

Course Code: 621

VERMICOMPOST PRODUCER (REVISED) NSQF LEVEL 3



NATIONAL INSTITUTE OF OPEN SCHOOLING

(An Autonomous Institution under MoE, Govt. of India)

A-24-25, Institutional Area, Sector-62, NOIDA-201309 (U.P.)

Website: www.nios.ac.in, Toll Free No. 18001809393

COURSE TEAM

ADVISORY COMMITTEE

Chairman

NIOS, NOIDA, (U.P.)

Director, Vocational

NIOS, NOIDA, (U.P.)

CURRICULUM COMMITTEE

Dr. Gagnesh Sharma

Director
National Centre of Organic &
Natural Farming, Ghaziabad, (U.P.)

Dr Shivadhar

Principal Scientist
Division of Agronomy
IARI, Pusa Campus, New Delhi

Dr. Vipin Sharma

Associate Director and Head
Krishi Vigyan Kendra
Gautam Buddha Nagar, (U.P.)

Dr. Bipin Kumar

Scientist, WTC, IARI-ICAR
New Delhi

Dr Pravin Kumar Upadhyaya

Scientist
Division of Agronomy
ICAR-IARI, New Delhi

Dr. Rajpal Singh

Assistant Professor & Head
Department of Agronomy
Amar Singh College, Lakhaoti
Bulandshahr, (U.P.)

Dr. Sachin Kumar Vaid

Scientific Officer, NCONF
Ghaziabad, (U.P.)

Dr Neelima Pant

Assistant Director (Academic)
NIOS, NOIDA, (U.P.)

LESSON WRITERS

Dr Pravin Kumar Upadhyaya¹

Scientist
Division of Agronomy
ICAR-IARI, New Delhi

Dr. Bipin Kumar

Scientist, WTC, IARI-ICAR
New Delhi

Dr. Rajpal Singh

Assistant Professor & Head
Department of Agronomy
Amar Singh College, Lakhaoti
Bulandshahr, (U.P.)

Dr. Sachin Kumar Vaid⁴

Scientific Officer, NCONF
Ghaziabad, (U.P.)

Mr. Sachin Singh

Assistant Professor, (Agronomy)
Janta Vedic College, Baraut
Baghpat, (U.P.)

Mr. Prashant Agrawal

Senior Executive Officer
(Agriculture & Animal Husbandry)
Vocational Education Department
NIOS, NOIDA (U.P.)

EDITOR**Dr Shivadhar**

Principal Scientist
Division of Agronomy
IARI, Pusa Campus, New Delhi

Dr. Vipin Sharma

Associate Director and Head
Krishi Vigyan Kendra
Gautam Buddha Nagar, (U.P.)

PROOF READER**Dr. Gagnesh Sharma**

Director
National Centre of Organic & Natural Farming
Ghaziabad, (U.P.)

COURSE COORDINATOR

Mr. Prashant Agrawal

Senior Executive Officer
(Agriculture & Animal Husbandry)
Vocational Education Department
NIOS, NOIDA, (U.P.)

GRAPHICS/DTP

M/s Sri Krishna Graphics
Delhi

How to use the Study Material

Congratulation! You have accepted the challenge to be a self-learner. NIOS is with you at every step and has developed the material in *Vermicompost Producer* with the help of a team of experts, keeping you in mind. A format supporting independent learning has been followed. If you follow the instructions given, then you will be able to get the best out of this material. The relevant icons used in the material will guide you. These icons have been explained below for your convenience.

Title: will give a clear indication of the contents within. Do read it.

Introduction: This will introduce you to the lesson linking it to the previous one.



Objectives: These are statements that explain what you are expected to learn from the lesson. The objectives will also help you to check what you have learnt after you have gone through the lesson. Do read them.



Notes: Each page carries empty space in the side margins, for you to write important points or make notes.



Intext Questions: Very short answer self check questions are asked after every section, the answers to which are given at the end of the lesson. These will help you to check your progress. Do solve them. Successful completion will allow you to decide whether to proceed further or go back and learn again.



What You Have Learnt: This is the summary of the main points of the lesson. It will help in recapitulation and revision. You are welcome to add your own points to it also.



Terminal Exercise: These are long and short questions that provide an opportunity to practice for a clear understanding of the whole topic.



Answers to Intext Questions: These will help you to know how correctly you have answered the questions.

www

Web site: These websites provide extended learning. Necessary information has been included in the content and you may refer to these for more information.

NSQF (National Skill Qualification Framework)

The National Skills Qualifications Framework (NSQF) is a competency-based framework that organizes all qualifications according to a series of levels of knowledge, skills and aptitude. These levels, graded from one to ten, are defined in terms of learning outcomes which the learner must possess regardless of whether they are obtained through formal, non-formal or informal learning. The learning will enable the learner to acquire desired competency levels, transit to the job market and, at an opportune time, return for acquiring additional skills to further upgrade their competencies.

NSQF Level

Each level of NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level. Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are Process, Professional knowledge, Professional skill, Core skill and Responsibility.

NOS (National Occupational Standards)

NOS define the measurable performance outcomes required from an individual engaged in a particular task. They list down what an individual performing task should know and also do. These standards can form benchmarks for various education and training programs and recruitment range of HRM practice. Just as each job role may require the performance of a number of tasks, the combination of all the NOSs corresponding to these tasks would form the Qualification Pack (QP) for that job role. The NOSs and QP for each job role corresponding to each level of the NSQF are being formulated by the concerned Sector Skill Councils (SSCs).

Course “*Vermicompost Producer*” is based on the following National Occupational Standards (NOS) for “Vermicompost producer” formulated by Agriculture sector Skill Council of India:

1. AGR/N1212 (V3.0) : Identify appropriate site and prepare bed for vermicomposting
2. AGR/N1213 (V3.0): Inoculate earthworms in prepared unit and manage the vermicomposting process
3. AGR/N1214 (V3.0): Identify maturity of vermicompost and harvest using approved procedures
4. AGR/N9908 (V3.0): Undertake basic entrepreneurial activities for small enterprise
5. AGR/N9903: Maintain health and safety at the workplace
6. Employability Skills (60 Hours)
(DGT/VSQ/N0102) (V1.0)

For more information about NSQF and NOS, kindly browse in the mentioned websites:

<https://nsdcindia.org/>; <http://www.asci-india.com/National%20Occupation%20Standards.php>

CONTENTS

1. Introduction to Vermicomposting	1
2. Basics Requirements for Establishment of Vermi-compost Unit	20
3. Process of Making Vermibed and Vermicompost Production	41
4. Preparation of Vermiwash	62
5. Harvesting, Packaging and Storage of Vermicompost	73
6. Basic Entrepreneurial Activity for Small Enterprise	102
7. Hygiene and Cleanliness	113
8. Maintain Health and Safety at Workplace	127
9. *Employability Skills (60 hrs)	141

* The Employability Skill Workbook (60 hrs) for this course has been adopted from Directorate General of Training (DGT). To access the workbook QR code is given at page no. 163



1

INTRODUCTION TO VERMICOMPOSTING

Vermicompost is a process of decomposing organic waste material with the help of earthworms and microorganisms to make a nutrient-rich compost known as vermicompost. It is an oxygen-requiring process and does not need high temperatures but produces little heat. The organic matter is digested by the earthworms, and the vermicast is excreted, which is full of plant nutrients. Earthworms have enzymes, microbes, and hormones in their intestines, which accelerate decomposition of organic matter. (Fig. 1.1)



Fig. 1.1: Vermicompost

Source: <https://creativecommons.org/licenses/by-sa/4.0/>



Notes



OBJECTIVES

After reading this lesson, you will be able to:

- understand the concept of vermicomposting and the role of earthworms in organic waste decomposition;
- differentiate vermicompost from traditional compost in terms of nutrient content, decomposition process, and benefits;
- discuss the benefits of vermicomposting for soil health, crop productivity, and sustainable agriculture;
- identify the materials required and conditions suitable for setting up a vermicomposting unit;
- evaluate the role of vermicomposting in climate change mitigation, waste management, and organic farming systems.

1.1 SCOPE AND IMPORTANCE IN AGRICULTURE

1.1.1 Soil Fertility Enhancement

- **Rich in nutrients:** Vermicompost is rich in plant-available nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, and trace minerals. These nutrients play an important role in soil fertility.
- **Improves soil structure:** Vermicompost improves soil structure by enhancing aggregation, thereby increasing soil aeration, water-holding capacity and drainage. It helps to reduce the soil compaction, particularly in heavy clay soils.
- **Microbial activity:** Vermicompost enhances the activities of the useful microbes in the soil. These microbes increase nutrient cycling, break down organic matter, and assist in the suppression of soil-borne pathogens.

1.1.2 Sustainable Agriculture

- **Environmentally friendly:** Vermicomposting is an environmentally friendly process. It utilizes organic wastes such as food scraps, farm waste, and other biodegradable wastes and reduces pollution. This encourages more eco-friendly farming practices.
- **Reduces dependence on chemicals:** As an organic source of nutrients, vermicompost reduces or eliminates the need for chemical fertilizers, which can degrade soil health and cause environmental pollution.
- **Soil regeneration:** Vermicomposting can regenerate soil health under various stresses like drought, excessive rainfall, or pest infestations.



1.1.3 Increased Crop Yield and Quality

- **Improved crop yield:** Vermicompost is nutrient-rich and improves the growth and yield of crops. The use of vermicompost resulted in high yields of crops, as obtained from the use of chemical fertilizers.
- **Better plant health:** Vermicompost assists in producing stronger, healthier plants. It enhances root growth, and the crops become resistant to diseases, pests, and harsh weather conditions.
- **Better quality of produce:** Vermicompost also increases the quality of crops in terms of taste, size, and nutrient content. Healthier and tastier vegetables, fruits, and herbs are produced using vermicompost than the chemical fertilizers.

1.1.4 Cost-effectiveness

- **Low-cost input:** Vermicomposting has low input costs, particularly when farm residues and waste materials are used as raw materials. Vermicomposting can be started by farmers at a low cost.
- **Fertilizer costs:** Vermicompost is a natural fertilizer and, therefore, reduces the total input costs. It also guarantees better utilization of nutrients since it releases nutrients slowly.
- **Less pesticides:** Vermicompost can also help decrease the use of pesticides and fungicides by enhancing the health of the soil and plant resistance, which also reduces expenses.

1.1.5 Climate Change Mitigation

- **Carbon sequestration:** Vermicomposting helps in sequestering carbon in the soil, and this is significant in reducing the impact of climate change. It also contributes to enhancing the water-holding capacity of soil and offering resistance to drought conditions.
- **Reduction in greenhouse gas emissions:** This process is aerobic and thus reduces the methane emissions compared to anaerobic decomposition. Vermicomposting also reduces greenhouse gas emissions, making the agricultural practices more sustainable.

1.1.6 Waste Management

- **Recycling of organic wastes:** Vermicomposting provides an effective method of recycling organic wastes, which are otherwise disposed of in landfills. It



Notes

assists in transforming agricultural waste, food waste, and other biodegradable wastes into useful organic matter.

- **Zero waste agriculture:** Agricultural activities generate a lot of organic waste. Vermicomposting utilizes the waste generated and converts it into valuable resources. This supports zero-waste agricultural systems.

1.1.7 Improves pH and Buffering Capacity of Soil

- **Stabilization of pH:** Vermicompost is also known to stabilize the pH of the soil to make it more favorable to plants. It neutralizes soils that are too acidic or alkaline, giving the best growing conditions.
- **Buffering capacity:** It helps in enhancing the buffering capacity of soil, which makes the soil more stable and able to resist abrupt changes in pH or nutrient levels.

1.1.8 Role in Organic Farming

- **A key component in organic farming:** Vermicompost is an important component of organic farming as a source of nutrients. It assists organic farmers to ensure that the soil is healthy and has the capacity to supply the nutrients without affecting the sustainability of the ecosystem.
- **Regulatory compliance:** Most organic certification schemes demand the application of organic inputs and vermicompost meets this requirement and also makes sure that crops are not contaminated with synthetic chemicals.

1.1.9 Environmental Impact

- **Soil erosion:** Vermicompost can reduce soil erosion caused by wind and water because it enhances soil structure and water retention. This helps in the sustainability of the soil health, and it maintains the topsoil.
- **Reduction of wastes:** Vermicomposting is useful in recycling agricultural and food wastes, which have a negative impact on the environment due to their disposal in the landfills, which in turn release toxic gases like methane.

1.1.10 Localized and Small-scale Farming Benefits

- **Smallholder farmers:** Vermicomposting is particularly useful to small-scale and localized farmers who cannot afford the cost of chemical fertilizers or the bulk of large-scale equipment. The process can be scaled, and even small amounts of vermicompost can enhance crop productivity.
- **Employment generation:** The expansion of vermiculture and vermicomposting activities generates employment in the rural areas, which helps in local economies.



1.2 ROLE OF EARTHWORMS IN SOIL FERTILITY

Earthworms are often referred to as “Nature’s Ploughman” or “Farmer’s Friend” due to their significant role in soil health and ecosystem functioning. They consume organic materials such as dead plant materials and leaf litter, and they reduce them into small particles. They also help in the recycling of agro-wastes through their feeding, burrowing, and casting activities, which enhance soil fertility and soil structure.

Key roles of earthworms in soil health:

- **Soil aeration and porosity:** Earthworms make the soil porous, which enhances the circulation of air and the growth of roots.
- **Water holding capacity:** Burrowing by worms improves the capacity of the soil to store more moisture, which helps in maintaining plant health between rainfalls or irrigations.
- **Microbial activity:** Earthworms stimulate soil microbial activity, promoting the breakdown of organic material through decomposition.
- **Nutrient cycling:** They enhance the rate of nutrient cycling, which adds valuable minerals and nutrients to the soil, which can be used by plants.
- **Soil fertility:** Earthworms are bio-indicators that indicate the health and fertility of soil. Their presence indicates a healthy, productive soil ecosystem.
- **Heavy metal remediation:** Earthworms play a significant role in cleaning up heavy metal contamination in soil. They accumulate heavy metals in their bodies, effectively removing them from the soil, and also alter the chemical forms of the metals, making them less harmful to other organisms and potentially less mobile in the environment
- **Pest control:** Their activities also assist in the protection of plants against pests.



INTEXT QUESTION 1.1

State Fill in the Blank:

1. Vermicomposting is an (aerobic/anaerobic) process.
2. The most commonly used species in vermicomposting is
3. Vermicompost enhances activity in the soil.
4. Vermibed provides and food for earthworms.



Notes

1.3 VERMICOMPOSTING

- **Characteristics of earthworms for vermicomposting:** The earthworms used in vermiculture must have a high feeding rate, fast production of cocoons, and adaptability to the environment.
- **Anatomy of earthworms to reproduce:** Earthworms possess a ring-shaped organ known as the clitellum, which produces mucus to cover their eggs in protective cocoons. At the age of six weeks, earthworms start producing cocoons, and this process goes on until six months.
- **Vermibed:** Earthworms live in nutrient-rich moist soil or organic material called a vermibed. These beds should be handled with a lot of care because toxic conditions or poor environments may decrease the population of the earthworms. In general, earthworms are very important in ensuring healthy soil, boosting agricultural production, and vermicomposting, which is beneficial to the soil health and plant growth. The vermiculture process requires proper care to maintain a healthy population of earthworms to facilitate the process of composting (Fig. 1.2).



Bed method



Cement rings method



Pit method



Commercial models



Polybag method

Fig. 1.2: Vermibed

1.4 MATERIALS REQUIRED FOR VERMICOMPOSTING

Vermicomposting is a technique of using earthworms to convert organic wastes into nutrient-rich compost. The essential materials involved include (Fig. 1.3):

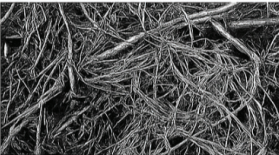
Raw Materials			
	 		
Earthwork			

Fig. 1.3: Raw materials for vermicompost

A. Organic waste (feedstock): This is the primary food for earthworms, which they break down into compost. Suitable materials include:

- Vegetable and fruit scraps



Notes

- Coffee grounds, eggshells, and tea bags
- Grass clippings and plant residues
- Shredded paper, cardboard, and sawdust
- Aged animal manure

B. Bedding Materials: These give earthworms a comfortable living condition and assist in moisture retention. Common bedding materials are:

- Crop residue dry or green (Fig. 1.4)



Fig. 1.4: Bedding materials

- C. Water:** The vermicomposting environment requires moisture to be healthy. The optimum moisture content is that of a squeezed sponge, making the soil wet and not wet.
- D. Vermibed or Container:** A vermibed or container is where the composting materials and earthworms are kept. It must be well drained and well ventilated to allow free flow of air.
- E. Earthworms:** The key component in vermiculture. Common species for composting include red wigglers (*Eisenia fetida*) and European nightcrawlers (*Eisenia hortensis*). (Fig.1.5)



Fig. 1.5: Common species of earthworms



- F. Temperature and climate control:** To keep worms healthy, the environment must stay between 15°C to 24°C. Insulation and shading can help to maintain temperature.
- G. pH adjusters:** pH of the compost can be adjusted using materials such as crushed limestone or wood ash to maintain it within an appropriate range that is suitable to earthworms.
- H. Aeration tools:** Proper aeration is necessary for aerobic (oxygen-rich) decomposition. Compaction is prevented by regularly turning the bedding and by the use of vented containers.

1.5 DIFFERENCE BETWEEN VERMICOMPOST AND OTHER TYPES OF COMPOST

1. Process of decomposition:

- **Vermicompost:** It is the process of decomposition of organic matter by earthworms. The compost is made up of castings of earthworms that feed on organic wastes.
- **Other Compost:** Typically involves microbial decomposition (bacteria, fungi, etc.) of organic matter. This can happen either aerobically (with oxygen) or anaerobically (without oxygen) depending on the composting method.

2. Time to produce:

- **Vermicompost:** Generally, it takes 2-3 months to produce, depending on conditions (temperature, moisture and feedstock).
- **Other Compost:** May require 3-6 months or more, particularly in the more traditional composting processes, which need to be turned and kept in the right conditions.

3. Nutrient content:

- **Vermicompost:** Rich in macro (Nitrogen, phosphorus and potassium), micronutrients (iron, zinc, manganese, copper) and growth hormones (auxins, gibberellins, cytokinins). It also contains beneficial enzymes and beneficial microorganisms.
- **Other compost:** Usually contains macronutrients (nitrogen, phosphorus, potassium), but may lack the same level of micronutrients and beneficial microorganisms found in vermicompost.



Notes

4. Soil Health:

- **Vermicompost:** Enhances the structure of soil, water holding capacity and microbial activity. It assists in enhancing the growth of plant roots, improved aeration, and soil health. (Table 1.1)
- **Other Compost:** Enhances soil fertility and soil structure, and may not provide the same immediate effects on microbial activity and soil porosity as vermicompost.

Table 1.1: Chemical Composition of Vermicompost vs. Other Compost

S. No	Property	Vermicompost	Other compost
1	Nitrogen (N)	1.5-2.5%	1-3%
2	Phosphorus (P)	0.5-1.2%	0.5-1.5%
3	Potassium (K)	0.5-1.0%	0.5-1.5%
4	Calcium (Ca)	2-3%	1-2%
5	Magnesium (Mg)	0.5-1.5%	0.2-0.5%
6	Micronutrients	High (Iron, Zinc, Manganese, Copper)	Moderate to Low
7	Organic Matter	30-40%	20-40%
8	pH	Slightly acidic to neutral (6-7.5)	Neutral to slightly alkaline (6-8)

1.6 KEY TERMS RELATED TO VERMICOMPOSTING

1.6.1 Vermiculture

- **Definition:** Vermiculture refers to the practice of breeding and raising earthworms for various purposes, including vermicomposting (the production of nutrient-rich compost). It entails control of the environment and conditions in order to maximize the population of earthworms.
- **Focus:** It is concerned with the care, maintenance, and multiplication of earthworms, mostly to produce vermicompost.
- **Uses:** Vermiculture has uses in sustainable agriculture, waste recycling, and the manufacture of organic fertilizers.

1.6.2 Vermicomposting

- **Definition:** Vermicomposting is the process of using earthworms to break down organic waste materials (like kitchen scraps, plant residues, and manure) into vermicompost, a nutrient-rich, organic fertilizer.



- **Process:** Earthworms feed on organic matter, break it down, and produce castings that contain nutrients that enhance soil fertility, structure, and microbial activity.
- **Advantages:** It enhances soil aeration, water-holding capacity and microbial life, and is useful in farming.

1.6.3 Vermibed

- **Definition:** A vermibed is a container or bed designed for vermicomposting, the process of using earthworms to decompose organic waste into nutrient-rich compost. **Function:** The vermibed supplies moisture, oxygen and food that earthworms need to flourish. It is also the foundation of the composting process.

1.6.4 Vermicast or Worm Castings

- **Definition:** Vermicast, also known as worm castings, is the nutrient-rich excrement of earthworms, produced after they consume and process organic matter. **Benefits:** Vermicast has beneficial microorganisms, enzymes, and plant growth hormones, and it enhances soil structure, fertility, and plant health.

1.6.5. Vermicomposting Bed or Bin

- **Definition:** A vermicomposting bed or bin is the place or container where earthworms are reared and organic waste is composted. It is meant to facilitate the activity of earthworms and provide adequate airflow, moisture, and drainage.
- **Types:** The common types are plastic bins, wooden boxes, and outdoor composting pits.

1.6.6. Feedstock

- **Definition:** Feedstock is the organic materials that are given to the earthworms in the vermicomposting process. These are crop residues, animal dung, kitchen waste, manure, shredded paper, grass cuttings, and other biodegradable wastes.
- **Quality:** Good quality feedstock is necessary to make good quality vermicompost and to sustain a good earthworm population.

1.6.7. Cocoon

- **Definition:** A cocoon is the protective covering made by earthworms for their eggs. It has embryos of earthworms and offers a secure habitat for the worms to grow. (Fig. 1.6).



Notes



Fig. 1.6: Cocoon of earthworm

- **Importance:** The cocoon plays an important role in the reproduction of the earthworm and guarantees the unending production of worms in vermiculture activities.



INTEXT QUESTIONS 1.2

State Fill in the Blank:

1. Vermicast is also known as
2. is the protective covering made by earthworms for their eggs.
3. Red wigglers are scientifically known as
4. Vermiculture involves the breeding and raising of
5. The ideal temperature range for vermicomposting is°C.
6. Paramparagat Krishi Vikas Yojana was launched in the year

1.7 OCCUPATIONAL HEALTH AND SAFETY (OHS) REQUIREMENTS FOR WORK IN VERMICOMPOSTING

Vermicomposting is a job that deals with organic materials, earthworm populations, and a healthy and safe environment to the workers and the earthworms. There are certain health and safety measures that should be adhered to in order to guarantee the safety and well-being of workers. Below is a summary of key occupational health and safety (OHS) requirements relevant to vermiculture and vermicomposting.



1.7.1 Personal Protective Equipment (PPE)

PPE is necessary to safeguard the employees against possible risks, including bacteria, pathogens, sharp items, and dangerous dust. Key PPE for vermicomposting tasks includes:

- **Gloves:** To protect hands from direct contact with composting materials, potentially harmful bacteria, and sharp objects (e.g., broken glass, metal).
- **Face masks or respirators:** To prevent the inhalation of dangerous dust or spores of decaying organic matter, which may lead to respiratory problems.
- **Goggles:** To prevent the exposure of the eyes to dust, compost or foreign objects.
- **Boots:** This is to protect the feet, particularly when dealing with wet and muddy substances.
- **Protective clothing or coveralls:** To avoid skin contact with organic material and reduce the possibility of contamination.

1.7.2 Ergonomics and Manual Handling

Strain injuries may be caused by manual handling of materials such as compost, bedding and organic waste. Ergonomic practices include:

- **Use of lifting aids:** Mechanical devices (e.g., forklifts, wheelbarrows, or lifting tools) should be used to move heavy compost or waste piles.
- **Proper lifting techniques:** Workers should be trained on proper lifting techniques (bend knees, not back) to avoid musculoskeletal injuries.
- **Small tools and equipment:** Small tools and equipment such as compost forks, knives, and other farming equipment should be handled carefully.

1.7.3 Hygiene and Sanitation

Hygiene is essential to reduce the chances of infection and a clean working environment:

- **Handwashing:** Employees are expected to wash their hands well when they have touched organic matter or when they have touched earthworms.
- **Clean workstations:** Composting areas, tools, and equipment should be cleaned regularly to avoid accumulation of disease-causing bacteria and pests.
- **Waste disposal:** Waste materials and old compost should be properly disposed of to avoid rodents or insects.



Notes

1.7.4 Ventilation and Indoor Air Quality

In indoor vermiculture systems (e.g., vermiculture bins or greenhouses), proper ventilation is necessary to ensure good air quality and prevent the buildup of harmful gases:

- **Ventilation systems:** Make sure that there is proper air circulation to avoid excessive moisture and the development of anaerobic conditions that may cause foul odors and molds.
- **Temperature Control:** Temperature control in indoor systems makes sure that worms and microorganisms are active but not overheated and do not produce toxicity.

1.7.5 Hazardous Materials Handling

During the vermiculture activities, workers can be exposed to hazardous materials, including:

- **Chemical fertilizers or pesticides:** There are instances where workers might be required to deal with chemical fertilizers or pesticides in the process of dealing with crop or plant health. Proper training on handling chemicals safely (using labels, gloves, etc.) is essential.
- **Manure handling:** Fresh manure may have dangerous pathogens such as *E. coli* or *Salmonella*, and workers should be cautious when handling manure-based compost.
- **Composting materials:** In rare cases, toxic materials like heavy metals might be present in contaminated organic waste (e.g., from industrial sources). Regular monitoring of incoming waste materials is essential.

1.7.6 Risk of Allergies and Respiratory Issues

Organic matter that is decomposing may produce dust, mold, and spores, which may cause allergic reactions or respiratory problems.

- **Dust control:** Employees are expected to wear masks to reduce dust and mold spore inhalation.
- **Respiratory health:** Periodic health screening of the employees who are engaged in the composting process, particularly those who develop such symptoms as coughing, wheezing, or skin rashes.

1.7.7 Pest Control and Biohazards

Pests that may be attracted to composting areas include:



- **Rodents:** Rats and mice are prevalent in organic waste heaps, and thus precautionary measures should be taken to keep them away.
- **Insects:** Flies and mites are some insects that can breed in the decaying material and are a health hazard.
- **Biohazard risk:** Workers should be aware of bacteria, viruses, and parasites (e.g., *Toxoplasmosis*, *Salmonella*) that could be present in the compost and practice proper hygiene to avoid contamination.

1.7.8 Training and Awareness

Safety training programs ought to be set up to train workers on safety measures:

- **Vermiculture and vermicomposting training:** The employees must be aware of the hazards and safety measures peculiar to the breeding of earthworms, waste treatment, and composting.
- **Emergency procedures:** Education in the method of managing emergencies such as fire, chemical spillage or exposure to dangerous biohazards.
- **First aid:** All workers should be provided with basic first aid training, including the treatment of minor injuries, or exposure to chemicals.

1.7.9 Equipment Safety

Accidents should be avoided by proper use and maintenance of equipment:

- **Safe use of tools:** Tools used in composting such as forks, shovels and rakes should be in good condition to prevent accidents.
- **Equipment maintenance:** Machinery used in larger vermiculture operations (e.g., for shredding waste or aerating compost) should be regularly serviced and maintained to ensure safe operation.

1.7.10 Environmental Safety

The environmental factors must be taken into consideration so that the vermiculture operation does not cause any threat to the surrounding environment:

- **Water management:** Appropriate drainage and water management to prevent run off of composting sites into local water bodies.
- **Waste management:** Non-compostable materials and waste should be disposed regularly in a responsible manner to prevent environmental pollution.

**INTEXT QUESTIONS 1.3****State True or False:**

1. Earthworms are referred to as “Nature’s Ploughman.”
2. Vermicompost is high in synthetic fertilizers.
3. Vermicomposting is a thermophilic process.
4. Vermicompost enhances soil pH stability.
5. Vermibeds should be dry and compact to be effective.

1.8 CENTRAL AND STATE GOVERNMENT SCHEMES RELATED TO VERMICOMPOST

The Central and State Governments of India have introduced several schemes to promote vermicomposting as part of sustainable agriculture and waste management initiatives (Table.1.2).

Table. 1.2: Central and State Governmentschemes related to vermicompost in India

S. No.	Scheme	Level	Implementing Ministry/Dept.	Year Started	Vermicompost Support Provided
1.	Paramparagat Krishi Vikas Yojana (PKVY)	Central	Ministry of Agriculture and Farmers Welfare	2015	Financial assistance for organic farming and vermicompost units
2.	National Mission on Sustainable Agriculture (NMSA)	Central	Ministry of Agriculture and Farmers Welfare	2014-15	Support for vermicompost units under soil health management
3.	Rashtriya Krishi Vikas Yojana (RKVY)	Central/ State	Ministry of Agriculture & State Agri Depts	2007	Assistance for compost infrastructure, including vermicompost
4.	MGNREGA (for compost pits and organic manure pits)	Central	Ministry of Rural Development	2005	Wage and material support for vermicompost pits in villages
5.	State Organic Mission - Sikkim	State	Sikkim State Government	2010	Infrastructure, training, and subsidies for vermicompost units



Notes

S. No.	Scheme	Level	Implementing Ministry/Dept.	Year Started	Vermicompost Support Provided
6.	Uttarakhand Organic Commodity Board Scheme	State	Uttarakhand Organic Board	2003	Vermicompost production promotion and subsidies
7.	Organic Farming Policy – Kerala	State	Kerala Agriculture Departments	2010	Promotion of local compost including vermicompost
8.	State Horticulture Mission (various states)	State	State Horticulture Departments	Varies	Assistance for on-farm composting and vermicomposting
9.	Madhya Pradesh Organic Policy Scheme	State	MP State Organic Certification Agency	2011	Support for input production including vermicompost
10.	Jharkhand State Organic Farming Scheme	State	Jharkhand Organic Mission	2016	Training & assistance in vermicompost and bio-inputs



WHAT YOU HAVE LEARNT

- Vermicomposting is the decomposition of organic waste using earthworms and microorganisms to produce nutrient-rich vermicompost.
- Earthworms digest organic matter and excrete **vermicast**, which is rich in plant nutrients.
- Their intestines contain **enzymes, microbes, and hormones** that accelerate decomposition.
- Common species of Earthworms: **Eisenia fetida, Eudrilus eugeniae, and Perionyx excavatus.**
- Vermicompost rich in plant-available nutrients: N, P, K, Ca, Mg, and trace minerals.
- Vermicompost improves soil structure: enhances aggregation, aeration, water-holding capacity, and drainage.
- Vermicompost reduces soil compaction, especially in heavy clay soils.
- Vermicompost boosts microbial activity: supports nutrient cycling, organic matter breakdown, and suppression of soil-borne pathogens.



Notes

Introduction to Vermicomposting

- Vermicompost environmentally friendly: uses organic wastes, reduces pollution.
- Vermicompost reduces dependency on chemical fertilizers.



TERMINAL EXERCISE

A. Short Subjective Questions

1. Define vermicomposting and mention two of its benefits.
2. What is the role of earthworms in improving soil fertility?
3. Name three types of organic wastes suitable for vermicomposting.
4. Mention any two central government schemes supporting vermicomposting.
5. What is vermibed and why is it important?
6. How does vermicompost enhance soil microbial activity?
7. Explain how vermicomposting helps in climate change mitigation.
8. Distinguish between vermiculture and vermicomposting.
9. What personal protective equipment is recommended during vermicomposting?
10. State two differences between vermicompost and traditional compost.

B. Long Subjective Questions

1. Explain the scope and importance of vermicomposting in the agricultural sector.
2. Describe the occupational health and safety measures to be taken during vermicomposting activities.
3. Compare and contrast vermicompost and traditional compost in terms of nutrient composition and decomposition process.
4. Discuss the role of earthworms in improving soil health and supporting organic farming.
5. List and explain five major government schemes (Central and State) in India that promote vermicomposting and organic farming.

Introduction to Vermicomposting

6. Understand the biological principles and processes involved in vermicomposting.
7. Analyze the chemical and physical properties of vermicompost and their impact on soil fertility.
8. Learn about the anatomy and function of earthworms in the composting process.
9. Gain knowledge about government schemes and support for vermicomposting in India.
10. Understand the occupational health and safety (OHS) measures associated with vermicomposting operations.



Notes



ANSWER TO INTEXT QUESTIONS

1.1

Fill in the blanks

1. Aerobic
2. *Eisenia fetida*.
3. Microbial
4. Habitat

1.2

Fill in the blanks

1. Worm castings.
2. Cocoon
3. *Eisenia fetida*.
4. Earthworms.
5. 20–30 °C.
6. 2015

1.3

State True/False

1. True
2. False
3. False
4. True
5. False

KEY LEARNING OUTCOME

- Explain the concept of vermicomposting and analyze the role of earthworms in decomposing organic waste into nutrient-rich manure.
- Differentiate vermicompost from traditional compost with respect to nutrient content, decomposition process, and overall benefits.
- Assess the benefits of vermicomposting in improving soil health, enhancing crop productivity, and promoting sustainable agriculture practices.



2

BASICS REQUIREMENTS FOR ESTABLISHMENT OF VERMI- COMPOST UNIT

Learners! In the previous lesson, you learned how earthworms play a vital role in the process of vermicomposting and why they are often referred to as the farmer's best friends. You are now familiar with the fundamental concept of vermicomposting. But do you know what it takes to actually set up a vermicomposting unit?

Before jumping into the process, it is important to understand the basic requirements that must be fulfilled for successful vermicompost production. Setting up a vermicompost unit is not just about collecting earthworms and organic waste. It involves selecting the right site, choosing the appropriate raw materials maintaining the proper temperature and moisture, and preparing a suitable shelter to protect the worms from direct sunlight, heavy rains, and predators.

Did you know? Vermicomposting can be done at household, farm, or even industrial scale, but in every case, the basic requirements remain the same for effective and sustainable composting. Proper care at this stage ensures healthy worm growth and efficient compost production.

In this lesson, you'll explore how to establish an efficient vermicomposting unit—from selecting the ideal site and materials to choosing suitable earthworm species and understanding their biology. You'll also learn about different types of vermibed, their construction, and essential tools and techniques. Get ready to build a sustainable, eco-friendly system for turning organic waste into valuable compost!



OBJECTIVES

After reading this lesson, you will be able to:

- understand the site selection criteria for vermicompost units;
- identify materials and structures for vermicomposting setup;
- learn about suitable earthworm species and their needs;
- explore tools and equipment used in vermicompost preparation;
- know types of vermibeds and their construction techniques.

2.1 DISCUSS ABOUT THE APPROPRIATE SITE SELECTION

Before starting vermicomposting, it is very important to select a proper site where the earthworms can live comfortably and convert waste into compost efficiently. The success of vermicomposting largely depends on the conditions of the place where it is done. Let's understand step-by-step what makes a site suitable for setting up a vermicompost unit.

2.2.1 Flat and Firm Fround

The composting bed (called a vermibed) should be made on level ground. It should not be uneven or loose. A firm surface helps the bed stay in place and keeps it safe from collapsing. If the ground is uneven, rainwater may collect there, which is harmful to earthworms.

2.1.2 Raised Beds

It is always better to prepare the bed a little above the ground level. A raised bed stops outside water like rainwater or wastewater—from flowing into the compost pile. This helps maintain the right amount of moisture in the compost. Too much water can drown the worms and spoil the compost.

2.1.3 Shaded Area or Shed

Earthworms are sensitive to light and heat. They work best in cool and moist conditions. So, the compost bed should be kept under shade to protect it from direct sunlight. You can use a shed made of local materials like bamboo, thatch, or even old tin sheets. In some cases, vermicomposting can also be done under the shade of large trees. The goal is to keep the worms cool, comfortable, and safe from extreme weather.



Notes



Notes

2.1.4 Easy Access to Water

Water is very important for vermicomposting. The compost pile must be kept moist, not too dry and not too wet. So, a water source like a tap, tank, or hand pump should be available nearby. This makes it easy to sprinkle water regularly on the compost to maintain the right moisture level.

2.1.5 Use of Local and Low-cost Materials

The type of structure or shed for vermicomposting can vary depending on what materials are easily available in the area. For example, in rural areas, people can use bamboo and straw to build a simple shed. In larger farms or urban areas, cemented tanks or plastic vermibeds can be used. The choice depends on how much compost you want to make (small or large scale) and how much money you can spend.

2.2 EXPLAIN VARIOUS TYPES OF VERMI-BEDS, VERMICOMPOSTING STRUCTURE AND METHODS

For successful vermicomposting, it is important to choose the right place and structure. Earthworms need a shaded, airy, and clean environment that is free from pests and predators like ants or rats. The shade can be either permanent (like a built shed) or temporary (like under a tree). Also, it is important to ensure that the area doesn't get waterlogged and allows proper drainage and air movement. There are mainly three common types of structures used for vermicomposting. Let's learn about them in detail:

2.2.1 Vermicomposting in Pits or Trenches

In this method, composting is done in dug-out pits or trenches in the ground. These pits are usually 1 meter wide and 0.5 meter deep. The length of the pit can vary based on how much space is available and how much compost you want to produce. The pits or trenches can be made using bricks, cement, or concrete, and sometimes even with readymade plastic materials like HDPE (High Density Polyethylene). While this method is simple and cost-effective, it also has some problems.

Challenges

- Water stagnation during the rainy season or overwatering is a major issue. This can harm the earthworms.
- Excess water causes leaching, where nutrients get washed away into the soil.

Basics Requirements for Establishment of Vermicompost Unit

- Lack of air in the pit can reduce oxygen for worms, making it hard for them to survive and work.

So, if this method is used, it's important to ensure proper drainage and avoid overwatering.

2.2.2 Vermicomposting in Windrows (Heaps on the Ground)

In this method, long heaps of organic waste are prepared directly on the ground. These heaps are also called windrows. Usually, each heap is 1 meter wide and 0.5 meter high, and the length depends on the available space. If more space is available, several heaps can be made in parallel rows, keeping about 1 meter distance between them for easy movement and watering. To make the beds stronger, people sometimes arrange loose bricks (without cement) around the sides. This helps the heap keep its shape and makes the composting area neat.

Advantages

- Easy to manage and expand.
- Good air flow, so earthworms remain active.
- Suitable for both small and large-scale composting.

2.2.3 Vermicomposting in Small Containers or Structures

If you want to make vermicompost on a small scale, you can use everyday containers like: earthen pots, old plastic tanks, wooden boxes, wash basins, any unused or abandoned structure, etc. Just make sure to create holes at the bottom of the container so that extra water can drain out and air can move through. These holes are very important to avoid the compost from becoming too wet and to provide air to the worms. This method is very useful for home composting, especially for kitchen waste or garden leaves. It doesn't require much space or money and can be done in backyards, balconies, or gardens.



INTEXT QUESTIONS 2.1

1. State True or False:

- (a) Earthworms prefer bright sunlight and dry conditions for composting.
- (b) Vermicomposting can be done at the household level using old plastic containers.
- (c) A raised compost bed helps prevent rainwater from entering and spoiling the compost.



Notes



Notes

- (d) Windrow method involves composting inside large cemented tanks only.
- (e) It is important to have a water source nearby to maintain the right moisture in the compost.

2. State Fill in the blanks:

- (a) Vermicomposting is a method of converting waste into compost using earthworms.
- (b) Earthworms need a and environment to stay healthy and active.
- (c) In the trench method, a major problem is of water during the rainy season.
- (d) Small-scale vermicomposting can be done using, wooden boxes, or old plastic tanks.
- (e) Compost bed should be made on and firm ground to avoid collapsing.

2.3 DISCUSS ABOUT THE VARIOUS TYPES OF MATERIAL USED FOR VERMICOMPOSTING

Once you've selected a suitable location and arranged for the bedding materials and structural setup (temporary or permanent), the next crucial step is to prepare the vermi-bed. Follow these well-defined steps and material required to ensure successful vermicomposting:

2.3.1 Ensure Proper Shading for the Vermi-bed

Earthworms are sensitive to direct sunlight and excessive heat. Therefore, it is essential to set up the vermi-bed in a shaded area. This can be done in two ways:

- Temporary shading: Use thatched roofing made from locally available materials like paddy straw, dried palm or coconut leaves, bamboo mats, etc.
- Permanent structure: Construct a fixed shed with roof materials such as corrugated sheets, tin, or asbestos to protect the bed throughout the year.

This shaded structure helps maintain moderate temperature and humidity—ideal conditions for earthworm activity.



2.3.2 Create a base layer of biodegradable material (5–6 cm thick)

The first layer of the vermi-bed should consist of a cushiony and breathable base made from easily decomposable dry organic matter. Suitable materials include:

- Wheat or rice straw
- Dried leaves
- Banana or coconut leaves
- Other crop residues

This layer helps in aeration and drainage, ensuring excess moisture does not accumulate at the bottom.

2.3.3 Add a Partially Decomposed Cow Dung Layer (30 cm Thick)

On top of the base layer, spread a thick layer (30 cm) of 15 to 20-day-old partially decomposed cow dung. Fresh dung should be avoided as it may release heat and harm the worms. This layer acts as a primary food and nutrient source, offering a rich microbial environment for earthworms to thrive.

