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Production of Vermicompost from Domestic Waste with Cow Dung by using *Perionyx Excavatus*

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ABSTRACT

Vermicomposting is one of the eco-friendly method to composting the domestic waste materials, vermicomposting is a process which the earthworms convert the organic waste into manure rich in high nutritional content. *Perionyx excavatus* sps are most commonly used in composting process. Vermicomposting are easily handled and supply nutrients and growth hormone. Nutrients content of vermicomposting in higher than traditional compost. *Perionyx excavatus* is the potential epigeics earthworm species for breaking down and processing organic waste is well known. *Perionyx excavatus* is a commercially produced earthworm. It is a beautiful worm with an iridescent blue or violet sheen for vermiculture and vermicomposting process. It is a very small worm poorly suited as fishing Bait, but has an impressive growth and rate far in excess of the other species grown in indoor culture. This tropical worm with a very poor tolerance of low temperature and fluctuations in the environment *Perionyx excavatus* is often referred to as the traveler for its tendency often to leave the indoor culture the maturation period of the worms is approximately 30-55 days under ideal conditions.

KEYWORDS: *Vermicomposting, vermiculture, Perionyx excavatus*

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INTRODUCTION

Vermicomposting is a green technology for the production of valuable vermicompost from different kinds of organic substrates with various earthworm species including Eudrilus euginea (Suthar et al., 2017; Parthasarathi et al., 2016; Sharma and Garg, 2018a). primarily for vermicast production employing the earthworm, Eudrilus eugeniae, and the physico-chemical and microbiological changes during the process of seaweed vermicomposting, and in vermicompost, earthworm growth rate, biomass gain, cocoon productionrate and number recovered are not well established.

One material gaining interest is agricultural manure wastes composted through the action of worms (Edwards, 1998; Handreck, 1986). These materials, called vermicomposts, are being used as organic fertilizers, soil amend ments, and potting substrate components. Vermicomposts also have characteristics of conventional composts. Vermicomposts are easily handled and supply nutrients during crop growth. Depending on the origin, vermicomposts differ in chemical composition (Handreck, 1986); however, vermicomposts of the same waste origin have reproducible characteristics (Tomati et al., 1990).

Vermicomposts have the same reported benefits as conventional composts such as a source of organic matter, increased moisture-holding characteristics, and enhanced nutrient uptake and plant hormone-like activity (Galli et al., 1990; Tomati et al., 1988). The increases in plant growth have mostly been related to improvements in physical and chemical structure of the growth media. However, the use of vermicompost appears to affect plant growth in ways that can not be directly linked to physical or chemical properties (Dash and Petra, 1979). It seems likely that some growth promotion is due to plant hormone-like activity related to microflora associated with vermicomposting and to metabolites produced as a consequence of secondary metabolism (Parle, 1963; Tomati et al., 1987; Atiyeh et al., 2002).

What is Vermicomposting?

Vermicompost (vermi-compost, vermiculture) is the product of the composting process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. Vermicast (also called worm castings, worm humus, worm manure, or worm feces) is the end-product of the breakdown of organic matter by earthworms. These castings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than the organic materials before vermicomposting. Vermicompost contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner. It is usedin farming and small scale sustainable, organic farming. Vermicomposting can also be applied for treatment of sewage sludge. A variation of the process is vermifiltration (or vermidigestion) which is usedto remove organic matter, pathogens and oxygen demand from wastewater or directly from blackwater of flush toilets (Tomati et al., 1990; Grapelli et al., 1985).

Terms related to vermicomposting:

Vermicomposting:

Vermicomposting is a method of making compost, with the use of earthworms, which generallylive in soil, eat biomass and excrete it in digested form. This compost is generally called vermicompost or Wormicompost.

Vermiculture:

Vermiculture means scientific method of breeding and raising earthworms in controlled conditions.

Vermitechnology:

Vermitechnology is the combination of vermiculture and vermicomposting.

