Horticultural crop production

Level III

Learning Guide#18

Unit of Competence: - Prepare Compost

Module Title: - Preparing Compost

LG Code: AGR HCP1 M L06 O1-LG -18

TTLM Code: AGR HCP1 TTLM 0120v1

LO1: Identify characteristics of raw materials required

Instruction Sheet	Learning Guide #18

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- . Reviewing relevant documents
- . Reviewing current raw material supplies
- . Conducting compost recipe calculations
- . Specifying and documenting Characteristics required raw materials
- . Identifying substitute types of raw material

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Review relevant.
- Review current raw material supplies for suitability for production of defined compost products.
- Conduct compost recipe calculations
- Specify and document characteristics required raw materials
- Identify substitute types of raw material

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1 to Sheet 5”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self check 4” and Self check 5” **in page -8, 13, 15, 20, and 25** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 in page 26
6. Do the “LAP test” **in page – 27** (if you are ready).

Information Sheet-1	Reviewing relevant documents

1.1 Concepts of compost

1.2 Compost is stable aerobically decomposed organic matter. It is a biologically active material mostly of organic origin that can vary in texture. It is typically dark brown with an earthy appearance and smell. A good example is shown in Figure 1. Compost is the result of a managed decomposition process in which successions of aerobic micro-organisms break down and transform organic material into a range of increasingly complex organic substances, many of which are loosely referred to as humus. These substances are responsible for many of the important characteristics of high quality, healthy soils including their ability to hold plant available nutrients and moisture. Compost is ideally made from a mixture of organic materials that are blended to achieve an appropriate carbon to nitrogen ratio. Regardless of the method used, the composting process is managed to maintain temperature, oxygen and moisture levels within accepted ranges. Compost can be produced using a range of equipment from basic pile turning with front-end loaders to sophisticated in-vessel processing. However it is process management rather than equipment that determines compost quality**.**

Figure.1 Example of good compost.

Composting

- Composting is a natural biological process, carried out under controlled conditions, which converts organic material in to a stable humus-like product called compost.
- During the composting process, various microorganisms (bacteria, fungi) and other larger organisms like worms and insects break down organic material in to simpler substance.
- These need certain conditions to live. These include moisture and air (Composting is an aerobic process, meaning that the microorganisms require oxygen to do their work).
- To make the best possible compost, the micro-organisms must be able to work

Raw materials: are commonly used as raw materials for compost production which includes crop residuals, dairy waste, food organics such as, food waste, kitchen waste, food processing waste, forestry residuals, manures, plant materials such as, garden organics, green organics, green waste, yard waste, sewage facility grit and screenings, wood and timber, other organic waste or by-product of processing.

Advantages of compost:

The application of compost has been reported to be efficient enough in restoration of the soil. The addition of organic matter even in a little to the soil have shown a positive effect on the physical, chemical and biological soil properties……..

- Improves soil structure
- Improves pore space
- Increases water-holding capacity
- Better water supply for crops
- Increases the diversity of micro-organism
- Multitude of biochemical processes
- Increases the capacity to buffer pH and pollutants
- Better storage and exchange capacity for (micro) nutrients
- Reservoir of N P K S steadily released by mineralization
- Increase in soil organic matter (SOM) improves overall soil quality influencing many soil functions that SOM also. Soil organic matter (particularly > 5µm), play important decisive role in orientation of soil clay particles, soil compaction and hence regeneration of its structure

❖ **Constraints on composting**

- Preparing compost, liquid manure is *very labor intensive and time consuming*.
- Making your own *compost* is not possible everywhere. It *depends on space, available material, local conditions and other factors;*
- Applying compost could *enhance weeds and diseases in the crop* to be grown
- A compost heap *attracts vermin, such as insects, rats, mice and also snakes*
- The concentration of available nutrients in organic fertilizers is considerably lower than in chemical fertilizers. The exact nutrient content of most organics like compost or manure varies a lot.
- Inadequate attention to the biological process requirements
- Lack of vision and marketing plans for the final compost product

- Poor feed stock which yields poor quality finished compost, for example heavy metal contamination
- inadequate pathogen and weed seed suppression
- Nuisance potential, such as odors and rats
- Poor marketing experiences
- Poor integration with the agricultural community
- perverse incentives such as fertilizer subsidies or over-emphasis on capital intensive projects
- land requirements are often minimal, but can be a constraint

1.2. Identifying conditions that affect production requirement

The site which is going to be used for preparation of organic fertilizer should fulfill: -

- **Availability of moisture (water): -** Water availability **(**moisture content) during preparation of compost should be considered.
- **Availability of raw materials:-** This is required to be decomposed by micro-organisms. For this, any biodegradable matter is used like banana stem peels, coconut leaves, sugar cane trashes, stems of crops, grasses, husks, dung, sewage, discarded cattle feeds, etc.
- **Availability of micro-organisms: -** Species to be used for decomposition should be high in terms of growth rate or protein conversion, high temperature and pressure tolerance, high reproduction rate, etc.
- **Temperature: -** The optimum temperature required for preparation of compost is about 20-30 ^{O}C. But survival of micro-organisms is even at lower temperature and up to 48 ^{O}C air temperatures. If temperature is high, we can reduce it by shade.
- **Labor availability: -** Labor is very important to perform different activities before, during and after preparation of compost. Preparation of compost is labor intensive.
- **Soil PH: -** Optimum PH of the soil for preparation of compost is about 6.8 to 7.5.

- **Location: -** The site for preparation of compost should be close to the farm or place of utilization to minimize transport cost.
- **Accessibility: -** The site should be accessible to all times and preferably be near the road and ease for supervision

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the important of compost? (5 pts)
2. What is the definition of composting? (5 pts)
3. Write the constraints on composting? (5 pts)

Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Reviewing current raw material supplies

2.1 Raw materials of compost

Plant materials, both dry and green

1. Weeds, grasses and any other plant materials cut from inside and around fields, in clearing paths, in weeding, etc.

2. Wastes from cleaning grain, cooking and cleaning the house and compound, making food and different drinks, particularly coffee, tea, home-made beer, etc.

3. Crop residues: stems, leaves, straw and chaff1 of all field crops – both big and small – cereals, pulses, oil crops, horticultural crops and spices, from threshing grounds and from fields after harvesting.

4. Garden wastes – old leaves, dead flowers, hedge trimmings, grass cuttings, etc.

5. Dry grass, hay and straw left over from feeding and bedding animals. Animal bedding is very useful because it has been mixed with the urine and droppings of the animals.

6. Dropped leaves and stems from almost any tree and bush except plants which have tough leaves, or leaves and stems with a strong smell or liquid when crushed, like Eucalyptus, Australian Acacia, Euphorbia, etc. However, we have found farmers making good quality compost including stems of Euphorbia. 7. Stems of cactus, such as prickly pear, can be used if they are crushed or chopped up. They are also a good source of moisture for making compost in dry areas. When the compost is made correctly, the spines are destroyed.

Water

Enough water is needed to wet all the materials and keep them moist, but the materials should not be made too wet so that they lack air and thus rot and smell bad. Both too little and too much water prevent good compost being made. Water does NOT need to be clean like drinking water. It can come from :} Collected rainwater; } Collected wastewater, e.g. from washing pots and pans, clothes, floors, etc.; } Animal urine; or } Human urine. Water can

also be collected from ponds, dams, streams and rivers, particularly if men are willing to do it. It is not fair to expect women to collect all the water needed to make compost.

Animal materials

1. Dung and droppings from all types of domestic animals, including from horses, mules, donkeys and chicken, from night pens and shelters, or collected from fields. 2. Chicken droppings are important to include because they are rich in nitrogen. 3. Urine from cattle and people:

Catch urine in a container from animals when they wake up and start moving around in the morning. Provide a container – like an old clay pot or plastic jerry can – in the toilet or latrine where people can pass or put their urine. Night soil (human faeces): almost all human parasites and other disease organisms in human faeces are killed by the high temperatures when good compost is made.

Compost making aids – "farmers' friends"

Micro-organisms (fungi and bacteria) and smaller animals (many types of worms, including earthworms, nematodes, beetles and other insects) turn waste materials into mature compost. These are found naturally in good fertile soils like those from forests, old animal dung and old compost. Adding any of these to new compost helps in the decomposition process. Adding compost making aids is like adding yeast to the dough to make bread. The farmers in Ethiopia call these materials the 'spices' to make good compost.

Air

Including dry materials in the compost, e.g. old leaves and stalks, provides space for air to circulate inside the compost. Air is needed because the soil organisms need oxygen.

Heat

Decomposition of organic wastes produces heat. Compost needs to be kept hot and moist so the plant and animal materials can be broken down quickly and thoroughly. Heat destroys most of the weed seeds, fungal diseases, pests and parasites.

The contributions of the different compost-making materials A good balance of carbon and nitrogen

2.2. The reviewing of raw materials suppliers

Evaluating your raw materials suppliers to the benefits of a given procurement and project delivery model should consider several criteria that are essential to defining a successful procurement and follow-on project:-

Transparent: All procurement processes, methodologies, and selection criteria must be fair, objective and transparent to the professional services and construction community.

Cost-effective: Any procurement methodology should ensure that the owner is receiving best value for the services and construction being purchased. To the extent possible, services should be priced, and price should be evaluated as part of the selection methodology.

Objective-focused: Procurement selection strategies should be based on clearly defined evaluation criteria that mirror project challenges and opportunities for project success.

Efficient: The cost for implementing the procurement process should be minimized in favour of using funding to maximize delivery of actual project scope. Similarly, the bidding community's resources should be respected by minimizing to the extent practical the cost to propose on work.

Timely: The duration of the procurement processes should be minimized, allowing for sufficient response time from bidders and a reasonable time period to evaluate proposals without other undue delays. Valuable time should be conserved and made available for execution of project scope.

Inclusive: The overall procurement process should ensure that local sub consultants and sub contractors have equal access to project scope for which they are qualified. Projects should be packaged for wide participation, especially for alternative delivery models that might otherwise preclude local firms from at-risk work.

Compatible: Procurement methodologies must remain consistent with existing regulatory and procurement policies unless specific changes are approved to accommodate identified alternative delivery benefits. With this finally, take into account the time zone differences, i.e. know about the time slots in which the supplier is available for communication

Generally raw materials that might be used as possible inputs to produce compost are

- animal mortalities
- bio-solids such as sewage sludge
- crop residuals
- dairy waste
- fats and oils
- food organics such as
- food processing waste
- food waste
- kitchen waste
- forestry residuals
- manures
- organic sludge’s
- other organic waste or by-product of processing
- paper mill wastes
- paper-based materials
- sawdust and wood shavings
- sewage facility grit and screening

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the raw materials that might be used as possible inputs to produce compost? (10point)
2. What are the three major categories of organic material (10)?

Note: Satisfactory rating – 20 points **Unsatisfactory – below 20 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Conducting compost recipe calculations

Determining the Right C/N Ratio

As stated previously, we can classify "green" materials as being high in nitrogen and "brown" materials as high in carbon. The input material should have a carbon/ nitrogen ratio of 25:1 to 40:1, as this mixture allows for the most rapid and efficient degradation of the organic material.

For example, if we want to achieve a 30:1 C/N ratio using vegetable wastes and various high carbon wastes, we can use the following algebraic equations to find the appropriate mix.

Material	C:N
GREEN: Material with High Nitrogen Values	
Vegetable wastes	12-20:1
Coffee grounds	20:1
Grass clippings	12-25:1
Cow manure	20:1
Horse manure	25:1
Poultry Manure (fresh)	10:1
Poultry Manure (with litter)	13-18:1
Pig Manure	5-7:1
BROWN: Material with High Carbon Values	
foliage (leaves)	30-80:1
Corn stalks	60:1
Straw	40-100:1
Bark	100-130:1
Paper	150-200:1
Wood chips and sawdust	100-500:1

Table 2**.1 C/N Ratio**

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. Determining the right C/N Ratio ?(10)

Note: Satisfactory rating – 10points **Unsatisfactory - below 10 points**

Answer

Score = _____

Rating: _____

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Specifying and documenting Characteristics required raw materials

4.1 Characteristics compost-making materials

A good balance of carbon and nitrogen

Both carbon and nitrogen are needed to make good compost. They are used by the micro-organisms to grow and multiply, and to get energy. Some of the carbon is converted to carbon dioxide, and this escapes to the atmosphere. Most of it remains and becomes humus, and the nitrogen becomes nitrates. Methane is not produced if there is a good supply of air to the organisms carrying out the decomposition process. Materials with good nitrogen content help in making good compost, but they should be less than the carbon-containing materials. Carbon-containing materials should always be more than those containing high nitrogen. A good balance of carbon and nitrogen is needed to make good compost.

The contributions of dry and green plant materials

Dry materials give structure to the compost making process; they provide space for air to circulate so that the micro-organisms can be active and make heat. Green plant materials provide moisture for compost making; they give water and nutrients to the micro-organisms so that they multiply and break down the organic materials into humus.

The importance of good water/moisture and air balance

Water is essential for compost preparation.

1. Sufficient moisture helps for quicker decomposition because it is essential for micro-organisms to be active.
2. Excess water causes rotting of the materials and creates a bad smell.
3. Without enough moisture the decomposition process slows down and the materials will not be changed into compost.

This shows that moisture and air must be balanced to make good compost. Farmers quickly learn how to judge the amount of water needed to be added in making compost.

The importance of air

Compost should have sufficient air.

