Compost and rural composting

Dry and fresh plant tissues and also animal wastes can be introduced directly into or on the soil. They are then decomposed at varying speeds, but have only slight and sometimes detrimental effects and bring about scarcely any substantial soil improvement. Process known since antiquity make it possible to convert such wastes into useful agents for soil improvement i.e., compost.

The word compost is derived from the Latin word "COMPONERE" to mean put together.

Compost:

Compost is a product of decomposition of plant and animal wastes with various additives. The compost had the largest variation of all organic material ranging from neglected garbage dumps to carefully composted and treated substances with high fertility.

Composting:

Composting is a process of converting organic matter in to manure in a short time by accelerating fermentation process under controlled conditions is called composting.

The organic material that is usually handled for composting are waste vegetative material such as spoiled straw, peanut hulls, saw dust, dried leaves etc., stubbles, chilli plants, cotton stalks, tobacco stems, weeds, municipal rubbish etc., according to availability.

The following basic rules are important for the production of good quality compost:

1. The purpose of composting is to convert organic matter into growth promoting substances, for sustained soil improvement and crop production.
2. The organic matter is partially decomposed and converted by microbes. These microbes require proper growth conditions, for their activity .i.e moisture content: 50 % and 50 % aeration of total pore space of the composting material .This is achieved through stacking and occasional turning over. Microbes also need sufficient nitrogen for synthesizing their body cells [the optimum C:N ratio of the composting material is 20:1 to 30:1]
3. Soil microorganisms constitute sufficiently to the decomposition of organic matter through their continuous activities. The majority of these soil animals provide optimal conditions in their digestive track for their synthesis of valuable permanent humus and stable soil crumbs. A typical compost earthworm is *Eisenia foetida*.
4. Certain additives accelerate the conversion and improve the final product. The materials such as lime, earth, gypsum, rock phosphate act as effective additives .The addition of nitrogen (0.1 to 1 %) is important in case of large C:N ratio of the composting material. Addition of lime (0.3 to 0.5 %), if sufficient lime is not present. The preparation of compost takes 2-3 months. The composition of compost varies with in wide limits.

The following average values are rough estimates

Composition of compost (Rough)

S. No.	Constituent	Percentage
1	Dry matter	30-50
2	Organic matter	10-15
3	N	0.3
4	P	0.1
5	K	0.3

Methods of composting

The process of composting was first initiated in England during the period of First World War (1914 -1918).

The various systems of composting are-

1. ADCO process (Agricultural Development Company)
2. Activated compost process
3. Indore process
4. Bangalore process
5. Coimbatore process
6. Rain -water compost
7. Rural compost
8. Urban compost
9. Mechanical compost and
10. Vermicompost.

1. ADCO process:

Agricultural Development Company was initiated, [A private concern operating at Harpenden, England] developed by **Hutchinson, H.B and Richards, E.H.** during 1914-1918, at Rothamsted Experimental Station, England.

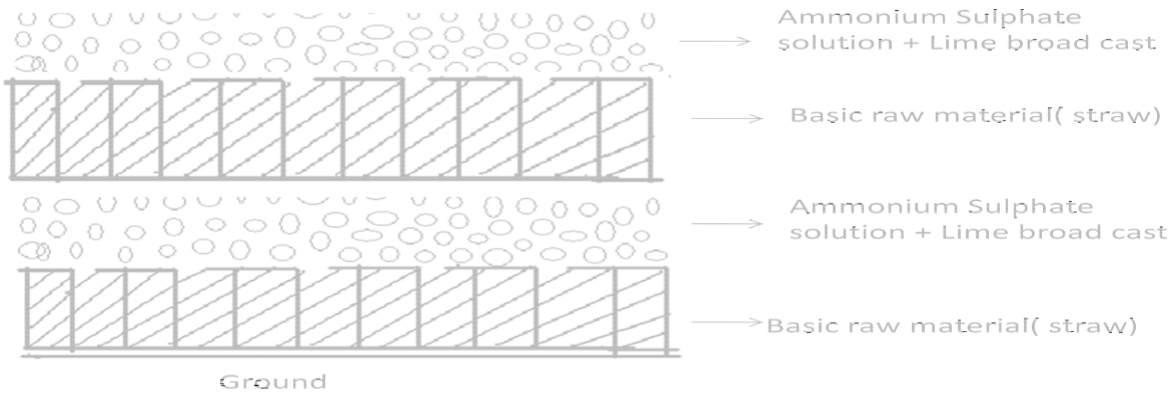
Materials needed:

1. Straw and other wastes -Basic raw material
2. Ammonium sulphate/Ammonium phosphate /Super phosphate/Muriate of potash Ground limestone/ urea - Starters

Procedure:

The basic raw material straw is spread in layers and sprinkled over with a solution of ammonium sulphate. Then powdered lime stone is applied as broadcast. Then another straw layer is put on. The piling of the layer is continued till a decent heap of convenient height is built up. After about 3 months of fermentation the resulting material is similar to FYM and hence called “synthetic FYM”

The ADCO process was patented and concentrated starters were put in the market with the trade names of ADCO accelerator and ADCO complete manure with full direction for their use.



2. Activated compost process:

This method was developed by **Fowler and Ridge in 1922** at Indian Institute of Science, Bangalore

Materials needed:

1. Basic raw materials (Straw and farm wastes)
2. Starters: a) Cow dung b) Urine c) Night soil d) Sewage and sludge

Procedure:

In this process the basic raw material for composting straw and other farm Wastes is treated with mixture of cattle dung and urine as decoction. So that every portion of mass comes in contact with the inoculants (dung + urine) and fermentation takes place evenly. On piling up in a heap of 3 feet or 4 feet height and turning over form time to time, keeping moist with dung and urine decoction, very high temperatures attained. When the temperatures beginto drop at the end of one week. The volume of the material gets reduced. Further quantity of the basic material is added onto the heap. About 25 % of the new materials should be added a t one time and thoroughly mixed with starters (dung +urine decoction) at intervals as before. If properly carried out, the compost will be read y in 5-6 weeks. Night soil and se wage and sludge are also used as starters in this method.

3. Indore process:

This process is developed in India by **Howard and Ward** at the Indian Institute of plant Industry, Indore

Materials needed: a) Straw or organic farm wastes as basic raw materials

b) Cattle dung as starter (urine, earth and wood ashes)

Procedure:

A compost pit of dimensions of 30 x 14 x 3 feet with sloping sides (narrow at bottom and at wide surface) is prepared and the raw material is spread in layers of 3” thickness. A mixture of urine, earth, and wood ashes is sprinkled and this is followed by 2” layer of dung. The pit is filled up this way until the material occupies a height of 3 feet above the ground level. As air can conveniently penetrate only to a depth of 1.5 to 2.0 feet extra aeration has to be provided, which is done by means of artificial vents (holes) of 4” diameter pipe for every 4 feet length of the pit. The pit is watered twice a day i.e., morning and evening with rose can. The material is turning over 3 times, i.e.,

First – at the end of the first fort night

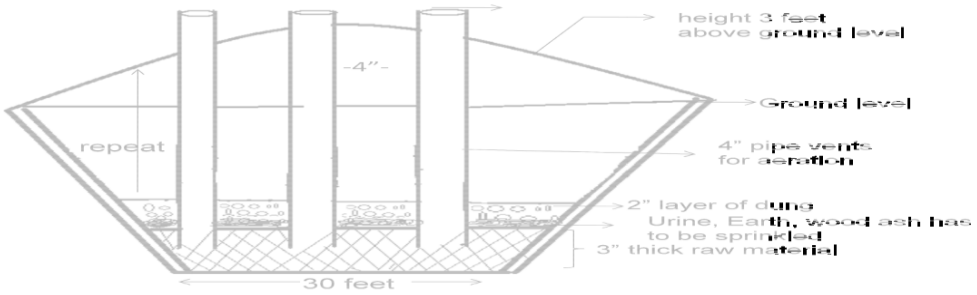
Second – at the end of the second fort night

Third – when the material is two months old in the process of composting.

Observations:

1. After 10 days of composting the following things happens
   a) Synthesis of humus begins i.e., development of fungi and the height of the material is reduced by half
   b) Check anaerobic decomposition, as indicated by the foul smell and fly breeding
   c) If there is an anaerobic decomposition, turn over material for proper aeration
   d) If insufficient fermentation, hasten by watering the material.
2. At the end of two months
   a) Fungal activity is over
   b) Materials become dark
   c) Now the bacterial aeration takes place
   d) Stock the material on the ground after 2 months .So 25 % of additional free nitrogen will be fixed from atmosphere.

Compost is ready by 3-4 months. One cattle pair produced 50-60 cartloads per year.