2.3.4 Apply the Earthworm Feed Layer (20 cm Thick)

Now, add a 20 cm thick layer of partially decomposed earthworm feed, which is a mixture of cow dung and biodegradable waste. Suitable waste materials include:

- Agricultural waste (e.g., crop residues, husks)
- Vegetable and fruit market waste
- Food processing waste (e.g., peels, pulp)
- Paper mill sludge, distillery waste
- Biogas slurry
- Municipal organic waste
- Feed Preparation Tip:
 - Chop the organic waste into small pieces (5–6 cm in size).
 - Mix thoroughly with cow dung.
 - Sprinkle with water to maintain moisture.
 - Turn the mixture periodically to allow partial decomposition (takes 15–20 days).
- Earthworms digest decomposed material more effectively, making this step crucial for faster composting.



Notes

2.3.5 Introduce Earthworms (1000 worms/m²)

Once the feed is laid down, introduce about 1000 earthworms per square meter onto the bed. The best time to release them is during the early morning or late evening, when temperatures are moderate. Commonly used earthworm species for composting include *Eisenia fetida* (red wigglers).

2.3.6 Cover the Bed Surface

To protect the worms from direct light and maintain surface moisture:

- Cover the top with gunny bags, banana/coconut leaves, or a thin layer of rice straw.
- This not only keeps the bed moist but also allows the worms to move freely while shielding them from predators.
- The total height of the vermi-bed can be maintained between 0.5 to 0.75 meters, depending on the materials used and the composting scale.

2.3.7 Maintain Optimal Moisture (50–60%)

- Moisture is vital for worm survival and composting efficiency. Keep the bed consistently moist (not soggy) by:
- Sprinkling water regularly – preferably in the morning or evening.
- Avoiding waterlogging, which can reduce oxygen levels and harm the worms.
- You can check moisture by squeezing a handful of the material: it should feel like a wrung-out sponge – moist but not dripping.



INTEXT QUESTIONS 2.2

1. State True or False:

- (a) Earthworms can survive well in direct sunlight and hot temperatures.
- (b) Fresh cow dung should be used directly for vermicomposting.
- (c) Partially decomposed organic waste is better digested by earthworms than fresh waste.
- (d) A base layer of dried straw or leaves helps in proper drainage and air flow.
- (e) Gunny bags or straw can be used to cover the top of the vermi-bed to protect the worms.



2. State Fill in the blanks:

- The first layer of the vermi-bed should be made of materials like straw or dried leaves.
- A 30 cm thick layer of partially decomposed is added above the base layer.
- About earthworms are released per square meter of vermi-bed.
- The total height of the vermi-bed should be between to meters.
- The ideal moisture content in a vermi-bed should be around to %.

2.4 TYPES OF SUITABLE EARTHWORM AND THEIR REQUIREMENTS FOR VERMICOMPOSTING

Earthworms are one of the most significant and beneficial soil organisms found abundantly in natural ecosystems. They play a crucial role in improving soil fertility, structure, and aeration by decomposing organic matter and enhancing microbial activity. They constitute a large portion of the total biomass in the soil, meaning their living bodies contribute significantly to the life within the soil environment. Globally, there are about 3000 known species of earthworms, spread across different continents and climatic zones. In India, approximately 384 species have been recorded, highlighting the country's rich soil biodiversity. .Scientifically, earthworms fall under the category of higher non-chordates, meaning they are animals without a backbone. Their taxonomic classification places them in the phylum Annelida, which consists of segmented worms. Within this phylum, they belong to the class Oligochaeta and further to the order Linicolae. Various species of earthworms are grouped into different families based on their structural features, reproductive behavior, and ecological roles. A species is a group of individuals that share common characteristics and can reproduce among themselves. Some of the species are given as under:

Family	Genus	Species
Lumbricidae	<i>Eisenia</i>	<i>fetida</i>
	<i>Eisenia</i>	<i>andrie</i>
Eudrilidae	<i>Lumbrieus</i>	<i>rubellus</i>
	<i>Endrilus</i>	<i>euginiae</i>
Megascolecidae	<i>Perionyx</i>	<i>excavatus</i>
	<i>Lampita</i>	<i>mauritii</i>
Moniligastridae	<i>Dravida</i>	<i>willsii</i>



Earthworms play diverse roles in soil ecosystems, and their behavior can be better understood by examining how and where they live. They can be broadly classified based on their feeding habits and natural habitat. Understanding these categories helps us identify which species are best suited for purposes like vermicomposting and soil improvement.

2.4.1 Classification Based on Feeding Habits

Earthworms can be divided into two main groups depending on the kind of material they consume:

2.4.1.1 Phytophagous Earthworms

Phytophagous earthworms feed primarily on partially decomposed organic matter such as plant residues and decaying biomass. Because of this preference, they are also known as humus or manure farmers. These worms are highly efficient in breaking down organic waste and are most commonly used in vermicomposting systems. Two of the most widely recognized species in this group are *Eisenia fetida* (commonly known as red wigglers) and *Eudriluseugeniae* (African night crawler).

2.4.1.2 Geophagous Earthworms

Geophagous earthworms feed mainly on mineral soil, ingesting soil particles along with organic residues. Also referred to as humus feeders or ploughmen, these worms dwell deeper in the soil layers, particularly in furrows and underground burrows. While they are not used in vermicomposting, they are incredibly important for improving soil structure, aeration, and nutrient cycling.

2.4.2. Classification Based on Habitat

Earthworms also vary in their habitat preferences and the role they play in the soil ecosystem. Based on where they are commonly found, they are categorized into three ecological groups:

2.4.2.1 Epigeic Earthworms

Derived from the Greek word meaning “upon the earth,” epigeic earthworms are surface dwellers, usually found in the top layer of soil amidst fallen leaves, crop residues, and decomposing organic matter. Due to their ability to consume large quantities of organic waste and withstand a wide range of temperatures, they are highly efficient in vermicomposting. These worms are also known as surface feeders. Key species include *Eisenia fetida*, *Eisenia andrei*, *Eudriluseugeniae*, *Lumbricus rubellus*, *Perionyx excavatus*, *Dendrobaena veneta*, and *Dendrodrilus rubidus*.



2.4.2.2 Anecic Earthworms

From the Greek term meaning “out of the earth,” anecic earthworms are deep burrowers. They build vertical tunnels deep into the soil, coming up occasionally to the surface to feed. These species are moderate decomposers but play a key role in improving soil porosity and structure. Their tolerance to temperature and moisture fluctuations is relatively low. Common anecic species include *Aporrectodea trapezoides*, *Lumbricus terrestris*, *Lampito polyphemus*, *Lampitomauriti*, and *Aporrectodea longa*.

2.4.2.3 Endogeic Earthworms

Meaning “within the earth,” endogeic earthworms live entirely below the soil surface. They rarely come to the top layer and feed on organic matter mixed with mineral soil, helping in soil mixing, aggregation, and aeration. These species are not ideal for composting, but they are crucial for maintaining healthy soil structure. Important endogeic species include *Octochaetonathurstoni*, *Aporrectodea caliginosa*, *Allolobophora rosea*, *Drawidabarwelli*, and various species from the *Amyntas* genus.

2.4.3 Suitable Earthworm Species for Vermicomposting

Out of the many earthworm species found in nature, certain types are particularly well-suited for **vermicomposting** – the process of using earthworms to convert organic waste into nutrient-rich compost. Among the different ecological groups, the **epigeic species**—those that live near the soil surface and feed on decomposing organic matter—are the most effective for this purpose.

Three epigeic species stand out as ideal candidates for vermicomposting: *Eudriluseugeniae* (African night crawler), *Eisenia fetida* (red wiggler), and *Perionyx excavatus*. These species are widely used across various composting systems due to their rapid growth, high feeding rates, and adaptability.

2.4.4 Desirable Traits of Earthworms used in Vermicomposting

The following characteristics are considered essential for selecting earthworms best suited for compost production:

- A good vermicomposting species should have a high rate of biomass consumption, meaning it can feed quickly and in large quantities on organic residues. Additionally, it must efficiently convert the ingested material into body proteins, which supports rapid growth and overall composting efficiency.
- The species should exhibit a broad tolerance to environmental conditions, allowing it to function well across varying levels of temperature, humidity,



Notes

and organic matter composition. Its ability to thrive on diverse types of biodegradable waste is also important to ensure adaptability in different composting setups.

- Another important trait is reproductive efficiency. The earthworm should produce a large number of cocoons with short hatching periods, which ensures quick and sustained population growth within the composting unit.
- The life cycle of the species should be such that it reaches the mature or reproductive phase quickly, enabling it to multiply and process waste continuously and efficiently.
- In addition to growth and reproduction, resistance to diseases and environmental stress is vital. A robust species can withstand fluctuating composting conditions without compromising its performance.
- Lastly, instead of relying on a single species, it is often more effective to use a mixture of compatible species. This diversity allows for better utilization of various organic materials and enhances the overall stability and efficiency of the composting process.



INTEXT QUESTIONS 2.3

1. State True or False:

- (a) *Eisenia fetida* is an epigeic species commonly used in vermicomposting.
- (b) Endogeic earthworms are surface feeders and ideal for composting.
- (c) Earthworms help improve soil structure, aeration, and fertility.
- (d) There are only about 50 species of earthworms found in India.
- (e) A good composting earthworm species should grow quickly and reproduce efficiently.

2. State Fill in the blanks:

- (a) Earthworms belong to the phylum and class
- (b) The red wiggler, also known as, is widely used in vermicomposting.



- (c) Epigeic earthworms live on the of the soil and feed on organic waste.
- (d) Earthworms that feed mainly on mineral soil are called earthworms.
- (e) A desirable earthworm for composting should produce many and have a short period.

2.5 DESCRIBE THE TOOLS & EQUIPMENT AND MATERIALS USED IN MAKING VERMICOMPOST UNIT

Establishing a vermicompost unit requires a combination of simple tools, basic equipment, and organic materials. These facilitate the construction of vermibeds, maintenance of environmental conditions, and efficient processing of organic waste. The requirements may vary depending on the scale of operation – household, institutional, or commercial but the core components remain largely the same.

2.5.1 Tools and Implements

These are essential for cutting, turning, and managing compost materials:

Spade or Shovel: Used for mixing and turning organic matter, cow dung, and decomposed feed.

Hand Fork: Helps in loosening the materials for better aeration and worm movement.

Rake: Useful for leveling and spreading materials evenly on the vermibed.

Sickle or Knife: Used for chopping organic residues like straw, leaves, and vegetable waste into smaller pieces (5–6 cm) to facilitate faster decomposition.

Watering Can or Hose Pipe with Sprayer: For maintaining moisture content (50–60%) in the vermibed through controlled sprinkling.

Buckets and Tubs: Used for collecting and transporting raw materials or compost.

2.5.2 Equipment and Structures

These are used to create the composting space and maintain favorable conditions for earthworms:



Notes

- **Vermibed or compost tank:** The core structure where vermicomposting takes place. It can be:
 - Brick-and-cement tank (permanent structure)
 - Pits or trenches (dug into the ground)
 - HDPE vermibeds (portable, commercial vermibed units with drainage and aeration provisions)
- **Shade structure:** A shed or roof (thatched, tin, or polyhouse) to protect worms from direct sunlight and heavy rains.
- **Drainage pipes:** Installed in permanent structures to allow excess water to drain out, preventing waterlogging.
- **Sieves or mesh screens:** Used to separate worms from the finished compost during harvesting.

2.6 INTERNAL AND EXTERNAL ORGANS OF EARTHWORMS AND THEIR REPRODUCTION

Earthworms are soft-bodied, long, and cylindrical animals that live in the soil. Though they look simple from the outside, they have a well-organized body system on the inside. Let us learn about the external organs, internal organs, and how they reproduce.

2.6.1 External Organs of Earthworms (Visible from Outside)

The body of an earthworm is covered with a moist, slimy skin and shows some important features:

(a) Segments

The earthworm's body is made up of 100–120 ring-like segments called metamerer. These rings give the body its flexible movement and are all similar in appearance.

(b) Mouth

Located at the front end (anterior side) of the worm, the mouth helps in taking in soil and organic matter, which the worm uses as food.

(c) Anus

Located at the rear end (posterior side), the anus is where undigested waste is removed from the body.

**(d) Clitellum**

This is a thickened, glandular band present around segments 14 to 16 in mature earthworms. It looks like a smooth, light-colored ring. The clitellum helps in reproduction by forming a cocoon for eggs.

(e) Setae

Each segment (except the first and last) has tiny, bristle-like hairs called setae. These help the worm grip the soil and move forward or backward.

(f) Prostomium

This is a small, fleshy lobe that hangs over the mouth. It acts like a cover and helps the earthworm to sense the soil and find food.

2.6.2 Internal Organs of Earthworms (inside the body)

Though earthworms don't have bones or eyes, they have many important internal systems for digestion, circulation, and more.

(a) Digestive system

- Earthworms eat soil containing organic matter.
- The food travels from the mouth → pharynx → esophagus → crop → gizzard → intestine.
- The crop stores food, the gizzard grinds it, and the intestine digests it with the help of enzymes.
- Nutrients are absorbed, and the waste exits through the anus.

(b) Circulatory system

- Earthworms have a closed circulatory system, meaning blood flows through blood vessels.
- They have five pairs of hearts (aortic arches) near the front of the body.
- Blood carries nutrients and oxygen to the entire body.

(c) Respiratory system

- Earthworms do not have lungs.
- They breathe through their skin, which must always stay moist so that oxygen can dissolve and enter the body, and carbon dioxide can exit.

**(d) Nervous system**

- Earthworms have a simple brain (nerve ring) and two ventral nerve cords running along the body.
- They can sense light, touch, moisture, and vibrations, even though they don't have eyes or ears.

(e) Excretory system

- Wastes are removed from the body by structures called nephridia (present in almost every segment).
- They help remove excess water and nitrogenous waste from the body.

(f) Reproductive organs

- Earthworms are hermaphrodites, meaning each worm has both male and female reproductive organs.
- They have testes and sperm sacs (for producing sperm) and ovaries (for producing eggs).

2.6.3 Reproduction in Earthworms

Even though each earthworm has both male and female organs, they cannot fertilize their own eggs. So, they reproduce through mating.

(a) Mating process

- Two earthworms come together and lie side by side, facing opposite directions.
- They **exchange sperm** through their male reproductive openings.
- This process happens mostly at night and during the rainy season.

(b) Cocoon formation

- After mating, the clitellum secretes a mucous ring, which forms a cocoon around the body.
- As the earthworm wriggles backward, the cocoon collects eggs and sperm and slips off the body.

(c) Hatching

- The cocoon is left in the soil, where the fertilized eggs develop inside.
- After 2 to 3 weeks, young baby earthworms hatch from the cocoon and begin their life in the soil.



2.6.4 Discuss various types of vermibeds along with their specifications and their preparation techniques

Vermibeds are special beds or structures made for vermicomposting, which means using earthworms to convert waste (like vegetable peels and cow dung) into rich, dark, healthy compost called vermicompost. Let's learn all about the types of vermibeds and how to make them!

2.6.4.1 Why Do We Need Vermibeds?

- To give earthworms a safe and comfortable place to live
- To keep composting materials like cow dung, leaves, and kitchen waste together
- To keep moisture and air at the right levels
- To easily collect vermicompost after the process is complete

2.6.4.2 Types of Vermibeds

Vermibeds are mainly of three types depending on the materials and structures used.

1. Pit or Trench Type Vermibed

What is it?

A pit or trench dug in the ground and used as a composting bed.

Specifications

- Size: 3 meters (length) × 1 meter (width) × 0.3 to 0.5 meters (depth)
- Should be in a shady and well-drained place

How to Prepare

1. Choose a place that doesn't get waterlogged.
2. Dig a trench or pit of the mentioned size.
3. Line the bottom with dry leaves or sugarcane trash to help with drainage.
4. Add cow dung and kitchen waste layer by layer.
5. Release earthworms (like *Eisenia fetida* or *Perionyx excavatus*) into the pit.
6. Cover with a wet gunny bag or straw to protect worms from sunlight.
7. Sprinkle water every day to keep it moist (not too wet!).



Notes

Pros

- Cheap and easy to make
- Materials available locally

Cons

- Can get flooded in rainy season
- Hard to collect compost from the pit

2. Brick or cemented tank type vermibed

What is it?

A permanent bed made with bricks or cement.

Specifications

- Size: 3m (L) × 1m (W) × 1m (H)
- Floor should be slightly sloped for drainage
- Drainage holes at the bottom or corner

How to Prepare

1. Build a rectangular tank using bricks and cement.
2. Allow it to dry for a few days.
3. Place a layer of sand or gravel at the bottom.
4. Add dry leaves or coconut husk.
5. Then, add alternate layers of organic waste and cow dung.
6. Introduce earthworms.
7. Cover with wet cloth, straw or jute bags.
8. Keep sprinkling water to maintain moisture.

Pros

- Durable and lasts long
- Easy to manage compost and worms

Cons

- More expensive to construct



3. Portable or fabric vermibed

What is it?

A ready-to-use vermibed made of UV-stabilized HDPE fabric (plastic cloth) supported by metal or bamboo poles.

Specifications

- Size: Usually 3m × 1m × 0.75m
- Has air vents and drainage outlet
- Comes with a zip or flap for collecting compost

How to Prepare

1. Place the fabric bed on a flat surface (cemented or soil).
2. Tie and fix the fabric bed using poles and ropes.
3. Put a base layer of sand, bricks or coconut husk.
4. Add layers of organic waste, cow dung, and soil.
5. Introduce earthworms.
6. Cover with wet gunny bags or straw.
7. Keep the bed moist but not soggy with regular watering.

Pros

- Easy to move and install
- Clean and well-managed system
- Reusable and can be folded when not in use

Cons

- Can be a bit costly to buy
- Needs proper care and protection from animals



INTEXT QUESTIONS 2.4

1. State True or False:

- (a) Earthworms breathe through their lungs.
- (b) Setae are tiny bristle-like hairs that help earthworms move through soil.
- (c) Portable vermibeds are made from bricks and cement.



Notes

- (d) Sieves or mesh screens are used to separate earthworms from compost.
- (e) Earthworms can fertilize their own eggs without mating.

2. State Fill in the Blanks:

- (a) Earthworms belong to the phylum and class
- (b) The is a thick band around segments 14 to 16 of an earthworm and helps in reproduction.
- (c) A sickle or knife is used to cut organic waste into small pieces of about cm for faster decomposition.
- (d) The three main types of vermibeds are pit or trench, brick or cemented tank, and vermibeds.
- (e) A or hose with a sprayer is used to maintain moisture in the vermibed.



WHAT YOU HAVE LEARNT

- Earthworms are called “farmer’s friends” because they improve soil health by decomposing organic waste and enhancing microbial activity.
- Vermicomposting is the process of using earthworms to turn organic waste into nutrient-rich compost.
- A suitable site for vermicomposting should have flat ground, shade, proper drainage, and easy access to water.
- There are different types of vermicomposting structures such as pits, windrows, and containers suited for small to large-scale operations.
- Vermibeds can be of three main types: pit/trench, brick or cemented tanks, and portable fabric vermibeds.
- Essential tools and equipment include spade, rake, sickle, watering can, and containers for mixing and maintaining compost.
- The vermi-bed preparation involves laying down organic materials like straw, decomposed cow dung, and earthworm feed, followed by the introduction of worms.
- Earthworms are classified based on their feeding habits (phytophagous and geophagous) and habitat (epigeic, endogeic, anecic).

Basics Requirements for Establishment of Vermicompost Unit

- Important external organs of earthworms include segments, clitellum, setae, mouth, and prostomium; internal systems support digestion, respiration, circulation, and reproduction.
- Suitable species for vermicomposting are epigeic earthworms like *Eisenia fetida*, *Eudriluseugeniae*, and *Perionyx excavatus*, which are efficient composters due to their rapid growth and feeding habits.



Notes



TERMINAL EXERCISE

1. Why is a shaded area important for setting up a vermicomposting unit?
2. List any two tools used in vermicompost preparation and their uses.
3. What is the function of the clitellum in earthworms?
4. Name any two suitable species of earthworms for vermicomposting.
5. Differentiate between epigeic and endogeic earthworms.



ANSWER TO INTEXT QUESTIONS

2.1

1. True/False

- (a) False (b) True (c) True (d) False (e) True

2. Fill in the blanks

- (a) organic (b) cool, moist (c) stagnation
(d) earthen pots (e) flat

2.2

1. True/False

- (a) False (b) False (c) True (d) True (e) True

2. Fill in the blanks

- (a) biodegradable (b) cow dung (c) 1000
(d) 0.5, 0.75 (e) 50, 60



Notes

2.3

1. True/False

- (a) True (b) False (c) True (d) False (e) True

2. Fill in the blanks

- (a) Annelida, Oligochaeta (b) Eisenia fetida (c) surface
(d) geophagous (e) cocoons, hatching

2.4

1. True/False

- (a) False (b) True (c) False (d) True (e) False

2. Fill in the blanks

- (a) Annelida, Oligochaeta (b) Clitellum (c) 5–6
(d) portable or fabric (e) watering can

KEY LEARNING OUTCOMES

- Identify the site requirements and setup process for establishing a successful vermicompost unit.
- Distinguish between different types of vermibeds and describe their preparation techniques.
- Recognize suitable earthworm species for composting and understand their role in the soil ecosystem.
- Understand the external and internal anatomy of earthworms, including their reproduction process.
- Use appropriate tools and materials for managing a vermicomposting setup effectively.



3

PROCESS OF MAKING VERMIBED AND VERMICOMPOST PRODUCTION

Learners! In the previous lesson we have discussed about basics requirements for establishment of vermicompost unit. In this lesson we will understand about how to make vermibed and how to proceed for vermicomposting? It is essential to explore how and where earthworms are introduced to initiate the composting process. A key concept in this context is the term “Vermibed”, which is derived from two words: ‘*vermi*’, meaning earthworms, and ‘*bed*’, referring to a structured resting or living space.

Creating an ideal vermibed is crucial for the success of vermicomposting. It involves the selection of appropriate organic materials that are partially decomposed, moist, and soft enough to be consumed by the worms. The bed should provide optimal conditions such as proper aeration, moisture, temperature, and pH to support the biological activity of earthworms. In this lesson, you will gain detailed knowledge about the step-by-step process of vermibed preparation, the types of materials used, and the necessary care and maintenance practices to ensure the health of the worm population. A well-maintained vermibed ensures faster composting and better-quality vermicompost.



OBJECTIVES

After reading this lesson, you will be able to:

- enlist the characteristics of a good vermibed;
- select an appropriate site for vermicomposting;
- prepare a vermibed using appropriate techniques;



Notes

Process of Making Vermibed and Vermicompost Production

- take suitable precautions while preparing a vermibed;
- maintain the vermibeds properly; and
- manage threats of the earthworms and vermicompost.

3.1 ARRANGEMENT AND PREPARATION OF MATERIAL FOR VERMIBED

The success of vermicomposting largely depends on the proper arrangement and preparation of materials for the vermibed, which serves as the habitat for earthworms. A well-constructed vermibed provides ideal living conditions, supporting the decomposition of organic matter and the production of high-quality vermicompost (Fig. 3.1)

(a) Selection of vermibed site

- Choose a shaded, cool, and well-drained area.
- The site should be protected from direct sunlight and heavy rain.
- Concrete or raised platforms are ideal to prevent waterlogging and entry of predators.

(b) Base layer

- Lay a 4–6 cm thick layer of coarse material such as broken bricks, sand, or dry leaves.
- This layer ensures drainage and prevents water stagnation.

(c) Bedding material

- Add 15–20 cm of partially decomposed organic material like cow dung, chopped crop residues, dried leaves, or sawdust.
- The material should be moistened and allowed to decompose slightly before placing the worms.

(d) Introduction of feed

- Add fresh organic waste in layers over the bedding.
- Avoid adding oily, salty, or non-biodegradable items.
- Mix the feed with a little cow dung slurry to initiate microbial activity.



(e) Moisture management:

- Maintain moisture around 60–70%.
- Sprinkle water regularly to keep the bed damp but not soggy.

(f) Covering

- Use a breathable jute bag, gunny cloth, or straw to cover the bed.
- This retains moisture and provides darkness, favorable for worms.

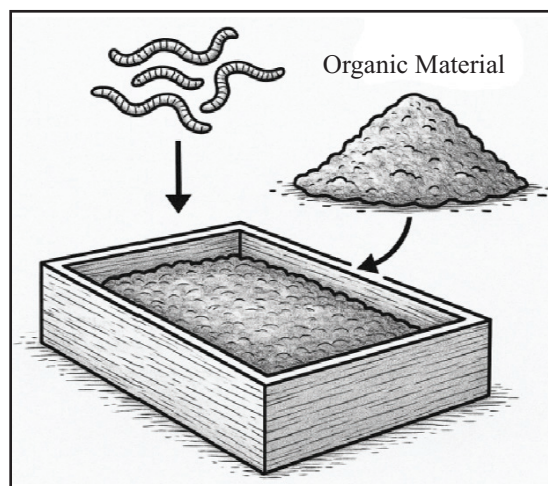


Fig. 3.1: Arrangement and preparation of material for vermibed

3.2 LAYOUT AND PLACING OF MATERIAL IN VERMIBED

The layout and systematic placing of material in a vermibed are crucial for creating a healthy and productive environment for earthworms. The vermibed acts as both the habitat and feeding zone, so it must be arranged to ensure proper aeration, moisture retention, and ease of movement for the worms (Fig. 3.2).

3.2.1 Vermibed Structure/Layout

- The vermibed can be constructed using brick walls, cement tanks, wooden crates, or HDPE vermibed sheets.
- Standard dimensions: 3 meters (length) × 1 meter (width) × 0.5 meters (height).
- The floor should be slightly sloped or have a drainage outlet to prevent waterlogging.



Notes

Process of Making Vermibed and Vermicompost Production

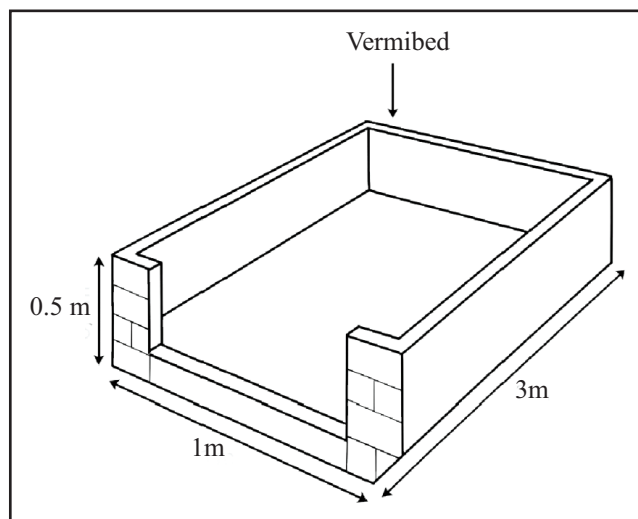


Fig. 3.2: Vermibed Structure/Layout

3.2.2. Layering of materials (Fig. 3.3)

(a) Bottom layer (4–6 cm)

- **Material:** Bricks, coarse sand, pebbles, or gravel.
- **Purpose:** Facilitates drainage and prevents anaerobic conditions.

(b) Second layer (10–15 cm)

- **Material:** Partially decomposed organic waste like straw, dried leaves, or sugarcane trash.
- **Purpose:** Acts as a bedding material, allowing worms to settle and burrow easily.

(c) Third layer (15–20 cm)

- **Material:** Cow dung mixed with bio-degradable kitchen waste or agricultural residues.
- **Condition:** Must be partially decomposed and moistened.

(d) Top layer (2–3 cm)

- **Material:** A thin layer of fine compost, dry leaves, or soil.
- **Purpose:** Helps retain moisture and provides insulation.

3.2.3 Moisture Maintenance

- After layering, sprinkle water uniformly to maintain 60–70% moisture.
- Avoid overwatering to prevent suffocation of earthworms.



3.2.4 Earthworm Inoculation

- Introduce earthworms after 7–10 days of bed setup, once the temperature of the material stabilizes.
- Gently spread 1–2 kg of earthworms per cubic meter over the surface.

3.2.5 Covering

- Use a moist jute sack, straw mat, or shade net to cover the vermibed.
- It maintains humidity, protects from predators, and creates a dark environment favorable for worms.



Fig. 3.3: Placing of material for vermicomposting

Source: Vermicomposting Model, Biomass Utilization Unit, ICAR-IARI, New Delhi



INTEXT QUESTIONS 3.1

State True or False

- (a) Vermicompost is rich in both macro and micro nutrients. (T/F)
- (b) Vermicomposting process involves action by earthworm and microorganisms. (T/F)
- (c) Vermicompost improves soil fertility and productivity. (T/F)
- (d) Sprinkle water uniformly to maintain 60–70% moisture in vermicomposting. (T/F)
- (e) Standard dimensions of vermibed is 3 meters (length) × 1 meter (width) × 0.5 meters (height). (T/F)



3.3 INOCULATION OF EARTH WORMS AND MANAGEMENT OF VERMICOMPOSTING PROCESS

The inoculation of earthworms is a critical step in initiating the vermicomposting process. It involves introducing selected earthworm species into a properly prepared vermibed where they feed on organic waste and convert it into nutrient-rich compost. Proper management after inoculation ensures efficient decomposition and healthy worm activity.

3.3.1 Inoculation of Earthworms

(a) Timing and conditions:

- Inoculate earthworms 7–10 days after placing the organic material to allow partial decomposition and temperature stabilization.
- Ideal bed temperature: 20°C to 30°C.
- Maintain **60–70% moisture** content for ease of movement and feeding.

(b) Selection of earthworms:

- Common species: *Eisenia fetida* (Red Wigglers), *Eudriluseugeniae* (African Nightcrawler).
- These are surface dwellers and efficient converters of organic waste.

(c) Inoculation method:

- Gently place 1–2 kg of worms per cubic meter on top of the bed.
- Allow them to burrow naturally into the feed material.
- Do not disturb them for the next few days to help them adapt.

3.3.2 Management of Vermicomposting Process (Fig. 3.4)

(a) Feeding:

- Add organic feed (vegetable peels, cow dung, farm waste) in thin layers weekly or as needed.
- Avoid acidic, oily, or toxic materials (like citrus, meat, or dairy).

(b) Moisture maintenance:

- Sprinkle water to maintain optimal moisture.
- Avoid waterlogging; provide drainage to remove excess water.



(c) Aeration:

- Occasionally turn the upper layers (not deeper than 5–7 cm) to prevent compaction and ensure aeration.
- Proper air flow prevents foul odor and anaerobic conditions.

(d) Temperature control:

- Protect from direct sun and heavy rain using a shade net or roof.
- If temperature rises above 35°C, sprinkle water or shift to a cooler place.

(e) Pest and predator control:

- Keep the vermibed covered with moist gunny bags or straw to deter ants, birds, and rodents.
- Remove infesting agents manually or use safe barriers.

3.3.3 Compost Harvesting

- After 45–60 days, compost becomes dark, granular, and odor-free.
- Stop feeding a week before harvesting.
- Collect compost from the top and middle, leaving worms and bottom bedding undisturbed.

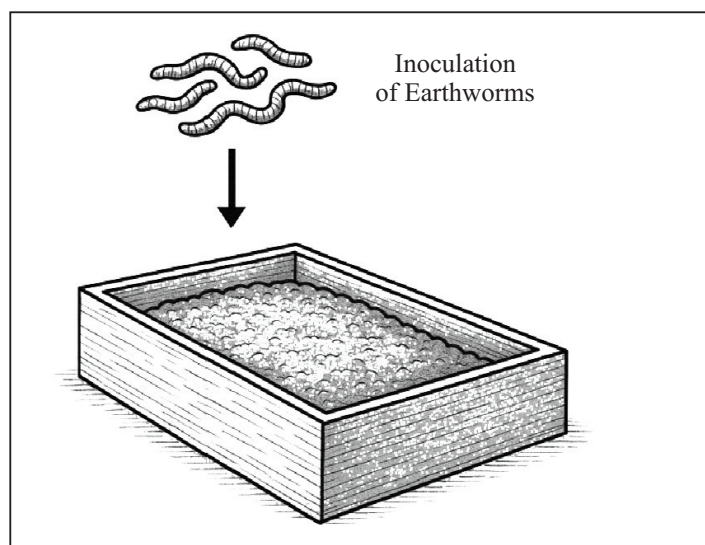


Fig. 3.4: Management of vermicomposting process



Notes

3.3.4 Importance of Proper Aeration and Drainage

Proper aeration and drainage are fundamental to the success of a healthy and efficient vermicomposting system. Earthworms are living organisms that require oxygen and a balanced moisture environment to survive, grow, and decompose organic material effectively.

3.3.4.1. Importance of Aeration

- Oxygen Supply
- Prevents Anaerobic Conditions
- Promotes Microbial Activity
- Enhances Worm Activity

3.3.4.2 Importance of Drainage

- Moisture Control
- Prevents Leachate Accumulation
- Reduces Pest Infestation
- Improves Compost Quality

3.4 FAVOURABLE CONDITIONS FOR EARTHWORM CULTURE IN THE COMPOSTING MATERIAL

For successful vermicomposting, it is essential to create and maintain optimal conditions that support the health, reproduction, and composting efficiency of earthworms. The following are the key factors that determine a suitable environment for earthworm culture in composting material:

1. Moisture content (60–70%)
2. Temperature range (20°C–30°C)
3. pH Level (6.5–7.5)
4. Proper aeration
5. Organic feedstock
6. Shelter and darkness
7. Absence of predators



3.5 TECHNIQUES OF EARTHWORM INOCULATIONS, FEED MANAGEMENT AND WATERING METHODS

3.5.1 Earthworm Inoculations

The selection and inoculation of earthworms are crucial steps in establishing a successful vermicomposting system (Fig. 3.5. and 3.6). It is recommended to use efficient composting species such as *Eisenia fetida*) and *Eudriluseugeniae*, as these species are highly effective in decomposing organic waste and reproducing rapidly under favorable conditions (Fig. 3.5).

For optimal performance, inoculate 1–2 kilograms of earthworms per cubic meter of the vermibed. The timing of inoculation is also important. Earthworms should be introduced 7–10 days after the bedding preparation, allowing the organic material to partially decompose and the temperature to stabilize, ensuring a safe and comfortable environment for the worms.

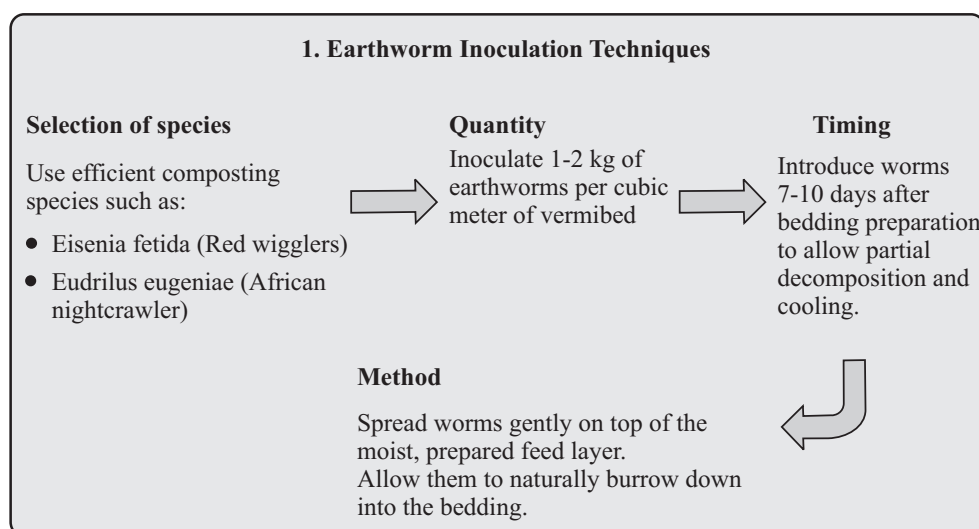


Fig. 3.5: Earthworm inoculation

The inoculation method involves gently spreading the earthworms over the surface of the moist, prepared feed layer. There is no need to bury them, as the worms will naturally burrow down into the bedding in search of cooler, darker, and nutrient-rich zones. This method minimizes stress on the worms and helps them quickly adapt to their new habitat.

3.5.2 Feeding Management

Feeding should be done in thin, even layers on a weekly basis. This approach helps avoid compaction and overheating of the bed. It's important to regularly observe



Notes

Process of Making Vermibed and Vermicompost Production

how much of the feed is being consumed and adjust the quantity accordingly to match the worms' needs. Overfeeding can lead to foul odors and pest infestations (Fig.3.6).

Certain materials must be strictly avoided in a vermicompost unit. These include oily, spicy, or salty foods, as well as meat, dairy products, and citrus fruits. Such substances can harm the worms, alter the pH of the compost, and attract pests. Synthetic and non-biodegradable wastes should never be introduced into the vermibed.

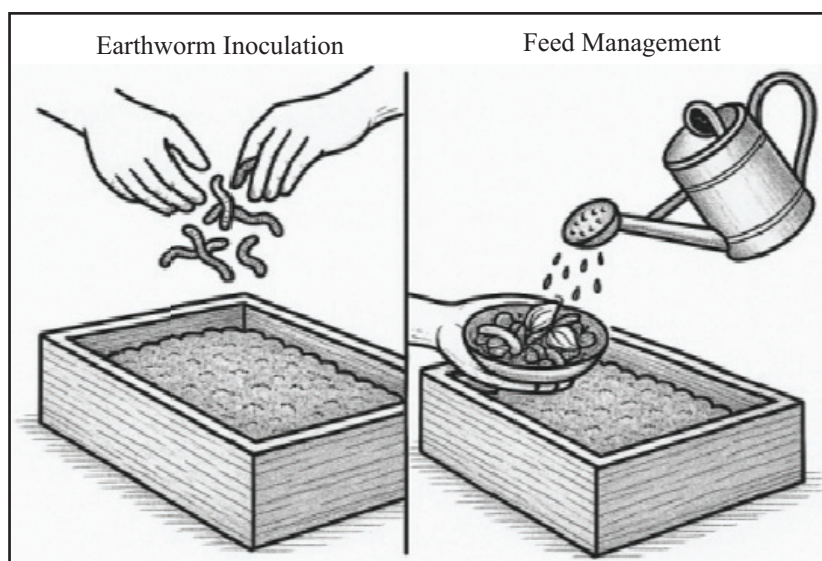


Fig. 3.6: Techniques of earthworm inoculation, feed management and watering method

3.6 TOOLS AND MATERIALS USED IN INOCULATION OF EARTHWORMS AND MANAGEMENT OF FEEDS AND PROTECTION FROM PREYS

A. Tools and materials for earthworm inoculation (Fig. 3.7.):

1. **Earthworms** – Species like *Eisenia fetida* or *Eudriluseugeniae*
2. **Moisture Meter** – To monitor and maintain optimal moisture (60–70%)
3. **Thermometer** – For checking compost temperature (ideal: 20–30°C)
4. **Hand Gloves** – For safe handling of earthworms and bedding material
5. **Spade or Shovel** – For turning and preparing bedding



6. **Buckets or Baskets** – To transport worms and materials
7. **Measuring Scale or Container** – To measure worm quantity (1–2 kg per m³)

B. Tools and materials for feed management:

1. **Organic Feedstock** – Vegetable peels, cow dung, crop residues, etc.
2. **Chopping knife/Cutter** – To shred large pieces of organic waste
3. **Sprayer/Watering Can** – To moisten the compost regularly
4. **Compost Fork or Rake** – For light turning of the top layer
5. **Sieve/Screen** – For separating vermicompost from earthworms during harvesting

C. Tools and materials for protection from predators:

1. **Wire Mesh or Netting** – To cover the vermibed and prevent birds and rodents
2. **Neem Leaves or Powder** – Natural repellent for ants and insects
3. **Moist Gunny Bags or Straw Mats** – To cover the bed and maintain humidity
4. **Raised Platform or Bricks** – To prevent entry of ants and waterlogging
5. **Boundary Wall or Enclosure** – To protect the bed from animals and pests

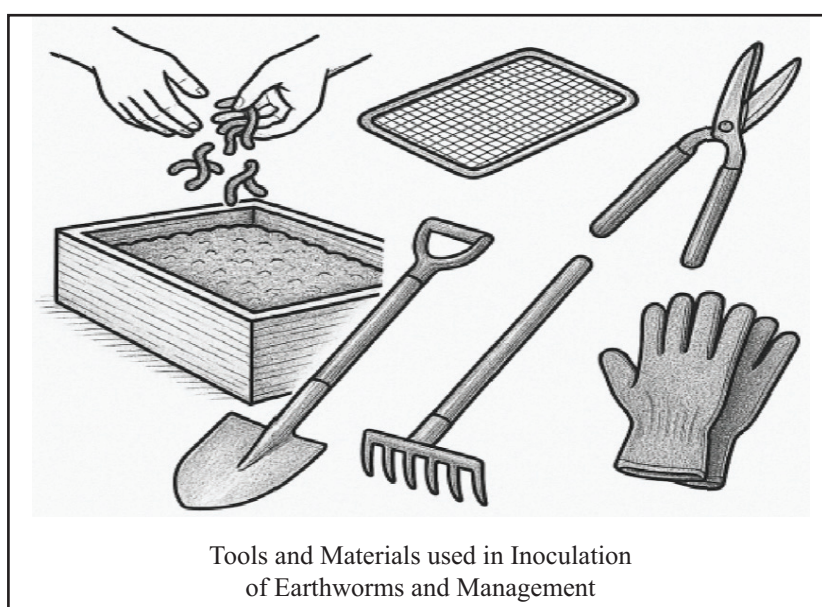


Fig. 3.7: Tools and material for inoculation of earthworm



Notes



INTEXT QUESTIONS 3.2

State Fill in the blank

- (a) The ideal composting temperature is
- (b) Neem leaves or powder are for ants and insects.
- (c) If temperature rises above, sprinkle water or shift to a cooler place.
- (d) Maintain moisture content for ease of movement and feeding.
- (e) Top layer of vermibed should

3.7 IMPORTANCE OF MAINTAINING OPTIMUM CONDITION IN VERMICOMPOST UNIT/HEAP

Maintaining optimum conditions in a vermicompost unit or heap is essential for ensuring the health, activity, and reproduction of earthworms, as well as for producing high-quality compost efficiently. Earthworms are living organisms that are sensitive to their environment. Therefore, the physical, chemical, and biological conditions of their habitat must be well regulated.

