Impact of Sugarcane pressmud on the quality of vermicompost and the growth of *Eudrilles eugenia*

K. Bakkiaraj [1], S.Jayakumar [2*]
1.Research Scholar, Dept. of Zoology, Presidency College, Chennai 5.
2. Associate Professor of Zoology, Presidency College, Chennai 5.

***Abstract* - Enormous amount of sugarcane press mud is generated by sugar industries in India every year. This research paper reports the potential of earthworms to convert sugar mill pressmud waste mixed with cow dung into vermicompost, using the earthworm *Eudrilles eugenia*. Five different treatment were maintained having different ratios of sugarcane pressmud (SP) and cowdung (CD). The growth and cocoon production of *E. eugenia* was monitored for 60 d. Maximum growth was recorded in 1:3 SP and CD, but earthworms grew and reproduced modetately up to 1:2 SP and CD feed composition. However, higher concentration of SM significantly affected the growth and reproduction of earthworms. Vermicomposting resulted in reduction of carbon content and increase in nitrogen and phosphorus concentration. The results clearly indicate that vermicomposting sugarcane pressmud could be effective in the management of SP and converting into organic fertilizer, if mixed with a maximum of 50 % with cowdung.**

***Index Terms* -sugarcane pressmud, bagasse, *Eudrilles eugenia,* carbon, nitrogen, phosphorus.**

I. INTRODUCTION

India is one of the largest growers of sugarcane with enormous amount of sugarcane pressmud accumulated annually. India's sugar production for the fiscal year 2022-23 amounted to 32.74 million tonnes, along with approximately 11.4 million tonnes of pressmud (Down to earth, 2023). Sugar-distillery complexes, integrating the production of cane sugar and ethanol, constitute one of the key agro-based industries. There are presently nearly 400 sugar factories in the country along with around 300 molasses based alcohol distilleries. These include sugarcane trash, bagasse, pressmud and bagasse fly ash. Vermicomposting of pressmud is an efficient method of waste disposal, enabling recycling of organic matter. Vermicomposting of pressmud is one of the most promising technologies for solid waste treatment. The organic substrates in solid waste can be biodegraded and stabilized by composting and the final compost products could be applied to land as the fertilizer or soil conditioner. The present research paper deals with the effect of pressmud on the growth of earthworms and various physical and chemical nature of vermicompost obtained from sugarcane pressmud.

Vermicomposting is an environmentally responsible process. The practice has several environmental, economic, and educational benefits. Vermicomposting makes the environment healthier as it reduces waste in a healthy, natural process (Deepali *et al*., 2015). Vermicomposting is conversion of organic solid waste through earthworm which converts the organic matter into worm castings. Vermicomposting is the combined activity of microorganisms and earthworm. Microbial decomposition of biodegradable organic matter occurs through extracellular enzymatic activities, whereas decomposition in earthworm occurs in elementary tract by microorganisms inhibiting the gut. Microbes such as fungi, actinomycetes, protozoa etc. are reported to inhibit the gut of earth worm. The worm species that are commonly used in vermicomposting are *Eisenia foetida, Eudrilus Eugenie* and *Lambito mauritii*. Approximately 50 kg of worms gives 50 kg of manure per day. These worms survive in the moisture range of 60- 80% and temperature range of 20- 40°C. Vermicomposting is less labor-intensive since, the worms do almost all of the work. Vermicompost improves soil structure, due to the slime produced by worms, nutrients are retained even after rain. Worm castings hold beneficial microorganisms longer than compost. Worms reproduce quickly, making vermin culture a self-sustaining process. Using worms for composting has been shown to reduce the methane and nitrous oxide

levels in landfills, which are worse for the environment than carbon dioxide gas (Vinodhini *et al*., 2016).

