Production of Vermicompost from Rose Flower Petal Wastes

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Abstract— *The flower waste obtained from markets and temples could be effectively utilized for vermicomposting and production of good quality vermicompost. Eudrilus eugeniae species is good for vermicomposting of flower waste at shorter time period. The results obtained proved that 30% inclusion of flower waste along with cow dung gives good yield of vermicompost. Eudrilus eugeniae does not require soil for habitation. Provision of good quality cow dung enhances the water holding and nutrient supplying capacity. Maximum temperature (27.96^{o}C) was recorded in VT6 and pH ranged between 7.58 and 8.76 in all treatments. VT6 treatment also showed the maximum electrical conductivity (3.94 mhos/cm). 42.50% of Organic Carbon was observed in VT2. A high concentration of N (0.59%) was found in VT5 treatment and phosphorous (0.68%) in VT4. The maximum weight of earthworm (3080 mg) was achieved in VT5 with a growth rate of 24 mg/worm/day. High yield of vermicompost (1422gm/2kg of substrate) was also obtained in VT5 treatment. The present study revealed that the temperature at a range of 26^{0}C, pH 7.5 to 8 and moisture content of 49 to 50% were the ideal parameters to activate metabolic activity, cocoon production and reproductive action of Eudrillus eugeniae..*

Keywords*— *Earthworm, Eudrillus, Vermicomposting, Flower wastes, Rosa berberia.

I. INTRODUCTION

Floriculture is an art and science and it has been recognized as an economic activity with the potential for creating employment. In Tamil Nadu flowers like Marigold, Tuber Rose, Jasmine, Mullai, Rose, Crossandra, Chrysanthemum, Arali, etc are cultivated in large numbers. Tamil Nadu takes third place by cultivating the flowers in an area of 32,290 ha. Flowers are marketed regularly in local market and mainly operated in open yards like road sides. The price of flowers mainly depends on the quality, supply, demand and freshness. Heavy rainy season and too hot summer season results in deterrent for selling flowers. Floral waste generation also occurs largely during functions, worships, ceremonies, festivals, etc. This ultimately results in the large amount of flower waste which creates severe environmental pollution and health hazard. Biological processes such as vermicomposting converts floral waste into organic fertilizer would be of great benefit.

Vermicomposting is a biological conversion process of organic materials and involves a joint action of earthworm species and microbes, which is being used for solid waste management [1]. Floral waste degradation is a slow process as compared to kitchen waste degradation [2]. Therefore there is a need of proper and eco-friendly method for floral waste degradation. In this the present investigation is aimed to document the stepwise physico chemical changes during floral waste degradation and vermicompost production by using an indigenous species of earthworm

II. MATERIAL AND METHODS

2.1 Collection of rose flower waste

Rose *(Rosa berberia)* flower waste was collected from local flower market and temples at Salem. About 10kg was collected and the non-biodegradable part of rose flower waste was removed by hand sorting and the biodegradable waste were segregated and shredded into small pieces.

2.2 Collection of earthworms

Earthworm species *Eudrilus eugeniae species was* procured from local suppliers at Salem, Tamil Nadu, India.

2.3 Combinations of composting substrate

For vermi-composting, rose flower waste and cow dung was mixed in different ratios. These rose floral waste substrates were filled in the plastic bins.

- VT 1 – Positive control (Cow dung alone + Earthworm)
- VT 2 – Negative control (Rose flower waste alone + Earthworm)
- VT 3 - 10% Flower waste (200g Flower waste +2kg Cow dung + Earthworm)
- VT 4 - 20% Flower waste (400g Flower waste +2kg Cow dung + Earthworm)
- VT 5 - 30% Flower waste (600g Flower waste +2kg Cow dung + Earthworm)
- VT 6 - 40% Flower waste (800g Flower waste +2kg Cow dung + Earthworm)
- VT 7 - 50% Flower waste (1000g Flower waste +2kg Cow dung + Earthworm)