1. When there is sufficient air, oxygen enters the compost heap. When there is enough oxygen, special bacteria can convert nitrogen into nitrate, the materials are decomposed properly and there is a good smell.
2. If there is not enough air and too much water, the nitrogen is converted into ammonia. The ammonia escapes into the air removing nitrogen from the compost and making it smell bad.
3. If there is excess air and too little water, the materials dry up and do not decompose to become compos

4.2. Selecting suitable raw materials for compost preparation

To produce high quality of *compost* raw materials should have the following characteristics:-

- **Low carbon to nitrogen ratio**

Carbon and nitrogen are needed by the microorganisms which compost organic material. Carbon is an energy source essential for cell growth. Nitrogen is the major source for proteins needed by microorganisms. A material's carbon and nitrogen content is expressed as the carbon/nitrogen ratio (C/N) on a weight basis. To balance the C/N ratio for composting, mixtures of materials which have high and low ratios are used. Fertilizers may also be used to balance the C/N ratio. The C/N ratio decreases during composting as carbon is lost in the form of carbon dioxide. Table 6 summarizes the optimal conditions for composting.

- **Free from contamination**

Most pathogens and weed seeds are destroyed during thermophilic decomposition. Pathogenic destruction is a most important aspect of this stage, not only the accelerated rates of decomposition. This is of particular importance if compost contains night soil or sewage sludge. In order to make sure all pathogens and seeds are exposed to temperatures and microbes capable of killing them, it is necessary to turn the pile at least three times and mix the outside of the pile with the inside.

Fly breeding can be an unwanted nuisance in a composting operation. If wastes are infested with eggs and/or larvae at the time of collection it must be processed and composted immediately. Frequent turning or insulation with a manure plaster is an

effective method of controlling flies because eggs and larva are exposed to fatally high interior temperatures. Burning of dry material piled on the outside of the heap is a method used in India to kill larva which have migrated to the cooler outer layer of the pile). To prevent larva from migrating into the cooler surrounding soil it may be necessary to locate the heap on a surface which is covered or sealed (e.g. a paved or compacted area). Allowing chickens and fowl to eat the larva also helps control fly populations, however, their presence often needs control as the birds tend to scratch at and scatter piles.

- **Medium moisture contents**

Moisture content for successful composting should range from 50-65% (by weight)). Below 40%, decomposition is extremely slow because it is too dry for microorganisms to function. Above 60% the material is too wet, air spaces are reduced and the heap becomes anaerobic. A higher moisture content may be maintained if the pile is turned frequently or has a loose structure (maintained with lots of straw and fibrous materials) to enhance aeration.

- **Neutral PH**

The pH during composting is rarely a concern. Most plant materials added to a compost pile have a pH between 5-7 which is desired for microbial activity. Once decomposition starts, the pH drops slightly as organic acids are generated and then increases during the thermophilic stage to the optimal range of between 6. 5 and 8.5). If the pile becomes anaerobic, the pH drops further as acids are generated from fermentation. Restoring aerobic conditions by turning will reverse this trend. It is not recommended to buffer or add lime to the pile because it results in ammonia generation and a loss of nitrogen. Liming is best added to finished compost or to the growing media if needed.

- **Soft and Easily decomposable**

Plants of very young nature also should not be incorporated as they will very easily decompose leaving little residue in the soil. Woody plants will decompose very slowly. Hence, the best stage for incorporation of plants in either at the following stages or before they attain the woody texture.

- **Free from alkaline and acidic**

The pH in the raw material is important because too much alkali in the heap results in the loss of nitrogen which evaporates through the loss of ammonia gas. For this reason, it is not advisable to add lime.

On the other hand, if the refuse contains a high acid content, it may prevent the material from having the required amount of like-warmness, eventually preventing accumulation of heat thus hindering its decomposition. This is because some micro-organisms in the heap are killed by the presence of too much acid.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the characteristics of raw materials (10 points**)**
2. List the characteristics of raw materials to produce high quality of *compost*(6 points**)**
3. **Note: Satisfactory rating – 16points Unsatisfactory - below 16 points**

Answer

Score = _____

Rating: _____

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet 5	Identifying substitute types of raw material

5.1 Raw materials and formulations

White button mushroom requires a well-composted substrate for its growth. It is a saprophytic fungus and requires carbon compounds, which generally come through the agricultural waste materials. Besides carbon, it requires nitrogen and other essential elements, such as phosphorous, sulphur, potassium and iron, vitamins such as thiamine, biotin, etc. All the raw materials that contain these compounds are mixed in a fixed proportion and fermented in a set pattern to form a substrate, which is known as compost.

Raw material and Ingredients required for composting

1. **Base materials**

Base materials are the bulk component of the compost. Various crop residues can be used for this purpose though the wheat straw is favoured all over the world. However, quality compost can be prepared using variety of other materials including paddy straw, hay, barley, oat, maize stalks and leaves, sugarcane bagasse, sugarcane trashes and leaves, soybean stalks, mustard stalks, etc. These materials should preferably be freshly harvested/ procured and should be around 5-8 cm long. These base materials act as a reservoir of cellulose, hemicelluloses and lignin which is utilized by A.bisporus during its growth as a carbon source. They also provide a little quantity of nitrogen. Besides acting as a nutrient source, they also add bulk to the compost and proper physical structure to the substrate and ensure adequate aeration during composting for the build up micro flora essential for the composting process and also for the nutrition of mushroom. Rice and barley straw are very soft and degrade quickly during composting. These materials also absorb more water as compared to wheat straw. While using these materials care must be taken on quantity of water used for wetting, schedule of turnings and adjustment to the rate and type of supplements.

2. **Supplements**

Above base materials do not have adequate amount of nitrogen and other nutrients required to start the fermentation process. The compounding mixture is supplemented

with other materials having nitrogen and carbohydrate sources to achieve the proper CN ratio. These materials can be classified as follows.

a. Animal manure

Horse manure undoubtedly is the best material for compost preparation. However, due to difficulties encountered in procuring good quality horse manure, use of this material has been restricted to few farms only. More and more farms are switching over to easily accessible materials. Chicken manure has proved to be the best alternative to horse manure. Other manures viz., pig; cattle and sheep have also been tried for compost preparation but with limited success. All these manures provide nitrogen to the compounding mixture, little of carbohydrate is also provided. These materials are highly variable in composition and their N-content may vary from 1-4 percent and it is released slowly during composting process. In addition to providing nutrients, they greatly increase bulk of compost, which is very important factor under Indian conditions considering the high cost of wheat straw vis-à-vis chicken manure. If horse manure is used in composting then it should be used along with bedding and urine, as it may not require any further supplementation. If it is not having enough bedding and urine when collected from a clean stable, supplementation with inorganic nitrogen along with some wheat straw may prove useful. Chicken manure if used, should preferable be a deep litter chicken manure having nitrogen contents above 3%. If such manure is not available then the manure from cages can also be tried. Chicken manure is generally used under short method of composting. However, some of the growers are using this under long method and are getting fairly good yields, while some have met with failures. Chicken manure harbours heavy population of pathogenic nematodes and harmful fungi including Sepedonium maheshwarianum, Stachybotrys atra, Papulaspora sp. and Verticillium sp. Growers should therefore avoid the use of this material under long method of composting.

b. Carbohydrate sources

These materials are essentially required to hasten the composting process, to balance the C/N ratio and also for the establishment of the bacterial flora in the compost. Molasses, wet brewer's grains, malt sprouts, potato wastes, apple and

grape pumice can be employed as carbohydrate source, since these materials provide readily available nutrients to microorganisms.

3. **Nitrogen fertilizers**

In this category of fertilizers, urea, calcium ammonium nitrate, ammonium sulfate can be kept. Nitrogen content of these fertilizers is very high (24-46%) which is released quickly, resulting in quick establishment of micro flora.

4. **Concentrate meals**

Animal feeds are generally kept in this category, which include wheat or rice bran, dried brewer's grain, meal/cakes of soybean, cotton seed, castor, sunflower, etc. These materials supply both nitrogen and carbohydrates, which as in case of animal manures are released slowly. Nitrogen content may vary from 3-8% depending upon the source

5. **Supplements to rectify mineral deficiencies**

In addition to carbon and nitrogen, A. bisporus also requires little quantities of potash, phosphorous, calcium and magnesium for its growth. Fertilizers viz., muriate of potash and superphosphate can be kept in this category. Besides above gypsum and calcium carbonate can also be kept here. Gypsum also has stabilizing effect on ammonium content. An increased ammonium concentration is obtained with gypsum, which is an indicator of productive compost. Furthermore, gypsum serves as a calcium source for the mushroom. It converts the oxalic acid produced by the mushroom mycelium into calcium oxalate. Requirement of phosphorous, potassium, and magnesium is generally met by chicken manure or horse manure when compost is produced by short or by indoor method. However, long method compost where chicken manure is not added addition of these materials may be required.

Formulations

A large number of formulations are available with the growers and these are based on cost and availability of raw materials in the particular region. To initiate a composting process and to minimize the loss of dry matter during composting 1.5-1.75 percent nitrogen is generally kept in the compounding mixture. The main objective of computing a formulation is to achieve a balance between carbon and nitrogen compounds. At stacking C: N ratio is adjusted to 25-30:1, which comes

down to 16:1 after composting. N level in the compounding mixture at start should not be less than 1.5% as this will give improper compost with high CN ratio and such compost will be easily attacked by cellulose loving fungi. Further it should also not be higher than 1.75% as such compost will be easily attacked by yellow moulds and more time will be required to finish the composting process. Known and estimated values of nitrogen and water contents of different materials viz. straw, chicken manure, wheat bran and other chemical fertilizers can be used as guidelines in computing formulations having desired balance of nitrogen and C N ratio. These materials can be regularly tested for balancing the nitrogen in compounding mixture for productive compost preparation. Formulations for white button mushroom compost normally should have N-1.5-1.8%, P2O5-1.21.5%, K2O-2.0-2.3%, CaO-1.5-3% and MgO-0.4-0.5% on dry weight basis.

Formulations having horse manure as one of the ingredients is termed as natural compost, while others are termed as synthetic composts. In addition to C and N, various other materials play an important role. Only in recent times importance of these minerals in mushroom cultivation has been realized. Chicken droppings have maximum amount of all the above elements and it should become an integral part of mushroom compost. An example as to how to arrive at standard formulation having desired N value is given in

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What are additives? 3 points
2. List the some additives. 5 points

Note: Satisfactory rating – 8 points **Unsatisfactory – below 8 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Operation Sheet-1	Identifying substitute types of raw material

Objectives: - at the end of this practice the trainees will able to:-

- Identify materials and tools used for raw materials
- Select suitable substitute types of raw material

❖ **Procedure**

To select all raw materials for composting, follow the following procedures.

1. Prepare materials, tools and equipment's use raw materials collection
2. Wear suitable personal protective equipment
3. Select site where raw materials are available
4. Identify OHS hazards
5. Collect raw materials
6. Reject contaminant raw materials
7. Dispose wastes safely
8. Clean and store tools and equipment's

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hours.

Task 1. Identifying substitute types of raw material

List of reference Materials

1. Arefaine Asmelash. 1994 EC/2002 GC. Dekuaie tefetro: intayn bkhmeyn (Making compost: what it is, and how is it made).
2. In Tigrinya. Tigray Bureau of Agriculture and Natural Resources and Institute for Sustainable Development, Addis Ababa, Ethiopia.
3. Assefa Mitiku Tegegn & Sisay Kebede Haile. 1991 EC/1999 GC. Yebsebashe Azegedgadget leanesetenya geberyewotch (Compost making for smallholder farmers). In Amharic
4. AgriService, Addis Ababa, Ethiopia. Brandjes, P., P. van Dongen & A. van der Veer, 1995.

Horticultural Crops Production

Level III

Learning Guide#19

Unit of Competence: -Prepare Compost

Module Title: - Preparing Compost

LG Code: AGR HCP1 M06 LO2-LG-19

TTLM Code: AGR HCP1 TTLM 0120v1

LO2: Assess and prioritize raw materials required for production

Instruction Sheet	Learning Guide #19

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- . Identifying and assessing raw material options
- . Gaining representative samples of prioritized raw materials
- . Submitting revisions raw materials and product specification.
- . Confirming handling requirements, stockpiling location and arrangement on site

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Identify and assess raw material options
- Gain representative samples of prioritized raw materials.
- Submit revisions raw materials and product specification
- Confirm handling requirements, stockpiling location and arrangement on site

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1 to Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 , and Self check 4” **in page - 32, 35, 37, 38 and 43** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 and Operation Sheet in page
6. Do the “LAP test” **in page –** (if you are ready).

Information Sheet-1	Identifying and assessing raw material options

1.1 Identifying and assessing raw material options

Raw Materials

Technically, compost may be made from any organic material. That is, it may be made from any part of an organism, plant or animal, that contains carbon. Compost also requires a source of nitrogen, oxygen, and water, plus small amounts of a variety of elements usually found in organic material, including phosphorus, copper, potassium, calcium, and others. In order for the organic materials to combine with the other materials and decompose into compost, several living organisms and microorganisms are needed. These include **sow bugs,** which help digest the materials and transport **bacteria; earthworms,** which aerate the materials with their tunnels; a variety of fungi, which help digest decay-resistant cellulose; mold-like bacteria called Actinomycetes, which attack raw plant tissues; and many others.