Sugarcane industries generate large amount of waste in the form of bagasse and pressmud per day. Most of the part of these wastes are usually burnt in the field due to lack of proper management techniques, which creates severe environmental pollution and health hazards, hence it was thought to attempt use sugarcane pressmud and bagasse for cheap and eco friendly treatment methods like vermicomposting. It is the proces of compost formation by earthworms. Earthworms are crucial drivers of the process, by fragmenting and conditioning the organic solid substrate and dramatically altering its biological activity. In this study, both wastes were pretreated with an organic nutrient preparation Jeevamrutham (effective microbial suspension) for 15 days at 30°c than it was used to fill up in 2 kg capacity plastic tubs and earthworm Eiseniafetida was used to convert this raw materials into highly nutritive vermicompost. The process were subjected for optimization of parameters like temperature of vermireactor, pH of material, particle size of wastes and moisture content of reactor by using Eiseniafetida earth worm species for six weeks. It was found that 25°C temperature, pH 7.0, 1-2mm particle size, Sugarcane industries generate large amount of waste in the form of bagasse and pressmud per day. Most of the part of these wastes are usually burnt in the field due to lack of proper management techniques, which creates severe environmental pollution and health hazards, hence it was thought to attempt to use sugarcane pressmud and bagasse for cheap and eco friendly treatment method that is vermicomposting (Yadav, 1992). Earthworms are crucial drivers of the process, by fragmenting and conditioning the organic solid substrate and dramatically altering its biological activity (Yaduvansi and Yadav, 2016). In this study, both wastes were mixed with cowdung and was used to fill up in 2 kg capacity in earthern pots and earthworm *Eudrilles eugenia* was used to convert this waste material into highly nutritive vermicompost. The process was subjected for optimization of parameters like temperature of treatment, pH of material, particle size of wastes and moisture content by using *E. eugenia* earthworm species for 60 d. It was found that 25°C temperature, pH 7.0, 2-5 mm particle size was favourable.

II. MATERIALS AND METHODS

The earthworm *Eudrilles eugenia* were maintained in vermicompost pits. The worms were kept at a constant temperature of 25±2ºC and relative humidity of 80% in darkness. Cow dung was procured from the dairy farm situated in Acharapakkam village, Chengalpattu Dt. Cow dung was spread for 10 d in shade, so that the gases and heat were removed. Sugarcane pressmud and bagasse collected from Eraiyur sugar mills, Eraiyur, Perambalur Dt., were dried in shade for 15 d. The experiment was carried out in earthern pots of size 50 cm height and 45 cm diameters were filled with mixture of cow dung (CD) and sugarcane pressmud (SP) in the ratio 1:1, 1:2, !:3. In another treatment sugarcane pressmud (SP), cow dung (CD) and bagasse (BS) were mixed in the ratio 1:1:1, !00% CD was taken as control. The earthern pots were covered with cloth to avoid spillage of compost infestation of insect and flies, as well as to avoid escape of earthworms. The bottom of the pots was uniformly spread with sand for about 1 inch height. Above this, the treatment mixture was added. Then 25 g of earthworms were introduced into the substrate for vermicomposting.

The vermicomposting pot was placed on a plastic tray to collect the vermiwash. The entire setup was maintained in a cool area for about 60 days. The substrate moisture content was maintained at 70-80 % by sprinkling water twice a day, in the morning and evening. Once in 2 days, the surface of the substrate was mixed for better aeration and to speed up the composting process and to eliminate volatile gases. At the interval of every 20 d, the worms, hatchlings and cocoons were counted and tabulated. After the completion of the experiment, the vermicompost was sieved, air dried and stored in plastic bags for physico-chemical analysis.

Growth rate of the worms : The growth rate of the worms was determined as the quotient of the difference obtained from the initial total count of worms and the total number of living worms at the end of the study, divided by the experimental time period (R = (N2-N1)T

where R = growth rate,

N1 – Total number of initial worms,

N2 -Total number of living worms after experimental period,

T- time period of the experiment.

The length and weight of the worms were measured by millimeter scale and Digital balance respectively. The mortality of earthworms were confirmed dead when they remained immobile and motionless when pricked or touched with a object. Freshly laid cocoons of the earthworms were collected, counted and reintroduced into the respective pots.

Physico-Chemical Analysis : Five gram of air dried vermicompost was suspended in 50 ml of distilled water (1:10 ratio) and shaken well for 1 hr. Then the supernatant was collected, filtered and the pH and EC was estimated using pH and EC meter. The porosity, water holding capacity, density, organic carbon content (%), C:N ratio were determined as per standard protocols. The N, P, K, Ca, Mg, Fe were determined by using Atomic Absorption Spectrophotometer.

III. RESULTS AND DISCUSSION

The earthworms *Eudrilles eugenia* were acclimatized to the laboratory conditions for a period of 15 days before the commencement of the experiment. The growth pattern of the earthworms were studied by measuring the worm length, weight, mortality, cocoon production were studied. The data obtained regarding the growth rate and cocoon production were tabulated.

Treatment	Number of days of treatment		
	20	40	60
CD-Control	3.71±0.01	5.18±0.31	4.15±0.01
CD + SP 1:1	2.81±0.01	3.91±0.12	3.35±0.14
CD + SP 1:2	2.15±0.11	3.41±0.01	3.11±0.22
CD + SP 1:3	1.23±0.01	1.89±0.11	1.65±0.14
CD +SP +BS 1:1:1	2.14±0.01	2.95±0.21	2.26±0.21

Table 1 showing the growth rate of *E. eugenia*.

