ORIGINAL RESEARCH PAPER
Volume - 9 | Issue - 12 | December - 2020 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

VERMICULTURE & VERMICOMPOSTING PRODUCTION

Zoology

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KEYWORDS

INTRODUCTION

Vermiculture: Is the culture of earthworms. The purpose is to continually increase the number of worms in order to obtain a sustainable harvest. The worms are either used to expand a Vermicomposting operation or sold to customers who use them for the same or other purposes.

Vermicomposting: is the process by which worms are used to convert organic materials (usually wastes) into a humus-like material known as Vermicomposting. The purpose is to process the material as quickly and efficiently as possible. These two processes are similar but different. If your goal is to produce Vermicomposting, you will want to have your maximum worm population density all of the time. If your purpose is to produce worms, you will want to keep the population density low enough that reproductive rates are optimized Bureau of Jail Management and Penology (2010).

Organic farming by earthworms (Sir Charles Darwin's 'friends of farmers') can provide a sustainable and also highly economical solution to the various problems created by the destructive agrochemicals in farm production. Earthworms Vermicomposting are scientifically proving to be an 'extraordinary powerful growth promoters and protectors' for crops (5-7 times over other bulky organic fertilizers and 20-40 % higher over chemical fertilizers). Bureau of Plant Industry (BPI), Department of Agriculture Philippines (2010). They are rich in NKP, micronutrients, beneficial soil microbes like 'nitrogen-fixing' and 'phosphate solubilizing' bacteria, 'mycorrhizal fungi', humus and growth hormones – auxins, gibberlins and cytokinins. It has very high 'porosity', 'aeration', 'drainage' and 'water holding capacity' and makes the soil soft. More significantly it also protect plants against various pests and diseases either by suppressing or repelling them or by inducing biological resistance in plants to fight them or by killing them by their beneficial microbes (chitin and cellulose degraders). 'Vermi-wash' (liquid filtered through the body of worms). Agriculture has also been responsible for huge emissions of greenhouse gases and induction of global warming. Of the increase of atmospheric carbon over the last 150 years, about a third (33.3 %) is thought to have come from agriculture. Jeanroy, Amy (2005). Vermiculture: Make Your Own Compost With Vermiculture. Chemical agriculture has further augmented GHG emissions. From their production in factories to their transport and use in farms agrochemicals generate huge toxic wastes and pollution and greenhouse gases. Soil amended with Vermicomposting have significantly greater 'soil bulk density' scientifically prove that vermiculture technology with the aid of earthworms and its metabolic products (Vermi-cast) can boost farm production without agrochemicals (completely organic) and justify the beliefs of Sir Charles Darwin who called the earthworms as 'friends of farmers' centuries ago. Besides, it will provide several social, economic and environmental benefits to the society by way of producing 'chemical-free' safe, 'nutritive and protective' foods (even against some forms of cancers) for the people, salvaging human wastes and reducing the needs for costly landfills, mitigating global warming by sequestering carbon into soil.

Vermicomposting is basically a managed process of worms digesting organic matter to transform the material into a beneficial soil amendment. As per the USDA guidelines for compost practices, vermicomposts are defined as organic matter of plant and animal origin consisting mainly of finely-divided earthworm castings, produced non-thermophilically with bio-oxidation and stabilization of the organic material, due to interactions between aerobic microorganism and earthworms, as the materials pass through the earthworm gut.

Good quality compost production in ambient temperature can be accomplished in shorter time by the process of Vermicomposting that involves use of proper species of earthworms. The native cellulose activity of earthworms and microorganisms in earthworm gut promote faster decomposition of ingested organic material. The combined effect of enzymatic activity and grinding of organic materials to fineness by earthworms produces the Vermicomposting and this is not observed in compost pits without earthworm.