- The most common raw materials used to make compost are yard wastes such as grass clippings, leaves, weeds, and small pruning's from shrubs and trees. Most home garden compost piles and municipal compost facilities use yard wastes exclusively because of the large volume of materials available.
- Industrial compost facilities tend to use waste materials generated within a particular plant or region. For example, sugar beet pulp is mixed with other materials to make compost in an area where sugar refineries operate. Spent hops and grain from breweries also make excellent compost materials. Other materials include sawdust and wood chips from lumber mills, fish waste from canneries, and dried blood and pulverized animal bones from slaughterhouses. Agricultural compost facilities use materials readily available on nearby farms.
- These include animal manure, used stable straw, spoiled fruits and vegetables, field refuse, vineyard and orchard pruning's, rotted hay, and other agricultural waste products. Some of the more unusual raw materials used to make compost include seaweed, chicken f
- Feathers, peanut shells, and hair clippings.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is the advantage of identifying and assessing raw material (5points)
2. What is the role of prioritize raw materials (5points)
3. What are the conditions that affect the production of organic fertilizers? (5points

What are the conditions that affect the production of organic fertilizers? (5points**Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points**

Score = _____
Rating= _____

You can ask your teacher for the copy of your answer

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Gaining representative samples of prioritized raw materials

2.2. Gaining representative samples of prioritized raw materials

During the preparation of raw materials for preparation of organic fertilizer you should have to make ready different raw materials which have different quality as options. But, you should have to give priority for raw materials which has *accessibility, easy to collect and manage, near to compost site and which has high capability, low cost and revenue, which cannot affect environmental condition, easily operated materials during preparation,* which has reliability and security of supply, non contaminated, etc. Sampling is vital to know the representative data.

Testing Materials on the farm

A few characteristics of raw material and compost can be determined on the farm using simple procedures that require only available or inexpensive equipment. The characteristics include density, moisture, content, pH, and soluble salts. At a minimum, a good weighing scale is required. The scale should be able to read numbers that are at least one-hundredth the size of the sample (for example, 1/8 ounce for a 1-pound sample or 1 gram for a 100-gram sample). Scales that can read to 0.1 gram are preferable. Other equipment required depends on the specific test.

Laboratory safety

The tests described here are not hazardous, but a few simple safety precautions need to be observed. Gloves should be available and worn when hot containers are handled. Safety glasses or goggles should also be available. Work areas should be well vented. Observe appropriate equipment precautions. For example, do not use metal containers in a microwave oven and do not leave a microwave oven unattended while samples are being heated.

Samples

The first step in testing material is obtaining a representative sample. The sample should reflect the overall qualities of the material being tested. It is best to collect many samples from different locations in a pile and/or from several piles. Mix these samples and then draw subsamples to be tested from the mixture. If a single sample is taken, collect it from a

location that is typical of the whole pile. Avoid taking samples from the center, edge, and outer surface. These areas are more likely to have different qualities from the bulk of the material in the pile.

Samples can lose moisture and undergo other changes in the time that elapses between collecting and testing material. Therefore, samples should be collected shortly before testing. If they must be collected some time in advance, they should be refrigerated in a covered container or at least kept away from heat, sunlight, and other conditions that might alter their characteristics.

The sample size should be convenient to work with and suited to the testing equipment and containers. Establish a standard sample size so that testing procedures are consistent. The calculations can sometimes be simplified by using samples sizes that have round numbers, such as 100 grams, 1 pound, or 1 liter, then weighing the dried sample. In general, the larger that the sample is, the more accurate the testing results will be. However, this must be balanced with practicality. For example, larger samples take a longer time to dry for moisture content determinations.

Density

Density is calculated by dividing the weight of a substance by the volume that it occupies. In composting work, a material's bulk density generally is required. Bulk density is the mass of a pile or container of material divide by the volume of the pile or container. The volume includes the air spaces between particles. For example, the density of a pile of wood chips (bulk density) is more important to know than the density of an individual wood chip (particle density).

Density can be determined by filling a container of known volume and weight with the material to be tested and then weighing the filled container. The density equals the filled container weight minus the empty container weight divided by the container volume.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Why we take sample of each raw materials (5 points)
2. Write the characteristics of raw materials testing in the farm? 4 points

Note: Satisfactory rating – 9 points **Unsatisfactory – below 9 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Submitting revisions raw materials and product specification

Quality compost with animal dung and urine

1. Animal dung contains water, nitrogen, phosphorous and potassium, as well as micro-nutrients.
2. Animal dung and urine are very necessary to prepare good quality compost – urine especially is high in potassium and nitrogen.
3. Both dung and urine help to produce a high temperature so that the materials decompose into compost easily.
4. Urine, in particular, accelerates decomposition.

Important compost making aids

Compost making aids are farmers' friends as they help speed up the process of decomposition. They are like the yeast in making bread and beer or wine, or the salt and spices in making tasty food. They include:

1. Good top soil and old compost: These contain bacteria, fungi and many small animals to work on breaking down the materials into mature compost.

2. Ashes from wood and charcoal are good to mix in because they contain phosphorous, potassium, and many micro-nutrients like zinc, iron and magnesium.

3. Heat is produced by the action of bacteria and fungi on the plant and animal materials, and their activity keeps the compost hot. Covering compost with a black plastic sheet can also absorb the heat from the sun and stop it escaping so that the compost making process goes fast.

4. Larger organisms: Look for larger organisms, like earthworms and beetles, in old moist compost, old animal dung or good top soil and add these to the compost making materials without drying and sieving them.

5. Composting facilitators/promoters are important because: They provide key bacteria, fungi and micro-organisms to make the compost; They provide nutrients for the organisms in the soil so they remain in a good condition and reproduce rapidly; and They help speed up

the composting process and ensure that good quality compost is produced. Methods for using compost making aids include any or all of the following:

1. Make a mixture of dry top soil, old compost and ashes. Then crush it and, if possible, sieve it so it is like salt or a fine powder.
2. Mix the powder with fresh composting materials, particularly with dry or green plant materials like grass and/or straw, and put this in layers between other materials.
3. Do NOT put the compost making aid material as a layer by itself. It needs to be mixed with the other materials so it can accelerate the compost making process.
4. Ash is good as it contains minerals, BUT if you put a high quantity in one layer, the minerals are strongly concentrated and can slow down or stop the microorganisms from making compost.

How micro- and macro-organisms work

The production of good quality mature compost depends on the number and types of micro- and macro-organisms living in the soil. These are living organisms that require air, moisture and heat in the compost heap so that they can live, work and multiply/reproduce. Compost materials supply food and energy (starch, soluble sugars, carbohydrates, amino acids) for the micro-organisms. In the presence of air supplying oxygen and moisture, the micro-organisms convert the available food into humus and soluble plant nutrients, which stay in the compost heap, and carbon dioxide, which diffuses out into the atmosphere. Most of the carbon in compost materials stays in the humus and only a small amount leaves as carbon dioxide. As the micro-organisms grow and multiply, they produce heat which speeds up the compost making process. Heat also kills many weed seeds, pests, parasites and diseases from the fields, and in the animal dung and human faeces. The heat ensures that healthy mature compost is produced

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. In what condition landscape expert do interact with other staff and customers? 4 points
2. Where does landscape architects work belong? 5 points
3. Discuss employer duties in landscape work? 7 points

Note: Satisfactory rating – 16 points **Unsatisfactory – below 16 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-4	Confirming handling requirements, stockpiling location and arrangement on site

4.1. Site security for stockpiling

Some form of access control and site security should be provided to prevent illegal waste dumping and vandalism. Commonly, waste management facilities are enclosed within by barbed-wire or chain-link fencing. Installation of security systems (i.e., building alarms, video cameras) may also be necessary to augment basic security precautions, depending upon the degree of vandalism encountered in the area.

4.2 Confirming stockpiling location and arrangement

4.2.1 Raw materials storing area

A well-defined storing area should be included in the layout and design of all organics processing facilities. A dedicated area allows for traffic controls that prevent delivery vehicles from entering processing areas and possibly creating safety issues. It also allows for feedstock to be inspected before they are processed so that potentially harmful, unacceptable materials, such as sharps and large objects, can be removed. Including small, temporary storage space in the storing area provides operations staff with the flexibility to manage surges in feedstock deliveries and preprocessing, as well as processing equipment, in a more consistent manner. Another benefit to providing temporary storage is that feedstock can continue to be received in the event that processing is disrupted for short periods of time (i.e., as a result of equipment malfunction or process upsets). At facilities accessed by roadways subject to traffic congestion, storage provides flexibility to schedule deliveries during off-peak traffic hours, which can help to reduce collection and transfer costs. The size of the receiving area will vary based on the daily capacity of the facility, and the number and types of vehicles delivering feedstock. At a minimum, the receiving area should allow for at least two vehicles to unload materials simultaneously and for material handling equipment to LOAD within the storage area at the same time. At larger facilities, it may be necessary to accommodate more than two vehicles at the same time. To help mitigate odors, the size of storage space in the receiving area should be limited to be between one and three days' worth of material. Regardless of the amount of storage provided, operations staff should always strive to process materials the same day it arrives at

the facility. If feedstock will be stored for more than one day, store them on a “first-in, first-out” basis: older feedstock should not be covered by newer feedstock or otherwise be inaccessible as new materials are received.

4.2.2. Outdoor storing areas

Ideally, outdoor storing areas should be paved or have some other hard surface (e.g., concrete or lime- or cement-stabilized soil) that can withstand the loads from heavy trucks and wheel loaders. This is, in part, to ensure that the storing area can be accessed during all anticipated weather conditions, and feedstock can be removed or processed on a regular basis (rather than accumulating and leading to nuisance conditions). The storing area should have a slope of between 0.5 and 2%, and surface water runoff should be captured for treatment. Environmental regulations also often require that outdoor storing areas be constructed overtop an environmental liner (e.g., clay or synthetic material) to protect groundwater resources.

4.2.3. Enclosed storing area

As a result of the potential for some feedstock’s (e.g., food waste) to generate odors’ and/or to attract birds and wildlife, it may be beneficial for the storing area to be partially or fully enclosed within a building. There are a number of building types that can be used, ranging from wood frame and fabric-style buildings, to engineered metal structures. The style of building used is a function of the amount of interior space needed, interior clearance requirements, ventilation design for odour capture, and corrosion protection. Designing the receiving building so that delivery vehicles can be completely indoors with access doors closed when unloading significantly reduces the risk of odour releases. However, this approach does increase the size and cost of the building, particularly if it must be designed to accommodate large tractor-trailer units that are typically used to transport materials from transfer stations. The concept of using two doors to create an “airlock” that delivery vehicles must pass through to enter the receiving building is another means of reducing the risk of odour emissions. However, these types of systems also increase the size and complexity of the building, and its construction cost. Overhead doors that open and close quickly are a recommended feature that should be incorporated into receiving buildings. Whenever the overhead doors are opened, the ability of ventilation systems to prevent odorous air from leaving the building is severely compromised. Using doors that can be opened or closed in 15 seconds or less can help to significantly reduce the impacts on ventilation systems, and

also reduce delivery vehicle unloading times. Air curtain technology has become a popular means of balancing structural design and construction costs with the need for odour containment at organic waste processing facilities. An air curtain system consists of a fan and ducting system installed along the top frame of overhead doors.

The system blows air down wards at a high velocity over the entire width of the door opening, and creates an invisible barrier that prevents interior air from leaving and exterior air from entering. Some facility operators also claim that the high-velocity air current also deters birds from entering the facility through open doors. Floors within enclosed receiving areas are normally constructed of concrete, although it may be feasible to use asphalt. In either case, the floors should be sloped away from doors so that any leachate that escapes from feed stocks is contained within the building. Floor drains can collect leachate and direct it to storage tanks, but drains are prone to clogging and can become an ongoing maintenance issue. Absorbing leachates with dry feed stocks, wood chips, or compost, and then composting the absorbent may be a preferable method of managing leachate.

4.2.4 Amendment storage area

The amendments typically used at municipal processing facilities, such as straw, wood chips, and sawdust, are normally high in carbon and have a low moisture content, and can be stored outdoors without producing odours. However, it may be necessary to provide some type of containment or enclosure to prevent these amendments from getting wetted by precipitation or carried away by strong winds. Depending upon climatic and hydrogeological conditions, providing a liner system under amendment storage areas to prevent ground water impacts may be necessary. Local building codes and by laws may contain specific requirements, including maximum pile heights, and volumes and separation distances between piles. The need for fire detection and sprinkler systems must also be considered and incorporated into facility design.

4.2.5 Compost curing area

At facilities that use enclosed or in-vessel composting technologies, curing activities normally take place in a separate, outdoor area. At outdoor composting facilities, curing often takes place at the same location as active composting for convenience and to reduce material handling requirements.

When curing and active composting areas are separated, they should be located up-slope so that drainage from receiving and active processing areas does not flow into or through the

curing area. Like outdoor receiving areas, the working surface in outdoor curing areas should be designed to meet the expected wear and tear from site equipment, including wheel loaders and trucks. Although concrete and asphalt are the most desirable working surfaces, their capital costs can be prohibitive. Therefore, curing pads are often constructed of gravel, crushed concrete, lime- or cement-stabilized soil, or asphalt millings.

Clay working pads covered with a layer of topsoil or wood chips have also been used. Curing areas are most often underlain by a clay or synthetic liner system for ground water protection. Curing pads should also have a slope of between 0.5 and 2% to promote drainage. It is important to ensure that windrows and piles are oriented in the same direction as the pad's slope to prevent blocking the flow of runoff and leachate draining from one pile into an adjacent pile.

