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PUDUCHERRY POLLUTION CONTROL COMMITTEE

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BENEFITS OF VERMICOMPOSTING IN ENHANCING SOIL NUTRIENTS AND PROMOTING SUSTAINABLE CROP PRODUCTION

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ENVIRONMENTAL INFORMATION, AWARENESS, CAPACITY BUILDING AND LIVELIHOOD PROGRAMME (EIACP), PUDUCHERRY

About EIACP

1. Environmental Information System (ENVIS) was renamed as EIACP (Environmental Information, Awareness, Capacity Building and Livelihood Programme).
2. ENVIS came into existence as a plan programme in 1983.
3. It is a project funded by the Ministry of Environment, Forests and Climate Change (MoEF&CC), to facilitate collection, analysis and dissemination of information on various facets of environment.
4. The information is being disseminated through the quarterly newsletter and website.

About Puducherry EIACP PC Hub

Puducherry EIACP Hub was started on 22nd September, 2005. Our centre located at the Puducherry Pollution Control Committee (PPCC), Puducherry focuses on special reference to "Status of Environment and Related Issues". Activities of our centre include collection, analysis, storage, retrieval and dissemination of information in the subject area allotted. The information is being disseminated through the quarterly newsletter and various environmental awareness program in schools and colleges for imparting Environmental comprehension among students.

The Aims and Objectives of EIACP are as under:

1. To nurture green, sustainable and inclusive workforce in order to enhance both living and environment standards while fostering gainful and self-employment of youth.
2. To conduct skilling courses not only in traditional areas but also in new emerging areas like electric vehicles, hazardous waste/ Bio-medical waste etc. considering their future scope, requirements and prospects.
3. To be involved in the Mission LiFE (Lifestyle for Environment) conceptualized by the Ministry.
4. To facilitate technical and environmentally conscious industrial participation focused on sustainable development.
5. To develop national and international collaboration for knowledge exchange and skilling and facilitating attainment of the SDGs.
6. To aid sustainable livelihoods of tribal population especially in NER based on traditional knowledge and crafts.
7. To facilitate informed decisions and policy making by catering to demand for research, innovation and data on emerging issues related to environment.
8. To facilitate transition to environmentally conscious futuristic citizens including awareness among public/communities on environment related issues.

THE BENEFITS OF VERMICOMPOSTING IN ENHANCING SOIL NUTRIENTS AND PROMOTING SUSTAINABLE CROP PRODUCTION

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Abstract

In the process of vermicomposting, earthworms turn organic waste into finely broken-down material, called vermicompost, which resembles peat. The fact that vermicompost is an environmentally benign process that turns a wide range of organic residues into useful agricultural inputs is becoming more widely known. When applied, vermicompost is a great source of humus and plant nutrients that enhance the soil's natural organic matter, physico-chemical and biological characteristics. Application of vermicompost increase the production of field crops, vegetables, flowers, and fruit crops. In this article, the method of vermicompost production, selection of earthworm species, nutritional benefit of vermicompost and its significance for sustainable crop production are discussed in brief.

Keywords

Vermicomposting, Earthworm, Organic Wastes, Soil Nutrients, Crop Production.

Introduction

Earthworms are responsible for turning over soil; this was originally noted by Aristotle (4th century B.C.), who referred to them as "intestine of the earth." Darwin (1881) did, however, highlight their significance in the decomposition of plant and animal matter in soil and forest litter. As one of the soil engineers, earthworms are essential to the maintenance of ecosystem services and the control of biogeochemical processes. Earthworms transform organic waste into humus, which enhances the condition of the soil. As a result, the soil becomes more fertile and supports crop growth. For this reason, earthworms are considered to be the friends of farmers. Vermicomposting is a basic biological composting method that uses specific earthworm species such as *Eudrilus eugeniae*, *Perionyx excavatus*, *Eisenia andrei*, *Eisenia fetida*, and *Lumbricus rubellus* etc. to process waste into a higher-quality final product, the vermicompost. Vermicompost comprise of a variety of microorganisms, humus like material, live earthworms, and their cocoons (Thamizharasan et al., 2021). Earthworms can consume almost any kind of organic material; on a daily basis, one kilogram of worms can consume one kilogram of residue (Prajapati et al., 2023). Vermicomposting is therefore an inexpensive and efficient technique to recycle domestic waste, animal waste from pigs, poultry, and cattle, food scraps, and agro-industrial waste. When applied as manure, vermicompost enhance the productivity of organic crops, such as grains, millets, pulses, oilseeds, fruits, vegetables, and nurseries (Shubha et al., 2021; Prajapati et al., 2023).

