Scope of Vermitechnology

The branch of science that studies the importance and utilization of different epigeic earthworm species to answer problems related to ecology and environment is known as Vermitechnology. It is a useful technique for stabilization of both industrial and domestic organic waste, organic farming and waste water treatment. Vermitechnology is an aerobic stabilization of nonhaemophilic and bio-oxidation process of decomposition of organic wastes that depends upon earthworms for fragmentation, mixture and promotion of microbial activity. It is based on the principle that during feeding, the earthworms fragment the waste materials that results in increase of its surface area for further colonization of microorganisms. Charles Darwin was the pioneer of vermitechnology related studies. He was the first man on this planet to demonstrate the role of earthworms in the ecosystem. He published a book entitled *"The formation of humus through the action of earthworms"* in the year 1881. Since then both developing and developed nations have adapted vermitechnology as a tool for different organic waste management practices. It is reported to be already in commercial practice in USA, Canada and USA, and being used efficiently in Philippines and Asia.

Vermicast or vermicompost, which is the final product of vermin-composting, is richer in nutrients than the initial raw materials. Vermicast appears as a peat-like material which is capable of showing high water holding capacity, porosity, drainage, aeration and microbial activity. In the process of vermicomposting, the essential plant macronutrients such as nitrogen (N), phosphorus (P) and potassium (K) present in the organic waste materials are converted through the action of microorganisms into much more soluble and stabilized forms which are easily available to the plants as compared to the parent substances. The process of vermicomposting is best suited for mesophilic temperature range such as 35-40°C. By both mechanical and biochemical actions of earthworms, it prepares organic manures and combines it with soil particles.

About 3000 species of earthworms are distributed all over the world and 384 earthworm species have so far been reported from India. Most of the earthworms are terrestrial in nature, which prefer soil as their habitat. However, some of the species such as *Pontodrilus burmudensis* live in the estuarine water. Earthworms can be found in diverse habitats, and organic waste materials like manure litter, compost etc. are attractive habitats for them but they are also available in hydrophilic environment as well as in very cold environment such as under the snow. Although earthworms are placed under saprophages, they are classified as detrivores and geophages based on their feeding habits. Detrivores are found at or near about the soil surface on leaf litter or dead roots and any other plant debris. Few examples of detrivorous earthworms are *Octochaetona curensis*, *Perionyx excavates*, *Octochaetona serrata*, *Eisenia fetida*, *Polypheretima elongate*, *Lampito mauritii* and *Eudrilus euginae*. The earthworms that are geophages feed beneath the surface; they ingest huge quantities of organically rich soil. Two common examples of geophages are *Octochaetona thurstoni* and *Metaphire posthuma.*

Selection of suitable earthworm species for vermicomposting is the most important aspect of vermitechnology. Vermicompost produced by different earthworm

species exhibit significant variation in respect of nutrient composition. Vermicomposting potential of various detrivorous earthworm species has been studied by different researchers. The results revealed that *Perionyx excavates*, *Eisenia fetida*, *Eudrilus eugeniae* and *Metaphire posthuma* exhibit greater range of tolerance in extreme atmospheric conditions than any other species of earthworms. So these are the most widely used species of earthworms for vermicomposting of organic waste materials. They can tolerate high temperature upto 42°C and low soil temperature below 5°C. The polyphenol concentration and Carbon: Nitrogen ratio is the two most important factors for determination of palatability in detrivorous earthworm species.

The first step for every vermicomposting operation is the selection of suitable organic waste. Earthen pots or pits, cemented tanks, wooden boxes lined with either plastics or stones can be used for vermicomposting. Slightly darker and humid places, 40-50% moisture content in beds, neutral pH and slightly decomposed organic matter with high nitrogen content facilitate the earthworms to grow faster and produce more cocoons. Physico-chemical changes in degradation of organic waste material are carried out through enzymatic digestion and enrichment by excrement of nitrogen. About 5-10% of initial raw material is absorbed into the tissue of the earthworms for their physiological activities and the rest is excreted as vermicast. The process of decomposition continues even after the release of the cast by the establishment of microbes. Since huge number of microorganisms, hormones and enzymes are already present in the intestine of earthworms; the partially degraded organic substrates degrade rapidly and are converted to vermicompost within a very short period of time. The end product is well humidified, much stabilized and a potential organic fertilizer that can increase the fertility of soil and act as stimulator for growth of plants, and is appropriate for agricultural application.

Micro- and macro-nutrients present in vermicompost make it ideal organic manure which has the capability to enhance the biomass production and number of crops. It is assumed that earthworm excretes certain vitamins, metabolites and similar substances into the soil which can be D vitamin or B vitamin. It has been reported that vermicompost, specifically those obtained from animal waste sources have more mineral elements than the commercially available plant growth media. Apart from that, some of these elements are converted to forms such as soluble potassium, nitrates, calcium, exchangeable phosphorus and magnesium which can be readily taken up by the plants. The quality and quantity of nutrients present in vermicompost and its superiority over traditional compost or synthetic plant growth media can be explained by higher rate of humification, breakdown of polysaccharides and accelerated mineralization of organic matter resulting from earthworm activities during vermicomposting. Further, the excess earthworms obtained from vermicomposting can be used in protein rich animal feed and medicines.

To overcome the ever-growing waste management problems of developing countries, vermitechnology can be used as a potential weapon. Earthworms have the capacity to stabilize a wide range of toxic organic wastes into value added products. When vermicompost is applied in the field, it enhances the quality of soil through

increasing microbial biomass and microbial activity which play a major role in nutrient cycling.

Habit and habitat of Earthworm:

- Earthworms are segmented invertebrates, that are reddish brown in color.
- Being terrestrial in nature, it mostly inhabits the upper layer of the moist soil.
- It is also fossorial in nature, i.e. it burrows the soil and lives inside burrows made in moist soil.
- They feed on organic matter present in the soil and the undigested substances are expelled in the form of castings.
- The holes of earthworm can be recognized by the presence of castings termed as pellets.
- Earthworms are generally known as farmer's friend as the fecal deposits of earthworm helps to increase the fertility of soil and burrowing aids in adequate aeration of the soil.
- They are distributed globally and are ranged from sea level to altitude of 3000m.
- However, it is more abundant during the rainy season.
- The earthworm is nocturnal in nature, meaning it stays active at night.

External morphology of Earthworm

- **Mouth:**
  - It is crescentic in shape and lies on the ventral side of a first segment i.e. peristomium.
  - Dorsal to it, prostomium is present.
- **Anus:**
  - It is present on the anal segment, i.e. the last segment.
  - The anal segment lies in the vertical slit like aperture.
  - Its size is small.
- **Male genital pore:**
  - The male genital pores lie ventrolaterally on 18^{th} segment.
  - They are a pair of crescentic apertures.
  - The male reproductive bodies get discharged through these pores.
- **Female genital pore:**
  - A single, minute female genital pore is present in the 14^{th} segment mid-ventrally.
  - The female reproductive bodies are discharged through it.
- **Dorsal pores:**
  - They are present after 12 segments except the last segment.

- Coelomic fluid oozes out from this pore that lubricates the surface of body.

- **Nephridiopores:**
  - They are present in all segments except first two segments.
  - In a body wall, several minute nephridiopores are present.
  - The apertures of integumentary nephridia represent the nephridiopores.
  - The metabolic wastes are discharged out of the body through these pores.
- **Spermathecal pores:**
  - They are situated ventrolaterally.
  - They are through intersegmental in nature found in segment 5/6, 6/7, 7/8, 8/9.
  - The spermatozoa enter the spermatheca through these pores.
  - During copulation, these pores store sperm.
- **Genital papillae:**
  - The genital papillae are the most prominent structures present in the ventral side of the body of earthworm.
  - It is a conical elevation found in segment 17 and 19 a pair each.
  - These papillae aids in temporary attachment in course of reproduction.

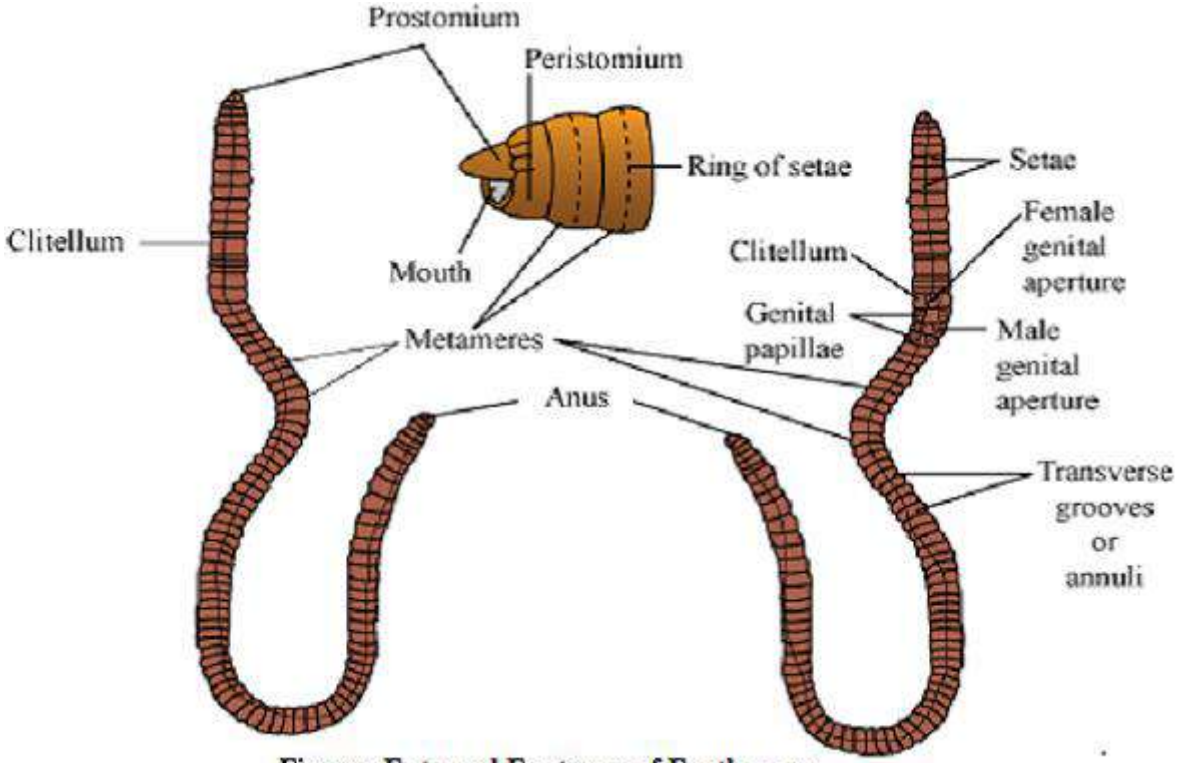

Figure: External Features of Earthworm

Morphology of Earthworm

Earthworms have a tube-like arrangement or cylindrical shaped and reddish-brown segmented body. The body is divided into small segments. The dorsal side is characterized by a dark line of blood vessels and the ventral side is characterized by the

genital openings. The mouth and the prostomium (an organ helps in burrowing) distinguish the anterior end.

The segments 14-16 of a matured earthworm consist of a glandular tissue called clitellum which helps us to distinguish the mouth and tail ends. The body is divided into three segments with respect to clitellum- preclitellar, clitellar and postclitellar.