4.2.6 Finished compost storage area

Finished compost should be stored away from operating areas so that it is not contaminated by incoming feed stocks or surface water runoff from active composting and curing pads. Ideally, the product storage area is also easily accessible by customers; they should not have to drive through operating areas to access the storage area, as this increases safety risks. The storage area should have graded surfaces (e.g., sloped at 0.5 to 2%) that promote drainage and prevent water from pond, which can raise the product's moisture content (and affect sales efforts) and/or result in anaerobic conditions and odours. The product storage area should also have a working surface consisting of a strong sub-base and base material that is able to support the weight of wheel loaders and trucks without rutting. Large ruts can limit vehicle access and can lead to further water pond. The size of product storage areas is a key consideration and is normally determined by the facility's production cycle and the demand for compost over the year. Consider the following when designing storage areas: Market cycle information (i.e., how much product is sold during each month of the year), in combination with the facility's anticipated monthly or weekly production output, is used during the facility design stage to determine storage requirements. The form in which products are sold affects storage space requirements. When compost products are sold in bulk, they can be stored in large stockpiles that maximize space utilization. However, if products are bagged and palletized, the amount of required space increases significantly since pallets holding bagged compost cannot be stacked.

4.2.7 Additional infrastructure requirements

Depending upon the site and location of the processing facility, there may be additional infrastructure required. If the processing facility is located at an existing waste management facility (e.g., landfill or recycling centre) or public works yard, it may be possible to share existing infrastructure.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the important of site security for stockpiling?(2 points)
2. Define raw materials storing area?(2 points)
3. Define Residuals storage areas?(2 points)

Note: Satisfactory rating – 10 points Unsatisfactory – below 10 points

You can ask your teacher for the copy of your answer

Answer sheet

Score = _____

Rating= _____

Name: _____ Date: _____

Short answer questions

List of reference Materials

1. Green manuring and other forms of soil improvement in the tropics. (English translation by H Huf.) Agrodok-series No. 28.
2. Agromisa, Wageningen, The Netherlands. Distributed by CTA (Technical Centre for Agricultural and Rural Cooperation, ACP/EEC). Dalzell, N,A. & S. Riddlestone. 1987. Soil management: Compost production and use in tropical and subtropical environments.
3. Bernan Associates, USA. Edwards, S., Arefayne Asmelash, Hailu Araya & Tewolde Berhan Gebre Egziabher, 2007. Impact of compost use on crop yields in Tigray, Ethiopia, 2000-2006 inclusive. FAO, Rome. Available at

Horticultural Crops Production

Level III

Learning Guide-20

Unit of Competence: -Prepare compost

Module Title: - Preparing compost

LG Code: AGR HCP1 M06 LO3-LG#20

TTLM Code: AGR HCP1 TTLM 0120v1

LO3: Organize for processing

Instruction Sheet	Learning Guide#20

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Reviewing Job sheet
- Identifying Composting technologies and methods
- Selecting and checking machinery, equipment and materials
- Identifying and assessing Potential Occupational Health and Safety (OHS) hazards
- Complying enterprise OHS guidelines
- Selecting suitable Personal Protective Equipment (PPE

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Review Job sheet to clearly identify all processing requirements.
- Identify Composting technologies and methods
- Select and check machinery, equipment and materials
- Identify and assess Potential Occupational Health and Safety (OHS) hazards
- Comply enterprise OHS guidelines.
- Select suitable Personal Protective Equipment (PPE)

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1 to Sheet 6”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self check 4, Self check 5 and Self check 6” **in page -50, 59, 61, 64, 66 and 68,** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, 2 and 3 in page 69, 69 and 70.
6. Do the “LAP test” **in page – 71** (if you are ready).

Information Sheet-1	Reviewing Job sheet

1.1 Job sheet or work order

May include:

- Batch number
- Compost (batch) recipe
- Job number
- product batch order and packaging requirements
- Raw materials or product quantity and quality requirement

Reconditions to be fulfilled before preparing compost

- There are two main methods for preparing compost. One is called the Indore method and the other is the Bangalore method. The names come from districts in India where the compost making processes were first developed. The difference between the two methods is in the way the materials are put together and in the time taken for completing the compost heap or filling the pit. The Indore method can be prepared either in a pit or as a heap or pile above the ground, but its preparation must be completed in less than a week. The complete Indore method uses a sequence of three layers of materials: dry plant materials, green plant materials, animal manure and some soil. It is suitable for times and places where there are plenty of materials to make the mature compost, and labor, such as in a school or with a farmers' group, to put them together quickly. The Bangalore method is prepared in areas where composting materials and water availability are limited, and labor is also limited. The materials can be collected over a week or more, and then the new layers are made until either the heap is about 1 to 1.5 meter tall, or the pit is full. The Bangalore method uses only two layers of materials: dry plant materials and green plant materials. It is very suitable for making compost from household wastes, or in farms where there are no domestic animals. Both the Indore and the Bangalore methods can include animal manure as an additional layer. Including animal manure ensures the best quality compost. But good quality compost can be made even without animal manure, i.e. just from plant materials and kitchen wastes. Preparing compost needs dedication.

Find out who will provide the water, and how. Decide if it is possible to collect and use urine. Be prepared to give time and effort, i.e. work hard, to prepare good quality compost. Set a target for the area of farmland or garden to be covered by the mature compost. Adding mature compost to a small field or even a small area in a field and then planting it with a high value crop can show good economic returns in a year. Collecting composting materials, layering or piling, and mixing are the main tasks during compost making. These need physical and mental preparation to overcome the burden of hard work, but it is only for a short time. Seeing good crops grow well and getting good yields from well-composted soil is very rewarding. In Ethiopia, and other places with warm to hot climates, mature compost can be prepared in three to four months. In colder places, decomposition to make mature compost can take from six months to a year.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Define waste materials? 4 points
2. What mean Storage of waste material and debris? 4points
3. List the Waste material and debris produced during landscape work? 8 points

Note: Satisfactory rating – 16 points Unsatisfactory – below 16 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Identifying Composting technologies and methods

2.1 Composting methods

Several composting methods are applicable to farm operation. The method chosen is dependent on the quality, capital investment, labor investment, time investment, and land and raw material availability.

The four broad methods of composting developed for use in large-scale composting are

- Passive piles
- windrows,
- aerated static pile
- In-vessel systems.

Figure 2.1 Mechanization has made large-scale composting possible: a drum chipper (left) and windrow turner (right).

Mechanization has gradually advanced, with the development of self-propelled turners which has greatly enhanced the efficiency of windrows. Current composting systems can broadly be divided according to the level of technology used, and whether the facilities are open or closed to the environment. As the windrow system is unable to supply sufficient aeration to very moist feed stocks, the aerated static pile composting system was developed in the early 1970s in Beltsville, US. In this system, the windrows are located on top of an air distribution system, made of perforated pipes embedded in wood chips. Aeration is forced through the static pile either by blowing (positive pressure) or by drawing (negative pressure). The forced aeration claims to shorten the active decomposition period from 40 days or more in the

windrow system to about 21 days in the static pile system. The initial Beltsville system draws air into the pile through negative pressure. The drawbacks of this system were cooling of the outside of the pile, and high temperatures (>80°C) in the core of the pile.

Vermicomposting

Vermicomposting, also known as vermiculture, is a simple technology using the natural digestion process of red worms and earthworms to break down organic material. From the moment it hatches, a worm can consume daily its body weight in organic matter such as vegetables, fruit, leaves, grass, meat, fish, sludge, cardboard, and paper.

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Figure 2.2 Earth worm working to produce humus.

There are many way of small scale composting method.

Methods to make Compost

There are many ways of making compost. Taking into account the factors, such as availability of organic materials and weather conditions, a choice can be made from different methods.

The following factors need to be considered during site selection

1. .The site should be accessible for receiving the materials, including water and/ or urine, and for frequent watching/monitoring and follow-up.

2. The site should be protected from strong sunlight and wind, e.g. in the shade of a tree.

3.. The site should be protected from high rainfall and flooding.

Preparing the site

1. Clear the site of stones, weeds and grasses, but do not cut down any young trees. Instead, put the site so it is in the shade of the tree(s). The tree(s) will grow, provide shade and protect the compost heap.
    1. Heap method.

2. Mark out the area for the compost heap. A minimum area is 1.25 m x 1.25 m. If it is smaller than this, the heap will dry out quickly so compost will not be made properly. The area can be larger, up to 3 m x 2.5 m.
3. Dig a shallow trench in the ground the same size as the compost heap. Make the trench about 20–25 cm deep. The bottom and sides of the trench should be smeared with water or a mixture of cow dung and water. This seals the pit so that moisture with nutrients does not leak out of the base of the compost heap.
4. The foundation layer of compost making materials is placed in the trench or pit
5. The trench holds moisture during the dry season.
6. Materials are added in layers to make the heap

2. Pit Method

The pit method is best done at the end of the rainy season or during the dry season. It is important to make the pits where there is sufficient water available; for example, by a pond, small dam, run-off from a road or track, etc. Women should not be expected to carry water just for making compost. Waste water and urine from people and animals can be collected in old containers, and used in making compost. The main reasons for making pit compost in the dry season are as follows:

1. After harvesting is complete, farmers can arrange their time to make compost including working together in groups according to their local traditions to share their labour.

2. If farmers have a biogas digester, the bio-slurry from the digester can be used to make high quality compost at any time of the year, but particularly during the dry season.

3. The pits can be filled two or more times so that a large quantity of compost can be made over the duration of the dry season.

4. If pit compost is made during the rainy season or in very wet areas, water can get into the bottom of the pit. This will rot the materials producing a bad smell and poor quality compost. In wet areas it is better to make compost through the piling method.

5. Poor quality compost will not be productive and this can discourage farmers and others from trying to make better quality compost.

6. It is very important to have frequent follow-up and control of the balance of air and water in the materials being decomposed to make compost.

Selecting and preparing the site

1. The site should be accessible for receiving the composting materials, including water and urine, and for frequent watching/monitoring and follow-up.

2. The site should be protected from strong sunlight and wind. It should be in a protected area, for example, in the shade of a tree.

3. The pit or pits should be marked or have a ring of stones or small fence around it or them so that people and animals do not fall into it or them.

4. The site should not be where floods can come.

Bangalore compost preparation methods

The Bangalore method is not as precise or as demanding as the Indore method because the composting materials are added as they become available. It is highly suitable where there is a shortage of both composting materials and water. The Bangalore method can be used for both piling and pit methods, but the pit method is preferred in Ethiopia. This is because the pit holds moisture better than the heap, and the wind cannot blow away the materials so easily in the dry season. However, inside house compounds, the piling method is also convenient.

Selecting and preparing the site

1. Select a site where it is easy to add materials, e.g. inside a house compound.

2. The site should be sheltered from rain and wind. The best is in the shade of a tree, or on the north or west side of a building or wall to be sheltered from sun for most of the day.
3. Clear the site of stones and weeds, but leave trees to grow and give shade.
4. Mark out the length and width of the heap; for example, 1–2 m x 1–1.5 m and dig a trench 20–25 cm deep, i.e. about the depth of a hand, to be at the bottom of the heap to hold the foundation layer and stop it drying out in the dry season.

3. Pit composting

Selecting and preparing the site

1. It should be in a place that is easy to take the materials, including water and urine, to the pit as well as for watching and follow-up.

2. The site should be protected from strong sunlight and wind. It can thus be, for example, in the shade of a tree, or on the west or north side of a building or wall.

3. The pit should be marked or have a ring of stones or a fence of branches around it so that people and animals do not fall into it.

4. The site should be protected and away from where floods can come.

4. Basket composting

If materials for composting are in short supply, you can still make good use of them by using the basket method of composting. It is especially useful for food production in home gardens.

Seeds or seedlings can then be planted around the basket structure. The plants will make use of the nutrients in the compost. If you build more compost baskets in your garden, place them in different areas every time so that the whole garden becomes more fertile.

5. Trench composting

Trench composting is suitable for groups. These can be groups of farming households, environmental clubs in schools, or youth group members who agree to

work together to collect the materials, make the compost, and then share it among the members, or use it in their common garden. Trench composting is good for mixed groups of men and women because men can do the heavy work of digging the trench and turning the compost materials, while the women can contribute materials and help carry the mature compost to where it is needed, including their own fields and gardens.

1. Plan to make compost in a trench at the end of the rainy season when there is plenty of suitable compost making materials available from clearing paths and compounds, etc., so that the mature compost is ready for the next growing season, or for making nursery beds for raising tree and vegetable seedlings.

2. The trench should be made at a convenient place for the members of the group to bring the collected materials; for example, near a path used by the members. It should also be under the shade of a tree to protect the people working to make the compost from getting too hot in the sun. In some communities, the people making and turning the compost do it in the evening or even at night to prevent getting overheated. The strong smell that can come from decomposing materials is also reduced in the cool of the evening or night.

3. A good size for the trench is as follows: } 0.5–1 metre deep, but not deeper than 1 metre } 1–1.5 metres wide } 2.5 metres or longer if there are plenty of materials, even up to 10 metres long

How to prepare and fill the trench

1. Mark out the size of the trench. Note: the length of the trench can be increased as more materials become available.

2. Dig down to 0.5–1 m and put the soil in a pile to one side of the trench. The soil is added in layers between the composting materials and/or used to cover the top of the filled trench.

