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VERMICOMPOSITING

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INTRODUCTION

Earthworms are terrestrial invertebrates belonging to the Order Oligochaeta, Class Chaetopoda, Phylum Annelida, which have originated about 600 million years ago, during the Pre-Cambrian Era. About 2,350 years ago Aristotle has said, "**Earthworms are intestines of the Earth**". Earthworms occur in diverse habitat, exhibiting effective activity, by bringing about physical and chemical changes in the soil leading to improvement in soil fertility. An approach towards good soil management, with an emphasis on the role of soil dwellers like earthworms, in soil fertility, is very important in maintaining balance in an ecosystem (Shuster *et al.,* 2000). Vermiculture is basically the science of breeding and raising earthworms. It defines the thrilling potential for waste reduction, fertilizer production, as well as an assortment of possible uses for the future (Pinoys, 2010). Vermiculture yields vermicompost as a by-product which helps in soil fertility.

Vermicomposting is basically composting with worms. Vermicomposting is a process of producing vermicompost or organic compost using worms. In this process the biodegradable wastes such as farm waste, livestock wastes, kitchen wastes, market wastes. etc. are converted into nutrient rich vermicompost.

Earthworms are the one of the nature's gift which liberates cost effective methods to generate organic fertilizers in agricultural field. These worms feed on biodegradable waste and breakdown it in an organic matter. They stimulate microbial activity and increases rate of mineralization. The castings left by them are exceptionally valuable and serves as a type of organic fertilizer.

Earthworm

Earthworms are invertebrates belonging to the phylum *Annelida* and class *Oligochaeta*. Earthworms are so called because they are almost always terrestrial and burrow into moist-rich soil, emerging at night to forage. The earthworms are long, thread-like, elongated, cylindrical, soft bodied animals with uniform ring like structures all along the length of their body. These bodies consist of segments, arranged in linear series, and outwardly highlighted by circular grooves called annuli. The body segmentation is merely an external feature but exists internally too. At the sides of the body on the ventral surface of each segment are four pairs of short, stubby bristles, or *setae*. The *setae* provide traction for movement and also enable the worms to cling to their burrows when predators try to pull them out. There is no well-marked head but a preoral called the *prostomium* is present. Earthworms have an opening at each of its ends, the opening at the anterior end is the mouth and the one at the posterior is the anus. The body is always kept moist by the secretion of the body wall and also by the body fluids that come out at regular intervals from very minute pores in the worms' body surface. The earthworms do not have any specific organ of sight, hearing or olfaction, but special cells exist all along the length of their body to take up these sensory functions.

Earthworms possess both male and female gonads. They deposit eggs in a cocoon without the free larval stage. At maturity, a cover-like tissue is developed just behind the anterior segments, called the *clitellum*.

In damp weather, the earthworms stay near the surface, often with mouth or anus protruding from the burrow, while during dry weather, they burrow to several feet underground, coil up and become dormant. Earthworms act as great benefactors of soil and agriculture. Earthworms continuously till and aerate the soil, supply it with organic matter, and help moisture reaching it via the burrows they make. Barring a few exceptions, most species of earthworms reduce plant pathogens, and are believed to release enzymes and hormones in their excreta beneficial to plant growth. In recent years earthworms have been increasingly employed in vermicomposting biodegradable solid wastes.

Advantages of Vermiculture

Vermiculture is one of the valuable attempts we have engaged in as it provides not only environmental protection but also helps us to acquire knowledge on its proper methodology.

Vermiculture is environment friendly since earthworms act on all biodegradable materials which somewhat helps in garbage disposal problems. There is no imported inputs needed for the method, the worms can be locally collected and the food for their feeding is also available locally as farm wastes, straw and other degradable wastes. This methodology is cost ineffective and highly profitable as both the worms and its by-product vermicompost is saleable.

Vermicompost is the profitable by-product of vermiculture, which is beneficial for both plants and soil. It improves soil aeration and soil texture thereby reducing soil compaction. Because of high organic matter and humus content it improves water retention capacity of soil. It also promotes better plant growth and upgrades the nutrient quality of soil due to the presence of both macronutrients (nitrogen, phosphorous and potassium) and micronutrients (manganese, copper, iron and zinc).

