Earthworms and Vermi-compost

Soil fauna play a prominent role in regulating soil processes and among these the termites and the earthworms play a vital role in maintaining soil quality and managing efficient nutrient cycling. In organic farming practices the soil is considered to be a living component with is physical, chemical and biological characteristics.

Various aspects of earthworm activities in nature, and benefits that can be derived with mass culture, *viz.*, for cast production, vermicomposting and commercializing live material, indicate needs of developing mass earthworm culture. This is popularly referred as vermiculture. Vermiculture, as a subject, involve background of various aspects on biology etc. of earthworm. All these are scattered in literature.

"Vermi-compost is a method of making compost with the use of earthworms, which generally live in soil, eat bio-mass and excrete it in digested form. This compost is generally called vermi-compost or wormi-compost." It is estimated that 1800 worms which is an ideal population for one sq. meter can feed on 80 tonnes of humus per year.

Earthworms form a major component of the soil system and these organisms have been efficiently ploughing the land for millions of years and assisting in the recycling of organic nutrients for the efficient growth of plants. Advent of chemical fertilizers and biocides and their large scale application have changed the structure of soils and have, in most cases, eliminated soil organisms. Thus, human interference in natural ecosystems through modern practices of agriculture, silviculture and horticulture involving large scale application of chemicals in the form of fertilizers and pesticides has been responsible for the destruction of endemic soil fauna. For millions of years before the so called green revolution, earthworms have been ploughing the soil and fertilizing them.

VERMICOMPOST

Vermicompost is a stable fine granular organic matter, when added to clay soil loosens the soil and provides the passage for the entry of air. The mucus associated with the cast being hygroscopic absorbs water and prevents water logging and improves water holding capacity. Thus, in the sandy soils where there is the problem of water retention, the strong mucus coated aggregates of vermicompost hold water for longer time.

In the vermicompost, some of the secretions of worms and the associated microbes act as growth promoters along with other nutrients. It improves physical, chemical and biological properties of soil in the long run on repeated application. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb these nutrients. The soil enriched with vermicompost provides additional substances that are not found in the chemicals. The multifarious effects of vermicompost influence the growth and yield of crops.

Microbes are the **primary decomposers** while earthworms are the major **secondary decomposers**. Earthworm manure is formed from the dead tissues of plant and animals and thus is naturally the source of macro and micro nutrients in limited quantities. The weather conditions and the soil type in the tropical countries do not favour the restoration of carbon resource in the soils. The application of organic manure replenishes organic carbon to the impoverished soils. The presence of high level of oxidisable organic carbon helps in the slow release of nutrients from the manure and curbs the leaching of nutrients. The beneficial activity because of the nutrient availability.

VERMICULTURE PROCESS

It is very simple and easy to method. It needs careful step wise programme. However, like all live animal or culture of any biological

material, first step is to start purely as a test experiment on a small scale. This enables acquire personal experience(s) on various aspects. For beginners, hobbyist and farmers, simple procedure should be first to start on experimental scale and record every detail of steps followed and responses on earthworms.

