03. Composting of organic wastes – composting technologies

COMPOSTING OF ORGANIC WASTES

Composting is a process of allowing organic materials to decompose more or less controlled conditions to produce stabilized product that can be used as a manure or soil amendment. Composting is basically a microbial process, which change the property of the organic material or mixtures.

Compost is the material resulting from the decomposition of plant residues under the action of bacteria and fungi. Composting is simply an acceleration of natural process or organic matter mineralization. The final product is dark brown in colour and resembles FYM in its properties and appearance.

Essential requirements for composting

A bulky organic manure

A suitable starter

Addition of enough water

Aeration

Main systems of composting

ADCO process (Hutchinson and Richards of England)

Activated compost process (Fowler and Rege)

The Indore process (Howard and Wad)

The Bangalore process (C.N.Acharya)

The coimbatore method

Benefits of composting:

- Enables clean environment
- Absorbs odors, degrade toxic substances and heavy metals
- Avoids un-necessary dumping of wastes
- Supply valuable organic manure

Composting technologies

1. Crop residue composting

- Collect the available crop residues and weeds
- Shred them to a size of 2 to 2.5 cm length
- Mix these wastes with green residues (freshly collected), if available
- Form the compost heap (4 feet height)
- Add the bio-inoculants (2 kg of bio-mineralizer or 40 kg of cowdung for 1 tonne of waste)

- Properly aerate the compost either by providing perforated PVC pipes or by mechanical turning
- Maintain the moisture at 60 % by regular watering
- The compost will mature in 60 days

2. Vermi-composting

Vermicomposting is a process of degradation of organic wastes by earthworms. The species like *Eisenia foetida* and *Eudrilus eugeniae* are effective in converting the agricultural wastes into compost. The various steps involved in making vermicompost are as follows

Methods followed:

Heap method

Pit method – aboveground and belowground

Belowground method pit size : 10 X 1 X 0.3 m

Each layer : 6-7cm thick

Sprinkle water once in 8-10 days

Release : 2-2.5 kg worms / pit

Steps:

Collect the predigested wastes and mix cattle dung @ 30 %.

Place it in the pit/container layer by layer

Moist the residues at 60 % moisture

Allow the verms in to the feed material / residues @ 1 kg/ tonne of residue

Protect the pit or container from ants and rats (which are the enemies of verms)

The residue will be composted in 30 to 40 days

Remove the composted materials layer by layer at a weekly interval so as

To avoid any damage /disturbance to the feeding verms.

Nutritive value of vermicompost

The nutrients content in vermicompost vary depending on the waste materials that is being used for compost preparation. If the waste materials are heterogeneous one, there will be wide range of nutrients available in the compost. If the waste materials are homogenous one, there will be only certain nutrients are available. The common available nutrients in vermicompost is as follows

Organic carbon = 9.5 – 17.98%

Nitrogen = 0.5 – 1.50%

Phosphorous = 0.1 – 0.30%

Potassium = 0.15 – 0.56%

Sodium = 0.06 – 0.30%

Calcium and Magnesium = 22.67 to 47.60 meq/100g

Copper = 2 – 9.50 mg kg-1

Iron = 2 – 9.30 mg kg-1

Zinc = 5.70 – 11.50 mg kg-1

Sulphur = 128 – 548 mg kg-

3. Coirpith composting

Coirpith is an agricultural waste produced from the coir industry. Approximately 180 grams of coirpith is obtained from the husk of one coconut. Coirpith contains Carbon : Nitrogen in the ratio of 112:1 and contains 75 per cent lignin which does not permit natural composting as in other agricultural wastes.

Mushroom *Pleurotus* has the capacity to degrade part of the lignin present in coirpith by production of enzymes like cellulases and lactases. The carbon: nitrogen ratio of coirpith is reduced from 112:1 to 24:1 as a result of composting.

Composting method

Select a shaded place of 5 x 3 m dimension and level it after removing weeds. Spread 100 kg of coirpith uniformly. Spread 100 g of *Pleurotus* spawn on this and cover with a second layer of 100 kg of coirpith. On the surface of the second layer, spread one kg of urea uniformly.