Additionally, vermicomposting is a great approach to promote organic farming, reduce soil pollution, improve soil fertility, and substitute synthetic fertilizers. This naturally occurring manure is inexpensive, easily manageable, and a great source of growth hormones and nutrients. It stimulates growth four to five times more than other organic fertilizers and 30 to 40% more than chemical fertilizers (Mukherjee et al., 2016). Furthermore, vermicomposting offers scope of entrepreneurship in rural areas where huge mass organic residues are generated. Community-level vermicomposting project execution with public participation can aid in widespread adoption and address climate change challenges (Mukherjee et al., 2016; Gamage et al., 2023).

Selecting a suitable species for vermicomposting

The three main groups of earthworms are called epigeic, endogeic, and anecic species based on the habitat and feeding habit. At the soil's surface, epigeics are prevalent and feed on litter. Breaking down leaf litter into stabilised organic materials is the primary role of epigeic organisms. Epigeic earthworms include *Eudrilus eugeniae*, *Eisenia fetida* and *Perionyx excavatus*. Endogeic species of earthworms include *Octolasion cyaneum*, *Murchieona muldali*, *Allolobophora chlorotica* etc. They feed mostly on dead roots and organic debris found in the soil. Worms known as anecic consume soil. By burying leaves in the soil, they cause plant remnants to decompose (Lavelle et al., 1989; Lachnicht et al., 2004). Anecic earthworm species include *Aporrectodea longa*, *Aporrectodea nocturna*, *Lumbricus friendi*, and *Lumbricus terrestris*. They contribute significantly to the decomposition of organics and the nutrient enrichment of the soil.

Vermicompost has traditionally been produced from animal dung and has been shown to be an effective fertilizer and soil conditioner (Ismail, 1997). In a three-month period, the population number of *Eudrilus eugeniae* increased by 40 times, while the biomass produced by the species increased by 200 times, according to research done in the laboratory by Kale (1986). It has been discovered that *Eudrilus eugeniae* produces more biomass than *Perionyx excavatus*. Numerous research (Kale et al., 1982; Reinecke et al., 1992; Benitez et al., 2005; Garg and Kaushik, 2005) have demonstrated that epigeic earthworms are thought to be the best for vermicomposting. Manure can be produced from organic waste by epigeic earthworms, such as *Eudrilus eugeniae* and *Eisenia fetida*, which live at the surface and feed on plant materials such as agro-industrial wastes through phytophagy (Gajalakshmi and Abbasi, 2002; Gajalakshmi and Abbasi, 2003; Gajalakshmi and Abbasi, 2004a; 2004b; Gajalakshmi et al., 2005; Sankar Ganesh et al., 2009).

Method of production for vermicompost

Various modes such as windrows, beds or bins, flow-through reactors, troughs, towers, pits or trenches, and containers, can be used for vermicomposting. These methods can be broadly categorized into two groups, according to Pilli et al. (2019): batch systems and continuous flow systems. In a batch system, a set quantity of feedstock/organics is introduced to the system at the start of the process, the feedstock is given time to be processed by the worms, and vermicompost is produced in batches. The vermicompost is harvested at the end of this time, and the system is cleaned and made ready for the following batch. Small-scale vermicomposting businesses benefit greatly from batch systems since they are easier to manage and need less capital expenditure for equipment. In continuous flow systems, in contrast, these systems entail a steady supply of feedstock into the vermicomposting process together with continuous vermicompost harvesting. These systems need a more intricate design that includes a technique to regulate the system's moisture content and a mechanism for separating the vermicompost from the worms. Continuous flow systems are suitable for large scale operation since they can handle bigger volumes of feedstock and require less labor.