Earthworms are hermaphrodites i.e., they carry both male and female sex organs. Segments 5-9 accommodate four pairs of spermathecal apertures. The female genital pore is situated at the 14^{th} segment and a pair of male genital pores is situated at the 18^{th} segment. The body consists of S-shaped setae, which help in locomotion in the earthworm. Setae are present in each segment except in the first, last and clitellum segments.

Anatomy of Earthworm

Externally, a thin non-cellular cuticle covers the body wall of the earthworm. Underneath this cuticle, a layer of the epidermis, followed by two muscle layers and coelomic epithelium (inner layer) is sheathed. The epithelium consists of a single layer of glandular columnar epithelium.

Digestive System

The alimentary canal is a long tube running from first to the last segment of the body. The food of earthworms is the leaves and decaying organic matters which are mixed with soil.

According to the diet, the parts of the alimentary canal and their secretion differ from other organisms. The alimentary canal begins at the mouth (buccal or oral cavity) (1-3 segments), passes through the pharynx, oesophagus (5-7 segments), muscular gizzards (8-9 segments), stomach (9-14 segments), intestines, and finally ends at the anus. The food particles get digested gradually as they travel through various compartments of the alimentary canal.

The muscular gizzards grind the soil particles and other matters and at the stomach, the humic acid of the hummus gets neutralized by the calciferous glands present in them. The typhlosole (26-35segments) present in the intestine increases the surface area for absorption.

Circulatory System

Earthworms have a closed circulatory system, constituting a heart, blood vessels, and capillaries. The segments 4-6 consist of blood glands that help in the production of blood cells and haemoglobin.

Respiratory System

Earthworms lack a well-developed structure for respiration. They respire through their moist skin by diffusion.

Excretory System

Nephridium is coiled tubules that regulate the volume and composition of the body fluids and thus, act as the excretory organ in earthworms. Nephridia are arranged in three segments- septal (15-last segments), integumentary (3-last segments) and pharyngeal nephridia (4-6 segments). A funnel that is connected to nephridia delivers wastes and excess fluid and is excreted out via the digestive tube.

Nervous System

The sensory input and muscular responses are controlled by the ganglia which are arranged segment-wise in the organism. These ganglia, on the paired nerve cord, make up the nervous system of the earthworms.

Sensory System

Although earthworms lack eyes they have specialized receptor cells to recognize the changes around them. Specialised sensory organs and chemoreceptors help them to respond to stimuli perfectly. The sensory system of the earthworms is present in the anterior portion of the body.

Reproductive System

Earthworms are bisexual. Hence, each individual carries both male and female reproductive systems in them.

The male reproductive system consists of two pairs of testes (10-11 segments), vasa deferentia (till 18^{th} segment), and two pairs of accessory glands (17^{th} and 19^{th} segments). The prostate and spermatic ducts open by a pair of male genital pores (18^{th} segment). The spermatozoa are stored in the four pairs of spermathecae (6-9 segments).

The female reproductive system consists of one pair of ovaries and oviduct. Ovaries open into an ovarian funnel running below the ovaries and join the oviduct and open at female genital pore (14^{th}segment).

Earthworm - Lampito mauritii

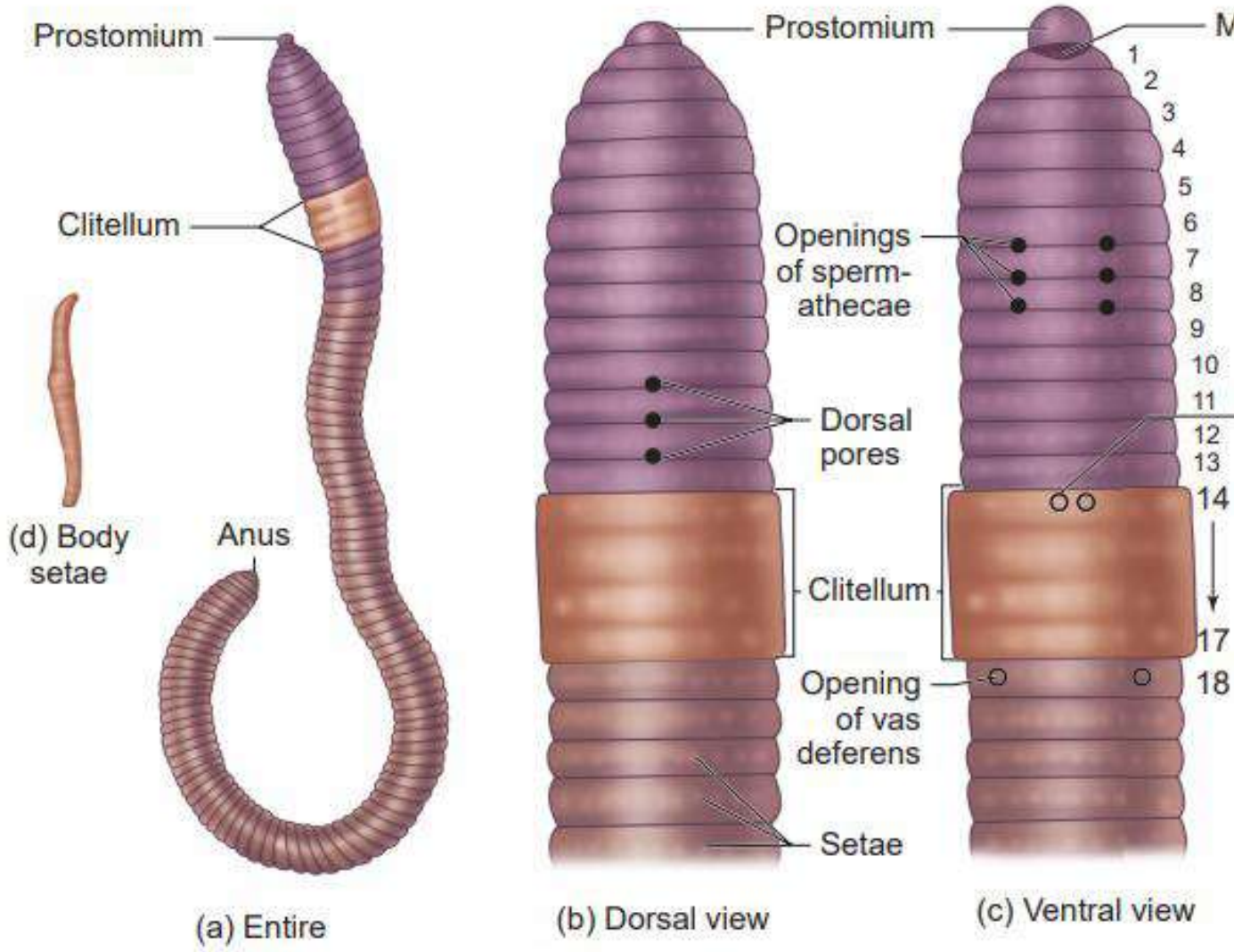

Figure 4.2 *Lampito mauritii*

Earthworm is a terrestrial invertebrate that inhabits the upper layers of the moist soil, rich in decaying organic matter.

Earthworm - *Lampito mauritii*

Earthworm is a terrestrial invertebrate that inhabits the upper layers of the moist soil, rich in decaying organic matter. It is nocturnal and during the day it lives in burrows made by burrowing and swallowing the soil. In gardens, they can be traced by their faecal deposits known as worm castings on the soil surface. Earthworms are considered as "Friends of Farmers". The common Indian earthworms are Lampito mauritii (Syn. Megascolex *mauritii), Perioynx excavatus* and *Metaphire posthuma* (Syn. Pheretima

posthuma). Earthworms are also conveniently classified based on their ecological strategies as epigeics, anecics and endogeics (Figure 4.1). Epigeics (Greek for "up on the earth") are surface dwellers, eg. Perionyx excavatus and Eudrilus eugeniae. Anecics (Greek for "out of the earth") are found in upper layers of the soil, eg. Lampito mauritii, Lumbricus terrestris. Endogeics (Greek for "within the earth") are found in deeper layers of the soil eg. Octochaetona thurstoni.

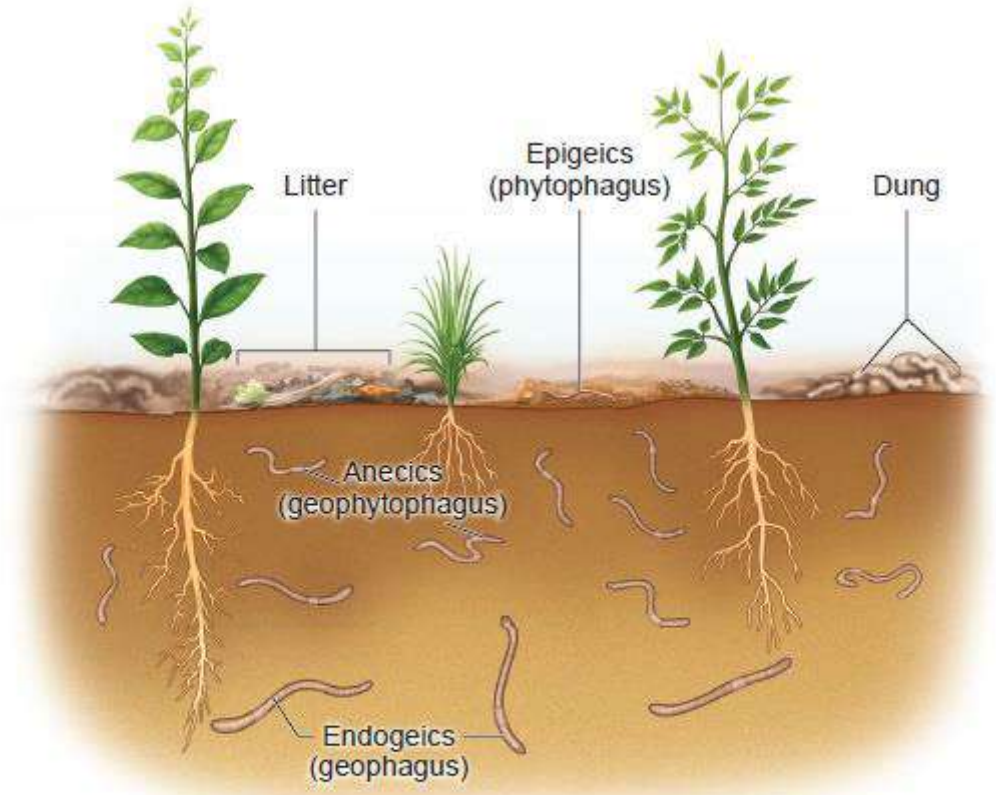

Figure 4.1 Earthworm classification based on ecological strategies

Table 4.1: Morphological and anatomical differences between *Lampito mauritii* and *Metaphire posthuma*