Each combination was prepared in triplicates. The bins with different combinations were left for 12 days prior to experimentation and watering was done on alternate days. Then they were mixed upside down for pre composting, microbial degradation, softening of waste and for thermo stabilization

2.4 Preparation of composting substrate

The experiment was performed in plastic containers (60cm length x 30cm width x 30cm depth) with uncovered top surface. The vermibed substrates (VT1 to VT 7) consisted of rose flower waste and cow dung in different combinations by dry weight as described above. These wastes were used to provide bedding for the earthworms as well as a carbon supplement. Cow dung was used as inoculants. Alternate two layers of floral waste and cow dung are placed one over another. Adult clitellate worms, Eudrilus eugeniae ranging in length from 12cm to16.7cm were added at the rate of 100 grams of earth worms per 1Kg of composting substrate. The moisture content was maintained throughout the period of the study by periodic sprinkling of water. Watering was stopped, when the vermicompost got ready as indicated by uniform dark brown to black colored granular structure. The vermin cast was passed through 2-3 mm sieve and the earthworms were removed manually. The vermin cast was air dried by spreading it in large trays. The ratios of bioconversion rate of flower waste into vermicompost for all the groups were calculated. After sufficient moisture was lost, samples were analyzed. Cow dung substrate alone was used as positive control. Rose flower waste substrate alone was used as negative control.

2.5 Physiochemical parameters

Gravimetric method was used for determining the moisture content .Temperature was measured with the help of Mercury thermometer at the depth of 10 cm and their mean values were taken in centigrade [3]. Vermicompost were oven dried at 100^0C then ground in the blender and sieved for its physiochemical analysis. Particles smaller than 2mm in diameter were used for analysis. Electrical conductivity was determined by using pH and electrical conductivity meter. 10 grams of dried sieved vermicast sample was diluted to 100 mL with distilled water (1:10 w/v) and kept for shaking in a rotary shaker for two hours. After two hours the sample was left for half an hour for settling and then filtered through a whatman filter paper no 42. The filtrate was used for pH and EC analysis [4]. Total organic carbon (TOC) was measured by the method of Nelson and Sommers [5]. The total nitrogen of the sample was estimated by Kjeldahl method. Total potassium content of the was determined by flame photometric method and total phosphorous content was estimated by diacid digestion method.

2.6 Growth performance and Cocoon production rate

The growth and reproductive potential of earthworms in different treatments were determined. At the end of the experiment, adult worms and cocoons were counted separately. The worms were separated from the vermicompost and earthworm biomass was determined. The substrate in treatments was examined daily in order to determine the onset of cocoon production. When the cocoons appeared, they were picked up by hand sorting, washed lightly in distilled water and counted so as to determine the total number of cocoon production rate (cocoon/worm/ day). At the end of the experimental day, the earthworms were collected from each treatment bins and rinsed with distilled water to remove any adhering substances, dried briefly on paper towel and weighed using electronic balance. Without voiding their gut content the worms were weighed. Weighed earthworms were again introduced in each respective experimental container. From the data collected, the increased biomass rate (g/ earthworm/day), weight achieved at the maximum, and net biomass gain were calculated.

Growth rate determination, $R = (N2 - N1) / T$

Where R = Growth rate; N1= Initial biomass of earthworm (mg); N2= Final biomass of earthworm (mg); T= Time period of the experimental day

III. RESULTS

Experiments were conducted in plastic containers using different combinations of rose flower waste along with cow dung. Triplicates were taken for each test treatment. Cow dung alone was used as positive control and rose flower waste alone was used as negative control. After a pre-decomposting period of 15 days, 100 grams of clitellate earth worms were released in to bin per kilogram of composting substrate. During this period no mortality was observed, earthworms could survive in all treatments except negative control. Rose flower waste alone was not found suitable and all the earth worms did not survive.