3. The group members collect and bring materials from their houses, home compounds, cleaning paths, weeding, after harvesting vegetables, etc., if possible after having animals lie on the materials for one or more nights.

4. Look for and collect dry plant materials, such as long grasses and matting, sorghum and maize stalks to make a foundation layer. Get them broken up by animals walking and lying

down on them. Put these materials as a bottom layer in the trench. Sprinkle/scatter water over the dry materials until they are moist, but not wet.

5. Mix all the collected materials together. Some or all of the following are suitable: Cleanings from the house and from cooking; Crop residues – leaves and stalks from harvesting and clearing/cleaning vegetable fields; Grasses; Chicken and goat and sheep droppings, cow dung; and Ashes, etc. Add some old compost as a starter (like yeast).

6. Put the mixed materials in the trench in layers, each 20–25 cm thick at the sides and thicker in the middle.

7. Sprinkle/scatter water, or urine mixed with water over the materials, until they are moist but not wet. Any type of wastewater, even after washing clothes with hard washing soap, (but NOT with powder or liquid detergents) can be used for wetting.

8. Cover this layer with a thin layer of the soil taken from digging the trench.

9. Repeat this process of making layers until the trench is full and the middle is 25–50 cm higher than the surrounding ground.

10. Mix the soil that was dug out from the trench with straw, grasses, cow dung and water, in the same way as making a mud plaster to cover the walls of a house. Use this mixture to make a complete cover and seal over the top of the compost materials. Regularly check the mud plaster cover and repair cracks or other types of damage.

11. Put ventilation/testing sticks in the compost materials at about 1 metre intervals.

12. Finally, cover the trench with thatching grass or wide leaves of banana or pumpkin or fig trees, and/or plastic to keep in the moisture and heat.

13. Regularly use the testing sticks to monitor the progress of compost making.

14. The covered trench can be left untouched for three to four months, or longer, by which time mature compost will have been made. Evidence of compost making is seen first in the heat, and then in the fact that the heap shrinks down, and weeds start to grow on the mud cover.

How to turn over trench compost

1. After two months, the cover can be opened and the compost turned over. At the same time, the moisture balance and decomposition process can be checked.

However, if the decomposition process is not complete, the compost will have a strong smell. It is best to do the turning over process during the early morning, or in the evening, or even at night to reduce the smell.

2. Turning over the compost is best done by digging out all the compost from about 50 cm at one end of the trench, and putting this outside the trench. Then the remaining compost is turned over in units of 50 cm into the trench so the materials at the top are put at the bottom and those at the bottom are put on top. The materials taken out from the first 50 cm strip are put back at the end of the trench. This is the same method as that used in double digging a vegetable bed.

3. If the materials are not well decomposed and too dry, water can be sprinkled over the materials as they are turned over.

4. If the materials are too wet and smelling of ammonia, more dry materials can be added in the turning over process.

5. After turning over, the materials need to be covered and sealed as described above

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is the importance of appropriate handling and transportation of materials, equipment and machinery? 5points

Note: Satisfactory rating – 5 points **Unsatisfactory – 5 below points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Selecting and checking machinery, equipment and materials

The material, tools, equipments and machinery used for prepare compost are the following

- ✓ Sickles
- ✓ Rake
- ✓ Spade
- ✓ Machete
- ✓ Shovel
- ✓ Mattock/pick
- ✓ axe
- ✓ Hoe (small)
- ✓ Hoe (large)
- ✓ Forked hoe
- ✓ Watering can
- ✓ Rope
- ✓ Measuring tape
- ✓ Wheel barrow
- ✓ Sacks
- ✓ Graduated cylinder
- ✓ Pegs
- ✓ Wire mesh
- ✓ Nails
- ✓ Stake
- ✓ thermometer
- ✓ Thatch grass
- ✓ Harrows Plows
- ✓ Tractors and trailers
- ✓ Beam balance
- ✓ pH meter
- ✓ Hammer
- ✓ Saws
- ✓ Buckets
- ✓ Hand

❖ Equipment used for basic field tests

- ➢ oxygen probe
- ➢ representative sampling protocol
- ➢ sample preparation: sieving, weighing and drying
- ➢ test to assess moisture content
- ➢ temperature probe
- ➢ Water electrical conductivity (EC) meter.

❖ Load-shifting machinery

may include*:*

- ➢ particle size screening machinery such as trammel screens, vibrating screens, power screens or screening plants
- ➢ size reduction machinery such as tub-grinder, hammer mill, shredder or rotary shear
- ➢ Windrow turning machinery and other specialized machinery.

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write equipment used for basic field tests?(6 points)
2. Write at list 3 Load-shifting machinery?(5 points)
3. List at list 5 materials used for compost preparation?(6 points)

Note: Satisfactory rating – 17 points Unsatisfactory – 17below points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating= _____

Name: _____for compost preparation_____ Date: _____

Answer sheet

Information Sheet-4	Identifying and assessing Potential Occupational Health and Safety (OHS) hazards

4.1. Health and safety

Health and safety measures should be incorporated into the design of the facility to mitigate operator fatigue and the potential for injuries, as well as downtime due to human-error-related incidents. In organic processing facilities, there are somewhat unique conditions that should be taken into account. One critical consideration is the air quality within the facility and the potential for personnel to be exposed to elevated levels of air contaminants (example; ammonia, methane, carbon monoxide, dusts and bioaerosols). Typically, occupied areas within organic waste processing facilities are designed with six or more air changes per hour. Ventilation systems are often supplemented with source capture systems around unit processes, such as mixing and screening operations, and open processing vessels or piles. Where possible, processing technologies and material handling systems should be designed in a manner that controls temperature and humidity within buildings. This is necessary to prevent fog from developing inside the building, which can reduce visibility and lead to accidents.

❖ **Occupational health and safety**

Definition: Occupational health and safety is concerned with health and safety in its relation to work the working environment.

❖ **Aims of occupational health and safety**

Occupational health should aim at:-

- The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation.
- The prevention amongst workers of departures from health caused by their working conditions.
- The protection of workers in their employment from risks resulting from factors adverse to health.
- The placing and maintenance of workers in an occupational environment adapted to his physiological and psychological capabilities.
- To summarize the adaptation of worker to man and of each man to his job.

❖ **Hazards**

Identifying OHS hazards

Hazards are risks that occur when providing organic production work support that could affect our health or our safety. In the different activities there could happen different hazards to our health and safety this could be identified as;-

- biological hazards associated with waste
- ergonomic hazards associated with manual handling
- physical hazards such as:
- compressed air and water
- dust
- hammer mills and grinders
- hot or cold weather conditions
- noise
- shredders
- underfoot conditions
- vehicles and mobile machinery
- sharps or other physical contaminants in materials

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the hazards occurring during of compost raw materials collection?(1points)
2. List aims of occupational health and safety (4points)

Note: Satisfactory rating – 8points Unsatisfactory – 8 below points

You can ask your teacher for the copy of the correct answers.

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-5	Complying enterprise OHS guidelines

Enterprise procedures

May include:

- forms, work orders and job sheets
- hazard, incident and non-conformance reporting
- processes
- management system documents
- policies
- Work practices, procedures and work instructions

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the activities according to enterprise work procedures? 8 points

Note: Satisfactory rating – 8 points Unsatisfactory –8 below points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-6	Selecting suitable personal protective equipment (PPE)

6.1. Personal protective equipment

Personal protective equipment is to include that prescribed under legislation, regulations and enterprise policies and practices**.** Suitable personal protective clothing and equipment is selected, used, maintained and stored in accordance with “Occupational Health and Safety” requirements during raw materials collection.

6.2. Select personal protective equipment

Consider these factors when selecting personal protective equipments (PPE):-

- Type of hazardous materials, processes, and equipment involved.
- Routes of potential exposure (ingestion, inhalation, injection, or dermal contact).
- Correct size for maximum protection.
- Minimal interference with movement.

Personal protective clothing and equipment may include:-

- ✓ dust masks
- ✓ earmuffs
- ✓ fire extinguishers
- ✓ gloves
- ✓ hard hats
- ✓ protective clothing
- ✓ reflector high visibility vests
- ✓ safety footwear
- ✓ safety glasses

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Different types of PPE are described below

Eye protection: Use safety glasses for minor splash hazards, goggles for moderate hazards, and goggles combined with a face shield for severe hazards.

Hand protection: Hand protection is indicated for the possibility of severe cuts, lacerations, or abrasions, punctures, temperature extremes, and chemical hazards. (Nit rile loves are usually a good choice for general use.) Use heavy-duty gloves for non-incidental contact and gross contamination.

Body protection: Protective clothing includes lab coats, smocks, scrub suits, gowns, rubber or coated aprons, coveralls, uniforms, and pierce-resistant jackets and vests.

Head protection: Hard hats must be worn by electricians, construction workers, and any other workers when there is a danger of objects falling from above.

Self-Check 6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List personal protective equipments? (5points)
2. Mention the considering criteria's during personal protective equipments? (4points)

Note: Satisfactory rating – 9 points Unsatisfactory –9 below points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Operation Sheet 1	Identifying Composting technologies and methods

1.1 Prepare heap method of compost

Step1. Select site

Step2. Prepare raw materials

Step3. Measure 2m X 1.5m

Step4. Dig to make heap composting

Step5. 10-15 cm of material, which is difficult to decompose (twigs, stalks)

Step6. 15 cm of material which is easy to decompose (green and fresh)

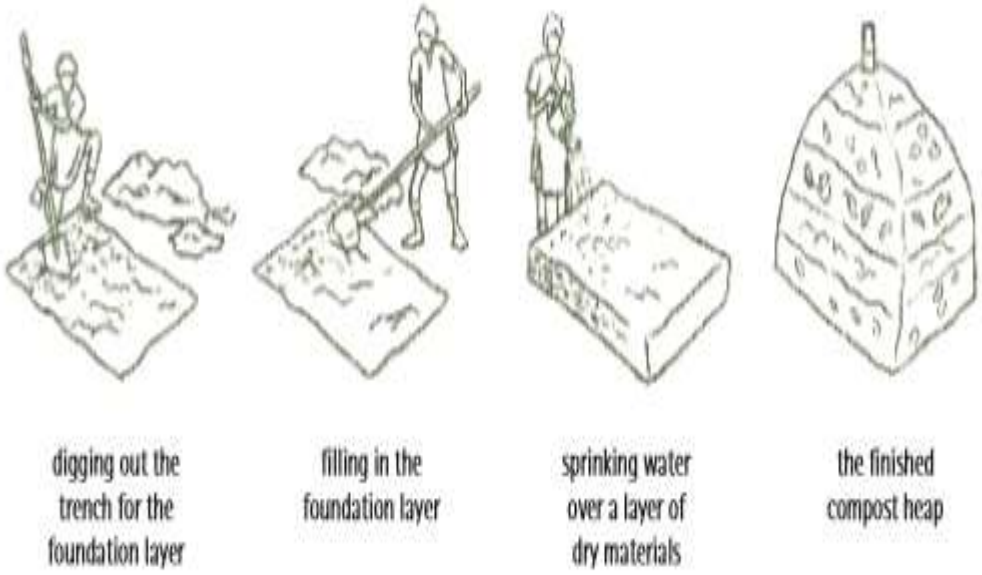
Step7. 2 cm of animal manure

Step8. 2 cm of wood ash

Step9. 2 cm of soil from the surface of arable land to obtain the micro-organisms needed for the composting process

1. Repeat step 6-9 until the heap reaches 1 to 1.5m high

Cover with grass or leaves (such as banana leaves) to prevent water loss



1.2 Prepare pit method of compost

Step1. Select site

Step2. Prepare raw materials

Step3. Measure 2m X 1.5m

Step4. Dig to make pit composting

Step5. 10-15 cm of material, which is difficult to decompose (twigs, stalks)

Step6. 15 cm of material which is easy to decompose (green and fresh)

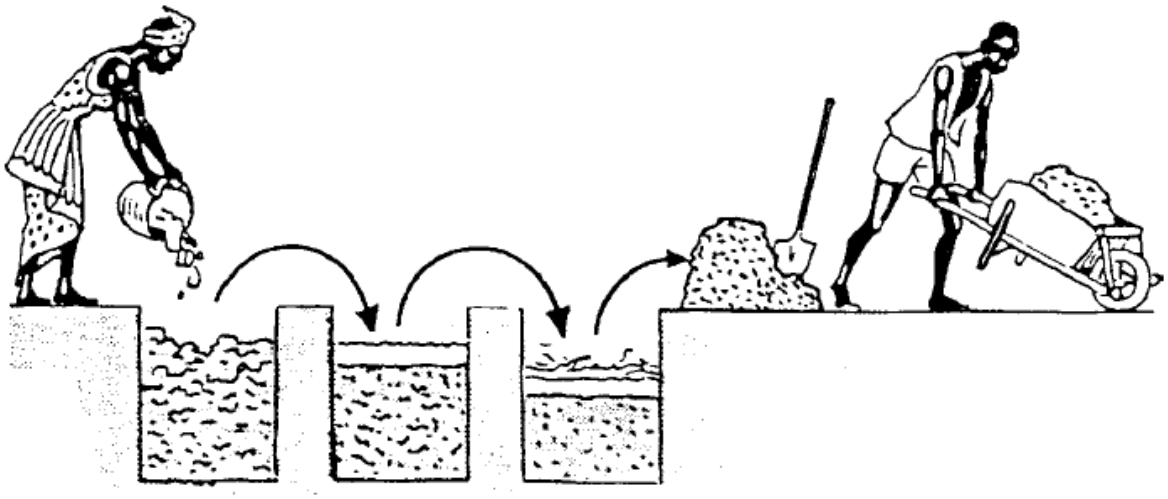
Step7. 2 cm of animal manure

Step8. 2 cm of wood ash

Step9. 2 cm of soil from the surface of arable land to obtain the micro-organisms needed for the composting process

1. Repeat step 6-9 until the heap reaches 1 to 1.5m high

Cover with grass or leaves (such as banana leaves) to prevent water loss



Process of pit composting

1.3 Prepare basket composting

- Dig circular holes 60 cm in diameter and 60 cm deep
- Line the bottom with material which is difficult to decompose (twigs, stalks)
- Add 15 cm of green vegetation (young leaves that have a high water content)
- Add 2cm of animal manure
- Add 2 cm of ash
- Repeat steps 3 to 5 until the hole is full
- Cover with grass or leaves to prevent water and nutrient loss
- Using thin sticks and weaving them together, mark the circular outline of the pit with a round basket.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hours.

