

**Paper 5.2, Unit - XI**  
**Vermiculture**

**It is defined as Rearing of earthworms for the production of vermicompost, waste degradation, vermiwash and other commercial uses.**

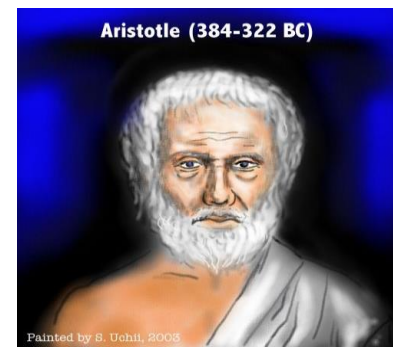
- The term Vermiculture is derived from the Latin word “vermis” meaning worm.
- Earthworms belong to Phylum Annelida and Class Clitellata.
- They are long and cylindrical in shape and show segmentation on body.
- There are about 3000 species of earthworms in the world which are adapted to moist environment.
- More than 300 species have been identified in India.



- Although, hermaphrodite, two mature earthworms are required to propagate.
- Normally, the average life span of earthworms varies with species ranging from 1 to 10 years.
- Earthworms are also called as “Farmer’s friends”, “Intestines of the earth” and by many other nicknames !
- They occur in diverse habitats especially those which are dark and moist
- Organic materials like humus, cattle dung and kitchen wastes are highly attractive for some species



# Earthworms in History



➤ Aristotle described them as the “intestines of the earth”

➤ Cleopatra renamed the worm "a sacred creature", whose removal from Egypt was punishable by death. Nile Valley is said to be the most fertile tract of land on earth and it is literally one vast bed of earthworm soil.



➤ Charles Darwin demonstrated they improved soil and plant productivity

*"It may be doubted whether there are many other animals which have played so important a part in the history of the world as have these lowly organised creatures."* - Charles Darwin on Worms



- **Vermicomposting** is the method of preparing enriched compost with the help of earthworms.
- It is one of the easiest methods to recycle agricultural wastes and to produce quality compost.
- Earthworms consume biomass and excrete the digested form called vermicompost / worm casts.
- Vermicompost is popularly called as Black gold.
- Vermicompost is rich in nutrients, enriches soil quality by improving its physicochemical and biological properties and also inhibits pathogenic microbes.
- **Vermiwash** is the nutrient rich liquid produced from vermicompost.
- **Vermitechnology** is the combination of vermiculture and vermicomposting.

# Useful Species for Vermiculture

Wide range of species are used for vermiculture but these most commonly used

- *Eisenia foetida*
- *Eisenia hortensis*
- *Eudrilus eugeniae*
- *Lumbricus rubellus*
- *Perionyx excavatus*



*Eisenia foetida*



*Eisenia hortensis*



*Eudrilus eugeniae*



*Lumbricus rubellus*



*Perionyx excavatus*



### RED EARTHWORMS

*Lumbricus rubellus* 1" to 4"

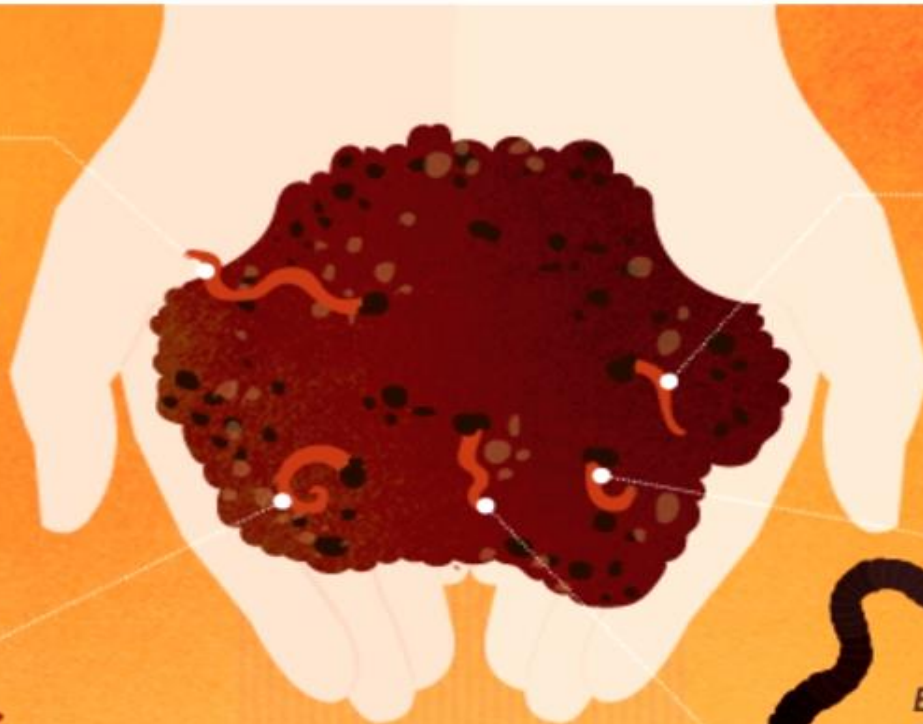
Common in composting circles. They can survive cold winters which makes them a threat to the ecosystem if released.



