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Organic Farming for Sustainable Agricultural Production

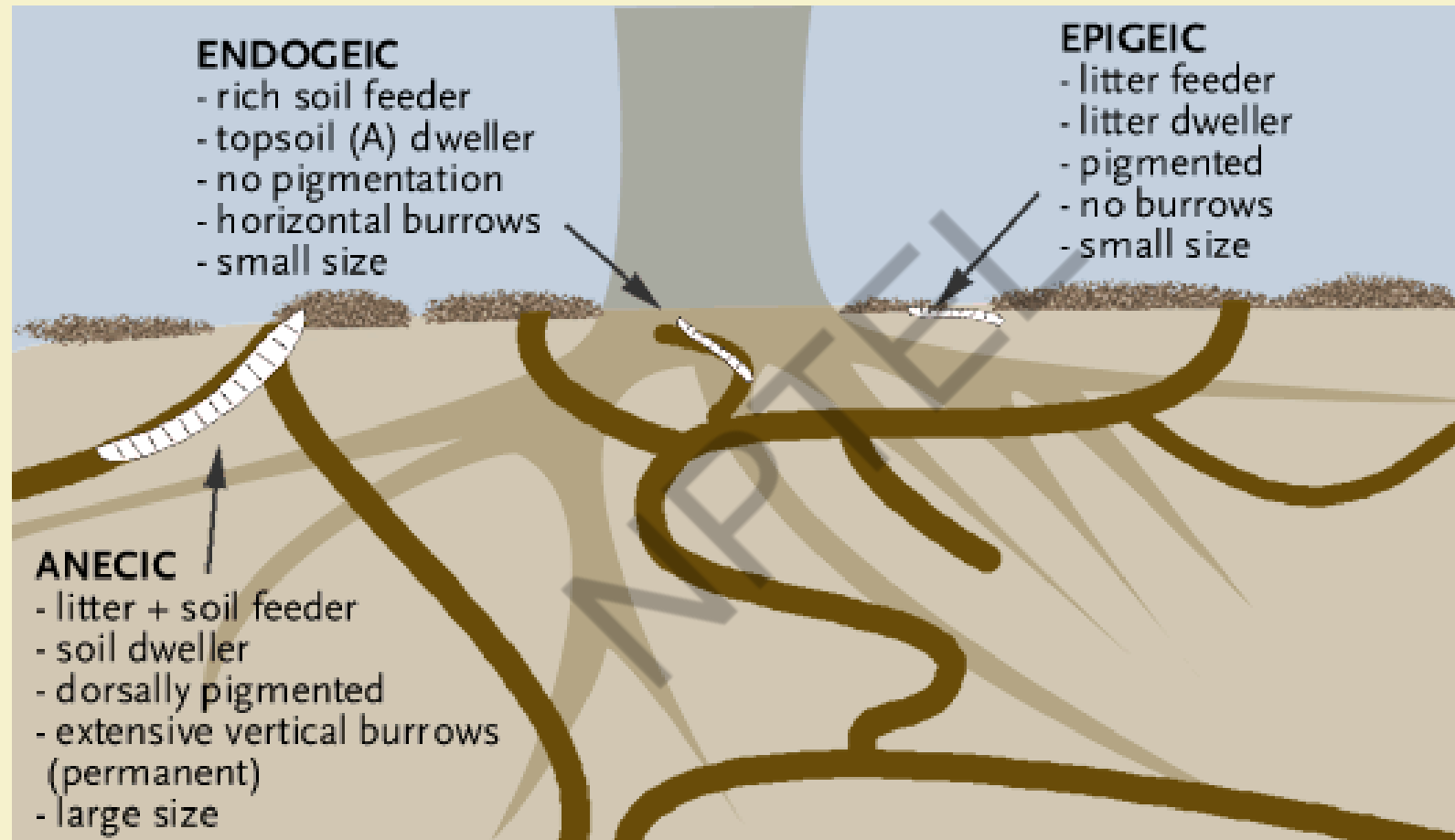
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Lecture 12: Vermicompost production Technology

What is Vermicomposting????

