Vermicomposting

S P Wani, K P Nagavallemma, and M Babu Rao

Earthworms are one of the major soil macro-invertebrates. They improve soil fertility and soil health. They eat farm residues and vegetable peelings and convert them into a nitrogen (N)-rich compost called vermicompost. By using vermicompost, water-holding capacity of soil can be increased; crops grow healthy and produce more and food and fodder quality is improved. Vermicompost contains 1.0 to 1.5% N, 0.8% phosphorus (P), 0.7% potassium (K), and also many other micronutrients [calcium (Ca), magnesium (Mg), copper (Cu), iron (Fe), zinc (Zn)]. With all these benefits importance of vermicompost is increased. It is easy to produce at low cost.

Selection of Earthworms

Earthworms are mainly divided into two types: burrowing type; and non-burrowing type. The non-burrowing type of earthworms (*Eisenia* spp, *Eudrilus* spp), available in local markets, is used for preparing vermicompost. These earthworms are red or purple, live on the soil surface, and eat 90% organic waste materials. The burrowing type of earthworms (*Pertima* spp) is generally seen in rice fields. These earthworms are pale in color, live inside the soil, and eat 90% soil; these are not selected for vermicomposting.

Types of Organic Materials

Vermicompost can be prepared from all types of organic residues such as:

- Agricultural residues
  - dry organic wastes (sorghum straw, rice straw after feeding cattle, dry leaves, pigeonpea residues, groundnut husk, wheat husk)
  - waste vegetables
  - soybean residues
  - weeds (particularly *Parthenium hysterophorus* before flowering)
  - sugarcane trash
- Sericultural residues
- Animal manures
- Dairy and poultry wastes
- Food industry wastes
- Municipal solid wastes
- Biogas-sludge
- Bagasse from sugarcane factories

Vermicompost Preparation

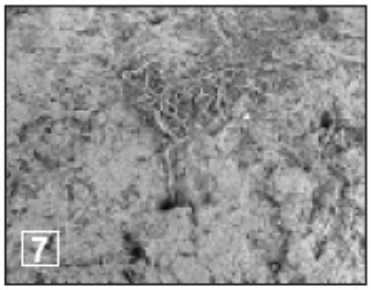
Vermicompost can be prepared by different methods in shady areas:

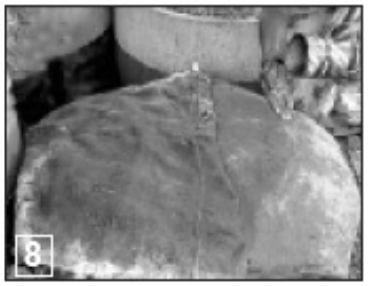
1. On the floor in a heap;
2. In pits (up to 1 m depth);
3. In an enclosure with a wall (1 m height) constructed with soil and rocks or brick material or cement; and
4. In cement rings.

The procedure for preparation of vermicompost is similar for all the methods. The preparation in cement rings is described below (see Figs. 1–12).

Step-wise procedure

- Cover the bottom portion of a cement ring with a polythene sheet (1).
- Spread a layer (15–20 cm thick) of organic waste material on the sheet (2).
- Sprinkle rock phosphate on this layer (3).
- Prepare cowdung slurry (4).
- Sprinkle the slurry as a layer.
- Fill the ring completely with the material in layers (5).
- Paste the top portion of the ring with cowdung or soil (6).
- Allow the material to decompose for 20 days.





- After 20 days release selected earthworms through the cracks (7).
- Cover the ring with wire mesh or gunny bags to prevent birds from picking the earthworms (8).
- Sprinkle water at 3-day intervals to maintain adequate moisture and body temperature of the earthworms.
- Check compost after about 2 months. Vermicompost is ready in 2–2½ months. It is black and light, and has no smell (9).

- When the compost is ready, remove from the ring and heap as a cone (10).
- Leave the heap undisturbed for 2 to 3 hours to allow the earthworms to move down the heap slowly.
- Separate the upper portion of the heap (11).
- Sieve the lower portion of the heap to separate the earthworms which can be used again for preparation of vermicompost (12).
- Pack the compost in bags and store these in a cool place.

Repeat process

About 20 days before removing the compost from cement rings place the organic waste, rock phosphate, and cowdung slurry in layers in another set of rings. Follow the step-wise procedure and use the earthworms separated from the compost as mentioned above.