3.7.1 Promotes Earthworm Health and Activity

- Earthworms require specific temperature, moisture, pH, and oxygen levels to function efficiently.
- Ideal conditions keep them active, ensuring continuous breakdown of organic matter.

3.7.2 Enhances Composting Speed

- Under favourable conditions, earthworms digest and convert organic waste faster.
- This leads to quicker vermicompost production (usually within 45–60 days).

3.7.3 Improves Quality of Vermicompost

- Optimum moisture and aeration promote the growth of beneficial microbes.
- The resulting compost is nutrient-rich, well-aerated, and has good structure and water-holding capacity.



3.7.4 Prevents Unpleasant Odors and Pests

- Balanced conditions prevent the development of anaerobic zones, which cause foul smells.
- It also reduces the risk of attracting flies, ants, rodents, and harmful microbes.

3.7.5 Ensures Earthworm Reproduction

- Proper environmental conditions help in the growth and multiplication of worms.
- This maintains or increases the population necessary for large-scale composting.

3.7.6 Reduces Mortality of Earthworms

- Extreme temperatures, dryness, or waterlogging can stress or kill worms.
- Consistent monitoring of moisture (60–70%) and temperature (20–30°C) helps prevent losses.

3.7.7 Increases Efficiency and Sustainability

- A well-managed unit requires fewer corrective actions, saves time and resources, and results in a sustainable waste management system.

3.8 THE EQUIPMENT TO MONITOR THE AERATION, TEMPERATURE AND MOISTURE

Effective monitoring is essential for maintaining the optimal conditions required for earthworm activity and composting efficiency. Below is a list of commonly used equipment to track aeration, temperature, and moisture levels in a vermicompost unit (Fig. 3.8):

3.8.1 Equipment to Monitor Aeration

1. Compost aeration probe or rod

- A long, narrow rod with a handle used to check for compacted layers and airflow.

2. Hand rake or turning fork

- Used for manual turning to assess the porosity and looseness of the compost.

3. Visual and physical check

- Though not an instrument, regular observation for signs like foul odor, compacted material, or slow decomposition can indicate poor aeration.



Notes

3.8.2 Equipment to Monitor Temperature

1. Soil/compost thermometer

- A long-stemmed thermometer that measures internal compost temperature.
- Ideal range: 20–30°C for vermicomposting.

2. Digital temperature probe

- Offers precise and real-time readings of compost temperature.

3. Infrared thermometer (Non-Contact)

- Useful for surface temperature checks in large or commercial vermibeds.

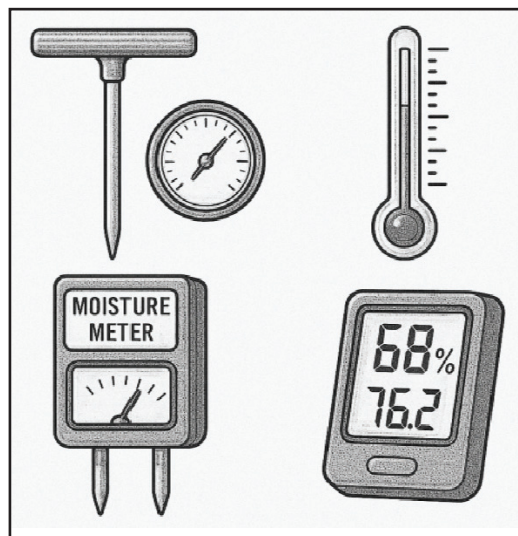


Fig. 3.8: Equipment to monitor aeration, temperature and moisture

3.8.3 Equipment to Monitor Moisture

1. Moisture meter

- A handheld device inserted into the compost to measure moisture percentage.
- Ideal moisture: 60–70%.

2. Squeeze test (manual method)

- Grab a handful of compost; it should feel like a wrung-out sponge – moist but not dripping.

3. Digital Hygrometer (with Probe)

- Measures both humidity and moisture levels in the composting area.



3.9 DISCUSS CONTROL MEASURES FOR THE DIFFERENT TYPES OF PREDATORS THAT PREY ON EARTHWORMS

In a vermicomposting setup, earthworms are vulnerable to a variety of natural predators that can reduce their population, disrupt the composting process, and affect the quality of the vermicompost. To ensure a healthy and productive environment for the worms, it is important to identify these predators and apply appropriate control measures.

3.9.1 Birds

Problem: Birds can easily spot and pick out worms, especially during feeding or bed maintenance.

Control measures:

- Cover vermibeds with wire mesh, shade nets, or gunny sacks.
- Build a roofed or netted structure over outdoor beds.
- Avoid exposing worms during daytime when birds are active

3.9.2 Ants

Problem: Ants invade the vermibed to feed on worm eggs and composting materials, creating stress for earthworms.

Control measures:

- Surround the vermibed with ant repellents like ash, turmeric, or neem powder.
- Place the vermibed on raised platforms with water or oil barriers at the legs.
- Avoid adding sugary food waste that attracts ants

3.9.3 Rodents (Rats, Mice)

Problem: Rodents dig into beds and eat earthworms and feedstock, disturbing the bed structure.

Control measures:

- Use rodent-proof enclosures or tightly sealed HDPE vermibeds.
- Install fine wire



Notes

3.10 PEST CONTROL MANAGEMENT IN VERMICOMPOST UNIT

Vermicomposting units are vulnerable to various predators and pests that can harm or disturb the earthworm population, reduce compost quality, or cause system failure. Effective pest and predator control management ensures the sustainability of vermicomposting operations (Table 3.1.) and (Fig. 3.9)

Table 3.1: Predators of earthworms and their control measures

S. No.	Predator	Harm caused	Control measures
1.	Birds	Pick and eat earthworms, especially during feeding	• Use nets or mesh covers over beds • Provide shaded roofing or vermibed tunnels
2.	Ants	Attack earthworms or feed on eggs and young worms	• Place vermibed legs in water-filled containers • Use barriers of ash or neem powder • Maintain high moisture (ants dislike wet beds)
3.	Rodents (rats, mice)	Dig into beds and eat worms or feed	• Elevate beds off the ground • Use wire mesh enclosures • Avoid placing food waste that attracts rodents
4.	Beetles and Centipedes	Attack and kill worms by biting or injecting venom	• Handpick and remove regularly • Maintain moist conditions • Keep surroundings clean and debris-free
5.	Snakes and Frogs	Rare, but may enter moist compost areas	• Fence compost area • Keep surroundings clear of hiding spots • Regularly inspect units



Notes

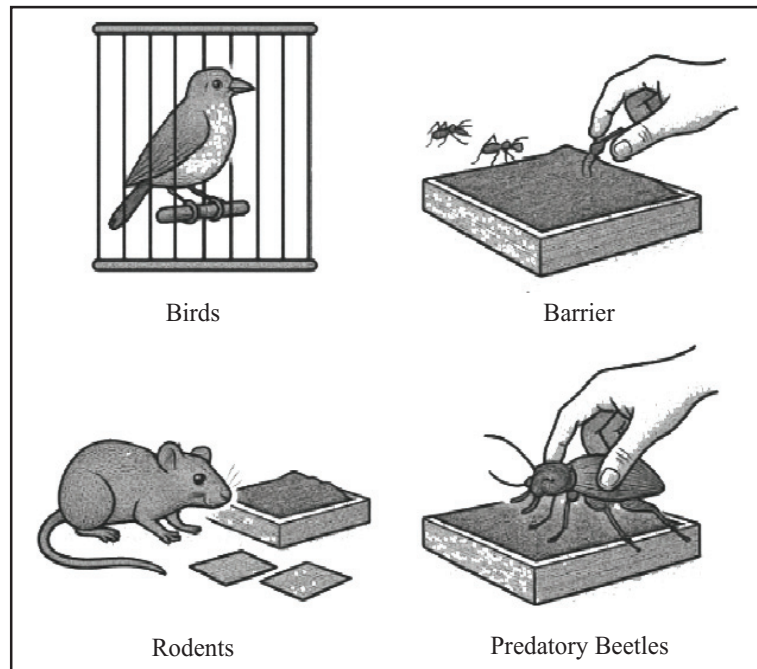


Fig. 3.9: Control measures of predators of earthworm

3.12 HEALTH AND SAFETY REQUIREMENTS DURING THE WORK PROCESS

Health and safety requirements are fundamental to any workplace, especially in agricultural and composting environments where workers are exposed to biological materials, tools, and varying physical conditions. Following proper safety practices ensures the well-being of individuals and the sustainability of the work process (Fig. 3.10).

1. Protects Workers from Health Hazards
2. Reduces Risk of Physical Injuries
3. Promotes Clean and Efficient Work Environment
4. Enhances Productivity
5. Compliance with Legal and Institutional Standards
6. Prevents Environmental Hazards



Notes



Fig. 3.10: Health and safety equipment

3.13 EXPLAIN HOW TO MONITOR AND ADJUST THE FEEDSTOCK QUALITY AND QUANTITY

In vermicomposting, **feedstock** refers to the organic material (such as kitchen waste, cow dung, dried leaves, etc.) fed to earthworms. Monitoring and adjusting its **quality** and **quantity** is essential for maintaining worm health, ensuring efficient decomposition, and producing high-quality compost.

3.13.1 Monitoring Feedstock Quality

To ensure that the feedstock is suitable for earthworms:

3.13.1.1 Check for Proper Decomposition Stage

- Feedstock should be partially decomposed to prevent heat build up.
- Fresh materials can cause temperature spikes harmful to worms.

3.13.1.2 Avoid Toxic Substances

- **Do NOT use:** Meat, dairy, oily, spicy, acidic (like citrus), salty foods, or synthetic waste (plastic, glass, rubber).
- **Safe materials include:** Vegetable peels, fruit scraps (non-citrus), tea leaves, cow dung, dry leaves, and shredded newspaper.



3.13.1.3 Maintain Correct pH

- Ideal pH range: **6.5 to 7.5**
- Add crushed eggshells or a little lime powder if the material becomes too acidic.

3.13.1.4 Observe Smell and Appearance

- A healthy bed has an earthy smell.
- Foul odor indicates anaerobic conditions or overfeeding.

3.13.1.4 Monitoring Feedstock Quantity

To avoid overfeeding or underfeeding the worms:

A. Feed in proportion to worm population

- General rule: Worms eat half their body weight in feed per day.
- For 1 kg of worms, add approx. 500 grams of organic feed daily.

B. Check for leftover material

- If the previous feed is still visible and not broken down after 2–3 days, reduce feeding.
- If compost is processed quickly and worms are active, increase feed slightly.

C. Follow layering technique

- Feed in thin layers instead of dumping large amounts.
- This prevents compaction, overheating, and foul odor.



INTEXT QUESTIONS 3.3

State True and False

- (a) For 1 kg of worms, add approx. 500 grams of organic feed daily. (T/F)
- (b) Ideal pH range: 6.5 to 7.5. (T/F)
- (c) Snakes and frogs are not rare pest in vermicomposting. (T/F)
- (d) To control bird use nets or mesh covers over beds. (T/F)
- (e) Infrared thermometer is use to measure temperature without contact with object. (T/F)



Notes



WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- The term “Vermibed”, which is derived from two words: ‘*vermi*’, meaning earthworms, and ‘*bed*’, referring to a structured resting or living space.
- The bed should provide optimal conditions such as proper aeration, moisture, temperature, and pH to support the biological activity of earthworms.
- Standard dimensions: 3 meters (length) × 1 meter (width) × 0.5 meters (height).
- After layering, sprinkle water uniformly to maintain 60–70% moisture.
- Common species: *Eisenia fetida* (Red Wigglers), *Eudriluseugeniae* (African Nightcrawler). Gently place 1–2 kg of worms per cubic meter on top of the bed.
- After 45–60 days, compost becomes dark, granular, and odor-free.
- Keep the vermibed covered with moist gunny bags or straw to deter ants, birds, and rodents.
- Maintain 60–70% moisture content for ease of movement and feeding.
- Ideal range: 20–30°C for vermicomposting.
- Digital Hygrometer (with Probe) is use to measures both humidity and moisture levels in the composting area.
- Birds, Ants, Rodents (rats, mice), Beetles and Centipedes Snakes and Frogs are pest of vermicomposting



TERMINAL EXERCISES

1. What is the role of optimum condition in vermicomposting?
2. List the major equipment used to monitor the optimum condition.
3. List the major tools and materials for earthworm inoculation.
4. List the major tools and materials for feed management.

Process of Making Vermibed and Vermicompost Production

5. What is the importance of proper aeration and drainage in vermicomposting?
6. Write the step of earthworm inoculation.
7. Enlist few earthworm species used in vermicomposting process.
8. Write short note on the following
 - (a) Vermibed
 - (b) Major Pest in vermicomposting



ANSWER TO INTEX QUESTIONS

3.1

- (a) True (b) True (c) True (d) False (e) True

3.2

- (a) 20-30 °C (b) Natural repellent (c) 35°C
(d) 60-70% (e) 2-3 cm

3.3

- (a) True (b) True (c) True (d) False (e) True

KEY LEARNING OUTCOME

- Explain the characteristic of ideal vermibed preparation.
- Enlist the techniques required for vermibed preparation.



Notes



PREPARATION OF VERMIWASH

Learner's, in the previous lesson you have learnt about the process of making vermibed and vermicompost production. Now, in the current lesson we will be learning about a vital product produced from the vermicomposting system, which is the "Vermiwash". Well, you must be thinking as to what is this product? Broadly, vermiwash is an odourless dark brown coloured liquid organic-fertilizer. Let us now learn about vermiwash in detail.



OBJECTIVES

After reading this lesson thoroughly, you will be able to:

- explain the purpose of vermiwash in agriculture;
- discuss the principle of vermiwash preparation;
- prepare vermiwash as per recommended procedure; and
- establish and maintain a vermiwash unit.

4.1 PURPOSE OF VERMIWASH PREPARATION

Vermiwash is a mixture of the excretory products, mucus (a thick liquid produced in some parts of the body) discharge of earthworms and the macro and micronutrients released from the organic matter used in the vermicomposting medium. You must be aware that the macronutrients are those nutrients that are needed in larger amount and micronutrients are those nutrients that are required in smaller amount by the body. Vermiwash is collected after the passage of water that flows through a column of worms and vermicomposting medium. You will be learning about it's preparation in the upcoming section.

Preparation of Vermiwash



Notes

Vermiwash is applied as a foliar spray in rice, maize, pulses, vegetables, mango, pomegranate, grapes, etc. It can be applied on almost all the crops without any adverse effects on them. When applied, it is easily transported to the leaves, shoots and the other parts of the plants. We can consider it environment friendly, when compared to the chemical fertilizers application. You can also use it as a liquid plant growth regulator, as it contains many growth promoting enzymes, vitamins and hormones, such as auxins, gibberellins etc. along with macro (Nitrogen, Phosphorus, Potassium) and micronutrients (Iron, Zinc, Manganese, Magnesium, Boron, etc.). So, vermiwash is used for many purposes. Let us make a list of them pointwise:

- Vermiwash is used for increasing the absorption of nutrients to the plants.
- It is used for correcting the deficiency (lack or shortage) of nutrients by immediate absorption by leaves.
- It is suitable as a micronutrient foliar spray to supplement the micronutrient requirements of the organic crop.
- It can be applied as a bio-pesticide (a form of pesticide based on micro-organisms or natural products) to protect and develop resistance against various disease and pests (*A pest* is an insect or small animal which damages crops or food supplies) in plants.
- Vermiwash can also be applied as anorganic fertilizer to initiate good flowering, high yield and better quality produce.
- It can also be used in crop nurseries and high value crops (high-value crop refers to the non-traditional food crops such as vegetables, fruits, flowers, house plants and foliage, condiments and spices, etc. that generate more revenue per unit area of land than a conventional grain crop). In these crops it is used as a nutrient source.

4.2 PRINCIPLE OF VERMIWASH PREPARATION

You might have observed that the earthworm's movement in the soil results in the formation of burrows (a hole or tunnel). These burrows are also known as 'Drilospheres', where large population of different microbes are present. When water passes through these passages, it washes the nutrients, microbes and enzymes from these burrows to the roots and it is later absorbed by the plants. The same principle is used in the preparation of vermiwash. Vermiwash is produced by allowing water to enter through the passages made by the earthworms on the vermicompost unit. Then, water is collected in the containers placed at the outlet of the vermiwash collection unit.



Notes

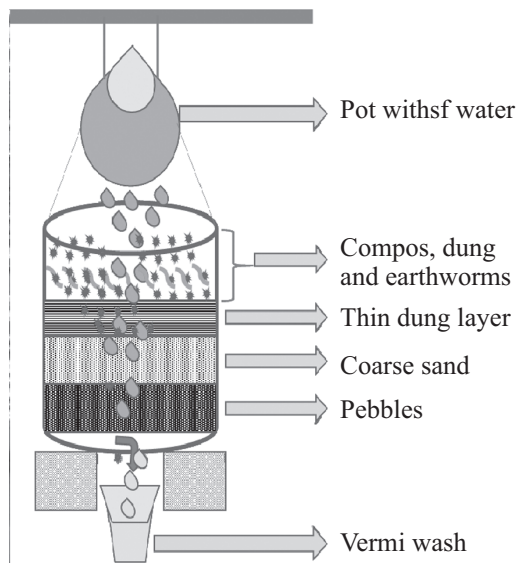
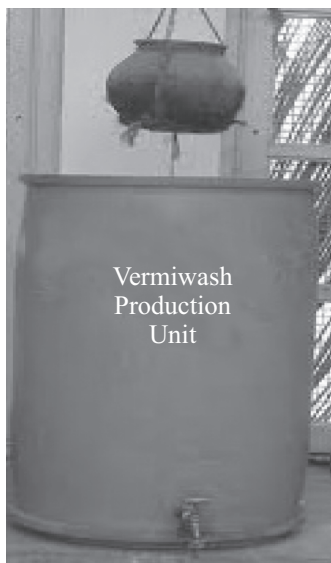
4.3 PREPARATION OF VERMIWASH

You can establish a vermiwash unit by using the easily available materials such as plastic barrels, buckets, small earthen pots, cemented floors, polythene, etc. We will be explaining you a simple and economical technique to collect the vermiwash. For this a system needs to be made. This system would consist of a plastic or iron barrel or cemented tank of 200 litres capacity with dimensions 10 ft × 4 ft × 2.5 ft (Fig. 4.1). This structure should be constructed under a shade and fitted with a tap just above the base of the tank (Fig. 4.2). We need to make a hole on one side and a tube can be attached in a way that half to one inch of the tube projects inside the barrel. At the end of the horizontal limb a tap should be attached and the other end should be closed with a dummy nut. Each tank or barrel should be filled with a layer of broken pieces of bricks or stones upto a height of 5-8 cm to facilitate drainage of excess water. It should be followed by 8-10 cm layer of clean and coarse gravel and then a layer of sand forming the vermiwash filtration and accumulation compartment of the system. The excess water should be allowed to pass through these layers and drain without any blockage from the tap. Then an alternate layer of decomposed cow dung followed by a layer of soil is put in the tank.



Fig. 4.1: Cemented tank for vermiwash preparation

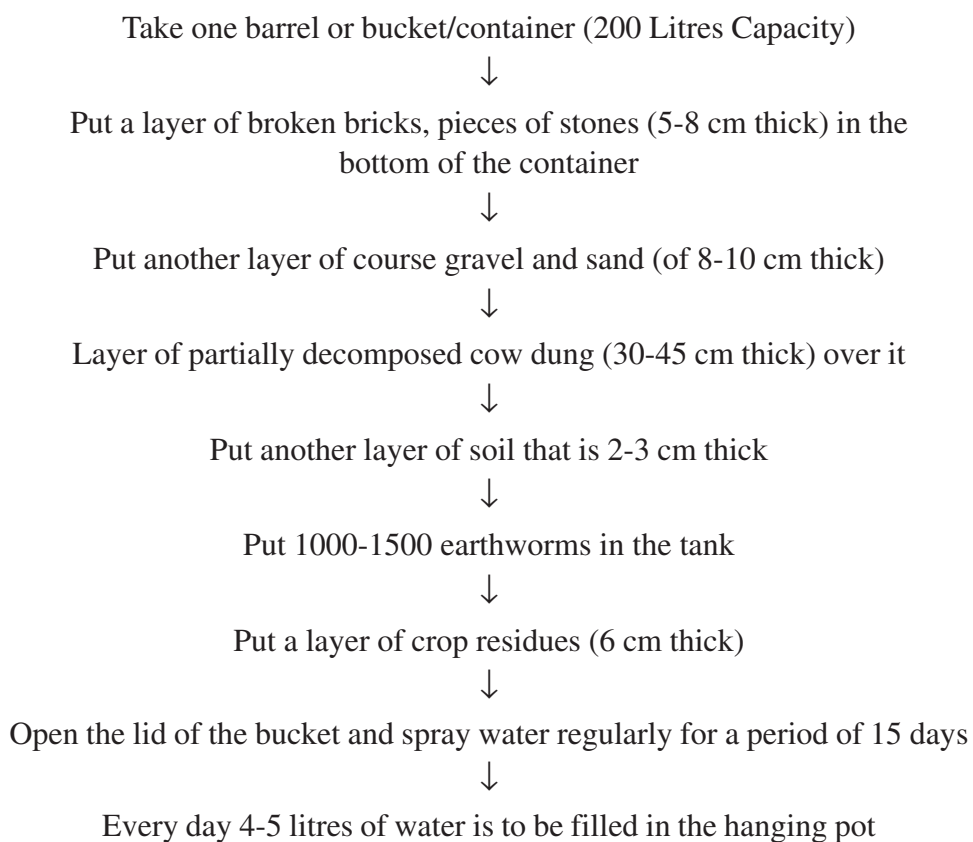
A thick layer of partially decomposed bio-waste (crop residues, grasses, dung, vegetable, wastes, etc.) amounting to about 100 kg should be added such that the substrates filled just upto the brim of the tank. The tanks should be watered frequently to ensure the sufficient moisture (about 50%) in the substrate. Introduce worms into the unit @ 1.5 kg per tank or 1000-1500 numbers. Water should be added every day to keep the unit moist. Vermiwash from each tank can be collected periodically from the bottom of the tank by releasing tap in a separate bucket and can be used for foliar spray.



Notes

Fig. 4.2: Setting up of a vermivash unit

Let us understand the preparation of vermivash stepwise through the following flow diagram (Fig. 4.3):





Notes

Preparation of Vermiwash

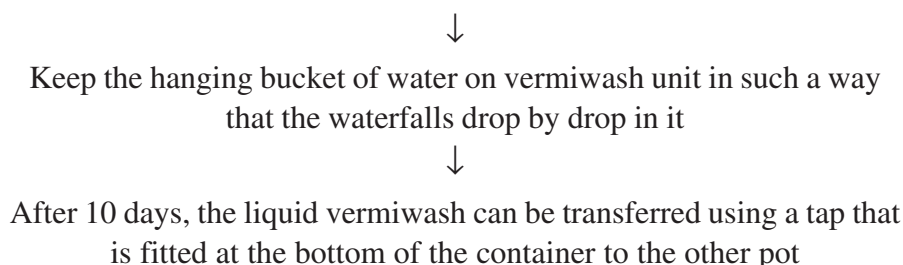


Fig. 4.3: Flow chart of preparation of vermiwash

Here, it is important to note that the layer of broken pieces of bricks or stones facilitates drainage of excess water. However, the coarse gravel and sand forms the vermiwash filtration and accumulation compartment of the system. The preferred earthworm species for vermiwash preparation are *Eudriluseugeniae* or *Eseniafetida*.

So, we hope that you have understood the principle and process of vermiwash preparation now. We also recommend you to visit a nearby vermiwash unit to understand the process vermiwash producers follow.

4.4 FUNCTIONING/HANDLING OF A VERMIWASH UNIT

You need to follow a few simple rules here that will help you in the proper functioning and smooth handling of your vermiwash unit. Let us make a note of them.

- For the first 2 days, keep the tap open and let the solution flow freely. This is required to clear off the impurities.
- Now keep the tap closed for 12 days and start collection from the 13th day after establishment of worm activities.
- The above explained unit will give 4-5 litres of vermiwash per day for 10 days after which the soil and dung mixture is to be replaced/ added.



INTEXT QUESTIONS 4.1

1. State True or False

- (a) Vermiwash is used for cleaning the plants.
- (b) Micronutrients can be supplemented to the crops by vermiwash.
- (c) Vermiwash can be collected from worms and composting columns.



- (d) Vermiwash can be used after drying of liquid medium.

2. State Fill in the Blanks

- (a) Earthworms are introduced into the unit @
- (b) Layer of broken pieces of bricks or stones facilitates
- (c) Vermiwash can be collected after day after establishment of worm activities.

4.5 COMPOSITION/QUALITY OF VERMIWASH

Vermiwash is alkaline (having a pH greater than 7) in nature and contains nitrogen, phosphorus, potash, calcium, magnesium and zinc in significant quantities. The nutrient status of vermiwash generally depends upon the amount and type of biological wastes used for the composting. The important nutrients present in vermiwash are given at (Table 4.1).

Table. 4.1: Important nutrients present in the vermiwash

pH	7.48 ± 0.03
Electrical conductivity (dS/m)	0.25 ± 0.03
Organic Carbon (%)	0.008 ± 0.001
Total Nitrogen (%)	0.01±0.005
Available Phosphate (%)	1.69 ± 0.05
Potassium (ppm)	25.0 ± 2
Calcium (ppm)	3.0 ± 1
Copper (ppm)	0.01 ± 0.001
Iron (ppm)	0.06 ± 0.001
Magnesium (ppm)	158.44 ± 23.42
Manganese (ppm)	0.58 ± 0.040
Zinc (ppm)	0.02 ± 0.001
<i>Nitrosomonas</i> (CFU/ml)	1.01 × 10 ³
<i>Nitrobacter</i> (CFU/ml)	1.12 × 10 ³
Total Fungi (CFU/ml)	1.46 × 10 ³



Notes

Preparation of Vermiwash

For your easy understanding, the abbreviations/difficult words used at Table 4.1 are described below:

- dS/m-deciSiemenspermetre, it is a unit of Electrical Conductivity. Electrical conductivity is the ability of electric current to flow through a material.
- ppm-parts per million.
- CFU/ml-colony forming units per millilitre. CFU is a measure of viable bacterial or fungal cells per millilitre.
- Nitrosomonas and *Nitrobactor*-*Nitrosomonas* and *Nitrobacter* are bacteria found in soil and water that are responsible for oxidation of ammonium to nitrite (*Nitrosomonas*) and nitrite to nitrate (*Nitrobacter*).

4.6 PRECAUTIONS TO BE TAKEN DURING VERMIWASH PREPARATION

You need to take certain precautions while preparation-of vermiwash. Let us know them

- The tap of the container should always be kept open to collect the washings.
- The unit starts yielding good quality vermiwash only after 13 days. So, you need to be a patient.
- The vermiwash should be stored in a cool and dry place. While preparing vermiwash, the water should be poured slowly. Do not mix the undecomposed material in the unit. Always use pre-decomposed material only.

4.7 ADVANTAGES OF THE VERMIWASH SPRAY

As vermiwash comes in a liquid state, hence it is used for foliar application. Foliar application refers to the spraying of fertilizer solutions containing one or more nutrients on the foliage of growing plants. Before applying to the crop, it is recommended to dilute the vermiwash with water in 1:1 ratio or it could be diluted with 10 percent cow urine. There are various advantages of the vermiwash spray. Let us enlist some of them:

- Vermiwash is an eco-friendly natural organic fertilizer prepared from the biodegradable organic wastes, hence it is free from chemical inputs.
- Vermiwash when used upto 20-30% dilution inhibits (prevents) the growth of pathogenic (disease causing) fungi.

Preparation of Vermiwash

- Vermiwash is used as an effective bio-pesticide when diluted with 10% cow urine or neem extract or garlic extract.
- It does not have any adverse effect on the soil, plant and environment.
- It promotes better root growth and nutrient absorption in the plant.
- It can also be added to the compost pits to speed up the degradation process.



Notes

4.8 BENEFITS OF ESTABLISHING A VERMIWASH UNIT

Vermicompost-vermiwash units are considered as “**An income generating enterprise for rural population**”. Production of vermiwash can benefit the farmers and industries both by generation of income and protection of environment as well. Let us know the other benefits pointwise:

Benefits to the Farmers:

- Low cost of crop production due to purchase of less amount of chemical fertilizers, as this will supplement as a nutrient rich fertilizer.
- Increased soil productivity through improved soil quality. Soil *productivity* is the capacity of a soil to produce certain yield of agricultural crops or other plants using a *defined* set of management practices.
- Better quantity and quality of the produce.
- Provides additional source of income generation to the landless people.

Benefits to the Industries:

- The waste organic products can be used. Waste management is a growing industry these days.
- Cost effective pollution reduction technology.
- Generate income by sale of the vermiwash.

Benefits to the Environment:

- Waste does not create any pollution, as they become valuable raw material for enhancing soil fertility.
- Organic waste management reduces the pollution of environment.

To the National Income:

- Boost the rural economy.
- Bring savings on the purchase of external inputs, such as fertilizers and pesticides.
- Less wasteland formation, which is one of the major concerns of today.



Notes

4.9 IS VERMICOMPOST AND VERMIWASH 100% ORGANIC?

In the production of vermiwash, water is passed through the burrows of *Eiseniafetida* and *Eiseniaeugetia* cultured units that contain soil and partially decayed cow dung. The wash is filtered through a natural layer of sand and brick pieces. Therefore, as we are not using any type of chemicals, hence making vermiwash is 100% organic and an eco-friendly process.

Important Points to Keep in Mind While Working in a Vermiwash Unit

- Wash sands and pebbles before putting them in the vermiwash unit.
- Do not add fresh cow dung in vermiwash unit. Fresh cow dung releases high amount of methane and heat that can kill the worms.
- The vermiwash unit should be prepared at a shady place.
- The unit should be moist but not wet. This implies that excess water may kill the worms and this would reduce the quality of the vermiwash.
- Check the unit periodically for eggs of the worms. The population count of the eggs should be optimum (less eggs means there is problem in the unit because of moisture or other factors).
- Vermiwash has a shelf life of 2 months only, so use it before its quality deteriorates.



INTEXT QUESTIONS 4.2

1. State True or False

- (a) Vermiwash is colourless bulky liquid organic fertilizer.
- (b) Vermiwash unit should be placed where ample sunlight is available.
- (c) Application of the vermiwash improves the nutrient status of the soil.
- (d) Vermiwash is a liquid organic fertilizer which is rich in phosphorus, nitrogen, calcium, etc.
- (e) Vermiwash has a shelf life of 6 months.

2. State Fill in the blanks

- (a) Vermiwash is liquid organic fertilizer collected after passage of water flows through a column of worms.

Preparation of Vermiwash

- (b) Before foliar spray vermiwash should be diluted with water in ratio.
- (c) Suitable earthworm species for vermiwash preparation are and
- (d) Vermiwash is % organic product.



Notes



WHAT YOU HAVE LEARNT

Let us recapitulate and enlist salient points that you have learnt through this lesson:

- Vermiwash is a liquid fertilizer consisting of plant nutrients, enzymes and plant growth hormones.
- Vermiwash is alkaline in nature and a rich source of macro and micro-nutrients.
- Vermiwash can be prepared at vermicomposting units that can even be done at homes.
- Excess watering and collection of the filtered solution of compost are the prime steps of vermiwash preparation.
- Vermiwash preparation involves a number of systematic steps that should be followed along with undertaking proper precautions.
- Vermiwash can be applied to the plants as a nutrient source. It also controls disease and insect-pests in plants. Hence, acts as a bio pesticide.
- Vermiwash is 100% organic and eco-friendly. A vermicomposting-vermiwash unit can be used in organic waste management processes.
- Vermiwash has a shelf life of 2 months only.



TERMINAL EXERCISES

1. Define vermiwash. Explain the purpose of vermiwash.
2. Name the earthworm species that are used in the vermiwash preparation.
3. What is the importance of vermiwash in organic agriculture?
4. Write down the steps involved in the preparation of vermiwash at a vermiwash unit.
5. State precautions to be taken in the production and application of vermiwash.



Notes



ANSWERS TO INTEXT QUESTIONS

4.1

1. (a) False (b) True (c) True (d) False
2. (a) 1.5 kg per tank or 1000-1500 numbers
(b) facilitates drainage of excess water
(c) 13th

4.2

1. (a) True (b) False (c) True (d) True
(e) False
2. (a) Odourless dark brown
(b) 1:1
(c) *Eudriluseugeniae*; *Eiseniafetida*
(d) 100

KEY LEARNING OUTCOMES

- Preparing vermiwash as per recommended procedure.
- Establishing and maintaining a vermiwash unit.



5

HARVESTING, PACKAGING AND STORAGE OF VERMICOMPOST

Dear learners, you have already learned how to set up a preparation of vermiwash. With this knowledge, you are now ready to take the next important step. Once the composting process is complete, the final product vermicompost must be carefully harvested, packaged, and stored. This ensures that compost remains rich in nutrients and beneficial microbes and is safe to use or sell. Proper harvesting techniques allow for the efficient separation of compost from worms and unprocessed material, while appropriate packaging maintains its integrity and shelf life. Additionally, correct storage practices help preserve the nutrient value, microbial activity, and moisture content of vermicompost, making it suitable for agricultural and horticultural applications.

In this lesson, you will explore the best practices, methods, and considerations involved in the harvesting, packaging, and storage of vermicompost to maximize its effectiveness as a natural fertilizer and soil conditioner.



OBJECTIVES

After reading this lesson, you will be able to

- learn different methods of separating vermicompost from earthworms and unprocessed material;
- understand the importance of proper harvesting in maintaining the quality of vermicompost;
- understand ideal storage conditions to preserve the nutrient content and effectiveness of vermicompost;
- identify suitable packaging techniques and materials for storing vermicompost.



5.1 TOOLS AND MATERIALS REQUIRED FOR HARVESTING VERMICOMPOST AND EARTHWORMS

- **Hand Gloves:** For hygiene and protection while handling compost and worms.
- **Garden Trowel or Hand Fork:** For loosening and turning compost during harvesting.
- **Sieve or Mesh Screen:** Used to separate fine vermicompost from larger particles and worms (Fig 5.1).

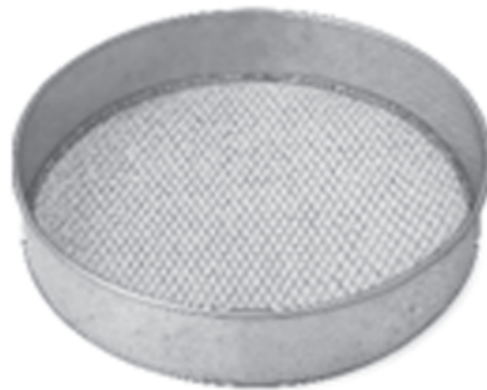


Fig. 5.1: Sieve

- **Harvesting Tray or Sorting Table:** A flat surface or tray used to manually sort compost from worms.
- **Buckets or Bins:** For collecting harvested compost and temporarily holding worms.
- **Plastic Sheet or Tarpaulin:** Used in light separation method, spreading compost under light to make worms move downwards.
- **Moisture Meter (optional):** To check the moisture content of compost before storage.
- **Shovel or Spade:** For bulk handling of compost during harvesting (Fig. 5.2).
- **Brush or Small Broom:** For cleaning tools and surfaces after harvesting.
- **Water Sprayer:** To maintain appropriate moisture levels during the process.
- **Worm Separator Machine (in commercial setups):** Mechanical equipment for faster separation of worms and compost.



Fig. 5.2: Spade

5.2 TECHNIQUES AND METHODS USED TO SEGREGATE WORMS AND VERMI-COMPOST

Segregating worms from vermicompost is a crucial step in the vermicomposting process. The goal is to separate the mature compost (castings) from the worms so the compost can be used and the worms can be reused for further composting (Fig. 5.3).

There are several techniques and methods used, generally categorized into manual, behavioral, and mechanical methods:



Fig. 5.3: Segregating worms from vermicompost



5.2.1 Manual Methods

Hand Sorting: In these methods Scoop out compost, place it on a flat surface under a light source. Worms burrow away from the light, allowing the top layer to be removed gradually. This method is simple and cost-effective but time-consuming and labor-intensive and suitable only for small-scale operations (*Vermicomposting: A Guide for Smallholder Farmers, ICAR*).

5.2.2 Behavioral Methods (Using Worms' Natural Instincts)

- (a) **Light Separation Method:** This method is similar to hand sorting but relies more heavily on a bright light. Worms avoid light and move to dark places. You scrape off the top layer periodically. Light separation method is best for small to medium-scale setups. Flat tray, bright light (sunlight or artificial) is important equipment needed in these methods (Fig. 5.4).



Fig. 5.4: Worms move towards dark place

Source: FAO – Simple Technologies for Sustainable Agriculture

- (b) **Migration Methods:** Use worms' preference for moisture, food, and darkness.
- (i) **Upward Migration (Stacking Trays):** In this process new food and bedding are placed in an upper tray. Worms migrate upward toward the new material. Result lower tray contains vermicompost with fewer worms (Fig. 5.5)
 - (ii) **Downward Migration:** In this process expose the top to light, and place fresh bedding or moist compost below. Worms migrate downward. Place vermicompost on a mesh screen over a new bin. Resulting worms drop into the new bin; compost remains on top (Fig. 5.6).



Notes

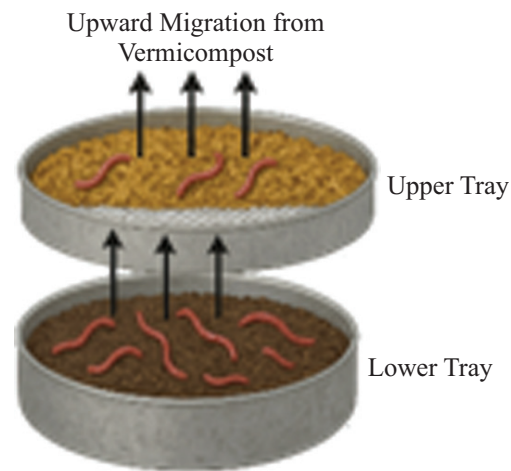


Fig. 5.5: Upward migration of worms

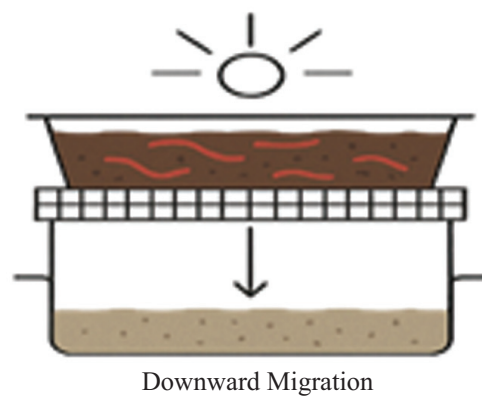


Fig. 5.6: Down word migration

- (iii) **Side Migration:** In this method push compost to one side and add fresh bedding/food to the other. Worms move toward freshfood (Fig. 5.7)

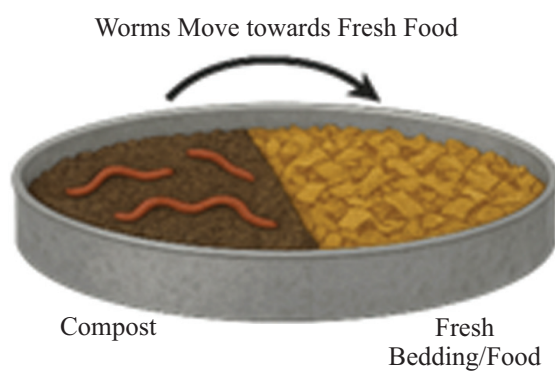


Fig. 5.7: Side Migration



Notes

5.2.3 Mechanical Methods

- (a) **Rotary Separator (Trommel Screener):** A rotating cylindrical sieve separates compost from worms based on particle size. This method is efficient, fast, suitable for large-scale operations but requires investment, power source.
- (b) **Vibrating Screens:** Uses vibration to sift castings through screens, separating worms. This method is efficient but costly and suitable for industrial use (Fig. 5.8).



Fig 5.8: Vibrating Screen

5.2.4 Water Flotation Methods

Vermicompost is placed in water. Worms float or swim; compost sinks. Pros of this method is quick separation. Some constraints like risk of worm stress/drowning, compost becomes wet and needs drying (Source: *Clive A. Edwards et al., Vermiculture Technology*).

5.2.5 Baiting Technique

In this process place food baits (e.g., banana peel) inside mesh bags on top of the compost. Worms gather in the bag, which can be lifted out. This technique is cost effective and simple.



