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Research Article

NITROGEN, PHOSPHORUS, AND POTASSIUM RANGE OF VERMICOMPOST USING *EISENIA FETIDA* AND *PERIONYX EXCAVATUS*

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ABSTRACT

The aim of the presentation is to produce vermicomposting from organic kitchen solid wastes using two types of earthworms such as *Eisenia fetida* and *Perionyx excavatus* and check the nitrogen, phosphorus, and potassium level between *E. fetida* and *P. excavatus.* This study examines the potential of the *E. fetida* and *P. excavatus* in the vermicompost of kitchen waste. As kitchen waste is rich in organic material. Physical and biochemical parameters were analyzed during the period of 60 days. Pre-decomposition is 15 days and subsequent vermicomposting is 60 days indicates, the rule of these species of vermitechnology increase was found in all the parameters such as total nitrogen (%), available phosphorus (%), and exchangeable potassium (%) while a decrease was found in pH and carbon-to-nitrogen ratio in *E. fetida* as the timing of vermicomposting increased from 0 days to 60 days.

Keywords: *Eisenia fetida, Perionyx excavatus,* Vermicompost, Earthworm, Nitrogen, Phosphorus, Potassium, Kitchen waste.

INTRODUCTION

Fertilizers pesticides, herbicides, nematocides, and fungicides have been use to increase the crop yield but these all cause pollution and side effects on human and animal health and make soil sick [1]. These long-term use of inorganic fertilizers without organic supplements damages the soil physical, chemical, and biological properties and causes environmental pollution. Fertility is a significant property of agricultural soil. Application of chemical fertilizer reduces land productivity and land fertility. Land needs to be prevented from degradation. Green manures are an effective alternative to chemical fertilizers in the management and preservation of soil fertility and productivity, adding organic matter and nutrients in the soil. Vermicompost appears to be the most promising alternative. It is a good source of different macro- and micro-nutrients particularly nitrogen, phosphorus, and potassium (N-P-K) [2].

Vermicompost is used for conversion of solid wastes into a nutrient-rich material. "Vermi" means worms (earthworms) and "compost" means farming [3].

Vermicompost also benefits the environment by reducing the need for chemical fertilizers and decreasing the amount of waste going to landfills. Vermicompost production is trending up worldwide and it is finding increasing use especially in Western countries, Asia-Pacific, and Southeast Asia [4].

On the one hand, there is a large number of the producer to human activities which are reaching macro- and micro-nutrients while tropical soil is deficient in all necessary plant nutrients and on the other hand, a large amount of such nutrient are getting in the form of domestic waste and agricultural by product [1].

Management of solid waste has become one of the biggest problems that we are facing today. Vermicomposting is the better [5].

Vermicomposting is the operation of the composting process of organic materials by involving earthworms. Vermicompost is also worm castings, worm compost, vermicast, worm humus, or worm manure [6]. Vermicompost is not only valuable compost and bio control agent but also an effective way of solid waste management. Earthworms consume biomass and excrete in a digested form called worm cast. The casts are rich in nutrients, growth promoting substance, beneficial soil from casts are popularly called black gold (microflora and having properties of inhibiting pathogenic microbes) [7]. Vermicompost is earthworm excrement, called castings, which can improve the biological, chemical, and physical properties of the soil. The chemical secretions in the earthworm's digestive tract help break down soil and organic matter, so the castings contain more nutrients that are immediately available to plants. The vermicompost caused by earthworms metabolize and disposal mixture of soil and organic matter is the advanced form of the compost [8].

Earthworms

Earthworms are invertebrates, which mean they do not have backbones. They are tube-shaped, the segmented worm found in the phylum *Annelida* and class *Oligochaeta* [9]. Earthworms have a brain, five hearts to pump blood, and parts inside their bodies which help them to breathe. It conducts respiration through the skin. The earthworm's body is covered with chemoreceptor [10].

Earthworm is commonly found living in soil, feeding on live and dead organic matter. The earthworm's digestive system is a tube running straight from the mouth, located at the tip of the front end of the body, to the rear of the body, where digested material is passed to the outside. Species vary in their feeding habitat and allows the worms to move nutrients such as potassium, phosphorous and nitrogen in the soil.

About 500 species of earthworms are known in India and over 5000 in the world. The most common members of the earthworm to be used in vermicomposting include: *Eisenia andrei, Eisenia fetida, Dravida willsii, Eudrilus eugeniae, Lampito mauritii, Lubrieus rubellus, Lumbricus terrestris, and Perionyx excavatus* [11].

