Review of Composting Using Different Types of Organic Waste Materials

Mr.V.Satheesh[1], Dr.P.Jothimani[2], Dr.S.Prabhu[3]
[1, 2, 3] Dept of sericulture
[1, 2, 3] Forest College and Research Institute,
Tamil Nadu Agricultural University, Mettupalayam– 641301.

Abstract- *Large quantities of organic matter need to be supplied to soils in the tropics and subtropics in order to provide plant nutrients, to help moisture retention and to keep the soil structure in good condition. Because the rate of organic matter oxidation is fast, due to high soil temperatures, frequent additions of compost are required, each year if possible. Hence it is most worthwhile to take care in saving organic waste so that it can be composted and recycled to help the soil in its task of food production.*

Virtually anything which has once lived, of plant or animal origin, will decompose in a compost heap. Fresh green material breaks down very quickly, straws and woody material take longer; leather and bones are very slow and may need to be put through several heaps to reach complete breakdown.

In some communities many of the organic materials which might be composted are more important for other purposes. For instance, fresh green weeds and leaves are frequently used for animal fodder; straw from paddy (rice) and other cereals is used for the same purpose. In some parts of the world, wood and sun-dried dung are the only sources of fuel for cooking. In these latter cases, material for composting will become more readily available as tree-planting programs are implemented to generate adequate firewood. By contrast, in towns and especially in cities, the disposal of refuse and night soil or sewage sludge is becoming an increasing problem. The composting of these materials can supply organic matter for local farms and market gardens which grow the food for the urban population; the ease and cost of transport will limit the distance that the compost can be sent into the countryside.

Keywords- organic wastes, composting, manure, misplaced resource, waste management.

I. INTRODUCTION

Composting is the decomposition or breakdown of organic waste materials by a mixed population of micro-organisms (microbes) in a warm, moist, aerated environment. The wastes are gathered together into a heap so that the heat which is evolved in the process can be saved. As a result the temperature of the heap rises, thereby speeding-up the basic degradation process of nature which normally occurs slowly in organic wastes which fall on to the surface of the ground. The final product of the process is compost or humus which is of value in agriculture for improving the structure and moisture-retention properties of the soil and for supplying plant nutrients as the compost finally breaks down to mineral matter.

II. DIFFERENT TYPES OF ORGANIC MATERIALS USED FOR COMPOSTING:

A compost heap needs a supply of mixed organic wastes, sometimes an activator to supply extra nitrogen and micro-organisms, a little soil and, if available, some recycled compost. The mass needs moistening, either with water or wet sludge/night soil and then exposure to air for composting to proceed.Some items should not be put into compost heaps. They take no useful part in the process, will not break down, and may cause problems for people handling the product in agriculture. Such materials include broken china, glass or pottery, pieces of metal or wire, plastic bottles and sheet plastic, rubber, nylon and other man-made fibres, fresh coal ash and soot from chimneys. Organic materials which should not be put into heaps are plants, twigs and fruit with hard thorns or prickles, and the roots of persistent perennial weeds which may not be killed by the heat evolved in the heap.

III. USEFUL ORGANIC WASTE MATERIALS

Large quantities of organic wastes are generated in nature. Thought must be given to collecting as much as possible from the following sources - home, garden, crops, livestock, forest, rivers, seas, industry, town and city refuse.

3.1. Home wastes:

Domestic wastes include material from food preparation such as vegetable peelings and unwanted leaves, fruit skins, egg shells, tea leaves and coffee grounds. Scraps of fish and meat can lead to problems by attracting flies or

vermin unless they are put into the hot centre of an active compost heap. A little paper and cardboard can be used if it has been torn up and soaked in water first. Rags of cotton or wool, and even pieces of leather, will eventually disintegrate. House dust, sweepings and ash from wood fires can all be used. Coal ash and chimney soot should only be included after they have been left in the open for 6months.A most important waste in the home is that .from humans. It is vital that the collection and treatment are done hygienically to prevent the spread of disease and the causing of odours. In villages and towns which do not have waterborne sewage disposal systems, human waste is collected in the form of night soil. In many countries there is a prejudice against the use of night soil on crops; however, there is evidence that such prejudice is now weakening. In China night soil has been used for crop fertilization for centuries. The use of this waste is vital in closing the nutrient cycle thereby preventing the loss of the major plant nutrients. This in turn reduces considerably the need for artificial fertilizers in a community where cash and transport are needed to bring them in, even if they are indeed available. In the United Kingdom, with its long estab- lished sewage system, about 40 percent of the sewage sludge produced is returned to agriculture.