Figure 1:- Earthworm – *Eudrilus eugeniae* (a and b) and vermicompost (c)

The preparation of vermicompost requires a number of steps in the vermicomposting process. In essence, vermireactors were constructed by vermibed by layering sawdust, river sand, and soil in circular plastic or wood containers at intervals of 1 cm, 2 cm, and 4 cm in thickness. To this, appropriate number of adult earthworms of selected species from respective culture fed with cow dung was introduced. The temperature should be between 20 and 30°C, and the moisture content of the bed or pit should be maintained between 40 and 50% (Prajapati et al., 2023). Shredded newspaper, coconut coir, or any other appropriate material can also be used to make the vermibed. Before adding the worms, the bedding needs to be wet with water and left for a day or two. Vermicompost, often known as worm castings, or vermicast manure the feed/ substrate to be processed as laid on top of the vermibed. The vermicompost thus generated should be moved to one side of the worm bin in order to start the harvesting process.

Nutritional benefit and importance of vermicompost in sustainable crop production

The plant matter that earthworms consume is broken down by them and subsequently expelled as worm castings. It's common to refer to worm casts as "black gold". Earthworms consume a wide range of organic wastes, reducing the volume by 40 to 60%. Each earthworm weighs between 0.5 and 0.6 g, consume waste equal to its body weight, and excretes casts that make up around half of the organic material it process each day. Researchers have examined the chemical and biological characteristics of these worm castings. Castings have a pH of approximately 7.0 and a moisture content ranging from 32 to 66%. Compared to microbial processed compost, the worm castings have a larger percentage (almost double) of macro and micronutrients (Saranraj and Stella, 2012). Vermicompost has a range of nutrients: 0.26 to 0.42% potassium, 1.16 to 1.93% phosphorus, and 0.46% to 0.66% nitrogen. Vermicompost includes enzymes, beneficial soil microorganisms, plant growth hormones, and minerals. Vermicompost can have a carbon to nitrogen ratio ranging from 25.0 to 44.9. It has been demonstrated that vermicomposting lowers the organic manure or residue's carbon-to-nitrogen (C:N) ratio, increasing the material's availability of nitrogen, phosphorus, potassium, and total microbial counts (Srivastava et al., 2002).

Since vermicompost includes micronutrients and healthy soil bacteria in addition to NPK. Vermicompost is a stable, fine-grained organic manure that works well for crop development and seedling nurturing. It enhances the biological and physiochemical properties of the soil. Plant growth is greatly influenced by the high nutrition and growth-promoting content of the cast, the suitable soil microbiology, and other variables.

It stops nutrient losses and balances the pH of the soil. Additionally, earthworms increase the soil's phosphorus availability. Vermicompost enhances the rate of infiltration and reduces soil compaction. Organic matter's nitrogen is either converted to earthworm biomass or expelled as ammonium. Additionally, the microbial biomass in the soil contains 73.3 µg N/gram. Vermicompost reduces the prevalence of dangerous pests and microorganisms like bacteria, fungi, and other microorganisms and is free of pathogens, toxic substances, and weed seed. It has important vitamins and hormones like gibberellins and auxin, which are good for increasing crop yield.

Conclusion

Vermicomposting is a sustainable and environmental friendly waste management technique that turns organic waste into vermicompost. Scientific research has concentrated on demonstrating the ecological traits and advantageous effects of earthworms in recent years. The rate of soil turnover, soil mineralization, and soil organic matter humification are all influenced by earthworm activity. Worm-worked soils also have an improvement in soil texture consistency along with an increase in porosity, infiltration, and soil water retention. Earthworms and microorganisms recycle organic wastes efficiently, and that this process is crucial for agricultural crop development, growth, and production. Vermicompost has a high nutritional value and efficiently transforms waste product into a valuable by-product through the composting process.