Nutrient	Content
Organic carbon	9.5to17.98%
Total nitrogen	1.5to2.10%
Total phosphorous	1.0to1.50%
Total potassium	0.60%
Ca and Mg	22.00to70.00 m.e /100g
copper	100 ppm
iron	1800 ppm
zinc	50 ppm

Table 1: Nutrient content of vermi-compost

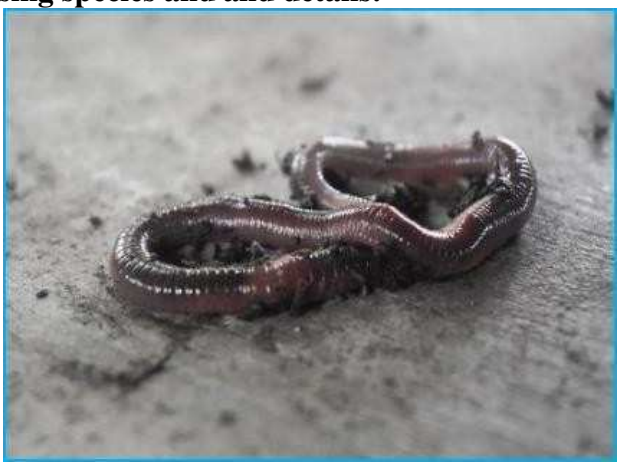
Element	vermicompost	Farmyard manure	Bacterial compost
N%	2.1-2.6	1.1-1.5	1.2-1.5
P%	1.5-1.7	0.7-0.8	0.7-0.9
K%	1.4-1.6	0.6-0.7	0.6-0.7

Table 2: NPK Content in basic manure

Types of earthworms:

- Earthworms belong to phyllum Annelida of Animal Kingdom. They are long and cylindrical in shape and size having a large number of grooves. There are about 3000 species of earthworms in theworld which are adapted to a range of environment
- More than 300 species have been identified in India. Although, hermophrodite, two mature earthworms are required to propagate. At the time of egg laying, the clitellum is transformed into hard, girdle like capsule called cocoon. Shedding of cocoon ranges from 1 to 5, only a few of them survive and hatch. The juveniles and again formation of cocoons takes a period of 50-60 days. Normally, the average life span of earthworms varies with species ranging from 1 to 10 years.
- Epigeics (surface feeders) are important in vermicomposting. The epigeics such as Eisenia foetida and Eudrilus eugeniae are exotic worms and Perionyx excavatus is a native one being used for vermicomposting in India.
- Epianecic are feeders on leaf litter and soil at upper layers of soil. This group such as Lampito mauritii is indegenous and is active in in-situ decomposition of organic wastes and residues in soil.
- Both epigeics and epianecics groups of earthworms are slender, shorter in length and red to dark brown in colour. They have high reproduction activity and efficient in recycling of organic materials. Increased attention has been paid to Eisenia foetida and Eudrilus eugeniae which have been found to be potential agent in vermicomposting of wide range of agricultural wastes and can grow at a wide range of temperature varying from 0-40 ◦C. However, the optimum temperature ranges from 20-30◦C.

Using species and and details:



Scientific classification	
Kingdom	Animalia
Phylum	Annelida
Class	Clitellata
Subclass	Oligochaeta
Order	Haplotaxida
Family	Megasecolecidae
Genus	perionyx
Species	P. excavatus
Binomial name	
Perionyx excavatus	

Perionyx excavatusis a commercially produced earthworm. Popular names for this species include **composting worms**, **blues**, or **Indian blues**. This species is marketed for its ability to create fine worm castings quickly. It has recently become more popular in North America for composting purposes

- The growth of individual earthworms increased the lower the population density, but the greatest overall earthworm biomass production occurs at the highest population density
- This species belongs to the genus Perionyx. It may have its origins in the Himalayan mountains. This species is suited for vermicomposting in tropical and subtropical regions

Life cycle:

The life cycle of *Perionyx excavatus* has been studied and the potential of this epigeicearthworm species for breaking down and processing organic wastes is well known. Understanding of its optimal environmental requirements is required in order to optimize and accelerate the vermicomposting process. The rates of growth and reproduction of *P. excavatus,* ona variety of organic wastes, were evaluated in these experiments. The time of maturation and therates of growth of this species, under various population density pressures and temperatures between 15°C and 30°C, were also assessed. Increasing temperatures up to 30°C accelerated the growth of earthworms and lessened the time to sexual maturity. However, the highest rates of reproduction occurred at 25°C both in cattle solids and sewage sludge. The mean time to egg hatching decreased and the degree of hatching success increased with increasing temperature. Earthworms grew at similar rates in cattle solids, pig solids and aerobically digested sewage sludge, but the earthworms did not grow well in horse solids and grew only poorly in turkey wastes.

Importance of vermicompost:

- Vermicompost is a rich source of nutrients, vitamins, enzymes, antibiotics and growth hormones. So it gives disease resistance to plansts. Nutrient content of vermicompost is higherthan traditional composts. It is a valuable soil amendment.
- Vermicompost horbours certain microbial populations that help in N fixation and P solubilization. Its application enhances nodulation in legumes and symbiotic mycorrhizal associations with the roots.
- Superiority of vermicompost over other synthetic growth media is more pronounced in plant nurseries. It can be used as rooting medium and for establishment of saplings in nurseries. It improves taste, lusture and keeping quality of the produce.
- It has immobilized enzymes like protease, lipase, amylase, cellulase and chitinese which keep on their function of biodegradation of agricultural residues in the soil so that further microbial attack is speeded up.
- It does not have foul odour as is associated with manures and decaying organic wastes.

Source of plant nutrients:

Earthworms consume various organic wastes and reduce the volume by 40%-60%. each earthworm weights about 0.5 to 0.6 g, eats waste equivalent to its body weight and produces cast equivalent to about 50% of the waste it consumes in a day. These worm castings have been analyzed for chemical and biological properties. The moisture content of castings ranges between 32 and 60% and the pH is around 7.0. the worm castings contain higher percentage (nearly two fold) of both macro and micro nutrients than the garden compost (Table 1)

Nutrient element	Vermicompost (%)	Garden compost (%)
Organic carbon	9.8 - 13.4	12.2
nitrogen	0.51- 1.61	0.8
phosphorous	0.19 - 1.02	0.35
potassium	0.15 - 0.73	0.48
calcium	1.18 - 7.61	2.27
magnesium	0.093 - 0.568	0.57
sodium	0.058 - 0.158	<0.01
zinc	0.0042 - 0.110	0.0012
copper	0.0026 - 0.0048	0.0017
iron	0.2050 - 1.3313	1.1690
manganese	0.0105 - 0.2038	0.0414

Table 1: Shows nutrient compositions of vermicompost and garden waste

From earlier studies also it is evident that vermicompost provides all nutrients in readily available from and also enhances uptake of nutrients by plants. Sreenivas et al..(2000) studied the integrated effect of application of fertilizer and

vermicompost on soil available nitrizen (N) and uptake of ridgegourd (Luffa acutangula) at rajendranagar, Andra pradesh, india. Soil available N increased significantly with increasing levels of vermicompost and highest N uptake was obtained at 50% of the recommended fertilizer rate plus 10 t ha-1.

Vermicompost, similarly, the uptake of Nitrogen (N), Phosphorous (P), Potassium (K), and magnesium (Mg), by rice (Oryza sativa) plant was highest when fertilizer was applied in combination with vermicompost (Jadhav et al. 1997).