Repeat this sandwiching of one layer of coirpith with spawn followed by another layer of coirpith with urea up to one metre height.

Sprinkle water to keep the heap moist. Allow the heap to decompose for one month.

Manure conversion

The coirpith is converted into good manure after 30 to 40 days and the lignin content is reduced from 40 per cent to 30 per cent. The nitrogen content is increased from 0.20 per cent to 1.06 per cent. Coirpith compost contains macronutrients and micronutrients. It can absorb water up to eight times its weight. Coirpith, when added to sandy soil at 2 per cent increases the water holding capacity up to 40 per cent. It can be applied to a wide variety of crops and can be used to prepare potting mixture and can be applied as organic manure in kitchen gardens.

4. Composting of crop residues and weeds:

Composting is one of the useful ways for utilizing the some of the weeds and noncommercial plants like *Parthenium*, Water hyacinth*, Ipomoea* etc. instead of their eradication. The plants can be composted using *Trichoderma viridi* and *Pleurotus sajor-caju* as a microbial consortium with supplementation of urea. Select an elevated shady area of a thatched shed and mark an area of 5x1.5 meter. Cut the composting materials into 10 – 15 cm size. Spread 100 kg of these materials over the marked area. Sprinkle 1 bottle of microbial consortia over this layer. Again spread another 100 kg of composting materials over this layer. Spread 1 kg of urea uniformly over this layer. Likewise repeat these processes of spreading composting materials, then microbial consortia, again composting materials followed by urea application until a minimum of 1-meter height is reached. Sprinkle water to attain a moisture level of 50% to 60%. The surface of the heap is covered with a thin layer of soil. Water should be sprinkled depending upon the necessity to maintain the moisture around 50%. A turning is given at the end 20 days to give a thorough mixing of outside material with that of the inside ones. The bio-converted compost will be ready in about 40 days time.

5. Method of composting the Municipal Solid Wastes

Biodegradable municipal solid waste should be separated and collected for composting. Five hundred kg of material should be heaped in the compost yard. In that heaped waste, 1 kg of TNAU microbial consortium should be applied in the form of slurry to cover the full waste material. This 1 kg microbial consortium can be mixed with 5 litres of water to make slurry. This slurry is sufficient to cover 0.5 tonne of material Then, 50 kg of cowdung should be mixed with 30 litre of water to form cowdung slurry. This cow dung slurry should be sprayed over the heap of municipal solid waste Then, 1 kg of urea should be mixed with solid waste. 60% moisture should be maintained through out the period of composting. Compost should be turned up once in 15 days to create good aeration, and for thorough mixing. Because of this practice, a uniform composted material will be obtained. Solid waste can be composted with in 90 days by this method with the indication of reduction in the volume, appearance of dark coloured materials and a small of earthy odour After the completion of composting, compost should be sieved through normal mesh to separate unwanted and partially composted material

6. Value addition of poultry waste compost

A known quantity of poultry droppings and coir pith @ 4:5 ratio should be mixed well to attain a C/N ratio of 25:1 to 30:1 which is considered to be the optimum C/N ratio

for compositing. *Pleurotus sajor-caju,* a lignocellulolytic organism, should be inoculated into the mix @ 2 packets per tonne of waste in order to speed up the composting process. The mix should be heaped under the shade. The moisture content of the mix should be maintained within 40 – 50%. Periodical turning should be given on 21st, 28th and 35th day of composting. Another two packets of *Pleurotus sajor – caju* is to be added when turning is given on the 28th day of composting. A good quality compost will be obtained in 45 days, which contains 2.08% N, 1.93 % P and 1.41 % K with C/N ratio of 10-16

7. Enriched Farm Yard Manure (EFYM)/ Reinforced FYM

Phosphorus content in FYM is relatively low and complete utilization of nitrogen and potassium in the manure is seldom realized. Hence, heavy quantities intended to supply the needed quantity of phosphorus will result in wastage of nitrogen in most soils. To overcome this P insufficiency, addition of superphosphate to the manure is recommended and the process is called reinforcing / enriching and the resultant material is called "enriched farmyard manure". The Single Super Phosphate (SSP) can be sprinkled either in the cattle shed or on the manure heap. Rock phosphate can also be recommended for this purpose.