The growth pattern of earthworm *E. eugenia* over the experimental period of 60 days is shown in table 1. The growth rate was lesser in the treatments when compared to the control. As the concentration is increased to 1:3 ratio, the growth rate was drastically reduced. Further addition of sugarcane bagasse reduced the growth rate, which could be attributed to the impact of two agro-waste on the feeding of the worms. It was observed that there was a weight loss by the time of completion of the study. The weight loss might be associated with the depletion of food [Bhat *et al*., 2016], [Sonia *et al*., 2001]. Jesikha *et al*., [2013] reported a related pattern of weight loss when earthworms attained sexual maturity because earthworm utilizes the energy for reproduction purposes such as copulation, cocoon formation, and egg laying.

Treatment	Number of days of treatment		
	20	40	60
CD-Control	13.7±0.01	14.5±0.01	15.1±0.01
CD + SP 1:1	4.7±0.01	5.5±0.01	5.9±0.14
CD + SP 1:2	2.7±0.11	2.9±0.01	3.4±0.12
CD + SP 1:3	1.2±0.01	1.4±0.11	1.3±0.04
CD + SP +BS 1:1:1	2.3±0.01	2.7±0.01	2.4±0.01

Table 2 showing the cocoon production of *E. eugenia.*

The cocoon production by earthworm *E. eugenia* in different treatments is shown in Table 2. The highest cocoon production rate (5.9±0.14) was obtained in 1:1 CD and SP treatment, whereas the lowest (1.2±0.01) was in 1:3 CD and SP treatment, while the control showed the highest cocoon production of 15.1±0.01. Therefore, the reproduction rate was found significantly higher in 1:1, and according to Chauhan and Singh [2012], it may be due to less toxic effect of sugarcane pressmud and aeration due to mixing of the treatment regularly. Similarly, Chaudhuri and Nath [2011] also reported that sources with a significant amount of metabolizable organic matter facilitate growth and reproduction in the earthworm. The weight gain by earthworm was higher in 1:1 and 1:2 CD and SP treatment but cocoon production was lower in 1:2 treatment than 1:3 CD and SP treatment. It indicates that sugarcane pressmud is not suitable for reproduction but suitable for a biomass supporting medium when supplied in moderate amount.

S.No	Parameters	0 d	60 d
1	pH	7.4	7.0
2	EC (mS/cm)	7.6	12.4
3	Water holding capacity (%)	42.3	88.5
4	density (Kg m-3)	483	356
5	Organic carbon (%)	26.5	13.8
6	C:N ratio	25.4	21.8
7	Nitrogen (%)	4.56	5.16
8	Phosphorous (%)	5.34	7.04
9	Potassium (%)	3.74	4.25
10	Calcium (%)	1.54	2.45
11	Magnesium (%)	125	143
12	Iron (ppm)	78	86

Table 3 showing the physicochemical parameters of vermicompost.

Table 3 shows the physico-chemical properties of vermicompost from the experiments. The pH of the vermicompost is decreased from 7.4 to 7.0; whereas

the EC significantly increased (2 times over control) probably due to the degradation of organic matter and thereby releasing minerals such as calcium, magnesium, potassium and phosphorous. Vermicomposting converts sugarcane pressmud into compost in 60 days, reduces the C:N ratio and increases N, P and K. Vermicomposting has improved the porosity and water holding capacity, whereas decreased the bulk density due to the high humus content [Guoxue *et al*., 2001; Tognetti *et al*., 2005]. The major and micronutrients were also increased significantly indicating the degradation of organic materials into exchangeable calcium, magnesium, phosphorous, potassium, nitrogen, copper and iron. To conclude, vermicomposting of sugarcane press mud is a natural, ecofriendly, cost-beneficial, less laboured and speedy process where, the earthworms ingest the organic material and produced humus like vermicastings. Vermicastings are rich in nutrient and thereby enriched the physico-chemical characteristics of the soil. In addition, the reduced pH solubilizes the macro and micronutrients, which make them readily available to the plants. The results were in concurrence with the findings of Suthar and Singh [2008] and Sakthivel et al. [2017]. The physioco-chemical nature of the vermicompost makes it a suitable option for better growth of plants. The rich nutrient content makes it a suitable organic fertilizer for agricultural purpose. Moreover, this vermicompost can be used as a fertilizer in agriculture land as it has a higher amount of nitrogen, phosphorus, and potassium. Similarly, Chauhan and Singh [2012] reported highest potassium and calcium content in vermicompost from various organic agro-wastes.