S.No	Characters	*Lampito mauritii*	*Metaphire posthuma*
1.	**Shape and size**	Cylindrical 80 mm – 210 mm in length 3.5mm - 5.0 mm in width	Cylindrical 115 – 130 mm in length 5 mm in width
2.	**Colouration**	Light Brown	Dark Brown
3.	**Segmentation**	165 – 190 Segments	About 140 Segments
4.	**Clitellum**	14^{th} – 17^{th} Segments (4)	14^{th} – 16^{th} Segments (3)
5.	**Spermathecal opening**	Three pairs 6/7, 7/8 and 8/9	Four pairs 5/6, 6/7, 7/8 an 8/9
6.	**Pharynx**	3^{rd} – 4^{th} segment	Runs up to 4^{th} Segment
7.	**Oesophagus**	5^{th} segment	8^{th} segment
8.	**Gizzard**	6^{th} segment	8^{th} – 9^{th} segment
9.	**Intestine**	7^{th} segment to anus	15^{th} segment to anus
10.	**Intestinal caeca**	Absent	Present in 26^{th} segment
11.	**Lateral hearts**	8 pairs from 6^{th} to 13^{th} segments	3 pairs from 7^{th} to 9^{th} segments
12.	**Pharyngeal nephridia**	5^{th} - 9^{th} segment	4^{th} – 6^{th} segment
13.	**Micronephridia**	14^{th} to last segment	7^{th} to last segment
14.	**Meganephridia**	19^{th} to last segment	15^{th} to last segment
15.	**Male genital pore**	18^{th} segment	18^{th} segment
16.	**Female genital pore**	14^{th} segment	14^{th} segment

மண்புழுக்களில்(Earthworms) அல்லது **மழைப்புழுக்களில்** பல வகைகள் உண்டு . பொதுவாக மண்புழுவனாது, வளைத்தசை உருளைப்புழுக்களின் தொகுதியின் கீழ் அமைகிறதுஇது உழவர்களின் நண்பன் . என்று புகழப்படுகிறதுஏனெனில் ., தாவரக்கழிவுகளை உண்டு, அதனால் அதன் உடலிலிருந்து வரும் செரிமானக் கழிவால், அதன் வாழிட மண்ணை வளப்படுத்துகின்றனஇவற்றின் வாழ்க்கைச் சுழற்சியால் . மண்ணானது, மேலும் மிருதுவாக மாறுகிறது . மண்ணில் காற்றோட்டமும், நீரும் அதிகம் தங்கி விடுவதால், தாவர வேர்கள் அதிகத் தேவைகளை அடைகிறதுழுக்களுக்கே பெரும்பு. உரிய *கிளைடெல்லம்*(clitellum) இதன் சிறப்பு உடலுறுப்பாகும்சித்த . மருத்துவத்தில் இது பூமி வேர், நாங்கூழ் புழு என அறியப்படுகிறது.

இதன் உருளைவடிவமான உடல், பல கண்டங்களாக பிரிக்கப்பட்டது போல, வெளித்தோற்றத்தில் உள்ளளது. உடலின் நுனி முதல், உடலின் அடி(மலப்புழை வரை)வரை, நீண்ட குழாய் போன்ற வாய்திறப்பு உள்ளது. முன்நுனிக்கு அருகே உடல் சற்று பருத்துக்காணப்படுகிறது. இதனை **வலயம்** (அ) கிளைடெல்லம் என்றழைப்பர்.

ஒற்றை அடுக்குக் கொண்ட இதன் புறத்தோல், வளைத்திசுக்களால் ஆனது. அதன் கீழ் நீண்ட தசைநார்களால் உள்ளன. இந்த தசைநார்கள் சுருங்கும் போது, மண்புழு அளவில் சிறியதாகி, உடல் பருத்து விடும். வளைத்திசுக்கள் சுருங்கும் போது, மண்புழுவின் உடல் நீண்டு விடும். இப்படி மாறி மாறி நார்தசைகள் இயங்குவதால், மண்புழு இடம் பெயருகிறது.

பெருந்தொகையான நுண்ணிய தோல்முடிகள், இந்த இயக்கத்திற்கு துணைப் புரிகின்றன.வளைத்திசுக்கள் சுருங்கும் போது, இந்த முடிகள் உடலின் பின்பகுதியை அசையாது பிடித்துக்கொள்கிறது. இதனால் உடலின் முன்நுனி நீள்கிறது. அதேபோல, முன்நுனியின் முடிகள் பிடித்துக் கொள்ளும் போது, பின்பக்க உடல், முன்னே இழுக்கப்படுகிறது.

உடலின் முன்நுனியிலுள்ள வாய் மண்ணை விழுங்கி, உடலின் இறுதிவரை அனுப்பும் போது செரிமானம் நடைபெறுகிறதுமழைப்புழுவின் . அடிப்பகுதி மேற்பகுதியை விட சற்று தட்டையாக இருக்கிறதுமுன் .,பின் உடலானது சமமாக அமைந்து, இது **இருபக்கச் சமச்சீர் உடலி** என்ற பெயரினைப் பெறுகிறது.

மண்புழு உரம் (*vermicompost*) திடக்கழிவு மேலாண்மையில் முக்கிய பங்கு வகிக்கிறது. இயற்கையில் கிடைக்கும் விவசாயக் கழிவுப் பொருள்களான சாணம், இலை, தழை போன்றவற்றை உள்கொண்டு எச்சங்களை சிறுசிறு உருண்டைகளாக மண்புழுக்கள் வெளியேற்று வதையே மண்புழு உரம் என்கிறோம். இதில் தழைச்சத்து, மணிச்சத்து, சாம்பல்சத்து ஆகிய அத்தனையும் இருக்கிறது.45 முதல் 60 நாளில் மண்புழு உரம் உற்பத்தியாகிவிடும்.

உலகத்தில் மண்புழுக்களில் 3000 வகைகள் கண்டறியப்பட்டுள்ளன. இவற்றில் இந்தியாவில் 384 வகைகள் உள்ளன. இதில் 6 வகையான மண் புழுக்கள் உரம் தயாரிக்க உகந்தவை. பெரும்பாலும் உரம் தயாரிக்க சிவப்பு ஊர்ந்தி எனப்படும்(*எயசெனியா பெடிடா* (*Eiseniafoetida*), *எயசெனியா ஆண்ட்ரி* (*Eiseniaandrei*) மற்றும் *லும்ப்ரிகஸ் லுபெல்லஸ்* (*Lumbricusrubellus*)) மண்புழு இனங்கள் பயன்படுத்தப்படுகிறது.

- மண்புழு உரம் தயாரிக்க அமைக்கப்படும் தொட்டி, அகலம் ஒரு மீட்டருக்கு மிகாமல் இருக்க வேண்டும்.
- இடவசதிக்கு ஏற்ப நீளம் இருக்கலாம்அரை அடி ஆழத்திற்கு குழி வெட்டி ., சுற்றுச்சுவர் அமைக்க வேண்டும்.
- முதலில் தொட்டியின் அடியில் செங்கல் அல்லது கூழாங்கற்களை பரப்பி அதற்கு மேல் மணலை பரப்பி பின்னர் பண்ணைக் கழிவுகளை நிரப்ப வேண்டும்.
- அந்த குழியில்தென்னைநார் கழிவை கொட்டி, அதன் மீது "கரும்புக்கூழ் கழிவு' கழிவைத் தூவ வேண்டும்.
- அடுத்ததாக, நன்கு காய்ந்த எரு பொடியை பரப்பி அதன் மீது ஈரமான சாணத்தை கொட்டி அதில் மண் புழுக்களை விடவேண்டும்சாணத்தை • . உணவாக எடுத்துக் கொண்ட மண்புழுக்கள் வெளியேற்றும் கழிவுகள் உரமாக கிடைக்கும்.
- பண்ணையில் சேரும் கழிவுகளை, அடுத்ததடுத்த தொட்டிகளில் நிரப்பி சேகரித்து பயிர்களுக்கு இடலாம்.
    - விவசாயிகள் தங்கள் வயல்களிலும், தோட்டங்களிலும் கூட நீர்த்தேங்காத மேட்டுப் பகுதியில் மண்புழு உரக்கூடத்தை அமைத்துக் கொள்ளலாம்.
    - 50-க்கு 20 என்ற அளவில் 1000 சதுர அடி பரப்பில் வெப்பம் குறைவாக இருக்கும் வகையில் கீற்றுக்கொட்டகை அமைப்பது நல்லது.
    - இதில் 20-க்கு 20 அளவில் 2 அடி உயரத்தில் 800 கன அடி அளவுக்கு தொட்டி கட்டி அதனை நான்காகப் பிரித்துக் கொண்டால் உரக்கூடம் தயாராகி விடும்.

- மக்காத குப்பைகள் இல்லாமல் பார்த்துக் கொள்வதுடன் இடையிடையே நீர்தெளித்து வர வேண்டும்ஏனெனில் ., மக்கத எச்சங்கள் வெப்பத்தை வெளிப்படுத்தும்.
- ஒரு சதுர மீட்டருக்கு 200 மண்புழுக்கள் என்ற அளவில் இட்டால் 3-வது வாரத்திலேயே மண்புழுக்கள், தங்கள் எச்சத்தை கழிவுகளாக மேற்பரப்பில் வெளித்தள்ளுகின்றன. வாரம் ஒருமுறைகூட இவற்றை சேகரிக்கலாம்.

பயறு நடவு செய்த பின்னர், கடைசி உழவில் ஏக்கருக்கு,

- நெல்லுக்கு ஒரு டன்னும்,
- கரும்புக்கு ஒன்றரை டன்னும்,
- பருத்திக்கு ஒரு டன்னும்,
- மிளகாய்க்கு ஒரு டன்னும்,
- சூரியகாந்திக்கு ஒன்றரை டன்னும்,
- மக்காச்சோளத்துக்கு ஒன்றரை டன்னும் பயன்படுத்த வேண்டும்.

மண்புழு உர பயன்கள்

மண் வளம்மண்புழு உரம் இடுவதால் மண்துகள்கள் ஒன்றாக இணைந்து ஒட்டி, குருணை போன்ற கட்டிகள் உருவாகி மண்ணின் கட்டமைப்பை மேம்படுத்துகிறதுஇதனால் மண்ணின் காற்றோட்டம் மற்றும் நீர்ப்பிடிப்புத் .திறன் மேம்படுத்தப்படுகிறது

- களிமண் பாங்கான மண்ணில் உள்ள குழம்புத் தன்மையைக் குறைத்து பயிர்கள் நல்ல மகசூல் கிடைக்க வாய்ப்பளிக்கிறது
- மண்ணின் நீர்பிடிப்புத் தன்மை அதிகரிப்பதால் பயிர் பாதுகாப்பதுடன், கோடைக் காலத்தில் மண்ணின் வெப்பநிலையைக் குறைத்து வேர்க்காயம் ஏற்படுவதைத் தடுக்கிறது.
- மழைக் காலங்களில் மண் அரிப்பை தடுப்பதுடன், மண்ணை வெப்பமாக வைத்திருக்கவும் உதவுகிறதுஇதனால் சத்துக்களை எடுக்கும் புத .ே வேர்கள் உருவாக வாய்ப்பளிக்கிறது.
- மண்புழு உரத்தால் ஏற்படும் அமிலமும் கார்பன்)ஆக்சைடு-டை-CO_2) வாயுவும் மண்ணின் காரத் தன்மையைக் குறைத்து உரப்பிடிப்புத் திறனை மேம்படுத்துகிறது.
- மண்ணில் உள்ள கரையாத தாதுக்களை கரையச் செய்து தாவரங்களுக்கு கிடைக்கக் கூடிய பேரூட்டச் சத்துக்களையும், அனைத்து வகை நுண்ணூட்டச் சத்துக்களையும் சீரான அளவில் வழங்குகிறது.