### BLUE WORMS

*Perionyx excavatus*  
1 1/4 to 2 3/4"

Common composting worm for tropical climates.



### RED WIGGLERS

*Eisenia foetida*  
*Eisenia andrei* 2" to 4"

These species are nearly impossible to tell apart and normally occur together in the same habitat. They are shallow burrowers and perfect for composting.



### AFRICAN NIGHTCRAWLERS

*Eudrilus eugeniae* 6" to 8+"  
Common composting worm for sub-tropical and tropical climates.

## Common Types of WORMS



### EUROPEAN NIGHTCRAWLERS

*Eisenia hortensis* 3" to 8"  
a common worm used for fishing bait and gaining popularity for composting.

**CANADIAN NIGHTCRAWLERS**  
*Lumbricus terrestris*



Not suitable for composting because they bury deeper into the soil.

# Eisenia foetida

The most frequently used species of compost worm it is commonly known as: the “compost worm”, “manure worm”, “redworm”, and “red wiggler” .

*Eisenia fetida* (formerly *foetida*) grow to a length of 6 – 13 cm on average. They are reddish in colour, with yellowish rings, making them easy to distinguish from other species.

In threatening situations they exude a foul-smelling mucous, which is the reason for the name of this species: “fetida” means stinky.





# Eudrilus eugeniae

The less well known *Eudrilus eugeniae* is used in the tropics. It is also known by the name of African Nightcrawler ("African" or "ANC" for short)



# Comparison between conventional cattle dung compost and vermicompost



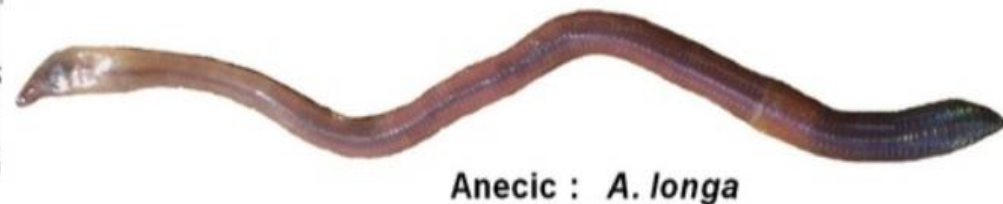
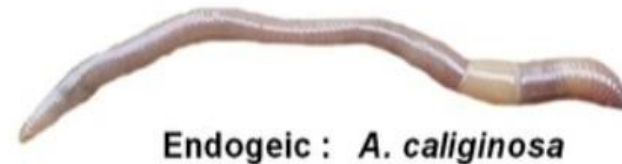
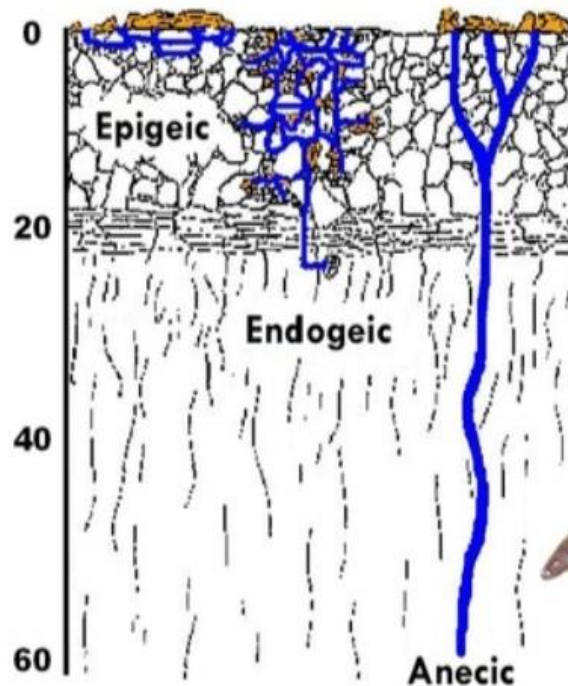
**Cattle dung Compost**