4. Bangalore process [Aerobic and anaerobic process]:

This process of composting was developed by **Dr. C. N. Acharya** in the year 1949.

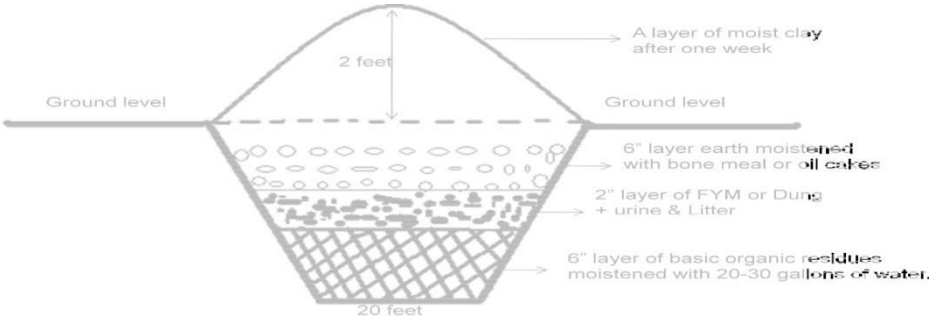
1. Basic raw material used: Any organic material
2. Starters or inoculants [Undecomposed]: FYM or mixture of dung and urine or litter
3. Additives: Bone meal or oil cakes, wood ash

Procedure [Pit size: 20 x 4 x 3 feet]:

The basic raw material is spread in a pit of 20 x 4 x 3 feet dimensions to a depth of 6 " layer, moistened with 20-30 gallons of water if the material is dry. Over this FYM or preferably a mixture of dung, urine and litter (un-de composed) from the cattle shed is placed as a layer of 2" thickness. It is again covered on the top with a layer of earth to a thickness of 6 ". It is beneficial to mix the earth with bone meal or oilcakes, wood ash etc., to improve manurial value of the compost .T he piling of layers is continued till the heap raises above the ground level to a height of 2 feet .Then the heap is kept open for one week to facilitate aerobic decomposition. Later the heap is plastered with a layer of moist clay for anaerobic

fermentation t o occur. Fissures, or cleavages (cracks) that occur in the clay layer, have to be sealed off periodically. The compost will be ready in 4-5 months period starting from the day of preparation. This process is called as aerobic and anaerobic decomposition of compost.

In this process the basic raw material is not so well decomposed as in the other methods. But organic matter and N contents are well conserved. The number of turnings are reduced. The out turn of the compost is relatively greater and cheapest process.

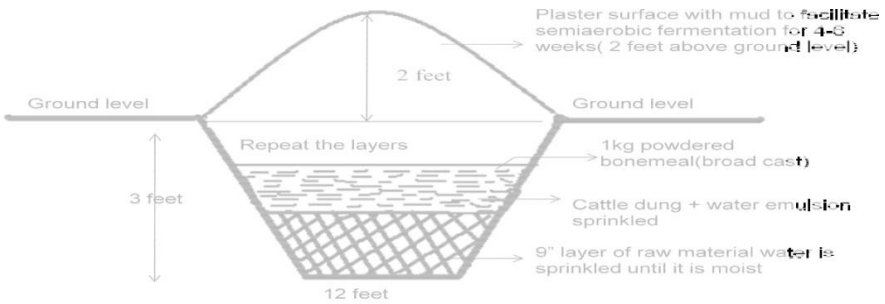


5. The coimbatore process:

1. The basic raw materials: Raw organic matter
2. Starters: Powdered bone meal and cattle dung and water emulsion prepared by mixing
3. Dung in water @ 5-10 kg dung in 5 to 10 liters water.

Procedure [Pit:12 x 6 x 3 feet]:

The basic raw material loosely spread [Pit:12 x 6 x 3 feet] to a depth of 9" and water is sprinkled till the entire material is moist. The n about one kg of powdered bone meal is broadcasted uniformly above the layer and above this an emulsion of 5-10 kg of fresh cattle dung in 5-10 liters of water is applied .Repeat this process until a heap 2 feet above ground level is formed .Then the entire exposed surface area of heap is plastered with mud to facilitate semi-aerobic fermentation which would takes place for above 4-6 weeks depending upon the nature of the raw material .After 4-6 weeks ,the mud plaster is removed to permit aerobic fermentation . If the heap has sunk unevenly which is a sign of defective fermentation, the material is reheaped after forking and moistened. The decomposition is complete in 3-4 months and is fit for application to the field.