- மண்ணில் உள்ள தீங்கு விளைவிக்கக் கூடிய கன உலோகங்களை தாற்காலிகமாக ஈர்த்து வைத்துக் கொள்வதால் தூய்மையான நிலத்தடி நீருக்கும், மண்வள மேம்பாட்டிற்கும் வித்திடுகிறது.
- ரசாயன உரங்களைத் தேவைக்கு அதிகமாக பயன்படுத்துவதால், மண்ணின் இயற்கைத் தன்மை கெட்டுவிடுகிறதுஆனால் . மண்புழு உரத்தை மண்ணில் இடுவதால் மண்வளம் இயற்கையாகப் பாதுகாக்கப்பட்டு, பயிர்களுக்கு வளர்ச்சி ஊக்கியாகவும் செயல்படுகிறது.

பயிர் மகசூல்[தொகு]

- வாழை, தென்னை, கரும்பு, பழப்பயிர்கள் குறிப்பாக எலுமிச்சை, சப்போட்டா, கொய்யா, மா போன்ற பழப் பயிர்கள் கோடையில் முழுமையாகப் பாதுகாக்க மண்புழு உரம் பெரிதும் பயன்படுகிறது.
- மண்புழு உரத்தில், அதிகப்படியாக அங்கக கரிமம் 20 முதல் 25 சதம் வரை உள்ளது இது மண்ணின் வளத்தை மேம்படுத்தி பயிருக்கு தேவையான . சத்துப் பொருள்களை தேவையான நேரத்தில் தேவையான அளவு .இதனால் மகசூல் அதிகரிக்கிறது .கொடுக்கிறது

குறிப்பாக பழங்களின் நிறம், ருசி, மணம், பழங்கள் சேமித்து வைக்கும் காலம் போன்றவை அதிகரிக்கின்றன.

- இதைப் போன்று பூக்கள், காய்கனிகள், தானியங்கள், நல்ல விலைக்கு விறபனை செய்ய வழி வகுக்கிறது,
- பூச்சி நோய் தாக்குதலை வெகுவாகக் குறைக்க உதவுகிறதுநச்சுத்தன்மை . .இல்லாத உணவை உற்பத்தி செய்ய மிகவும் உதவுகிறது மண்புழு உரம் பயன்படுத்துவதால் மண்ணில் உப்பு கடத்தும் திறன் அதிகரித்து கார அமிலத் தன்மை சீர்படுகிறது.
- மண்புழு உரத்தில் உள்ள ஆக்ஸின், சிஸ்டோஹைனின் ஆகியவை பயிரை வளரச் செய்கிறது.ஜிபிரிலின் பயிரை பூக்கச் செய்கிறது .
- மண்புழு உரத்தில் அதிகப்படியாகக் காணப்படும் கியூமிக் அமலம் வேர் வளர்ச்சியை ஏற்படுத்தும்இதனால் பயிருக்குத் தேவையான உரங்களை . .மண்ணில் இருந்து எடுக்க உதவுகிறது
- மண்புழு உரம்
  இடுவதால் சோளம், மக்காச்சோளம், கம்பு, பருத்தி, சிறுதானியப் பயிர்களின் மகசூல் அதிகரித்து வறட்சியைத் தாங்கி வளர வாய்ப்புள்ளது.

Steps involved in Vermiculture

Introduction

Composting is one of the feasible means for converting bio-degradable solid wastes into beneficial organic soil amendments for supporting environment friendly agricultural production system. Many beneficial organisms and microorganisms act as chemical decomposer in the process of formation of stable organic end-products (compost) during composting. Among them, decomposers like earthworms play significant role in stimulating the process of composting, enhancing nutrient value while fastening the process of stable organic end-product formation. This process of involvement of earthworms in preparing enriched compost is called vermicomposting. It is one of the simplest methods to recycle agricultural wastes and to produce quality compost. Earthworm acts physically an aerator, crusher and mixer, chemically a degrader and biologically a stimulator in the process of decomposition. Earthworms consume biomass (decaying organic matter) and excrete it in a digested form called as worm casts or worm manure. Worm casts are popularly called as black gold. They are rich in essential plant nutrients, plant growth promoting substances, beneficial soil micro flora and having properties of inhibiting pathogenic microbes. As a result, the organic endproducts produced by the use of earthworms i.e. vermicompost also inherits most of the beneficial properties (to soil health and crop productivity) of black gold. Vermicompost acts as an organic soil amendment- improves three dimensional soil health's (physical, chemical & biological properties). On application of vermicompost, it enhances the soil quality by improving its physicochemical and biological properties. The earthworm's underground burrows modify soil hydro-thermal and aeration regimes by making the soil more porous thus, allowing free movement of air, infiltration of water into deeper soil layers for better profile moisture recharge and root water uptake processes. Vermicompost is becoming popular as one the major components of the organic farming system because of its high nutritive value in addition to an important organic soil amendment.

Terms related to vermicomposting

i) Vermiculture: Vermiculture is the scientific method of breeding and raising earthworms under controlled conditions (mostly hydrothermal regimes).

ii) Vermitechnology: Vermitechnology means the combination of vermiculture and vermicomposting.

Preparation of vermicompost:

Vermicompost is obtained by turning organic debris and residues to compost using earthworms. Earthworms can feed on many types of organic waste like agricultural waste, forest litters, kitchen waste, etc. The organic wastes after entering the earthworms' alimentary canal undergo some chemical changes rendering it odourless and neutral. Vermicompost production unit can be set up in any land which is not under any economic use but shady and free from water stagnation. The site should also be nearer to a water resource. Vermicomposting production unit may be set up in cement or brick tank,

wooden boxes, plastic bins, silpaulin bags of varying dimensions (preferable size of 10′ x 4′ x 2′), a basket, a bucket and even in soil pits. A quality vermicompost can be produced by using the suitable earthworm (350 – 360 worms per m3 of bed volume); bedding material that will provide the worms a relatively stable habitat and feeding with good worm food. Utmost care should be taken to maintain
adequate moisture (about 60% water content by weight), aeration, and temperature (28 - 350
C) during the composting period.
Agro-waste Cowdung
Vermicompost pit
Vermicompost
Application of vermicompost in different crops
Earthworm

Requirements for vermicomposting

a. Basic raw material

Any types of biodegradable wastes like crop residues, weed biomass, vegetable waste, leaf
litter, hotel refuse, waste from agro-industries and biodegradable portion of urban and rural
wastes can be used as basic raw materials for vermicomposting. A mixture of leguminous and
non-leguminous crop residues enriches the quality of vermicompost.

b. Selection of suitable earthworm

Only surface dwelling earthworms should be used for vermicomposting.

c. Starter: cow dung, biogas slurry, or urine of cattle

During the beginning of the process of composting, cow dung can be used as feeding material
in order to breed sufficient numbers of earthworms. On attaining desired number of worm population, subsequently other sources of organic wastes can be provided to maintain the population of earthworms.

d. Site Selection

Vermicompost production can be done in any place which is having shades, high humidity
and cool. Abandoned cattle shed, or poultry shed or unused buildings can also be used. If it is to be produced in the open area, artificial shading should be provided. The waste heaped for vermicompost production should be covered with moist gunny bags.

e. Containers for vermicompost production

A cement tub may be constructed to a height of 2½ feet and a breadth of 3 feet. The length may be fixed to any level depending upon the size of the room. The bottom of the tub is made sloppy to drain the excess water from vermicompost unit. A small sump is necessary to collect the drain water. If hard floor is used, hollow blocks/bricks may be arranged in a compartment to a height of one foot, breadth of 3 feet and length to a desired level to have quick harvest. In this method, moisture assessment will be very easy. Vermicompost can also be prepared in wooden boxes, plastic buckets, silpaulin bag or in any containers with a hole at the bottom for draining excess water.

f. Thatched roof/vermished

A thatched roof or vermished may be provided to protect the process from direct sunlight and rain.

Role of earthworm in vermicomposting

a. A brief description of earthworm

Earthworms belong to phylum Annelida of the animal kingdom. They are long and cylindrical in shape while vary in size with large number of grooves. There are about 3000 species of earthworms identified in the world while in India alone; more than 300 of them are found which are adapted to a range of environment. Being hermaphrodite in nature, two mature earthworms are required to propagate. The clitellum is transformed into hard, girdle-like capsule called cocoon at the time of egg laying. Only a few of the shed cocoons (ranges from 1 to 5) survive and hatch. The juveniles and again the formation of cocoons take a period of 50-60 days cycle. Normally, the average life span of earthworms varies with species, ranging from 1 to 10 years.

b. Suitable earthworm for vermicomposting

The surface feeder earthworms, Epigeics are important for vermicomposting. The Epigeics used for vermicomposting are such as Eisenia foetida, Eudrilus eugeniae (both are exotic worms) and Perionyx excavatusis (native to India). Epi-anecic feeds on leaf litter and upper layers of soil. The indigenous Epi-anecic, Lampito mauritii is active in the in-situ decomposition of organic wastes and residues in soil.

Both epigeics and epi-anecics groups of earthworms are slender, shorter in length and red to dark brown in colour. They are very active in reproduction process and efficient in the recycling of organic materials as well. Among many available earthworm species, *Eisenia foetida* and *Eudrilus eugeniae* are the most popular ones in vermicomposting, mostly because of their ability to convert wide range of bio-degradable wastes into black gold while adapting to outstretched temperature ranges (0 - 40◦ C). However, the optimum temperature for most of the earthworm species in vermicomposting ranges from 20-30◦C.

Important characteristics of red earthworm *(Eisenia foetida)*

1. Body length 3-10 cm
2. Body weight 0.4-0.6 g
3. Maturity 50-55 days
4. Conversion rate 2.0 q/1500 worms/2 months
5. Cocoon production 1 in every 3 days
6. Incubation of cocoon 20-23days

c. How does earthworm facilitate vermicomposting?

Materials consumed by earthworms undergo physical breakdown in the gizzard resulting in particles of size <2 μ, thereby giving an enhanced surface area for microbial processing. This finally ground material is exposed to various enzymes such as protease, lipase, amylase, cellulase and chitinase secreted in lumen by the gut wall and associated microbes, which facilitates breaking down the complex biomolecules into simple compounds. Only 5-10% of the ingested material is absorbed into the tissues of worms for their growth and rest is excreted as cast.

d. Favourable conditions for earth worm culture in the composting material

• pH: Near neutral (range between 6.5 to 7.5)
• Moisture: 60-70% of the moisture (wt./wt.); below and above this range, mortality of worms taking place
• Aeration: 50% aeration from the total pore space
• Temperature: Range from 180 C to 350 C.

Methods of vermicomposting

Vermicomposting is done by various methods. Among them, bed and pit methods are more common.

a. Bed method: Composting is done on the pucca / kachcha floor by making a bed (dimension: 6 x 2 x 2 feet) of organic mixture. This method is easy to maintain and to practice.

Stepwise procedure:

1. Processing involves collection of wastes, shredding, mechanical separation of the metal, glass and ceramics and storage of organic wastes.

2. Pre-digestion of organic waste for twenty days by heaping or dumping the material along

with cattle dung slurry. This process partially digests the material and fit for earthworm consumption.

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 the soil and also while watering; all the dissolvable nutrients go into the soil along with water.

4. A layer of 15-20 cm of chopped dried leaves/grasses should be kept as bedding material at the bottom of the bed.

5. Beds of partially decomposed material of size 6x2x2 feet should be made. Each bed should contain 1.5-2.0 q of raw material and the number of beds can be increased as per raw material availability and requirement.