**Vermicompost**

# Types of earthworms based on their feeding and burrowing habitat

1. **Epigeic** : types live at soil surface in decaying plant or animal residues
2. **Endogeic**: types live underground and eat soil to extract nutrition from degraded organic residues
3. **Anecic** : types burrow deep in the soil but come to the surface at night to forage for freshly decaying organic matter



## ENDOGEIC

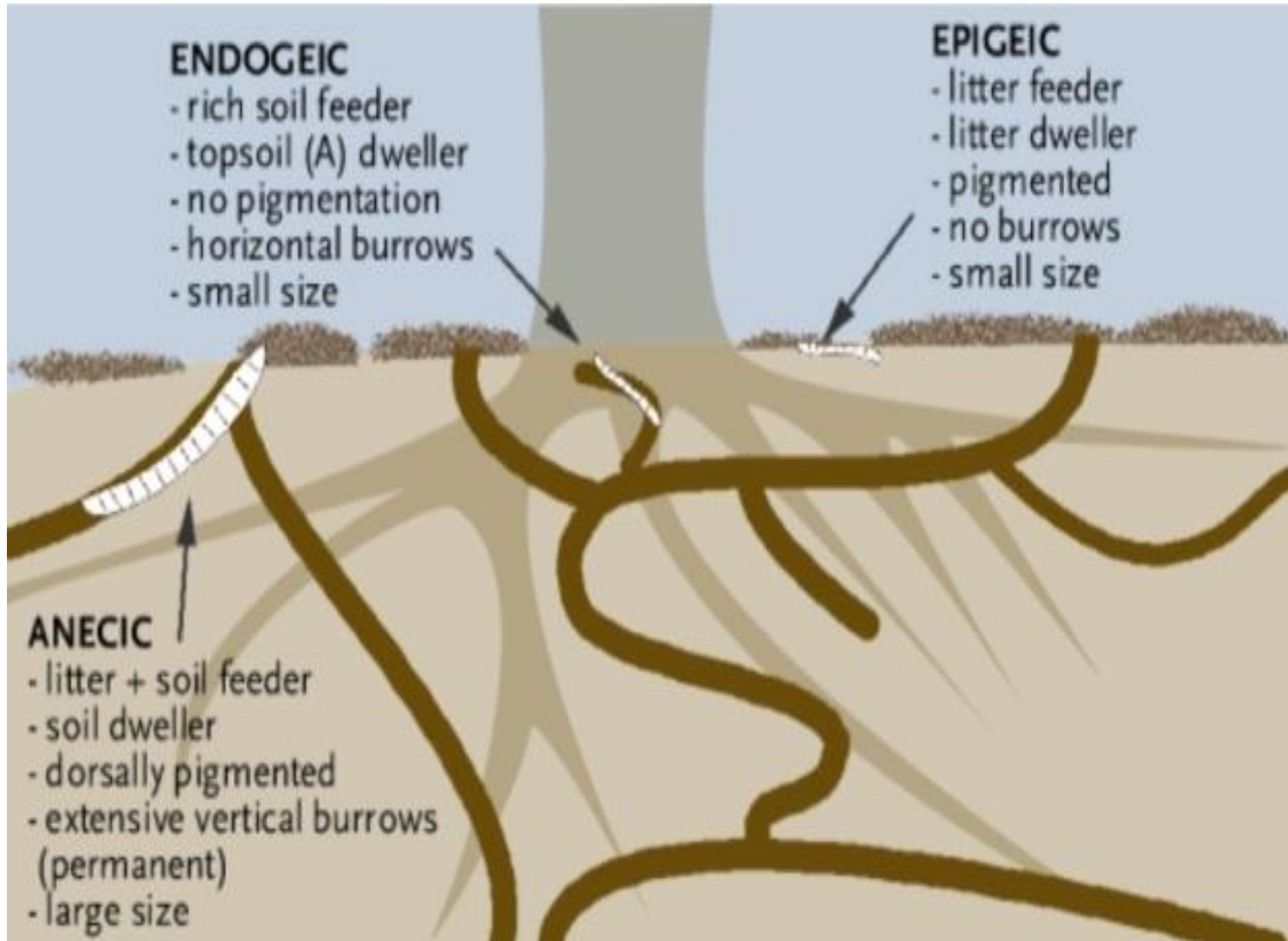
- rich soil feeder
- topsoil (A) dweller
- no pigmentation
- horizontal burrows
- small size