Task 1. Prepare heap method of compost

Task 2. Prepare pit method of compost

Task 3. Prepare basket composting

List of reference Materials

1. AS 4454–2003 Australian Standard for Compost, soil conditioners and mulches.
2. Available from SAI Global www.techsheet.com Ph: 1800 699 9277. Buchanan M (2002) Compost maturity and nitrogen release characteristics in Central Coast Vegetable production.
3. Californian Integrated Waste Management Board publication (www.ciwmb.ca.gov/Organic wastes/Publications/). Buchanan M, Brinton W, Shields F, West J, Thompson W, Cotton M (2002)
4. The CCQC Compost Maturity Index. In 'Proceedings of Waste and Recycle 2002 Conference' Perth WA, pp. 83-92. Buckerfield J, Webster K (2003) Composted organics for soil rehabilitation.
5. Report to Natural Heritage Trust. Millar PD (2002) Composting: A durable technology for disinfestation of manure, sewage sludge and organic residuals in an era of emerging and re-

Horticultural Crops Production

Level III

Learning Guide#21

Unit of Competence: - Prepare compost

Module Title: - Preparing compost

LG Code: AGR HCP1 M06 LO4-LG-21

TTLM Code: AGR HCP1 TTLM0120v1

LO4. Carry out compost production processes

Instruction Sheet	Learning Guide#21

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- ✓ Identifying and collecting raw materials and additives for processing
- ✓ Identifying and taking action for Potential contamination of products
- ✓ Identifying physical contaminants
- ✓ Handling and stockpiling Physical contaminant
- ✓ Confirming Composting technology and methods
- ✓ Pre-processing raw materials
- ✓ Mixing pre-processed raw materials
- ✓ Handling feedstock mixtures
- ✓ Assigning codes and creating batch documentation
- ✓ Identifying Compost and other products
- ✓ Comparing characteristics of products
- ✓ Identifying Potential hazards in handling products

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Identify and collect raw materials and additives for processing
- Identify and take action for Potential contamination of products
- Identify physical contaminants
- Handle and stockpile Physical contaminant
- Confirm Composting technology and methods
- Pre-process raw materials
- Mixing pre-process raw materials
- Handle feedstock mixtures
- Assign codes and create batch documentation
- Identify Compost and other products
- Compare characteristics of products
- Identifying Potential hazards in handling products

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1 to Sheet 12”.
4. Accomplish the “Self-check 1- Self-check 12 **in page -79, 83, 85,87, 92,94,98, 100,103, 107,109 and 111** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 in page -- .
6. Do the “LAP test” **in page –** (if you are ready).

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Information Sheet-1	Identifying and collecting raw materials and additives for processing

1.1 Raw materials identification

- Raw materials that have high potential for preparation of compost are –

1. Plant residue and other plant bodies

The plant nutrient composition of agricultural wastes usually has some relationship to nutrient content of plant materials. This is understandable as most agricultural wastes originate directly or indirectly from plant materials. There can be considerable variation in the nitrogen, phosphorus and potassium content of plant material.

A). Crop residues

Residues from most crops are returned directly to the soil during harvesting. These comprise all items discarded after harvesting and threshing of the produce, like stem, leaves, husk, peels, sugarcane trash, vegetable waste, orchard leaf litter, processed food waste and processing wastes.

b). Peat moss litter

This material is being increasingly used in market gardens to build up the organic matter content of the soil. The light brown fibrous peat is better than the dark brown materials because it is better medium for biological activity as a result of it is absorbs more water readily and cellular composition.

c). Weeds

Especially seaweed is important manure and is collected after heavy weather and piled in heaps to dry and rot. Seaweed has been used as a fertilizer since long. For those farmers who are close

to the sea, it can be very useful. Many species are known and it is found in most seas. Seaweed is a potential fertilizer, which is literally waiting to be picked up.

It contains many trace elements and growth regulating substances, which are highly beneficial to crops. Most seaweed decays rapidly in the soil to release easily soluble nitrogenous compounds.

d). Forestry Wastes

These also comprise various types of plant products like wood shavings, peels, saw dust and pulp. All these besides various types of forest leaf litter can be used.

2. Animal residue

A great variety of animal substances are used as manures. Cattle dung, sheep dung, horse dung, goat dung, and poultry dropping etc. can be used.

A). Birds Guano

The term “Guano” is properly restricted to a fertilizing materials consisting almost wholly of the excreta of sea birds. The excreta of the birds are highly nitrogenous, consisting very largely of uric acid, together with a fair amount of phosphoric acid derived from the fish which is the exclusive diet of the birds.

b). Poultry manure (dropping)

In some areas of the country there are available appreciable quantities of poultry manure mixed with variable amounts of litter. The average recoveries in the excreta from laying birds of the nitrogen, potassium and phosphorus in the food are respectively about 70, 80, and 75%. The recovery of nitrogen is greater than that from larger animals.

c). Larger animal dung

The wastes of larger animals like cattle dung, sheep dung, goat dung, horse dung, camel dung, donkey dung, etc. are used as sources of organic fertilizers.

3. Town Refuse

Waste materials of various types have to be collected and disposed of in all towns and the possibility of their value for manorial purposes has frequently been considered.

A). Sewage and Sludge

Sewage and sludge are the domestic and industrial wastes which contain large quantities of plant nutrients and are used for growing of crops near many towns.

b). Screened Dust

In most towns the cleaning departments collect and remove the refuse from building and streets to a depot where paper, ranges, bottles, metals and cinders are removed by hand, by magnet and by screening and the sale of these materials in an important item in local

revenue. In some cases the screened dust is mixed with richer manorial waste material. For example, it is sometimes used to absorb slaughter house refuse or it is mixed with garbage.

4. Industrial Wastes

Some types of industrial wastes, waste from food processing, distillery, brewing, etc. can also be used as a source of raw materials for preparation of organic fertilizers.

A). Brewing and distilling products

Like malt culms, which are the root lets of germinated barley and other industrial crops are useful local sources of organic fertilizers, but cannot be expected to have much direct fertilizing value.

b). Rape dust and other cake residues

During extracting the ground rape seed with oil solvents the residues which is really improved by the complete removal of the oil, is used only for manure. Rape dust contains about 5%of N with such small quantities of P and K that it must in the main be treated as nitrogenous manure.

- Generally the raw materials available for composting include

  Animal mortalities, Bio solids such as :Sewage sludge, Crop residuals, dairy waste, fats and oils, and food organics such as: food processing waste, food waste ,kitchen waste, forestry residuals, manures, organic sludge's, other organic waste or by-product of processing, paper mill wastes, paper-based materials, sawdust and wood shavings, sewage facility grit and screenings, Wood and timber (non-treated).

1.2 Additives

May include:

- biological inoculants that aid the processing of particular
- raw materials or manufacture of compost products with
- particular attributes
- ferrous sulphate or other chemical additives
- lime
- nutrients
- urea.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is composting?(2)
2. List row materials for composting?(3)
3. Discuss advantages of crop residues?(1)
4. Compare cattle, goat, swine and chicken manure?(2)
5. Write advantages for composting agricultural wastes for fertilizer use?(2)

Note: Satisfactory rating – 10 points Unsatisfactory – below 10 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	**Identifying and taking action for Potential contamination of products**

2.1 Composting health and safety

Pathogens, toxic chemicals, dust and heavy metals are the main health and safety concerns for both waste workers and the general public. Compost workers tend to be more exposed since they are directly handling the waste for an extended period of time.

Health risks are influenced by the composting technology and the raw organic materials used as feed stock.

There are two classifications of pathogens; primary and secondary. Primary pathogens can infect healthy individuals, whereas secondary pathogens usually infect individuals with weakened immune systems. Bacteria, protozoan and viruses are primary pathogens, and fungi and actinomycetes are secondary pathogens.

Human excreta and animal manure contain pathogens which are found in MSW from the disposal of sludge, diapers, and yard trimmings containing domestic animal waste. Problems of contamination and action take

Heavy Metals

Heavy metals, such as cadmium, lead, and mercury, are found in MSW because of discarded objects like batteries, lighting fixtures, paints, and inks. Establishing and enforcing heavy metal standards is an effective way to ensure appropriate compost use.

Developing countries should exercise caution if applying industrialized country compost standards because the standards are site specific and may be inappropriate. The following factors for setting high quality compost standards were recommended by the World Bank in developing countries:

■ Heavy metals concentrations should be safe for use under all soil conditions

■ Compost has to be of a quality such that no leaching, or plant uptake, of heavy metals will occur even under acidic soil conditions

■ prevent the accumulation of heavy metals even after repeated applications, which might occur on lands near cities

■ guarantee all future land use options with standards set sufficiently low so that site-specific controls, even after many years of application, are unnecessary

■ limited to only one class since laboratory testing facilities are usually too limited to ensure the quality of two compost classes

■ prevent the gradual pollution of relatively clean lands

■ Conservative since testing costs tend to reduce testing frequency to an absolute minimum

■sufficiently stringent to promote development of composting procedures and systems design that can be exported to other countries

■ Encompass all soil amendments, such as worm castings from vermicomposting operations

It is also suggested that the standards be re-evaluated after five years of experience with MSW composting in different communities. If the standards cannot be achieved continuously at different locations, the reasons for exceeding the limits should be identified and, if possible, mitigated (World Bank, 1997a). The World Bank's (1997a) proposed standards are for unrestricted application. There may be cases where compost of poorer quality could be used in limited applications such as mine tailings reclamation and daily landfill cover. Design Precautions

Precautions to mitigate environmental and public health effects can be implemented in the design and sitting phases of the composting project.

The following criteria are recommended for sitting a composting facility

■ locate away from wetlands or flood plains

■ meet quality standards, such as waste sources low in toxic compounds and heavy metals, and not extremely saline

■ avoid densely populated neighborhoods and areas where adjacent land users may find the operations inappropriate, such as hospitals, religious facilities, schools

■ locate in accordance with urban plans and zoning regulations

■ avoid locating on top of sites which have wastes beneath them, or where toxic waste has been previously disposed

■ Plan sites to have buffer zones separating the facility from the surroundings, such as hills, trees, fences

■ Distance from the surface of the facility to groundwater/clay layers/bedrock should be a minimum of 1 to 1.5 meter

Developing countries should exercise caution if applying industrialized country compost standards because the standards are site specific and may be inappropriate.

The following factors for setting high quality compost standards were recommended by the World Bank:

■ Heavy metals concentrations should be safe for use under all soil conditions

■ Compost has to be of a quality such that no leaching, or plant uptake, of heavy metals will occur even under acidic soil conditions

■ prevent the accumulation of heavy metals even after repeated applications, which might occur on lands near cities

■ guarantee all future land use options with standards set sufficiently low so that site-specific controls, even after many years of application, are unnecessary

■ limited to only one class since laboratory testing facilities are usually too limited to ensure the quality of two compost classes

■ prevent the gradual pollution of relatively clean lands

■ Conservative since testing costs tend to reduce testing frequency to an absolute minimum

■ sufficiently stringent to promote development of composting procedures and systems design that can be exported to other countries

■ encompass all soil amendments, such as worm castings from vermicomposting operations

.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the composting criteria recommended for sitting a composting facility? (5 points)

2. List the factors for setting high quality compost standards were recommended by the World Bank? (10 points)

Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Identifying visible or physical contaminants

3.1 physical contaminants of compost

- ✓ Charcoal ashes - Ash from a charcoal is high in carbon dioxide, which will rob the pile of oxygen and slow down the composting process.
- ✓ Dog and cat manure - Manure from these animals may contain pathogens which are harmful to infants and children.
- ✓ Residue from crops that have been infested by pests or disease - Larvae from pests and bacterial diseases may not be killed by the heat of the composting process and can be transferred to new crops when you plant.
- ✓ Eucalyptus, acacia leaves - Leaves from these trees are poisonous to some beneficial microbes that are important in composting. Do not build your pile under these trees.
- ✓ Meat or animal fat - Meat and fat take a long time to break down and can attract flies and rodents and also there are another physical or visible contaminants such as

- biological contaminants such as pathogens
- chemical contaminants such as pesticides or heavy
- metals
- physical contaminants such as:
- glass
- metals
- plastics
- rubble, stone and soil
- sharps
- other non-biodegradable materials

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is physical contamination? (7 points)

2. List and explain some of physical contaminations (5 points.)

Note: Satisfactory rating - 12points **Unsatisfactory – 12 below points**

You can ask your teacher for the copy of the correct answers.