3.2. Garden wastes

Wastes from the garden include the remains of vegetable crops, dead flowers, stems, stalks, thin prunings and dry bonfire ash. Most garden weeds are of particular value; they are normally the only whole plants put into compost heaps and contain a wide variety of trace elements. However, the roots of the persistent, perennial weeds are best burnt. Bonfire ash should be covered until use; rain will rapidly leach out the useful nutrients, especially potassium. A proportion of dry, fallen tree leaves, up to 20 percent, can be used but an excess should be avoided as they can greatly reduce the decomposition rate of other wastes. Where there is an excess of fallen leaves they should be gathered into a separate heap and allowed to decay over 1-2 years into leaf mould; this needs no attention apart from occasional watering. The resulting mould is useful for mulching and for potting mixtures. Similarly, an excess of fresh lawn mowings is undesirable as they can settle quickly into a thick layer which prevents air movement through the compost heap. Such mowings should not exceed 50 percent of the heap and they must be mixed in with stalky, strawy material to keep the mass well opened out.

As much soil as possible should be shaken from the roots of garden plants before they are put into the heap as too much soil will slow down the composting process.

To provide extra material for the compost heap annual plants such as sunflowers (Helianthus annuus L.), and perennial plants such as Russiancomfrey (Symphytum X uplandicumNym.)and sunn hemp (Crotalaria juncea) can be grown. Such plants should be used just before they form seeds. As mentioned earlier, material with hard prickles or thorns should be kept out of the heap.

3.3. Crop Wastes

A wide range of crop wastes from farms, market gardens and plantations are excellent for composting if suitably mixed; they are not so good if employed singly.The wastes from cereal crops such as paddy (rice), wheat, barley, millet and sorghum are useful, not only the straws but also the husks, chaff and bran obtained on threshing and milling. Maize (sweet corn) straw is especially helpful as it grows tall and provides a lot of material. The leaves and stems of the pulses such as chick peas, pigeon peas and mung beans, and oil seeds plants such as castor, groundnut, linseed and sunflowers all supply suitable wastes. The stalks of cotton, jute and tobacco and sugarcane trash may all be used. The leaves of shrubs and trees such as arecanut, coconut and banana can also be collected

Most of these materials are from mature plants or are fallen leaves. Consequently their C/N ratios are high and they need to be mixed with wastes having low C/N values, such as manures, in order to compost properly.

3.4. Livestock & Poultry Wastes

The manures, dung, urine and droppings from all types of animals and poultry are excellent for composting. Not all the major, minor and trace nutrients in feed and fodder are used by the animal for body maintenance and the production of meat, milk, wool and eggs; some are excreted in the form of body wastes and will normally be a large percentage of the total nutrients consumed. A similar relationship exists between humans, their food, and night soil. Manures provide material of low C/N value for blending with the crop wastes mentioned in the previous section. If such manures were composted by themselves, air would fail to penetrate the mass which would quickly go anaerobic and cause bad smells; in addition much nitrogen, a valuable plant nutrient, would be lost in the form of ammonia gas.Hence, where possible, crop wastes such as straws should be used in animal sheds as bedding. In this way they will soak up urine, a rich source of potassium, and dung. Deep littering is more effective in providing material for recycling than is daily cleaning of dung from bare floors. Where sufficient bedding is used for cattle, pigs and poultry in the tropics, there appear to be no ill-effects on animal

cleanliness and health, and it does not create a fly breeding problem.

Sometimes there is only sufficient straw for feeding the cattle and none left over for bedding. In such cases, earth can sometimes be removed from silage pits and threshing floors, and silt recovered from water supply tanks and channels; this is stored close to the cattle shed. This earth or silt is then spread on the floor of the cattle shed to absorb the urine and is renewed every three or four months; by this time it will have been trodden into a compact mass by the cattle and will need breaking up. If they are available, dry sawdust and wood shavings can be used in a similar manner.