## EPIGEIC

- litter feeder
- litter dweller
- pigmented
- no burrows
- small size

## ANECIC

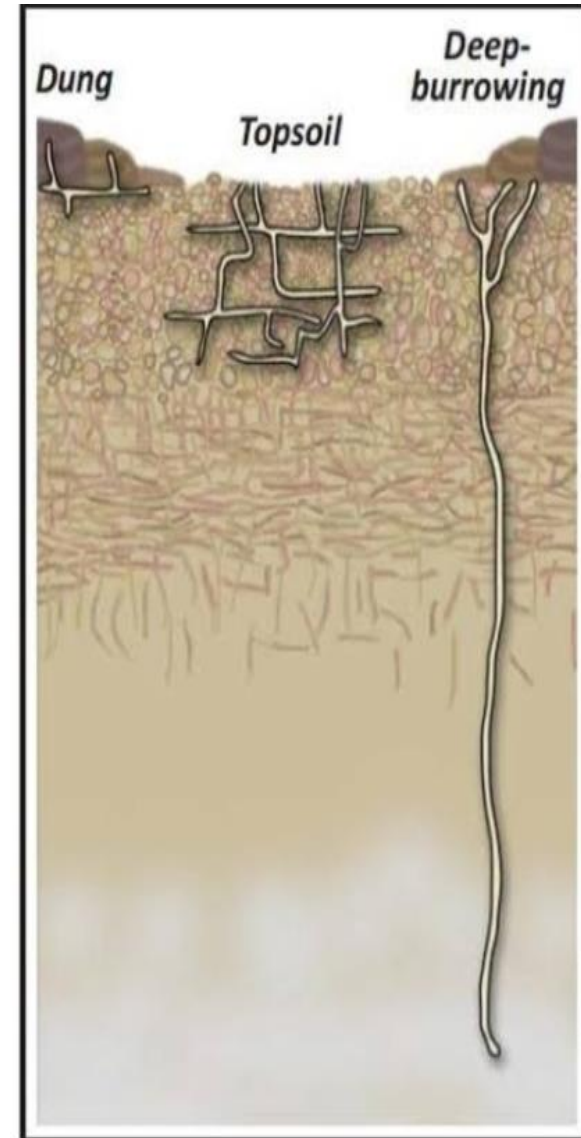
- litter + soil feeder
- soil dweller
- dorsally pigmented
- extensive vertical burrows (permanent)
- large size



➤ Epigeics (surface feeders) are important in vermicomposting. The epigeics such as *Eisenia foetida* and *Eudrilus eugeniae* are exotic worms and *Perionyx excavatus* is a native one being used for vermicomposting in India.

➤ Both epigeics and anecics groups of earthworms are slender, shorter in length and red to dark brown in colour. They have high reproduction activity and efficient in recycling of organic materials.

➤ Increased attention has been paid to *Eisenia foetida* and *Eudrilus eugeniae* which have been found to be potential agent in vermicomposting of wide range of agricultural wastes and can grow at a wide range of temperature varying from 0-40 °C. However, the optimum temperature ranges from 20-30 °C.



## Procedure for vermicompost

- It is mostly prepared in either pit or heap method. The dimensions either heap or pit are 10 x 4 x 2 feet. The length and width can be increased or decreased depending on the availability of material but not the depth because the earthworms' activity is confined to 2 feet depth only.
- First of all select a site which is not under any economic use and is shady and there is no water stagnation. The site should be near to a water source.



**PIT**



**HEAP**



- **1st layer:** bedding material of 1" thick with soft leaves
- **2nd layer:** 9" thick organic residue layer finely chaffed material
- **3rd layer:** Dung + water equal mixture of 2" layer.