6. Red earthworm (350 -360 worms per m3 of bed volume) should be released in the upper layer of the bed.

7. Water should be sprinkled with can immediately after the release of worms.

8. Beds should be kept moist by sprinkling of water (daily) and by covering with gunny bags/polythene.

9. Bed should be turned once after 30 days for maintaining aeration and for proper decomposition.

10. Compost gets ready in 45-50 days.

11. The weight of the finished product is about 75% of the raw materials used.

b. Pit method: Composting is done in the cemented pits, wooden boxes, plastic buckets, silpaulin bag, baskets, etc. The unit is covered with thatch grass or any other locally available materials.

Stepwise procedure:

1. Pit size of dimensions 10´x 4´ x 2´ of either cement or vermibag is maintained. The length and width can be increased or decreased depending upon the availability of material but not the depth because the earthworms' activity is confined to 2 feet depth only.

1st layer: bedding material of 1" thick with soft leaves

2nd layer: 9" thick organic residue layer finely chaffed material

3rd layer: dried cattle dung + water equal mixture of 2” layer.

The layer is continued until the pile is filled up.
2. On 25 days old unit, 795-820 worms are introduced into the pit (350 -360 worms per m3 of bed volume) without disturbing the pit.

3. Proper moisture and temperature is maintained by frequent watering, turnings and subsequent staking.

4. The turnover of the compost is 75% (If the total material accommodated in the pit is 1000 kg; the out turn will be 750 kg).

5. The filled materials are watered and turned at regular interval.

c. Recomposting and In-situ vermicomposting

Recomposting is done in the same pit or bed following the same steps as described in the above mentioned pit/bed methods. *in-situ* vermicomposting can be done by direct field application of vermicompost at 5 t/ha followed by application of cow dung (2.5 cm thick layer) and then a layer of available farm waste about 15 cm thick. Watering should be done at an interval of 15 days.

Handling and harvesting of vermicompost

Handling and harvesting of earthworm and vermicompost is an easy task, but it needs little attention, otherwise it may disturb the earthworm activity and also may delay the process of vermicomposting. Vermicomposting is a 5 phase process, needs care at each and every stages to get a quality vermicompost for fetching remuneration on a sustainable basis. The commonly faced problems, management options, different phases of vermicomposting, and precaution to be taken care during different phases of composting are listed below.

a. Commonly faced problem in vermicomposting

Vermicomposting is more sensitive than other composting methods and may induce to the following problems:

• Extreme weather condition: Vermicompost is susceptible to extreme weather conditions such as frost, heavy rainfall, drought and overheating.
• Putrefication: Anaerobic conditions (due to compaction and lack of oxygen) can quickly lead to putrefication.
• Predators: ants, birds, lizards may disturb the activity of earthworm.

b. Five Phases of vermicomposting

Collection of waste materials

Pre-digestion

Earthworm bed preparation and composting

Harvesting of vermicompost & Earthworm

Packing and storing of vermicompost

c. Precautions to be taken during the five phases:

i) Collection of waste material: The collected waste material should be processed for shredding, mechanical separation of the metal, glass and ceramics and should be stored in a proper place.

ii) Pre-digestion: Pre-digestion of organic waste should be done for at least 20-25days by heaping the material along with cattle dung slurry and regular watering. This process partially digests the material and fit for earthworm consumption. Addition of higher quantities of acid-rich substances such as citrus wastes should be avoided. Any organic wastes – cow dung, crop residues, farm wastes, vegetable market wastes, and fruit wastes can be used as a raw material for composting. Use of wet dung should be avoided for vermicompost production. At least 20-25 days old cow dung should be used to avoid excess heat generation.

iii) Earthworm bed preparation and composting
The earthworm bed prepared for vermicomposting must ensure the five basic things to obtain quality vermicompost from a short span of time. The five basic necessities are listed below:

• Hospitable living environment, called as bedding
• A food source
• Adequate moisture
• Adequate aeration
• Protection from extreme temperatures

Bedding:

Bedding is any material that provides the worms a relatively stable habitat. This habitat must have the following characteristics:

i) High absorbency

Earthworms breathe through their skins and therefore, must have a moist environment of living. Worm dies if their skin dries out. The bedding material must be able to absorb and retain water fairly enough if the worms are to be thrived.

ii) Good bulking potential

The flow of air is reduced or eliminated if the material is too dense to begin with, or packs too tightly. There should be proper aeration as worms require oxygen to live, just as we do. A variety of factors, including the range of particle size and shape, texture, strength and rigidity of the materials affect the overall porosity of the bedding.

iii) Low protein and/or nitrogen content (High Carbon: Nitrogen ratio)

Bedding material with high Carbon: Nitrogen ratio is desirable as high protein/nitrogen levels can result in rapid degradation, heating creates an inhospitable environment for the worm. Heating can occur safely in the food layers of the vermicomposting system, but not in the bedding.

Vermiculture bed

Vermiculture bed or worm bed (3 cm) can be prepared by placing saw dust, straw, coir waste, sugarcane trash etc. at the bottom of tub/container. A layer of fine sand of 3 cm thick should be spread over the culture bed followed by a layer of garden soil (3 cm). All layers must be moistened with water. In case of bed method, the floor of the unit should be compacted to prevent earthworms' migration into the soil.

Under ideal conditions earthworms are able to consume in excess of their body weight each day, although in general they consume ½ of their body weight per day. They feed on anything organic that is, of plant or animal origin, manures are the most commonly used worm feedstock. Dairy and beef manures are generally considered as the best natural food for Eisenia foetida, with the possible exception of rabbit manure. The former, being more often available in large quantities, is the feed most often used.

• Horse dung, due to the risk of Tetanus virus, lethal to human beings is not advisable to be used as feeding material for earthworms.

• Paddy husk, marigold and pine needles should not be used as feeding materials for Earth worms.

COMPOSTING

1. Precautions to be taken while filling the vermicomposting unit:
i) The vermicompost heap should not be overloaded, in order to avoid high temperature that adversely affects earthworm's population.
ii) Organic materials free from stones, glass pieces, plastics, ceramic tubes, etc. should be used.

2. Precautions to be taken during the period of composting:
i) Temperature maintenance: Temperature should be maintained at 30o C by upturning and staking and regular sprinkling of water.
ii) Moisture maintenance - Moisture should be maintained at about 60% by proper drainage and aeration and by sprinkling of water.
iii) Avoid water stagnation: The pit should be a bit inclined toward the hole at the bottom of the pit or tube to drain out the excess water. Make sure to have a drainage channel around the heap to avoid stagnation of water.
iv) The compost materials should be turned upside down giving some day's gap without disturbing the basal layer.

v) Protection from pest and diseases:

Flies are commonly attracted to the decomposing organic material. Other than this, the worms are not subjected to diseases caused by micro-organisms. A disease known as "sour crop" caused by environmental conditions and is subjected to predation by insects and certain animals. To avoid the problems, selection of proper bedding material and composting material are must, and also have to maintain moisture and temperature in the composting unit.

vi) Technique to avoid predators

There are few predators like ants, birds and lizards; they damage or predate the earthworm. To avoid all these problems of predation, the pit or heap should be covered by gunny bags. Make sure that compost beds/heaps are not covered by plastic sheets/material since this can trap the heat and gases due to non-porous nature. The most effective means of controlling ant is to increase the moisture level in bed, so that ants won't be able to tolerate anymore. The composting unit can also be converted into an Island surrounded by water.

vii) Protection from sunlight and rain: A thatched roof may be provided to protect the vermicomposting unit from direct sunlight and rain.

d. Assessing the maturity of vermicompost and harvesting

Black granular compost formation after 40-45 days at the surface of tank indicates the compost is ready for harvesting, which can be done by scrapping layer-wise from top of the tank. Watering should be stopped 5 days before the harvesting and compost should be collected from the top without disturbing the bottom layer.

Harvesting of vermicompost

In the tub method of composting, first harvesting can be done after 2 months and the castings formed on the top layer are collected periodically. The collection may be carried out once in a week, scooping the casting with hands and heaped it in a shady place. The harvesting of casting should be restricted to earthworm presence top layer. This periodical harvesting is necessary for free flow of air and retaining the quality of compost. Otherwise, when watering is done the finished compost gets compacted. In case of small bed vermicomposting method, periodical harvesting is not required. Since the height of the waste material heaped is around 1 foot, the produced vermicompost can be harvested at one time after the process is over.

e. Methods of earthworm harvesting:

1. Manual method

• Used by small scale growers.
• Involves hand sorting or picking the worm directly from compost by hand.

2. Screen method

• A box is constructed with screen at bottom and compost along with earthworm spread above the box can be separated.

3. Cow Dung Ball

• A cow dung ball is placed into the bed and the ball is kept for about 24 hrs.
• The cow dung ball should be taken out on the next day and finding all the worms sticking to the ball.
• The worms can be separated out by placing the cow dung ball in a bucket full of water.
• The collected worms can be used for the next batch of composting.

Sieving may be done to separate earthworm and cocoon

f. Storing and packing of vermicompost

• The harvested vermicompost should be stored in dark and cool place and it should be protected from sunlight.
• It is more advisable to store the compost in open dark room rather than closed sector.
• The moisture level of prepared compost should be maintained, so packing should be done at the time of selling.
• The compost can be stored for one year without loss of quality, if moisture is maintained at 40 % level.

Composting

Feedstock and Nutrient Balance

Composting, or controlled decomposition, requires a proper balance of “green” organic materials and “brown” organic materials. “Green” organic material includes grass clippings, food scraps, and manure, which contain large amounts of nitrogen. “Brown” organic materials includes dry leaves, wood chips, and branches, which contain large amounts of carbon but little nitrogen. Obtaining the right nutrient mix requires experimentation and patience. It is part of the art and science of composting.

Particle Size

Grinding, chipping, and shredding materials increases the surface area on which microorganisms can feed. Smaller particles also produce a more homogeneous compost mixture and improve pile insulation to help maintain optimum temperatures (see below). If the particles are too small, however, they might prevent air from flowing freely through the pile.

Moisture Content

Microorganisms living in a compost pile need enough moisture to survive. Water is the key element that helps transports substances within the compost pile and makes the nutrients in organic material accessible to the microbes. Organic material contains some moisture in varying amounts, but moisture also might come in the form of rainfall or intentional watering.

Oxygen Flow

Turning the pile, placing the pile on a series of pipes, or including bulking agents such as wood chips and shredded newspaper all help aerate the pile. Aerating the pile allows decomposition to occur at a faster rate than anaerobic conditions. Care must be taken, however, not to provide too much oxygen, which can dry out the pile and impede the composting process.

Temperature

Microorganisms require a certain temperature range for optimal activity. Certain temperatures promote rapid composting and destroy pathogens and weed seeds. Microbial activity can raise the temperature of the pile’s core to at least 140° F. If the temperature does not increase, anaerobic conditions (i.e., rotting) occur. Controlling the previous four factors can bring about the proper temperature.

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Onsite Composting

Organizations that are going to compost small amounts of wasted food can compost onsite. Composting can significantly reduce the amount of wasted food that is thrown away. Yard trimmings and small quantities of food scraps can be composted onsite. Animal products and large quantities of food scraps are not appropriate for onsite composting.

Things to Think About

- The climate and seasons changes will not have a big effect on onsite composting. Small adjustments can be made when changes happen such as when the rainy season approaches.
- Food scraps need to be handled properly so they don't cause odors or attract unwanted insects or animals.
- Onsite composting takes very little time or equipment. Education is the key. Local communities might hold composting demonstrations and seminars to encourage homeowners or businesses to compost on their own properties.
- Creating compost can take up to two years, but manual turning can speed up the process to between three to six months.
- Compost, however, should not be used as potting soil for houseplants because of the presence of weed and grass seeds.
- You can leave grass clippings on the lawn-known as "grasscycling." These cuttings will decompose naturally and return some nutrients back to the soil, similar to composting.
- You can put leaves aside and use them as mulch around trees and scrubs to retain moisture.