3.5. Waste from Forests:

Large amounts of organic material should normally be available from forests and wooded areas. Unfortunately, in many tropical countries population pressure has created a greater demand for firewood than local trees can supply. In consequence, extensive deforestation has taken place, often resulting in hillside soil erosion. This situation can only be improved by tree planting programmes. The other problem has been that of shifting cultivation using the slash-and-burn method. In this, areas of forest are cleared for cultivation but all the trees, shrubs and plants are burnt. As a result, there is a total loss of the organic matter; although the phosphorus, potassium, minor and trace nutrients are mainly saved in the ash, the major nutrient, nitrogen, is almost entirely lost. This technique represents a tremendous loss of resources. The plot can often only be cultivated for a few years, then a new site has to be chosen, leaving the impoverished one to lie fallow and slowly reclothe itself with vegetation. This practice may have been tolerable in the past but population pressure now forces farmers to shorten the fallow period and thus insufficient time is available for natural regeneration. The result is a rapid and serious breakdown in soil fertility.

Unfortunately, it is exactly these hard mature woody wastes from forest trees and shrubs, containing much cellulose and lignin, which are so important in composting in the tropics. Fresh green crop wastes break down very quickly in the compost heap; these provide the sugars and simple organic compounds which lead to the great increase in the numbers of micro-organisms and the evolution of heat which causes the temperature to rise sufficiently for disease organisms to be killed. However, the resulting compost degrades or mineralizes quickly in the soil, releasing the required plant nutrients; it probably has little long-term effect on soil organic matter in the tropics. Such green wastes need to be complemented by woody wastes which only decompose a little in the compost heap but which continue to break down in the soil over many years, providing a reservoir of organic matter for enhanced water retention and improved soil structure. Recent work on the composting of brushwood and of wood chips from larger tree branches shows that these materials will break down if care is taken. Consequently, when more trees are planted and the firewood supply assured in a local area, forest thinnings and litter can become an important source of organic waste material for composting.

3.6. Rivers and the Sea (waste from fisheries):

A number of useful materials for composting can be obtained from rivers, canals, ponds and the sea. The most important is naturally water because compost heaps need a moisture content of 50-60 percent, either as water bound up in plant tissues or present in manures and night soil, or as water added during formation of the heap and any subsequent turning.

Green aquatic plants are often available in quite large quantities. The most notorious is the water hyacinth (Eicchorniacrassipes) which spreads extremely rapidly, transpires enormous quantities of water which could otherwise be used for crops, and can block waterways to passage of boats. Being of very high moisture content such plants need to be wilted for several days before composting if they are being used in large quantities. In areas close to the sea, supplies of seaweed of several types are often an important source of organic material. If handled skilfully sea- weed can form up to about 50 percent of the material in a compost heap. It needs first to be drained of seawater. If the compost is to be used on heavy clay land the seaweed should ideally be washed with fresh water to remove its salt content; for other soils this is rarely necessary. The seaweed is then well mixed with strawy crop wastes to provide absorbent material and an open matrix; the mixture is next spread 300 mm deep for 2 days during which the weed loses about half its moisture content by drainage and evaporation. It is then blended with further vegetable and crop wastes and built quickly into a compost heap. If seaweed is mishandled it can degrade rapidly into a slimy, smelly, anaerobic mass which quickly attracts flies.Silt can be recovered from waterways and water tanks; it can be used in the cattle shed or directly in, or over the top of, the compost heap. Some compost in techniques in China use large quantities of silt when composting night soil, water hyacinths or grass. Silt obtained from glacial rivers is especially rich in nutrients; the highly fertile terraced fields of the Hunza Valley in the Himalayas were built from such silt taken back up the mountain side.

In ponds which are used for intensive fish culture large amounts of plant, animal and microbial debris sink to the

bottom; the pond mud thereby becomes rich in both organic matter and in the plant nutrients.