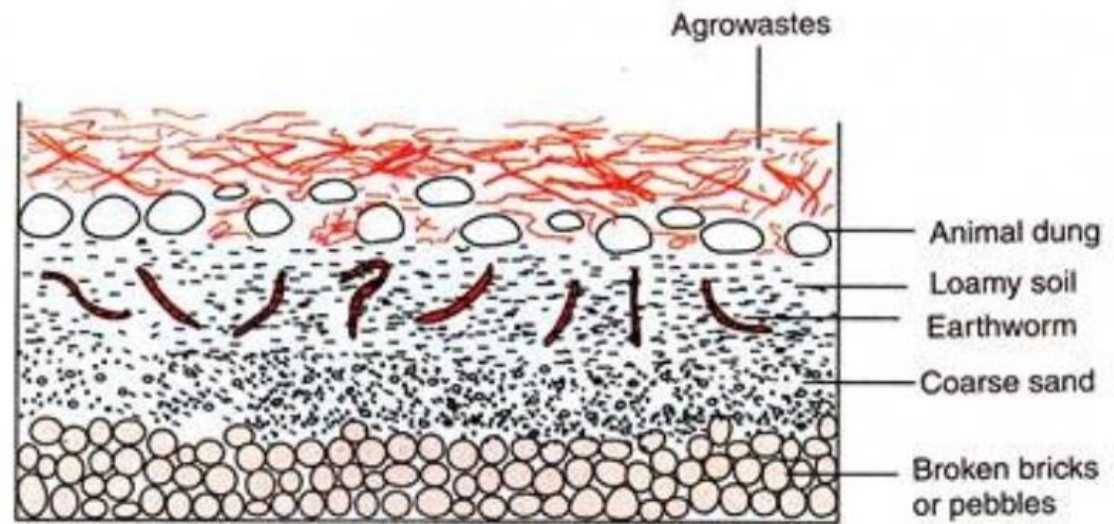


Fig. 33.1 : Diagram of a pit for operation of vermicomposting process.

### **Favourable conditions of earth worms in the composting material**

- ✓ pH: Range between 6.5 and 7.5
- ✓ Moisture: 60-70% of the moisture below and above range mortality of worms taking place
- ✓ Aeration: 50% aeration from the total pore space
- ✓ Temperature: Range between 18 0C to 35 0C