INTEXT QUESTIONS 5.1



Notes

A. State True or False

1. Hand gloves are used to protect the earthworms from sunlight.
2. A sieve or mesh screen helps separate fine compost from worms and large particles.
3. The light separation method is based on the worms' attraction to light.
4. Rotary separators and vibrating screens are ideal for small-scale vermicomposting units.
5. In the upward migration method, worms move toward new food placed in the lower tray.

B. State Fill in the Blanks

1. A or mesh screen is used to separate fine vermicompost from larger particles and worms.
2. In migration, worms are encouraged to move to the side where fresh food is added.
3. The method uses rotating cylindrical sieves to separate compost from worms.
4. A is used to maintain moisture content during the harvesting process.

5.3 PHASES OF VERMICOMPOSTING

Vermicomposting typically goes through the following key four phases:

5.3.1. Pre-treatment Phase (Waste Preparation)

Dear learners, Before earthworms can begin their work of turning waste into rich compost, the organic material needs to be prepared. This important first step is called the pre-treatment phase.

In this phase, organic waste such as kitchen leftovers, farm waste, or biodegradable materials from industries is collected and allowed to partially decompose for a few days. This is often called pre-composting.



Notes

Important precautions to follow:

- Do not add oily, salty, spicy, acidic, or dairy products – they can hurt the worms.
- Chop or shred the waste into smaller pieces – this helps it break down faster and makes it easier for worms to digest.
- Try to keep the carbon to nitrogen ratio (C : N) of the waste between 25 : 1 and 30 : 1. This balance supports better decomposition and compost quality.

By preparing the waste properly, we give the worms a healthy and comfortable environment to thrive and that leads to better vermicompost!

In this phase Organic waste (like kitchen scraps, farm waste, or biodegradable industrial waste) is collected and often pre-composted or partially decomposed for a few days before introducing earthworms.

Main purpose of this phase is reducing the temperature and toxicity of fresh waste, which may harm the worms.

Precautions to be taken during this phase:

- Avoid adding oily, salty, acidic, or dairy-based items.
- Shred waste to accelerate decomposition and ease worm digestion.
- Ensure the initial C:N ratio is around 25 : 1 to 30 : 1.

5.3.2 Inoculation Phase (Worm Introduction)

Earthworms are introduced into the prepared organic material. Main purpose of this phase is to earthworms feed on the decomposed organic matter and begin the vermicomposting process.

Precautions to be taken during this phase:

- Ensure the temperature is between 15°C–30°C (59°F–86°F).
- Moisture content should be around 60–70% (damp like a wrung-out sponge).
- Avoid strong light; keep the compost in a shaded or dark place.

5.3.3 Active Composting Phase (Decomposition and Vermicast Production)

Earthworms consume organic matter and excrete nutrient-rich castings (vermicast). This is the most active phase.



Precautions to be taken during this phase:

- Regularly monitor moisture and pH (ideal pH is around 6.5–7.5).
- Turn or fluff the material gently if it becomes too compact to ensure aeration.
- Avoid overfeeding; unprocessed food can lead to foul odor and pests.

5.3.4 Maturation and Harvesting Phase

Once most of the waste has been processed, the compost is left to stabilize and mature. Earthworms may be separated and reused (Fig. 5.9).



Fig. 5.9: Mature vermicompost

Precautions to be taken during this phase:

- Allow compost to sit for 1–2 weeks to mature after worm removal.
- Use techniques like light separation (worms move away from light) to collect worms.
- Store finished vermicompost in a dry, cool place in breathable bags (e.g., jute sacks) to preserve microbial activity.

General Precautions Through-out All Phases

- **Avoid toxic substances:** No chemicals, synthetic pesticides, or plastic.
- **Temperature Control:** Avoid extreme cold or heat.



Notes

Harvesting, Packaging and Storage of Vermicompost

- **Moisture Monitoring:** Too dry kills worms, too wet causes anaerobic conditions.
- **Pest Management:** Use tight-fitting lids or mesh covers to avoid flies or rodents.
- **Regular Observation:** Watch for worm activity, smell, and signs of imbalance.

5.4 COMMONLY FACED PROBLEMS IN VERMICOMPOSTING

Dear learners, Even though vermicomposting is a simple and natural process, sometimes things can go wrong if we don't take proper care. But don't worry! Most of these problems have easy solutions.

Let's look at some common issues you might face while vermicomposting—and how you can fix them:

5.4.1. Foul Smell

Cause: Overfeeding, poor aeration, or too much wet food waste.

Solution: Reduce feeding; mix in dry materials like shredded newspaper or dry leaves to absorb moisture and improve aeration.

5.4.2. Fruit Flies and Gnats

Cause: Exposed food scraps or excess fruit/vegetable waste.

Solution: Bury food scraps under bedding; avoid citrus and sugary fruits; cover with a layer of dry bedding.

5.4.3. Too Wet or Too Dry Bin

Too Wet Cause: Excess moisture from food waste or poor drainage.

Too Dry Cause: Lack of moisture due to dry bedding or hot weather.

Solution:

- For wet bins: Add dry bedding like cardboard, paper, or coir. Improve drainage.
- For dry bins: Lightly sprinkle water or add moist food waste.

5.4.4. Worms Escaping

Cause: Poor environment—too hot, acidic, dry, or low oxygen.

Solution: Check temperature (ideal 15–25°C), pH (6.5–7.5), and moisture. Fix any imbalance. Cover with moist bedding to make worms comfortable.



5.4.5 Pests (ants, maggots, mites, etc.)

Cause: Excess food, sugary or oily items, or exposed waste fly, ants, centipeds maggots, mites, mole, rat, birds attack on earthworms (Fig. 5.10 and Fig. 5.11).

Solution: Avoid meat, dairy, and oily food. Keep the bin clean and balanced. Use barriers for ants (like petroleum jelly or water moats).



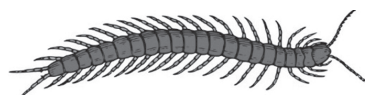
Fig. 5.10: Ant attack on earthworm



Fly



Ant



Centipede



Mole



Rat



Bird

Fig. 5.11: Pests of Earthworm



Notes

5.4.6 Unpleasant pH Levels

Cause: Too much citrus or acidic food.

Solution: Avoid citrus, onions, and tomatoes in large amounts. Add crushed eggshells to neutralize acidity.

5.4.7 Slow Decomposition

Cause: Low temperatures, insufficient moisture, or imbalance in green (nitrogen) and brown (carbon) materials.

Solution: Maintain proper C:N ratio (~25-30:1), keep moist, and chop food waste into smaller pieces.

5.4.8 Worm Death

Cause: Extreme temperatures, toxic substances, poor bin maintenance.

Solution: Keep bin in shaded, well-ventilated area. Avoid adding chemicals, citrus, meat, and salty foods.

5.4.9 Ammonia Smell

Cause: Excess protein-rich food (like legumes, grains) breaking down anaerobically.

Solution: Add dry, carbon-rich materials like shredded paper to balance and reduce smell.

5.4.10 Clumping of Worm Castings

Cause: Excess moisture or lack of turning.

Solution: Mix in dry materials occasionally and ensure proper airflow.

5.5 PROCEDURES TO PROCESS AND PACKAGING VERMICOMPOST

Dear learners, after successfully completing the composting process, the next important steps are harvesting, drying, sieving, packaging, and storing the vermicompost. These steps ensure that the final product is safe, effective, and ready for use or sale. Let's walk through these steps together.

5.5.1 Harvesting the Vermicompost

Harvest after 45–60 days of composting, when the feed is completely converted into dark, granular, earthy-smelling material.



Flow chart of step of Harvesting

Stop feeding worms for 7–10 days before harvest.



Pile compost in a cone-shaped heap under shade.



Wait a few hours; worms will move to the bottom.



Collect the upper layer of compost by hand or sieve.

5.5.2 Drying the Vermicompost

Purpose: To reduce moisture content to below 20% for safe storage.

Method:

- Spread compost in thin layers on a clean, dry surface under shade.
- Avoid direct sunlight to protect microbial activity.
- Dry for 2–3 days until crumbly and free-flowing.

5.5.3 Sieving (Filtering)

Purpose: To remove large particles, un decomposed materials, and to ensure uniform texture (Fig. 5.12).



Fig. 5.12: Sieving of vermicompost



Notes

Procedure:

- Use mesh sieves (3–5 mm).
- Return larger particles to the vermicompost bed or pre-digestion pit for further composting.

5.5.4 Quality Checking (Optional but Recommended)

Check for: (Table 5.1 and Table 5.2)

- Moisture content (below 20%)
- pH (6.5–7.5)
- Absence of foul odor
- Granular texture
- Pathogen and heavy metal levels (for commercial packaging)

Table 5.1: Quality Standards of Vermicompost
(As per FCO, 2009 and updates)

Parameter	Standard Requirement
Moisture Content	15–25%
Ph	6.5 to 7.5
Electrical Conductivity	< 4 dS/m
Total Organic Carbon (TOC)	Minimum 18%
Total Nitrogen (N)	Minimum 0.5%
Total Phosphorus (as PO)	Minimum 0.5%
Total Potassium (as KO)	Minimum 0.5%
C:N Ratio	< 20:1
Heavy Metals	Below permissible limits (see below)
Particle Size	< 4 mm (90% material should pass through)
Pathogen-Free	Should be free from pathogens
Weed Seeds	Nil

**Table 5.2: Maximum Permissible Limits of Heavy Metals (FCO)**

Heavy Metal	Maximum Limit (mg/kg)
Cadmium (Cd)	5.0
Chromium (Cr)	50.0
Copper (Cu)	300.0
Lead (Pb)	100.0
Arsenic (As)	10.0
Mercury (Hg)	0.15
Nickel (Ni)	50.0
Zinc (Zn)	1000.0

5.5.4.1 Additional Desirable Features

- Rich in beneficial microbes like N-fixers, phosphate solubilizers
- Contains plant growth hormones like auxins and gibberellins
- Improves soil structure, water holding capacity, and aeration

5.5.4.2 Certification and Sale Requirements (India)

- Vermicompost must be tested and approved as per FCO standards before sale.
- Only registered manufacturers with proper facilities can sell it as fertilizer.
- Labelling must include nutrient content, manufacturer name, FCO license number, and date of manufacture.

5.5.5 Packaging of Vermicompost**5.5.5.1 Ideal Packing Materials of Vermicompost**

- HDPE bags (high-density polyethylene)
- LDPE bags (low-density polyethylene)
- Woven sacks with liners
- Eco-friendly jute bags with inner lining (for sustainability)

5.5.5.2 Procedure of Packaging

- Use clean, dry bags.
- Fill 1 kg, 5 kg, 10 kg, or 25 kg as per market demand.
- Seal the bags tightly to avoid moisture and pest contamination.



Notes

5.5.5.3 Label should include:

- Brand name (if any)
- Nutrient content (N-P-K)
- Batch number and date
- Instructions for use
- Storage instructions
- Weight

5.5.6 Storage and Transportation**5.5.6.1 Storage**

- Keep in a dry, cool, shaded area.
- Avoid direct sunlight and rain.
- Stack bags properly to prevent damage.

5.5.6.2 Transportation

- Use covered vehicles.
- Handle gently to avoid compaction or tearing of bags.

Step	Purpose
Harvesting	Separate compost from worms
Drying	Lower moisture for storage
Sieving	Uniform product, remove debris
Quality Check	Ensure safe and effective compost
Packaging	Protect product, ease of transport
Storage/Transport	Maintain quality till end user

**INTEXT QUESTIONS 5.2****A. State Fill in the blank**

1. In the active composting phase, worms produce nutrient-rich castings known as
2. The ideal C:N ratio of vermicompost feed should be around
3. Earthworms prefer feed with moisture content around%, similar to a wrung-out sponge.



B. State True/False

1. Earthworms can be fed with fresh cow dung immediately after collection.
2. Earthworms consume about twice their body weight in feed per day.
3. Pre-treatment of feed helps reduce harmful gases and heat before adding to the compost bed.
4. Plastic, glass, and citrus peels are suitable materials for earthworm feed.
5. The Fertilizer Control Order (FCO), 1985 sets quality standards for vermicompost.

5.6 FEED REQUIREMENTS OF EARTHWORMS TO CONTINUE COMPOST CYCLE AFTER HARVESTING

Dear learners, once you've harvested the vermicompost, don't forget about the hardworking earthworms! They need to be re-fed with fresh organic material to stay healthy and active. This helps maintain a continuous cycle of composting, ensuring that you always have a steady supply of nutrient-rich vermicompost.

Remember: Happy worms = Better compost!

5.6.1 Types of Feed (Raw Materials)

Earthworms (like *Eisenia fetida*) feed on organic biodegradable materials, preferably semi-decomposed. Common feed materials include:

Agricultural Waste:

- Dry leaves
- Straw
- Sugarcane bagasse
- Crop residues

Animal Waste (Pre-composted):

- Cow dung (ideal, aged 10–15 days)
- Buffalo dung
- Goat droppings (mixed with cow dung)

Kitchen & Food Waste (Optional):

- Vegetable peels
- Fruit scraps (avoid citrus and oily food)
- Tea leaves



Notes

Other Materials:

- Spent mushroom substrate
- Agro-industrial waste (free from chemicals)

5.6.2 Pre-treatment of Feed

Earthworms do not prefer fresh or raw dung/plant waste. The material must be partially decomposed before adding:

- Pre-decompose the feed for 10–15 days in open heaps, turning it occasionally.
- Maintain moisture (~50–60%) during pre-decomposition.
- This process reduces heat and harmful gases (ammonia/methane).

5.6.3 Moisture and Texture Requirements

- **Moisture:** 50–60% is ideal. The feed should feel like a squeezed sponge—not dripping wet, not dry.
- **Texture:** Soft, loose, and crumbly. Avoid compacted or soggy material.
- **C: N Ratio:** 25–30:1 is ideal. You can balance it using both dung (nitrogen-rich) and dry leaves/straw (carbon-rich).

5.6.4 Quantity and Frequency of Feeding

- Earthworms consume about half of their body weight per day in ideal conditions.
- For every 1 kg of worms, provide about 0.5–1 kg of feed per day.
- Feed once every 5–7 days or as needed, depending on consumption.

5.6.5 What to be Avoid in Feed

Avoid these materials	Reason
Meat, dairy, oily food	Attract pest
Citrus and onion peels	To acidic for worms
Plastic, glass and chemicals	Toxic and non-biodegradable
Fresh dung	Generate heat and gases



5.7 CONTINUATION OF CYCLE

Dear learners, harvesting vermicompost is not the end – it's the beginning of a new cycle! To keep the process sustainable and ongoing, it's important to take good care of the earthworms after harvesting. Here's how you can restart the cycle:

Steps to Continue the Composting Cycle:

5.7.1 Separate the Worms

After harvesting, most worms gather at the bottom of the compost heap. Gently collect them.

5.7.2 Transfer to a New Bed

Move the worms into a fresh bed filled with pre-decomposed organic material (not raw waste).

5.7.3 Maintain Proper Conditions

Ensure the bed has enough moisture, good airflow, and is kept in a shaded place.

5.7.4 Start Feeding Again

Add organic waste gradually and let the worms get back to work – the composting continues!

5.8 LEGISLATION AND POLICIES

Understanding and following the correct laws and workplace procedures is essential for ensuring a safe, legal, and environmentally responsible vermicomposting operation. These regulations help maintain product quality, protect human health, and support sustainable agricultural practices.

5.8.1 Laws and Acts

These are official rules passed by the government to regulate work practices, protect workers, the environment, and ensure quality outputs.

Legislation	Purpose / Relevance
Fertilizer Control Order (FCO), 1985	Regulates quality standards for fertilizers like vermicompost.
The Environment (Protection) Act, 1986	Controls pollution, waste handling, and environmental protection.



Notes

Harvesting, Packaging and Storage of Vermicompost

Legislation	Purpose / Relevance
The Factories Act, 1948	Ensures worker safety, sanitation, and health in industrial setups.
The Occupational Safety, Health and Working Conditions Code, 2020	Provides a framework for health, safety, and welfare of workers.
The Solid Waste Management Rules, 2016	Guides proper disposal and composting of biodegradable waste.
The Insecticides Act, 1968	Regulates the safe use of chemical substances in agriculture.

5.8.2 Workplace Policies

These are internal rules created by the organization/farm to ensure smooth, legal, and safe operations.

Common Work Policies:

Policy	Purpose
Health & Safety Policy	Ensures use of PPE, safe equipment handling
Waste Management Policy	Guidelines for composting, recycling, disposal
Quality Control Policy	Ensures vermicompost meets FCO standards
Environmental Policy	Promotes eco-friendly farming/composting
Emergency Procedures	What to do in case of accidents/fire/injury

5.8.3 Work Procedures

These are step-by-step instructions for safely and efficiently performing tasks.

Examples of Procedures:

- How to prepare vermicompost safely
- How to operate shredders or mixers
- Proper handling of cow dung and organic waste
- Safe storage and application of compost
- Monitoring temperature and moisture in compost beds
- Washing hands/tools after handling waste

**Why These Are Important**

Benefit	Explanation
Legal compliance	Avoids penalties and closures from authorities
Worker safety	Reduces accidents and health risks
Environmental protection	Prevents pollution and promotes sustainable practices
Product quality assurance	Ensures compost meets market and certification needs
Efficiency and consistency	Everyone follows the same safe and proven methods

**INTEXT QUESTIONS 5.3****A. State True/ False**

1. Earthworms prefer fresh cow dung over pre-composted dung.
2. Moisture content of around 50–60% is ideal in worm feed.
3. 3.Worms can eat plastic and oily food without harm.
4. The C:N ratio of 25–30:1 is suitable for feeding worms.
5. Feeding should be done every 15–20 days regardless of consumption.

B. State Fill in the Blanks

1. Earthworms should be fed with organic matter.
2. Avoid feeding worms with and as they attract pests.
3. After harvesting, worms usually gather at the of the compost heap.

5.9 PROCESS TO ENSURE DECOMPOSITION OF ORGANIC MATTER

Dear learners, before using organic waste in vermicomposting, it is important to decompose it properly. This helps to reduce harmful substances and makes the waste safe and healthy for earthworms. Let us understand what decomposition is and how we can manage it effectively.



Notes

5.9.1 What is Decomposition?

Decomposition is the biological breakdown of organic materials (like crop residues, leaves, animal waste, food scraps) into simpler, stable substances (like humus) by the action of microorganisms (bacteria, fungi, actinomycetes).

5.9.2 Basic Principles of Decomposition

1. **Microbial Action:** Bacteria and fungi break down carbon and nitrogen-based materials.
2. **Aerobic Conditions:** Decomposition is faster and odor-free when oxygen is present.
3. **Moisture and Temperature:** Microbes need water and warmth to thrive.
4. **C:N Ratio:** Balance between carbon-rich (“browns”) and nitrogen-rich (“greens”) materials is essential.

5.9.3 Steps to Ensure Proper Decomposition

1. **Material Collection and Segregation**
 - Use only biodegradable material like:
 - Dry leaves, straw, sawdust (carbon-rich)
 - Cow dung, vegetable waste, green leaves (nitrogen-rich)
 - **Avoid:** plastics, chemicals, glass, metal, bones, meat, dairy, oily food.
2. **Shredding and Size Reduction**
 - Cut or shred large or tough materials (e.g., branches, stems).
 - Smaller particles decompose faster due to increased surface area.
3. **Maintain Correct C:N Ratio**

Ideal C:N ratio: ~25–30:1

 - Too much carbon (dry matter) ! slow decomposition
 - Too much nitrogen (wet material) ! foul odor, anaerobic conditions
4. **Moisture Control**
 - Maintain 50–60% moisture (like a wrung-out sponge)
 - Too dry → microbes become inactive
 - Too wet → oxygen is blocked, causes bad odor



5. Provide Adequate Aeration

- Turn the pile every 5–7 days to introduce oxygen.
- Prevents anaerobic (foul-smelling) conditions.
- Promotes uniform microbial activity.

6. Temperature Monitoring

- Active composting raises the internal temperature to 40–60°C (104–140°F).
- This kills pathogens and weed seeds.
- Turning the pile helps maintain even heat.

5.9.4 Stages of Decomposition

Stage	Description	Duration
1. Mesophilic	Initial microbial activity at 20–40°C	1–3 days
2. Thermophilic	High activity at 40–60°C, rapid breakdown	5–15 days
3. Cooling	Microbial diversity increases, material stabilizes	15–30 days
4. Maturation	Humus forms, compost stabilizes	30–60 days

5.9.5 Signs of Proper Decomposition

Good Sign	Bad Sign
Earthy smell	Rotten or sour odor
Warm pile (initially)	Cold pile (inactive)
Dark brown/black color	Slimy or greasy texture
Crumbly texture	Wet and sticky matter

5.10 HEALTH AND SAFETY REQUIREMENTS DURING VERMICOMPOSTING

Dear learners, vermicomposting is a natural and eco-friendly process. However, like any activity that involves handling waste, it requires some important safety precautions. By following proper health and safety measures, we can protect ourselves and ensure smooth, hygienic composting.

5.10.1 Risk Assessment

- Assess the materials used (e.g., food scraps, paper, manure) for biological or chemical hazards.
- Identify potential risks such as bacteria, fungi, insects, or toxic substances.



Notes

5.10.2 Hygiene Measures

- Always wash hands thoroughly after handling compost or worms.
- Avoid touching your face, eating, or drinking while working.
- Keep composting areas clean and dry to prevent mold and pests.

5.10.3 Waste Screening

- Remove non-organic materials (plastic, glass, metal) from input waste.
- Avoid composting pet waste or meat unless properly processed, as these can carry harmful pathogens.

5.10.4 Ventilation

- Ensure that indoor composting areas are well-ventilated to avoid buildup of gases like ammonia or methane.

5.10.5 Ergonomic Safety

- Use proper lifting techniques when handling bins or compost sacks.
- Use tools (like hand forks or scoops) to minimize direct contact with decomposing material.

5.10.6 Use of Personal Protective Equipment (PPE)

While not heavy-duty, the PPE for vermicomposting is still important to reduce exposure to microbes, allergens, and irritants.

PPE Item	Purpose
Gloves (rubber or nitrile)	Prevent direct contact with compost, microbes, and sharp materials
Protective apron or coveralls	Keeps clothing clean and reduces contamination risk
Dust mask or respirator (optional)	Protects against dust, mold spores, and odors (especially during turning or drying)
Safety glasses or goggles (optional)	Protects eyes from splashes when dealing with moist compost or liquid worm tea
Closed-toe, waterproof shoes	Protect feet from spills, sharp objects, and wet ground



5.10.7 Emergency and First Aid Considerations

- First Aid Kit should be nearby in case of cuts or exposure to irritants.
- Allergy management: Some people may be sensitive to mold spores or dust – masks and antihistamines may help.
- Cuts or open wounds: Avoid compost contact if you have unprotected cuts to reduce infection risk.

5.11 QUICK TESTS TO CHECK MATURITY

5.11.1 Smell Test

- Earthy smell = mature
- Rotten or ammonia-like odor = still decomposing

5.11.2 Germination Test

- Plant a few fast-growing seeds (like mustard or moong) in the vermicompost.
- Good germination and healthy seedlings = mature
- Poor germination or seed burn = immature

5.11.3 Bag Test

- Seal a handful in a plastic bag for 2–3 days.
- Open and smell. Foul odor indicates incomplete decomposition.

Why Maturity of vermicompost Matters

- Immature vermicompost can contain phytotoxins or pathogens that harm plants.
- Mature compost ensures nutrient availability, better soil structure, and safe application for crops and seedlings.

5.12 ENVIRONMENTALLY SAFE PRACTICES IN VERMICOMPOSTING

Dear learners, vermicomposting is a green and sustainable method of converting organic waste into rich compost with the help of earthworms. While it is naturally eco-friendly, following certain environmentally safe practices ensures that the process remains clean, safe, and effective for both people and the planet.



Notes

5.12.1 Why are Environmentally Safe Practices Important?

- They protect soil, water, and air from pollution.
- They keep humans, animals, and plants safe from harmful effects.
- They help earthworms stay healthy, which is essential for composting.

Key Safe Practices to Follow

Practice	Why it Matters
Use only biodegradable waste	Non-organic or plastic items harm earthworms and pollute the compost.
Avoid chemicals or pesticides	These can kill helpful microbes and worms.
Maintain proper drainage	Prevents waterlogging, which can cause bad odor and harmful bacteria.
Control temperature and moisture	Ensures healthy worm activity and prevents foul smell.
Use shade or cover	Protects worms from extreme heat and rain.
Handle waste with gloves and tools	Prevents contact with sharp or harmful objects.
Monitor for pests (ants, flies)	Helps maintain hygiene and protects worms.

5.12.2 Safe Disposal of Leftovers

- Unusable material or contaminants (like plastic or metal) should be separated and disposed of properly.
- Wash hands and tools regularly to maintain hygiene and safety.

By following environmentally safe practices in vermicomposting, we support healthy ecosystems, reduce waste, and promote sustainable farming. Let's compost responsibly for a greener tomorrow!

In conclusion, proper harvesting, packaging, and storage are essential to maintain the quality and effectiveness of vermicompost. By carefully separating worms, drying the compost, sieving it for uniformity, and storing it in suitable conditions, we ensure that the final product is safe, nutrient-rich, and ready for use or sale. These steps not only improve the compost's shelf life but also support sustainable agriculture by providing a natural and eco-friendly fertilizer to farmers and gardeners.



INTEXT QUESTIONS 5.4



Notes

A. State True /False

1. A foul odor from compost is a sign of proper decomposition.
2. Wearing gloves is optional and not necessary during vermicomposting.
3. Earthworms can survive well in compost containing pesticides.
False
4. Proper aeration during decomposition helps maintain oxygen levels.
5. Shade is necessary to protect worms from harsh weather.

B. State Fill in the blank

1. A rotten or ammonia-like smell in compost indicates it is
2. Using toxic feedstock can harm and reduce compost quality.



WHAT HAVE YOU LEARNT

- Different techniques & methods used to segregate worms and vermi-compost
- Migration method of worms
- Phases of vermicomposting and necessary precautions to be taken during these phases
- Problem faced during vermicomposting
- Procedure of collection and storing and packing of vermicompost
- Feed requirements of the earthworms to continue compost cycle after harvesting
- Legislation, standards, policies, and procedures at work
- Process to ensure decomposition of organic matter
- Characteristics of mature vermicompost
- Quality standard of vermicompost including chemical composition (as per FCO).



Notes



TERMINAL EXERCISE

1. List and explain any three common feed materials used for earthworms in vermicomposting.
2. What is the importance of pre-treatment of feed before giving it to earthworms?
3. Explain the upward and downward migration methods of worm separation.
4. What are the key principles of decomposition in organic waste management?
5. Describe the hand sorting method of worm separation.
6. Explain the importance of decomposing organic waste before vermicomposting.
7. How does moisture affect microbial activity in decomposition?
8. Explain the downward migration technique of worm separation.
9. Why is PPE (Personal Protective Equipment) important in vermicomposting? Give two examples.
10. Explain any three precautions taken to ensure safety during vermicomposting.
11. Write a short note on light separation method.
12. What are the key signs that show vermicompost is mature and ready for use?



ANSWER TO INTEXT QUESTIONS

5.1

- A.** 1. False 2. True 3. False 4. False 5. False
- B.** 1. Sieve 2. Side 3. Rotary Separator (Trommel Screener)
4. Water sprayer

5.2

- A.** 1. Vermicast, 2. 25:1 to 30:1, 3. 50-60%
- B.** 1. False 2. False 3. True 4. False 5. True



5.3

A. 1. False 2. True 3. False 4. True 5. False

B. 1. Pre -decomposed
2. Meat and oily food
3. Bottom

5.4

A. 1. False 2. False 3. False 4. True 5. True

B. 1. Immature 2. Earthworms 3. True

KEY LEARNING OUTCOME

- Demonstrate knowledge of various methods used to separate vermicompost from earthworms and unprocessed organic matter effectively.
- Explain the significance of proper harvesting techniques in preserving the physical, chemical, and biological quality of vermicompost.
- Describe the ideal storage conditions necessary to maintain the nutrient content and microbial activity of vermicompost during storage.
- Identify and evaluate suitable packaging materials and techniques to ensure long-term stability and usability of vermicompost for agriculture and horticulture.



6

BASIC ENTREPRENEURIAL ACTIVITY FOR SMALL ENTERPRISE

After learning about the methods of harvesting and packaging vermicompost, students are now prepared to explore the entrepreneurial dimensions of this sustainable practice. The transition from a vermicomposting practitioner to a small business entrepreneur requires knowledge of the market, customer behavior, funding options, regulations, and efficient business practices. This chapter helps learners understand how to create a sustainable and profitable vermicompost business by applying basic principles of entrepreneurship (Fig 6.1).

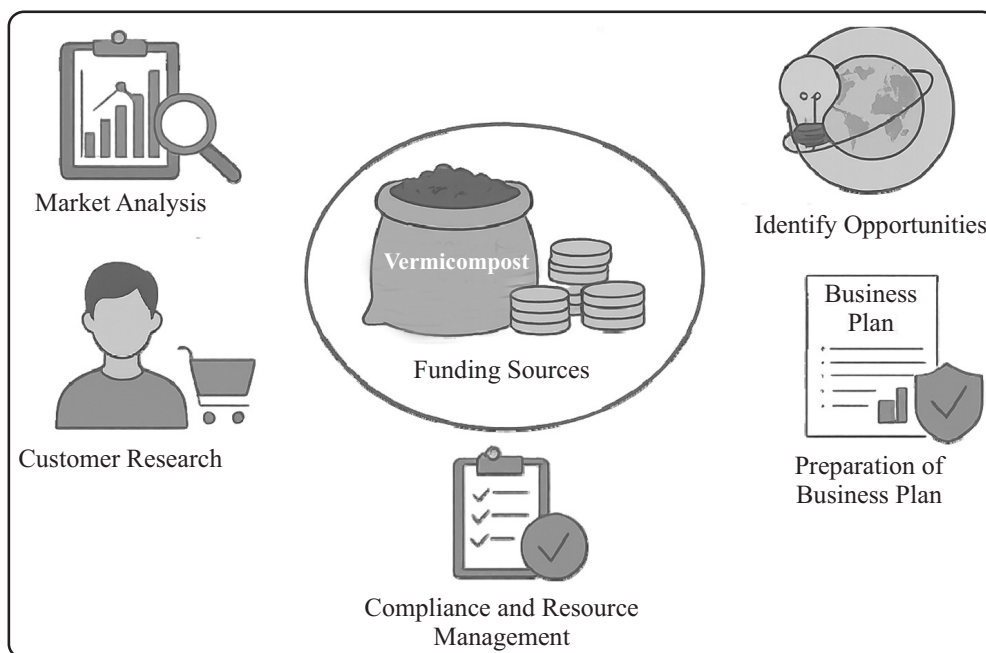


Fig. 6.1: Basic entrepreneurial activities



Let us begin by imagining a young farmer named Aarti in rural Maharashtra. After attending a local agricultural training camp, she started making vermicompost from kitchen and farm waste. Today, Aarti sells her compost to neighboring farmers and has even branded her vermiwash in recycled bottles. Through this lesson, you will learn how Aarti's small idea turned into a growing venture—and how you can do the same.

**OBJECTIVES**

After reading this lesson, you will be able to:

- analyze the market demand and supply for vermicompost and its related products;
- identify potential customers and assess their needs and preferences;
- develop a basic business plan suitable for small-scale vermicompost enterprises;
- understand compliance, funding, environmental practices, and efficient resource management.

6.1 ANALYZING THE DEMAND AND SUPPLY OF VERMICULTURE, VERMICOMPOST, AND VERMIWASH IN THE MARKET

Understanding market dynamics is the first step in setting up a business. The demand for organic and sustainable products like vermicompost and vermiwash has increased due to growing awareness of environmental and health concerns (Fig. 6.2).

- Survey local and regional markets for buyers (farmers, nurseries, home gardeners).
- Observe seasonal patterns in compost sales – demand peaks during sowing and planting seasons.
- Assess competitors and their pricing strategies.
- Estimate supply potential based on your production capacity.
- Use simple tools like questionnaires, Google Forms, and market mapping for analysis.
- Visit agriculture exhibitions, farmers' markets, and nurseries to understand current trends.
- Identify if there is more demand for bulk compost (for farms) or small packaged units (for home gardens).



Notes

Activity: Prepare a local market report by visiting 3 nurseries or farms. Note prices, packaging types, and brands available.

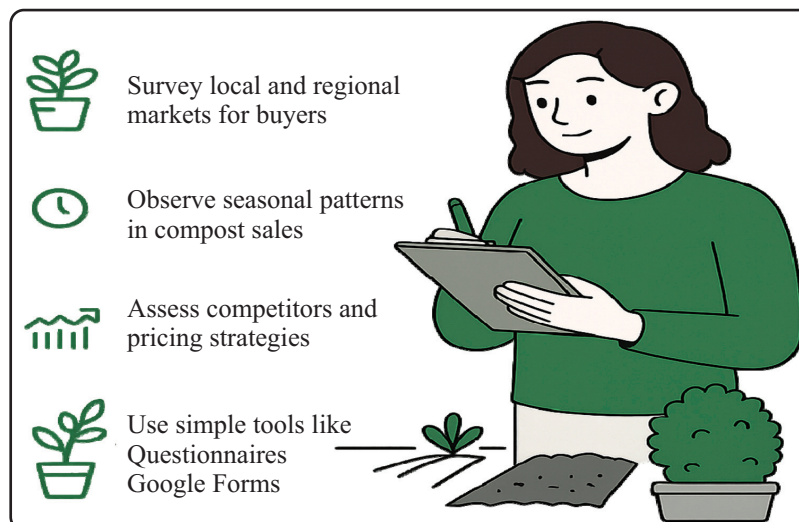


Fig. 6.2: Aarti analyzing demand and supply of vermicompost and vermiwash

6.2 IDENTIFYING TARGET CUSTOMERS AND ASSESSING THEIR NEEDS AND EXPECTATIONS

Different customers have varying needs. Identifying your customer base helps in creating value-added products.

- Target groups include farmers, horticulturists, florists, households, and municipalities.
- Assess preferred product form (powdered compost, vermiwash liquid, granulated compost).
- Gather feedback on packaging, pricing, and quantity requirements.
- Conduct interviews or distribute feedback forms to potential customers.
- Determine whether customers prefer eco-friendly packaging, subscription services, or doorstep delivery.
- Study customer preference for organic certification, odor-free product, and shelf life.

Real Story: A women's self-help group in Tamil Nadu realized that urban terrace gardeners wanted odorless, small packs of vermicompost. By meeting this need, they boosted their sales by 300% in a year.



6.3 IDENTIFYING TYPES OF AGRICULTURAL ENTREPRENEURSHIP/BUSINESS OPPORTUNITIES

Entrepreneurship in agriculture is not limited to farming.

- **Production-based:** Focused on manufacturing and selling vermicompost.
- **Service-based:** Providing consultancy, setting up worm beds, or offering packaging solutions.
- **Input supply:** Selling worms, bins, composting kits, etc.
- **Educational:** Offering training programs and workshops.
- **Franchise model:** Create a brand and offer business models to others.
- Collaborate with NGOs, schools, or urban gardens to promote composting.

Example: Raj from Punjab partnered with a school to teach composting and began selling kits to students' families.

6.4 PREPARING A BASIC BUSINESS PLAN FOR AGRICULTURAL ENTREPRENEURSHIP

A business plan serves as a blueprint for operations and funding.

- **Executive Summary:** Brief of your venture and goals.
- **Market Research:** Demand, competitors, and pricing.
- **Operations Plan:** Sourcing, production, harvesting, packaging.
- **Marketing Strategy:** Branding, distribution, and sales.
- **Financial Plan:** Costing, profit projections, breakeven analysis.
- Include SWOT analysis (Strengths, Weaknesses, Opportunities, Threats).
- Set short-term and long-term targets.
- Include contingency plans for risks like rain, pest attack, or market slowdown.

Sample Budget: For a micro-unit with 2 worm beds (approx. Rs 20,000 initial investment).

Item	Cost (Rs)
Worms	3,000
Beds & Shade	5,000
Packaging Bags	2,000
Tools & Equipment	5,000
Miscellaneous	5,000

Tip: Keep updating your plan as you learn from the market.



Notes



INTEXT QUESTIONS 6.1

True/False:

1. Demand analysis is not important before starting a vermicompost business.
2. Target customers can include nurseries and households.
3. Business plans should not include a financial plan.

6.5. SOURCES OF FUNDING FOR AGRICULTURAL ENTERPRISES

Funding helps in procuring raw materials, infrastructure, and marketing.

- **Self-financing:** Personal savings or family funds.
- **Bank loans:** NABARD, cooperative banks.
- **Microfinance Institutions:** Loans to small businesses with low-interest rates.
- **Government subsidies and grants:** Especially for organic farming and waste management.
- **Crowdfunding platforms:** For social and eco-friendly projects.
- **SHG (Self Help Groups) and FPOs (Farmer Producer Organizations)** support small entrepreneurs.

6.6 GOVERNMENT SCHEMES AND PROGRAMS

Understanding schemes increases chances of financial and technical support.

- PMEGP (Prime Minister's Employment Generation Programme)
- Startup India and Stand-Up India
- NABARD-supported schemes for composting units
- Rural Development Programmes promoting organic agriculture
- National Mission on Sustainable Agriculture (NMSA)
- Registering on Udyam portal for MSME benefits

Case Study: A startup in Odisha received 10 lakh under Startup India and used it to launch vermiwash in 5-litre cans.



6.7 IMPORTANCE OF COMPLIANCE WITH GOVERNMENT REGULATIONS

Legal compliance ensures safety, quality, and standardization.

- Registering the business entity (proprietorship, partnership, etc.)
- Obtaining required licenses (FCO certification for compost)
- Following labor laws, waste management rules, and health regulations
- Maintain records of sales, customer feedback, and waste source.
- Environmental clearance may be required in urban zones.

Checklist:

1. GST registration (if applicable)
2. Trade license from local authority
3. Certification for organic input (FCO)

6.8 ENVIRONMENTAL RESPONSIBILITY IN PRODUCTION

Sustainability is crucial for long-term viability.

- Avoid using contaminated inputs like plastic or chemical waste.
- Minimize energy usage and water wastage.
- Ensure safe disposal of non-compostable materials.
- Monitor odor and leachate control in the composting site.
- Create green boundaries with plants, promote natural shade.
- Use solar drying and manual harvesting when possible.

Story: A unit in Gujarat uses cow dung slurry and solar drying to reduce its carbon footprint by 40%.



INTEXT QUESTIONS 6.2

True/False:

1. Government schemes are not useful for small enterprises.
2. Environmental practices are essential in vermicomposting.
3. Business registration is not needed for selling vermicompost.



Notes

6.9 EFFICIENT INPUT RESOURCE MANAGEMENT PRACTICES

In vermicomposting, just like in any successful business, wise use of resources plays a crucial role. When you manage your raw materials, water, space, and energy properly, you ensure better productivity, higher quality compost, and increased profits. This section highlights key input management techniques that help vermicomposting entrepreneurs achieve efficiency and sustainability.

6.9.1. Measured Use of Biodegradable Waste

Waste is the raw input for vermicomposting. But more doesn't always mean better. Excessive or unmeasured waste can disturb the composting balance, cause overheating, or attract pests. A disciplined, measured approach ensures healthier compost and a smoother process. Use kitchen waste, cow dung, leaves, and farm residues in calculated amounts. Always weigh or estimate the volume before adding to the beds.

Why it matters:

- It prevents excess heat and foul odor.
- Maintains balance between waste and worm activity.
- Ensures faster and consistent decomposition.

6.9.2 Maintain Ideal Moisture (60–70%)

Moisture is like oxygen for the worms—vital for survival and activity. But both dryness and over-watering can harm the composting ecosystem. Use the “**squeeze test**”—take a handful of compost and squeeze. If it feels like a moist sponge and a few drops come out, the moisture is perfect. Add water in dry seasons or provide drainage in the rains to maintain balance.

Why it matters:

- It prevents worm dehydration or drowning.
- Boosts microbial activity.
- Supports healthy, odor-free composting.

6.9.3 Reuse Packaging Materials

Packaging can quietly become a large expense. Being smart with packaging means being both cost-effective and environmentally friendly. Use recycled containers, old sacks, cloth bags, or biodegradable materials. Encourage buyers to return bags for reuse or offer small incentives for eco-friendly practices.

**Why it matters:**

- Reduce production costs.
- Minimize waste and environmental footprint.
- Enhance the eco-brand image of your enterprise.

6.9.4 Rotate Worms Across Beds

Over time, a worm bed can become nutrient-exhausted or overcrowded. Worms may slow down in such beds, leading to reduced output. Transfer worms to new, freshly prepared beds every 1.5 to 2 months. This ensures active decomposition continues. Older beds can then be harvested for mature vermicompost.

Why it matters:

- Keeps worms active and healthy.
- Supports continuous production cycles.
- Allows separation of worms and compost efficiently.

6.9.5 Ensure Proper Aeration and Mixing

Air is just as important as moisture in a compost bed. Without it, decomposition slows down and unpleasant smells may develop due to anaerobic (airless) conditions. Turn the compost lightly using a wooden stick or hand rake once every 7–10 days. Make sure not to disturb the worms too much. Beds should have good drainage and structure to allow airflow.

Why it matters:

- Promotes aerobic bacteria and earthworm activity.
- Reduces foul smell and improves compost texture.
- Accelerates the composting process.