- Vermicomposting (Latin *vermes*= worms) is a simple **biotechnological process of composting**, in which certain species of earthworms are used to enhance the process of waste conversion and produce a better end product.
- **Vermicomposting is the process of recycling organic matter into nutrient rich compost using worms. It is carried out generally under aerobic condition.**
- **Vermicompost is a stable organic manure produced as vermicast by earthworm feeding on biological wastes materials. It is an efficient recycling process of animal, agriculture and industrial wastes.**
- Vermicompost is a mixture of worm cast, humus, live earthworms and their cocoons. The major constituents are essential macro and micro nutrients, enzymes, vitamins, antibiotics, humic acid and growth hormones.

Earthworm Ecological Group



Earthworm Ecological Group (Contd.)

Epigeic Species (Tiger worm, red wiggler, manure worm, compost worm)
epi = top; geic = earth

Small size (1 – 7 cm) and uniformly pigmented (red brown pigment), lives in litters and consumes decomposable organic matter
e.g. *Eisenia foetida*, *perionyx excavatus*



Eisenia foetida

Endogeic Species (Topsoil dweller)
endo = in or internal; geic = earth

Small to large in size (2-12 cm), weakly pigmented, lives in burrows in organic mineral complex of soil, consumes soil
e.g. *Apprrectodea caliginosa*,
Octolasion cyaneum



Eudrilus eugeniae

Anecic Species (Subsoil dweller)

Very large in size (8-15 cm), brown pigment interiorly and dorsally, lives in deep vertical burrow in soil, but feeds on litter, casting on surface. e.g. *Lumbricus*



Perionyx excavatus

Epigeic and Anecic species used for Vermicompost in tropical countries

Why Vermicomposting????

- ✓ An important source of organic manure
- ✓ Helps in recycling any organic wastes into a useful biofertilizer and leaves no chance of environmental pollution.
- ✓ An eco-friendly, non-toxic product, consumes low energy input while processing.
- ✓ Improves physical, chemical and biological properties of soil without any residual toxicity.
- ✓ Reduces the incidences of pests and diseases in crop production.
- ✓ Improves quality of agricultural produce.

Flow chart of Vermicomposting

Waste collection and
mixing with cow
dung



Loading of Wastes
mixture in bed



Maintenance of moisture and
temperature in bed and
Earthworm release



Maturity Judgement
(Colour granules and C/N
ratio)



Harvesting
(Earthworm separation
and drying)



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Wastes Characteristics

Wastes	C: N ratio	Suitability
Animal manure, oil seed residues, fish manure Industrial wastes (potato industry wastes baggage wastes etc.)	<19	Most suitable for high N content
Vegetable waste, food processing waste including pulses, oil seeds, tea etc, kitchen waste, green and succulent crop waste and weed biomass and green manures	19-27	Moderately suitable
Water hyacinth, Stubbles and crop wastes, twigs and crop foliage	30-85	Moderately suitable
Saw dust and coir wastes	90-550	Less suitable



Mixing of waste mixture and cow dung

- In preparation of **waste mixture**, animal and plant based organic wastes are **generally mixed** together.
- Before mixing, the plant wastes generally undergo **size reduction by cutting or crushing**.
- After size reduction, the plant based **organic wastes are mixed with animal based wastes like cowdung**.
- For hastening the decomposition process, **compost accelerators (Cellulolytic and lignolitiic microorganiism)** are added to the wastes mixture.
- The proportion of cow dung in wastes mixture must be **minimum 30%**. Under unlimited supply of cowdung, the share may go up to **70%**.





