VERMI-COMPOSTING BY DOMESTIC & AGRICULTURAL WASTE

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ABSTRACT

An innovative discipline of vermiculture biotechnology, the breeding and propagation of earthworms and the use of its castings has become an important tool of waste recycling the world over. Epigeics like Eisenia foetida have been used in converting organic wastes (agro waste and domestic refuse) into vermicompost. We started a project on vermitechnology using the earthworm species Eisenia foetida.

Keyword: - *Vermi-technology, Earthworms (Eisenia foetida), Compost, Vermicast, Recycle*

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1. INTRODUCTION

What is composting?

Composting is the decomposition of organic materials into nutrient rich soil. Through composting the process of decomposition speeds up due to a controlled environment. The process is "started by bacteria and fungi which break down organic matter for their own food."

What is Vermicomposting?

Vermicomposting is the process by which worms are used to convert organic materials (usually wastes) into a humus-like material known as vermicompost. The goal is to process the material as quickly and efficiently as possible.

Vermicomposting" is a simple composting method which employs specialty worms such as red worms (Eisenia foetida) to breakdown food scraps into nutrient rich compost. "Vermiculture" is the side issue of the breeding of common worms for use in Vermicomposting, as each individual vermicomposter can be regarded as a miniature worm farm. There is an array of benefits of Vermicomposting for Residence buildings, and these include:

1.1 Aim and Objectives

Primary Goals

- To create awareness of Vermicomposting
- To assess past and present Vermicomposting users to find out what worked, what did not work and any suggestions for future users
- To create a Vermicomposting educational package with the intentions of encouraging, educating, and informing vermicomposter owners

Secondary Goals

- To create awareness of the larger environmental issues of waste management
- To reduce organic food waste from the Residential Zones.

Tertiary Goal

- To provide a background for people to do further research and to use as a model for other area, nursery, farm and office community etc.,

1.2 Problem Identification

What is chemical fertilizer?

Chemical fertilizer is a substance applied to soils as directly on to plants to provide nutrients optimal for their growth and development. The essential nutrient contained in these fertilizers is nitrogen, phosphorous and potassium (NPK), as well as other nutritional substance in smaller amounts-all presented in a form that can easily be absorbed and metabolized by plants. Chemical fertilizers have become a staple in many yards and gardens, and can be key components of a healthy lawn care routine. Road on for some basic information on chemical fertilizer and how you can use it most effectively in your yard.

Disadvantages of Chemical Fertilizers

- Water soluble in most forms. Since water releases the nutrients, it is not uncommon to lose one-third of the nutrients by leaching out of the soil before the plant can access them.
- Short life span, unless using a controlled release form.
- Doesn't build up the soil. The basic synthetic elements contribute nothing to enhance soil fertility.
- May decrease soil fertility. Chemical nitrogen stimulates the growth of existing microorganisms, which then use up organic matter in the soil. Repeating this cycle regularly leaves soil depleted.
- Excess growth can occur with some varieties or with surplus application. This results in more mowing or pruning, places stress on roots, causes heavier grass stains on clothes from lawns.
- Danger with incorrect application. Potential of harm from excess, especially lawns getting coverage overlap.
- Trace nutrients missing, in many synthetic blends. Excess of major nutrients can bind up other nutrients in the soil, making them unavailable to the plant.
- Environmental problems occur with chemical run-off.
- Excess phosphorous can collect in the soil and cause pollution problems.
- Nitrogen is volatile: is lost easily into the atmosphere when fertilizer is left on the ground and not watered into the soil. It is also lost from bags in storage, if not sealed properly.
- High energy consumption required to produce these products.

1.3 Solution of Problem

Bio-fertilizers and their utilization

Bio fertilizers are microbial inoculants consisting of living cells of micro-organism like bacteria, algae and fungi alone or combination which may help in increasing crop productivity by way of helping in the biological nitrogen fixation, solubilization of insoluble phosphorus fertilizer materials, stimulating growth or in decomposition of plant residues.

Advantages of using Bio-fertilizer

- Can replace 20 to 50 % of chemical fertilizer 'N' and 15 – 25 % of phosphoric fertilizers.
- Bio-fertilizers being cheap, provide highly cost effective supplement of chemical fertilizers.
- Increase farm productivity, generally 10-40 % in grain yield and 15 – 30 % in vegetable growth.
- Activates soil biologically thereby increasing natural fertility of soil, which causes sustainable agriculture.
- Help in stimulating plant growth in general and roots in particular as they serve various growth promoting hormones like auxins, gibberellins etc and vitamins. They help in better nutrient uptake and increase tolerance towards drought and moisture stress.
- Secrete some fungi static and antibiotic like substances, which reduce the incidence of various soil borne diseases. It has got antagonistic behavior against pathogens.
- They help to proliferate and survival of other beneficial microorganisms in soil.
- Help in decomposing plant residues in soil, thereby improving C/N ratio, improving soil texture and structure. Also help in increasing water-holding capacity.
- In composting processes improve the quality and nutrient value of the compost.
- Being environment friendly and cost effective do not cause any harmful effect on soil and environment. On the contrary they help in degradation of other harmful chemicals such as weedicides and pesticides. Thereby they help in increasing the biodegradation capacity of the soil