3.1 Physio- chemical characteristics of vermicompost

The variation of pH, EC, Temperature and Moisture content in different substrate material (flower waste & cow dung) including controls are presented in table-1. The pH values ranged between 7.58 and 8.76. The maximum pH 8.76 was recorded in control treatment (VT2) and the minimum pH of 7.66 was noticed in VT7 treatment. The pH value gradually decreased from 8.76 to 7.66 during the end of the experiment days. The pH shifted towards acidic range which might be attributed to mineralization of the nitrogen and phosphorus into nitrites/nitrates and orthophosphates. pH in the final vermicompost samples might have been changed due to the microbial activity during the bioconversion of different substrates.

TABLE 1
PHYSICAL COMPOSITION OF VERMICOMPOST SAMPLES IN DIFFERENT TREATMENTS

S.No.	Compositing Substrate	pH	EC (mhos/cm)	Temperature (^oC)	Moisture (%)
1	VT 1	00	00	00	00
2	VT 2	8.76±0.32	1.52±0.02	27.29±0.50	40.33±1.52
3	VT 3	8.37±0.12	2.64±0.23	25.97±0.15	42.33±0.57
4	VT 4	8.00±0.11	2.19±0.03	25.67±0.58	44.33±2.52
5	VT 5	7.58±0.20	2.95±0.13	26.20±0.86	49.66±1.52
6	VT 6	7.78±0.22	3.94±0.06	27.96±0.06	50.33±1.52
7	VT 7	7.66±0.12	3.76±0.12	27.50±0.50	50.33±1.52

The electrical conductivity (EC) of vermicompost ranged between 1.52 and 3.94 mhos/cm in various treatments. The maximum electrical conductivity (EC) 3.94 mhos/cm was obtained in VT6 treatment and the minimum electrical conductivity (1.52) were found in VT2.

The temperature variations indicated that it was higher in larger proportions of rose flower waste and it decreased as the amount of cow dung increases in composting mixture. The highest temperature of 27.96^0C was noted in VT6 and the lowest temperature (25.67^0C) was found in VT4 treatment at 45th day of experiment. Another significant observation was that the temperature increased (27.9^oC) in earlier period of composting and then decreased to 26.2^oC in later period of Vermicomposting.

The moisture content of the wastes varied between 40.33% and 50.33%. The highest moisture content (50.33%) was recorded in VT6 & VT7 treatments whereas lowest moisture content (40.33%) was found in negative control treatment. The present study high moisture (50%) content in VT6 than the control, which may be due to the assimilation rate by microbial population indicating the higher rate of degradation of flower waste by earthworm.

The NPK Contents of the harvested vermicompost was depicted in table-2. This shows a significant difference between the treatments. The concentration of N was highest (0.59%) in VT5 treatment. On the other hand, the amount of in P and K were high (0.68 and 1.62%) in VT4 & VT3 treatments and low Nitrogen (0.39%) in VT7 treatment. The maximum percentage (42.50%) of Organic Carbon was observed in VT2 treatment and minimum percentage (29.16%) of organic carbon was observed in VT7 treatment.

TABLE 2
CHEMICAL CHARACTERISTICS OF VERMICOMPOST SAMPLES IN DIFFERENT TREATMENT

S. No.	Compositing Substrate	Total Organic Carbon (%)	Total Nitrogen (%)	Total Phosphorus (%)	Total Potassium (%)
1	VT 1	00	00	00	00
2	VT 2	42-50±0.50	0.43±0.01	0.44±0.05	0.91±0.03
3	VT 3	41.76±0.68	0.55±0.04	0.41±0.01	1.62±0.14
4	VT 4	39.67±0.58	0.53±0.03	0.68±0.03	1.17±0.11
5	VT 5	39.33±1.15	0.59±0.02	0.60±0.04	1.60±0.52
6	VT 6	31.00±1.00	0.46±0.04	0.56±0.05	0.67±0.04
7	VT 7	29.16±1.04	0.39±0.01	0.45±0.05	0.76±0.16

3.2 Yield of vermicompost

Vermicompost production rate was different according to the composition of flower waste mixture (Figure-1). The highest vermicompost yield (1422 gms) was obtained from VT5 treatment followed by 1213 & 1100 gms were harvested in VT4 & VT3 respectively. The lowest vermicompost yield of 809 gm was noticed in VT7 treatment.