6.9.6 Store Feedstock and Compost in Shaded, Dry Areas

Rain, humidity, or direct sunlight can damage both your inputs and final product. Compost can lose nutrients or become infested if not stored properly. Keep raw material (like cow dung or vegetable waste) in a covered shed. Store finished vermicompost in bags or bins placed in a shaded, dry corner. Make sure containers allow some airflow to prevent fungal growth.



Notes

Why it matters:

- Preserves nutrient quality.
- Prevents spoilage and loss of product.
- Maintains market readiness for longer durations.

For any vermicomposting entrepreneur, mastering these practices is the key to running a profitable, eco-friendly, and sustainable enterprise. By respecting the resources available and using them wisely, one builds not only a successful business but also contributes positively to the environment.

Pro Tip: Use a moisture meter and turn the compost every 3–4 days for aeration.

6.10 OPTIMIZING PRODUCTION WITH SMART TECHNOLOGIES

Smart practices help improve yield and quality.

- Use of moisture sensors and thermometers.
- Adoption of rotary separators or vibrating screens.
- Employ data recording apps for tracking input-output.
- Digital marketing to expand reach.
- Use e-commerce platforms like Amazon, Flipkart, or local apps.
- Monitor worm activity and feed levels using mobile sensors.

App Suggestion: “Kisan Suvidha” or “AgriApp” for farmers.



INTEXT QUESTIONS 6.3

True/False:

1. Using too much waste can affect vermicompost quality.
2. Digital marketing is not useful in compost businesses.
3. Smart technologies reduce production efficiency.

By applying entrepreneurial principles, individuals can convert vermicomposting into a profitable and sustainable business. This lesson complements the knowledge of harvesting and packaging with real-world business applications, enabling learners to set up and manage small enterprises aligned with environmental goals and market needs.

Entrepreneurship is not only about profit – it is about purpose. As you step into the world of organic business, remember that you’re contributing to soil health, food safety, and environmental restoration.



Notes



WHAT HAVE YOU LEARNT

- How to analyze market demand for vermicompost products.
- Ways to identify customer needs and target audiences.
- Various entrepreneurship models in the agricultural/organic sector.
- Structure of a basic business plan for small enterprises.
- Sources of funding, government schemes, and the importance of compliance.
- Role of environmental sustainability and efficient input management.
- How smart technologies can improve production and marketing.



TERMINAL EXERCISE

A. Very Short Answer Questions

1. Define vermiwash and mention one of its major uses.
2. Name two target customer groups for vermicompost.
3. What is the role of branding in marketing vermicompost?
4. List any two government schemes supporting agro-entrepreneurship.
5. Mention one environmental responsibility while producing vermicompost.

B. Short Answer Questions

6. Explain any three key components of a basic business plan for a vermicompost unit.
7. Discuss how a self-help group can promote vermicompost-based entrepreneurship.
8. Describe the environmental precautions that need to be taken in vermicompost production.
9. How can digital marketing help in selling vermicompost? Give examples.
10. What steps should be taken to identify and assess customer needs?



Notes

**ANSWER TO INTEX QUESTIONS****6.1**

- | | | |
|----------|---------|----------|
| 1. False | 2. True | 3. False |
|----------|---------|----------|

6.2

- | | | |
|----------|---------|----------|
| 1. False | 2. True | 3. False |
|----------|---------|----------|

6.3

- | | | |
|---------|----------|----------|
| 1. True | 2. False | 3. False |
|---------|----------|----------|

KEY LEARNING OUTCOME

- Analyze the market demand and supply trends for vermicompost and vermiwash.
- Identify target customers and assess their preferences and expectations.
- Develop a basic business plan for a small-scale vermicompost unit.
- Recognize suitable funding sources and government schemes for agri-business.
- Apply environmentally sustainable and smart practices in vermicompost production.



7

HYGIENE AND CLEANLINESS

Dear learners, you have already learned you explored the foundational entrepreneurial activities crucial for running a small enterprise successfully, you are now ready to take the next important step. In this chapter you will learn about the importance of hygiene and cleanliness. Hygiene and cleanliness are fundamental aspects of a healthy life and play a critical role in maintaining individual well-being as well as public health. The word *hygiene* refers to the conditions and practices that help maintain health and prevent the spread of diseases, while *cleanliness* involves keeping oneself and the surrounding environment free from dirt, germs, and other harmful substances. Together, these practices form the cornerstone of a safe and organized society.

Maintaining hygiene and cleanliness is not just about personal grooming but also extends to homes, workplaces, public places, and institutions. Personal hygiene includes daily habits like bathing, brushing teeth, washing hands, wearing clean clothes, and maintaining nail and hair hygiene. These habits prevent the buildup of harmful microorganisms that can cause infections or illness. Environmental cleanliness, on the other hand, ensures that the surroundings like living spaces, schools, offices, streets, and public toilets are clean, odor-free, and free of litter and contaminants.

In workplaces good hygiene and cleanliness improve productivity and attendance by reducing the spread of communicable diseases. In healthcare settings, strict hygiene practices are essential to prevent hospital-acquired infections. Similarly, in the vermicomposting industry, maintaining cleanliness standards ensures the safety and quality of the vermicompost being prepared and served.



Notes



OBJECTIVES

After reading this lesson, you will be able to:

- understand importance of personal health and hygiene at workplace;
- explain the common health-related guidelines by Organizations/Government at the Workplace;
- comprehend the importance of good housekeeping at the workplace; and
- explain the importance of timely reporting of personal health issues.

7.1 REQUIREMENTS OF PERSONAL HEALTH, HYGIENE, AND FITNESS AT WORK

7.1.1 Personal Health

Personal health refers to the overall physical, mental, and emotional well-being of an individual. At the workplace, it becomes crucial because employees spend a significant portion of their day at work (Fig. 7.1).



Fig. 7.1: Regular health check-ups

- **Regular health check-ups:** Periodic medical examinations help in early detection of illnesses.
- **Healthy diet:** Consuming nutritious food and staying hydrated ensures energy and alertness throughout the day.



- **Sufficient sleep:** Inadequate sleep leads to poor concentration and increased risk of errors or accidents.
- **Mental health management:** Employees should be encouraged to practice stress-relief techniques like meditation or counseling when needed.

7.1.2 Personal Hygiene

Hygiene plays a significant role in preventing the spread of diseases in the workplace. Personal hygiene includes daily practices that promote cleanliness and prevent infections (Fig. 7.2).

- **Cleanliness and grooming:** Employees should maintain personal cleanliness (daily bathing, clean clothes, oral hygiene) to prevent illness and maintain a professional appearance.
- **Hand hygiene:** Frequent hand washing or sanitization is crucial, especially before meals, after using the restroom, or when handling shared equipment.
- **Nail and hair care:** Keeping nails trimmed and clean, and maintaining tidy hair prevents the spread of germs and contributes to a neat appearance.
- **Use of protective gear:** Where required, using gloves, masks, or hairnets (especially in food, healthcare, or lab settings) ensures hygiene and safety.
- **Clean workstation:** Regularly cleaning personal desks, tools, and digital devices prevents the spread of bacteria and promotes a tidy work environment.



Fig. 7.2: Personal hygiene



Notes



INTEXT QUESTIONS 7.1

State Fill in the blanks

- (a) Periodic medical examinations help in early detection of
- (b) Stress-relief techniques are or
- (c) Personal hygiene includes daily habits like,,, and and
- (d) The word refers to the conditions and practices that help maintain health and prevent the spread of diseases.
- (e) involves keeping oneself and the surrounding environment free from dirt, germs, and other harmful substances

7.1.3 Physical fitness (Fig. 7.3)

- (a) **Regular physical activity:** Exercise improves endurance, flexibility, and overall stamina, reducing absenteeism and fatigue.
- (b) **Ergonomics:** Using ergonomic chairs, desks, and equipment helps prevent posture-related issues like back pain or repetitive strain injuries.



Fig. 7.3: Physical fitness



- (c) **Stretching and movement breaks:** Taking short breaks to stretch or walk around during long working hours helps reduce muscle tension and improve circulation.
- (d) **Hydration:** Drinking sufficient water throughout the day supports physical and mental performance.
- (e) **Healthy BMI maintenance:** Keeping body weight in check helps avoid lifestyle diseases like diabetes, hypertension, and cardiovascular issues.

7. 2 COMMON HEALTH-RELATED GUIDELINES BY ORGANIZATIONS/GOVERNMENT AT THE WORKPLACE

Government bodies and organizations worldwide have laid down various health-related protocols to ensure employee well-being.

7.2.1 Occupational Safety and Health Standards (OSH)

- International Labor Organization (ILO), Ministry of Labor & Employment (India), and comparable organizations worldwide
- Potential health risks in the workplace must be recognized and evaluated by the employer.
- Providing protective equipment (masks, gloves, helmets, etc.) for employees who may be subjected to biological, chemical, or physical hazards.
- Risk assessments and safety audits must be carried out on a regular basis.
- It is necessary to guarantee proper lighting, ventilation, and sanitation.

7.2.2 Regular Health Screenings and Medical Facilities

Guidelines by: Factories Act, 1948; Shops and Establishments Acts (State-specific); Employees' State Insurance (ESI) Scheme

- Mandatory periodic medical check-ups, especially for workers in hazardous environments.
- Provision of on-site medical rooms or tie-ups with local hospitals.
- First aid kits must be accessible in all departments.

7.2.3 Cleanliness and Hygiene (Fig. 7.4)

Covered under: Factories Act, 1948; Food Safety and Standards Authority of India (FSSAI) guidelines (for food industries)



Notes

- Workplaces must be kept clean and free from waste or pollutants.
- Toilets and washing facilities should be clean and gender-segregated.
- Clean drinking water must be provided to all employees.



Fig. 7.4: Common health-related guidelines by organizations/government at the workplace

7.2.4 Working Hours and Rest Periods

Guidelines by: Labour laws, Shops and Establishments Acts

- Daily working hours are limited to 8–9 hours with appropriate meal/rest breaks.
- Weekly holidays and paid leave are mandatory to prevent fatigue and health issues.
- Overtime must be regulated and compensated.

7.2.5 Mental Health and Well-being

Initiatives by: Ministry of Health and Family Welfare; National Mental Health Programme (NMHP)

Organizations are encouraged to promote mental health awareness and provide counseling services.

- Flexible working arrangements and stress management programs are suggested.
- Anti-harassment policies to protect mental well-being at the workplace.



7.2.6 Covid-19 and Infectious Disease Guidelines

Guidelines by: Ministry of Health and Family Welfare, WHO

- Mandatory use of face masks and hand sanitizers during outbreaks.
- Physical distancing and staggered work hours to minimize contact.
- Thermal screening and isolation policies for symptomatic employees.

7.2.7 Ergonomics and Workplace Design

Recommended by: National Institute of Occupational Health (NIOH)

- Proper design of chairs, desks, and computer setups to prevent musculoskeletal disorders.
- Adequate space, lighting, and temperature control to ensure physical comfort.

7.2.8 Training and Awareness

- Mandatory health and safety training during induction and at regular intervals.
- Display of health and hygiene posters and emergency protocols.
- Drills for fire safety, earthquake preparedness, and chemical spills (if applicable).

7.2.9 Waste Management and Environmental Health

Guidelines by: Central Pollution Control Board (CPCB); Biomedical Waste Management Rules (for healthcare settings)

- Proper segregation and disposal of hazardous, e-waste, and biomedical waste.
- Pest control and cleanliness drives must be conducted periodically.

7.2.10 Employee Insurance and Compensation

Under: Employees' State Insurance Act (ESI), Employee Compensation Act

- Medical benefits, sickness allowance, and disability compensation are provided to employees.
- Health insurance policies are often included as part of employee benefits.

7.3 IMPORTANCE OF GOOD HOUSEKEEPING AT THE WORKPLACE (FIG. 7.5)

Good housekeeping is not just about keeping the workplace clean – it is a vital component of workplace safety, efficiency, and overall organizational discipline.



Notes

It involves a series of practices that ensure the workplace remains tidy, organized, and hazard-free. Here's an in-depth explanation of its importance:



Fig. 7.5: Importance of good housekeeping at the workplace

7.3.1 Promotes a Safe Working Environment

- **Reduces accidents and injuries:** Cluttered floors, misplaced tools, or unmarked spills can lead to slips, trips, and falls. Proper housekeeping helps eliminate these hazards.
- **Minimizes fire hazards:** Proper storage of flammable materials and disposal of waste reduces the risk of fire outbreaks.
- **Improves emergency preparedness:** Clear pathways and accessible emergency exits are crucial during evacuations or emergencies.

7.3.2. Enhances Efficiency and Productivity

- **Saves time:** When tools, documents, and materials are stored properly, employees spend less time searching for them, leading to better time management.
- **Supports workflow:** Organized workstations allow for smoother processes, reducing delays and confusion.
- **Boosts morale:** A clean and organized environment positively affects employee mindset and motivation.

7.3.3 Extends Equipment and Asset Life

- **Reduces wear and tear:** Clean and well-maintained equipment performs better and lasts longer, reducing repair and replacement costs.
- **Prevents contamination and damage:** Proper housekeeping ensures that equipment and materials are not damaged by dust, moisture, or improper handling.



7.3.4. Ensures Compliance with Regulations

- Many government regulations and industry standards require cleanliness and orderliness to ensure occupational health and safety (e.g., under the Factories Act, OSH Code 2020, or ISO standards).
- Failure to comply can result in penalties, legal issues, or shutdowns.

7.3.5 Improves Professional Image

- A clean and organized workplace reflects positively on the organization, enhancing its reputation with clients, visitors, and potential employees.

7.3.6 Supports Health and Hygiene

- Prevents the spread of diseases by controlling dust, pests, and contamination.
- Especially important in food processing, healthcare, and laboratory settings.

7.3.7 Encourages Responsibility and Discipline

- Regular housekeeping creates a culture of accountability, where employees take ownership of their work areas.
- Encourages employees to follow proper procedures and maintain standards.

7.3.8 Facilitates Inspections and Audits

- Clean, orderly workplaces make it easier for inspectors to assess safety, hygiene, and compliance quickly and effectively.



INTEXT QUESTIONS 7.2

State True or False

- Proper storage of flammable materials and disposal of waste reduces the risk of fire outbreaks. (T/F)
- Physical distancing and staggered work hours to minimize contact. (T/F)
- Daily working hours are limited to 8–9 hours with appropriate meal/rest breaks. (T/F)
- According to Factories Act, 1948 periodic medical check-ups, especially for workers in hazardous environments are not mandatory. (T/F)
- Risk assessments and safety audits must be carried out on a regular basis. (T/F)



7.4 IMPORTANCE OF INFORMING AUTHORITIES ABOUT HEALTH ISSUES

Importance of informing the designated authority on personal health issues related to injuries and infectious diseases

Timely reporting of personal health issues, especially those related to injuries and infectious diseases, to the designated authority at the workplace is crucial. It plays a vital role in ensuring employee safety, preventing the spread of illness, and maintaining a healthy and productive work environment.

7.4.1 Prevents the Spread of Infectious Diseases

- **Early containment:** Informing the authority helps initiate early isolation or quarantine protocols, preventing the disease from spreading to coworkers.
- **Protects vulnerable employees:** Timely reporting protects employees with weaker immune systems, chronic illnesses, or those in sensitive roles (e.g., food handlers, healthcare workers).
- **Compliance with health guidelines:** Organizations can activate health protocols (like sanitization, contact tracing, or testing) aligned with public health advisories (e.g., from the Ministry of Health or WHO).

7.4.2 Ensures Proper Medical Attention and Support

- **Access to medical facilities:** Reporting an injury or illness allows the organization to provide immediate first aid or professional medical care.
- **Health monitoring:** It enables regular follow-up and monitoring to ensure full recovery and prevent worsening of the condition.
- **Eligibility for insurance claims:** Proper documentation of incidents is essential for processing claims under employee health insurance, compensation, or accident benefit schemes.

7.4.3 Promotes Workplace Safety and Risk Management

- **Identification of hazards:** Reporting injuries (like slips, chemical exposure, or repetitive strain injuries) helps identify hazardous areas or unsafe practices.
- **Prevention of future incidents:** Authorities can investigate the root cause and implement corrective actions (e.g., repairing faulty machinery, updating safety protocols).
- **Improves training needs:** Helps management assess gaps in safety training or protective equipment usage.



7.4.4 Legal and Ethical Responsibility

- **Mandatory reporting requirements:** Labor and health laws often require the reporting of workplace injuries and illnesses (e.g., under the Factories Act, ESI Act, or OSHA regulations).
- **Protects employer and employee rights:** Documentation ensures transparency and protects both parties from potential legal disputes.

7.4.5 Maintains Productivity and Continuity

- **Prevents outbreaks:** Rapid action minimizes absenteeism caused by mass infections.
- **Effective work reallocation:** Informing management helps them redistribute tasks or arrange substitutes to avoid workflow disruptions.

7.4.6 Builds a Culture of Care and Responsibility

- **Encourages openness:** Promotes a workplace culture where employees feel safe sharing health concerns without fear of stigma.
- **Fosters responsibility:** Employees learn to take responsibility for their health and for the well-being of their coworkers.

7.5 IMPORTANCE OF INFORMING THE DESIGNATED AUTHORITY ON PERSONAL HEALTH ISSUES RELATED TO INJURIES AND INFECTIOUS DISEASES

Informing the designated authority about personal health issues especially those related to injuries and infectious diseases is a crucial responsibility in the workplace. It ensures the safety of the affected individual, co-workers, and the overall organization. Here's why it is important:

7.5.1 Ensures Prompt Medical Attention

Immediate care: Reporting injuries or health issues enables quick medical intervention, minimizing the risk of complications (Fig. 7.6).

Timely treatment: Early diagnosis and treatment of infectious diseases reduce severity and speed up recovery.

Support services: The organization can provide access to medical facilities, first aid, or health insurance benefits.



Notes



Fig. 7.6: Ensure prompt medical attention

7.5.2 Prevents the Spread of Infectious Diseases

- **Early containment:** Prompt reporting allows the organization to isolate or manage infected individuals to prevent disease transmission.
- **Sanitization measures:** It enables disinfection of affected areas, preventing further infections.
- **Health monitoring of others:** Close contacts of the infected person can be monitored or tested.

7.5.3 Supports Workplace Safety and Compliance

- **Risk assessment:** Authorities can assess how the injury or illness occurred and implement safety measures to avoid recurrence.
- **Legal compliance:** Organizations must maintain health and safety records as per labor and health regulations (e.g., Factories Act, Occupational Safety Rules).
- **Audit preparedness:** Proper documentation supports compliance during inspections or audits.

7.5.4 Facilitates Insurance and Compensation Claims

- **Proper documentation:** Reporting ensures incidents are officially recorded, which is essential for claiming insurance, sick leave, or compensation.
- **Eligibility for benefits:** Ensures employees receive their entitled health coverage, medical reimbursement, or disability support.



7.5.5 Maintains a Healthy Work Environment

- **Promotes hygiene and cleanliness:** Reporting health issues leads to improved sanitation and hygiene practices in the workplace.
- **Boosts morale and trust:** Employees feel cared for when health concerns are addressed quickly and transparently.
- **Reduces absenteeism and disruption:** Controlling disease spread helps maintain workforce strength and productivity.

7.5.6 Encourages a Culture of Responsibility

- **Promotes transparency:** Employees understand that reporting health issues is essential and not something to hide or fear.
- **Shared responsibility:** Fosters a culture where everyone contributes to maintaining a safe and healthy environment.



WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- The word *hygiene* refers to the conditions and practices that help maintain health and prevent the spread of diseases.
- *Cleanliness* involves keeping oneself and the surrounding environment free from dirt, germs, and other harmful substances.
- Personal health refers to the overall physical, mental, and emotional well-being of an individual.
- Regular Health Check-ups, Healthy Diet, Sufficient Sleep and Mental Health Management: are required for personal health.
- Personal hygiene includes daily practices of Cleanliness and Grooming, Hand Hygiene, Nail and Hair Care, Use of Protective Gear, and Clean Workstation.
- Risk assessments and safety audits must be carried out on a regular basis.
- Daily working hours are limited to 8–9 hours with appropriate meal/rest breaks.
- Good housekeeping is not just about keeping the workplace clean—it is a vital component of workplace safety, efficiency, and overall organizational discipline.
- Organizations must maintain health and safety records as per labor and health regulations



Notes



TERMINAL EXERCISE

1. Differentiate between hygiene and cleanness.
2. Write down about Occupational Safety and Health Standards.
3. What is required for personal fitness?
4. What are the ways to achieve personal hygiene?
5. Write down about the Covid-19 and Infectious Disease Guidelines
6. Explain the importance of Good Housekeeping at the Workplace.



ANSWERS TO INTEXT QUESTIONS

7.1

- (a) Illnesses (b) meditation or counseling.
(c) bathing, brushing teeth, washing hands, wearing clean clothes, and maintaining nail and hair hygiene.
(d) Hygiene (e) Cleanliness

7.2

- (a) T (b) T (c) T (d) F (e) T

SUGGESTED ACTIVITY 7.1

1. Write about your daily routine activity for hygiene before and after reading this chapter.
2. What are the changes you feel after practicing hygiene and cleanness.

KEY LEARNING OUTCOMES

- Elucidate the benefits of hygiene and cleanness in their life
- State the importance of a healthy life at the workplace.



8

MAINTAIN HEALTH AND SAFETY AT WORKPLACE

Dear learners, you have already learned you explored the importance of hygiene and cleanliness successfully, you are now ready to take the next important step. In this chapter you will learn about the importance of maintaining health and safety, as well as workplace hygiene. We assume that after completion of this certificate programme you will be able to start your own vermicomposting farm. Here, maintaining the health and safety of yourself and your co-workers will be your foremost duty. You have to make sure that your co-workers and others are protected from any hazards (danger) and risks (a situation involving exposure to danger) that may harm them. This involves effective control of any risk or injury that could arise at the workplace. If you have a small unit, then your worries would be less, but you would still need to take precautions. However, large scale composting sites are associated with a number of health and safety hazards, which can cause harm to both human health as well as could cause financial losses. For handling the risks and hazardous materials, you need to undertake proper analysis and find ways to manage risk. We will be discuss about the risks towards health and safety of equipment and stores that are associated with vermicomposting unit and their management at a vermicompost farm in this lesson.



OBJECTIVES

After reading this lesson thoroughly, you will be able to:

- Explain the importance of health and safety at the workplace;
- Identify the risks associated with vermicomposting sites and undertake risk management;



Notes

Maintain Health and Safety at Workplace

- maintain clean and efficient workplace;
- provide appropriate emergency procedures; and
- improve the health and safety at a vermi-compost unit.

8.1 IMPORTANCE OF HEALTH AND SAFETY AT THE WORKPLACE

Workplace safety is very important for all workers, as everyone desires to work in a safe and protected environment. Whether you are managing a small or large vermi-compost unit, it is your duty and moral responsibility to ensure the protection of your co-workers and provide them with a safe working environment. There are numerous benefits of following health and safety practices in the workplace. Let us enlist a few of them:

- **Protecting Your Employees**

If you and your employees are following health and safety guidelines, it will primarily protect everyone from injuries/accidents, illness or any other form of harm that can take place at the workplace.

- **Reducing Absences and Improving Productivity**

Following health and safety guidelines and maintaining a safe work place will reduce the risk of work-related illnesses and injuries, and therefore reduce the instances of staff absences. Also, if one is working in a safe and healthy environment, it will increase his/her morale, which in turn will improve productivity of the farm. In addition, accidents and incidents may cause damage to equipment or people and stop the work for some period of time leading to financial losses.

- **Saving Money**

By maintaining health and safety practices at the workplace, and therefore reducing absences and improving productivity, you will be saving money by retaining staff. Money spent on accident repairs, equipment losses and staff absences will decrease and the business' profits will increase.

- **Minimizing Environmental Damage**

Vermicomposting is a good way for waste management. Proper health and safety procedures should be followed and safe disposal of farm waste should be done to minimize environmental damage.



8.2 IDENTIFYING RISKS AT COMPOSTING SITES/RISK ASSESSMENT

Large composting sites are associated with a number of health and safety hazards which can cause harm to human health and environment. Identifying the risks at the composting farm will help you and your unit to be safe from any hazards or accidents. Hence, analysis of the risks should be carried out so that all the safety measures can be taken properly and effectively. Let us identify the associated risks with health and safety of the employees at a vermicomposting site:

8.2.1 Health Related Risks

- **Diseases Caused Due to Dusts and Bioaerosols**

The composting sites inherently generate dusts and bioaerosols. The bioaerosols are made up of very small biological particles (fungi, bacteria, viruses and pollen), which remain suspended in the air and can be inhaled by people working there. Bioaerosols, organic dust, particulate matter of microbes, plant or animal origin materials and microbial constituents such as fragments, toxins and metabolites cause hazardous health issues to the workers working at the composting units. The concentration of bioaerosols are greatest in the lower part of the atmosphere and it decreases with altitude. Their size varies from 10 nanometres to 100 micrometers. Pollen grains are the largest bioaerosols and virus particles are the smallest one. The virus bioaerosols are less likely to remain suspended in the air over a long period of time, due to their heavy weight. These are typically introduced into the air through wind turbulence from earth surface and are responsible for causing diseases in the composting area. Well-known disease outbreaks caused by bioaerosols includes pneumonia and tuberculosis. The bioaerosols may increase human respiratory problems. This may be due to traces of heavy metals and microorganisms that are suspended in the air at the composting sites. Let us enlist a few important diseases at the composting sites at Table 8.1.

Table 8.1: Some Diseases and Causal Agents that Occur at Composting Sites

Causal Agents	Disease
<i>Bacteria</i>	
<i>Vibrio cholera</i>	Cholera
<i>Salmonella typhi</i> and other species	Typhoid and other enteric fevers
<i>E-coli</i>	Diarrhoea
<i>Tubercle bacilli</i>	Tuberculosis



Notes

Maintain Health and Safety at Workplace

Causal Agents	Disease
Viruses Infectious Hepatitis Epidemic gastroenteritis virus Small round viruses (SRV's)	Inflammation of the liver Gastro-enteritis Food poisoning and gastroenteritis
Parasites <i>Entamoeba histolytica</i> <i>Balantidium coli</i> <i>Giardia lamblia</i>	Amoebic dysentery Balantidiasis (an infection) Diarrhea

A precise understanding of bioaerosols and their effects on human health is extremely important for effective health risk assessment.

8.2.2 Potential Sources of Accidents and Incidents

● Fire

Fire is one of the potential hazards at a composting site. The fire may be caused due to sparks originating from vehicles, processing operations, lightening, cigarettes and spontaneous combustion of raw materials stored in bulk. It could also be caused by a short circuit. It is important for you to note that the large compost heaps can generate temperature of up to 80°C as a result of biological processes of organic matter decomposition. So, this may also cause fire in the composting farm. However, few safety measures are suggested to combat such a situation:

- As you can understand that fire can be caused due to human negligence as well as it could be due to short circuit. So, you need to train your workers about the risks caused due to fire and advise them to refrain from the bad habits that may lead fire in the unit including smoking.
- Proper moisture in the composting pit and turning of bed periodically prevents self-ignition of the compost heap. So, please do not forget this.
- If you have taken up vermicomposting on a large scale for commercial purposes, then you need to spend considerable amount of money on office space, permanent sheds for vermibed, storage place for raw material and the finished product, etc. Permanent buildings will reduce the risk of fires as compared to open/temporary structures.
- Fire safety planning includes emergency routes and exits, fire detection, warning systems and appropriate fire fighting appliances such as fire



extinguisher and fire hoses (Fig. 8.1). It is also important to provide suitable information to the employees and others at the workplace about fire safety in the form of notices or sign boards. Staff training/mock drill should also be conducted.



Fig. 8.1: Fire safety equipment

Source: <https://www.lrbconsulting.co.uk/health-and-safety-blog/simple-rules-to-tackle-a-small-fire/>

- **Accidents due to Human Negligence**

Any unattended vermicompost pit in the farm may lead to an accident or an incident. So, it is the responsibility of each and everyone working at the farm to be careful about this. Also, proper lighting should be provided near to pits so that no one falls into it.

8.2.3 Risks Associated with Poorly Managed Vermibed

- **Smells/Odors from Vermibeds**

You must have observed that a well-managed vermibed is odorless. But, when the feed material is high in nitrogen content and it is added to the bed, it leads to anaerobic condition. This causes the production of bad odor or smell in the bed. Even when the feed materials are not partially decomposed before their addition to the bed, it also results in the production of bad smell. The beds if they are more than 1m deep or they are too wet may also smell. The beds smell because of



Notes

Maintain Health and Safety at Workplace

production of certain gases such as ammonia, hydrogen sulphide, methane, carbon monoxide, etc. Do you know that these gases may cause global warming due to the greenhouse effect? Thus, a badly managed bed produces smells and also adds to environmental pollution. Such beds also attract pests and delay the composting process. You can easily avoid such situations by adopting good management practices such as the use of partially decomposed organic wastes.

- **Moisture Content in Vermibed**

Moisture content in the composting unit must be maintained above 50%. The lower moisture content in the bed results in increased worm mortality. Under anaerobic decomposition, addition of excess water must be avoided to restore healthy conditions and prevent the worms from dying. Maintain optimum moisture level in the bed by turning the beds periodically.

- **Needless Pest Species**

The composting units are the breeding (the natural process of reproduction) sites for fruit flies and rodents. The rodents are attracted by certain food materials from the kitchen wastes and they can cause spreading of certain diseases to the human beings. You should avoid the use of dairy or animal products in your worm bin to decrease the possibility of attracting pests.

- **Escaping of Worms**

Worms generally stay in the bin, but may try to leave the bin when introduced for the first time, or often after a rainstorm, when the outside humidity is high. Also, the dying earthworms cause unhealthy condition in the composting unit that may encourage the worms to escape. Maintaining proper conditions in the worm bin and putting a light cover over the bin when introduced for the first time would eliminate this problem.

- **Mold**

Mold in the bedding, not only indicates that the bedding is too wet, but also shows that it is too acidic. Change the mold affected bedding and remove the citrus fruits (which is too acidic) completely from the bedding until the problem is solved. Reintroduce the worms slowly and carefully. Some mold/fungi can cause health related problems to the human beings and pets too, so you need to be quite careful. The problems of poorly managed vermibeds can easily be tackled by taking proper management steps. We have already discussed the management of vermibeds in the previous lesson; please review it if you face any problem.



INTEXT QUESTIONS 8.1



Notes

1. State True or False

- (a) Vermicomposting is the best solution for waste management.
- (b) Dust particles emitted from the composting units cause respiratory problems in the human beings.
- (c) Bioaerosols are visible through the naked eyes.
- (d) Compost heaps can generate high temperature that may cause fire in the composting farm.

2. State Fill in the blanks

- (a) Bioaerosols consists of,, and
- (b) Maintain condition to avoid emission of smells or odours from the composting bin/bed.
- (c) gas is emitted due to anaerobic condition of composting.
- (d) Provide to prevent escaping of worms from the composting unit.

8.3 RISK MANAGEMENT AT COMPOSTING SITES

Now, you might have understood that there are various types of risks pertaining to safety and health hazards at the composting site. Therefore, you need to follow few important steps for managing the risks associated with the composting sites:

- Adequate preventive measures should to be taken for all the personnel who come in contact with the composting area.
- Undertake basic safety checks before operation of all tools, equipment, machinery and vehicles.
- Always use protective clothing and equipment, such as, gloves, masks, safety glasses, boots etc. (Fig. 8.2) while working in the composting units.



Notes



Fig. 8.2: Protective clothing to be used at a vermicomposting unit

Source: https://www.aphis.usda.gov/animal_health/emergency_management/inhouse_composting/ovr/ppe/ppe0038.html

- Always handle composting materials with shovel and other forms of scoopers (Fig. 8.3).



Fig. 8.3: Handling composting material with shovel

- Use equipment and materials safely and correctly and return the same to the designated storage area when not in use.
- Keep a lid on the composting bin or cover the vermibeds and ensure that the access for animals is blocked.
- *First aid* is the *first* and immediate assistance given to any person suffering from either a minor or serious illness or injury. This is done to preserve life, prevent the condition from worsening or to promote recovery. Always keep a first aid kit at the composting premises to provide necessary initial treatment, in case of any emergency. A first aid kit is a collection of supplies and equipment that is used to give medical treatment (Fig. 8.4.). In general the kit should contain:



- Antiseptic wipes or sprays: for reducing the risk of infection in abrasions or around wounds.
- Cotton Balls: for applying antiseptic lotions.
- Bandages: for securing dressings.
- Saline: for cleaning wounds or washing out foreign bodies from eyes.
- Dressing: a dressing is a sterile pad applied to a wound to promote healing and protect the wound from further harm.
- Antiseptic solution: to apply on wounds.
- Relispray: spray for pain relief.
- Ice pack: to keep on sprain or fracture for immediate relief.
- Soap: used with water to clean superficial wounds once bleeding is stopped.
- Scissors: to cut dressing/bandages.
- Thermometer: to check body temperature.
- Few recommended medicines for fever and pain relief.

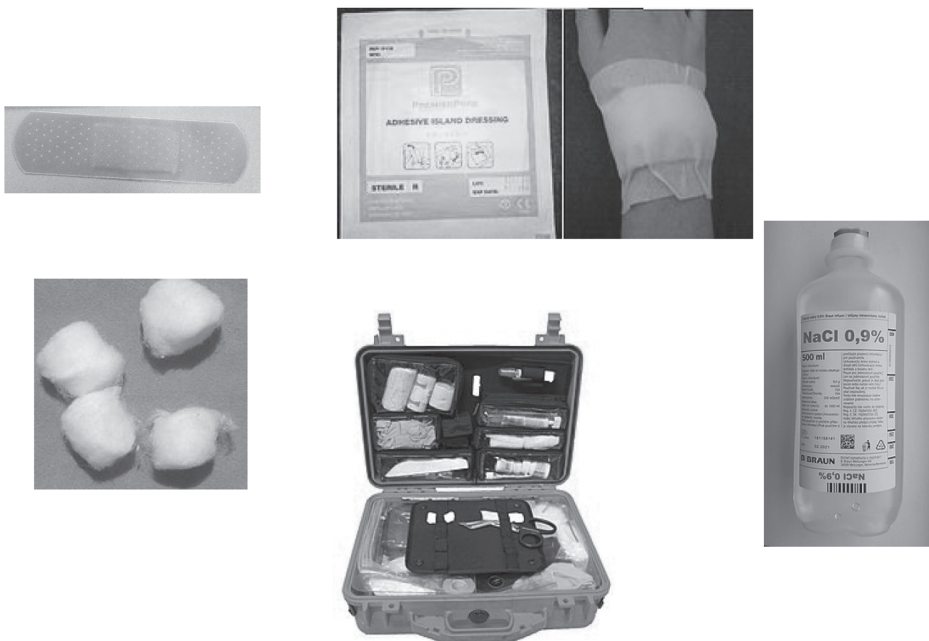


Fig. 8.4: First aid kit



Notes

Maintain Health and Safety at Workplace

- Proper waste disposal should be encouraged without harming the environment.
- Maintain a healthy composting farm. You are required to maintain a healthy composting farm for obtaining better quality and quantity of vermicompost. There are a number of precautions that should be taken to maintain a healthy composting farm. Let us enlist some of them:
 - Floor of the unit should be compact to prevent the migration of earthworms into the soil.
 - Aeration in the vermibed should be maintained for the proper growth and multiplication of the earthworms.
 - Do not overfeed the worms. Also, the feed wastes should be free from plastics, chemicals, pesticides and metals.
 - Regulate the bin temperature between 18-25°C for proper decomposition of the food waste. This can be done by periodical turning of the beds.
 - Use only 15-20 days old cow dung to avoid excessive heat generation in the bed.
 - Keep the bed moist (optimum moisture level between 50-60 %) at all the times.
 - Keep the bin dark (avoid light entering the bin) to ensure faster decomposition.
 - Address the worm problems intermittently, e.g. remove any harmful pests present in the vermibed.
 - Empty excess liquid (leachate) from the bin/vermibed. These can be used as a nutrient rich bio fertilizer. After maturity of the compost remove the worms to avoid their death due to feed scarcity.

8.4 IMPROVING HEALTH AND SAFETY AT A VERMICOMPOSTING UNIT

The Occupational Health and Safety Regulation (it is concerned with the health and safety of the people at work) is required for managing the prevention of work-related injuries and diseases at the workplace (Here, workplace refers to your vermicomposting unit). So, as an employer or vermicompost producer you must do the following:

- Create a plan for improving the health and safety by identify hazards at your workplace and take appropriate measures to eliminate or minimize them. So, you need to develop a safety plan.

Maintain Health and Safety at Workplace

- Inspect your workplace regularly. Check all the equipment and tools to ensure that they are well maintained and are safe to use.
- Manage a cordial relationship with your co-workers who may be stressed, frustrated, confused or angry. A positive working atmosphere would motivate and sustain your employees.
- Train your employees, especially if there is a risk for possible injuries associated with a particular job. Always provide written instructions and safe work procedures. This will help them as they can check for themselves what needs to be done, if they are unsure of a task or have forgotten some part of their training.
- Encourage your workers to share their ideas and thoughts on measures to improve the safety at the workplace.
- All employees should be aware of the local emergency services available. They should be able to communicate the location and directions on emergency situations. Also, everybody should be able to understand the emergency equipment and procedures including how to use the first aid kit as per the workplace requirements.
- Maintain a record of all the first aid treatments, inspections, incident investigations, and training activities that are carried out at the workplace. This information can help you to identify trends that result in accidents/incidents or risky work procedures and thereafter you may take appropriate measures to enhance workplace safety.



INTEXT QUESTIONS 8.2

1. State True or False

- (a) One should undertake the basic safety checks before operation of all tools, machinery and vehicles for managing the risks associated with the composting sites.
- (b) Workers should wear protective clothing, masks and gloves while working at the composting units.
- (c) Aeration in the vermibed should be maintained for the proper growth and multiplication of the earthworms.
- (d) Training of employees should be carried out periodically, especially if there is a risk for the possible injuries associated with a particular job.



Notes



Notes

2. State Fill in the Blanks

- (a) A should be made to improve the health and safety at the workplace.
- (b) is done to preserve life and prevent the individual's condition from worsening or to promote recovery.
- (c) is used for cleaning wounds or washing out foreign bodies from the eyes.
- (d) The bin temperature should be regulated between for proper decomposition of the food waste.



WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt in this lesson:

- Workplace safety is very important as everybody desires to work in a safe and protected environment. It is the duty and moral responsibility of an employer to look after the protection of his/her co-workers and provide them a safe working environment.
- The appropriate health and safety practices at the workplace results in protecting the employees from accidents and incidents, reduces absences, improves productivity and saves money spent on absences and damage to the equipment. It also minimizes environmental damage.
- Analysis of the risks should be carried out so that all the safety measures can be taken properly and effectively.
- The composting sites inherently generate dusts and bioaerosols that cause hazardous health issues to the workers at the composting unit.
- The bioaerosols may increase human respiratory problems due to traces of heavy metals and microorganisms that are suspended in the air at the composting sites.
- Fire could be caused due to sparks from vehicles, processing operations, short circuits, cigarettes and spontaneous combustion of raw materials stored in bulk at these sites. Fire safety planning and appropriate fire fighting equipment such as fire extinguishers and fire hoses should be installed in the unit as a precautionary measure to tackle different types of fire.

Maintain Health and Safety at Workplace



Notes

- Smells/Odours from vermibeds, improper moisture content in the vermibed, pests, escaping of worms and development of mold are the problems of a poorly managed vermibed. These can be easily tackled by taking proper risk and vermibed management steps.
- For risk management at the composting site you need to undertake the basic safety checks before operation of all tools, machinery and vehicles.
- Use equipment and materials safely and correctly and return the same to the designated storage when not in use.
- Always keep a first aid kit at the composting premises to provide necessary initial treatment, in case of any emergency.
- Proper waste disposal should be encouraged to prevent environmental damage.
- Maintain a healthy composting farm for obtaining better quality and quantity of vermicompost.
- Develop a plan for improving the health and safety by identifying the potential hazards at your workplace and take appropriate measures to eliminate or minimize them.
- Inspection of the workplace should be carried out on regular basis.
- All equipment and tools should be checked regularly to ensure that they are well maintained and safe to use.
- Written instructions and safe work procedures and checklists should be created in the form of Standard Operating Procedures (SOPs) and provided to the workers so that they can refer to it when required.
- Protective equipment, gloves, masks, safety glasses, helmets, etc. should be used while working at the composting units.
- Periodical training of the employees should be carried out, especially if there is a risk for possible injuries associated with a particular job.
- All employees should be able to use emergency equipment and follow emergency procedures including first aid as per the workplace requirements.



TERMINAL EXERCISE

1. Why health and safety is important at workplace? Enlist few benefits of a healthy and safe workplace.



Notes

Maintain Health and Safety at Workplace

2. What safety measures can be adopted to prevent fire at a vermicompost unit?
3. What do you mean by bioaerosols? What are the agents that cause health hazards in human beings at composting sites?
4. Enlist the measures to handle and maintain the earthworms in the composting pits?
5. What are the precautionary measures that should be taken to maintain a healthy composting farm?
6. What are the steps involved in improving the workplace health and safety?
7. How do you manage hazards occurring at the composting sites?



ANSWERS TO INTEXT QUESTIONS

8.1

1. (a) True (b) True (c) False (d) True
2. (a) Fungus, bacteria, virus and pollen
(b) Aerobic (c) Ammonia (d) Shade

8.2

1. (a) True (b) True (c) True (d) True
2. (a) Safety plan (b) First aid (c) Saline (d) 18-25°C

KEY LEARNING OUTCOMES

- Able to maintain safety and health of the worker at a vermicomposting unit by taking appropriate risk management measures.



