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Vermicompost Preparation from Plant Debris, Cattle Dung and Paper Waste by Using Three Varieties of Earthworms in Green Fields Institute of Agriculture, Research and Training, Vijayawada(AP), India

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ABSTRACT

Vermicomposts have higher level of available nutrients like carbon nitrogen, phosphorous and potassium, calcium and magnesium derived from the wastes. The paper has attempted to evaluate for development of efficacy vermicompost by using three varieties of earthworms. The use of earthworms in the degradation of different types of wastes is continuing from the past so many years. These wastes include industrial, agricultural of plant debris and domestic waste papers and cattle dung. In this study three varieties of earthworms used such as *Eisenia fetida, Eudrilus eugeniae* and *Perionyx excavates* in the vermicomposting of plant debris, cattle dung and waste paper. As waste paper, cattle dung and plant debris are rich in carbon while deficient in nitrogen cow dung was mixed with it to make it suitable for three earthworms. A mixture of waste paper, plant debris and c dung in the ratio of 1:1:1 was found to be the best ratio than 3(paper waste): 2(cattle dung) and 5(plant debris). In 60 days time excellent quality and quantity of compost was produced by three earthworms. Physical and biochemical parameters were analyzed during this period of 60 days. Pre decomposition of 10 days and subsequent vermicomposting of 60 days indicates the role of this species in vermibiotechnology. Increase was found in all the parameters like, Total nitrogen (%), Available phosphorus (%) and Exchangeable potassium (%) while a decrease was found in pH and C:N ratio as the timing of vermicomposting increased from 0 days to 60 days.

Keywords: Vermicompost, Plant debris, Paper waste, Cattle dung, *Eisenia fetida, Eudrilus eugeniae* and *Perionyx excavates.*

INTRODUCTION

The increase in population causes an increase in the quantity and type of urban and rural wastes. Such wastes are undesirable pollutants to the environment and time could even be a health menace. As far as rural wastes are concerned, there are enormous quantities of organic materials that are not utilized. “Vermicomposting technology” is a fast growing one with its pollution free, cost effective and efficient nature. Since 2,350 years ago Aristotle was reported, vermiculture is basically the science of breeding and raising earthworms. It defines the thrilling potential for waste reduction, fertilizer

production, as well as an assortment of possible uses for the future[1].

Vermicomposting is the process of producing organic fertilizer or the vermicompost from bio-degradable materials with earthworms. Composting with worms avoids the needless disposal of vegetative food wastes and enjoys the benefits of high quality compost. The earthworm is one of nature's pinnacle "soil scientists." Earthworms are liberated and cost effective farm relief. The worms are accountable for a variety of elements including turning common soil into superior quality. They break down organic matter and when they eat, they leave behind castings that are an exceptionally valuable type of fertilizer[5].

In recent years, Julka and Smith were reported earthworms have been identified as one of the major tools to process the biodegradable organic materials[3,2]. The utilization of waste materials through the earthworm has given the concept of vermicomposting. The vermicompost technology approach utilizes waste management process by involving earthworms[4]. Improvement of soil through vermiculture has now become a popular part of organic farming. Vermicmpost is accepted as humus biofertilizer, soil fertility booster, soil activator and soil conditioner with required plant nutrients of storage polysaccharides and structural polysaccharides, vitamins, enzymes, growth regulators and beneficial microorganisms like nitrogen fixing, phosphate solubilising, denitrifying, decomposing bacteria and methanogenic bacteria[11,12] . "The Green Revolution" that was promoted in early part of 20th century, was a boost to food production without foreseeing its ill effects. The recent realizations to maintain ecological balance for sustenance of agricultural production, farmers and scientists alike are aiming at finding an alternative to chemical agriculture. India has a long tradition of agriculture with a rich heritage of eco friendly agriculture technologies. In India the tropical climate prevailing is very congenial for farming. Talking in consideration such favorable environmental conditions, early farmers developed such technologies which were used to reap a big harvest throughout the ages. But after 1950, when green revolution was introduced, there was a sudden hike in consumption of chemical fertilizers, pesticides, insecticides and hybrid seeds. Unfortunately such extravagant use of these technologies and interference in natural processes in so called modern agricultural technologies seem to have failed in maintaining harmony with nature. As a result even sustainability of agriculture as a whole is at stake.