6. Rain watered compost:

In dry areas where it is difficult to obtain water for watering, the composting can be done with the aid of rain fall.

The compost heap is built up as usual before the rains set in. The turnings are given during the rainy period at the end of rains the material will be ready for application. About 400 mm rain fall received in 3-4 months is considered sufficient.

7. Rural compost:

Compost prepared using farm organic wastes and fresh dung and /or urine soaked earth as starter is called as Rural Compost. This is within the reach of farmers, as they can individually prepare the compost in their farm sheds.

Procedure:

Composting can be done in a pit size of 3 x 6 x 3 feet size located on an elevated place. Even length and width are adjustable depending upon the raw material available .Keep the sides of the pit slanting .When a number of pits are dug, keep 12 feet gap between the pits for facilitating turnings .Locate the compost pits away from the civilians areas.

Basic raw material: 1) Green succulent, non-woody and non-fibrous material (12"thick)

2) Dry materials like sugarcane trash, stubbles etc., (3" thick)

3) Starter: Dung and water

Neutralizing agents for organic acids: Bone meal is preferred to ash as it provides Ca and also phosphate, which are desirable constituents in the final product.

The organic material is spread in layers. The thickness depends upon compost ability of materials. Green succulent non-woody materials can be laid in 12 " layer while tough woody materials like sugarcane trash and stubbles are spread in 3" layer. Bone meal or ash is sprinkled in a thin layer over the material to provide the base for neutralizing organic acids produced during the decomposition .Dung and water is then sprinkled over the layer. Dung functions as starter while the water provides the moisture. The layers are thus built up to a height of one foot above the ground level .It is desirable to cover the surface of the heap with a layer of earth. Periodically watering is done.

Precautions;

1. Over watering creates anaerobic decomposition.
2. Turnings are necessary to hasten the aerobic decomposition
3. After turning the compost must be re-heaped and covered
4. Use the compost immediately
5. It is to be preserved by providing suitable cover
6. The compost will be ready by three months to one year depending upon material (Sugarcane trash –late).

8. Urban compost:

Compost prepared by local bodies ,municipalities, corporations etc., with their out put of street sweepings, municipal rubbish etc., as organic matter using night soil as starter is called urban compost

Methods of urban composting:

I. Method of urban composting:

Using municipal or town rubbish as basic raw material and night soil as starter. Sprinkling of copper sulphate powder between layers will put down the offensive odour due putrefactive fermentation of the material, yielding foul smelling organic compounds called Mercaptans.

II. Method of composting:

Night soil and rubbish are mixed in 1:4 ratio .Copper sulphate is added between layers at the rate of one kilogram for every 400 kg o f the mixture and the mixture is racked up to heaps of convenient size.

The heaps are moisned and racked up for every fort night and rebuilt. During the period of two month s, the manure will be ready for use. The product is dry and powdery, free from foul smell.

III. Method of composting:

Town refuse is he aped into a pit of dimensions of 8 x 4 x 4 feet. A groove measuring 6x1 x 1 feet is made at the top in the centre and is filled up with night soil and covered over with refuse. Heap is moistened daily with sullage water and racked up once a week. For six week s by which the decomposition pro cess would be complete and the product would be ready for use as manure.

IV. Method of composting:

The layer of waste material of 6" thick and night soil 2 " thick are altered; the final top layers will be the waste material. The heap is covered by 9" thick layer of soil. The material will be ready in about five months.

9. Mechanical compost:

In big cities like Delhi, Bombay, Calcutta (kolkat), while disposing the urban wastes face In numerable problems such as cost, land, labour for composting operations, involving human contact with filthy and obnoxious materials with a result mechanical composting is undertaken. mechanical composting can be undertaken at a central location and in s mall compact area .it is only mechanized composting which may prove effective in not only serving as a means of disposal of urban wastes but also of providing the country with large quantities of organic matter.

The advantage of mechanical composting-

1. Sanitary control with odour control device
2. Operational convenience, both in dry and wet seasons
3. Efficient recovery of discarded materials like metal, glass etc.,
4. High quality manure in a short period
5. Eliminates large anaerobic decomposition
6. Reduces preparation cost @ 10% for every tonne
7. Economically, cheaper than chemical fertilizers

10. Vermicompost technology:

An emerging technology for recycling of crop residues and other organic solid wastes is the utilization of earthworm technology to convert them into vermicompost.