1.4 Literature review

Edwards and Burrows (1988) studied the agronomic impacts of vermicompost and found that it consistently improved seed germination, enhanced seedling growth and development, and increased plant productivity much more than would be possible from the mere conversion of mineral nutrients into plant-available forms. The growth responses of plants from vermicompost appears more like hormone-induced activity associated with the high levels of nutrients, humic acids and hamates in vermicompost rather than boosted by high levels of plant-available nutrients.

Studies made by Baker and Barrett (1994) at CSIRO Australia found that the earthworms can increase growth of wheat crops by 39%, grain yield by 35%, lift protein value of the grain by 12% and fight crop diseases. Palainsamy (1996) also studied that earthworms and its vermicast improve the growth and yield of wheat by more than 40%.

Kaushik and Garg (2004) studied the ability of epigeic earthworm *E. fetida* to transform textile mill sludge mixed with cow dung and/or agricultural residues into value added product, i.e., vermicompost. The growth, maturation, mortality, cocoon production, hatching success and the number of hatchlings were monitored in a range of different feed mixtures for 11 weeks in the laboratory under controlled environmental conditions. The maximum growth and reproduction was obtained in 100% cow dung, but worms grew and reproduced favorably in 80% cow dung + 20% solid textile mill sludge and 70% cow dung + 30% solid textile mill sludge also.

2. COMPOSTING

What Happens During Composting?

The easily degradable carbon is converted in to carbon dioxide and process does not stop at a particular point. Material continues to break down until the last remaining nutrients are consumed by the last remaining organisms and until nearly all of the carbon is converted to carbon dioxide. However, the compost becomes relatively stable and useful long before this point. Compost is judged to be "done" by characteristics related to its use and handling such as carbon to nitrogen ratio, oxygen demand, temperature and odor. The carbon, chemical energy, protein and water in the finished compost are less that that of the raw materials. The volume of the finished compost is 50% or less of the volume of the raw material.

Figure No.1 Compost Cycle of Soil

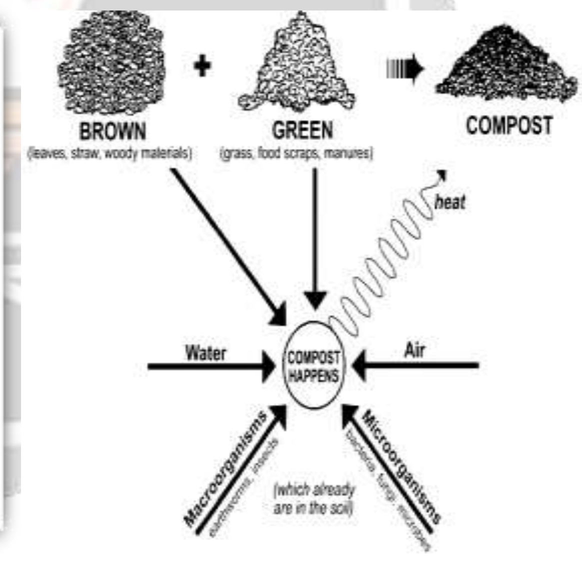

Figure No.2 Composting

2.1 Vermicomposting

Vermicomposting is an ecobiotechnical stabilization process, which involves the breakdown of organic waste and in contrast to microbial composting it involves the joint action of earthworms and mesophilic microorganisms and does not involve a thermophilic stage. Worms require environment that is encouraging for microbial degradation and to maintain biochemical processes that enhance microbial decomposition. They add various intestinal micro flora in matrix, moreover gut enzymes play dominant role in this process. Further, earthworm also enhances microbial activities by improving the environment for microbes. It turns wastes in more homogenized, nutrient rich and well stabilized product. Studies have shown that

Vermicomposting is an effective method for treating pathogen rich wastes. There are several indicators for performance evaluation of Vermicomposting process, like, worm survival and biomass growth, and worm population growth. The quality of vermicompost is generally evaluated same as in case of compost. Since worm grazes the pathogens, Vermicomposting potentially ensures the removal of pathogens, if effectively commenced even for shorter period of a week. The waste material treated in microbial composting is less moist, as higher moisture content reduces the interstitial air passage. This can lead to process failure, as it become anaerobic. In Vermicomposting, higher humidity can be tolerated as the worm burrows act as channels for air passage.