Precautions used for Vermiculture

Vermiculture should be done with some precautions taken into consideration for successful culture. Vermiculture pit should be protected from direct sunlight for their better survival as direct heat can kill the worms. Water should be sprayed whenever necessary to maintain appropriate moisture level in the pits. The worms should be protected from excessive rain and predators like ants, rat, birds, moles and variety of invertebrates as these feed on earthworms.

Ecology of Earthworms

Geographical distribution

Earthworms are found in most parts of the world with the exception of deserts (where they are rare), areas under constant snow and ice, mountain ranges, areas bereft of soil and vegetation. Such features are natural barriers against the spread or migration of earthworm species, and so are the seas, because most species cannot tolerate salt water even for a short period or the areas influenced by salt water intrusion.

Some species are widely distributed. Michaelsen has used the term *peregrine* to describe such species. some of the species which occur only in specific areas and are not able to spread widely have been termed *endemic*.

Factors affecting Earthworm distribution

The distribution of earthworms in soil is affected by following factors:

i) Physical and Chemical characters of soil (temperature, moisture, *p*H, inorganic salts, aeration and texture),
ii) Available food (herbage, leaf litter, dung, consolidated organic matter), and
iii) Reproductive potential and dispersive power of the species (Edwards and Bohlen, 1996).

Temperature

The activity, metabolism, growth, respiration and reproduction of earthworms are all influenced greatly by temperature. Fertility and the growth period from hatching to sexual maturity are also dependent on temperature.

pH

Earthworms are sensitive to changes in *p*H. They prefer conditions of neutral reaction. Earthworms find it difficult to survive if the *p*H falls below 6 and thus they migrate or are killed.

Light

Earthworms are very sensitive to light. The photoreceptor cells detect light and the Earthworms moves away to avoid strong light. The deep burrowing worms and other species emerge at the surface only at night for this reason.

Moisture

Moisture levels have to be maintained at around 50% so that the microbial activity is high and the food matter is easy to feed upon. Excess water leads to anaerobic conditions, which in turn lowers the *p*H and creates acidic conditions. Acidic conditions reduce productivity and cause migration. Water influences the number of biomass of Earthworms.

Food

One of the most important factors that control the establishment and continuity of earthworm populations is food and its quantity. Higher nitrogen ratio helps in faster growth and greater production of cocoons. Fresh green matter is not easily fed upon. Decomposition by microbial activity is essential before earthworms can feed on fresh waste. All biodegradable matter can be Taken as feed for Earthworms.

Soil Texture

Soil texture influences earthworm populations due to its effect on other properties, such as soil moisture relationships, nutrient status and cation exchange capacity, all of which have important influences on earthworm populations.

Effect of Earthworm on Soil quality

Earthworms, which improve soil productivity and fertility, have a critical influence on soil structure. Earthworms bring about physical, chemical and biological changes in the soil through their activities and thus are recognized as soil managers.

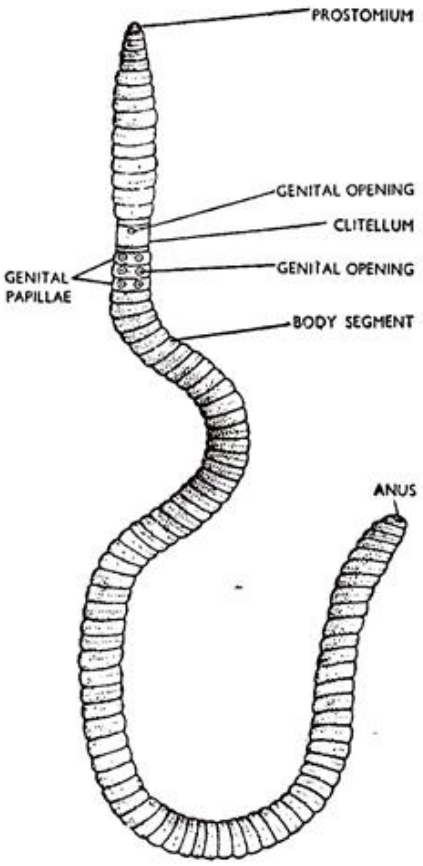


Fig: *Pheretima posthuma.*

Review of Literature

The role of earthworms in soil formation and soil fertility is well documented by the developed vegetable mould through the action of worms (Darwin, 1881). Three main Ecological groups of Earthworm is recognized with its relationship to soil and land use (Lee, 1985). The activity, growth, metabolism, respiration of Earthworm is presented as Biology of Earthworms (Edward et.al. 1972). The Biology of Earthworms is termed under the

terminology of Vermicology **(Ismail, 1997).** The changes in the invasion of morphology are seen on Earthworm due to the various effects (Alban et.al. 1994).