3.7. Urban Wastes

The countryside produces most of the food for the inhabitants oftownsties of urban wastes in the form of refuse and night soil or sewage sludge. To complete the cycle of nature such wastes should be returned to the countryside for mixing into the soil.In many parts of the world the population is still increasing rapidly; not only are there intermittent shortages of food, there is also extensive rural unemployment and a drift of people from the countryside into towns and cities. As such centres of population grow so do the problems of urban waste collection and transport over lengthening distances to the countryside. The future will definitely see increasing quantities of urban waste being generated and greater difficulties in its disposal.Urban refuse comprises the solid wastes from human dwellings; it contains food wastes, paper and cardboard, cinders and ash from heating systems, containers in glass, plastic or metal, plus derelict furniture and household appliances. In addition there are substantial quantities of commercial refuse from offices, shops and markets together with industrial and construction waste. In poorer countries there is undoubtedly a large amount of salvage and recycling of metals and other materials which have any value and cities; in turn the latter generate roughly comparable quanties.In refuse only the vegetable/putrescible and paper fractions are of any value in composting; all other materials are unwanted and can cause problems to the composting process or to those using the compost product. Hence Table 6 shows that the refuse from Europe is much less suited to composting and needs more separation of unwanted components.Grubben (1982) describes the practice of certain market gardeners close to two cities in Benin, West Africa, who incorporate large quantities of fresh or only slightly decomposed refuse into their soils prior to growing leafy vegetables. An extension project to teach compost making proved a complete failure, apparently due to the high labour input required to make mature compost. Nevertheless, use of raw refuse cannot be recomm- ended for general practice because it is unhygienic; even composting city refuse for a few days, to bring it to its temperature peak, will greatly reduce the number of disease organisms (pathogens) which are present.

In addition to refuse, the other component of urban wastes important to composting is night soil, or sewage sludge where there is a waterborne sanitation system. There is an urgent need to recycle this material, with its wealth of plant nutrients, back to agriculture if the need for mineral fertilizers is to be reduced. However, night soil and sewage sludge contain many of the pathogens to which the human body is prey and hence care must be taken to prevent such disease organisms affecting workers and food crops. Partial control can be achieved in biogas digesters and almost total destruction by composting. The sludge from such biogas digesters is a valuable addition to the compost heap.

In many of the less developed countries where cities have grown rapidly and there are insufficient funds for adequate waste disposal, the material collected is often dumped in pits, quarries and hollows close to the city. This not only represents a loss of organic matter and plant nutrients to agriculture but can cause pollution of water supplies and give rise to problems of smell, flies, vermin and scavenging animals and birds. Ultimately, with sufficient finance and organization these materials will need to be separated and the compostable fraction returned to the countryside for soil enrichment.

3.8. Agro-industrial Wastes

The agro-industries process the primary products from smallholdings, farms, plantations, forests and animal slaughter houses into foodstuffs and products, either for return to the grower or for distribution into local, national or international markets. The by-products and wastes arising from these operations are available in substantial quantities, often as large as the desired foodstuff or main product. Some of these materials have already been mentioned under this Section of Wastes, where they are left on the smallholding or farm and not transported to a processing factory. Wastes from such factories are often poorly used or are dumped, leading to environmental pollution problems and a loss of plant nutrients and organic matter which should otherwise be returned to the soils growing the primary products.Agro-industrial wastes come from the growing and processing of a wide range of fruits, nuts and vegetables, beverages such as cocoa, coffee and tea; cereals such as paddy, maize, wheat, millet and sorghum; pulses such as beans and peas; fibres of cotton, wool, jute and silk; sugar; meat, fish and marine products; nuts and seeds for vegetable oils; tobacco and saw mill wastes.Some of these wastes have significant value as animal feedstuffs either locally or for export to animal feed compounders in the West.Animal products are often processed into fertilizers of reasonable nitrogen and/or phosphorus content. In sugar production most bagasse is normally used as fuel in the factory boilers. Other wastes are sometimes employed as raw materials for industrial processes; an example is the use of cocoa pods in Ghana as a source of potash for the manufacture of soap. The remaining wastes, especially in small local agro-industries, should be available for compost production either centrally at the factory or

distributed to nearby smallholders for incorporation into their heaps. Plate 6 shows coffee pulp which is an example of such wastes.

IV. CONCLUSION

Thus there are number of well-tried composting processes for the treatment of organic wastes from agricultural or municipal sources, or a mixture of the two. However, unlike landfill or incineration, these composting processes are not solely techniques of waste disposal; they are intended to prepare the wastes for return to the soil as part of the Cycle of Life Via composting the wastes should be prepared for rapid assimilation by the soil with minimal disruption of soil processes and maximum benefit in maintaining, or indeed improving, soil fertility. Hence wise use of the compost is just as important as choosing the best methods for its production. Accordingly, it is necessary to look at the various needs for, and methods of, improving soil fertility and seeing what part the use of compost can play in the programme. The composition and properties of compost on a biological, chemical and physical basis need to be examined. This helps in deciding how to use the compost for vegetable growing, tree planting and field crops.

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