Materials required

Materials required for vermicomposting in one cement ring (90 cm diameter × 30 cm height) or in a pit/walled enclosure (1.5 m × 1 m × 1 m):

	Cement ring	Pit/tank
Dry organic wastes (DOW)	50 kg	400 kg
Cowdung slurry (CS)	15 kg	120 kg
Rock phosphate (RP)	2 kg	16 kg
Earthworms (EW)	500–750	4000–5600
Water (W)	5 L every three days	40 L every three days
Ratio of DOW:CS:RP:EW:W	5:1.5:0.2:50–75:0.5	

The weights for all the ingredients except EW are expressed in kg.

Precautions

- Use only plant materials such as vegetable peelings, leaves, or grass.
- Remove glass, metal, and plastic materials from the organic material.

Usage

Vermicompost can be used for all crops (agricultural, horticultural, ornamental, and vegetable) at any stage of the crop.

Dosage

- For general use in agriculture, 3–4 t ha^{-1}.
- For fruit trees, 5–10 kg per tree.
- For vegetables, 3–4 t ha^{-1}.
- For flowers, 500–750 kg ha^{-1}.

Application

- For agricultural crops: Apply vermicompost by broadcasting when the seedlings are 12–15 cm in height and water the plants normally.
- For flowers, vegetables, and fruit trees: Apply vermicompost around base of the plant, cover with soil, and water regularly.

Advantages of Vermicompost

- Contains valuable nutrients [N (1–1.5%), phosphorus (P) (0.8%), potassium (K) (0.7%), micronutrients], enzymes, plant hormones, and antibiotics required for plant growth.
- Promotes fast growth of plants and increases crop yields.
- Increases the quantity and improves the quality of fruits, vegetables, and flowers.
- Maintains humus content of the soil.
- Increases water-holding capacity of the soil.
- Easy to produce and incurs low cost.
- Reduces salinization and acidification.
- Reduces soil erosion.
- Reduces pest attack.

Conclusion

By applying vermicompost in the fields, soil physical, chemical, and biological properties will be improved. Vermicompost application will also help in higher yields with improved grain quality.

On-farm Generation of N-rich Organic Material

S P Wani and M S Kumar

Soils in the tropics are low in organic matter content and have low nutrient supplying capacity. Soil organic matter plays an important role in crop production. To maintain or increase organic matter content regular application of organic materials such as farm compost, farmyard manure, and plant residues is needed. However, short supply of organic manures and competitive uses of farm residues as feed and fuel makes it difficult to apply to soil at desired levels. Fast-growing and nitrogen (N)-fixing trees such as *Gliricidia sepium* play an important role in tropical farming systems and are grown as green manure and shade trees, and for fodder and fuel. Growing *Gliricidia* plants on farm bunds serves dual purpose of producing N-rich organic matter under field conditions and also helps in conserving soil through reduced soil erosion. *Gliricidia* has fast growth, N-rich leaves, tolerance to pruning, ability to coppice vigorously, and good fodder value. It can be grown on bunds as rainfed plants even at places which receive only 500 mm rainfall annually.

The steps for growing *Gliricidia* are given below:

- *Gliricidia* can be established through cuttings which are taken from stems of at least one-year-old plants and have a minimal length of about 50 cm.
- In rainy season (July–August) cuttings can be planted under humid conditions in the soil in 10–15 cm deep holes.
- The stake method is simple, but suitable mainly for situations where only a few trees are to be established, such as for fence posts.
- For establishing large number of plants, seed propagation method is the most convenient and reliable means of establishment.
- Seeds should be soaked in water for 8–10 hours or overnight. The soaked seed can be planted in small plastic bags filled with soil and watered regularly.
- Alternatively, seeds should be immersed in concentrated sulfuric acid (H_2SO_4) for one minute. Then the acid should be poured out carefully and the seeds should be washed with running water for 3–4 hours. Treated and thoroughly washed seeds can be planted in small plastic bags filled with soil and watered regularly.
- Three to four-month-old seedlings can be planted on bunds in the rainy season at 50 cm spacing.
- One year after planting, harvesting can be started by lopping the plants at 0.75 m length above the ground. Green matter (leaves and tender stems) are separated from firewood. The tree prunings can be applied to the soil surface as mulch or incorporated as green manure.
- Lopping is done at 3–4 month intervals and 3–4 times per year.
- *Gliricidia* plants can be managed well through pruning at appropriate times (e.g., before planting rainy and postrainy season crops) so that nearby crop rows are not adversely affected.
- When plants are established, from first year onwards loppings from 700-m long bunds provide about 45 kg N ha^{-1} yr^{-1} (equivalent to 100 kg urea). Along with N, phosphorus, potassium, and other plant nutrients are also added back to the soil.