E. fetida [12]

E. fetida worms are used for vermicomposting of both domestic and industrial organic waste [13].

E. fetida is known under various common names such as red worm, brandling worm, panfish worm, trout worm, tiger worm, red wiggler worm, and red California earthworm [14].

Native to Europe the species is now found on all the continents of the world. Except for Antarctica.

P. excavatus [15]

Perionyx excavates a commercially produced earthworm. The popular name for this species includes composting worms, blues, or Indian blue worm. It has recently become more popular in North America for composting purposes. It may have its origins in the Himalayan Mountains.

EXPERIMENTAL SETUP [16]

Two sets of experiment were conducted in the present study.

Pre-composting experiment

A worm bin of 45×30×15 cm measurement was filled with a mixture (5 kg) of cow dung and kitchen waste; it was daily sprinkled with water so that it gets decomposed. Furthermore, this waste was turned up and down for proper aeration and decomposition. This experiment continued for 15 days.

Vermicomposting experiment

In this study, plastic container was filled with the pre-composed mixture and cow dung. Each 25 adults mature *E. fetida, P. excavatus* worms were taken from the stock culture and were uniformly release on the top of the container of all the two experimental containers.

The containers were covered by mesh garden cloth and were observed daily to check the various parameters necessary for the survival and reproduction of earthworms. This whole setup was maintained for 60 days until the finely granular vermicompost was prepared.

During the composting process, the material was analyzed for different physicochemical attributes such as pH, total nitrogen, phosphorus, and potassium, as per the methods suggested by other workers [17-19]. During the course investigation, the sample was examined at periodic intervals after 45–60 days of the vermicompost.

METHODOLOGY

Collection of materials

Worm bin (45×30×15 cm)
Kitchen waste (tomato, banana peels, and dried leaves)
Cow dung.

Collection of earthworms

- *E. fetida*
- *P. excavatus*

Process of pre-compost

Make a worm bin. Make smalls hole drilled in the bottom so water can drain from the compost. Usually start with kitchen waste, since we have good worm bin, just add cow dung. It needs to be moist, but not so wet. Leave the setup for 15 days, pre-compost is done. Chopped hard materials are required. Sprinkle cow dung slurry on the heap for quick decomposes (Fig. 1).

Fig. 1: Pre-compost for 15 days

Fig. 3: Bed 2 (*Perionyx excavatus*)

Fig. 2: Bed 1 (*Eisenia fetida*)

Fig. 4: 28th day Bed 1(*Eisenia fetida*)

Fig. 5: 28th day Bed 2 (*Perionyx excavatus*)

Fig. 8: 45th day Bed 1(*Eisenia fetida*)

Fig. 6: 36th day Bed 1 (*Eisenia fetida*)

Fig. 9: 45th day Bed 2 (*Perionyx excavatus*)

Fig. 7: 36th day Bed 2 (*Perionyx excavatus*)

Fig. 10: 60th day Bed 1 (*Eisenia fetida*)

Vermicompost process

Make two beds Bed 1 and Bed 2. Place fine bedding material such as partially decomposed cow dung/dried leaves over the soil or sand layer. Release 25–35 mature earthworms are added such as *E. fetida* (Bed 1) (Fig. 2) and *P. excavatus* (Bed 2) (Fig. 3).

Allow to vermicomposting. Sprinkle water as and when necessary to maintain 70–80% moisture content. Worms are continuously consuming degraded organic materials and excrete. The excreted matter is called as worm cast or vermicast (Figs. 4-9).

Our final product vermicompost get in 60 days (Figs. 10 and 11).

The mature vermicompost sample was collected for each vermicompost bed about 250 gm and kept in the polythene bag which is free from contamination and they are analyzing the physicochemical parameters.

Table 1: List of Parameters analyzed for different species of earthworm

S. No	Parameters	Method	Units (%)	List of Parameters analyzed for different species of earthworm		Specification
				Bed 1 (*E. fetida*)	Bed 2 (*P. excavatus*)	
1	Moisture	FAO method	%	24.30	20.50	15.0–25.0
2	Colour	Physical observation	–	Black	Black	Dark brown to black
3	Odour		–	No odour	No odour	Absence of foul odor
4	Bulk density	FAO method	g/cm^3	0.28	0.15	0.7–0.9
5	Total organic carbon	IS method	%	24.30	20.50	Minimum 16.0
6	Total nitrogen	IS method	%	0.98	0.9	Minimum 0.5
7	Total phosphorus	IS method	%	17.8	15.2	Minimum 0.5
8	Total potassium	IS method	%	2.34	0.75	Minimum 1.0
9	C:N ratio	By calculation	–	12:05	12:70	20:1 or less
10	pH	EPA method	–	6.78	6.54	6.5–7.5

