Lesson 5

Harvesting methods and utilization

Learning outcomes

- The trainee explains the harvesting methods of vermicompost.
- The trainee explains the appropriate harvesting method in small-scale production methods.
- The trainee knows the role of sunlight and temperature in the harvesting process.
- The trainee explains the role of nutrients added to the production environment in the harvesting process.
- The trainee knows the physical properties that vermicast must have.
- The trainee knows the chemical properties that vermicompost should have.
- The trainee knows the biological properties that vermicompost should have.
- The trainee explains the role of earthworms in heavy metal removal.
- The trainee knows the preservation and storage conditions of vermicompost before use.

Instructions for the trainer

Trainer explains to students the terms commonly used in vermicomposting using Supplementary Material 1 (SM-1). The setup of the presentation was designed to

display first the image of vermicompost production and then the term associated with the image.

- The instructor shares theoretical knowledge through presentation.
- The trainer shows the trainees the SM-3, which visualizes pit-type vermicompost production, and asks them to explain the appropriate harvesting method.
- The trainer shows the trainees the SM-4, which visualizes pile-type vermicompost production, and asks them to explain the appropriate harvesting method.

Basic requirements: Computer, projector

5. Harvesting methods and utilization

The vermicompost is ready in 75-90 days and the resulting material becomes black, granular, light, moderately loose, crumbly and rich in humus. Watering should be avoided two to three days before emptying the beds to facilitate the separation of the worms from the compost. The general procedures for harvesting vermicompost are described below. Any method can only be adopted according to preference. In addition, two or more methods can be applied on the same pile. Except for the first method, the rest are intended for batch harvesting.

5.1. Manual collection of vermicompost

This method is applied when it is desired to collect small quantities of vermicast only a few days after the compost heap has been filled with compost worms. In this case only the top layer is covered with a thin layer of vermicast and the rest of the heap is not completely decomposed. The vermicast on the heap is collected by hand/trowel and transferred directly into a container. This method is recommended if organic soil amendment is needed in the preparation of a fertile potting mix. Over time, as vermicompost collects at the bottom of the heap, it is also collected by hand.

5.2. Vermicompost harvesting with pyramidal pile

Vermicompost is first collected to form a pyramid-like pile within the composting enclosure, provided the pile is exposed to light, or transferred on a plastic sheet or a sack to a flat surface elsewhere in the open sun. This method of vermicompost collection takes advantage of the worm's sensitivity to light because the worms will tend to move deeper into the pyramid. The vermicompost on the bottom, side and top surface of the heap is then collected by hand or with a trowel. After the first cycle of vermicompost collection, a few minutes are passed to allow enough time for the worms to go deeper and another cycle is started. The original pile is divided into several smaller piles for faster harvesting of the vermicompost.

5.3. Sieving or screening of vermicompost

The method of vermicompost harvesting is done manually with a device called a sieve, which consists of a wire mesh nailed to wood. A small portion of the vermicompost pile spread on flat ground is transferred to the sieve and shaken so that the fine vermicompost falls to the ground. All undecomposed substrates and worms are retained in the sieve and the worms are manually separated.

5.4. Harvesting vermicompost by promoting the migration of earthworms

The method of vermicomposting is based on the ability of worms to detect food sources. Worms have the habit of leaving the depleted food pile and moving towards fresher and more flavourful sources. Although there are many modifications to this technique, the basic principle remains the same, with the aim of providing fresh or more palatable food that will enable the worms to migrate from the depleted pile to the new food source.

5.5. Storage and packaging of vermicompost

Harvested vermicompost should be stored in a dark and cool place because sunlight will lead to loss of moisture and nutrient content. Also, the harvested vermicompost material should be stored in the open rather than packed in pouches. Packaging should be done at the time of sale and a laminated pouch is always recommended. During outdoor storage of compost, it should be periodically sprinkled with water to maintain the moisture level and beneficial microbial population. If the humidity of vermicompost is maintained at 40%, it can be stored for as long as one year without compromising its quality [20].

5.6. Utilization

The vermicompost obtained at the end of the vermicompost production process must have some physical, chemical, and biological properties in order to be used as an input in sustainable agricultural activities.

5.6.1. Physical properties

- A good vermicompost is always non-toxic, well decomposed, ecologically compatible and environmentally friendly.
- All types of green waste i.e. municipal waste, agricultural waste, sewage sludge, industrial waste and human excreta can be used for conversion by earthworms.
- When the turning of the soil takes place properly, it is symptomatic of aerobic decomposition, which will produce normal odor after preparation. In case of improper ventilation, bad odor may occur.
- The final result of vermicomposting will consist of fine particulate structure and granular form.
- Vermicompost plays the role of "soil conditioner" by improving soil porosity, drainage and water holding capacity.

5.6.2. Chemical properties

- Vermicompost is rich in almost all essential macro and micro plant nutrients. Various experiments indicate that the average nutrient content of vermicompost is higher than that of other conventional composts produced by other procedures.
- Among all secondary nutrients, the calcium content in vermicompost is higher than in other composts.
- Unlike other conventional compost, vermicompost contains worm mucus, which makes it easier to prevent the nutrients present there from washing away.
- Due to worm transformation, the heavy metal present in the feed material was found to decrease in worm castings due to its accumulation in the worm tissue. Depending on the feed used, the rate of heavy metal removal depends on vermicomposting techniques. This feature makes vermicompost less polluting than other composts. Thus, it becomes more environmentally sustainable.
- There are some differences between simple farm manure and vermicompost in terms of chemical properties. Vermicompost has a higher range of macro- and micronutrients as well as soil organic carbon status, as can be observed from Table 3.

5.6.3. Biological properties

- The by-product of soil breakdown is an inhabitant of various microorganisms, i.e. bacteria, fungi and actinomycetes. These microorganisms secrete various enzymes and phytohormones that help in improving plant growth. Thus vermicompost facilitates both microbial and enzymatic activity.
- The microbial population of nitrogen fixing bacteria and other symbiotic combining bacteria is expected to be in a good range of numbers in vermicompost.
- In addition, vermicompost harbors a large number of vesicular-arbuscular mycorrhiza (VAM) propagules. These propagules survive for up to 11 months after shedding and help to increase microbial activity to produce nitrogen and phosphorus in a form that the plant can readily utilize.

When applying vermicompost into the soil; between 120 and 150 grams of solid vermicompost should be used for each square meter of application area in agricultural areas or soils to be applied. The application should be repeated twice a year to guarantee successful results. Vermicompost should be mixed with the soil in the application area. Laying vermicompost on the application surface may make it difficult for plants to take useful nutrients from the soil. For this reason, it is necessary to mix the soil and vermicompost in such a way as to form a homogenous structure. To do this, use a shovel, pickaxe, or hoe to dig up the soil in the application area, mix the vermicompost and the excavated soil, and fill the pit again with the homogeneous mixture (soil and vermicompost).

Table 3. **Chemical properties of vermicompost**		
Properties	**Compost**	**Vermicompost**
pH	7.16	7.72
EC (dSm^{-1})	3.65	6.88
OC	20.5	17.3
Total N (%)	2.42	3.5
Total P (%)	0.88	0.71
Total K ($mg.kg^{-1}$)	653.5	950.5
Total Ca (%)	2.9	3.5
Total Mg (%)	1.5	2.8
Total Fe ($mg.kg^{-1}$)	4467	6045
Total Zn ($mg.kg^{-1}$)	115.5	189.5
Total Cu ($mg.kg^{-1}$)	59	38
Total Mn ($mg.kg^{-1}$)	221.45	344.15
C:N	8.47	5.51