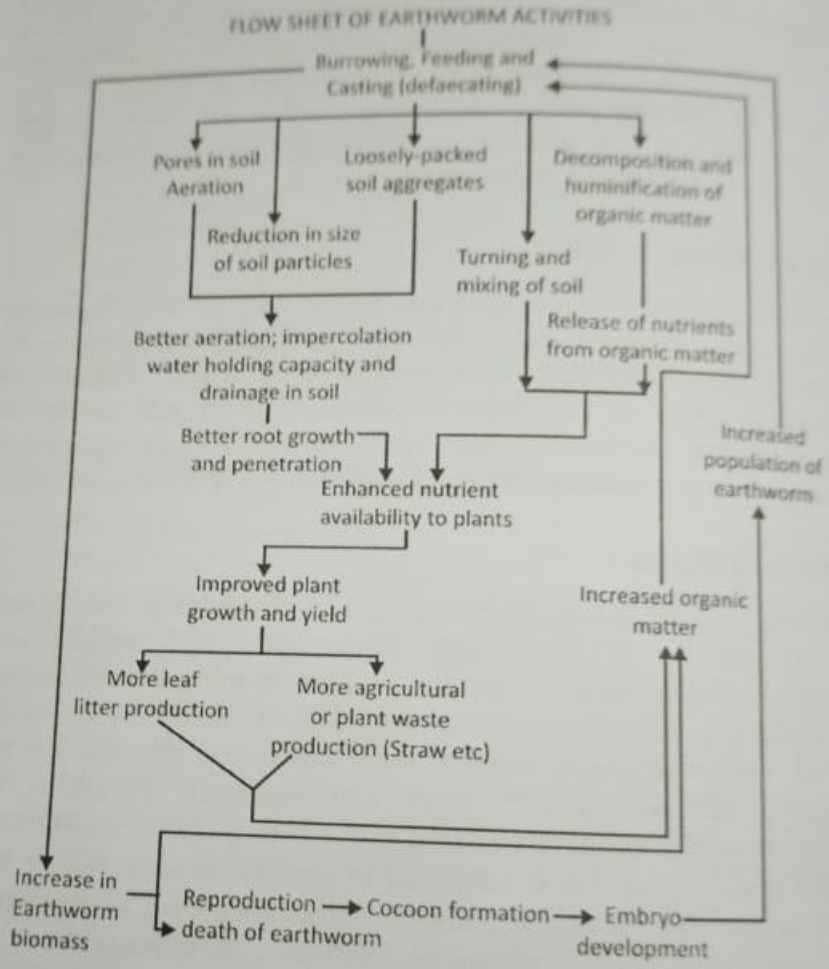

FIG. 9.1: Action of earthworm for production of vermicompost.

The care should be observed that how these fair in particular medium with increase or decrease in their numbers, waste matter conversion, cast production and composting etc. Following are the important levels of planning:

1. Site selection
2. Availability of decomposable organic waste, its daily quantity and quality, alternate organic material, transportation and stocking etc.,
3. Marketable outlet and requirement with future scope.
4. Collection and study of know how on earthworms to be cultured.
5. Collection, procurement of suitable species.
6. Testing of suitability of species on performance in available organic waste.
7. Maintenance of seed culture for eventual large scale culture.

Other important considerations should also be kept in mind, like funding, availability of labour, quality of waster and packaging etc. etc. are to be kept in mind. These aspects comprise essential steps in any project formulation. In terms of wider utilization of vermiculture, first step is selection of suitable species for culture and eventual vermi-composting.

Selection of Suitable Species

The selection of suitable species for vermiculture is based on the requirement, *viz.*, for composting, poultry and animal feed, marketing for fish or other forms of culture and sale for fish baits. As yet demands in India for fish bait is meagre and lack for wanting development of fresh water sport fisheries, including for selected fish species (like Eel Fish) culture and also large scale culture. For all culture feeds, care has to be taken that earthworm feed does not harbour parasites and pathogens.

The selection for suitable species is based on biological and ecological parameters, like habitat characteristics, distribution in soil or feed media and trophic functions. Usually, following three types of earthworms which can be used in vermiculture: (1) Epiges, (2) Endoges, and (3) Aneciques.

Date:

Vermicompost

come up to surface for casting.

BASIC CHARACTERISTICS OF SUITABLE SPECIES

Farmers or gardener needs only those species which can quickly convert organic waste to vermi-compost. Therefore, a worm should have following characteristics: (1) Worm species should be tolerant to disease. (2) The culturing techniques should be simple enough to adopt. (3) Worm should be efficient convertor of plant or animal bio-mass to body proteins, so that its growth rates are high. (4) It should have high consumption, digestion and assimilation rate (composting qualities). (5) The worm should have wide adaptability (tolerance) to environmental factors (capability to live in varying temperature conditions). (6) The worms should have feeding preference and adaptability for wide range or organic material (high and rich organic matter). (7) The worm should produce large numbers of cocoons that should not have long hatching time, so that multiplication and organic matter conversion is fast. (8) Growth rate, maturity from young one to adult stage should be fast. (9) Worm should have compatibility or tolerance with other worms (as with possibility of mixture of species by ameteurs). (10) Worms should be disease resistant. (11) Worms on introduction in substrate, should have least inactivity period (= vermistabilization period). (12) The worms should feed near the surface of organic matter.