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-4	Handling and stockpiling physical contaminant

During preparation and application some organic fertilizers are potentially toxic to human beings and pollutant environmental conditions. Additionally there are many physical contaminants during preparation and application of compost, these are:-sharp materials, stone, hard soil and other un degradable materials, those which are high effect on skin of the workers.

Skin contact with sewage or sludge or compost or their residues, injection by mouth, smoking while working with them and other avoidable exposure are the main physical contaminants during handling, stockpiling location and arrangement on site.

The best solutions for these contaminants are using personal protective equipments like:-goggle, gloves, mouse musk, protective cloth etc.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is physical contamination in handling of raw materials? (10 points)

2. How we minimize or reduce these contaminations? (5 points

Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-5	Confirming Composting technology and methods

5.1. Composting process and techniques

Composting is the natural process of 'rotting' or decomposition of organic matter by microorganisms under controlled conditions. Raw organic materials such as crop residues, animal wastes, food garbage, some municipal wastes and suitable industrial wastes, enhance their suitability for application to the soil as a fertilizing resource, after having undergone composting. Compost is a rich source of organic matter. Soil organic matter plays an important role in sustaining soil fertility, and hence in sustainable agricultural production. In addition to being a source of plant nutrient, it improves the physico-chemical and biological properties of the soil. As a result of these improvements, the soil:

(i) becomes more resistant to stresses such as drought, diseases and toxicity;
(ii) (ii) helps the crop in improved uptake of plant nutrients; and
(iii) (iii) Possesses an active nutrient cycling capacity because of vigorous microbial activity.

These advantages manifest themselves in reduced cropping risks, higher yields and lower outlays on inorganic fertilizers for farmers. be maintained to maximize the microbial activity in the compost production system.

- **Influencing Factors:**

- C: N ratio in raw materials.
- Moisture content
- Aeration
- Reaction
- Shredding
- Turning
- Microbial activity
- Nutrient supply

5.2. Types of Composting

Composting may be divided into two categories by the nature of the decomposition process. **In anaerobic composting**, decomposition occurs where oxygen (O) is absent or in limited supply. Under this method, anaerobic micro-organisms dominate and develop intermediate compounds including methane, organic acids, hydrogen sulphide and other substances. In the absence of O, these compounds accumulate and are not metabolized further. Many of these compounds have strong odours and some present phytotoxicity. As anaerobic composting is a low-temperature process, it leaves weed seeds and pathogens intact. Moreover, the process usually takes longer than aerobic composting. These drawbacks often offset the merits of this process, viz. little work involved and fewer nutrients lost during the process.

Aerobic composting takes place in the presence of ample O2. In this process, aerobic microorganisms break down organic matter and produce carbon dioxide (CO2), ammonia, water, heat and humus, the relatively stable organic end product. Although aerobic composting may produce intermediate compounds such as organic acids, aerobic micro-organisms decompose them further. The resultant compost, with its relatively unstable form of organic matter, has little risk of phytotoxicity. The heat generated accelerates the breakdown of proteins, fats and complex carbohydrates such as cellulose and hemi-cellulose. Hence, the processing time is shorter. Moreover, this process destroys many micro-organisms that are human or plant pathogens, as well as weed seeds, provided it undergoes sufficiently high temperature. Although more nutrients are lost from the materials by aerobic composting, it is considered more efficient and useful than anaerobic composting for agricultural production. Most of this publication focuses on aerobic composting. 2 On-farm composting methods Composting objectives may also be achieved through the enzymatic degradation of organic materials as they pass through the digestive system of earthworms. This process is termed vermicomposting.

⌘ Methods of Composting

There are a few methods available for production of compost namely:

(1) Heap method
(2) Pit method
(3) Cage method

(4) Barrel method

5.3. Compost Production Process

Composting systems are often described in terms of a complete process from the reception of raw material through to the handling of the end-product. However, when only the composting process itself is considered, most systems are nearly always variations of a common theme.

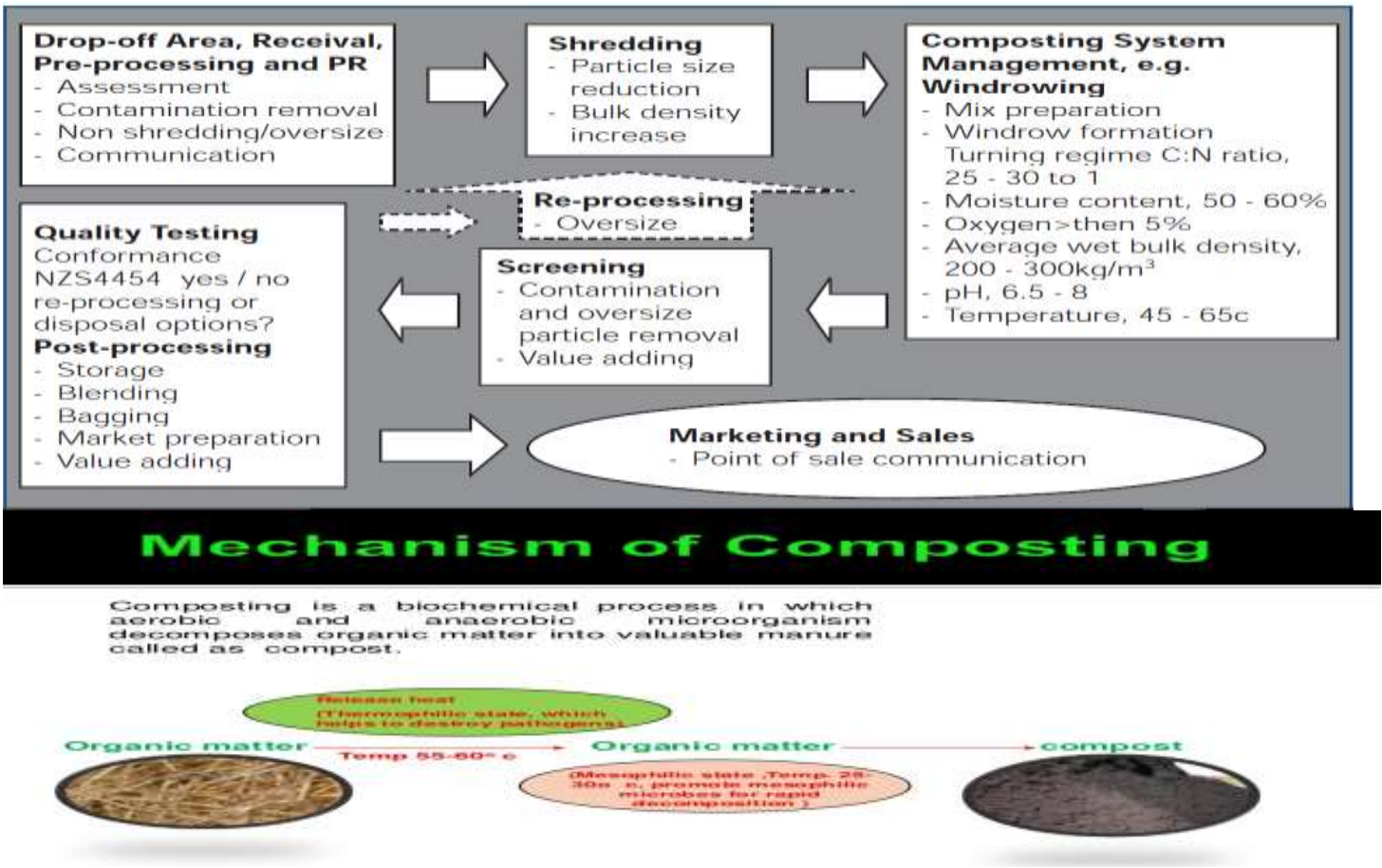

Figure- Composting and processing technologies and methods

Fig 5.1 pit method of compost

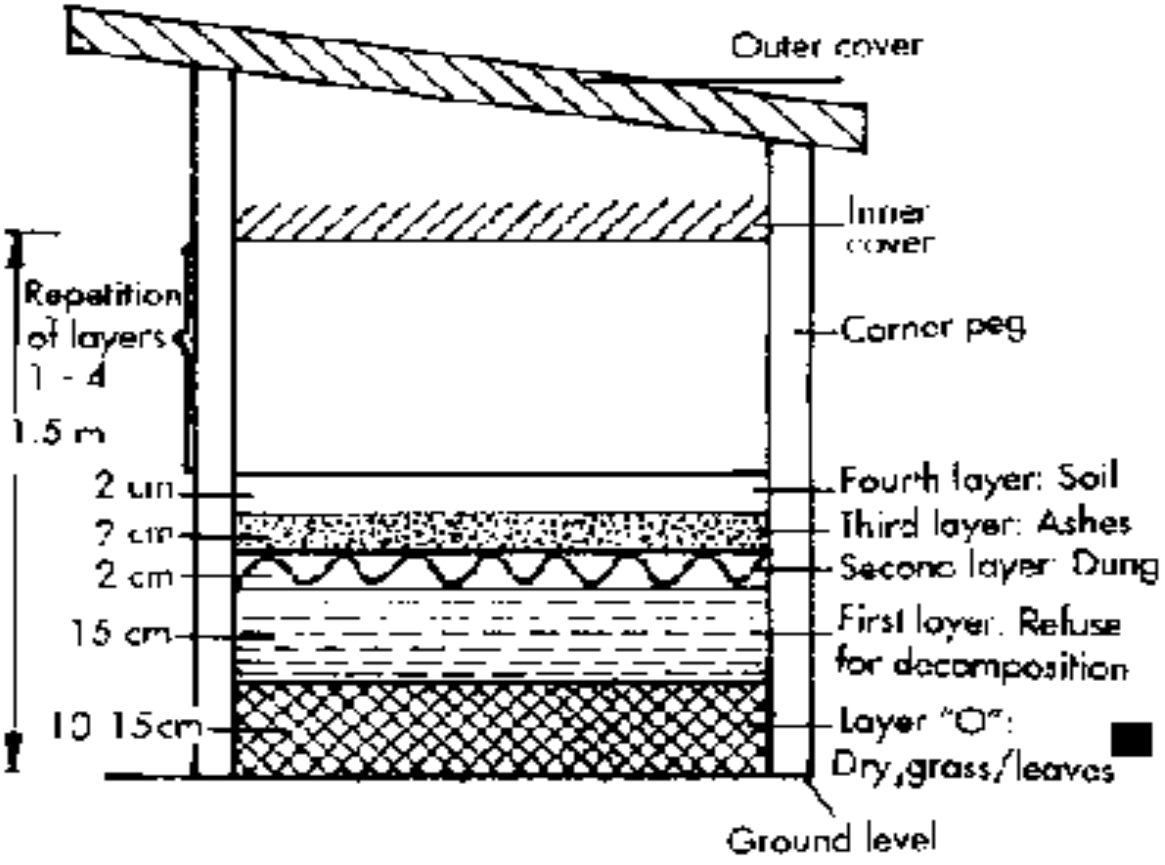

Figure5.2 Heap method of compost

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is composting? (3point)
2. List methods of composting? (8 point)

Note: Satisfactory rating – 11 points Unsatisfactory – below 11 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-6	Pre-processing raw materials

6.1 Pre-processing

The goals of pre-processing include reducing the size of brush, creating a homogeneous mix, and ensuring that compost mixes have acceptable C: N ratios and moisture levels.

Particle size reduction Tree trimmings and brush over 1" in diameter must be physically broken down by a chipper or grinder before they can be added to a compost mix. Unshipped, these materials do not have a sufficiently small surface area to make carbon accessible to microbes. Although costly to process, chipped brush provides carbon to composting microbes and enhances pile aeration by providing structure. Brush can be stockpiled prior to processing for long periods of time without causing odors. This allows the operator to chip or grind less often, during slow periods or when leased equipment is available.

Brush must be size-reduced or ground into chips in order to compost. Brush mixed with grass and leaves (commingled) can be costly to grind with equipment that is not designed specifically to handle wet materials. Many grinders on the market are most effective on dry woody materials and require extensive maintenance when handling a wet, green mixture.

The costs and benefits of a commingled yard waste stream should be carefully considered in designing a program.

⌘ Pre-processing is the activity that should be done for making favorable condition of material for composting. It may include, but not limited to:

- Immediate incorporation with absorbent raw materials
- Materials size reduction
- Moisture adjustment through such things as addition of water
- Particle size screening
- Physical contaminant removal.

Self-Check -6	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is the purpose of pre-processing? (3)
2. List the activities of pre-processing of composting

Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-7	Mixing pre-processed raw materials

7.1 Compost starting mixes

To obtain a high compost quality, it is first of all important that the organic input materials are of high quality. They should be free from pollutants and other undesirable materials like plastics, metal or glass. High-quality compost can only be produced with source separated organic materials. To guarantee a good composting process, the starting mixture has to have an adequate C/N ratio between 25 and 35. The mixture should also have an appropriate structure to allow optimal oxygenation of the material without too much loss of temperature. The higher the windrow is, the coarser the mixture has to be.