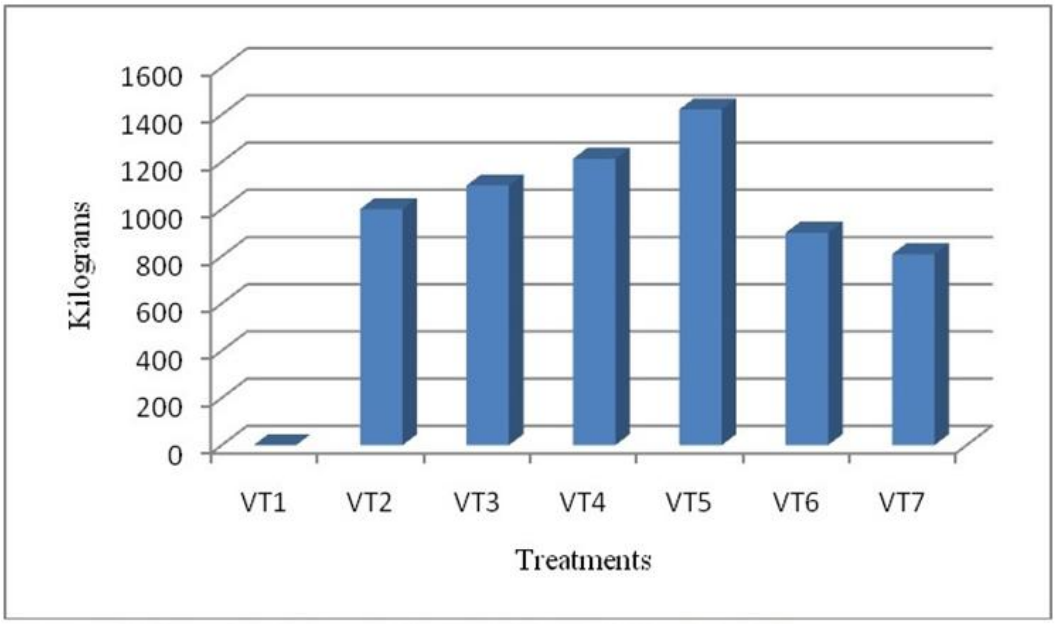

FIGURE 1: Yield of Vermicompost in different combination of Flower Waste Substrate

3.3 Growth and reproduction rate of *Eudrilus eugeniae*

The growth rate (mg weight gained/day/earthworm) has been referred as a good comparative index to study the growth of earthworms in different waste substrates. The growth rate of earthworm species in different substrates during the study period is given in Table-3. The biomass of earthworm species showed progressive increase to 3083mg on 45th day of experiment with a growth rate of 24 mg/worm/day in VT5. The minimum weight was observed as 2325 mg of earthworm with the growth rate of 7.22 mg/worm/day in VT2. These values showed a gradual decline (10.22mg/worm/day and 12.00mg/worm/day) with increasing proportion (40 & 50%) of rose flower waste. However, in VT2 the weights (7.22mg/worm/day) of adults were less when compared to treatments. The increased biomass with 30% flower waste suggests that the role of flower waste as food material and enriching the substrate with essential nutrients.

TABLE 3
BIOMASS GAIN OF *EUDRILUS EUGENIAE* IN DIFFERENT TREATMENTS

S. No.	Compositing Substrate	Initial Biomass of Earthworm (mg)	Final Biomass of Earthworm (mg)	Net Biomass gain of Earthworm (mg)	Biomass increase rate (gm/Earthworm/day)
1	VT 1	2000	00	00	00
2	VT 2	2000	2325.00±25.00	325.00±0.05	07.22±0.55
3	VT 3	2000	2476.60±58.60	476.66±58.59	10.59±1.29
4	VT 4	2000	2818.00±38.31	818.00±38.31	18.18±0.85
5	VT 5	2000	3080.00±29.00	1080.66±29.00	24.00±0.65
6	VT 6	2000	2542.00±74.84	542.66±74.84	12.00±1.67
7	VT 7	2000	2466.00±76.60	466.00±76.60	10.22±1.76