Earthworm is capable of decompose organic matter into organic compost called Vermicompost. Vermicomposting is defined as a low cost technology system for processing or treatment of organic wastes (Hand et.al. 1988). Bhadauria et.al. (1989) reported the population dynamics of Earthworm and their contribution to nutrient cycling during cropping. The role of Earthworm in recycling of nutrients, soil structure, soil productivity and agriculture, and their application in environment and organic waste management is well understood (Ansari and Ismail, 2001). The solid waste management system comes under the term Vermitechnology.

MATERIALS AND METHOD

The study was conducted in Laboratory of the Department of Zoology in Kalyan P.G. Autonomous College, Bhilai Nagar, Chhattishgarh, during the month of September and October.

Earthworm types

Pheretima posthuma is a local type of earthworm used in vermiculture.

Scientific Classification:

Kingdom : Animalia

Phylum : Annelida

Class : Oligochaeta

Order : Ophisthopora

Family : Megascolecidae

Genus : *Pheretima*

Specie : *posthuma*

Raw Materials

Agriculture waste like Cow dung, paddy straw fibres (bhusa), Peanut shells are taken as raw material to make the growing system of worms and the same is used to feed the Earthworms.

A 40cm X 140cm dimension of Bin is used to make the growing system for the worms. The image shows the growing Bed for the worms.

METHODOLOGY

Vermiculture is the science of worm composting. Worms can eat according to body weight each day on fruit and vegetable scraps, leaving castings as the byproduct. Worm castings are called worm compost.

Cleaning: We started the methodology by cleaning the bin which will be used for making the vermi-bed as a growing system of Earthworms. There should no be chemical traces in the materials used as that is lethal for worms. Apart from the Bin another tin compartment was used which was thoroughly cleaned.

Setup: A low light area was chosen for the setting up the growing system for the worms. Worms prefer low light and dark areas as they are Photophobic. The Bin was kept inside the Tin compartment and the compartment was filled with a level of 1cm water to avoid predator like Ants.

Preparation of Vermi-Beds: The Vermi-Bed was prepared inside the Bin. A simultaneous layer of cow dung and paddy fibres was put together inside the bin which composed the whole Vermi-Bed. No Greeny organic matter is used as this slows the growth of the worms and sometimes death of the worms. This Vermi-bed makes the growing system for the worms.

Introducing Worms to Vermi-Beds: After the preparation of vermi-bed about 30-40 worms (*Pheretima posthuma*) were introduced inside the beds. The worms were equally distributed inside the bin for proper growth and degradation of the organic waste.

Feeding: The worms was feeded on the same organic matter present in the bin. After few days the organic matter which composed of agricultural waste and other products got finner in texture as they got degraded by the worms.

Water and Areation: Proper moisture and aeration was controlled by watering every 2-3 days. 60-70% of moisture was retained. The bin was turned in regular intervals to offer aeration and avoid anaerobic respiration.

OBSERVATION

The purpose of this project work ‘Vermiculture’ is to study the ecology of the Earthworms and their lifecycle with the help of proper observation of the worms. During the whole

duration of the project we have seen different stages of the worms which explain the lifecycle of the worms. The cycle begins with an adult Earthworm which grows and matures into a full size worm with fully developed clitellum and sexual organs. These mature worms reproduce and produces cocoon. Cocoon is the tough skin of clitellum where fertilized egg are captured and creates an egg sac. After the incubation period tiny thread like worms hatches out from the cocoons.

Vermiculture is a way of composting using earthworms. Earthworms can be successfully utilized to reduce the duration of compost production from agriculture and other organic wastes. Vermiculture reduces waste, can be used for producing fertilizers and this helps in maintaining the ecological balance.