Plant growth promoting activity:

Growth promoting activity of vermicompost was tested using a plant bioassay method. The plumule length of maize (Zea mays) seedlings was measured 48h after soaking in vermicompost water and in normal water. The marked difference in plumule length of maize seedlings indicated that plant growth promoting hormones are present in vermicompost (Table 2)

Treatment	Initial length (cm)	Final length (cm)
Tank water	16.5	16.6
Vermicompost water	17.6	18.6

Table 2 Plumule length of maize seedlings

Improved crop growth and yield vermicompost plays a major role in improving growth and yield of different field crops, vegetables, flowers and fruits crops. The application of vermicompost gave higher concentration germination (93%) of mung bean (Vigna radiata)compared to the control (84%). further, the growth and yield of mung bean was also significantly higher with vermicompost application. Likewise, in another pot experiment, the fresh and dry matter yields of cowpea (vigna unguiculata) were higher when soil was amended with vermicompost than biodigested slurry (Karmegam et al. 1999, karmegam and Daniel 2000).

How to use Vermicompost:

you can use your vermicompost immediately, or you can store it for up to a year and use it throughout the gardening season. Worm castings can be directly mixed with your potting soil or garden soil as an organic fertilizer. The compost can also be used as a top dressing for your indoor or outdoor plants. In pots and containers, don't use pure vermicompost. Mix a ratio of 1:4 vermicompost to potting soil. You can also use vermicompost to make "worm tea" liquid fertilizer to sprinkle near the roots of plants. Mix two tablespoons of castings with a quart of water and let it stand for a day, shaking it occasionally.

- **Use like compost** -- dig it lightly into the topsoil when mulching grow beds or preparing new beds, or apply a light top dressing around mature plants, shrubs, and trees. Vermicompost generally goes about three times as far as ordinary (aerobic) compost, so use one-third as much.Generally, 3 tablespoons of vermicompost per plant is plenty. Then, water each plant deeply taking care to soak the worm compost that you just spread, which will help work the nutrients down into the soil.
- **Use for germinating seeds** -- castings mixed 50/50 with potting soil produces a growing mediumfor seedlings that give plants a great start to life.
- **Use on transplants**, especially bare-root transplants spray roots with a diluted "worm tea" solution to help prevent transplant shock.
- **Store in dark, cool place** -- keep in a breathable container where the castings won't dry out. The active microbes will keep for up to a year.

Advantages of Vermicomposting

- It is a natural fertilizer
- It is not hazardous for the soil
- It improves soil aeration and texture
- Water retention ability is improved
- It improves the nutrient status of the soil
- This method is cost effective

Disadvantages of Vermicomposting

- Composting takes a lot of time to process (3 months)
- It produces bad smell
- There is a need spend time on maintenance as constant monitoring is required
- This technique requires a lot of laborers and is pretty hard to implement in urban areas

MATERAILS AND METHODOLOGY

Collection of raw materials:

A range of agricultural residues, all dry wastes, for example, sorghum straw and rice straw (after feeding cattle), dry leaves of crops and trees, pigeonpea (Cajanus cajan) stalks, groundnut(Arachis hypogaea) husk, soybean residues, vegetable wastes, weed (Parthenium) plants before flowering, fiber from coconut (Cocos nucifera) trees and sugarcane (Saccharum officinarum) trash can be converted into vermicompost.In addition, animal manures, dairy and poultry wastes, food industry wastes, municipal solid wastes, biogas sludge and bagasse from sugarcane factories also serve as good raw materials for vermicomposting.

Starter: Cow dung, Biogas slurry, or urine of cattle

Collection of earthworms: Soil animal: Earth worms (Species: ***Perionyx excavatus***) was brought from Gonagipalayam, it was imported from north india figure 1

Thatched roof/vermished.

pH: Range between 6.5 and 7.5

Moisture: 60-70% of the moisture below and above range mortality of worms taking place

Aeration: 50% aeration from the total pore space

Temperature: Range between 15 0C to 30 0C.

Figure 1: shows *periyonx excavatus earth worm*

Size of the worm compost:
Most compost heaps is 1-2m wide, 30-50 cm high, and can be as long as desired. Since Eudrilus eugeniae is an epigenic species, i.e. a surface dweller which works in the upper layers of the soil, the composed should not be over 60cm deep.