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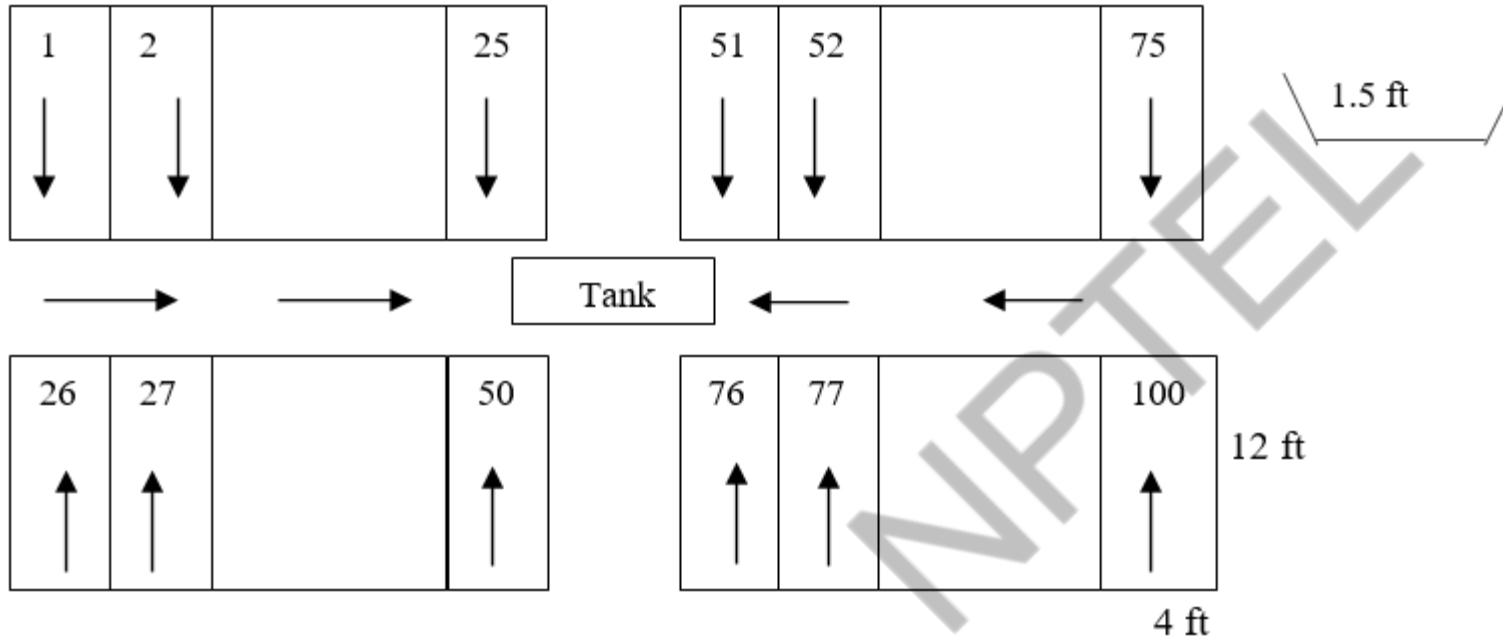
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Lecture 13: Vermicompost production Technology (Contd.)

Cement structured bed

Polythene lined earthen bed

various types of bed structure



Tank: vermibed wash collection point; —————> indicate slope (2-4%)