Fig. 1: showed decomposition experiment in a cement tank of 50x45x35cm

Fig. 2: show impact of composting period on three earthwormnumber, weight and biomass

Vermiculture is ecofriendly since earthworms feed on anything that is biodegradable, vermicomposting then partially aids in the garbage disposal problems. No imported inputs required, worms are now locally available and the materials for feeding are abundant in the locality as market wastes, grasses, used papers and farm wastes. It is also highly profitable, both the worms and castings are saleable[5].

Seanapatti and other co-workers developed applied use of earthworms in the breakdown of a wide range of organic residues, including sewage sludge, animal wastes, crop residues, and industrial refuse to produce vermicompost, has been recommended Hartenstein and Bisesi, 1988; Van Gestel *et al*., 1992; Dominguez and Edwards, 1997. The importance of the earthworms in waste management, environmental conservation, organic farming and sustainable agriculture has been highlighted by several workers[6,7,8]

Therefore an experiment was conducted during summer session from January 2016 to March 2016 with the objectives to find the best source of bedding material in relation to the nutrient status as well as the multiplication of earthworms and to find out the best species of earthworm vis-a-vis different bedding materials.

MATERIALS AND METHODS

The cattle dung (15 days old) was procured from nearby gudavalli village dairy farm. The moisture content of the medium was maintained at about 50%.-80%, Plant waste from Horticulture University and the paper waste was procured from the Kaleswara Rao market, Vijayawada, Krishna Distrct, Andhra Pradesh, India. The procured paper was shredded before using by means of a paper shredder. Earthworms (*Eisenia fetida, Eudrilus eugeniae* and *Perionyx excavates*) were procured from GPC Biotech India, Kesarapalli, Krishna District, Andhra Pradesh, India. For the present study, separate vermi-bed was made using 15 days old cattle dung, plant waste and paper waste for mass culture of *Eisenia fetida, Eudrilus eugeniae* and *Perionyx excavates.* The culture was constantly monitored throughout the period of study with time by time spraying of water. Mature clitellate worms for experimental purpose were taken from this stock culture.

The experiments was conducted in to two parts in the present study. The first part of pre-decomposition experiment a ceramic tank of 50x45x35cm (Fig. 1) measurement was filled with a mixture (10kg) of cattle dung, plant debris and shredded paper, it was daily sprinkled with water so that it gets decomposed. Also this waste was turned up and down for proper aeration and decomposition. This experiment was continued for 10 days and second part of composting experiment was study plastic tubs were filled with the pre-decomposed mixture of cow dung and shredded paper. 50 numbers of each variety of adult, mature, clitellate worms were taken from the stock culture and were uniformly released on the top of the containers of all the three experimental containers along with plant waste. The experiments were conducted inside the vermicompost shed located in green fields institute of agriculture research and training, gudavalli, Vijayawada Krishna district, Andhra Pradesh, in order to avoid the danger of predators and snow in during the months of January and February. The containers were covered by mesh garden cloth and were observed daily in order to check the various parameters necessary for the survival and reproduction of earthworms. These two experiments were maintained for 60 days till the finely granular vermicompost was prepared.

During the experiments of composting process the material was analysed for different physico-chemical attributes such as total Nitrogen, available Phosphorus, exchangeable Potassium and pH, by using conventional methods as well as for earthworm number, cocoon production and weight loss of organic substrate. During this research experiment, the samples were examined at periodic intervals after 30 and 60 days of vermicomposting.