Vermicomposting Materials

The biologically degradable and decomposable organic wastes are used in vermiculture and vermicomposting. Commonly used composting materials are as follows:

Animal dung: Cattle dung, sheep dung, horse dung, goat dung and poultry dropping etc may be used for this purpose. In use of animal dungs other than cattle dung, various preliminary testing and precautions for pathogens and responses to earthworms are necessary. The uses of horse dung should be done carefully because tetanus virus is common in horse dung and is lethal to human beings.

Agricultural waste: Agricultural waste obtained after harvesting and threshing may be used. They include stem, leaves, husk (excepting paddy husk), peels, vegetable waste, orchard leaf litter, processed food wastes, sugarcane trash and baggase; and processing wastes.

Forestry wastes: These are plant products such as wood shavings, peels, saw dust and pulp. All these besides various types of forest leaf litter can be used. The unutilized forest waste such as leaf litter amy also be used for vermicomposting.

City leaf litter: The burnt leaf litter from avenue or residential areas may be used, however, reports are not available. If it is used, this would keep cities clean and would provide useful product. The leaf litter of mango, guava, grasses and certain weeds may be used, but we need more information on this aspect.

Waste paper and cotton cloth etc.: These are decomposable organic waste. These if are not being recycled for other useful products, can be recycled with vermicomposting.

City Refuge

City refuge or garbage on daily production basis comprise important items of city factors and a considerable portion of city refuge can be sorted and recycled or composted. Most of household as kitchen waste with little manipulation can be used for vermicompose.

Biogas slurry: After recovery of biogas, if not required for agricultural use, viz., in conventional composting can be used for vermicomposting.

Industrial wastes: The industrial wastes like waste from food processing, distillery etc. can also be used in vermiculture with some manipulations.

PRELIMINARY TREATMENT OF COMPOSTING MATERIAL

Initially, proper collection, sorting or separation of compostable, non-compostable and non-biodegradables like plastics, stone, glass, ceramics and metals should be done.

Heavily contaminated wastes (even in kitchen wastes, heavily spicy wastes) with chemicals should be separated. The clean matter selected for composting should be heaped and large lumps should be broken. The separated matter should be spreaded in a layer upto 1 foot and to be exposed to sun for a day. This helps in killing several unwanted organisms and removes foul smell. The mixing of daily organic waste produce may be done with somewhat pretreated leaf litter in approximate ratio ranging from 10 to 40% of the waste to be vermicomposted.

Pre-Treatment of Leaf Litter and Agricultural Waste

They are heaped on ground and exposed to sun. Heaps are then be beaten with some stick or bamboo to break into smaller pieces. Materials like crop plant stems and bagasse etc. are required to be cut into smaller pieces for enhancing decomposition and vermicomposting processes. The non-marketable vegetable produce which are sometimes infected with insect pests should be chemically treated. The common example to these is insect pest popularly known as brinjal borers which effect several vegetables.

These insects can be controlled by chopping waste into smaller pieces up to 4" size and spread over ground. This layer be then sprayed with 4% aqueous solution of some Neem insecticidal formulation. This would gradually kill insect pests stages without making waste unfit for vermicomposting. Neem formulation can also be prepared by collecting Neem fruits, drying and taking out seed kernel as we take out almonds by removing hard outer covering. 20-25 gm Neem seed kernel be wrapped in a cloth over night and squeezed in half liter of water with repeated dipping and squeezing with turning movements.

REQUIREMENTS FOR VERMICOMPOSTING

Container: The shape and size of the vermicomposting container, depend on the requirement, that is quantity of waste to be composted and number of live earthworms we want to culture. On an average, 2000 adult earthworms can be maintained in containers of 1 m^2 dimension. These with appropriate conditioning of composting material would convert approximately 200 kgs wastes every month. Interestingly, roughly in a container of 2.23 × 2.23 mt. About 10 kgs of earthworms can convert approximately 1 ton per month. However, to have optimal conversion normally only upper 9-12" layer is composted. This should be softly scrapped off.

Bedding material: This is the lower most layer of earthworm feed substrate that is required to be vermicomposted. For this any biodegradable matter is used like banana stem peels, coir pith, coconut leaves, sugarcane trash, stems of crops, grasses or husk. Waste or discarded cattle feed can also be used for bedding.

Moisture content: Moisture content during vermicomposting should be maintained between 30-40 per cent. If moisture is high, dry cow dung manure or leaf litter should be mixed with substrate.