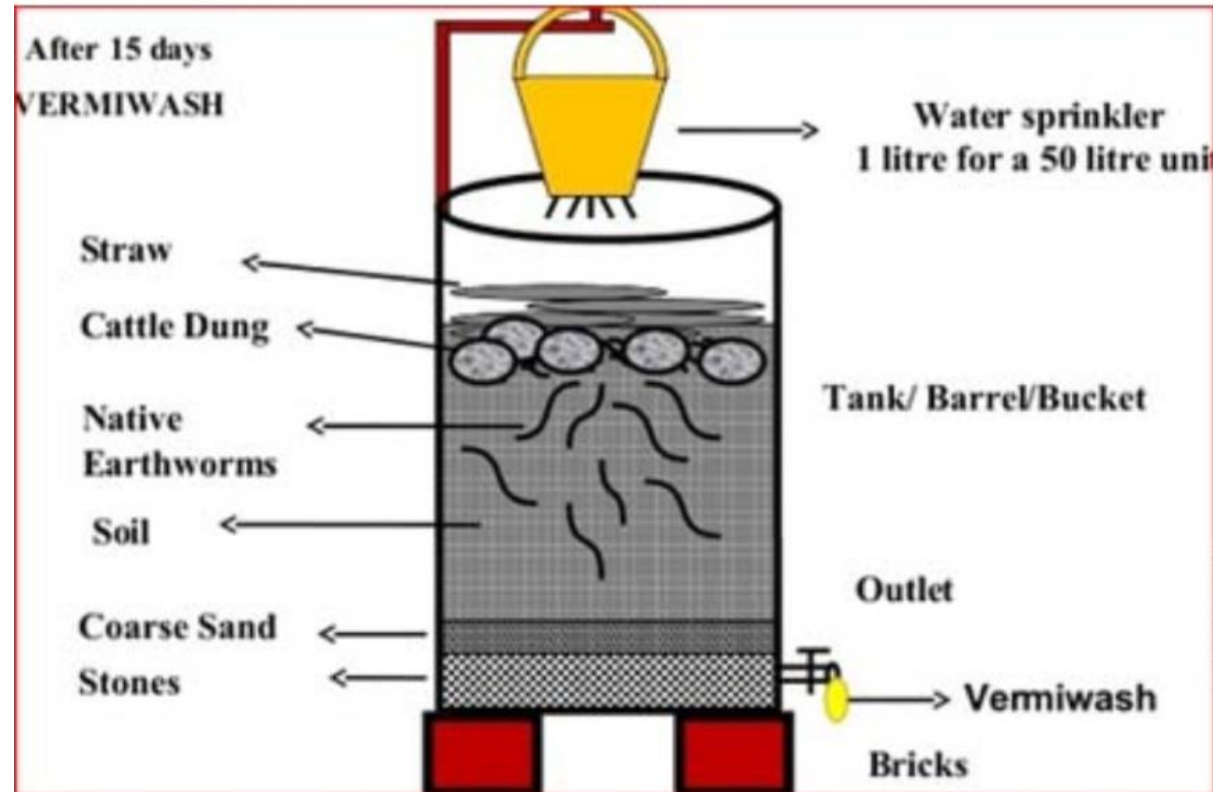
# Advantages of Vermicomposting

1. Reduces garbage disposal costs
2. Produces less odor and attracts fewer pests
3. Requires little space, labor, or maintenance
4. Enhances germination rate of the seeds, plant growth and crop yield.
5. Enriches soil with micro-organisms.
6. Increase water holding capacity of soil.
7. Improves root growth of plants.
8. Enriches soil with plant hormones such as auxins and gibberlin.
9. It is helpful in elimination of biowastes .
10. Produces free worms for fishing and poultry



# Vermiwash

- It is the nutrient rich liquid produced with the help of earthworms or from vermicompost.



The turnover of the compost is 75%  
[the total material accommodated in  
the pit is 1000 kg; the out turn will  
be 750 kg]



## Properties of end product from vermicomposting

- Very finely structured, uniform, stable and aggregated particles of humified organic material
- Excellent porosity, aeration and water holding capacity
- Rich in available plant nutrients, hormones, enzymes and (benign) microbial populations
- Mostly pathogen-free:
  - Plant and human pathogens are killed during passage of the earthworm gut

## Precautions

- Do not cover vermicompost beds/heaps with plastic sheets because it may trap heat and gases.
- Do not overload the vermicompost heap to avoid high temperature that adversely affect their population.
- Dry conditions kill the worms and waterlogging drive them away. Watering should be done daily in summer and every third day in rainy and winter season.
- Addition of higher quantities of acid rich substances such as tomatoes and citrus wastes should be avoided.
- Make a drainage channel around the heap to avoid stagnation of water particularly in high rainfall areas in rainy season.
- Organic materials used for composting should be free from non-degradable materials such as stones, glass pieces, plastics, ceramic tubes/bulbs etc.

## **Natural enemies and their control**

ants, termites, centipedes, rats, pigs, birds etc.

Preventive measures include treating of the site with 4% neem based insecticide before filling the heap.

It can be applied in any crop at any stage, but it would be more beneficial if mixed in soil after broadcasting. The rate of application is as

- **Field crops 5-6 t/ha;**
- **Vegetables 10-12 t/ha;**
- **Flower plants 100-200 g/sq ft;**
- **Fruit trees 5-10 kg/tree.**

## Earthworms as a Protein Source for Animal Feed

Many mammals and birds prey on earthworms in nature. It has been suggested that earthworms contain sufficient high quality protein to be considered as bred animal food, and this potential of earthworms in animal feed has been confirmed by full analyses of the body tissues of earthworms, which show the kinds of amino acids that they contain and the nature of the other chemical body constituents.

Analyses of the constituents of the tissues of different species of earthworms show clearly that the essential amino acid spectrum for earthworm tissues, as reported by different authors, compares well with those from other currently used sources of animal feed protein, and that the mean amounts of essential amino acids recorded are very adequate for a good animal feed.



In addition, earthworm tissues contain a preponderance of long-chain fatty acids, many of which cannot be synthesized by nonruminant animals and also have an adequate mineral content. They contain an excellent range of vitamins and are rich in niacin, which is a valuable component of animal feeds, and they are an unusual source of vitamin B12. The overall nutrient spectrum of earthworm tissues shows them to have an excellent potential as a protein supplement to feed for fish, poultry, pigs, or domestic animals.

PROTEIN IN DRIED PROTEIN SOURCES