IV. CONCLUSION

The purpose of the experiment was to examine the effect of sugarcane pressmud on the growth and reproduction of *E. eugenia*. The refuse used in this experiment was cheap and available in large quantities, and those materials are mostly organic waste materials. Disposal of large quantities of this waste can cause serious environmental problems, if not properly managed. The use of appropriate food source is important for earthworm *E. eugenia* culture and to increase the growth and reproduction performance. The weight of earthworm *E. eugenia* was achieved better when equal volume of cowdung was mixed. The quality of vermicompost was also improved as per the results of physico-chemical parameters. Therefore, among the different concentration of pressmud used, 1:1 ratio was preferable as feed for culture and moderate reproductive performance of earthworm *E. eugenia* Earthworm production can help in the process of waste degradation, and the produced earthworm could be used as an alternate animal protein source for livestock, poultry, and fish.

V. ACKNOWLEDGEMENT

We thank the Principal and the Head of the Department of Zoology, Presidency College, Chennai for permitting to do the research work.

REFERENCE

[1] Down to earth, 2023.https://www. Down to earth.org.in/news/renewable-energy/sugarcane-byproduct-pressmud-can-be-a-sweet-spot-for-india-s-compressed-biogas-sector-93022#:~: text =India's%20sugar%20production%20for%20the, 11.4%20million%20tonnes%20of%20pressmud

[2] Deepali Munde, Snehal Sutar. Ranveer, A.C., 2015. Vermicomposting of pressmud from sugar industry. In J of Inn. In Engg Res. and Tech. [IJIERT] ISSN: 2394-3696 Vol 2(4).

[3] Vinothini V, Anuradha R, Senthilkumar R. Vermicompost production and nutrient analysis using Eudrillus eugeniae, World Journal of Pharmaceutical research. 2016; 5(6):1250-1257.

[4] Yadav, D.V. (1992). Utilization of pressmud cakes in Indian agriculture. Indian.J.Sugarcane Technol, 7:1-16.

[5] Yaduvanshi, N P S., Yadav, D.V., (1990). Effect of Sulphidation Pressmud and Nitrogen Fertilizer on Biomass Nitrogen Economy, Plant Composition in Sugarcane and on Soil Chemical Properties. J. Agri. Sci. 114, 259- 263.

[6] Bhat SA, Singh J, Vig AP. Effect on growth of earthworm and chemical parameters during vermicomposting of pressmud sludge mixed with cattle dung mixture. Procedia Environ Sci 2016; 35:425–34.

[7] Sonia V, Felix S, Antony C. Comparative study of growth and reproduction of earthworm Eudrilus

eugeniae in different organic substrate. IRA Int J Appl Sci 2016; 4(1):61–8.

[8] Jesikha M, Lekeshmanaswamy M. Effect of pongamia leaf medium on growth of earthworm (Eudrilus eugeniae). Int J Sci Res Publ 2013; 3(1):1–4.

[9] Chauhan HK, Singh K. Effect of binary combinations of buffalo, cow and goat dung with different agro wastes on reproduction and development of earthworm *Eisenia fetida* (Haplotoxida: Lumbricidae). World J Zool 2012; 7(1):23–26.

[10] Chaudhuri, P.S. and S. Nath: Community structure of earthworms under rubber plantations and mixed forests in Tripura, India. J. Environ. Biol., 32, 537-541 (2011).

[11] Guoxue L, Zhang F, Sun Y, Wong WC, Fang M. Chemical evaluation of sewage composting as mature indicator for composting process, Water Air Soil Sludge Pollution. 2001; 132:333-345.

[12] Tognetti C, Laos F, Mazzarino MJ, Hernndez MT. Composting Vs vermicomposting: a companion of end product quality. Compost Science Utility. 2005; 1:6-13.

[13] Suthar S, Singh S. Vermicomposting of domestic waste by using two epigeic earthworms (Perionyx excavatus and Perionyx sansibaricus). International Journal of Environment Science and Technology. 2008; 5(1):99-106.

[14] Sakthivel V, Malathi C, Jayashri S, Saralabai VC. Physico-chemical analysis of vermicompost produced from tea leaves waste mixed with cow dung using *Eudrillus eugeniae*, European Journal of Biotechnology and Bioscience. 2017; 5(6):35-36.

[15] Chauhan H K and Singh K (2012) Effect of binary combinations of buffalo, cow and goat dung with different agro wastes on reproduction and development of earthworm Eisenia fetida (Haplotoxida: Lumbricidae). World J Zool 7: 23-29.