wastes, it was concluded that *E. eugeniae* is a voracious feeder, breeder, very efficient epigeic earthworm species best suitable for the vermiculture practice in any non-toxic organic wastes for the production of worm biomass, vermicompost, vermiwash and vermicompost wash.

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