Vermicompost tank setup:
The quantity of raw materials required using a cement ring of 90 cm in diameter and 30 cm inheight or a pit or tank measuring 1.5 m × 1 m × 1 m is given below

Dry organic wastes (DOW) 50 kg

Dung slurry (DS) 15 kg
Rock phosphate (RP) 2 kg
Earthworms (EW) 500–700 Water
(W) 5 L every three days

The various ingredients are used in the ratio of 5:1.5:0.2:50–75:0.5 of DOW:DS:RP:EW:W. In the tank or pit system 100 kg of raw material and 15–20 kg of cow dung are needed for each cubic meter of the bed.

Vermicompost PreparationSteps in the process
Vermicomposting involves the following steps

- It is mostly prepared in either pit or heap method. The dimensions either heap or pit are 10 x4 x 2 feet. The length and width can be increased or decreased depending on the availability of material but not the depth because the earthworms' activity is confined to 2 feet depth only. First of all select a site which is not under any economic use and is shady and there is no water stagnation. The site should be near to a water source.
- 1st layer: bedding material of 1" thick with soft leaves
- 2nd layer: 9" thick organic residue layer finely chaffed material.
- 3rd layer: Dung + water equal mixture of 2" layer.
- Continue the layer up to pile to ground level in the case of pit method and upto 2' in heap or surface bed method. Protect the worms against natural enemies like ants, lizards, snakes, frogs, toads etc.,
- Maintain proper moisture and temperature by turnings and subsequent staking. At the day of 24th, 4000 worms are introduced in to the pit [1m2=2000 worms] without disturbing the pit by regular watering the entire raw material will be turned into the vermicompost in the formof worm excreta.
- The turnover of the compost is 75% [the total material accommodated in the pit is 1000 kg;the out turn will be 750 kg].
- Cover the bottom of the cement ring with a layer of tiles or coconut husk or polythene sheet
- Spread 15–20 cm layer of organic waste material on the polythene sheet (Fig. 4b). Sprinkle rock phosphate powder if available (it helps in improving nutritional quality of compost) on the waste material and then sprinkle cow dung slurry (Fig. 4c and d). Fill the ring completelyin layers as described. Paste the top of the ring with soil or cow dung (Fig. 4e). Allow the material to decompose for 15 to 20 days.
- When the heat evolved during the decomposition of the materials has subsided (15– 20 days after heaping), release selected earthworms (500 to 700) through the cracks developed (Fig. 4f).
- Cover the ring with wire mesh or gunny bag to prevent birds from picking the earthworms. Sprinkle water every three days to maintain adequate moisture and body temperature of the earthworms (Fig. 4g).
- The vermicompost is ready in about 2 months if agricultural waste is used and about 4 weeks if sericulture waste is used as substrate (Fig. 4h).
- The processed vermicompost is black, light in weight and free from bad odor.
- When the compost is ready, do not water for 2–3 days to make compost easy for sifting. Pile the compost in small heaps and leave under ambient conditions for a couple of hours when all the

worms move down the heap in the bed (Fig. 4i). Separate upper portion of the manureand sieve the lower portion to separate the earthworms from the manure (Fig. 4j). The culture in the bed contains different stages of the earthworm's life cycle, namely, cocoons, juveniles andadults.Transfer this culture to fresh half decomposed feed material. The excess as well as big earthworms can be used for feeding fish or poultry. Pack the compost in bags and store the bags in a cool place (Fig. 4k).

- Prepare another pile about 20 days before removing the compost and repeat the process by following the same procedure as described above.

Precautions during the process

The following precautions should be taken during vermicomposting:

- The Indian species of earthworms, Perionyx excavatus and Lampito maruitii are ideal for the preparation of vermicompost.
- Only plant-based materials such as grass, leaves or vegetable peelings should be utilized in preparing vermicompost.
- Materials of animal origin such as eggshells, meat, bone, chicken droppings, etc are not suitable for preparing vermicompost.
- Gliricidia loppings and tobacco leaves are not suitable for rearing earthworms. The earthworms should be protected against birds, termites, ants and rats.
- Adequate moisture should be maintained during the process. Either stagnant water or lack of moisture could kill the earthworms.
- After completion of the process, the vermicompost should be removed from the bed atregular intervals and replaced by fresh waste materials.