Vermicomposting

Red worms in bins feed on food scraps, yard trimmings, and other organic matter to create compost. The worms break down this material into high quality compost called castings. Worm bins are easy to construct and are also available for purchase. One pound of mature worms (approximately 800-1,000 worms) can eat up to half a pound of organic material per day. The bins can be sized to match the volume of food scraps that will be turned into castings.

It typically takes three to four months to produce usable castings. The castings can be used as potting soil. The other byproduct of vermicomposting known as “worm tea” is used as a high-quality liquid fertilizer for houseplants or gardens.

What Can Be Composted - Vermiculture?

- Food scraps
- Paper
- Yard trimmings such as grass and plants

Things to Think About

- Ideal for apartment dwellers or small offices.
- Schools can use vermiculture to teach children conservation and recycling.
- It is important to keep the worms alive and healthy by providing the proper conditions and sufficient food.
- Prepare bedding, bury garbage, and separate worms from their castings.
- Worms are sensitive to changes in climate.
  - Extreme temperatures and direct sunlight are not healthy for the worms.
  - The best temperatures for vermicomposting range from 55° F to 77° F.
  - In hot, arid areas, the bin should be placed under the shade.
  - Vermicomposting indoors can avoid many of these problems.

Aerated (Turned) Windrow Composting

Aerated or turned windrow composting is suited for large volumes such as that generated by entire communities and collected by local governments, and high volume food-processing businesses (e.g., restaurants, cafeterias, packing plants). It will yield significant amounts of compost, which might require assistance to market the end-product. Local governments may want to make the compost available to residents for a low or no cost.

This type of composting involves forming organic waste into rows of long piles called “windrows” and aerating them periodically by either manually or mechanically turning the piles. The ideal pile height is between four and eight feet with a width of 14 to 16 feet. This size pile is large enough to generate enough heat and maintain temperatures. It is small enough to allow oxygen flow to the windrow's core.

Large volumes of diverse wastes such as yard trimmings, grease, liquids, and animal byproducts (such as fish and poultry wastes) can be composted through this method.

Things to Think About

- Windrow composting often requires large tracts of land, sturdy equipment, a continual supply of labor to maintain and operate the facility, and patience to experiment with various materials mixtures and turning frequencies.
- In a warm, arid climate, windrows are sometimes covered or placed under a shelter to prevent water from evaporating.
- In rainy seasons, the shapes of the pile can be adjusted so that water runs off the top of the pile rather than being absorbed into the pile.
- Windrow composting can work in cold climates. Often the outside of the pile might freeze, but in its core, a windrow can reach 140° F.
- Leachate is liquid released during the composting process. This can contaminate local ground water and surface-water supplies. It should be collected and treated.
- Windrow composting is a large-scale operation and might be subject to regulatory enforcement, zoning, and siting requirements. Compost should be tested in a laboratory for bacterial and heavy metal content.
- Odors also need to be controlled. The public should be informed of the operation and have a method to address any complaints about animals or bad odors.

Aerated Static Pile Composting

Aerated static pile composting produces compost relatively quickly (within three to six months). It is suitable for a relatively homogenous mix of organic waste and work well for larger quantity generators of yard trimmings and compostable municipal solid waste (e.g., food scraps, paper products), such as local governments, landscapers, or farms. This method, however, does not work well for composting animal byproducts or grease from food processing industries.

In aerated static pile composting, organic waste mixed in a large pile. To aerate the pile, layers of loosely piled bulking agents (e.g., wood chips, shredded newspaper) are added so that air can pass from the bottom to the top of the pile. The piles also can be placed over a network of pipes that deliver air into or draw air out of the pile. Air blowers might be activated by a timer or a temperature sensors.

Things to Think about

- In a warm, arid climate, it may be necessary to cover the pile or place it under a shelter to prevent water from evaporating.
- In the cold, the core of the pile will retain its warm temperature. Aeration might be more difficult because passive air flowing is used rather than active turning. Placing the aerated static piles indoors with proper ventilation is also sometimes an option.
- Since there is no physical turning, this method requires careful monitoring to ensure that the outside of the pile heats up as much as the core.
- Applying a thick layer of finished compost over the pile may help alleviate any odors. If the air blower draws air out of the pile, filtering the air through a biofilter made from finished compost will also reduce any of the odors.
- This method may require significant cost and technical assistance to purchase, install, and maintain equipment such as blowers, pipes, sensors, and fans.
- Having a controlled supply of air allows construction of large piles, which require less land than the windrow method.

In-Vessel Composting

In-vessel composting can process large amounts of waste without taking up as much space as the windrow method and it can accommodate virtually any type of organic waste (e.g., meat, animal manure, biosolids, food scraps). This method involves feeding organic materials into a drum, silo, concrete-lined trench, or similar equipment. This allows good control of the environmental conditions such as temperature, moisture, and airflow. The material is mechanically turned or mixed to make sure the material is aerated. The size of the vessel can vary in size and capacity.

This method produces compost in just a few weeks. It takes a few more weeks or months until it is ready to use because the microbial activity needs to balance and the pile needs to cool.

Detailed Note on composting and Large scale & Small scale Composting

Compost is made by decomposing organic materials into simpler organic and inorganic compounds by the microorganisms in a process called composting. This process recycles various organic materials otherwise regarded as waste products. A good compost is rich in plant nutrients and beneficial organisms.

Compost is used to improve the soil fertility
in gardens, landscaping, horticulture, urban agriculture and organic farming. The compost is beneficial by providing nutrients as fertilizer to the crop, acting as soil conditioner, increasing the humus or humic acids content of the soil, and most important action of introducing beneficial colonies of microbes in the soil. The natural interaction of the soil, plant roots and nutrient / microorganisms of compost, improves the soil structure. An improved soil structure will increase the soil water retention ability and control soil erosion. Compost can result in land and stream reclamation and ecofriendly wetland construction. As a landfill cover, compost provides a healthy utilization of waste organic materials.

At its simplest level, composting requires gathering a mix
of 'Greens' and 'Browns'. Greens are materials rich in nitrogen such as leaves, grass, and food scraps and browns are more woody materials rich in carbon-like stalks, paper and wood chips. The materials are wetted to start them breaking down into humus, a process that occurs over a period of months. Most organic standards demand at least a 60 days composting process, however, composting can also take place as a multi-step, closely monitored process with measured inputs of water, air, and carbon- and nitrogen-rich materials.
The decomposition process is aided by shredding the plant matter, adding water, and ensuring proper aeration by regularly turning the mixture when open piles or "windrows" are used. Fungi, earthworms and other detritivores further break up the organic material. Aerobic bacteria and fungi manage the chemical process by converting the inputs into heat, carbon dioxide, and ammonium.

Fundamentals:

Home compost barrel

Composting is an *aerobic method* (meaning that it requires the presence of air) of decomposing organic solid wastes. It can therefore be used to recycle organic material. The process involves decomposition of organic material into a humus-like material, known as compost, which is a good fertilizer for plants.

Composting organisms require four equally important ingredients to work effectively:

- **Carbon —** for energy; the microbial oxidation of carbon produces the heat, if included at suggested levels. High carbon materials tend to be brown and dry.
- **Nitrogen —** to grow and reproduce more organisms to oxidize the carbon. High nitrogen materials tend to be green (or colorful, such as fruits and vegetables) and wet.
- **Oxygen —** for oxidizing the carbon, the decomposition process.
- **Water —** in the right amounts to maintain activity without causing anaerobic conditions.

Certain ratios of these materials will provide microorganisms to work at a rate that will heat up the compost pile. Active management of the pile (e.g., turning) is needed to maintain sufficient supply of oxygen and the right moisture level. The air/water balance is critical to maintaining high temperatures 130–160 °F (54–71 °C) until the materials are broken down.

The most efficient composting occurs with an optimal carbon:nitrogen ratio of about 25:1. Hot container composting focuses on retaining heat in order to increase the decomposition rate thus producing compost more quickly. Rapid composting is favored by having a C/N ratio of ~30 or less. Above 30 the substrate is nitrogen starved. Below 15 it is likely to outgas a portion of nitrogen as ammonia.

Nearly all dead plant and animal materials have both carbon and nitrogen, but amounts vary widely, with characteristics noted above (dry/wet, brown/green). Fresh grass clippings have an average ratio of about 15:1 and dry autumn leaves about 50:1 depending upon species. Mixing equal parts by volume approximates the ideal C:N range. Few individual situations will provide the ideal mix of materials at any point. Observation of amounts, and consideration of different materials as the compost pile is built up over time, can quickly achieve a workable technique for the individual situation.

Microorganisms

With the proper mixture of water, oxygen, carbon, and nitrogen, microorganisms are able to break down organic matter to produce compost. The composting process is dependent on microorganisms to break down organic matter into compost. There are many types of microorganisms found in active compost of which the most common are: Bacteria- The most numerous of all the microorganisms found in compost. Depending on the phase of composting, mesophilic or thermophilic bacteria may predominate.

- Actinobacteria- Necessary for breaking down paper products such as newspaper, bark, etc.
- Fungi- molds and yeast help break down materials that bacteria cannot, especially lignin in woody material.
- Protozoa- Help consume bacteria, fungi and micro organic particulates.
- Rotifers- Rotifers help control populations of bacteria and small protozoans.

In addition, earthworms not only ingest partly composted material, but also continually re-create aeration and drainage tunnels as they move through the compost.

Phases of composting

Three year old household compost

Under ideal conditions, composting proceeds through three major phases:[10]

- **Mesophilic phase:** An initial, mesophilic phase, in which the decomposition is carried out under moderate temperatures by mesophilic microorganisms.
- **Thermophilic phase:** As the temperature rises, a second, thermophilic phase starts, in which the decomposition is carried out by various thermophilic bacteria under higher temperatures (50 to 60 °C (122 to 140 °F).)
- **Maturation phase:** As the supply of high-energy compounds dwindles, the temperature starts to decrease, and the mesophiles once again predominate in the maturation phase.

Hot and cold composting - impact on timing

The time required to compost material relates to the volume of material, the size of the inputs (eg. wood chips break down faster than branches) and the amount of mixing or aeration - usually by turning the pile. Generally, larger piles will reach higher temperatures and remain in a thermophilic stage for days or weeks. This is referred to as hot composting and is the normal method for large-scale (eg. municipal) composting facilities and many agricultural operations.

A process often referred to as the 'Berkeley method' produces finished compost in eighteen days, but it requires the assembly of a least a cubic meter of material at the outset, and requires turning every two days after a four-day initial phase.[11] Many such short processes involve a few changes to traditional methods, including smaller, more homogenized pieces in the compost, controlling carbon-to-nitrogen ratio (C:N) at 30 to 1 or less, and monitoring the moisture level more carefully.

Cold composting is a slower process that can take up to a year to complete.[12] It results from smaller piles, including many residential compost piles that receive small amounts of kitchen and garden waster over extended periods. Piles smaller than approximately a cubic meter have trouble reaching and maintaining high temperature.[13] Turning is not necessary with cold composting, however, there is a risk that parts of the pile may go anaerobic as they get compacted or water-logged.