EMPLOYABILITY SKILLS

Dear learners, you have already learned you explored maintain health and safety at workplace successfully; you are now ready to take the next important step. In this chapter we will study, how to get good employable skill so that we can work with industries. Employability refers to a person's ability to get and keep a job. It includes the abilities, knowledge, attitudes, and personal characteristics that make people appealing to employers and boost their chances of getting and keeping a job. Employability is critical in today's competitive job market for both job seekers and those who are currently employed, as it determines career progression, job security, and overall professional success.

Academic credentials or technological expertise does not exclusively determine employability. It also includes a variety of transferrable talents, known as "soft skills," such as communication, teamwork, problem solving, flexibility, and leadership. Employers place a high value on these abilities because they contribute to an individual's capacity to collaborate successfully with others, deal with obstacles, and continually learn and grow in a quickly changing work environment.

Furthermore, a person's motivation to learn and acquire new abilities, as well as their ability to effectively promote themselves to employers, impact employability. This includes creating an eye-catching résumé, emphasizing relevant experiences, and presenting oneself confidently during interviews. Having a professional network, participating in continuous learning opportunities, and remaining current with industry developments are all-important for increasing employability.

Employability has evolved in recent years to include a focus on entrepreneurial skills and a desire to take initiative. Employers are increasingly looking for people who can think creatively, spot possibilities, and bring unique ideas to their organizations. This entrepreneurial mentality exhibits a proactive attitude towards work as well as the capacity to adapt to new difficulties and possibilities.



Notes



OBJECTIVES

After reading this lesson thoroughly, you will be able to:

- explain the different types of marketing;
- list the important marketing platform;
- maintain the consumer and producer linkage;
- export products;
- do business Planning;
- make project preparation for credit

9.1 CONSTITUTIONAL VALUES-CITIZENSHIP

Citizenship principles are established in the Indian Constitution (Fig. 9.1), notably in Part II (Citizenship) and Part III (Fundamental Rights). These ideals emphasise equality, liberty, justice, and dignity for all citizens. Here are some major constitutional ideals of Indian citizenship:

- **Equality:** The Constitution ensures equality for all people, regardless of caste, religion, gender, or place of birth. The equality principle assures that every citizen is treated equally and given equal legal opportunities and protections.
- **Liberty:** Indian citizens have the right to personal freedoms and liberties. Individual liberties such as freedom of speech and expression, freedom of religion, freedom of movement, and the right to life and personal liberty are all protected by the Constitution.
- **Justice:** the Indian Constitution promotes the values of social, economic, and political justice. It assures citizens' access to a fair and impartial legal system, as well as their protection against discrimination, exploitation, and arbitrary acts.
- **Dignity:** The Constitution recognises every citizen's inherent dignity and value. It outlaws all forms of inhuman or humiliating treatment and guarantees that citizens are treated with dignity and respect.
- **Sovereignty and Patriotism:** The Indian Constitution supports the country's sovereignty and expects citizens to be loyal to the country. It emphasises the



value of patriotism and citizens' responsibility to contribute to the country's well-being and prosperity. India is a secular country, and the Constitution encourages religious tolerance and respect for all religions. It protects citizens' right to practise and promote their faith while ensuring communal peace and an inclusive atmosphere.

- **Social Justice:** The Constitution emphasises the importance of social justice and supports the values of equality, non-discrimination, and affirmative action in order to help underprivileged and marginalised members of society. It seeks to bridge social and economic gaps and foster a more fair society.



Fig 9.1: Constitution of India

Source: <https://www.jatinverma.org/>

These constitutional concepts of citizenship serve as the foundation for Indian citizens' rights, obligations, and responsibilities. They embody the democratic and inclusive values upon which the Indian country is established, and they influence the operation of the government as well as people's relationships with the state.

9.2 BECOME A PROFESSIONAL IN 21ST CENTURY

To flourish in a fast changing environment, becoming a professional in the twenty-first century necessitates a mix of knowledge, skills, and flexibility. Here are some suggestions to help you become a professional in the twenty-first century (Fig. 9.2):

- **Determine Your Passions and Goals:** Consider your hobbies, values, and long-term work goals. Determine your areas of interest and make specific goals for your career growth.
- **Continuous Learning:** Adopt a philosophy of lifelong learning. Maintain your curiosity and aggressively seek opportunities to gain new information



Notes

and abilities. Keep up to speed on industry developments and breakthroughs, and consider formal education, online courses, workshops, and conferences as learning opportunities.

- **Develop transferable talents:** Focus on establishing transferable talents that are highly appreciated across sectors in addition to specialized knowledge. Communication, critical thinking, problem solving, flexibility, teamwork, leadership, and technology literacy are among them. These abilities will boost your employability and assist you negotiate a variety of job contexts.



Fig. 9. 2: Professional in 21st century

Source: <https://www.ict360.com/>

- **Embrace Technology:** Technology is important in the contemporary workplace. Keep up with technological advances, improve your digital literacy, and learn how to use technology to boost your productivity, communication, and problem-solving skills.
- **Develop a Professional Network:** Make significant connections with professionals in your field of interest. Attend industry events, join professional organizations, and participate in online and offline networking opportunities. Mentorship, direction, and future job possibilities may all be obtained through a strong professional network.
- **Gain Practical Experience:** Look for internships, part-time employment, or volunteer opportunities in the sector you want to work in. Practical experience



not only improves your abilities but also gives essential insights into the workplace and aids in the development of a professional track record.

- **Create a Professional Brand:** Establish a professional internet presence using platforms such as LinkedIn. Display your abilities, expertise, and accomplishments. Create a captivating CV and cover letter that showcase your unique value proposition for each opportunity.
- **Adaptability and resilience:** The workplace of the twenty-first century is marked by fast change and instability. Increase your adaptability, flexibility, and resilience. To stay ahead in your area, be open to new challenges, embrace change, and always learn and improve.
- **Recognise the value of Diversity and Inclusion in the Workplace:** Recognise the value of diversity and inclusion in the workplace. Develop cultural knowledge, promote inclusion, and learn to collaborate with individuals from all backgrounds.
- **Professional Ethics:** Maintain high ethical standards in your professional interactions. In your relationships with coworkers, clients, and stakeholders, demonstrate integrity, honesty, and responsibility.

9.3 BASIC ENGLISH SKILLS

For various reasons, basic English abilities are critical to employability. Here are some significant points emphasising the significance of English abilities in the workplace:

- **Communication:** English is often considered as the global business and communication language. English proficiency allows for successful communication with colleagues, clients, and stakeholders from various backgrounds. It promotes clear and succinct articulation of ideas, instructions, and information in the workplace, creating improved cooperation, collaboration, and comprehension.
- **Job Applications and Interviews:** English fluency is frequently required for job applications and interviews, particularly in international corporations or sectors with a global presence. A well-written English resume and cover letter show professionalism and attention to detail. The ability to explain concepts and reply convincingly in English during interviews increases your chances of impressing potential employers.

Effective English communication becomes increasingly vital as people advance in their jobs. It is frequently required for managerial or leadership positions



Notes

where workers are expected to successfully communicate with teams, clients, and senior management. Strong English abilities can lead to more senior roles and professional prospects.

- **Global Workforce:** Many businesses operate in worldwide marketplaces and have varied teams made up of people from various language backgrounds. Within such organisations, English is used as a common language for communication. Employees who are fluent in English can navigate and contribute successfully in a global workforce.

English is the major language used in a large number of professional materials, such as books, journals, research papers, and online learning platforms. Individuals with strong English abilities may access and exploit these resources for ongoing learning, professional growth, and staying current on industry trends.

- **Customer Service and Client Relations:** Interacting with English-speaking consumers or clients is widespread in areas such as hospitality, tourism, and customer service. Employees with strong English abilities may provide outstanding customer service, answer enquiries, and create relationships with clients, increasing customer satisfaction and the company's reputation.
- **International Assignments & Travel:** English proficiency is especially important for people who work on international assignments, travel for business, or work in expatriate jobs. It promotes successful partnerships and corporate interactions by enabling efficient communication and adaption in foreign contexts.

It is vital to highlight that basic English abilities serve as a foundation, while advanced English proficiency can improve employability and career prospects even more. Employers frequently favour individuals with high English communication skills because they are perceived as more adaptive, globally competent, and capable of contributing successfully in a varied and interconnected environment.

9.4 CAREER DEVELOPMENT AND GOAL SETTING

Career development and goal planning are critical procedures that help people prepare for and accomplish their professional goals. Here are some methods to help you with your professional growth and goal setting (Fig. 9.3):

- **Self-Assessment:** To begin, consider your hobbies, values, strengths, and limitations. Consider your interests, talents, and what inspires you. Consider

your long-term professional objectives and ambitions. Understanding yourself will assist you in aligning your employment options with your values and skills.

Notes



Fig. 9.3: Career development and goal setting

Source: <https://www.chemeketa.edu/>

- **Investigate job Options:** Conduct study and look at numerous job options that match your interests and ambitions. Learn about various sectors, career positions, and the necessary skills and requirements. To obtain direct knowledge and insights into various occupations, seek out informative interviews, work shadowing, or internships.
- **Set SMART goals:** Specific, Measurable, Achievable, Relevant, and Time-bound goals. Define particular professional goals that are both reasonable and feasible. Instead of declaring, “I want to work in marketing,” a SMART goal



Notes

Employability Skills

may be, “I want to secure a marketing coordinator position within the next two years in a consumer goods company.”

- **Create a Career Plan:** Make a thorough career plan outlining the measures you need to follow to reach your goals. Divide your long-term ambitions into smaller, more manageable benchmarks. Determine what talents, knowledge, or experiences you will need to gain along the road. Set deadlines for completing each milestone.
- **Develop your skills and knowledge:** Identifying the abilities and knowledge essential for your preferred professional path. Determine whether any more credentials, certifications, or degrees are required. Look for ways to improve your skills, such as online courses, workshops, seminars, or mentoring programmes. To remain competitive in your chosen sector, you must constantly update and improve your abilities.
- **Networking and Mentorship:** Create a professional network of connections in your chosen sector. Attend industry events, join professional organisations, and network with others on networks such as LinkedIn. Seek for mentoring from seasoned professionals who can offer direction, advice, and support throughout your career.
- **Gain Relevant Experience:** Look for internships, part-time work, or volunteer activities that will allow you to gain hands-on experience in your chosen industry. Practical experience is important for acquiring sector-specific skills and generating contacts in your chosen field.
- **Review and Adjust:** Review and reassess your professional objectives and success on a regular basis. Adjust your career strategy as required to reflect changing circumstances or new possibilities that occur. Continue to be versatile and open to new opportunities.
- **Seek Feedback:** To acquire insights into your strengths and places for progress, seek feedback from mentors, supervisors, or trustworthy coworkers. Use constructive comments to advance your professional development.
- **Milestones should be evaluated and celebrated:** Evaluate your progress towards your goals on a regular basis. Celebrate your accomplishments and milestones along the road to keep motivated and cheerful.

Keep in mind that professional growth and goal-setting are continual activities. As your interests and circumstances change, examine and adjust your objectives on a regular basis. To effectively manage your job path, you must be proactive, motivated, and open to learning.



INTEXT QUESTIONS 9.1



Notes

1. The Constitution ensures equality for all people, regardless of caste, religion, gender, or place of birth. (T/F)
2. The Constitution emphasises the importance of social justice and supports the values of equality, non-discrimination, and affirmative action in order to help underprivileged and marginalised members of society. (T/F)
3. Technology is important in the contemporary workplace. (T/F)
4. English is used as a common language for communication at Global Workforce. (T/F)
5. Self-Assessment begin with consider your hobbies, values, strengths, and limitations. (T/F)

9.5 COMMUNICATION SKILLS

Improving communication skills is critical for employability since good communication is important in many facets of the job. Here are some things you can do to improve your communication skills (Fig. 9.4):

Develop active listening skills by paying close attention to the speaker, keeping eye contact, and avoiding distractions. To display your interest, concentrate on understanding the material being delivered, asking clarifying questions, and providing relevant comments.

- **Improve Your Verbal Communication:** Take note of your public speaking abilities. Practice utilizing proper tone and loudness, as well as clarity and articulation. When interacting with diverse audiences, use succinct and organised language, avoiding jargon or complicated terminology. To enhance your delivery, practise speaking in front of a mirror or with a trusted buddy on a regular basis. Nonverbal signals, such as body language, facial emotions, and gestures, have a substantial influence on communication. Keep an open and positive body posture, keep eye contact, and utilise suitable hand motions to reinforce your message.
- **Improve Your Written Communication:** In professional contexts, written communication is vital. Practise grammar, sentence structure, and vocabulary to improve your writing abilities. Examine your written communication for clarity, conciseness, and organisation, whether it's in emails, reports, or other written materials.



Notes

- **Develop Your Presentation Skills:** Giving presentations is a typical responsibility in many organisations. Develop your presenting abilities by rationally arranging your topic, effectively employing visual aids, and engaging the audience via your delivery. To find areas for development, practise in front of a small group or videotape yourself.
- **Develop Empathy and Emotional Intelligence:** Understanding and empathising with the viewpoints and feelings of others is essential for effective communication. Actively listening, observing nonverbal signs, and responding empathetically to people will help you develop your emotional intelligence. This promotes greater professional ties and understanding.
- **Seek Feedback:** Actively seek feedback on your communication abilities from coworkers, bosses, or mentors. Request specific areas for improvement and actively implement their ideas.
- **Continuous Learning:** Stay current on communication trends and approaches by reading books, articles, or using internet resources. Attend courses or training sessions aimed at improving communication skills. Maintain your curiosity and look for opportunities to learn and improve your communication skills.
- **Participate in Group Activities:** Participate in group activities or team initiatives that need teamwork and efficient communication. This allows you to practice working with varied people, actively providing ideas, and constructively resolving problems.
- **Develop Confidence:** Confidence is essential for good communication. Before significant talks or presentations, practice and prepare thoroughly. Make use of positive self-talk and visualization strategies, and look for opportunities to practice your communication abilities in a variety of circumstances.

Keep in mind that strengthening communication skills requires time and practice. Be patient with yourself and commit to continuous improvement. You improve your employability and become a more successful and impactful professional by always honing your communication skills.

9.6 DIVERSITY AND INCLUSION

Diversity and inclusion contribute significantly to employability by establishing a more inclusive and equitable work environment. Here are a few examples of how diversity and inclusion affect employability:



- **Access to a broader talent pool:** Organisations may tap into a bigger talent pool by embracing diversity and inclusion practises. Employers boost their chances of discovering highly talented employees with unique experiences and ideas by aggressively pursuing applicants from varied backgrounds, including those of different races, genders, ages, abilities, and cultural viewpoints.
- **Innovation and creativity:** A varied and inclusive workforce brings together people from various backgrounds, viewpoints, and ways of thinking. This variety of view promotes organisational innovation and creativity. When people from different backgrounds work together, they bring a broad set of ideas, problem-solving methodologies, and insights to the table, resulting in more inventive solutions and a competitive edge in the market.

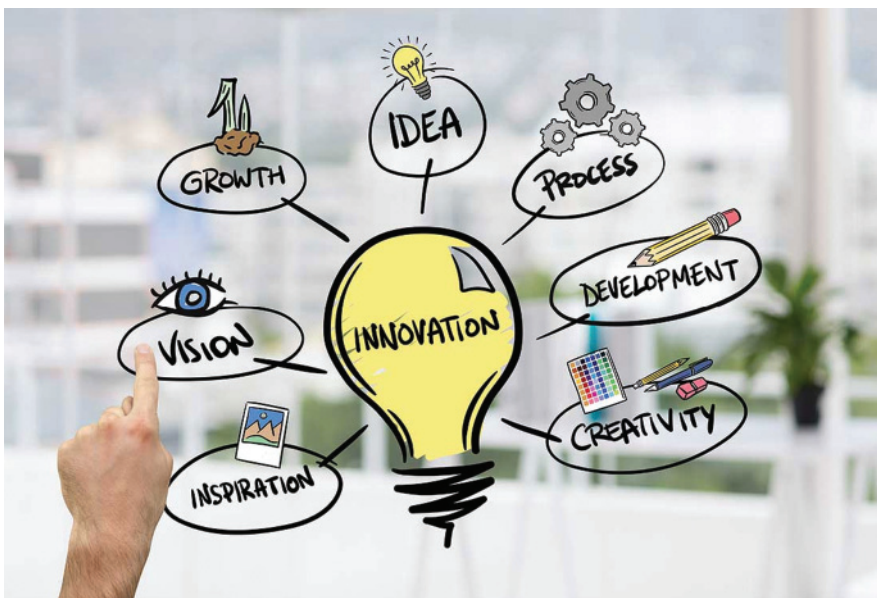


Fig. 9.4: Creative or Innovative

Source: <https://blog.webit.org/>

- **Improved decision-making:** Diverse opinions and viewpoints are encouraged to be heard in inclusive work settings. When employees from varied backgrounds are given a place at the table and their ideas are appreciated, better decisions are made. Diverse views aid in the identification of blind spots, the testing of assumptions, and the consideration of a larger variety of considerations, resulting in better informed and successful decision-making.
- **Enhanced problem-solving and adaptability:** Employees in inclusive work settings are more likely to collaborate and work together. When various



Notes

people work together to solve challenges, they bring a variety of talents, expertise, and experiences to the table. This collective diversity of abilities and viewpoints helps organisations to more successfully manage difficult issues and adapt to changing market conditions.

- **Increased employee engagement and retention:** Employee engagement and work satisfaction increase when they feel included, appreciated, and valued for their unique contributions. Inclusive environments foster a sense of belonging and psychological safety, allowing employees to be their true selves at work. This good work atmosphere increases employee retention, decreases turnover, and attracts top talent looking for inclusive environments.
- **Expanded market reach and customer satisfaction:** Organisations that are diverse and inclusive are better able to comprehend and serve a wide range of customers. Companies may produce goods, services, and marketing tactics that appeal to a wider spectrum of customers by reflecting the diversity of their customers. As a result, consumer happiness and loyalty rise.
- **Reputation and employer branding:** Organisations that prioritise diversity and inclusion are more likely to have a favourable reputation and effective employer branding. They are viewed as progressive, socially responsible, and appealing to job searchers who appreciate diversity and inclusive workplaces. This reputation can assist the organisation acquire top people and boost its overall competitiveness.

9.7 FINANCIAL AND LEGAL LITERACY

9.7.1 Financial Literacy

Financial literacy is important for employment because it provides individuals with the information and skills needed to handle their finances successfully. Here are some of the most important ways that financial literacy affects employability (Fig. 9.5):

- **Budgeting and money management:** Financial literacy teaches people the significance of budgeting and how to manage their income and spending. Individuals may better manage their personal finances by learning how to develop a budget, analyse costs, and make educated financial decisions. This includes living within their means, saving money, and avoiding debt. These abilities are required for individuals to exhibit financial responsibility and stability, which employers strongly respect.

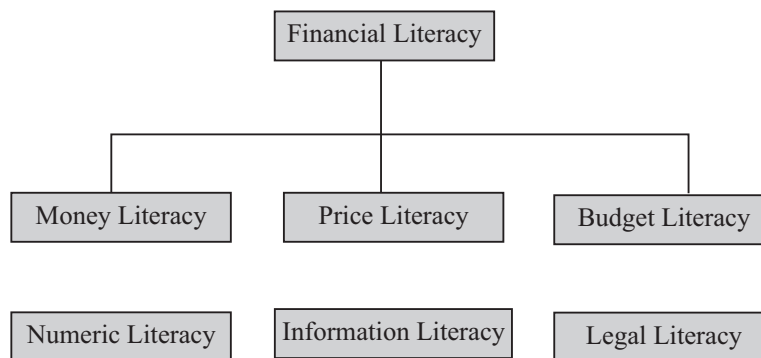


Fig. 9. 5: Flow chart of Financial literacy

- **Salary negotiation and benefit optimization:** Financial literacy enables people to properly negotiate their salary and grasp the worth of employee perks. Individuals who understand industry norms, the cost of living, and the effect of perks such as health insurance, retirement plans, and stock options may make educated judgements during job interviews and maximise their remuneration packages. Individuals with this understanding may fight for fair and competitive remuneration, which is critical for financial stability and overall job satisfaction.
- **Debt management and creditworthiness:** Financial literacy teaches people how to handle debt responsibly and keep excellent credit. Understanding topics like interest rates, credit ratings, and debt repayment plans enables people to make educated decisions about borrowing money, using credit cards, and repaying loans. Individuals improve their financial stability and raise their chances of being perceived as trustworthy and responsible by future employers by efficiently managing their debt and keeping good credit.
- **Entrepreneurship and financial decision-making:** Financial literacy is especially crucial for people who want to be entrepreneurs or establish their own firms. It teaches the information and skills required to manage firm finances, such as budgeting, cash flow management, financial forecasting, and capital access. Financial literacy enables entrepreneurs to make solid financial decisions, reduce risks, and handle the financial hurdles of beginning and sustaining a firm.
- **Job mobility and professional development:** Financial literacy may help with job mobility and career progression. Individuals may have the confidence



Notes

to explore new employment prospects, negotiate higher compensation, or engage in professional growth when they understand their financial condition and make educated judgements. Individuals with financial literacy are better able to make smart job choices and take advantage of opportunities that correspond with their financial goals.

9.7.2 Legal Literacy

Legal literacy, or an individual's grasp of legal rights, obligations, and processes, is important for employment. Here are some of the most important ways that legal knowledge affects employability (Fig. 9.6):

- **Employment rights and protections:** Legal literacy enables individuals to understand their employment rights and protections. Individuals can exercise their rights and fight for fair treatment in the workplace if they are aware of labour laws, employment contracts, minimum wage requirements, working hour limitations, and anti-discrimination legislation. This awareness aids individuals in navigating job relationships, effectively resolving disagreements, and protecting themselves from potential workplace breaches.



Fig. 9.6: Legal literacy an effective tool to control violence

Source: <https://twocircles.net/>

- **Compliance and ethical behaviour:** Legal literacy fosters a corporate culture of compliance and ethical behaviour. Individuals who are knowledgeable



of the rules and regulations that govern their sector are more likely to adhere to ethical standards, avoid unlawful acts, and make judgements that are in accordance with legal requirements. Employers appreciate individuals who display a strong dedication to legal and ethical behavior since it adds to a healthy work environment and the organization's reputation.

- **Contract negotiation and comprehension:** Legal literacy helps people to understand employment contracts and other legal agreements connected to their jobs. Individuals may negotiate favorable terms and ensure their rights are protected by understanding the terms, conditions, and duties specified in contracts. This expertise is especially useful for those in management or executive roles who may be engaged in contract negotiations or have control of contractual agreements.
- **Intellectual property protection:** Legal literacy is essential for those who work in areas that include intellectual property, such as technology, media, or creative industries. Individuals who understand copyright, trademarks, patents, and trade secrets are better able to preserve their intellectual property rights. This awareness enables employees to respect and protect intellectual property rights, adding to the organization's overall competitiveness and success.
- **Workplace health and safety rules:** Legal literacy involves understanding workplace health and safety standards. Understanding safety regulations, danger identification, and reporting processes aids in maintaining a safe workplace and preventing workplace accidents or injuries. Employers appreciate workers that prioritise workplace safety and contribute to a positive culture.
- **Dispute resolution and legal recourse:** Legal literacy provides persons with understanding of legal procedures and dispute resolution possibilities. When workplace problems emerge, employees who understand their legal choices, such as mediation, arbitration, or litigation, may make educated judgements about seeking legal redress if necessary. This awareness enables individuals to safeguard their rights and seek legal solutions.
- **Compliance with regulatory requirements:** Legal literacy is especially crucial in regulated businesses where specific rules and regulations must be followed. Finance, healthcare, and environmental services are examples of such industries. Individuals who are familiar with industry-specific legislation can help to ensure compliance, mitigate risks, and prevent legal ramifications for themselves and their organizations.

**INTEXT QUESTIONS 9.2****Fill in the blank**

1. Develop skills by paying close attention to the speaker, keeping eye contact, and avoiding distractions.
2. Budgeting, money management, Salary negotiation and benefit optimisation are come under
3. Employment rights, protections, Compliance and ethical behaviour are come under
4. Social Media helpful for community development,, and
5. Legal literacy is essential for those who work in areas of,, or

9.8 ESSENTIAL DIGITAL SKILLS

Nowadays, people in a wide range of fields and professions find it increasingly necessary to have specific digital abilities. The following are some fundamental digital abilities that are helpful in many situations:

- **Basic computer literacy:** Basic computer literacy refers to the ability to use computers, navigate an operating system, use a web browser, organise files and directories, and perform simple troubleshooting.
- **Internet navigation and search:** Internet navigation and search are essential for discovering pertinent information and making the most of online resources. These skills include how to conduct efficient online searches, assess the reliability of sources, and move around websites and web pages.
- **Email communication:** Email communication is still the main way that people communicate both personally and professionally. Effective communication requires a variety of abilities, including the ability to write and send emails, manage email accounts, organise folders, and comprehend email etiquette.
- **Digital Security and Privacy:** securing digital identities and preserving privacy online requires an understanding of the fundamentals of online security, such as password management, spotting phishing scams, and securing personal information.



- **Online collaboration and communication tools:** Effective teamwork and distant collaboration need the use of digital collaboration tools, including as video conferencing platforms, project management software, shared document editing tools, and instant messaging programmes.
- **Digital research and information evaluation:** It is crucial for academic endeavours, professional research, and decision-making to be able to quickly obtain information from digital sources, critically assess its veracity and credibility, and synthesise pertinent data.
- **Digital creativity and content creation:** These skills can improve one's capacity to articulate ideas, captivate audiences, and effectively communicate in the digital sphere. These skills include graphic design, photo and video editing, audio production, and basic coding.
- **Data literacy and analysis:** As data become more accessible, it is becoming increasingly important to be able to comprehend, examine, and evaluate data sets. Making educated decisions and spotting patterns and trends can be aided by knowledge of data visualisation, data analysis software, and fundamental statistical ideas.
- **Social Media Management:** It's helpful for community development, marketing, and personal branding to be familiar with the various social media platforms, understand social media strategies, and effectively engage and interact with audiences.
- **Adaptability and Continuous Learning:** It's critical to have the capacity to adjust to new technologies, platforms, and tools in the quick-changing digital environment. Growing personally and professionally requires adopting an attitude of lifelong learning, remaining current on trends, and being open to learning new digital skills.

9.9 ENTREPRENEURSHIP

The process of locating, developing, and pursuing possibilities to launch a new company or endeavour is referred to as entrepreneurship. It involves people—known as entrepreneurs – who take risks and invest money to create novel concepts, goods, or services in an effort to create economic value.

Entrepreneurship encompasses several key elements:

- **Innovation and Creativity:** Entrepreneurs frequently identify and launch new concepts, goods, or services to fill gaps in the market or address issues



Notes

already in existence. They use their ingenuity to build original solutions and advertise them.

- **Risk-taking:** Taking measured risks is a key component of entrepreneurship. Even though they are aware that success is not guaranteed, entrepreneurs are eager to put their time, effort, and money into new endeavours. They welcome ambiguity and are equipped to deal with difficulties and setbacks.
- **Opportunity Recognition:** Entrepreneurs have a strong eye for spotting business possibilities. They notice patterns, gaps, and new demands, and they think of methods to take advantage of those possibilities by adding value to their offerings.
- **Business Planning and Execution:** Entrepreneurs frequently identify and launch new concepts, goods, or services to fill gaps in the market or address issues already in existence. They use their ingenuity to build original solutions and advertise them.
- **Resource Management:** Successful businesspeople effectively manage resources including money, people, and time. They effectively allocate resources, seek funding or investment as necessary, and take well-informed decisions to maximise their business operations.
- **Building Networks and Relationships:** Successful businesspeople recognise the value of developing networks and relationships. To obtain knowledge, access resources, and form cooperative relationships, they interact with mentors, business experts, possible partners, and clients.
- **Adaptability and Resilience:** Entrepreneurship necessitates the capacity to adjust to shifting market conditions, technical developments, and consumer expectations. To remain competitive, entrepreneurs must be resilient in the face of difficulties, learn from mistakes, and adapt their plans as necessary.
- **Scaling and growth:** Over time, entrepreneurs want to see their businesses expand. They create plans for growing their business, gaining more clients, and breaking into new markets. To promote growth, this may entail bringing on new personnel, looking for additional funds, or putting new technology into place.

9.10 CUSTOMER SERVICE

Customer service refers to the support and assistance provided to customers before, during, and after their interaction with a product, service, or organization. It involves addressing customer inquiries, resolving issues or complaints, and ensuring customer satisfaction.



Effective customer service is crucial for building and maintaining strong relationships with customers. It encompasses various elements:

1. Communication
2. Knowledge and Expertise
3. Problem Solving
4. Empathy and Understanding
5. Timeliness
6. Personalization
7. Continuous Improvement
8. Positive Attitude

9.11 GETTING READY FOR APPRENTICESHIP AND JOBS

Preparing for apprenticeships and jobs involves several important steps to increase your chances of success. Here are some key considerations:

1. Identify Your Interests and Goals
2. Research Apprenticeships and Job Opportunities
3. Build Relevant Skills and Knowledge
4. Create a Professional Resume
5. Prepare a Compelling Cover Letter
6. Enhance Your Interview Skills
7. Network and Seek Guidance
8. Stay Updated and Persistent



WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt in this lesson.

- Citizenship principles are established in the Indian Constitution, notably in Part II (Citizenship) and Part III (Fundamental Rights).
- Equality, Liberty, Justice, Dignity, Sovereignty and Patriotism, Social Justice are some major constitutional ideals of Indian citizenship



Notes

Employability Skills

- Continuous learning, determine your passions and goals, develop transferable talents, embrace technology, develop a professional network, gain practical experience, create a professional brand, adaptability and resilience and professional ethics are required become a professional in 21st century.
- English is often considered as the global business and communication language.
- English fluency is frequently required for job applications and interviews, particularly in international corporations or sectors with a global presence.
- SMART goals mean Specific, Measurable, Achievable, Relevant, and Time-bound goals.
- Global businesses operate in worldwide marketplaces and have varied teams made up of people from various language backgrounds.
- Self-Assessment begin, consider your hobbies, values, strengths, and limitations. Consider your interests, talents, and what inspires you.
- Financial literacy is important for employment because it provides individuals with the information and skills needed to handle their finances successfully.
- Financial literacy teaches people the significance of budgeting and how to manage their income and spending.
- Legal literacy enables individuals to understand their employment rights and protections.



TERMINAL EXERCISE

1. What are Constitutional Values-citizenship? Explain major constitutional ideals of Indian citizenship.
2. What suggestions are required to become a professional in 21st century?
3. What is role of English to become a global professional?
4. How you can decide your career and goal?
5. How to improve communication skill to become a good professional?
6. What is financial and legal literacy? Explain it.
7. Role of digital education in professionalism?
8. What is entrepreneurship and its elements?



ANSWER TO INTEXT QUESTIONS



Notes

9.1

1. T 2. T 3. T 4. T 5. T

9.2

1. Active listening
2. Financial literacy
3. Legal literacy
4. Marketing, and personal branding.
5. Technology, media, or creative industries.

KEY LEARNING OUTCOMES

- Discuss the Employability Skills required for jobs in various industries
- List different learning and employability related GOI and private portals and their usage.
- Explain the constitutional values, including civic rights and duties, citizenship, responsibility towards society and personal values and ethics such as honesty, integrity, caring and respecting others that are required to become a responsible citizen.
- Discuss importance of relevant 21st century skills.
- Exhibit 21st century skills like Self-Awareness, Behavior Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn etc. in personal or professional life.
- Describe the benefits of continuous learning.
- Show how to use Basic English sentences for everyday conversation in different contexts, in person and over the telephone.
- Read and interpret text written in Basic English.
- Write a short note/paragraph/letter/e-mail using Basic English.



Notes

- Create a career development plan with well-defined short- and long-term goals.
- Demonstrate how to behave, communicate, and conduct oneself appropriately with all genders and PwD.
- Discuss the significance of escalating sexual harassment issues as per POSH act.
- Demonstrate how to carry out offline and online financial transactions, safely and securely.
- List the common components of salary and compute income, expenditure, taxes, investments etc.
- Discuss the legal rights, laws, and aids.
- Describe the role of digital technology in today's life.
- Demonstrate how to operate digital devices and use the associated applications and features, safely and securely.
- Create sample word documents; excel sheets and presentations using basic features.
- Describe the 4Ps of Marketing-Product, Price, Place and Promotion and apply them as per requirement.
- Create a sample business plan, for the selected business opportunity.
- Describe the significance of analyzing different types and needs of customers.
- Explain the significance of identifying customer needs and responding to them in a professional manner.
- Discuss the significance of maintaining hygiene and dressing appropriately.
- Create a professional Curriculum Vitae (CV).
- Use various offline and online job search sources such as employment exchanges, recruitment agencies, and job portals respectively.
- Discuss the significance of maintaining hygiene and confidence during an interview.
- Perform a mock interview.



- Explain the importance of active listening for effective communication.
- Discuss the significance of working collaboratively with others in a team.
- Show how to practice different environmentally sustainable practices
- List the institutions/schemes promoting Entrepreneur
- List the steps to set up an enterprise
- Describe different aspects involved viz., legal compliances, marketing aspect, budgeting, etc.
- Different Government schemes supporting entrepreneurship.

Or

To access Employability Skill Workbook, Scan the below QR code or open given link:

LEARN EMPLOYABILITY SKILLS ONLINE



Scan to Learn!

Visit : www.bharatskills.gov.in or
<https://www.skillindiadigital.gov.in>

Course Code: 621

**VERMICOMPOST
PRODUCER
(REVISED)
NSQF LEVEL 3
PRACTICAL MANUAL**



NATIONAL INSTITUTE OF OPEN SCHOOLING

(An Autonomous Institution under MoE, Govt. of India)

A-24-25, Institutional Area, Sector-62, NOIDA-201309 (U.P.)

Website: www.nios.ac.in, Toll Free No. 18001809393

COURSE TEAM

ADVISORY COMMITTEE

Chairman

NIOS, NOIDA, (U.P.)

Director, Vocational

NIOS, NOIDA, (U.P.)

CURRICULUM COMMITTEE

Dr. Gagnesh Sharma

Director

National Centre of Organic &
Natural Farming, Ghaziabad, (U.P.)

Dr Shivadhar

Principal Scientist

Division of Agronomy
IARI, Pusa Campus, New Delhi

Dr. Vipin Sharma

Associate Director and Head

Krishi Vigyan Kendra
Gautam Buddha Nagar, (U.P.)

Dr. Bipin Kumar

Scientist, WTC, IARI-ICAR
New Delhi

Dr Pravin Kumar Upadhyaya

Scientist

Division of Agronomy
ICAR-IARI, New Delhi

Dr. Rajpal Singh

Assistant Professor & Head

Department of Agronomy
Amar Singh College, Lakhaoti
Bulandshahr, (U.P.)

Dr. Sachin Kumar Vaid

Scientific Officer, NCONF
Ghaziabad, (U.P.)

Dr Neelima Pant

Assistant Director (Academic)
NIOS, NOIDA, (U.P.)

LESSON WRITERS

Dr Pravin Kumar Upadhyaya1

Scientist

Division of Agronomy
ICAR-IARI, New Delhi

Dr. Bipin Kumar

Scientist, WTC, IARI-ICAR
New Delhi

Dr. Rajpal Singh

Assistant Professor & Head

Department of Agronomy
Amar Singh College, Lakhaoti
Bulandshahr, (U.P.)

Dr. Sachin Kumar Vaid4

Scientific Officer, NCONF
Ghaziabad, (U.P.)

Mr. Sachin Singh

Assistant Professor, (Agronomy)
Janta Vedic College, Baraut
Baghpat, (U.P.)

Mr. Prashant Agrawal

Senior Executive Officer
(Agriculture & Animal Husbandry)
Vocational Education Department
NIOS, NOIDA (U.P.)

EDITOR

Dr Shivadhar

Principal Scientist

Division of Agronomy
IARI, Pusa Campus, New Delhi

Dr. Vipin Sharma

Associate Director and Head

Krishi Vigyan Kendra
Gautam Buddha Nagar, (U.P.)

PROOF READER

Dr. Gagnesh Sharma

Director

National Centre of Organic & Natural Farming
Ghaziabad, (U.P.)

COURSE COORDINATOR

Mr. Prashant Agrawal

Senior Executive Officer

(Agriculture & Animal Husbandry)
Vocational Education Department
NIOS, NOIDA, (U.P.)

GRAPHICS/DTP

M/s Sri Krishna Graphics
Delhi

CONTENTS

1. Visit to a vermicomposting unit	1
2. Morphological and anatomical description of an earthworm	5
3. Identification of different types of earthworms	8
4. Behavioral studies of earthworms	12
5. Designing a shed for vermicomposting	17
6. Identification of different types of raw materials for vermicomposting	21
7. Preparation of vermibeds	26
8. Preparation of feed for earthworms	29
9. Filling the organic materials in vermibeds	32
10. Inoculation of earthworms in vermibed	35
11. Watering of vermibeds	38
12. Covering of vermibeds	41
13. Turning of vermibeds for aeration	44
14. Identification of maturity stage of vermicompost	48
15. Assess time taken in formation of vermicompost	52
16. Harvesting of vermicompost	55
17. Sieving and separation of earthworms from harvested vermicompost	60
18. Assessment of physical appearance of vermicompost at different stages of formation	64
19. Moisture determination of vermicompost	68
20. Identification of ideal packing material for vermicompost	72
21. Safe storage of vermicompost	75
22. Monitoring population and health of earthworms	78
23. Identification and control of pests and predators	82
24. Prepare and collect vermiwash	85
25. Demonstration of online marketing	89
26. Exposure visit to commercial vermicomposting set up	92
27. Demonstration of personal hygiene practices to be followed at the workplace	96
28. Show how to sanitize and disinfect one's work area regularly	101



Notes

Practical 1

VISIT TO A VERMICOMPOSTING UNIT

AIM

To visit a vermicomposting unit.

OBJECTIVES

After completing this practical, you will be able to:

- familiarize yourself with the layout of a vermicomposting unit;
- become familiar with the infrastructure of a vermicomposting unit;
- identify the inputs required to run a vermicomposting unit; and
- acquaint with the routine day-to-day activities to manage a vermicomposting unit.

PRINCIPLE

Management of vermicomposting unit involves the understanding and performance of a series of time bound activities. Such activities involve the selection of a suitable species of the earthworm, preparation of vermibeds, making food substrate suitable for feeding to the earthworms, inoculation (introduction) of earthworms to the vermibed, taking care of worms, harvesting of mature vermicompost, packing and marketing of vermicompost, etc. Such management practices need to be performed timely and efficiently. Thus, after visiting such a unit, you will be able to get familiar with such tasks that will help you to manage a vermicomposting unit efficiently and profitably.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Vermicomposting unit with more than 10 operational beds.



Notes

- Notebook.
- Pen.
- Measuring tape

PROCEDURE

1. Visit a vermicomposting unit with at least 10 working beds.
2. Contact in-charge or manager of the unit, observe and noted own the series of activities being performed daily and their schedule.
3. Observe the unit and make note of the following :
 - (i) Location of the unit, layout of the unit, infrastructure required for starting a unit, transport connectivity to the nearest bus stand/railway station, nearest source of raw material (feed) for earthworms and location of market outlets for the produce.
 - (ii) Area of the vermicomposting unit, various types of rooms/sheds (permanent or temporary) in the unit. Draw a rough sketch in your notebook.
 - (iii) Mode of transport of feed/cowdung for the earthworms from the nearest source to the unit, cost of procurement and their processing.
 - (iv) Source of water. Is it tap water or water from the tube well? Also, note down the procedure for watering the beds.
 - (v) Name of earthworm species used, number of days required to complete one life cycle, number of cocoons produced in a week, number of the young ones produced per cocoon and survivability of the young ones.
 - (vi) Sources for procurement of earthworm species.
 - (vii) Length, breath and height of the vermibed, rate of inoculation of worms and types of vermibeds being maintained.
 - (viii) Harvesting: Duration when the first lot is ready to harvest and the method of harvesting.
 - (ix) Packing and storage of the vermicompost.
 - (x) Records maintained in the unit. Date of the start of the unit, date of introduction of worms, days taken to produce 1st lot of vermicompost, date of first harvesting and subsequent harvesting, quantity of the vermicompost produced in one cycle, income from the unit, etc.



Notes

OBSERVATIONS

- (i) Name and address of the unit visited.
- (ii) Name of the earthworm species used.
- (iii) Different types of vermibeds and their lay out.
- (iv) Infrastructure required for the unit and their placement.
- (v) Shed and materials required for construction and their source.
- (vi) Source of feed for the worm and their cost.
- (vii) Routine unit activities and the number of persons engaged in the unit.
- (viii) Number of vermibeds with mature compost.
- (ix) Harvesting process and the separation of worms.
- (x) Packaging – Quantity of packets, number of packets prepared per day.
- (xi) Storage of vermicompost – Method and duration.

RESULT

Visited (name and address) of the vermicomposting unit and noted the following activities being performed on routine basis:

.....

.....

.....

.....

.....

PRECAUTIONS

- Before visiting the vermicomposting unit, fix an appointment with the in-charge of the unit and plan your visit accordingly.
- Do not interfere with the ongoing activities in the unit.
- Do not touch anything in the unit without permission.