The earthworms being voracious eaters consume the biodegradable matter and give out a part of the matter as Vermi-castings. The Vermi-casting containing nutrients is a rich manure for the plants. Vermicomposting, apart from supplying nutrients and growth enhancing hormones to plants, improves the soil structure leading to increase in water and nutrient holding capacities of soil. Fruits, flowers and vegetables and other plant products grown using Vermi-compost are reported to have better keeping quality. A growing number of individuals and institutions are taking interest in the production of Vermicomposting utilizing earthworm activity. As the operational cost of production of this compost works out to less than`2.0/Kg., it is quite profitable to sell the compost even at `4.00 to `4.50/Kg

PROCESS

The process of composting crop residues or agri wastes using earthworms comprise spreading the agricultural wastes and cow dung in gradually built up shallow layers. The pits are kept shallow to avoid heat built-up that could kill earthworms. To enable earthworms to transform the material relatively faster a temperature of around 300Cis maintained. The final product generated by this process is called Vermicomposting which essentially consist of the casts made by earthworms eating the raw organic materials. The process consists of constructing brick lined beds generally of 2.5 to 3.00 m width and 2.00 to 2.5 m height are constructed inside a shed open from all sides. For commercial production, the beds can be prepared with 12 m length, 2.5 m width and 2.00 to 2.5 m height spread equally below and above the ground. While the length of the beds can be made as per convenience, the width and height cannot be increased as an increased width affects the ease of operation and an increased height on conversion rate due to heat built up.

Cow dung and farm waste can be placed in layers to make a heap of about 02.00 to 2.5 m height. Earthworms are introduced in between the layers . The beds are maintained at about 240-50% moisture content and a temperature of 20–30oC by sprinkling water over the beds.

When the commercial scale production is aimed at in addition to the cost of production, considerable amount has to be invested initially on capital items. The capital cost may work out to about `7000to `9000 for every tone of Vermicomposting production capacity. The high unit capital cost is due to the fact that large units require considerable expenditure on preparation of Vermi beds, shed to provide shelter to these beds and technology. However these expenditures are incurred only once.

Under the operational cost, transportation of raw materials as also the finished product are the key activities. When the source organic wastes and dung area way from the production facility and the finished product requires transportation to far off places before being marketed, the operational cost would increase.

ABOUT THE WORMS

about 350 species of earth worms in India with various food and burrowing habits Eisenia fotida, Eudrilus eugeniae and Perionyx

excavatusare some of the species that are reared to convert organic wastes into manure. A combination of epigeic species that form no permanent burrows and live on the surface, anemic that form semi-permanent and vertical burrows extending from the surface and endogeic that typically live throughout the deeper layers may be considered.

The worms feed on any biodegradable matter and Vermicomposting units are ideally suited for locations or units with generation of considerable quantities of organic wastes. One earthworm reaching reproductive age of about six weeks lays one egg capsule Thus the multiplication of worms under optimum growth conditions is very fast. The worms live for about 2 years. Fully grown worms could be separated and dried in an oven to make 'worm meal' which is a rich source of protein (70%) for use in animal feed.

LOCATION

Rural areas with predominance of agriculture, suburbs of cities and peri urban villages are considered ideal locations for setting up of Vermicomposting units on a larger scale from the view point of availability of raw material and marketing of the produce. As use of the compost is effect more particularly on fruit, vegetable, plantation and ornamental crops, Vermi-composting units may be located in areas with concentration of fruit and vegetable growers and floriculture units. Further, the nearness to a commercial dairy unit or large concentration of cattle population will have an added advantage of cheap raw material i.e. cow dung.

COMPONENTS OF A COMMERCIAL UNIT

Commercial units have to be developed based on availability of cow dung locally. If some big dairy is functioning then such unit will be an associated activity. Commercial units must not be designed based on imported cow dung. The philosophy is in-situ development using "Natural Resources".

Sheds

For a Vermi-composting unit, whether small or big, this is an essential item and is required for securing the Vermi- beds. They could be of that roof supported by bamboo rafters and purlins, wooden or steel trusses and stone/ RCC pillars. Locally available roofing materials to keep the capital investment at reasonably lower level. If the size is so chosen as to prevent wetting of beds due to rain on a windy day, they could be open sheds. While designing the sheds adequate pathways has to be left around the beds for easy movement of the labourers attending to the filling and harvesting the beds.