EPA: Environmental Protection Agency, C:N ratio: Carbon-to-nitrogen ratio, *E. fetida: Eisenia fetida, P. excavates: Perionyx excavatus*

Fig. 11: 60th day Bed 2 (*Perionyx excavatus*)

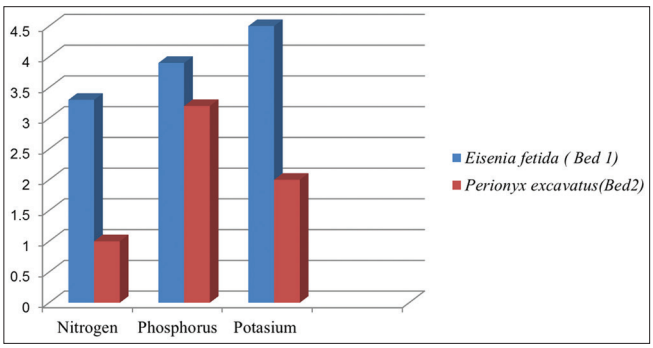

Fig. 12: Effect of vermicompost on nitrogen, phosphorus, and potassium range between Bed 1 (*Eisenia fetida*) and Bed 2 (*Perionyx excavatus*)

ANALYZING THE PHYSICOCHEMICAL PARAMETERS OF VERMICOMPOST MAINLY USING IS METHOD

I. Moister, per cent by weight
II. Color
III. Odor
IV. Particle size
V. Total nitrogen
VI. Total phosphorus
VII. Total potassium
VIII. Conductivity
IX. pH
X. Carbon-to-nitrogen ratio.

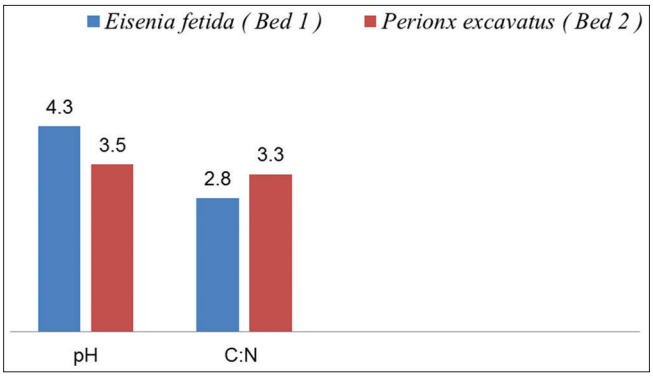

Fig. 13: Effect of vermicompost on pH and carbon-to-nitrogen range of kitchen waste

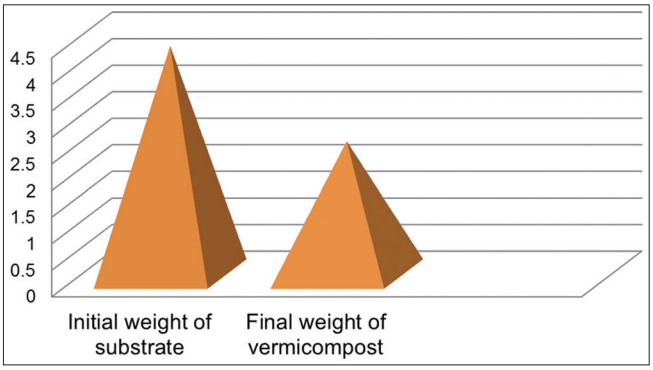

Fig. 14: Impact of vermicomposting on weight loss of organic substrate

RESULTS AND DISCUSSION

The results obtained depends upon environmental conditions on locations. It depends on the test. It should depend according to the environmental condition. The level of nutrients in compost depends on the source of raw materials and the species of earthworm (Table 1).

Bed 1 (*E. fetida*) vermicompost shows the higher N-P-K range than Bed 2 (*P. excavatus*) (Fig 12-14).

Vermicompost produced from the kitchen waste is not only having beneficial effects on soil health and growth, quality and yield of the crop but also playing a key role in the eradication of pollution hazards.

CONCLUSION

Plants require N-P-K nutrients for growth. Chemical fertilizers boosted NPK for food productivity but it decreases the nutrient quality and

affects soil fertility. The only alternative solution for this problem is Vermicompost which assures both food safety as well as farm security. Vermicompost not only biofertilizer but it is also a treatment for waste management prevent the environment pollution. Earthworms are used to produce the nutrient rich vermicompost. It is also a good friend for farmers.

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