Notes

- Wear protective clothing, such as apron, face mask, gloves, etc., before touching the vermibeds/earthworms.
- Maintain discipline and hygienic conditions in the unit.

KEY LEARNING OUTCOME

Proficient in understanding the layout of a vermicomposting unit, its infrastructure, its inputs requirements and routine activities performed at the unit.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 2

MORPHOLOGICAL AND ANATOMICAL DESCRIPTION OF AN EARTHWORM

AIM

To study the morphology and anatomy of an earthworm.

OBJECTIVES

After completing this practical, you will be able to:

- recognize the different external parts of the body of an earthworm; and
- identify various internal parts of an earthworm's body.

PRINCIPLE

Before understanding the effective management of a vermicomposting unit, you should know about the morphology and anatomy of an earthworm. Morphology is the study of the physical form and external body parts and anatomy is the study of internal structures/parts of an earthworm. Such studies can help us to identify the species of the earthworm. You will also come to know as to how the earthworms feed, how and what change happens to the organic feed when it passes through the different parts of the digestive system? We will also come to know how reproduction and various other vital activities are going on inside the earthworm.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Live earthworms.
- Local anesthetic drug to immobilize earthworms.
- Dissection tray.
- Pins.



Notes

- Magnifying glass.
- Notebook.
- Pen.

PROCEDURE

1. Visit a vermicomposting unit near to your place.
2. Pick a few earthworms and anaesthetize them.
3. Put an earthworm in the dissection tray and pin it.
4. Study the different body parts of the earthworm with the help of a magnifying lens.
5. Draw a well labelled diagram by observing the earthworm to depict its morphology.
6. Put another earthworm in the dissection tray.
7. Make a straight cut on the dorsal side from the posterior end to the anterior end. Stretch the skin by pinning it.
8. With the help of magnifying glass study the internal parts of the earthworm.
9. Draw a well labelled diagram of the internal body parts by observing through a magnifying glass.

OBSERVATIONS

A labeled diagram of an earthworm depicting the external body parts (Fig. 2.1) and internal body parts (Fig. 2.2) is given below. Record your observations as per the given diagram.

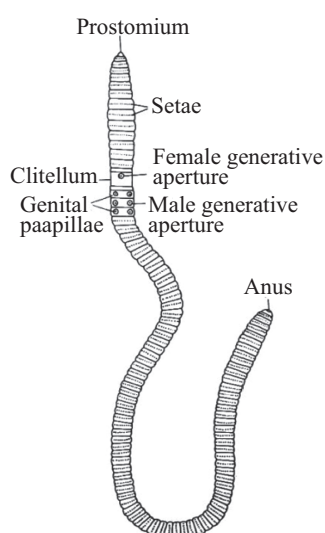


Fig. 2.1: External Body Parts of an Earthworm

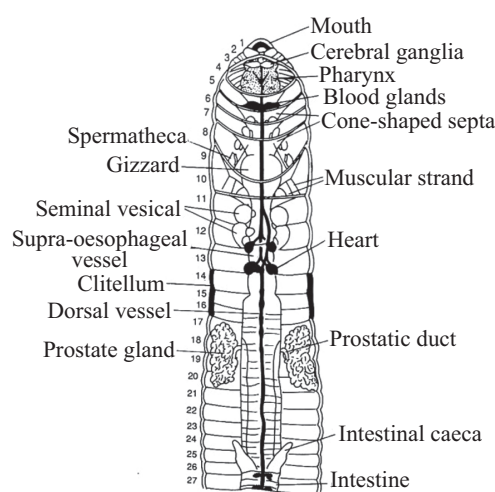


Fig. 2.2: Internal Body Parts of an Earthworm



Notes

RESULT

Observed the external and internal body parts of an earthworm. The labelled diagram of body parts is drawn below:

PRECAUTIONS

- Use hand gloves while taking out the earthworms from the vermibeds.
- Carefully draw a diagram of the external and internal body parts of an earthworm and label them.
- Enter a vermicomposting unit only after prior permission from the manager or in- charge.
- Do not interfere with the normal activities of the unit.
- Maintain hygienic conditions in the unit.

KEY LEARNING OUTCOME

Able to identify the external and internal body parts of an earthworm.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 3

IDENTIFICATION OF DIFFERENT TYPES OF EARTHWORMS

AIM

To identify different types of the earthworms.

OBJECTIVES

After completing this practical, you will be able to:

- identify different types of the earthworms; and
- select the suitable earthworm species for vermicomposting at your place.

PRINCIPLE

More than 8000 species of the earthworms are found all over the world. Not all the species can be used for vermicomposting. This is because only a few species can adapt themselves to high temperature produced during the decomposition of the organic matter content. Few of such widely used species are *Eisenia fetida*, *Eudrilus eugeniae*, *Lampito mauritii* and *Perionyx excavatus*. It is therefore necessary to identify such species.



Fig. 3.1: Earthworms for Vermicomposting



TOOLS/EQUIPMENT/MATERIAL REQUIRED

- Different earthworm species collected from various places.
- 97% ethanol solution.
- 10% formalin solution.
- Magnifying lens.
- Protective covering such as, apron, protective glasses and gloves.
- Notebook.
- Pen.

PROCEDURE

1. Visit few local vermicomposting units and ask the name of the species being used for composting.
2. Collect earthworms of some popular species.
3. Note down biological features of the species.
4. Go to a fertile field or garden. Dig soil and collect some earthworms.
5. Go to a nearby dirty water drainage, pond or any other stagnant water body. Dig the soil and collect earthworms.
6. After collection, kill earthworms in 97% ethanol and preserve in 10% formalin solution.
7. Compare the earthworms collected from the different habitats using magnifying glass.

OBSERVATIONS

Note down your observations in the table given below:

Name of Species	Colour	Length	No of segments	No of segments in which clitelum is present	No of cocoons produced per week	No of young ones produced/cocoon	No of days required to reach maturity	Whether used for vermicomposting or not	Classify as excellent/very good/good/average/poor species for composting



Notes

RESULTS

Earthworm species is/are promising for vermicomposting on our locality than other species

Some important characteristics of the promising earthworm species are:

.....

.....

.....

.....

.....

.....

PRECAUTIONS

- Take proper care while collecting earthworms, they should not be hurt or damaged.
- Contact nearby Agricultural Institute/Krishi Vigyan Kendra / Agriculture University or Agriculture Department and enquire about the names of the suitable earthworm species recommended for vermicomposting in your area and their key features for identification. Carefully note down their features. These features are unique for each species, so they need to be observed carefully.
- Enter vermicomposting unit after prior permission from the manager or unit in-charge.
- Do not interfere in the unit activities.
- Use apron, protective gloves and take protective measures while working in the vermibeds and collecting earthworms.

KEY LEARNING OUTCOMES

Able to identify different types of earthworms and select the suitable species for vermicomposting for your location.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Notes



Practical 4

BEHAVIORAL STUDIES OF EARTHWORMS

AIM

To study the behavior of the earthworms.

OBJECTIVES

After completing this practical, you will be able to understand the response of earthworms to:

- (a) Acidic or alkaline conditions; and
- (b) Sun light

PRINCIPLE

Earthworms live in immediate contact with the soil medium. As the physical and chemical conditions in the medium change, they have direct impact on the behavior of the earthworms. Earthworms may respond positively or negatively to the stimulus. Earthworms show negative behavior (they are photophobic) to light. Their response to the stimuli determines survivability, longevity, growth and fecundity (fertility). This directly influences the rate of production of vermicompost. Therefore, behavioral responses are important to study effective management of vermicomposting.

A. RESPONSE OF EARTHWORMS TO ACIDIC OR ALKALINE CONDITIONS

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Earthworms (*Eisenia fetida*) from composting beds.
- pH meter or pH indicator strips.



- Petridishes.
- Blotting papers.
- Sodium hydroxide (NaOH) solution of pH-8,9,10,11.
- Hydrochloric acid (HCl) dilutions of pH-1,2,3,4,5,6.
- Glass marking.
- Notebook.
- Pen/pencil.

PROCEDURE

1. Take petridishes, cut blotting papers to the size of petridish, place them in the petridishes.
2. Mark different dilutions (pH-1, 2, 3, 4, 5, 6) of HCl with the help of pH meter or indicator strips.
3. Soak the blotting paper with each dilute of acid solution (pH-1, 2, 3, 4, 5, 6) separately.
4. Put identification mark of the dilution on the petridish using a pen/pencil.
5. Similarly, make different sets of petridishes with sodium hydroxide solution (pH-8, 9, 10, 11) as above.
6. In each petridish, release four earthworms and observe their response.

OBSERVATIONS

Record your observations in the table given below:

pH of solution	Response of earthworms		% Respons	
	Name of active earthworms (out of four)	Number of irritated earthworms (out of four)	Active	Irritated
1.				
2.				
3.				
4.				



Notes

5.				
6.				
7.				
8.				
9.				
10.				
11.				

RESULTS

- Earthworms (*E. fetida*) is active within a pH range from to
- Earthworm species that is suitable at my location/will be used by me for composting is active within a pH range of to

PRECAUTIONS

- Petridishes should be cleaned properly and handled carefully.
- Earthworms of the same species, which are used or going to be used by you for composting should be used in the experiment.
- After taking the earthworms out of the vermibeds, the earthworms should be gently washed to get rid of any soil particles sticking to them.
- During experiment, the earthworms should be kept sufficiently wet.
- After completion of the experiment, all the left over earthworms should be washed gently in sufficient water to remove any acid or alkali sticking to their skin and put them back in the composting bed.

B. RESPONSE OF EARTHWORMS TO THE SUN LIGHT

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Earthworms.
- Six glass jars (approximate diameter 9 inches).
- Vermicompost.



- Rubber bands.
- Notebook.
- Pen.

PROCEDURE

1. Take two sets of glass jars with 3 jars in each set.
2. Fill each glass jar half with vermicompost.
3. Put water in each jar.
4. Cover one set of jars (three jars) with black cloth and tighten it with rubber bands so that no light can enter into jar.
5. Keep the other set of jars (three jars) uncovered and keep them under sun or strong light.
6. In each jar, introduce 10 earthworms on the surface.
7. Keep them for five minutes.

OBSERVATIONS

Observe the earthworms, whether they have moved into vermicompost or are staying at the surface.

S.No. of Jars	Covered Jar		Uncovered Jars	
	No of earthworms visible on surface	% of earthworms visible on surface	No of earthworms visible on surface	% of earthworms visible on surface

RESULT

Earthworms tend to avoid the light (photophobic). They are inclined to move to darkness.



Notes

PRECAUTIONS

- Earth worms after taking out from vermibeds should be washed gently to remove any particles attached to them.
- During the experiment, earthworms should be kept sufficiently wet.
- Vermicompost used to fill the glass jars should have sufficient moisture in it.
- The covering of jars is done in such a manner that it allows no entry of light into jars.
- To protect yourself from infections, use protective clothing such as, apron, gloves, etc.

KEY LEARNING OUTCOMES

Be able to demonstrate the response of earthworms to acidic or alkaline conditions and to the sun light.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 5

DESIGNING A SHED FOR VERMICOMPOSTING

AIM

To design a shed for vermicomposting.

OBJECTIVES

After completing this practical, you will be able to:

- recognize different types of sheds used for vermicomposting; and
- design a vermicomposting shed suitable for your location and requirement.

PRINCIPLE

The purpose of designing a vermibed is to protect the earthworms from rain, sun and heat. Design for vermicomposting shed varies from region to region and place to place. Preferably, it should be made from locally available raw materials so as to keep its construction cost low. For those areas, where tree branches or bamboo are available, they can be used as poles for the shed. Thatched roofing may also be done with dry vegetation such as straw, palm branches etc., based on their availability. These are called as temporary shed. Vermicomposting sheds may also be made from steel pipes or angles and roofing can be done with galvanized or steel sheets. These types of sheds are called as permanent shed. Roofing can also be done with High Density Polyethylene (HDPE) sheets, but if possible avoid them as they get overheated due to sun. Open sheds are preferred because of their low cost and they maintain ideal conditions for growth and multiplication of earthworms. Depending upon the availability of funds, composting sheds may also be made by bricks and the roof can be made with terracotta roof tiles, roof shingles, corrugated metal, steel sheets, timber clad, etc. The shed should be made



Notes

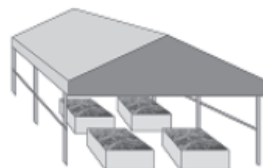
at some elevated level ground so that during rain the water does not stagnates. Old abandoned structures like that of factories or sheds can also be used for the purpose. But they should be well ventilated. Floor may be made up of soil or may be pakka (or cemented bricked). Kachha (unbricked) floor is also good but problem comes when soil burrowing predatory insects attack the beds.

One such insect is mole cricket (*Gryllotalps sps.*), which feed on cocoons and juveniles of earthworms. The cricket burrows in the soil and many a times become very difficult to control. In such cases, floor may be made pakka to prevent burrowing of these predators. To prevent entry of similar predators, a trench containing water may be made around the composting shed. In the absence of composing shed, vermicomposting can be done under the shade of a tree. While making sheds for your composting unit, the undermentioned points should be kept in mind:

- The shed should be made at an elevated platform.
- The shed should have outward slope.
- The shed should be well ventilated and near to a clean water source.
- The shed should be protected from pathogens, predators and contaminants.



Temporary Shed



Permanent Shed

Vermicomposting Under
a Tree

Fig. 5.1: Vermicomposting Under Different Sheds

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Vermicomposting unit.
- Notebook.
- Pen.

PROCEDURE

1. Visit a few vermicomposting units in your area.
2. Record distinguishing features of each vermicomposting shed.



3. Record measurements of each shed with the number of beds present in it.
4. Note the raw material required, source of their procurement and cost for designing the shed.
5. Compare different type of sheds, cost of construction and their pros and cons.
6. Select the shed type that suits your budget and composting requirements.

OBSERVATIONS

Record your observations in the table given below:

Type of shed	Raw material required/used	Appropriate cost of construction (Rs.)	Remarks

RESULT

The design drawn below is suitable for my location for vermicomposting (draw a sketch of the shed):

PRECAUTIONS

- Enter the unit after taking prior permission of the unit manager or in-charge.
- Always follow the bio-security and hygienic measures in the vermicomposting unit.
- Do not interfere with the farm activities.
- Wear protective clothing, face mask, eye protection glasses, gloves, etc. in the unit.

KEY LEARNING OUTCOMES

Be able to design an appropriate shed using the right materials for vermicomposting as per your requirement, location and budget.



Notes

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 6

IDENTIFICATION OF DIFFERENT TYPES OF RAW MATERIALS FOR VERMICOMPOSTING

AIM

To identify the different types of raw materials used for vermicomposting.

OBJECTIVES

After completing this practical, you will be able to:

- identify the different types of raw materials that can be used for vermicomposting; and
- select the suitable and available raw materials for vermicomposting.

PRINCIPLE

Earthworm species like *Eisenia fetida* and *Eudrilus eugeniae* can feed on a wide variety of biodegradable organic matter and convert them into compost. Some of the biodegradable materials are preferred more by earthworms. So, rate of composting depends on the type of organic matter offered as feed. Non biodegradable materials such as glass, plastics and stones cannot be composted. You should also avoid spicy cooked food and non-vegetarian food for composting.

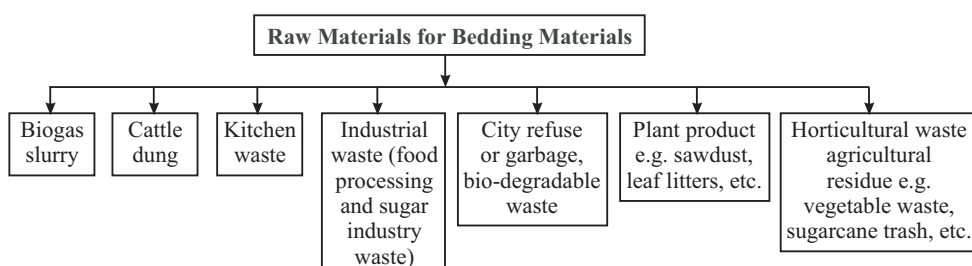


Fig. 6.1: Raw Materials for Bedding



Notes

TOOLS/EQUIPMENT/MATERIALS USED

- Vermicomposting unit in Agricultural Universities/Agriculture Institutes/ Krishi Vigyan Kendras/ Municipal Corporation Composting Sites/NGOs/ Nearby private composting units.
- Protective clothing and coverings such as apron, hand gloves, etc.
- Notebook.
- Pen.

PROCEDURE

1. Visit a few nearby vermicomposting units (as mentioned above).
2. Notedown the name and location of the vermicomposting units.
3. Observe and record the raw materials used for vermicomposting and its composting quality.

OBSERVATIONS

Record your observations in the table given below:

Name, address of the vermicomposting unit	Raw materials being used	Suitability of the raw material in composting (Excellent/Very Good/ Good/Average/Poor)

RESULT

Following types of biodegradable materials were found suitable for vermicomposting:

- (i) Agriculture waste from the left over, stalks of wheat, paddy, maize, cotton, millets, pulses, sunflower, ground net, shells, etc.
- (ii) Wastes of fruits and vegetables.



- (iii) Forestry waste such as, wood shavings, peels, sawdust, pulp, etc.
- (iv) Leather cutting waste.
- (v) Leaf litter.
- (vi) Weeds.
- (vii) Wastes from paper mills, breweries, sericulture, sugarcane, coffee/and mushroom industry.
- (viii) Left over slurry from biogas production.
- (ix) Waste products from the vegetable market.
- (x) Municipal solid waste.
- (xi) Animal dung.
- (xii) (write yourself)
- (xiii) (write yourself)

PRECAUTIONS

- Enter the vermicomposting unit only after seeking prior permission from the manager or in-charge of the unit.
- Do not interfere with the routine activities of the unit.
- Maintain hygienic conditions while visiting the vermicomposting unit.
- Carefully record all the information in a note book.
- Use protective clothing such as, apron, gloves, etc. in the unit.

KEY LEARNING OUTCOMES

Able to identify and select the suitable raw materials for producing a good quality vermicompost.

NOTES

.....

.....

.....



Notes

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 7

PREPARATION OF VERMIBEDS

AIM

To prepare a vermibed.

OBJECTIVES

After completing this practical, you will be able to:

- use suitable tools and equipment for preparing appropriate vermibed; and
- prepare vermibeds of different shapes and sizes.

PRINCIPLE

Vermicomposting can be carried out broadly in two ways. First, is in vessel composting system. In this type, you can use any locally available vessel like earthen pot, wash basin, garden pot, used plastic tank or wooden or metallic box etc. Vessel composting is more suitable for house hold composting. You can also do composting in cement or HDPE cistern or tank which may be placed over or under the ground. Second system of composting is composting in windrow or beds. In this type, the organic waste is placed in the form of a row or pile. Sometimes, composting is also carried out in tank or pits. However, the tank or pit system has got certain disadvantages such as high cost of construction, less chances of aeration, low exposed area, and stagnation of water in deeper layers, which slows down the rate of decomposition. Thus, vermicomposting in windrows or in beds on the surface is preferred.

Selection of a particular system of composting also depends upon many factors such as the quantity of waste to be handled, quality of waste, site of production, availability of raw materials, rain fall, day and night temperatures, profit target, availability of shed etc.



Notes



Composting in Cemented
Vermicomposting Pit



Vermicomposting in HDPE
Vermi-trenches



Vermicomposting in Windrows
Under Shade of a Tree



Vermicomposting in Used Plastic Tank

Fig. 7.1: Various Vermicomposting Systems

TOOLS/EQUIPMENT/MATERIAL USED

- Bricks.
- Feed/ Raw materials for vermicomposting.
- Protective clothing and coverings, such as gloves, apron, eye protection glasses, face mask, etc.
- Notebook.
- Pen.

PROCEDURE

1. Visit a few vermicomposting units of your area. Pen down their names and locations.
2. Observe the different type of the beds. Note down sizes, pros and cons of each bed.



3. Prepare a composting windrow or bed by putting the organic matter or feed in the form of a row. Keep the width of the windrow as 1m and height as 0.5m, respectively.
4. Each windrow can be demarcated by loose bricks. Windrows can be made even without demarcation of bricks.
5. Keep the length of bed/windrow as per the available area/space.

OBSERVATIONS

Record your observations in the table given below:-

Name and address of the composting unit	No. of Beds maintained	Type of the Bed/ system (in vessel or windrow)	Size of each Bed (Length, width and height)	Remarks/Pros and cons of each Type of Bed

RESULTS

..... type of vermibed is suitable for my location and requirements.

PRECAUTIONS

- Enter the composting unit only after taking prior permission from the unit manager or in-charge.
- Do not obstruct the ongoing farm activities in the unit.
- Wear apron, face mask, protective glasses, gloves (if required).
- Always follow the bio-security and hygienic measures in the composting unit.
- Do not keep width of windrow/bed more than 1 m, as it slows down the rate of decomposition.
- Do not keep the bed higher than 0.75m as it reduces the composting efficiency.



Notes

KEY LEARNING OUTCOMES

Be Proficient in making appropriate type vermibed using suitable tools and equipment.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 8

PREPARATION OF FEED FOR EARTHWORMS

AIM

To prepare feed for the earthworms.

OBJECTIVE

After completing this practical, you will be able to:

- procure raw materials from suitable source; and
- process the raw material and make it ready as feed for earthworms.

PRINCIPLE

Biodegradable raw materials are not preferred to be used as such for earthworms. They need some preliminary treatment prior to putting in vermicomposting beds. Such treated materials are readily accepted by the earthworms. Another reason for this treatment is that it reduces the time taken for composting as well. In other words, the process of vermicomposting becomes faster after partial decomposition of the raw materials.



Fig. 8.1: Preparing Feed for Earthworms



Notes

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Raw materials for vermicomposting (as identified in practical 6).
- Cowdung/sheep dung /goat dung.
- Spade.
- Rake.
- Garden hose.
- Wheel barrow.
- Protective coverings such as gum boots, apron, glasses, etc.

PROCEDURE

1. Transport the raw materials for vermicomposting (as identified in practical 6) from source to the site of composting.
2. Transfer the raw materials near to the composting shed with the help of spade and a wheel barrow.
3. Segregate non- compostable materials such as plastics, stone glass, ceramics, metals from the compostable materials.
4. If compostable materials contain large pieces, then, break them into smaller pieces.
5. Transport cowdung or animal dung to the source using wheel barrow.
6. Break the large lumps of cowdung, if it is there.
7. Mix the cow dung and raw materials (in the ratio of 3:1) using the rake.
8. Sprinkle water using the water hose or watering can.
9. Make a heap of the mixed material.
10. Keep the heap for partial decomposition for 2 to 3 weeks.
11. During this period, turn the heap by 5-6 times using the rake.
12. Keep the contents sufficiently moist by sprinkling water on it (maintain moisture level between 50-60%).

OBSERVATIONS

..... (kg) organic matter took days for its partial decomposition.

RESULT

Organic matter waste is partially decomposed and is ready to be offered to the earthworms as feed.



Notes

PRECAUTIONS

- Wear apron, eye protection glasses, gloves, gum boots etc. for your safety and hygiene.
- Use 2-3 days old cow dung or animal dung.
- Break the large lumps to smaller pieces.
- Heap should retain moisture whose range should be between 50 to 70% during the vermicomposting process.
- Partial decomposition period can be increased in case of wastes that are harder (e.g. the waste that takes more time for decomposition such as dried stems, palm leaves etc.) and accordingly, time can be reduced for the wastes that are softer (such as flowers and green leaves).

KEY LEARNING OUTCOMES

Able to prepare feed for earthworms after partial decomposition of the raw materials.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 9

FILLING THE ORGANIC MATERIALS IN VERMIBEDS

AIM

To fill the organic materials in the vermibed.

OBJECTIVES

After doing this practical, you will be able to:

- fill the biodegradable waste materials in the vermibeds whilst; and
- taking proper precautions.

PRINCIPLE

Earthworms need feed (waste organic material) for their growth and development. They feed on the waste materials, crush them and finely convert the matter into fine particles, pass them through gut, partially digest them and excrete them in the form of pellets or casts or vermicasts. This vermicast is rich in organic matter, microbes, enzymes and hormones. These further increase the rate of decomposition of the organic matter so that the process of vermicomposting goes on at a faster rate. Thus, filling of organic materials in the beds is an important step in vermicomposting.

TOOLS/EQUIPMENT/MATERIAL REQUIRED

- Partially decomposed organic matter.
- Spade.
- Rake.
- Protective coverings such as gum boots, gardening gloves, apron, etc.



- Wheel barrow.
- Garden hose bucket.
- Any locally available biodegradable material.
- Sand.
- Garden soil.

PROCEDURE

1. Select a vermicomposting bed of a size that is suitable to your requirements.
2. Lay a basal layer of sand upto 3-5 cm on the bed.
3. It is followed by 5 to 7 cm thick layer of garden soil.
4. On top of the previous layer, make a bedding layer which is made up of any locally available biodegradable material such as dried leaves, hay, straw (paddy or cereals or legumes), leaves, saw dust, peat moss, mushroom spent, coconut leaves, sugarcane wastes etc. Maintain thickness of this layer within 5 to 7 cm.
5. This layer is followed by a layer of partially decomposed organic matter as prepared in Practical 8.
6. Maintain the height of the filled bed upto 75cm.
7. Break the large lumps of materials that are used and level the bed using rake.
8. Sprinkle water on the bed with a garden hose or a watering can.
9. Leave the beds for 3-4 days. Record your observations.
10. Note the emission of heat by digging the bed with a gardening fork. If smell or any heat is evolved, sprinkle water, overturn the material with rake and wait for it to cool down.

OBSERVATIONS

Observations were made on evolution of heat or foul smell, if any

.....
.....

RESULT

The bed is suitable for introducing earthworms.

PRECAUTIONS

- Fill only pre-decomposed organic matter in the beds.



Notes

- Fill only decomposable organic matter (no stone, glass, plastics or ceramics etc. be put).
- Do not add any dairy, meat products, oily cooked food, citrus fruits, eggs in the beds.
- Keep height of the bed till 75cm only. In beds higher than 75cm, the rate of decomposition slows down.
- If beds evolve heat or foul smell do not introduce earthworms into the bed.
- In the absence of the availability of sand or soil you can straight away put straw layer followed by partially decomposed organic waste.
- In case, it is not possible to construct a shed, beds can be laid down under the trees such as, drumstick, subabul, banana or any other tree, so that the leaves falling from them add to the nutritive value of the compost. Moreover, your income will also be supplemented from the produce of these trees.

KEY LEARNING OUTCOMES

Be skilled to fill biodegradable waste materials in vermibeds as per the recommended procedure whilst taking proper precautions.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 10

INOCULATION OF EARTHWORMS IN VERMIBED

AIM

To inoculate (introduce) earthworms in the vermibed.

OBJECTIVES

After completing this practical, you will be able to:

- procure suitable earthworm species for vermicomposting; and
- introduce the earthworms in the prepared vermibeds.

PRINCIPLE

The presence of earthworms in the vermibeds increases the rate of decomposition of organic matter. By their movements, they keep turning the organic matter and thus cause aeration of the medium. They also consume the organic matter and convert them into fine matter. The earthworms mix enzymes, hormones and microbes from their gut to the excreted materials. All these factors create a conducive condition that leads to an increase in the rate of vermicomposting. That is why composting in the presence of earthworms takes less time and is superior to the ordinary compost.

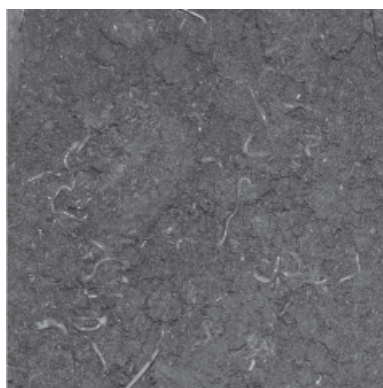


Fig. 10.1: Earthworms in Vermibed



Notes

TOOLS/EQUIPMENT MATERIALS REQUIRED

- Garden rake.
- Protective coverings, such as hand gloves, apron, face mask, etc.
- Antiseptic soap.
- Watering can.
- Garden can/hose.

PROCEDURE

1. Visit some vermicomposting units/Agriculture University/Krishi Vigyan Kendra/ Agricultural Institute/State Agriculture Department and arrange for obtaining a few suitable species of earthworms that are recommended for vermicomposting.
2. Pack the earthworms in the pre-existing vermicompost and sprinkle some water on it.
3. You could do it yourself, take the help of a garden rake and open some area of the pre-existing vermicomposting bed. By picking with the help of hands, collect earthworms in a trough (manger). Put some compost over it and sprinkle some water over it.
4. Carry the earthworms to the vermibeds to be inoculated.
5. Gently place the earthworms on the surface of the beds @ around 1000 worms/m².
6. Sprinkle water on the bed with a water can or a garden hose.
7. Observe the movement of the earthworms into the bed.
8. Wash your hands with an antiseptic soap after inoculation is done.

OBSERVATIONS

Record your observations as per points given below:

- (i) Earthworm species procured for inoculation
- (ii) Quantity of earthworms inoculated in each vermibed:
 - (a) Vermibed 1.....
 - (b) Vermibed 2.....
 - (c) Vermibed 3.....
 - (d) Vermibed 4.....
- (iii) Movement of earthworms into the bed



Notes

RESULT

Inoculation of earthworms in vermibeds is done.

PRECAUTIONS

- Wear an apron, hand gloves and take other hygiene and safety measures, while working at the vermicomposting unit.
- Beds should have sufficient moisture in them prior to inoculation of earthworms.
- During transportation of the worms from the source, they should be packed carefully with sufficient food, moisture and provision of air.

KEY LEARNING OUTCOMES

Able to inoculate earthworms in a prepared vermibed after taking correct precautions to obtain an optimum composting process.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 11

WATERING OF VERMIBEDS

AIM

To provide water to the vermibeds.

OBJECTIVES

After completing this practical, you will be able to:

- judge the water requirement of the vermibeds; and
- provide right quantity of water to the vermibeds.

PRINCIPLE

Earthworms do not have lungs for their breathing. They respire through their skin. Earthworms keep their skins moist with mucilage and water. Atmospheric air gets dissolved in the moist layer and by diffusion oxygen enters into the blood capillary of the earthworms. The insufficient moisture makes the earthworms uncomfortable and they may die due to lack of oxygen. Even for normal functioning of decomposition, microbes need moisture. That is why vermibeds need continuous availability of moisture. For normal vermicomposting, an optimum moisture level of 50 to 60% is required.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Watering cane/ water hose/ sprinklers.
- Protective covering such as, hand gloves, apron, etc.
- Moisture meter.



PROCEDURE

1. Observe the vermibeds for water requirements.
2. You can make use of moisture meter to exactly know the level of moisture in the beds.
3. You can use a simple test (Hand squeeze test) to know the right level of the moisture.

Hand Squeeze Test

The test is a simple rule of thumb test. Take some material from the bed in your hand and try to make a ball of it. If water squeezes out of the ball that means water level is more. However, if the ball crumbles that means water level is too less. Also, if the ball is stable, it indicates that the moisture content is optimum in the bed.

4. Water vermibeds with the help of watering can or water hose or sprinklers.
5. During summer, water is required more frequently than in winter.

OBSERVATIONS

Select any four vermibeds and observe the moisture level in the beds and record your observations in the table given below:

S.No. of Vermibed	Moisture Level			Remarks
	Too less	Right level	Too much	

RESULT

..... vermibeds were moisture is deficient. This is fixed by

..... vermibeds had right level of moisture.

..... vermibeds were over flooded. This is corrected by



Notes

PRECAUTIONS

- The beds should not be too wet or too dry.
- In case you see the water oozing out of beds, stop watering them, otherwise nutrients will flow away and quality of the vermicompost will degrade.
- Vermibeds should be watered with soft water only. In case you are using underground water get it tested so that it is not hard. The hard water is not suitable for vermicomposting.
- Wear apron, gloves and adopt other safety and hygiene measures in the unit.
- After finishing the work, wash your hands and face with antiseptic soap to avoid any infections.

KEY LEARNING OUTCOMES

Able to identify the moisture level of the vermibed and provide the right quantity of water to the beds.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 12

COVERING OF VERMIBEDS

AIM

To cover vermibed with suitable covering material.

OBJECTIVES

After completing this practical, you will be able to:

- select suitable covering material for the vermibeds; and
- cover vermibeds as per the recommended procedure.

PRINCIPLE

As you know, the earthworms are dark creatures (photophobic), so they move away from sunlight. They are therefore not seen feeding at the surface of the beds. If the beds are covered, then they can come near the surface and feed. This in turn increases the rate of vermicomposting too. Covering beds helps in retaining moisture. Hence, the covered beds don't need to be watered frequently. Covering vermibeds also saves the earthworms from predators. The covering material decomposes with time and acts as feed for the worms.



Fig. 12.1: Covered Vermibeds



Notes

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Gunny bags/hessian cloth or any other locally available biodegradable material.
- Protective covering such as hand gloves and apron.
- Rake.

PROCEDURE

1. Visit a few well settled vermicomposting units of your area.
2. Note the location and address of the unit.
3. Note the type of covering material being used in the unit and enquire about other options available for covering the bed.
4. Observe and note all the possible ways to cover the beds.
5. Practice covering of one bed using gunny bags/hessian cloth or any other locally available biodegradable material and rake.

OBSERVATIONS

Name and address of the vermicomposting unit	Number of beds being maintained	Material used for covering the beds	Any other material suggested	Remarks (Pros and cons of the material used)
1.				
2.				
3.				
4.				

RESULT

..... is found to be the best material for covering vermibeds in my locality because

.....
.....
.....
.....



Notes

PRECAUTIONS

- The bed covering material should be cheap and locally available.
- The material should be biodegradable.
- The material should not be polythene or HDPE or any other synthetic material.
- Before visiting the vermicomposting unit, take prior permission from in-charge or manager of the unit.
- Do not interfere with the normal functioning of the unit.
- Adopt all safety and hygienic means in the unit.

KEY LEARNING OUTCOMES

Able to select and use suitable and locally available covering material for the vermibeds.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 13

TURNING OF VERMIBEDS FOR AERATION

AIM

To turn the vermibeds for ensuring proper aeration.

OBJECTIVES

After completing this practical, you will be able to:

- judge the right time for turning of the beds; and
- turn the vermibeds properly.

PRINCIPLE

Turning of the vermibeds brings the undecomposed/partially decomposed material to the surface so that it is readily available to worms and aerobic microbes for decomposition. Thus, turning of the beds makes the process of vermicomposting



Fig. 13.1: Turning of the Vermibed



faster. Beds need to be turned when slow activity is observed in the beds or there is foul smell or composting is almost completed in the upper layer of the bed and lower layers are still underdecomposing. After turning and settlement of the earthworms in the bed, the top layer of the bed should be leveled gently using a rake so that the earthworms are not hurt.

TOOLS/EQUIPMENTS/MATERIALS REQUIRED

- Protective coverings such as apron, face mask, eye protection glasses, hand gloves, etc.
- Rake.
- Notebook.
- Pen.

PROCEDURE

1. Observe the vermibeds. First turning to bed should be given when the material on the top layer of the bed seems to be almost matured (composting process is completed in top layer).
2. Observe the bed, it should not be too wet at the time of turning. A wet bed will not allow proper aeration by the earthworm and microbes and affect the decomposition process.
3. Turn the bed gently using rake.
4. The earthworms should not be hurt during the process.
5. Visit some well settled vermicomposting unit of your area. Observe and note down its location, address and number of beds.
6. For each bed, enquire the date of putting the feed material in the bed, introduction of earthworms and number of earthworms initially inoculated, stage of beds/composting at first turning and date of 1st turning.
7. Similarly, note down the data mentioned above for 2nd or any other subsequent turnings.
8. Record your observations in the table.

OBSERVATIONS



Notes

Name, location and address of composting unit	Serial number of bed	Food material used in bed	Number of earthworms introduced in bed (x)	Mean no. of earthworms introduced in bed $\frac{x_1 + x_2 + \dots + x_{10}}{10}$	Date of introduction of worms	Date of 1 st turning of bed	Condition of bed at 1 st turning (colour, texture, stage of composting)	Date of 2 nd or more subsequent turnings	No of days taken for composting (y)	Mean no of days taken for composting $\frac{y_1 + y_2 + \dots + y_{10}}{10}$
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										



Notes

RESULT

With mean number of earthworms and Turnings, vermicompost is ready for harvesting days. More than one turnings of bed was needed in the following conditions:

.....
.....

PRECAUTIONS

- Wear hand gloves, eye protection glasses, face mask and adopt other safety or hygiene measures while working in the unit.
- Before visiting the vermicomposting unit seek prior permission from in charge or manager of the unit.
- Do not interfere with normal functioning of the unit.

KEY LEARNING OUTCOMES

Able to identify the right time for turning of beds and learnt to turn the beds correctly for proper aeration.

NOTES

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(Instructor's Signature)



Practical 14

IDENTIFICATION OF MATURITY STAGE OF VERMICOMPOST

AIM

To identify the maturity stage of vermicompost.

OBJECTIVES

After completing this practical, you will be able to:

- assess the physical properties of the vermicompost; and
- identify the mature vermicompost.

PRINCIPLE

As a vermicompost producer, it is very important for you to identify the right maturity stage of the vermicompost. If you apply under mature (complete decomposition has not taken place) vermicompost in the field/beds, they can be harmful for the plants. Moreover, if the mature compost is not harvested timely (kept in vermibeds for a longer period of time), it may be detrimental to the growth and multiplication of worms. In such a case, nutritive value of the vermicompost may decline. Thus, identification of the correct maturity stage of vermicompost is very important for effective and economic management of vermibeds. When vermicompost is completely formed, you cannot recognize any residue in the substrate. Mature beds are darker in colour. The surface of the mature bed looks brown to black with granular appearance. It looks like boiled tea leaves spread on the surface. Mature vermicompost is free of any foul odour. Many times the upper surface of the vermibed becomes granular, but lower layers remain under composed. In such cases, turning of the vermibed increases the rate of composting and gives desirable results in less time.



Fig. 14.1: Mature Vermicompost

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective covering such as, apron, face mask, hand gloves, etc.
- Notebook.
- Pen.

PROCEDURE

1. Seek permission from the manager or in-charge unit to visit vermicomposting units.
2. Visit the vermicomposting unit.
3. Enquire about the vermibeds having mature vermicompost and mark them.
4. Observe the marked vermibeds (mature beds) carefully and see how they differ visually from immature beds.
5. Visit each bed and record your observations in the notebook.

OBSERVATIONS

Record your observations in the table given below:

Serial No. of bed	Presence of any undecomposed lumps of cow dung or residues	Colour of the surface of bed	Presence of granules on surface	Smell of the materials of beds	Maturity stage of bed (Is it mature or not mature)
1.					
2.					
3.					
4.					
5.					



Notes

6.					
7.					
8.					
9.					
10.					

RESULTS

The identification features of the vermicompost at the maturity stage are as follows:

.....

.....

.....

PRECAUTIONS

- Enter the composting unit only after taking permission from in-charge or manager of the unit.
- Do not interfere in the routine activities of the unit.
- Maintain healthy and hygienic environment in the unit.
- Make use of protective clothing and covering such as hand gloves, masks, apron etc.
- In case, you observe any large lumps of cow dung or any other under composed material, just break them into smaller pieces for further decomposition.
- At the stage of appearance of granular material at the surface of the beds, turning of beds help in rapid decomposition.
- After finishing your work in vermibeds, wash your hands properly with antiseptic soap.

KEY LEARNING OUTCOMES

Skilled in identification of maturity stage of the vermicompost.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Notes



Practical 15

ASSESS TIME TAKEN IN FORMATION OF VERMICOMPOST

AIM

To assess the time taken in the formation of the vermicompost.

OBJECTIVES

After completing this practical, you will be able to:

- assess the time duration in which formation of the vermicompost takes place; and
- co-relate the various factors that affect the vermicomposting duration.

PRINCIPLE

The vermicomposting process is accomplished by microbes, earthworms and enzymes. It involves physical as well as biochemical changes in the feed substrates. Earthworms ingest large food particles, crush them in their intestines to reduce the size of the particles and mix several bacterial and enzymes to the substrate and excrete them in the form of aggregates/pallets or casts or vermicasts. These excreted materials are an ideal medium in which decomposition process of the substrate takes place faster. Earthworms by their burrowing activities cause aeration of the substrate, which leads to increased activities of aerobic microbes and results in quicker formation of vermicompost. Due to these reasons, formation of vermicompost/vermicomposting takes less time than other forms of composting.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective coverings such as, hand gloves, apron, face mask, etc.



- Notebook.
- Pen.

PROCEDURE

1. Visit vermicomposting units after seeking approval from the in-charges or managers of the unit.
2. Mark the mature vermibeds.
3. Enquire from the incharge or the manager of the unit, regarding materials used for composting, date of starting the bed, date of maturity of bed, species of earthworm used and any amendments or techniques used for making the process faster.
4. Record your observations in the table given below.

OBSERVATIONS

S.No. of Bed	Raw materials used for composting	Number of earthworms inoculated in beds	Date of starting of vermibed	Date of maturity of vermibed	Time taken for maturity of compost	Remarks (Amendment of substrate or any other technique used for making composting faster)
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						



Notes

RESULTS

With species of earthworms and waste material, time taken for vermicomposting ranged between to days.