2.1.2 Advantages of Vermi Composting

- It provides efficient conversion of organic wastes/crop/animal residues.
- It helps in reducing population of pathogenic microbes.
- It helps in reducing the toxicity of heavy metals.
- It is economically viable and environmentally safe nutrient supplement for organic food production.
- It is an easily adoptable low cost technology.
- It should be realized that Vermicomposting can be a useful cottage industry for the underprivileged and the economically weak as it can provide them with a supplementary income.
- It contains valuable vitamins, enzymes and hormones like auxins, gibberellins.

Table No.1 Nutrient content of vermicompost

Nitrogen	1.5 – 2.5 %
Calcium	0.5 – 1.0 %
Phosphorus	0.9 – 1.7 %
Magnesium	0.2 – 0.3 %
Potash	1.5 – 2.4 %
Sculpture	0.4 - 0.5 %

2.2 Earthworms

Urban conglomerations, with their ever-increasing population and consumerist lifestyle generate voluminous solid wastes. A substantial portion of solid waste is non-toxic and organic in nature. Existing methods to its treatment and disposal are rather expensive.

Vermicomposting technology is one of the best options available for the treatment of organics-rich solid wastes. The term Vermicomposting is coined from the Latin word 'Vermi' meaning to the 'worms'. Vermicomposting refers to composting or natural conversion of biodegradable garbage into high quality manure with the help of earthworms. Earthworms play a key role in soil biology; they serve as versatile natural bioreactors to harness energy and destroy soil pathogens. The worms do so by feeding voraciously on all biodegradable refuse such as leaves, paper (nonromantic), kitchen waste, vegetable refuse etc. Earthworms have been used for waste stabilization for many years, especially in Southeast Asian and European countries.

Table No.2 Population of Earth Worm

Criteria	Eisenia fetida	Eudrilus Eugenie	Perionyx excavatus
Duration of life cycle (days)	+70	+60	+46
Growth rate (mg/worms/day)	7	12	3.5
Maximum body mass (mg/worm)	1500	4294	600
Maturation attained at age (days)	+50	+40	+21
Incubation period (days)	+23	+16.6	+18.7
Number of hatching from one cocoon	1-9	1-5	1-3

What Worms Need?

Compost worms need five basic things:

1. An hospitable living environment, usually called "bedding"
2. A food source;
3. Adequate moisture (greater than 50% water content by weight)

4. Adequate aeration;
5. Protection from temperature extremes.

3. IMPLEMENTATION STRATEGY

Phase 1 Processing involving collection of wastes, shredding, mechanical separation of the metal, glass and ceramics and storage of organic wastes.
Phase 2 Pre digestion of organic waste for twenty days by heaping the material along with cattle dung slurry. This process partially digests the material and fit for earthworm consumption. Cattle dung and biogas slurry may be used after drying. Wet dung should not be used for vermicompost production.
Phase 3 Preparation of earthworm bed. A concrete base is required to put the waste for vermicompost preparation. Loose soil will allow the worms to go into soil and also while watering, all the dissolvable nutrients go into the soil along with water.
Phase 4 Collection of earthworm after vermicompost collection. Sieving the composted material to separate fully composted material. The partially composted material will be again put into vermicompost bed.
Phase 5 Storing the vermicompost in proper place to maintain moisture and allow the beneficial microorganisms to grow.