Table 4 shows the production of cocoons. High yield of cocoon production (374 numbers) was attained in VT4 treatment at a reproduction rate of 3.45 (cocoon/earthworm/day) at 45 day of experiment. The lowest number (92 numbers) of cocoon was found in VT7 treatment with a reproduction rate of 1.17 ± 0.17 (cocoon/earthworm/day).The mean number of cocoons produced per worm per day was 12.08 ± 0.32 in VT4 treatment which was greater than 2.96 of cocoons produced per day in VT7.

TABLE 4
REPRODUCTION RATE AND COCOON PRODUCTION OF *EUDRILUS EUGENIAE* IN DIFFERENT TREATMENTS

S. No.	Compositing Substrate	Cocoon Production started (week)	Total Number of Cocoon Produced (Numbers)	Number of Cocoons produced/day	Reproduction rate (Cocoons/worm)
1	VT 1	00	00	00	00
2	VT 2	2	121.00±06.55	03.89±0.21	0.46±0.05
3	VT 3	2	333.00±11.35	10.74±0.36	1.32±0.40
4	VT 4	2	374.00±10.00	12.08±0.32	3.45±0.38
5	VT 5	2	342.00±29.00	11.05±0.95	2.37±0.55
6	VT 6	2	143.00±13.52	04.61±0.43	1.89±0.11
7	VT 7	2	92.00±17.43	02.96±0.56	1.15±0.17

IV. DISCUSSION

Vermicompost is considered to be the high value product and is an excellent soil additive produced by earthworms. The present deals with the physico chemical changes during floral waste degradation and vermicompost production by using an indigenous species of earthworm.

4.1 Physico-chemical parameters

In the present investigation pH values were ranged between 7.58 and 8.76 in all treatment groups. The results of the present investigation corroborates with the findings of Vodounnon *et al*.,[6] who reported that the pH values of organic substrate and vermicompost ranged between 7.94 to 8.52 which was due to higher mineralization. vermicomposts tend to have pH values near neutral, which may be due to the production of CO_2 and the organic acids during microbial metabolism[7]. The electrical conductivity (EC) of vermicompost ranged between 1.52 and 3.94 mhos/cm in different treatments. The increased electrical conductivity (EC) during the vermicomposting process is in consistence with that of earlier studies [8],[9]. In this study our findings correlates with previous work of Sharma and Yadav [10] ,who has reported that the electrical conductivity of cow dung vermicompost was 5.44 and 4.87 mS/cm, respectively. The main reason for the increase in EC might have been due to release of different mineral salts in available forms [11].Their concentration increased gradually with time, which may contribute the increase in electrical conductivity of compost.

The temperature in the present study ranged between 25.6^{o}C to 27.9 ^{o}C temperature plays a vital role in vermicomposting. The increase in temperature can kill the earthworm. Similar types of results were observed from temple waste [12]. Nisha Jain [13], has also reported that 25^{o}C was found to be optimal for flower waste composting substrate material. Similar changes were also observed in temperature during vermicomposting, they reported that initial temperature (30^{o}C) of the vermibed was found to decrease up to 26^{o}C because of exothermic process of organic matters [14]. Relatively higher moisture content of vermicompost produced by Eudurillus eugeniae implied greated palatability of the substrate (VT5 treatment). The optimum moisture content for growth of earthwarm Eudrillus eugeniae was 85% in organic management [15]. Vermicompost samples of the present study showed higher (50.33%) moisture content, which may be because of assimilation rate by microbial population indicating the higher rate of degradation of flower waste by earthworm.