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PUDUCHERRY EIACP ENVIRONMENT EVENTS

Mission LiFE Programme:

Puducherry EIACP Hub conducted mass awareness campaign on Mission LiFE at Industry, Schools & Colleges in Puducherry. The details are as follows:

Sl. No.	Date	Name of the Industries/School/Colleges	No. of Participants
1.	13.10.2023	M/S. Lucas TVS, Villupuram Main Rd, Thiruvandarkoil, Puducherry.	27
2.	05.10.2023	Savarayalu Nayakar Govt Girls High School, Needarajapaiyer St, Puducherry	63
3.	06.10.2023	Jeevanandam Govt. Boys Higher Secondary School, Puducherry	103
4.	10.10.2023	Kamban Govt Higher Secondary School, Nettapakkam, Puducherry	84
5.	26.10.2023	Arignar Anna Government Higher Secondary School, Kunichampet	133
6.	26.10.2023	Government High School, Thirukkanur	692
7.	31.10.2023	Sekkizhar Government High School, Thattanchavady, Puducherry	96
8.	31.10.2023	Government Higher Secondary School, Sedarapet, Pondicherry	124
9.	19.10.2023	Rajiv Gandhi Arts And Science College, Thavalakuppam	123
10.	24.10.2023	Kasthurba College For Women, Villianur	102
11.	03.11.2023	M/s. Rane Madras Ltd, Thirubuvanai Main Road, Thirubhuvanai, Puducherry	56
12.	17.11.2023	M/s. Hindustan Unilever Ltd, Pondicherry	32
13.	09.11.2023	Kasturibai Gandhi Government Girls Higher Secondary School, Bahour	100
14.	09.11.2023	Kavingareru Vanidasanar Government High School, Bahour	305
15.	09.11.2023	Annai Sivagami Government Girls Higher Secondary School, Muthaliarpeth	300
16.	18.11.2023	Dr. Ambedkar Govt. Hr. Sec. School, Kirumampakkam	72
17.	27.11.2023	Government High School, Pillayarkuppam	130
18.	07.11.2023	Saradha Gangadharan College, Velrampet	120
19.	10.11.2023	Perunthalaivar Kamarajar Arts & Science College, Kalitheerthalkuppam, Madagadipet	80
20.	16.11.2023	Idhaya College of Arts and Science for women	90
21.	05.12.2023	Thiru Vi Ka Government High School, Arumbarthapuram	72
22.	06.12.2023	Thiruvalluvar Government Girls Higher Secondary School.	155
23.	26.12.2023	Acharya Arts & Science College, Uruvaiyar Rd, Achariyapuram	56
Total			3115

PHOTO CLIPS OF MISSION LIFE AWARENESS PROGRAMMES IN SCHOOLS/COLLEGES/INDUSTRIES



Regional Evaluation Workshop for South Zone

Attended Regional Evaluation Workshop for South Zone on 9th & 10th October, 2023 at Thiruvananthapuram, Kerala.



Regional & State Level Science Exhibition:



Puducherry EIACP Hub participated and displayed publication viz., calendars, Newsletters, Books, value added product etc., in the stall for the Regional & State Level Science Exhibition organized by the Directorate of School Education, Puducherry at Indira Gandhi Government Higher Secondary School, Lawspet, Puducherry from 07.12.2023 to 12.12.2023. 2495 students and staffs were participated.





Group Training:

Puducherry EIACP Hub conducted Hands-on Training Programme to the Swachhata Workers of Ariyankuppam Commune Panchayat on the title "Solid Waste Management" on 29.12.2023 at Community Hall, Ariyankuppam, Puducherry. 105 workers were participated.



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