The culturing of worms not only gave us an idea about their ecology and life cycle but also shown us an environment-friendly path to make compost. The compost made from this method can be used in any crops as this vermicopost is beneficial for the plants. It provides nutrients to the plants. The worms when placed directly in soil helps in soil aeration hence increases water retention capacity of the soil. Thus we can conclude that Vermiculture is an eco friendly, cheap, low maintenance and profitable methodology.

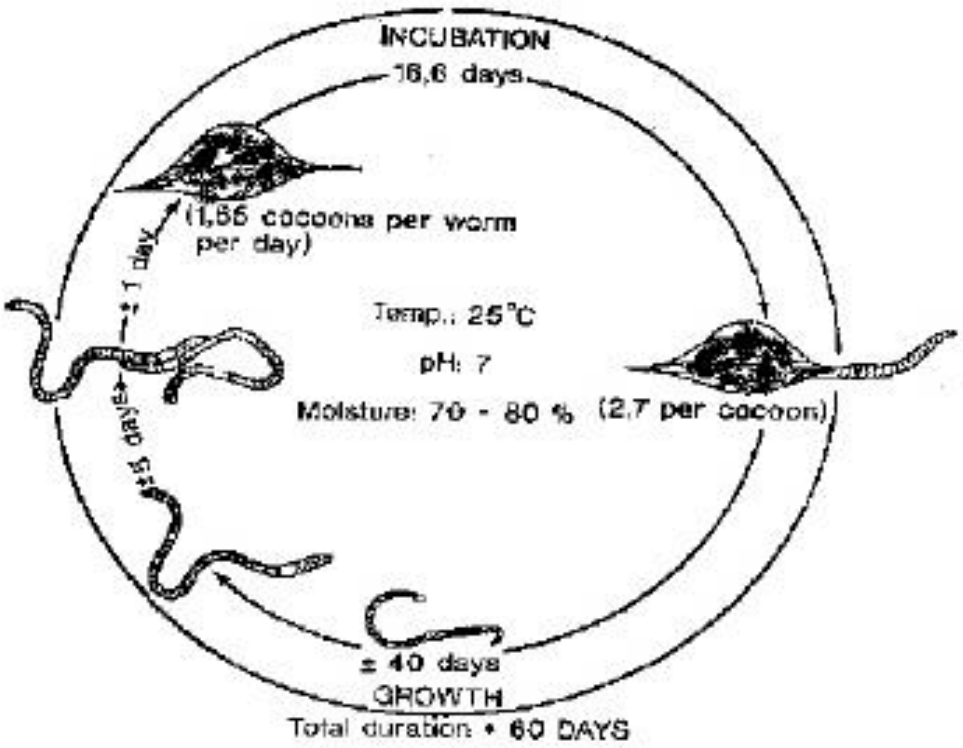


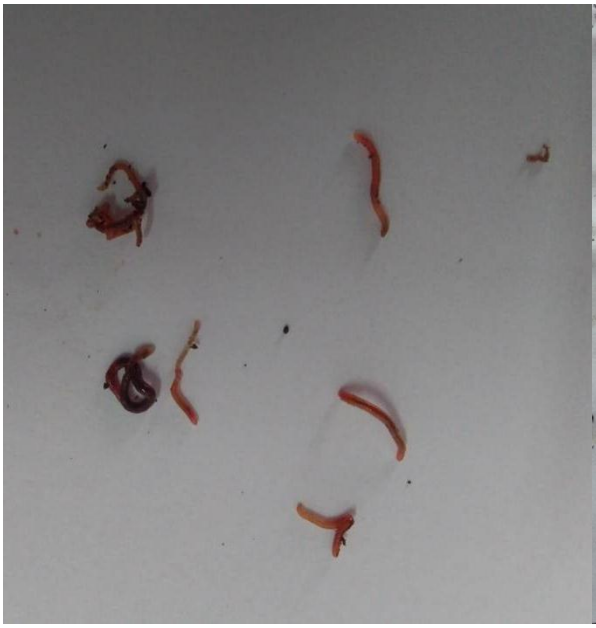
Fig: life cycle of *Pheretima posthuma.*

Setup for Vermiculture

Preparation of Vermi-Bed by layering cow dung and paddy fibres

Prepared Vermi-Bed

Earthworm used for Vermiculture



Juvenile Earthworms

Adult Earthworm

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