RESULT AND DISCUSSION

Plant debris and paper waste material is characterized with high values of pH, organic carbon and cattle dung low values of organic carbons. However, other nutrient such as total nitrogen, phosphorus and potassium were found in very trace amounts in three materials and excellent result

was obtained for nutrient ratio carbon and nitrogen. The process of vermicomposting activity showed significantly changes in the physical and chemical properties of plant debris, cattle dung and paper waste material that can be an important tool for organic compost farming. It is indicated in Table.1 that during vermicomposting the pH declines (from 8 to 7.3) with the advancement of vermicomposting period (from 0 to 30 to 60 days).

The result of Table 1 that the ratio of carbon and nitrogen and values phosphorus and potassium increased over 60 days of vermicomposting. Excellent values of total nitrogen (0.79%), phosphorus (2.50%) and potassium (1.40%) were compared with control (0day). The table 2 showed clearly evidence that there was no mortality of worms in the pre-decomposed cattle dung, plant debris and paper waste. Garg *et al.,* (2006) while working growth and reproduction of *E. foetida* in animal wastes also opined that pre-composting is very essential to avoid the mortality of worms[11]. Table.3 showed clearly indicates that vermibiotechnology reduces the amount of waste and also increased the nutrient content of the product (vermicompost) to be used as a biofertilizer in agricultural practices. Weight loss were found in three material of plant debris, cattle dung and paper waste by *Eisenia fetida* (61%) *Eudrilus eugeniae* (72%) and *Perionyx excavates* (60%).

Among results three tables of the vermicomposting are also supported by Elvira *et al.*, (1998)[9] who observed 20 to 42% loss of carbon as CO2 during vermicomposting of paper mill and

Table 1: Effect of vermicompost on different physico-chemical parameters of cattle Dung and plant debris and paper waste along with three types of earthworms

S.No	Parameters	Duration of Vermicompost and Percentage (%) of organic carbon			Comments
		0Days	30Days	60Days	
01	pH	7.9	7.5	7.2	Excellent
02	Total nitrogen	0.11	0.49	0.79	Excellent
03	Phosphorus	0.10	1.20	2.50	Good
04	Potassium	0.138	0.240	1.40	Excellent
05	Carbon and Nitrogen Ratio (C:N)	40:11	26:33	9:81	Moderate

Table 2: Impact of composting period on three earthworms of Eisenia fetida, Eudrilus eugeniae and Perionyx excavates number and biomass

S.No.	Type of Material	Type of Earthworm	Earthworm Number		Body weight of Earthworm		Comments
			0days	60days	0days	60days	
01	Cattle dung Plant debris Paper waste	Eisenia fetida	50	79	10.25	33.33	Excellent
02	Cattle dung Plant debris Paper waste	Eudrilus eugeniae	50	88	11.20	36.32	Excellent
03	Cattle dung Paper waste	Perionyx excavates	50	100	11.30	30.40	Excellent

Table 3: Impact of vermicomposting on weight loss of three organic substrate in the presence of three Earthworms

S.No.	Type of Material	Type of Earthworm	Initial weight of Substrate of mixed three materials (gm.)	After 60 days, Final weight of Vermicompost (gm.)	Loss of Percentage organic substrate (%) during Vermicompost	Remarks
01	Cattle dung Plant debris Paper waste	Eisenia fetida	2000	575	61	Good
02	Cattle dung Plant debris Paper waste	Eudrilus eugeniae	2000	900	72	Excellent
03	Cattle dung Plant debris Paper waste	Perionyx excavates	2000	750	60	Good

dairy sludge. The increase in earthworm population might be related with the decrease in C: N ratio with the advancement of time[10].

CONCLUSION

The results from the casting analysis had revealed that the organic waste of plant debris, cattle dung and paper waste can be converted into usable form with its excellent nutrient release. Though there may not be a great increase in nutrient, the small change in nutrient value and the reduction in C:N ratio make the plant to uptake. The castings which are rich in microorganism enhance the plant growth hormones. The result showed the increase in three types of Earthworm population in three substrate of paper waste, cattle dung and plant debris. The vermicompost is a eco friendly and cost effective methods. It is an ideal method for the management and development of solid waste. To conclude hold promise to play a significant role in protecting environment as it uses waste as raw material and in building up of soil fertility and improving soil health for sustainable agriculture practices.

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