**Lay out of
Vermicompost bed**

Length: 10 – 15 ft

Width: 3.5 – 4.0 ft

Depth: 1.0 – 1.5 ft

Slope: 2 - 4%

Top roof covered

**Sprinkler system for
irrigation**

Vermicompost Bed



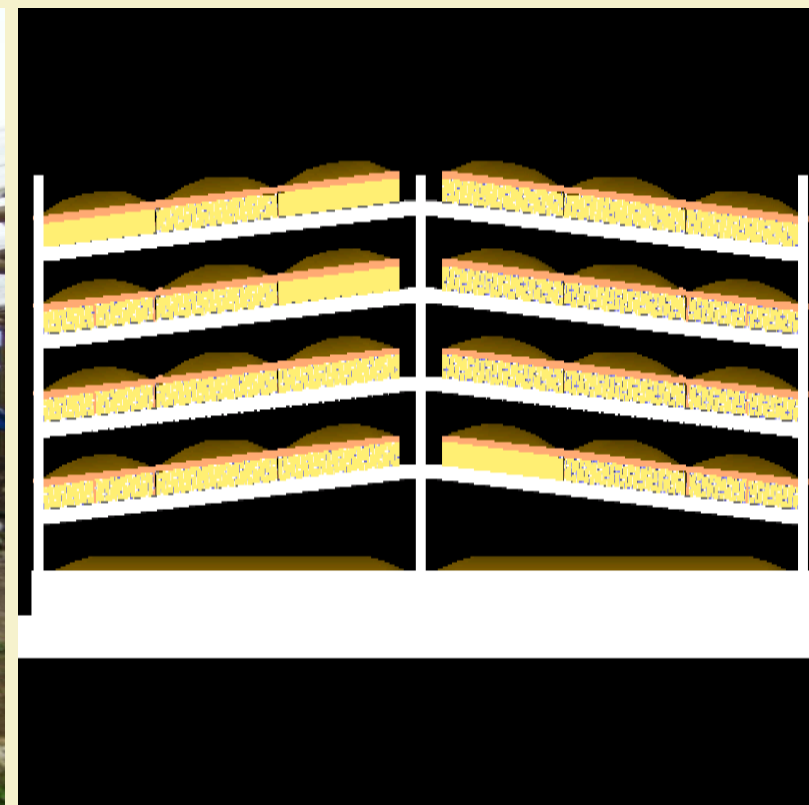
Bamboo Bed



Cemented Bed



Plastic bed



Multi-tier Vermicomposting Bed for limited Space area



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Loading of wastes mixture and earthworm in bed

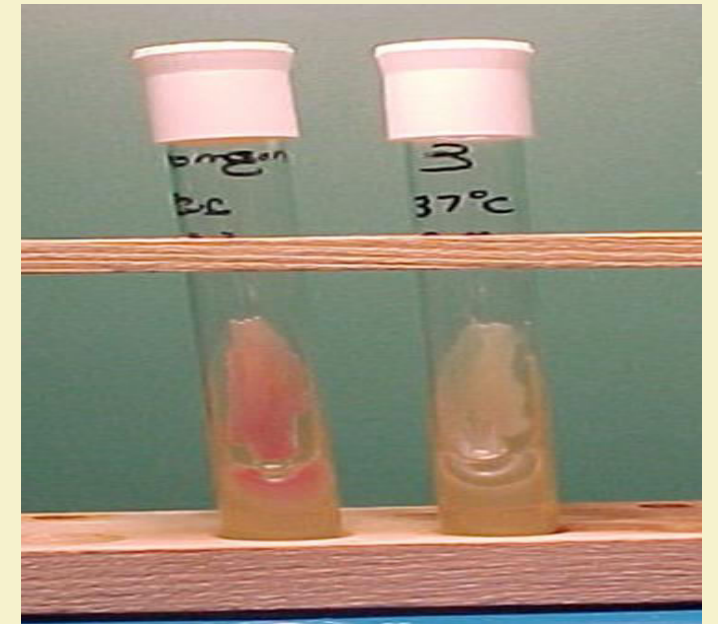
- The waste materials, immediately after mixing or after pre-decomposition, are loaded in the bed in a heap with a **maximum height of 1.5 ft.**
- Thereafter, **a thin layer of cow dung is placed on the surface** of waste materials as starter food for earthworms
- In the bed, after checking the **inside temperature (should not exceed 35 °C)** of the heaped material, the **earthworms** are released on the surface bed (minimum of **2 kg per bed or 2000-2500 in number**). However, if available, the quantity can be increased **up to 10 kg per bed.**

Worm propagation in mother bed/boxes

- For multiplications of healthy earthworm as seed material propagation boxes or beds are used.
- A box size of **2 ft length 1.5 ft width and 0.75 ft depth** or a bed size **12 ft length 4 ft width and 1 ft depth** are considered for multiplication.
- A mixture of succulent **green biomass** and **cow dung at 50 :50 ratio** in the bed
- Earthworm 500 per box or 4 kg per **bed** are released.
- A cover placed on the box or bed with **either gunny bag or insulating sheet**.
- Cover provides **a dark condition** for encouraging the worms to come to the surface for mating besides **maintaining ideal and moisture level** in the box.
- The production cycle in the box or bed will vary **from 50-60 days** depending on **species seasons environmental condition** and **feed material**.