Materials that can be composted

Potential sources of compostable materials, or feedstocks, include residential, agricultural and commercial waste streams. There is not a linear relationship between the source of a given feedstock and the method that it is composted. For example, residential food or yard waste can be composted at home, or collected for inclusion in a large-scale municipal composting facility. In some regions, it could also be included in a local or neighborhood composting project.

Organic solid waste

A large compost pile that is steaming with the heat generated by thermophilic microorganisms.

There are two broad categories of organic solid waste: green waste and brown waste. Green waste is generally considered a source of nitrogen and includes pre- and post-consumer food waste, grass clippings, garden trimmings and fresh leaves. Animal carcasses, roadkill and butcher residue can also be composted and these are considered nitrogen sources. [16] Brown waste is a carbon source and typical examples are dried vegetation and woody material such as fallen leaves, straw, woodchips, limbs, logs, pine needles, sawdust and wood ash (not charcoal ash).[17] Products derived from wood such as paper and plain cardboard are also considered carbon sources.

Food waste can be an important feedstock depending on the region. For example, residential food waste is collected as a separate waste stream in some municipalities, and will then be included in large municipal recycling facilities. In other areas, food waste may be part of the regular waste stream and the only option for composting will be backyard or community programs. [18]

Animal manure and bedding]

On many farms, the basic composting ingredients are animal manure generated on the farm as a nitrogen source, and bedding as the carbon source. Straw and sawdust are common bedding materials. Non-traditional bedding materials are also used, including newspaper and chopped cardboard. The amount of manure composted on a livestock farm is often determined by cleaning schedules, land availability, and weather conditions. Each type of manure has its own physical, chemical, and biological characteristics. Cattle and horse manures, when mixed with bedding, possess good qualities for composting. Swine manure, which is very wet and usually not mixed with bedding material, must be mixed with straw or similar raw materials. Poultry manure also must be blended with

carbonaceous materials - those low in nitrogen preferred, such as sawdust or straw.

Human excreta

Human excreta can be added as an input to the composting process since it is a nitrogen-rich organic material. It can be either composted directly in composting toilets, or indirectly in the form of sewage sludge after it has undergone treatment in a sewage treatment plant. Both processes require capable design as there are potential health risks that need to be managed. In the case of home composting, a wide range of microorganisms including bacteria, viruses and parasitic worms can be present in feces, and improper processing can pose significant health risks. In the case of large sewage treatment facilities that collect wastewater from a range of residential, commercial and industrial sources, there are additional considerations. The composted sewage sludge, referred to as biosolids, can be contaminated with a variety of metals and pharmaceutical compounds. Insufficient processing of biosolids can also lead to problems when the material is applied to land. Urine can be put on compost piles or directly used as fertilizer.[]Adding urine to compost can increase temperatures and therefore increase its ability to destroy pathogens and unwanted seeds. Unlike feces, urine does not attract disease-spreading flies (such as houseflies or blowflies), and it does not contain the most hardy of pathogens, such as parasitic worm eggs.

Uses

Compost can be used as an additive to soil, or other matrices such as coir and peat, as a tilth improver, supplying humus and nutrients. It provides a rich *growing medium* as absorbent material (porous). This material contains moisture and soluble minerals, which provides support and nutrients. Although it is rarely used alone, plants can flourish from mixed soil, sand, grit, bark chips, vermiculite, perlite, or clay granules to produce loam. Compost can be tilled directly into the soil or growing medium to boost the level of organic matter and the overall fertility of the soil. Compost that is ready to be used as an additive is dark brown or even black with an earthy smell.

Generally, direct seeding into a compost is not recommended due to the speed with which it may dry and the possible presence of phytotoxins in immature compost that may inhibit germination, and the possible tie up of nitrogen by incompletely decomposed lignin. It is very common to see blends of 20–30% compost used for transplanting seedlings at cotyledon stage or later.

Compost can be used to increase plant immunity to diseases and pests.

Composting technologies

Various approaches have been developed to handle various ingredients, locations, throughput and applications for the composted product.

Composting is a process for converting decomposable organic materials into useful stable products, therefore, valuable landfill space can be used for other wastes by composting these materials rather than dumping them on landfills. It may however be difficult to control inert and plastics contamination from municipal solid waste.

Co-composting is a technique that processes organic solid waste together with other input materials such as dewatered fecal sludge or sewage sludge.

Industrial composting systems are being installed to treat organic solid waste and recycle it rather than landfilling it. It is one example of an advanced waste processing system. Mechanical sorting of mixed waste streams combined with anaerobic digestion or in-vessel composting is called mechanical biological treatment. It is increasingly being used in developed countries due to regulations controlling the amount of organic matter allowed in landfills.
Treating biodegradable waste before it enters a landfill reduces global warming from fugitive methane; untreated waste breaks down anaerobically in a landfill, producing landfill gas that contains methane, a potent greenhouse gas.

Large-scale

Large-scale composting can be carried out in the form of in-vessel composting, aerated static pile composting, vermicomposting, or windrow composting.

Examples

Large-scale composting systems are used by many urban areas around the world.

- A large municipal solid waste composter is the Lahore Composting Facility in Lahore, Pakistan, which has a capacity to convert 1,000 tonnes of municipal solid waste per day into compost. It also has a capacity to convert substantial portion of the intake into refuse-derived fuel (RDF) materials for further combustion use in several energy consuming industries across Pakistan, for example in cement manufacturing companies where it is used to heat cement kilns. This project has also been approved by the Executive Board of the United Nations Framework Convention on Climate Change for reducing methane emissions, and has been registered with a capacity of reducing 108,686 tonnes carbon dioxide equivalent per annum.

Vermicomposting

Worms in a bin being harvested

Vermicomposting uses worms to decompose waste and make nutrient-rich "worm manure".

Vermicompost (vermi-compost) is the product of the decomposition 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. This process is called vermicomposting, while the rearing of worms for this purpose is called vermiculture.

Vermicast (also called worm castings, worm humus, worm manure, or worm faeces) 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 used in farming and small scale sustainable, organic farming.

Black soldier fly larvae

Black soldier fly (*Hermetia illucens*) larvae are able to rapidly consume large amounts of organic material when kept at around 30 °C. Black soldier fly larvae can reduce the dry matter of the organic waste by 73% and convert 16–22% of the dry matter in the waste to biomass. The resulting compost still contains nutrients and can be used for biogas production, or further traditional composting or vermicomposting The larvae are rich in fat and protein, and can be used as, for example, animal feed or biodiesel production. Enthusiasts have experimented with a large number of different waste products.[51]

A soil ball with indigenous worms in soil amended a few weeks previously with bokashi fermented matter.

Bokashi is a process that converts food waste and similar organic matter into a soil amendment which adds nutrients and improves soil texture. It differs from traditional composting methods in several respects. The most important are:

- The input matter is fermented by specialist bacteria, not decomposed.
- The fermented matter is fed directly to field or garden soil, without requiring further time to mature.
- As a result, virtually all input carbon, energy and nutrients enter the soil food web, having been neither emitted in greenhouse gases and heat nor leached out.

Other names attributed to this process include bokashi composting, bokashi fermentation and fermented composting.

Other systems at household level

An almost completed Hügelkultur bed; the bed does not have soil on it yet.

The practice of making raised garden beds or mounds filled with rotting wood is also called *hügelkultur* in German. It is in effect creating a nurse log that is covered with soil.

Benefits of *hügelkultur* garden beds include water retention and warming of soil. Buried wood acts like a sponge as it decomposes, able to capture water and store it for later use by crops planted on top of the *hügelkultur* bed.

மண்புழு உரம்

மண்புழு உரம் (*vermicompost*) திடக்கழிவு மேலாண்மையில் முக்கிய பங்கு வகிக்கிறது. இயற்கையில் கிடைக்கும் விவசாயக் கழிவுப் பொருள்களான சாணம், இலை, தழை போன்றவற்றை உள்கொண்டு எச்சங்களை சிறுசிறு உருண்டைகளாக மண்புழுக்கள் வெளியேற்று வதையே மண்புழு உரம் என்கிறோம். இதில் தழைச்சத்து, மணிச்சத்து, சாம்பல்சத்து ஆகிய அத்தனையும் இருக்கிறது.45 முதல் 60 நாளில் மண்புழு உரம் உற்பத்தியாகிவிடும்.

உலகத்தில் மண்புழுக்களில் 3000 வகைகள் கண்டறியப்பட்டுள்ளன. இவற்றில் இந்தியாவில் 384 வகைகள் உள்ளன. இதில் 6 வகையான மண் புழுக்கள் உரம் தயாரிக்க உகந்தவை. பெரும்பாலும் உரம் தயாரிக்க சிவப்பு ஊர்ந்தி எனப்படும்(*எயசெனியா பெடிடா* (Eisenia foetida), *எயசெனியா ஆண்ட்ரி* (Eisenia andrei) மற்றும் *லும்ப்ரிகஸ் லுபெல்லஸ்* (Lumbricus rubellus)) மண்புழு இனங்கள் பயன்படுத்தப்படுகிறது.

மண்புழு உரம் உற்பத்தி செய்யும் முறை[தொகு]

- மண்புழு உரம் தயாரிக்க அமைக்கப்படும் தொட்டி, அகலம் ஒரு மீட்டருக்கு மிகாமல் இருக்க வேண்டும்.
- இடவசதிக்கு ஏற்ப நீளம் இருக்கலாம். அரை அடி ஆழத்திற்கு குழி வெட்டி, சுற்றுச்சுவர் அமைக்க வேண்டும்.
- முதலில் தொட்டியின் அடியில் செங்கல் அல்லது கூழாங்கற்களை பரப்பி அதற்கு மேல் மணலை பரப்பி பின்னர் பண்ணைக் கழிவுகளை நிரப்ப வேண்டும்.
- அந்த குழியில்தென்னைநார் கழிவை கொட்டி, அதன் மீது "கரும்புக்கூழ் கழிவு' கழிவைத் தூவ வேண்டும்.
- அடுத்ததாக, நன்கு காய்ந்த எரு பொடியை பரப்பி அதன் மீது ஈரமான சாணத்தை கொட்டி அதில் மண் புழுக்களை விடவேண்டும். *சாணத்தை உணவாக எடுத்துக் கொண்ட மண்புழுக்கள் வெளியேற்றும் கழிவுகள் உரமாக கிடைக்கும்.

- பண்ணையில் சேரும் கழிவுகளை அடுத்ததடுத்த தொட்டிகளில் நிரப்பி சேகரித்து பயிர்களுக்கு இட
  - விவசாயிகள் தங்கள் வயல்களிலும், தோட்டங்களிலும் கூட நீர்த்தேங்காத மேட்டுப் பகுதியில் மண்புழு உரக்கூடத்தை அமைத்துக் கொள்ளலாம்
  - 50-க்கு 20 என்ற அளவில் 1000 சதுர அடி பரப்பில் வெப்பம் குறைவாக இருக்கும் வகையில் கிற்றுக்கொட்டகை அமைப்பது நல்லது.
  - இதில் 20-க்கு 20 அளவில் 2 அடி உயரத்தில் 800 கன அடி அளவுக்கு தொட்டி கட்டி அதனை நான்காகப் பிரித்துக் கொண்டால் உரக்கூடம் தயாராகி விடும்
- மக்காத குப்பைகள் இல்லாமல் பார்த்துக் கொள்வதுடன் இடையிடையே நீர்தெளித்து வர வேண்டும். ஏனெனில், மக்கத எச்சங்கள் வெப்பத்தை வெளிப்படுத்தும்.
- ஒரு சதுர மீட்டருக்கு 200 மண்புழுக்கள் என்ற அளவில் இட்டால் 3-வது வாரத்திலேயே மண்புழுக்கள், தங்கள் எச்சத்தை கழிவுகளாக மேற்பரப்பில் வெளித்தள்ளுகின்றன. வாரம் ஒருமுறைகூட இவற்றை சேகரிக்கலாம்.