Definition of vermicomposting:

Vermicomposting is a method of making com post, with the use of earthworms, which generally live, in soil eat biomass and excrete it in digested form. This compost is generally called vermicompost or wormicompost.

Definition of Vermiculture:

Vermiculture means scientific method of breeding and rising earthworms in controlled conditions.

Vermitechnology:

Vermitechnology is the combination of vermiculture and vermicomposting. Thus, earthworms can be used in the following areas.

1. For development of arable soils , turnover of soil, break down of plant organic matter aeration and drainage
2. For production of useful products like vermifertilizer and worm tissue for animal feed.
3. For maintenance of environmental quality and monitor of the environment for soil fertility, organic and heavy metal non-biodegradable toxic material pollution.

Vermiculture industry or vermicompost preparation:

1. Basic raw material: Any organic material generated in the farm like bhusa, leaf fall etc.,
2. Starter: Cow dung, Biogas slurry, or urine of cattle
3. Soil animal: Earth worms (Species: *Eisenia foetida*)

Favourable conditions of earth worms in the composting material:

1. pH: Range between 6.5 and 7.5
2. Moisture: 60-70 % of the moisture below and above range moderately of worms taking place
3. Aeration: 50 % aeration from the total pore space
4. Temperature: Range between 18 ^{0}C to 35 ^{0}C

Procedure:

It is mostly prepared in either pit or heap method .The dimensions either heap or pit are 10 x 4 x 2 feet .The length and width can be increased or decreased depending on the availability of material but not the depth because the earth worms activity is confined to the 2 feet depth only.

1st layer: Bedding material of 1" thick with soft leaves.

2nd layer: 9" thick organic residue layer finely chaffed material.

3rd layer: Dung + water equal mixture of 2" layer.

Continued the layer up to pile to ground level protect the worms against natural enemies like ants ,lizards ,snakes ,frogs ,toads etc., Maintain proper moisture and temperature by turnings and subsequent staking . At the day of 24^{th}, 4000 worms are introduced in to the pit [$1m^2$ =2000 worms] without disturbing the pit by regular watering the entire raw material will be turned into the vermicompost in the form of worm excreta .The turnover of the compost is 75 % [the total material accommodated in the pit is 1000 kg; The out turn will be 750 kg]

Harvesting of the vermicompost from the pit:

Stop watering before one week of harvest. All the worms spread across the pit come in close and penetrate each other in the form of ball in 2 or 3 locations. Heap the compost by removing the balls and place them in a bucket, then the material is sieved in 2 mm sieve, the material passed through the sieve is called as vermicompost which is stored in a polythene bags [Note: Vermicomposting is done under thatched roof to protect worms against rain and sun]

Nutrient composition of vermicompost

S.No.	Nutrient	Content
1	Organic carbon	9.15 to 17.98 %
2	Total nitrogen	1.5 to 2.10 %
3	Total phosphorus	1.0 to 1.50 %
4	Total potassium	0.60 %
5	Ca and Mg	22.00 to 70.00 m.e / 100 g
6	Available S	128 to 548 ppm
7	Copper	100 ppm
8	Iron	1800 ppm
9	Zinc	50 ppm

Besides the above nutrients the vermicompost also contains following enzymes

Enzymes : Protease ,Lipase ,Amylase , Cellulose

Source: Kale (1983) in Vermicompost published in Agro bios Vol.I, No.XI, April, 2003 Edited by Purohit, S S

Conversion rates:

1000 earth worms may convert 5 kg waste material per day

1000 worms weighs about a kilogram

Advantages of composting over direct application:

1. There will be no immobilization in compost because of narrow C:N ratio
2. Application is easy, because the compost is humified and have a structure of crumb and granular.
3. It is hygienic, pathogens and weeds seeds are destroyed.
4. No loss of nutrients
5. It improves physical properties better than compost on soil application**.**

Differences between Aerobic and anaerobic decomposition

S.No.	Aerobic decomposition	Anaerobic decomposition
1	This takes place in the presence of O2	This takes place in the absence of O2
2	CO_2 is produced	Methane gas is produced
3	High water content is required	Less water content is required
4	Organic matter conserved is around 50-60 %	Organic matter conserved is around 75%
5	Around 25-50 % N is lost	20 % nitrogen is lost and more N is conserved
6	Temperature built up is more.Hence , pathogens weed seeds are killed	Pathogens are only killed due to antibiogens.
7	More labour is required for turnings and watering	Less labour is required
8	Time taken for decomposition is3-4 months	Time taken is 5-6 months