PRECAUTIONS

- Enter vermicomposting unit only after seeking permission from in-charge or manager of the unit.
- Do not interfere with the normal functioning of the composting unit.
- Maintain healthy and hygienic conditions in the unit.
- Record all the observations carefully.
- Make use of protective devices such as apron, face mask, hand glove, etc. if required.
- Carefully wash your hands with antiseptic to prevent any chance of infection.

KEY LEARNING OUTCOMES

Able to assess the approximate time duration for the formation of vermicompost.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 16

HARVESTING OF VERMICOMPOST

AIM

To harvest the matured vermicompost.

OBJECTIVES

After completing this practical, you will be able to:

- identify the matured vermicompost by its physical appearance; and
- harvest matured vermicompost from the vermibeds as per recommended procedure.

PRINCIPLE

Earthworms and decomposers (an organism, especially a soil bacterium or fungus that decomposes organic material) present in vermibeds convert the biodegradable organic matter to vermicompost. When vermicompost is matured the upper surface of the bed show granular dark brown appearance just like boiled tea leaves. This is right stage for harvesting of vermicompost. Timely harvesting of vermicompost is necessary otherwise multiplication and growth of earthworm slowed down and maturity of vermicompost is delayed. Harvesting is a laborious process and involves some techniques. Such techniques can be perfected by learning and experience.

TOOLS/EQUIPMENT/MATERIAL REQUIRED

- Protective coverings such as, apron, face mask, hand gloves, etc.
- Rake.



Notes

- Trough.
- Watering can.
- Notebook.
- Antiseptic soap.
- Wheel barrow.
- Spade.

PROCEDURE

1. Observe the maturity of vermicompost by its physical appearance, odour and touch.
2. Follow any of the below mentioned method (as per recommendation for your locality) to harvest vermicompost.

Heap/Pyramid Method

- With the help of a wood strip, scrap the top layer of the bed and make small conical heaps.
- In this way make several heaps in a bed.
- Keep the height of each heap less than 25cm, preferably.
- Leave them as such for 6-24 hours.
- Earthworms present in heaps will move down.
- Collect the compost.
- Repeat the process several times to collect the compost.



Fig. 16.1: Bulk Harvesting by Heap/Pyramid Method



Harvesting by Inducing Migration of Earthworms

- When vermibeds are being laid down keep a gap of 1 m between two beds.
- After maturity of vermicompost in these two beds, put a fresh layer of feed in the gap between these two beds.
- Stop watering those two mature beds and continue watering to the fresh feed layer. This will ensure movement of earthworms from older beds to new beds.
- Fill the two older vermibeds with feed for earthworm.
- In this way keep on filling the vermibeds and harvesting of vermicompost.



Fig. 16.2: Harvesting by Inducing Migration of Earthworms

3. Visit three vermicomposting units.
4. Note address of each unit.
5. Seek permission from the in-charge or manager of the unit.
6. In each unit, ask the various methods being adopted for harvesting of mature vermicompost.
7. Make note of various observations on different techniques of harvesting along with their pros and cons.



Notes

OBSERVATIONS

Record your observation in the following table-

Name and address of the unit	Techniques used for harvesting of compost	Remarks for each technique
1.	1. 2. 3.	1. 2. 3.
2.	1. 2. 3.	1. 2. 3.
3.	1. 2. 3.	1. 2. 3.

RESULT

..... method is considered best for harvesting of vermicompost in my location.

PRECAUTIONS

- Enter the composting unit only after seeking permission from the in-charge or manager of the unit.
- During winter and rainy seasons, for drying the upper surface of bed, stop watering to vermibeds for 4-5 days or more until the upper layer gets dried.
- It is advisable that after 2 days of stopping watering process dug the bed with rakes and leave it as such for another 2-3 days so that the vermibeds dry faster.
- Break the large lumps of compost so that the earthworms are released and they could move to the deeper layers that still are having moisture.
- Slowly keep on harvesting the vermicompost until you are left with 10cm of the basal bed material containing migrated worms. Put fresh feed on top of it to start a new bed.
- Record all observations in the notebook carefully.



Notes

- Do not interfere with normal functioning of the unit.
- Maintain hygienic conditions in the unit.
- Wear apron , face mask, hand gloves etc., as per need.
- Wash your hands regularly with antiseptic soap to prevent any infection.

KEY LEARNING OUTCOMES

Be able to identify the matured vermicompost and harvest matured vermicompost from the vermibeds as per the recommended procedure.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 17

SIEVING AND SEPARATION OF EARTHWORMS FROM HARVESTED VERMICOMPOST

AIM

To sieve and separate earthworms from the harvested vermicompost.

OBJECTIVES

After completing this practical, you will be able to:

- sieve the compost properly and separate earthworm from harvested compost; and
- collect earthworms separately without harming them.

PRINCIPLE

The harvested vermicompost contains a large number of earthworms and cocoons. If they are not separated from the compost most of them will die. So earthworms and cocoons should be separated from the compost and put back to the left over beds. These left over earthworms rebuilt their population to continue the process of composting.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective coverings such as garden gloves, face mask, apron, etc.
- Garden rake.
- Sieve of 2.5 mm mesh.



PROCEDURE

1. Stop watering the vermibeds for 2-3 days before separation of the matured vermicompost from the beds.
2. Make conical heaps of the compost on bed.
3. Keep the heaps undistributed for 6 to 24 hours so that the left over worm can move into deeper moist layers. In this way most of the earthworms are separated from the compost.
4. Left over earthworms and cocoons can be separated by hand picking or sieving.
5. Separated vermicompost is sieved through mesh of size 2 to 2.5 mm to separate any earthworm left and cocoons. For sieving purpose you can use a mesh used by builders for sieving and or crushed stone powder. Even motorized sieving machines can be used for sieving in bulk.
6. Put the collected earthworms and cocoons back to the vermibeds.
7. Fill the beds again with partially decomposed feed to continue the process.



Fig. 17.1: Separation of Earthworms and Cocoons by Sieving Method

8. Visit few vermicomposting units.
9. Note name and location of each unit.
10. In each unit, ask the in -charge or manager for the method being used for sieving and separation of earthworms and cocoons from matured vermicompost.
11. Note down the information collected and observations in the note book carefully.



Notes

OBSERVATIONS

Record your observations in the table given below:

S.No. of the vermicompost unit	Name and location of the vermicomposting unit	Method used for separation of earthworm and cocoons	Remarks (pros and cons of each method)	Techniques used for sieving vermicompost
1.				
2.				
3.				

RESULT

Harvested vermicompost is free from earthworms and cocoons.

PRECAUTIONS

- Before sieving vermicompost, dry it under shade to reduce its moisture content, so that it can easily pass through the mesh.
- Maintain hygienic environment in the unit.
- Wash your hands carefully with an antiseptic soap/solution for maintaining hygienic conditions.
- Wear apron, face mask, hand gloves, etc. while working in the vermicomposting unit.
- Note down all the information carefully.

KEY LEARNING OUTCOMES

Able to sieve and separate earthworms from the harvested vermicompost without harming earthworms.

NOTES

.....

.....

.....

.....



Notes

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 18

ASSESSMENT OF PHYSICAL APPEARANCE OF VERMICOMPOST AT DIFFERENT STAGES OF FORMATION

AIM

To assess the physical appearance of vermicompost at different stages of formation.

OBJECTIVES

After completing this practical, you will be able to:

- recognize appearance of vermicompost at different stages of its maturity; and
- differentiate between the unmatured and matured vermicompost.

PRINCIPLE

Biodegradable materials filled in vermibeds undergo various physical, chemical and biological changes with time. These are the stages through which an organic waste passes to become a mature vermicompost. If you recognize those stages, you can assure yourself of the progress undergoing in vermicomposting process. Any variation or delay in these stages invites use of some intervention management steps so that the final product is of good quality and meet desired profit level.

As the time proceeds, materials present in vermibeds undergo certain changes in texture, colour and odour so that final product, i.e. matured vermicompost

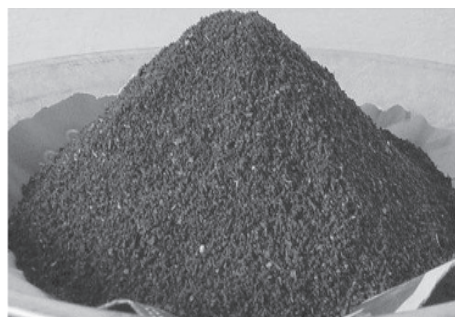


Fig. 18.1: Matured Vermicompost



(Fig. 18.1) is a dark brownish- black in colour which just looks like boiled tea leaves. The final product is free from of any unpleasant odour.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective coverings such as, apron, face mask, gloves, etc.
- Rake.
- Notebook.
- Pen.

PROCEDURE

1. Visit some vermicomposting unit.
2. Contact in-charge or manager of the unit and ask for three sets of beds.
3. Enquire about the date of start of the bed.
4. In each set mark the beds which were 15 days, 30 days, 45 days, 60 days, 75 days, etc. days old.
5. Collect the sample of decomposable materials from the vermibeds.
6. In your notebook, record various observations such as, the presence of lumps of decomposable materials, colour of the bed, texture of the material and odors, if any.

OBSERVATIONS

Record your observations in the following table

Serial no. of the beds	Decomposable material filled in beds	Preliminary treatment given to material	Days after the treatment	Appearance				Remarks
				Presence of large lumps of undecomposable matter	Colour	texture	Odour	
1.			15					
			30					
			45					
			60					
			75					
			--					



Notes

2.			15					
			30					
			45					
			60					
			75					
			--					
3.			15					
			30					
			45					
			60					
			75					
			--					

RESULT

The materials in the vermibeds takes to days for full decomposition. The decomposed material has following qualities:

.....

.....

.....

.....

PRECAUTIONS

- Before entering the composting unit seek prior permission for the in-charge or manager of the unit.
- Do not interfere with normal functioning and ongoing activities of the unit.
- Main healthy environment in the unit.
- Use protective clothing such as, apron, hand gloves, face mask, etc., if any required.
- Wash your hands properly with antiseptic soap to safe guard yourself.



Notes

KEY LEARNING OUTCOMES

Able to recognize appearance of vermicompost at different stages of its maturity and differentiate between the unmaturred and matured vermicompost.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 19

MOISTURE DETERMINATION OF VERMICOMPOST

AIM

To determine the moisture in vermicompost.

OBJECTIVE

After completing this practical, you will be able to:

- determine the moisture content of vermicompost; and
- fix the moisture content related issues in the vermibeds.

PRINCIPLE

As you know the vermicompost is a dynamic medium containing lot of microbes, hormones, enzymes, plant growth promoters, etc. A moisture content less than 50% in the vermibed is not good for survival or viability of the aforesaid ingredients. A too less moisture content reduces the quality of the vermicompost. Also, if the moisture is too much, it just unnecessarily add to the weight of the compost. A moisture level less than the optimum not only deteriorate the quality but also makes it to look like dry soil which fetch less price in the market. So, now you have understood as why it is necessary to maintain proper moisture content in the vermicompost. For moisture determination, various type of moisture meters/analysers are available in the market by which we can quickly find out the moisture level. Also, to fix the moisture content related issues in the vermibed, either provide water to the vermibed, if moisture content is less (Fig. 19.1) or stop watering them, if moisture content is in excess. Here, is described an easy and cheap laboratory moisture determination method.



Notes



Fig. 19.1: Watering of Vermibed for Proper Moisture

TOOLS/EQUIPMENTS/MATERIALS REQUIRED

- Vermicompost sample.
- Oven proof container.
- Oven.
- Protective coverings such as, hand gloves, apron, etc.
- Weighing balance.

PROCEDURE

1. Take weight of an empty oven proof container (W_1).
2. Put small sample of vermicompost in the container and weigh it (W_2).
3. Heat the container containing vermicompost at 220°F or 104°C for 24 hours to completely dry it and weigh (W_3).

OBSERVATIONS

Record your observations and do calculations as per formula given in the table below.



Notes

Practical Manual

Replicate (in g)			Average Moisture content $= \frac{I + II + III}{3}$ (% moisture)
I	II	III	
Description	Description	Description	
Weight of empty container (W ₁) = g	Weight of empty container (W ₁) = g	Weight of empty container (W ₁) = g	
Weight of container + vermicompost (W ₂) = g	Weight of container + vermicompost (W ₂) = g	Weight of container + vermicompost (W ₂) = g	
Weight of Container + Dry compost (W ₃) = g	Weight of Container + Dry compost (W ₃) = g	Weight of Container + Dry compost (W ₃) = g	
Calculation	Calculation	Calculation	
Weight of water (W ₂ - W ₃) = g	Weight of water (W ₂ - W ₃) = g	Weight of water (W ₂ - W ₃) = g	
Weight of solid (W ₃ - W ₁) = g%	Weight of solid (W ₃ - W ₁) = g%	Weight of solid (W ₃ - W ₁) = g%	
Moisture = $\frac{W_2 - W_3 \times W_3 - W_1}{100}$	Moisture = $\frac{W_2 - W_3 \times W_3 - W_1}{100}$	Moisture = $\frac{W_2 - W_3 \times W_3 - W_1}{100}$	

RESULT

Average moisture content of vermicompost is %.

PRECAUTIONS

- Take sample of vermicompost from three different depths.
- Wear hand gloves and apron while taking sample.
- Maintenance hygienic conditions in the vermicomposting unit.
- Wash your hands with soap to prevent any infection.

KEY LEARNING OUTCOMES

Be able to determine the moisture content of vermicompost and fix the moisture content related issues in the vermibeds.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Notes



Practical 20

IDENTIFICATION OF IDEAL PACKING MATERIAL FOR VERMICOMPOST

AIM

To identify the ideal packing material for vermicompost.

OBJECTIVES

After completing this practical, you will be able to:

- identify various packaging materials available for storing the vermicompost; and
- select suitable packaging material for storing vermicompost.

PRINCIPLE

As you know vermicompost contains mainly earthworm castings with sufficient number of microbes (fungi, bacteria, etc.), enzymes, hormones, plant growth promoters etc. For their survival sufficient moisture is required. So, vermicompost should be kept moist to maintain its quality. For maintaining its moisture content you can sprinkle water on it. Packing of the compost can be done after getting the order for sale. Too many surplus bags should not be filled as it might lead to loss in quality of compost. Preferably compost should be packed in moisture proof laminated eco-friendly bags. This will minimize the moisture evaporation loss. For this purpose laminated LDPE (Low Density Polyethylene) bags can be used. Now bio LDPE, bio MDPE (Medium density Polyethylene) and bio HDPE (high density polyethylene) bags are also available which are environment friendly. Select the type of bag which is eco-friendly, economical and durable.



Notes

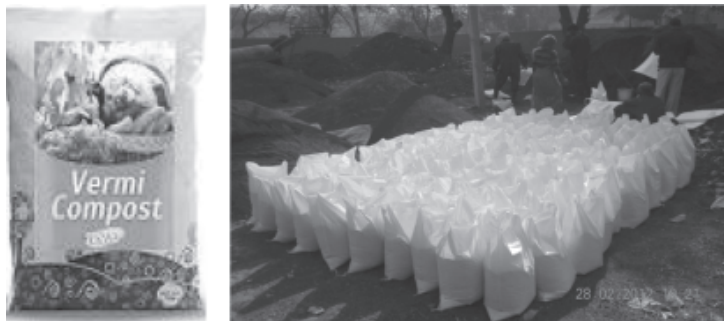


Fig. 20.1. Packets of Vermicompost

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective clothings, such as apron, gloves, etc.
- Notebook
- Pen

PROCEDURE

1. Visit 3 composting units.
2. Note down name and address of each unit.
3. Meet the in-charge or manager of the unit and enquire about the bags they are using for packing of vermicompost.
4. Ask whether the material of bags is eco-friendly (safe to environment) and moisture proof.
5. Note down address for procurement of the bags.
6. Record pros and cons of each packing material.

OBSERVATIONS

Record your observations in the table given below:

Name and address of composting unit	Type of material of bag	Remarks (Are the bags eco friendly and moisture proof?)	Source of bags/unit	Cost of bags/unit
1.				
2.				
3.				



Notes

RESULT

..... bag material is ideal for packing vermicompost.

PRECAUTIONS

- Select the types of bag that is not banned by authorities in your area.
- Material of the bag should be safe for environment.
- The bag should not show the release of any toxic material in compost during its storage.
- The bag should be of sufficient strength to bear the weight of compost packed in it.
- The design of the bag is such that it is easy to carry.

KEY LEARNING OUTCOMES

Able to identify and select suitable packaging material for storing vermicompost for longer usage.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 21

SAFE STORAGE OF VERMICOMPOST

AIM

To learn safe storage of vermicompost for long duration usage.

OBJECTIVE

After completing this practical, you will be able to

- store vermicompost safely for longer duration.

PRINCIPLE

After harvesting the vermicompost, it should be dried to achieve a moisture content of 30% and then sieved through mesh. Left over undecomposed materials, earthworms and cocoons are transferred to beds for further composting. Next step is storage. Proper storage of vermicompost ensures long shelf life of the product. Vermicompost should be stored in dark, cool place. It should be protected from direct sunlight as it may lead to moisture loss of vermicompost. If moisture is lost then microbes and beneficial products present in compost become less active. Vermicompost should also be protected from rain water as it can carry away the compost and may increase water content in the product that can cause anaerobic condition which is not good for quality of the compost. The vermicompost should be stored in a shed type structure. Water should be sprinkled on vermicompost periodically to maintain moisture content (minimum 35%). In absence of any pakka permanent (bricked) storage structure we go can go for temporary store made from locally available material like bamboo, straw, palm leaves, etc.

TOOLS /EQUIPMENT/MATERIALS REQUIRED

- Protective clothings.



Notes

- Notebook.
- Pen.

PROCEDURE

1. Visit any three vermicomposting unit is in your area.
2. Note down name and address of each unit.
3. Meet the in -charge or manager of the unit and visit the storage structures being used by them for storing vermicompost.
4. Note whether the storage structure is permanent bricked or temporary structure.
5. Record how structure is constructed.
6. Ask any suggestion by which construction cost may be reduced further.
7. Notedown as how compost is being transported from site of production or sieving to the shed.
8. Record moisture level of stored compost and see how it in maintained at optimum level.

OBSERVATIONS

Record your observations in the table given below:

S. No.	Name and address of composting unit	Type of storage structure		Materials used for designing the structure	Appropriate cost of construction	Remarks (Prons and cons each type structure)
		Permanent	Temporary			
1.						
2.						
3.						

RESULT

..... type of storage structure made up of materials are ideal for storing vermicompost in locality.

PRECAUTIONS

- Storage structure should preferably be made from locally available raw materials to reduce the cost of construction.



Notes

- Storage shed should be situated near the site of production or sieving to reduce labour for transportation.
- During storage, a minimum 35% moisture level should be maintained.
- Sprinkle water to maintain required moisture level, if necessary.
- Protect the compost from sun light and rain.
- Storage structure should be well aerated.
- Storage structure preferably be protected from pests and predators.

KEY LEARNING OUTCOMES

Able to store vermicompost safely for longer duration without deteriorating its quality.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 22

MONITORING POPULATION AND HEALTH OF EARTHWORMS

AIM

To monitor population and health of earthworms in vermibeds.

OBJECTIVES

After completing the practical, you will be able to:

- monitor population and health conditions of earthworms in vermibeds; and
- identify the healthy and unhealthy population of the earthworms.

PRINCIPLE

In vermicomposting beds, we should regularly monitor population and health of the earthworms. This is because the rate of vermicomposting depends upon the earthworm population density, growth and their health conditions. Poor population growth and bad health of earthworms slow down composting rate. Poor earthworm population density may be due to some wrong combination of feed substrate (like imbalance in C:N ratio), presence of anaerobic condition in beds, presence of some predators, unhealthy earthworms or due to mismanagement of vermibeds. An unhealthy earthworm may show some unusual symptoms, like swellings or constrictions on body surface, change in color of skin, reduced mobility size and other activities. These abnormal symptoms may be due to some microbial infections or chemical contamination in feed of the earthworms. Such earthworms may sometimes be destroyed, if required.

Health of the earthworm population can be improved by adopting proper management practices of the vermibeds.



TOOL/EQUIPMENT/MATERIALS REQUIRED

- Protective clothings, such as hand gloves, face mask, apron, etc.
- Rake.
- Notebook.
- Pen.

PROCEDURE

1. Visit few vermicomposting units.
2. Meet the in- charge or manager of the unit and enquire about earthworm populations with any abnormal symptom, observe the symptoms and record them.
3. Ask about the various management remedies being adopted by the unit to maintain good population and health of the earthworms.
4. Note down the reasons and proper remedies to be adopted.
5. For further information visit nearby Krishi Vigyan Kendra/Agricultural University/ Agricultural Institute or Department.

OBSERVATION

Record your observations in the table given below:

Table- 1

Reason for poor population growth	Treatments/Remedies given
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Table-2

Symptoms of ill health observed	Treatments/Remedies given
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Notes

RESULT

Monitored population and health of earthworms in vermibeds of different composting units.

PRECAUTIONS

- Take prior permission from in-charge or manager of vermicomposting unit before visiting it.
- Earthworms should not be damaged during the observation process.
- Do not interfere with normal functioning of the composting unit.
- Maintain healthy conditions in the vermicomposting unit.
- Wear hand gloves, mask, apron, if required.
- Destroy sick earthworms, if necessary.
- After finishing all work, wash your hands and face with an antiseptic soap to avoid any infection.

KEY LEARNING OUTCOME

Skilled in identifying healthy and unhealthy population of the earthworms present in the vermibeds.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Notes



Notes

Practical 23

IDENTIFICATION AND CONTROL OF PESTS AND PREDATORS

AIM

To identify and control pests and predators of the earthworms.

OBJECTIVES

After completing this practical, you will be able to:

- identify different pests and predators of the vermicompost; and
- control the pests and predators of the vermicompost using suitable measures.

PRINCIPLE

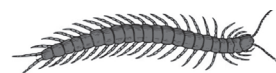
The vermibeds are visited or inhabited by various types of organisms. Some of them are harmless for earthworms and may be good decomposers of organic waste while others may be quite harmful for the worms. Few organisms that can harm worms are some anaerobic bacteria, ants (red ants are very harmful), mites, flat worms, leaches, centipeds, mole crickets, etc. Besides these, certain vertebrates like rodents, snakes, predatory birds directly or indirectly harm earthworms (Fig. 19.1) Most of these pests and predators may be controlled by proper habitat manipulation, and good management practices.



Fly



Ant



Centipede



Notes



Fig. 23.1: Pests of Vermibed

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective clothings, such as hand gloves, apron, etc.
- Garden rake.
- Enamel/ plastic trays.
- Notebook.
- Pen.

PROCEDURE

1. Visit a vermicomposting unit.
2. Meet the in-charge or manager of the unit.
3. Request the in charge or manager to show various types of common pests and predators of earthworms.
4. Using rake and plastic trays collect few pests and predators.
5. Note names of pests and predators collected and identify them.
6. Note down the control measures being adopted.

OBSERVATIONS

Record your observations in the table given below:

Name of pests or predators	Identifying features	Symptoms of their presence in beds	Stage of earthworms being attacked (cocoons, juveniles or adult)	Preventive measures being adopted	Remarks
1					
2					
3					
4					
5					
6					



Notes

RESULT

....., and are major pests and predators that are harming earthworms in the composting unit.

PRECAUTIONS

- Visit the vermicomposting unit only after seeking permission from the in-charge or manager of the unit.
- Donot interfere with normal functioning of the unit.
- Maintain hygienic conditions in the unit.
- Make use of protective materials, such as hand gloves, apron, face mask, etc. while collecting pests.
- Be careful while handling pests and predators.
- After finishing the work, wash your hands with an antiseptic soap to avoid any infection.

KEY LEARNING OUTCOMES

Able to identify and control pests and predators of the earthworms.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 24

PREPARE AND COLLECT VERMIWASH

AIM

To prepare and collect vermiwash.

OBJECTIVES

After completing this practical, you will be able to:

- prepare the vermiwash using suitable techniques; and
- collect vermiwash in suitable

PRINCIPLE

Vermiwash is a dark brown liquid which is made after passing water through a column of worms with medium. It is rich in nutrients, microbes, enzymes and plant growth promoters. It is a good liquid biofertilizer. It can be sprayed on plants. Application of vermiwash to plants is known to have beneficial effects on growth of crops. It also increases yield and quality of the produce. Vermiwash is diluted with water (10%) before spray. You can also mix 1 liter of vermiwash, one liter of cow urine, then add 10 liters of water, and keep it overnight and then spray. The spray also controls various crop diseases. Vermiwash is an eco-friendly bio fertilizer. It inhibits growth of fungi. It also acts as bio-pesticide (with mixed cow's urine or neem extract or garlic extract). It promotes better root growth and nutrient absorption. Application of vermiwash does not have any adverse effect on soil, plant and environment. Use of vermiwash reduces use of chemical fertilizers and thus saves us from harmful effects of chemical fertilizers.

TOOLS/ EQUIPMENT/MATERIALS REQUIRED

- Plastic barrels or an iron barrel or cemented tanks of capacity 200 liters.



Notes

- Earthworms species *Eisenia fetida* or *Eudrilus engeniae* (1-1.5 kg).
- Crop residues or dried leaves.
- Partially decomposed cow dung.
- Garden soil.
- Gravel.
- Sand.
- Containers (5 liter capacity)
- Buckets.

PROCEDURE

1. Take a plastic or iron barrel or cemented tank of capacity 200 liters, keep it under shade.
2. Make a hole just above bottom of the barrel and put a tap in it. Attach a pipe on the other end of tap projecting into barrel.
3. Each tank or barrel is filled with a layer of broken pieces of bricks upto a height of 5-8 cm.
4. The above layer is followed by a layer of gravel and then sand which is kept 8 to 10 cm thick.
5. On the top of above layer place a layer of partially decomposed cow dung. Thickness of this layer may be kept upto 30-45 cm.
6. On top of it, put another layer of garden soil having 2-3cm thickness.
7. Cover the above layer with crop residues or dried leaves (6 cm thickness).
8. Spray water on top to ensure moisture level 40%.
9. After a period of 10 days put 1-1.5 kg of earthworms of species *Eisenia fetida* or *Eudrilus engeniae* (1000- 1500 worms).
10. The unit is left as such for 15 days. Water may be sprinkled on top to maintain minimum moisture level (40%).
11. On top of the barrel, hang a container having holes at the bottom. 5 liters of water is put in the container and allowed to sprinkle on barrel overnight.



12. Open tap of the barrel next morning and collect vermiwash.
13. Next evening, fill the containers with 5 liters of water again, sprinkle water on top and repeat the process again. In this way 7- 10 liters of vermiwash is collected daily.
14. The collected vermiwash can be diluted with water or with cow urine (1.1).

OBSERVATIONS

.....

.....

.....

RESULT

Prepared and collected the vermiwash using suitable procedure.

PRECAUTIONS

- After installation of the unit, for the first 2 days keep the tap open to clear off all the impurities.
- Do not collect any vermiwash for 12 days of establishing it.
- For better quality of vermiwash, it is preferred to change soil and cow dung after every 10-15 days of its use.
- Wash sand and pebbles before putting them in the barrel.
- Use only 2-3 weeks old partially decomposed cow dung.
- In the unit minimum 40% moisture level should be maintained.
- Install the unit in shady place.
- Maintain sufficient population of earthworms (1000-1500 worms) in the unit and if required introduce more worms to maintain their activity.
- Store vermiwash in cool and dark place. Vermiwash can be used within two 2 months of its preparation.

KEY LEARNING OUTCOMES

Skilled in preparation, collection and use of vermiwash.



Notes

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 25

DEMONSTRATION OF ONLINE MARKETING

AIM

To demonstrate the online marketing of vermicompost.

OBJECTIVE

After doing this practical you will be:

- aware about various online marketing avenues available for vermicompost, vermiwash, earthworm and cocoons; and
- sale vermicompost and related products online.

PRINCIPLE

Scope of online marketing, or digital marketing is increasing day by day. It constitutes a major bulk of the total marketing in India. The objective of online marketing is to reach potential customers through online channels where they spend time in reading, searching, shopping or socializing. Online marketing make use of email, websites, display of advertisements, social media, etc. One of the major advantage of online marketing is that potential customers can be reached at affordable prices, as you reduce your cost for office premises, man power and advertisements. You get access to a wide range of market at a cost lower than by traditional methods. Your results are traceable and measureable. Through online tools you can make personal touch with each customer. Online purchasing is convenient for customers also. For online marketing you can setup your own website or open an account in Facebook or Instagram. You can upload videos, photos, related details, advertisements, etc. related to your product and establishment. Some of these media allow you to open a business account to



Notes

operate. You can give an attractive title to you account or website. You can also do marketing by Whatsapp. In these media at the end of the page or by the sides of the page a link for purchase is given and options for payment like with cash, credit card/debit card/internet banking/paytm/e-wallets/Google pay, phonepe etc. are given. You can put your products for sale on websites like Amazon and Flipkart. You may also give option of cashdown payment and cash on delivery. You should take some expert's advice before going for online marketing.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Vermicomposting unit actively engaged in online marketing.
- Notebook.
- Pen.

PROCEDURE

1. Visit a vermicomposting unit which is active in doing online marketing of vermicompost and related products.
2. Meet the person who is dealing with online marketing.
3. Enquire about various means and details of marketing.
4. Request the concerned person for marketing demonstration on computer or smart phone.
5. Practice the procedure of marketing in front of the concerned person, if possible.
6. Record your observations carefully.

OBSERVATIONS

Record your observations in the table given below:

S.No.	Common online marketing websites	Special features of the website	Problems associated with the website



Notes

RESULT

..... website is best for online marketing of the vermicompost and related products.

PRECAUTIONS

- Take permission from in-charge or manager of the composting unit before entering the unit.
- Do not interfere with functioning of the unit.
- Record your observations carefully and note all procedures and cautions/ cyber risks regarding online marketing.

KEY LEARNING OUTCOMES

Able to demonstrate and use online marketing platforms for sale of vermicompost and related products.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 26

EXPOSURE VISIT TO COMMERCIAL VERMICOMPOSTING SET UP

AIM

To visit a commercial vermicomposting set up.

OBJECTIVE

After completing this practical, you will be able to:

- set up a commercial vermicomposting unit.

PRINCIPLE

Commercial vermicomposting units are set up with high investments. It aims at utilization of waste in large quantity to produce large quantity of vermicompost continuously and to make large profits, like a business. The various processes involved need support of large number of machines. The objective of commercial vermicomposting unit is to keep cost of production to a low level. Mechanization leads to less use of man power. Various jobs like transportation of waste from source to unit and unit to beds; turning of beds; transportation of compost; watering of beds, sieving and packing of compost may be done by machines. Visit to such unit may give a exposure to that type of opportunities.

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Protective coverings such as, apron, face mask, gloves, etc.
- Notebook.
- Pen.



Notes

PROCEDURE

1. Visit a commercial vermicomposting unit.
2. Meet manger or in-charge of the unit and observe how various activities are being undertaken in the unit.
3. Record your observations in notebook.

OBSERVATIONS AND RESULT

1. Name and address of the commercial composting unit.
.....
.....
2. Decomposable raw material being used.
.....
.....
3. Sources of the raw material.
.....
.....
4. Quantity of raw material being utilized daily.
.....
.....
5. Quantity of vermicompost produced daily.
.....
.....
6. Type of vermibeds.
.....
.....
7. Type of shed for vermibeds.
.....
.....
8. Means of transporting waste to beds in the unit.
.....
.....



Notes

9. How vermibeds are turned?

.....
.....

10. How vermibeds are watered?

.....
.....

11. How earthworms are separated from vermicompost?

.....
.....

12. How the sieving of vermicompost is being done?

.....
.....

13. Type of shed being used for storing vermicompost.

.....
.....

14. Transportation of vermicompost to shed for storage.

.....
.....

15. Type and material of the bag being used for packing.

.....
.....

16. How packing of the bags is being done?

.....
.....

17. Daily quantity of compost being sold.

.....
.....

RESULT

Visited (name and address) vermicomposting unit. The following important activities are being performed in the commercial vermicomposting unit:

.....
.....



Notes

PRECAUTIONS

- Visit the unit only after taking permission from the manager or in-charge of the unit.
- Maintain hygienic conditions in unit.
- Wear apron, mask, goggles, hand gloves, if required.
- Do not interfere with routine activities of the unit.
- After visiting unit, wash your hands with an antibacterial soap.

KEY LEARNING OUTCOME

Able to set up a commercial vermicomposting unit.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 27

DEMONSTRATION OF PERSONAL HYGIENE PRACTICES TO BE FOLLOWED AT THE WORKPLACE

AIM

To create awareness and build the ability among individuals to understand, adopt, and consistently demonstrate appropriate personal hygiene practices at the workplace, thereby promoting a safe, healthy, and professional working environment for all employees.

OBJECTIVES

After completing this practical, you will be able to:

- understand the importance of personal hygiene in promoting health, safety, and professionalism in the workplace;
- describe key personal hygiene practices essential for maintaining cleanliness and reducing the spread of infections;
- develop the ability to implement daily hygiene routines, including handwashing, oral care, grooming, and wearing clean clothing;
- demonstrate correct hygiene behaviors through practical examples and role-play relevant to the work environment.

PRINCIPLES

1. Cleanliness is Mandatory
2. Hand Hygiene is Non-Negotiable
3. Appropriate Work Attire and PPE



4. Avoidance of Contamination
5. Personal Grooming Standards
6. Health Declaration and Fitness for Duty
7. Sanitation of Personal Belongings
8. Workstation Cleanliness
9. Proper Waste Disposal
10. Continuous Awareness and Training

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Liquid hand soap or antibacterial soap
- Clean running water or handwashing basin
- Paper towels or clean cloth towels
- Hand sanitizer (alcohol-based, e”60% alcohol)
- Face masks (disposable or reusable)
- Gloves (disposable – nitrile or latex)
- Aprons or overalls (for specific workplaces like food, labs)
- Hairnets or caps (for food or healthcare sectors)
- Surface disinfectants (e.g., phenyl, sodium hypochlorite solution)
- Dustbins with lids (preferably foot-operated)
- Disposable tissue papers or wipes
- Cleaning cloths and sponges (color-coded for hygiene)
- Nail cutter
- Posters or infographics showing hygiene practices
- Leaflets or brochures on hygiene guidelines
- Personal hygiene checklist formats
- UV light hand inspection device (for handwashing training)
- Thermometer (for temperature screening)



Notes

PROCEDURE

1. Preparation Before Demonstration

- Ensure access to:
 - Handwashing station or sanitizer dispenser
 - PPE (e.g., gloves, masks, caps, aprons)
 - Clean uniform/clothing
 - Mirror and grooming tools
 - Dustbin with lid

2. Steps of Demonstration

Step 1: Personal Cleanliness

- Explain and demonstrate:
 - Daily bathing and wearing clean clothes.
 - Clean, trimmed fingernails and tied-back hair (if long).
 - No strong perfumes or scented cosmetics in food/health-sensitive areas.

Step 2: Hand Hygiene

- Demonstrate:
 - When to wash hands:
 1. Before and after meals
 2. After using the restroom
 3. After touching common surfaces
 4. After sneezing/coughing
- How to wash hands (7-step method):
 1. Wet hands with clean water
 2. Apply soap
 3. Palm to palm



4. Between fingers
5. Back of hands
6. Fingertips and nails
7. Rinse and dry

Step 3: Respiratory Hygiene

- Demonstrate:
 - Using a tissue or elbow while sneezing or coughing
 - Immediate disposal of used tissues
 - Washing hands afterward

Step 4: Use of Protective Gear (PPE)

- Show how to:
 - Wear and remove mask, gloves, and caps properly
 - Dispose of single-use items in proper bins
 - Sanitize reusable gear regularly

OBSERVATIONS

- Frequency of handwashing (before/after meals, after using the toilet, after handling waste, etc.)
- Proper handwashing technique (using soap, scrubbing, rinsing, drying)
- Availability and use of hand sanitizers
- Face Hygiene
- Workplace Cleanliness Habits
- Use of Personal Protective Equipment (PPE) (where applicable)
- Toilet Hygiene Practices
- Food Hygiene
- Health Awareness
- Waste Management
- Training and Awareness



Notes

RECAUTIONS

- Wash Hands Properly and Frequently
- Avoid Sharing Personal Items
- Wear Clean and Appropriate Attire
- Maintain Nail and Hair Hygiene
- Cover Mouth and Nose Properly
- Use Protective Gear Where Required
- Avoid Coming to Work When Sick
- Ensure Cleanliness of Personal Work Area
- Proper Waste Disposal
- Practice Safe Food and Water Habits

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 28

SHOW HOW TO SANITIZE AND DISINFECT ONE'S WORK AREA REGULARLY

AIM

The aim of this practical exercise is to highlight the importance of regular sanitization and disinfection in maintaining a hygienic and safe workplace environment. Demonstrate the correct methods and practices for sanitizing and disinfecting various types of work surfaces and high-touch areas.

OBJECTIVES

After completing this practical, you will be able to:

- understand the importance of regular sanitization and disinfection
- differentiate between cleaning, sanitizing, and disinfecting
- identify commonly used disinfectants and sanitizing agents
- demonstrate the step-by-step procedure for effective sanitization
- establish a regular cleaning schedule

PRINCIPLES

Ensure that regular sanitation and disinfection are carried out to protect employees from potential infections, allergies, and contamination. A clean work environment reduces the spread of viruses, bacteria, and other pathogens. Always use disinfectants and cleaning agents that are approved by health authorities (e.g., WHO, EPA). Follow the manufacturer's instructions for effective use and safety. Use appropriate cleaning tools (wipes, microfiber cloths, sprayers) and techniques (wiping in one direction, avoiding cross-contamination) to ensure thorough disinfection.



Notes

TOOLS/EQUIPMENT/MATERIALS REQUIRED

- Disinfectant Spray or Solution
- Multipurpose Cleaner or Detergent
- Microfiber Cloths or Disposable Paper Towels
- Gloves (Disposable or Reusable)
- Face Mask
- Sanitizing Wipes
- Trash Bags / Bin Liners
- Hand Sanitizer
- Labelled Spray Bottles
- Checklists or Log Sheets

PROCEDURE

1. Gather Necessary Supplies

- Disposable gloves
- Face mask (if needed)
- Disinfectant spray or wipes (EPA-approved or 70% alcohol-based)
- Mild detergent (if surface is visibly dirty)
- Clean microfiber cloths or paper towels
- Trash bag or bin

2. Prepare the Area

- Wash your hands with soap and water or use hand sanitizer.
- Put on disposable gloves.
- Open windows or ensure good ventilation if using strong disinfectants.

3. Remove Visible Dirt or Debris

- Remove clutter from the surface.
- Use a clean cloth and mild detergent to wipe down visibly dirty surfaces before disinfecting.



4. Apply Disinfectant

- Spray disinfectant directly onto surfaces or use disinfectant wipes.
- Focus on high-touch areas: keyboard, mouse, desk surface, doorknobs, light switches, phone, chair arms, drawer handles, etc.

5. Allow Contact Time

- Let the disinfectant sit on the surface for the recommended contact time (usually 1–5 minutes, depending on product label) to kill germs effectively.

6. Wipe Dry (if needed)

- After the disinfectant has sat long enough, use a clean cloth or paper towel to wipe the surface dry (if the product requires it).



Fig. 28.1: Procedure of sanitize and disinfect one's work area regularly

7. Dispose of Waste

- Throw used paper towels, wipes, and gloves into a lined trash bin.
- Seal and dispose of the garbage properly.



Notes

8. Sanitize Hands

- Wash your hands thoroughly with soap and water for at least 20 seconds after removing gloves.
- Alternatively, use an alcohol-based hand sanitizer if soap and water are not available.

9. Repeat Regularly

- Perform disinfection at least **once daily** or more frequently in shared spaces.
- Create a cleaning log or schedule for accountability.

OBSERVATIONS

- Type of disinfectant (e.g., alcohol-based, bleach solution, commercial disinfectants)
- Cleaning tools used (e.g., microfiber cloths, spray bottles, gloves, masks)
- Step-by-step actions taken (e.g., spraying, wiping, drying)
- Specific areas cleaned (e.g., desk surface, keyboard, mouse, chair arms, drawer handles)
- Time taken for the entire process
- How often is the work area disinfected (e.g., daily, weekly, after shift changes)?
- Is there a fixed schedule or event-based cleaning (e.g., after eating, sneezing, external visitors)?
- Use of hand sanitizer before and after cleaning
- Use of gloves and masks during cleaning
- Safe disposal of used tissues or wipes
- Visibility of cleanliness (no dust, smudges, or stains)
- Absence of unpleasant odor or residues
- Feedback or self-assessment on thoroughness

PRECAUTIONS

- Use gloves, masks, and (if needed) eye protection to prevent direct contact with disinfectants or contaminated surfaces.
- Open windows or use exhaust fans while using chemical disinfectants to avoid inhaling harmful fumes.



Notes

- Always check the instructions and safety guidelines on disinfectant product labels (e.g., dilution rates, contact time, usage warnings).
- **Never mix bleach with ammonia** or other cleaners – it can produce toxic gases.
- Choose **EPA- or WHO-recommended disinfectants** effective against bacteria and viruses, including COVID-19.
- Before using any disinfectant on electronic devices, wooden furniture, or upholstery, test a small patch to avoid damage.
- Always disconnect power sources before disinfecting electronics like keyboards, phones, and monitors.
- Use paper towels or microfiber cloths that can be disposed of or sanitized after use.
- Spray disinfectant on cloths, not directly on surfaces (especially electronics), to avoid liquid damage.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)