Vermi-beds

Normally the beds have 2.00 to 2.5 m height depending on the provision for drainage of excess water. Care should be taken to make the bed with uniform height over the entire width to avoid low production owing to low bed volumes. The bed width should not be more that 1.5 m to allow easy access to the centre of the bed.

Land

About 0.5-0.6 acre of land will be needed to set up a Vermiculture & Vermicomposting production. The centre will have at least 6-8 sheds for convenience and a dedicated area for finished products. It should also have a bore well and pump set or watering arrangement and other equipments as described in the scheme economics. The land can be taken on lease for at least 10-15 years.

Buildings

When the activity is taken up on a large scale on commercial lines, considerable amount may have to be spent on buildings to house the office, store the raw material and finished product, provide minimum accommodation to the Manager and workers. The cost of the buildings along with the electrification of these buildings and the Vermi-sheds may be included under this item.

Seed Stock

This is an important item requiring considerable expenditure. Though the worms multiply fast to give the required numbers over a period of 6 months to a year, it may not be wise to wait till such a time having invested on the infrastructure heavily. Thus, worms @ 1 kg per m3of bed volume should be adequate to start with and to build up the required population in about two or three cycles without unduly affecting the estimated production.

Fencing and Roads/Paths

The site area needs development for construction of structures and development of roads and pathways for easy movement of hand-drawn trolleys/wheel barrows for conveying the raw material and the finished products to and from the Vermi-sheds. The entire area has to be fenced to prevent trespass by animals and other unwanted elements. These could be estimated based on the length of the 4 periphery of the farm and the length and type of roads/paths required. The costs on fencing and formation of roads should be kept low as these investments are essential for a production unit, yet would not lead to increase in production.

Water Supply System

As the beds have to be kept moist always with about 50% moisture content, there is a need to plan for a water source, lifting mechanism and a system of conveying and applying the water to the Vermi-beds. Drippers with round the clock flow arrangement would be quite handy for continuous supply and saving on water. Such a water supply system requires considerable initial investment. However, it reduces the operational cost on hand watering and proves economical in the long run. The cost of these items would depend on the capacity of the unit and the type of water supply chosen.

Technology

Farm technology and implements are required for cutting (shredding) the raw material into small pieces, conveying shredded raw material to the Vermi-sheds, loading, unloading, collection of compost, loosening of beds for aeration, shifting of the compost before packing and for air drying of the compost, automatic packing and stitching for efficient running of the unit.

Transportation

For any Vermi-composting unit transport arrangement is a must. When the source of raw material is away from the production unit, an off-site transport becomes major item of investment. A large sized unit with about 1000 tones per annum capacity may require a three tone capacity mini-truck. With small units particularly with the availability of raw material near the site, expending on transport facility may become in fructuous. On-site transport facilities like manually drawn trolleys to convey raw material and finished products between the storage point and the Vermi-compost sheds could also be included in the project cost.

ADVANTAGES OF VERMICOMPOSTING

Vermicomposting is rich in all essential plant nutrients, Provides excellent effect on overall plant growth, encourages the growth of new, shoots or leaves and improves the quality and shelf life of the produce, Vermicomposting is free flowing, easy to apply, handle and store and does not have bad odour, It improves soil structure, texture, aeration, and water holding capacity and prevents soil erosion, Vermicomposting is rich in beneficial micro flora such as a fixers, P- solubilizers, cellulose decomposing micro-flora etc in addition to improve soil environment, Vermicomposting contains earthworm cocoons and increases the population and activity of earthworm in the soil, It neutralizes the soil protection, It prevents nutrient losses and increases the use efficiency of chemical fertilizers, Vermicomposting is free from pathogens, toxic elements, weed seeds etc, Vermicomposting minimizes the incidence of pest and diseases, It enhances the decomposition of organic matter in soil, It contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.