Factors affecting the Composting Process:

I. The Type and Composition of the Organic Waste
II. The Availability Of Microorganism
III. Aeration
IV. The C, N and P Ratios
V. Moisture Content
VI. Temperature
VII. pH
VIII. Time

Preparation of Coir Waste Compost Using Yeast Sludge:

Yeast sludge is a waste product by alcohol distilleries @ 2t/day. This waste contain 6% N, 0.3% P and 0.9% K with other micronutrients, vitamins and growth promoting substances. The coir waste should be sieved so as to remove all the fibrous materials. For one tone of coir waste 200 kg of yeast sludge and 10 kg of rock phosphate should be added and mixed thoroughly. Moisture should be maintained at 60%. After mixing the material should be formed as heap. Within 4-5 days the temperature of the heap will be raised to 50-60° C. Within 40 to 50 days the coir waste and yeast sludge will become as mature compost. The matured compost will turn from

brown to black. There will not be any odor. The volume of the compost heap will be reduced to 1/3. The temperature of the heap will be 25-30°c and it should be constant. The compost will be very light and fine textured. The compost prepared by this means of above method contains N-1.09%, P-1.35%, K-1.95% besides copper, manganese, iron and zinc. This compost doesn't have any phytotoxicity and used for all agricultural crops.

C. Preparation of sugarcane trash compost using yeast sludge:

sugarcane trash collected from sugarcane field has to be cut into small bits using chaff cutter or shredder to a size of 1-2cm. for every tone of sugarcane trash 200 kg of yeast sludge and 10kg of rock phosphate are added and mixed thoroughly. Moisture is maintained at 60%. the heap is formed to a height of 1-1½ m. within 45-50 days sugarcane trash compost will be ready for application to crops. The sugarcane trash compost consists of N-1.2%, P-0.7%, K-1.5% and considerable quantities of micronutrients. This compost can be applied at the rate of 5t/ha.

d. Japanese method of composting:

Instead of pits in conventional composting system, vats of 18-30' in length, 3-4' in width and 2.5-3.0' height are made of bamboo stakes of 2.5-3.0' width. For growth a non-leaky surface is prepared with broken stone stable or brick and plastered with cement. About 2 feet space is kept free on one side of the vat to facilitate turning the residues regularly. Sliced and broken pieces of coconut, shells, leaves, fibrous materials, tender tree barks or pieces form the bottom 10-15 cm layer. Second layer of dry leaves, grass residues, groundnut haulms are of 10-15 cm height. Cow dung, urine, biogas slurry are sprinkled over and this layer of soil and ash is spread over. Nitrogen rich green leaves of pongamia, albizzia, daincha, sesbania and crop residues forms third layer of 10-15 cm. Fourth layer of 10-15cm contains organic wastes rich in phosphorous and potash. Over these 2-3 buckets of cow dung and biogas slurry are sprinkled. Fifth layer contains paddy or ragi straw that is rich in carbon and provides energy for microorganisms. Sixth layer contains exclusively of dried and powdered cow dung of 20-30cm. Over these small quantities of old compost, tank silt and ash are sprinkled. For rapid degradation *Aspergillus*, *Penicillium, Trichoderma* should be inoculated. *Pleurotus* and *Polyporus* should be inoculated for degradation of high lignin contained residues. *Azotobacter* and Phosphobacteria can be mixed for enriching the composts.

General Properties Of Commercially Accepted Compost.:

N %	>2	Color	Brown Black
C: N	<20	Odor	Earthy
Ash %	10-20	Water Holding Capacity (%)	150-200

Moisture %	10-20	CEC (Meq 100 g^{-1})	75-100
P %	0.15-1.5	Reducing Sugar (%)	<35%