Vermicompost accelerators

The microorganism multiplied in the laboratory is mixed with the organic wastes thoroughly before putting in the vermibed. Some important fungus species are *Paecilomyces fusisporus*, *Phaenerochete cryosporium*, *Trichoderma viride* and *Bacillus polymixa*.





Maintenance of moisture

Moisture content: 60-80 %

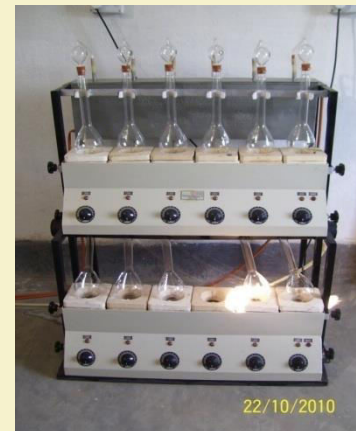
Temperature: 20 – 35 °C

Regular supply of water in the bed, watering can be done **manually** or by installation of automated **micro sprinkler system**

However, the tolerance limit of temperature differs with type of earthworm species. For stability of optimum temperature and moisture in the bed, both under extreme arid and temperate climate, the bed can be covered with an insulating materials like gunny bag, coconut coir mat etc with moistening at a regular interval.

Maturity Judgment of Vermicompost

- **Physical Characteristics of Vermicomposts:**
Colour, Particle size
- **Chemical Characteristics of Vermicomposts**
pH, C/N, macro and micro nutrient, humus content
- **Biological characteristics**
Enzyme activity, Microbial community





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Lecture 14: Vermicompost production Technology (Contd.)

Harvesting and earthworm separation

- The harvesting is generally done manually by using a shovel and loaded on to hand trolley.
- The separation of earthworm from vermicompost is generally done manually or by mechanical process.

Manual process:

Heap method and manual separation:

- Vermicompost after harvest is heaped in a dome shape in open space on a **cement floor** under bright **sunlight at height about 2- 3 ft.**
- Worms move to the lower layer as worms are light sensitive thus facilitating harvest of compost from upper surface. This process repeated 3-4 times.
- All adult worms migrate to the base of the heap and can be separated.
- This process is **time consuming**

Harvesting and earthworm separation

Mechanical process:

- The earthworms are separated by **sieving** using a wire net **of 2-3 mm in size**.
- In separation process the earthworms remain above the net and the vermicompost falls below on the floor and collected.
- The sieving unit may vary in size and its operational processes.
- The sieving frame including stand and net can be placed either on a simple platform or a spring loaded platform or run by motorized shaker.

Harvesting of Vermicompost



Heap method



Sun drying system



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Earthworm Separation by Manual and Mechanical process



Manual process



Mechanical process





Drying cum Seiving mechine for Industrial Purpose



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Drying and packaging

- For marketing, it is packaged at a moisture level ranging from **25 to 30%**.
- **Conventionally**, after separation of earthworm the vermicompost is dried in **natural process under sunlight**.
- Under cloudy weather, particularly during rainy season, open house drying becomes difficult.
- **Mechanical drying:** The important components are reciprocating **screening machine (3m in length and 1.5 m breadth)**, drying chamber consisting of **thermostat, a blower, baffle plates** inclined horizontally by an angle of 35°C for uniform distribution, a conveyor belt and bagging system.
- Besides, **Solar drying system can** also be practiced under sunny weather.
- After drying, the vermicompost is bagged immediately by manually or by mechanical device.
- The bag should be stored under cool condition in the shade.