மண்புழு உர அளவு

பயறு நடவு செய்த பின்னர், கடைசி உழவில் ஏக்கருக்கு,

- நெல்லுக்கு ஒரு டன்னும்,
- கரும்புக்கு ஒன்றரை டன்னும்,
- பருத்திக்கு ஒரு டன்னும்,
- மிளகாய்க்கு ஒரு டன்னும்,
- சூரியகாந்திக்கு ஒன்றரை டன்னும்,
- மக்காச்சோளத்துக்கு ஒன்றரை டன்னும் பயன்படுத்த வேண்டும்.

பயிர் மகசூல்

- வாழை, தென்னை, கரும்பு, பழப்பயிர்கள் குறிப்பாக எலுமிச்சை, சப்போட்டா, கொய்யா, மா போன்ற பழப் பயிர்கள் கோடையில் முழுமையாகப் பாதுகாக்க மண்புழு உரம் பெரிதும் பயன்படுகிறது.
- மண்புழு உரத்தில், அதிகப்படியாக அங்கக கரிமம் 20 முதல் 25 சதம் வரை உள்ளது. இது மண்ணின் வளத்தை மேம்படுத்தி பயிருக்கு தேவையான சத்துப் பொருள்களை தேவையான நேரத்தில் தேவையான அளவு கொடுக்கிறது. இதனால் மகசூல் அதிகரிக்கிறது.

குறிப்பாக பழங்களின் நிறம், ருசி, மணம், பழங்கள் சேமித்து வைக்கும் காலம் போன்றவை அதிகரிக்கின்றன.

- இதைப் போன்று பூக்கள், காய்கனிகள், தானியங்கள், நல்ல விலைக்கு விறபனை செய்ய வழி வகுக்கிறது,
- பூச்சி நோய் தாக்குதலை வெகுவாகக் குறைக்க உதவுகிறது. நச்சுத்தன்மை இல்லாத உணவை உற்பத்தி செய்ய மிகவும் உதவுகிறது. மண்புழு உரம் பயன்படுத்துவதால் மண்ணில் உப்பு கடத்தும் திறன் அதிகரித்து கார அமிலத் தன்மை சீர்படுகிறது.
- மண்புழு உரத்தில் உள்ள ஆக்ஸின், சிஸ்டோஹைனின் ஆகியவை பயிரை வளரச் செய்கிறது. ஜிபிரிலின் பயிரை பூக்கச் செய்கிறது.
- மண்புழு உரத்தில் அதிகப்படியாகக் காணப்படும் கியூமிக் அமலம் வேர் வளர்ச்சியை ஏற்படுத்தும். இதனால் பயிருக்குத் தேவையான உரங்களை மண்ணில் இருந்து எடுக்க உதவுகிறது.

மண்புழுகளை உற்பத்தி செய்யும் முறை:

மண்புழுகளை உற்பத்தி செய்வது மிகவும் எளிது.10 கிலோ சாணத்தை எடுத்துக் கொண்டு 2 கிலோ வெல்லத்துடன் கலக்கி,நல்ல ஈரப்பதமான இடத்தில் இந்தக் கலவையை மண் தரையில் கொட்டிவை ஒரு பத்து நாட்களுக்குத தண்ணீர்

தெளித்து கொண்டு வந்தால் மண்புழுக்கள் தானே உருவாகும் .இந்த மண் புழுக்களை சேகரித்து மண்புழு உரம் தயாரிக்கலாம்

மண்புழு உரம் தயாரிக்கும் முறை

மண்புழு உரம் தயாரிக்க படுக்கை முறை, குழி முறை, தொட்டி முறை என 3 முறை உள்ளது. படுக்கை முறையில் தரையில் இயற்க்கை சாணத்தையும் மற்ற கழிவுகளையும் போடா வேண்டும். இதில் அதிக அளவு மண்புழு உரம் தயாரிக்கலாம். குழி முறையில், குழி வெட்டி அடியில் சாணம் மற்றும் இதர தீவனக் கழிவுகளை போடலாம். ஆனால் குழிமுறையில் போதுமான காற்றோட்டம் இருக்காது. செலவும் அதிகம். தொட்டி முறை தான் நடுத்தர விவசாயிகளுக்கு சிறந்த முறை.

தொட்டி முறையில் மண்புழு உரம் தயாரிக்கும் முறை:

மண்புழு உரம் தயாரிக்க எப்போதும் நிழல், ஈரப்பதம், குளிர்ச்சி நிறைந்த பகுதியை தேர்வு செய்ய வேண்டும். 500-600 லிட்டர் கொள்ளளவு உள்ள சிமெண்ட் அல்லது பிளாஸ்டிக் தொட்டியை வாங்கலாம். அல்லது உங்கள் வீட்டில் தொட்டி இருந்தால் அதையே பயன்படுத்தி கொள்ளலாம்.மாடுகளின் சாணம் மற்றும் சிறிய துண்டுகளாக நறுக்கிய பசுந்தீவனக் கழிவுகள், உலர்ந்த இலைகள் 3:1 என்ற அளவில் கலந்து தொட்டிகள் போட வேண்டும். 15-20 நாட்களுக்கு இந்தக் கலவையை அப்படியே விட்டுவிட வேண்டும்.சிறிதாக நறுக்கிய இலைகள் மற்றும் பசுந்தீவனத்தை 15-20 செ.மீ அளவுக்கு போட வேண்டும். அதற்குமேல் மாடுகளின் சாணம், இதர கழிவுகளை அதே அளவு போட வேண்டும். மண்புழுக்களை 500-1000 எண்ணிகையில் மேல் அடுக்கில் விடனும்.மண்புழுக்களை விட்டவுடன் குளிர்ந்த நீர் தெளிக்க வேண்டும். இந்த

உள் அடுக்குகள் எப்போதுமே ஈரப்பதத்துடன் இருக்க தொடர்ந்து குளிர்ந்த நீர் தெளிக்க வேண்டும். 30 நாட்களுக்கு ஒரு முறை கிளறி விட வேண்டும். 45- 50 நாட்கள் ஆனவுடன் மண்புழு உரம் தயாராகிவிடும்.

மண் புழு உரம் அறுவடை செய்யும் முறை:

மண்புழு உரம் தயாரானவுடன் அது கருப்புநிறத் துகள்களாக மாறிவிடும். அதன்பின் தண்ணீர் தெளிப்பதை நிறுத்தி விட வேண்டும். மேலும் உரம் தயாரிக்கும் இடத்துக்கு அருகில் புதிய சாணத்தை வெல்லத்துடன் கலந்து (10 கிலோ சாணம் + 1 கிலோ வெல்லம்) நீர் தெளித்து வைத்தால் இந்த மண்புழு உரத்திலுள்ள மண்புழுக்கள் அருகில் உள்ள புதிய சாணம் மற்றும் வெல்லக் கலவைக்குச் சென்று விடும். இரண்டு நாட்கள் சென்றபின் மண்புழு உரத்தை பயன்படுத்திக்கலாம்.

மண்புழு உரம் இடும் முறை: மண்புழு உரத்தின் அளவு பயிர்களின் தன்மையைப் பொறுத்தது. விவசாய பயிர்களுக்கு, ஒரு ஹெக்டருக்கு 2-3 டன் அளவும், பழ மரங்களுக்கு, மரத்தின் வயதை பொறுத்து, 5 முதல் 10 கிலோ வரை ஒரு மரத்திற்கு இடவேண்டும்.காய்கறி செடிகளுக்கு, நாற்றுகள் வளர்ப்பதற்கு ஒரு ஹெக்டருக்கு ஒரு டன் அளவும், வளரும் செடிகளுக்கு 400-500 கிராம் பயன்படுத்தலாம். பூச்செடிகளுக்கு, ஒரு ஹெக்டருக்கு 750-1000 டன் வரை பயன்படுத்தலாம்.

இந்த கட்டுரை பற்றி ஏதேனும் சந்தேகங்கள் இருந்தாலும், இப்கோ கிஸானின் சேவையை உங்கள் மொபைலில் பெற நினைத்தாலும் 534351 அல்லது 9791735144 என்ற எண்ணிற்கு தொடர்பு கொள்ளவும். மேலும் "IFFCO KISAN" என்ற மொபைல் அப்ளிகேஷனை உங்கள் ஸ்மார்ட் போனில் பதிவிறக்கம் செய்து பயன்படுத்தலாம்.

மண்புழு உர பயன்கள்

மண்புழு உரம் இடுவதால் மண்துகள்கள் ஒன்றாக இணைந்து ஒட்டி, குருணை போன்ற கட்டிகள் உருவாகி மண்ணின் கட்டமைப்பை மேம்படுத்துகிறது. இதனால் மண்ணின் காற்றோட்டம் மற்றும் நீர்ப்பிடிப்புத் திறன் மேம்படுத்தப்படுகிறது.

- களிமண் பாங்கான மண்ணில் உள்ள குழம்புத் தன்மையைக் குறைத்து பயிர்கள் நல்ல மகசூல் கிடைக்க வாய்ப்பளிக்கிறது
- மண்ணின் நீர்பிடிப்புத் தன்மை அதிகரிப்பதால் பயிர் பாதுகாப்பதுடன், கோடைக் காலத்தில் மண்ணின் வெப்பநிலையைக் குறைத்து வேர்க்காயம் ஏற்படுவதைத் தடுக்கிறது.
- மழைக் காலங்களில் மண் அரிப்பை தடுப்பதுடன், மண்ணை வெப்பமாக வைத்திருக்கவும் உதவுகிறது. இதனால் சத்துக்களை எடுக்கும் புது வேர்கள் உருவாக வாய்ப்பளிக்கிறது.
- மண்புழு உரத்தால் ஏற்படும் அமிலமும் கார்பன்-டை-ஆக்சைடு(CO_2) வாயுவும் மண்ணின் காரத் தன்மையைக் குறைத்து உரப்பிடிப்புத் திறனை மேம்படுத்துகிறது.
- மண்ணில் உள்ள கரையாத தாதுக்களை கரையச் செய்து தாவரங்களுக்கு கிடைக்கக் கூடிய பேரூட்டச் சத்துக்களையும், அனைத்து வகை நுண்ணூட்டச் சத்துக்களையும் சீரான அளவில் வழங்குகிறது.
- மண்ணில் உள்ள தீங்கு விளைவிக்கக் கூடிய கன உலோகங்களை தாற்காலிகமாக ஈர்த்து வைத்துக் கொள்வதால் தூய்மையான நிலத்தடி நீருக்கும், மண்வள மேம்பாட்டிற்கும் வித்திடுகிறது.
- ரசாயன உரங்களைத் தேவைக்கு அதிகமாக பயன்படுத்துவதால், மண்ணின் இயற்கைத் தன்மை கெட்டுவிடுகிறது. ஆனால் மண்புழு உரத்தை மண்ணில் இடுவதால் மண்வளம் இயற்கையாகப் பாதுகாக்கப்பட்டு, பயிர்களுக்கு வளர்ச்சி ஊக்கியாகவும் செயல்படுகிறது.