Temperature: Requirement for optimal results is 20-30° C. However, survival of earthworms is even at lower temperatures and upto 48° C air temperature. Obviously with little provision of shade, temperature within worm feed substrate (material to be vermicomposted) can be reduced. For this it is desirable that substrate should not be tightly packed in containers.

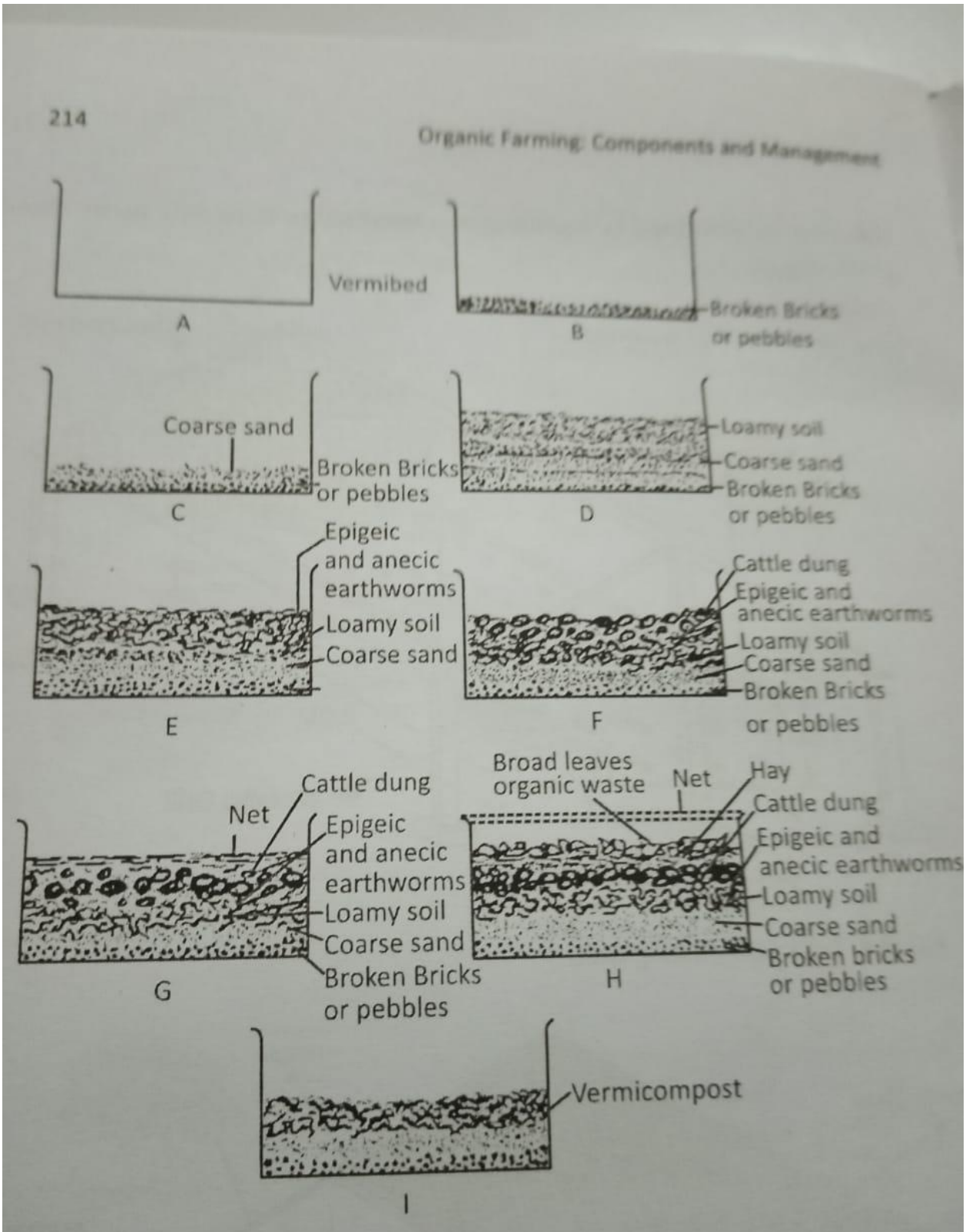

FIG. 9.6: Steps of vermicomposting.