The NPK Contents (%) of the harvested vermicompost showed a significant difference between the treatments. The concentration of N was high (0.59 %) in VT5. In a study by Manaig [16], reported that the NPK content of vermicompost is higher than the farmyard wastes. Sharma and Yadav [17], also reported an increased total nitrogen content in vermicomposts. Earthworms in waste material considerably enhances the amount of N due to earthworm mediated nitrogen mineralization of wastes and also the earthworm enhances the nitrogen levels of the substrate by adding their excretory products [18]. Total nitrogen content in vermicomposts can range quite widely from 0.1% to 4% or more [19]. High K content (0.68%) was recorded might be due to the high microbial activity which favours mineralization. Chaulagain *et al*., [20] reported that there is increased potassium content of the vermicompost using cow dung with banana pseudostem than other wastes. There is an increased phosphorous content in vermicompost also recorded in the present study. The increased phosphorous might be probably due to mineralization and mobilization of phosphorus as a result of bacterial and faecal phosphatase activity of earthworms [21]

4.2 Growth Rate, Biomass and Cocoon Production

The increased biomass of Eudrilus eugeniae (3080mg) was observed in VT5. The growth rate and the biomass of earthworm species during the study period showed progressive increase up to 4th week .Similar pattern of results were also reported [22], [23] and suggested that the rapid pre-reproductive phase of growth is followed by a phase of progressive biomass and growth reduction once sexual maturity was attained. The loss of biomass might be associated with the exhaustion of food. Neuhauser *et al*., [24] reported that the weight reduction also occurred when the earthworms attained their matured stage and also due to utilization of energy for the purpose of reproduction such as laying eggs, mating and cocoon formation [25].Temperature also influences the growth of earthworm by modifying metabolic activity [26]. Vasanthi *et al*., [27] also reported that the earthworm growth ability was high at 26^{o}C. So temperature also plays a vital role in the growth rate and biomass of the worms.

At the end of experiment (45 days) a high number of cocoon (374 numbers) productions were obtained in VT4 with a reproduction rate of 3.45 ± 0.38 (cocoon/earthworm/day). A high number of worms and cocoons were observed in cow dung and saw dust mixture (1:1 and 1:1.5) than the pure cow dung using epigeic earthworm *Eudrilus eugeniae*[28]. Also, high numbers of earthworms were observed in the feeding mixture of cow dung and leaf litter as compared to the cow dung as a sole feeding material. The presence of leaf litter in the mixture which may be favored earthworm multiplication. In a similar study, the maximum increase in population of *Eudrilus foetida* was observed in tree leaves as a sole feeding material than cow dung alone [29]. Suthar [18] reported that the nitrogen content of substrates is an important factor related to cocoon production. Getachew *et al.*, [30] have reported that food source also greatly influences growth rate and cocoon production. Survival, biomass and reproduction of earthworms are the best sign to analyse the vermicomposting process. Therefore, the increase in adult worm biomass and the production of significant numbers of cocoons in VT5 indicates that their reproductive activities are enhanced by the substrate. Our present study is also supported by the findings of Loni *et al.*, [31] who have reported that the total number of cocoons produced were lower in higher pH (alkaline) when compared to neutral pH (6.5 to 7.0).The present study revealed that the yield of vermicompost was higher in 30% flower waste and cow dung combination. So the ability of worm to consume and convert the wastes into vermicast varies according to the substrate and hence the difference in vermicompost yields.

V. CONCLUSION

The present study revealed that the flower wastes may be used as potential substrate for vermicomposting. Vermicompost also contains some of the secretions of worm and in association with microbes acts as growth promoters along with other nutrients. The physico chemical parameters such as pH, EC, temperature and moisture content were tested and found that the *Eudrilus eugeniae* were grown well in the pH of 7.58 ± 0.20 , 2.95 ± 0.13moh of EC, 26.20 ± 0.86^{0}C of temperature and 49.66 ± 1.52 % of moisture content. Good yields (1322gm/2kg of substrate) of vermicompost were obtained in VT5 treatment (30% rose flower waste inclusion). This ratio is recommended for vermicompost generating profits. The present study divulge that the temperature at the range of 26 to 27^{o}C, pH 7.5 to 8.0 and moisture content 49 - 50% were the ideal parameters to activate metabolic activity, cocoon production and reproductive action in *Eudrillus eugeniae*.

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