3.1 Design Methodology

3.2 Design of Tank

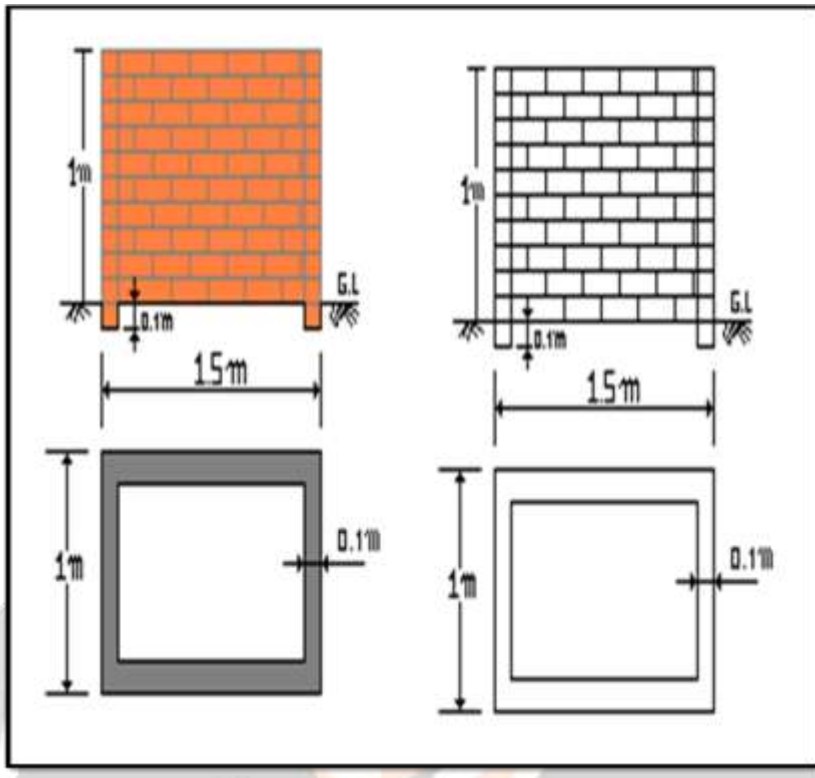

Figure No.3 Drawing of Tank

3.3 Quantity & Estimation

Table No.3 Quantity of Material used in Tank

Sr no	Name of material	Quantity	Amount
1	Bricks	250	750
2	Sand	1.32 m^3	500
3	Cement	2 bags	500
	Total		**1750 Rs/-**

Table No.4 Quantity Sheet

Sr no	particular	No	Length (L) M	Width (B) M	Height (H) M	Quantity
1	EXCAVATION UP TO 1.5 m Long wall Short wall	 2 2	 1.50 0.91	 0.10 0.10	 0.10 0.10	 0.03m^3 0.018m^3
					Total	**0.048m^3**
2	BRICK MASONARY UP TO 1.5 m Long wall Short wall	 2 2	 1.50 0.91	 - -	 1.1 1.1	 3.3m^3 2.00m^3
					Total	**5.3m^3**
3	50mm P.C.C AT BOTTOM OF TANK	1	1.3	0.91	0.5	0.59m^3

Table No.5 Labour work for tank

Sr no	Labours	Day	Rate	Amount
1	Mason	1	450	450
2	Male coolie	1	250	250
3	sundries		100	100
Total				**800 Rs/-**

Table No.6 Estimation of Material

Sr no	ITEM	Quantity	Cost of material
1	Bamboo Sticks	Requirement	300
2	Green Nat	1.5 Pices	900
3	Binding Wire	200gm	20
4	Sutali	Requirement	-
5	P.V.C Pipe	0.5 Feet	-
6	Gunny Bags	3 Bags	-
7	Banour	1	250
8	Cow Dug	½ Tractor	200
9	Worms	4 -4.5 Kg	450
10	Water	Requirement	-
		TOTAL	**2120 Rs/-**

TOTAL COST OF PROJECT

- COST OF MATERIAL USED IN TANK = 1750 Rs/-
- LABOUR WORK FOR TANK = 800 Rs/-
- COST OF MATERIAL = 2120 Rs/-
- TRANSPORTATION COST = 570 Rs/-

Total = 5240 Rs/-

3.4. Summary of Result

Wastes that can be used for Vermicomposting in my study are listed as below:

- Agriculture waste
- Animal waste (got waste , cow dug)
- Kitchen waste from house hold & restaurant
- Waste from market yard
- Food processing units: peel, rind & unused pulps of fruits & vegetable

Using waste in my study
The weight of animal waste is 250 kg
The weight of vegetable waste is 150 kg
1. Cost of animal waste 200 Rs.
2. Cost of vegetable and fruit waste is 150 Rs
Total Output cost of wastage in the Study is 350 Rs

The collection of first stage fertilizer
The weight of fertilizer (after grading) is around 40 kg.
The market value of 1 kg fertilizer is 20 Rs
Total Input cost is 40×20 = 800 Rs

Note: - The output cost is increasing at every stage.

4. CONCLUSION

Vermicomposting appears to be the most promising as high value bio-fertilizer which not only increases the plant growth and productivity by nutrient supply but is also 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 of crop productivity. Vermicompost produced from the farm wastes is not only having beneficial effects on soil health and growth, quality and yield of crop but also playing vital role in eradication of pollution hazards. The Problem of disposing the agro waste may be solved by constructing such the Vermicomposting production unit.

The agro waste converted in vermicompost which will earn economic benefits. No hazardous effluents are generated from a compost production unit using agro wastes.

Vermicompost can be used for all crops agricultural, horticultural, and ornamental and vegetables at any stage of the crop. It will reduce the requirement of more land for disposal of fruits and vegetable wastes in near future. It helps to create better environments, thus reduce ecological risk.

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