How to Use Vermicompost?

- Vermicompost can be used for all crops: agricultural, horticultural, ornamental and vegetables at any stage of the crop.
- For general field crops: Around 2–3 t ha-1 vermicompost is used by mixing with seed at the time of sowing or by row application when the seedlings are 12–15 cm in height. Normal irrigation is followed.
- For fruit trees: The amount of vermicompost ranges from 5 to 10 kg per tree depending onthe age of the plant. For efficient application, a ring (15–18 cm deep) is made around the plant. A thin layer of dry cow dung and bone meal is spread along with 2–5 kg of vermicompost and water is sprayed on the surface after covering with soil.
- For vegetables: For raising seedlings to be transplanted, vermicompost at 1 t ha-1 is applied in the nursery bed. This results in healthy and vigorous seedlings. But for transplants, vermicompost at the rate of 400–500 g per plant is applied initially at the time of planting and 45 days after planting (before irrigation).
- For flowers: Vermicompost is applied at 750–1000 kg ha-1.
- For vegetable and flower crops vermicompost is applied around the base of the plant. It is then covered with soil and watered regularly.

RESULT AND DISCUSSION

Stop watering before one week of harvest. Sometimes the worms spread across the pit come in close and penetrate each other in the forms of ball in 2or 3 locations. Heap the compost by removing the balls and place them in a bucket. However, under most instances, top layer has to be disturbed manually. Earthworms move downward and compost is separated. After collections of compost from top layers, feed material is again replenished and composting process is rescheduled. The material is sieved in 2mm sieve, the material passed through the sieve is called as vermicompost which is stored in polythene bags. After the process packaging properly and sold the compost or used as bio fertilizer.

Vermicomposting appears to be the most promising as high value biofertilizer which not only increases the plant growth and productivity by nutrient supply but also is cost effective and pollution free. Use of vermicompost promotes soil aggregation and stabilizes soil structure. This improves the air- water relationship of soil, thus increasing the water retention capacity and encourages extensive development of root system of plants. The mineralization of nutrients is observed to be enhanced, therefore results into boosting up ofcrop productivity.

Vermicompost has very 'high porosity', 'aeration', 'drainage' and 'water holding capacity'. Theyhave a vast surface area, providing strong absorbability and retention of nutrients. They appear to retain more nutrients for longer period of time. Study was showed that soil amended with vermicompost had significantly greater 'soil bulk density' and hence porous & lighter and never compacted.

Plate I Vermicompostfng In Integrated Farming System

Vermlcompost plts In the *tarmeTs* flew

Vermicompost

SUMMARY AND CONCLUSION

The production of degradable organic waste and its safe disposal becomes the current global problem. Meanwhile the rejuvenation of degraded soils by protecting topsoil and sustainability of productive soils is a major concern at the international level. Provision of a sustainable environment in the soil by amending with good quality organic soil additives enhances the water holding capacity and nutrient supplying capacity of soil and also the development of resistance in plants to pests and diseases. By reducing the time of humification process and by evolving the methods to minimize the loss of nutrients during the course of decomposition, the fantasy becomes fact. Earthworms can serve as tools to facilitate these functions. They serve as "nature's plowman" and form nature's gift to produce good humus, which is the most precious material to fulfill the nutritional needs of crops. The utilization of vermicompost results in several benefits to farmers, industries, environment and overall national economy.

To farmers:

- Less reliance on purchased inputs of nutrients leading to lowercost of production
- Increased soil productivity through improved soil quality
- Better quantity and quality of crops
- For landless people provides additional source of income generation.

To industries:

- Cost-effective pollution abatementtechnology To environment:
- Wastes create no pollution, as they become valuable raw materialsfor enhancing soil fertility.

To national economy:

- Boost to rural economy
- Savings in purchased inputs
- Less wasteland formation

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