Lignin-rich material can be stored for a long time without loss of nutrients. In contrast, N-rich material has to be treated as soon as possible to avoid a decline of quality through gaseous emissions and odours. The supply of organic input materials to compost plants often varies significantly during the year. Lignin-rich materials are mostly supplied in winter while high quantities of N-rich materials are supplied in spring and summer. For this reason, supply and storage of input materials should be balanced throughout the year. Adequate amounts of lignin-rich materials should be stored, in order to be able to compose an appropriate starting mixture when high supplies of N-rich materials become available.

A useful rule-of-thumb to prepare a starting mix is:

- 1/3 rough wood (e.g. shredded wood, saving rest material from compost, snipped bark).
- 1/3 medium-fine, fibrous material (e.g. shredded branches, wood fibers, straw, foliage, switch grass, reed).
- 1/3fine materials (kitchen waste, grass clippings, manure, vegetable waste).

To improve the composting process, clays such as zeolites (5-10 kg/m3 starting mixture) or clay-rich soil (3-5 % of the starting mixture) can be added. These materials buffer the composting process, diminish odor emissions and improve the formation of stable crumbs during the curing phase of the compost. The technical preparation of the input materials also plays an important role in the decomposition of the material. This is especially important for wood. If wood is chopped into chips, microbial colonization is inefficient and the capacity of the wood as a structure-adding material to improve the aeration of the windrow is low. If the wood is correctly shredded and well de-fibered, microorganisms have good access to the material and the aeration of the windrow is highly improved (Figure

). Finally, it is essential that the starting mixture contains sufficient moisture to allow the microorganisms to become active.

Figure 7.1 Wood chips (left) cannot be efficiently decomposed by compost microorganisms, whereas defibered wood (right) can. The use of defibered wood results in a better structure within the windrows and allows for a better aeration.

Table 2.4

The C/N ratio of different organic materials is important in designing a good starting mixture

Organic material	C/N	Organic material	C/N
Urine	0.8	Kitchen organic waste	15-25
Chicken manure	8-10	Garden waste	20-35
Food waste	14-17	Coffee grounds	20-30
Grass clippings	9-25	Fruit waste	25-40
Mature compos	12-15	Tree leaves	40-70
Young compos	15-18	Straw	50-100
Cow manure	15-20	Wood (sawdust)	200-500
Hay	15-25	Nut shells	35

Figure 7.2 Example of input materials for compost production. From left to right, top to bottom: manure, chicken manure, grass; garden waste, leaves, vegetables waste, eggshells, cocoa husks.

Self-Check -7	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the C/N ratio of different organic materials is important in designing a good starting mixture 6 point
2. Write the rule-of-thumb to prepare a starting mix 6 point

Note: Satisfactory rating – 12 points Unsatisfactory – below 12 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-8	Handling feedstock mixtures

8.1 Compost feedstock's

Different feedstock will add different amounts of carbon (energy) and nutrients to the compost. When composting on-farm, the availability of manure will influence the characteristics of the resulting compost. Some basic knowledge of manure types can be helpful in designing the right starting mixture for the composting process. The composition of manure is highly variable, according to animal type, animal diet, type of housing, and the amount and type of litter, and (spilling) water used. Storage conditions and the length of storage are important factors in the amount of gaseous losses. Treatment measures such as rotating the manure heap, aeration and the use of additives will also influence the loss of organic matter and nutrients.

Manure from deep-litter stables was found to be particularly rich in potassium, as this type of manure also contains the urine. Manure from ruminants (cattle, goats, sheep) differs essentially from manure from non-ruminants (pigs and poultry).Ruminants have a four-compartment stomach, and are able to digest structured and cellulose-rich plant materials, with the aid of fermentation by anaerobic bacteria that reside inside the rumen.

Self-Check -8	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is feed stock (5)?

Note: Satisfactory rating – 5 points **Unsatisfactory – below 5 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-9	Assigning codes and creating batch documentation

9.1. Assigning codes and creating batch documentation

When time and space is not critical, a farmer has significantly greater flexibility in how they use their compost. A batch of compost set up in the spring, even if not fully cured, can be applied to fields in the fall. However, batches set up in the summer and fall may not be mature enough for spring application, hence experienced farmers often wait a full year before using a batch to ensure the compost is fully cured and mature, especially when used on high-valued crops or in transplant medium.

Documentation is the key to GMP compliance and ensures traceability of all development, manufacturing, and testing activities. Documentation provides the route for auditors to assess the overall quality of operations within a company and the final product. Location of a plant is determined on the basis of proximity to raw material, nearness to potential market outlets and the availability of developed infrastructure. Consideration is also given to fair distribution of industrial projects. It is therefore proposed that the organic fertilizer plant be located near town.

Manure should be suitably contained before treatment. The location for storage and treatment of animal manure should be as far away as possible from produce growing areas. Barriers or some type of physical containment should be used in manure storage areas to prevent contamination of produce or production areas by pathogens. These can be spread from the stored manure by rain wash, subterranean water-flow or wind.

The batch number should be immediately recorded in a logbook or by electronic data processing system. The record should include date of allocation, product identity, and size of documentation of completion of each significant step in the batch production records (batch production and control records) should include:

1. Dates and, when appropriate, times
2. Identity of major equipment used (e.g., reactors, driers, mills, etc.)

3. Specific identification of each batch, including weights, measures, and batch numbers of raw materials, intermediates, or any reprocessed materials used during manufacturing
4. Actual results recorded for critical process parameters

❖ Generally, after all activities of composting is completed batch numbers or codes and creating batch documentation is the most important which can be done by the following way:

1. Manual or electronic recording systems that enable
2. Tracking of product such as:
3. delivery of final product via the assignment of batch numbers
4. individual batch preparation and formation
5. Production process.

Self-Check -9	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is the importance of assigning code /number during documentation? (5)
2. List the ways of coding /numbering? (5)

Note: Satisfactory rating – 10 points Unsatisfactory – below 10 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-10	Identifying Compost and other products

Comparison of organic and inorganic fertilizers

Organic fertilizer	Inorganic fertilizer
✪ Mostly dissolves slowly in the soil solution ✪ Slowly utilized by plants ✪ Contains low concentration of nutrients ✪ It is formed from locally available materials ✪ Carbon is an essential component of its basic structure ✪ Required as large quantities, in terms of rates	✪ Mostly dissolves quickly in the soil solution ✪ Rapidly utilized by plants ✪ Contains high concentration of nutrients than organic fertilizer ✪ Mostly commercial fertilizers ✪ Carbon is not an essential component of its basic structure ✪ Required as small quantities, in terms of rates

Benefit from compost

- Maintains soil fertility level.
- Increases the nutrient level of the soil or improve the soil's physical condition by improving soil structure and aeration.
- Increases the infiltration capacity of the soil, thus reducing surface runoff.
- Helps to retain plant nutrients and moisture.
- Well-decomposed compost buffers soil reaction and controls soil temperature.
- Increases soil microbial activity which helps mineralization of applied chemic fertilizers, making them more available to crops.

Farmers since ancient times have recognized significant benefit of organic fertilizer to crop productivity.

- It serves as a slow release source of nitrogen, phosphorus, and potassium for plant nutrition and microorganism growth.
- It processes considerable water holding capacity and thereby helps to maintain the water regime of the soil.

- It acts as a buffer against changes in PH of the soil.
- Its dark color contributes to absorption of energy from the sun and heating of the soil.
- It acts as “cement” for holding clay and silt particles together, thus contributing to the crumb structure of the soil and to resistance against soil erosion.
- It binds micronutrient metal ions in the soil that otherwise might be leached out of surface soils.
- Organic constituents in the humus substances may act as plant growth stimulants.

- Certain components of organic fertilizers are largely responsible for the formation and stabilization of soil aggregates.
- It used to enhance microbial functions such as nitrogen fixation decomposition.
- It used for production of polysaccharides and other non-humus substances.
- It serves in increases of competition and antagonism against plant pests.
- It used to increases ion absorption capacity.
- It used to reduce water losses through evaporation
- It serves as soil temperature moderates.
- It used to reduce toxicity of certain elements.
- It used to reduce land degradation and water pollution.
- It serves as a material used to improve soil physical and chemical properties.
- Organics like compost and manure are generally free or very low cost for most farmers.
- Organic fertilizers take relatively little skill to use properly.
- Plant or animal derived organics like compost or manure usually contain significant amounts of micronutrients in addition to macronutrients such as N, P, & K.
- Plant or animal derived organics like manure not only supply plant nutrients but also organic matter which improves soil physical conditions, stimulates beneficial soil microorganisms.
- Plants grown in organically fertilized soil might be more disease resistant than in soils with artificial fertilizer only
- Soil fertility is improved in the long run: nutrients from the organic fertilizer are released gradually over a long period. Much of the nitrogen in organics is in a slow release, organic form. This is a plus for nitrogen which is susceptible to leaching losses when supplied by chemical fertilizers.

- The phosphorus in organic fertilizer is less prone to soil tie-up than that from chemical fertilizers, making it more available to plant

Self-Check -10	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. *Compare organic and inorganic fertilizers*? (6 point)
2. List the use of compost/ (4points)
3. How compost improve soil structure? (4points)

Note: Satisfactory rating – 10points Unsatisfactory – below 10 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-11	Comparing characteristics of products

Well decomposed product of compost is:-

- ✓ Friable
- ✓ Does not stick in the hand
- ✓ Dark grey or blackish in color

Handling risk

During preparation and application, some organic fertilizers are potentially toxic to human beings and pollutant environmental conditions. However, they can be used safety if the user has full knowledge of the hazards involved and of the procedures to be followed to avoid these hazards

Common contamination of compost

- ✓ Physical contaminations:-stones, hard soils, metal, sharp materials and other non-biodegradable materials.
- ✓ Biological contaminations:-like pathogens

Self-Check -11	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List the Common contamination of compost (6 points)
2. What is handling risk? (3 points)

5. Write the characteristics of well decomposed compost? (6 point)

Note: Satisfactory rating – 15 points Unsatisfactory – below 15points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-12	Identifying Potential hazards in handling products

Material handling is concerned the delivery of materials to the right place at the right time with in the plant. It includes preparation and positioning materials to facilitate transfer. Obviously, no value is added to the product, but poor materials handling will add to costs and reduce productivity.

Composting should be done preferably during the less busy times in the nursery so that labor is available to collect and process wastes, build piles, and turn the compost. It may take as long as six months to one year to complete the entire cycle from collection of the organic materials to the use of finished compost.

The materials used for making compost may not all be available at the same time of year because crops are harvested at different times and at different area. This means that the continually available matter such as animal manures and bedding and other seasonal materials may have to be stored until the required quantities are collected.

Efforts should be made to minimize decomposition during storage in order to attain the maximum temperatures during composting. Storage of putrescible (subject to partial decomposition of organic matter by microorganisms, producing a foul smelling odor) wastes is difficult because they are prone to anaerobic breakdown and can cause fly breeding problems and bad odors. Problems can be minimized if materials are dried and kept cool until needed.

Self-Check -12	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is raw material handling? (10 points)
2. What are the hazards in handling of raw materials? (15points)

Note: Satisfactory rating – 25 points Unsatisfactory – below 25 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

List of Reference Materials

1. Californian Integrated Waste Management Board publication (www.ciwmb.ca.gov/Organic wastes/Publications/). Buchanan M, Brinton W, Shields F, West J, Thompson W, Cotton M (2002)
2. The CCQC Compost Maturity Index. In 'Proceedings of Waste and Recycle 2002 Conference' Perth WA, pp. 83-92. Bucker field J, Webster K (2003) Composted organics for soil rehabilitation.
3. Report to Natural Heritage Trust. Millar PD (2002) Composting: A durable technology for disinfestations of manure, sewage sludge and organic residuals in an era of emerging.

Horticultural Crops Production

Level III

Learning Guide#22

Unit of Competence: - Prepare Compost

Module Title: - Preparing Compost

LG Code: AGR HCP1 M L06 O5-LG-22

TTLM Code: AGR HCP1 TTLM 0120v1

LO5: Monitor composting process

Instruction Sheet	Learning Guide #22

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- ✓ Monitoring Composting batch by observation and use of field-testing equipment
- ✓ Maintaining Processing and operations records
- ✓ Reporting faults or variations

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- ✓ Monitor composting batch by observation and use of field-testing equipment
- ✓ Maintain Processing and operations records
- ✓ Report faults or variations

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below 3 to 6.
9. Read the information written in the information “Sheet 1 to Sheet 3”.
10. Accomplish the “Self-check 1, Self-check 2 and Self check 3” **in page -11, 15, 18, 21 and 23** respectively.
11. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 in page 24.
12. Do the “LAP test” **in page – 24** (if you are ready).

Information Sheet-1	Monitoring composting batch by observation and use of field-testing equipment

1.1 Monitoring and parameter adjustment

The compost pile must be monitored and the appropriate adjustments made throughout the composting period. This is necessary to sustain a high rate of aerobic microbial activity for complete decomposition with a minimum of odors as well as maximum destruction of pathogens, larvae, and weed seeds. Generally, the monitoring in compost are :-

- Temperature
- Odors
- Moisture
- Oxygen and carbon dioxide.

1.2 Monitoring equipment

- ❖ Equipment used for basic field tests

- oxygen probe
- representative sampling protocol
- sample preparation: sieving, weighing and drying
- test to assess moisture content
- temperature probe
- Water electrical conductivity (EC) meter.

Composting

- Composting is a natural biological process, carried out under controlled conditions, which converts organic material in to a stable humus-like product called compost.
- During the composting process, various microorganisms (bacteria, fungi) and other larger organisms like worms and insects break down organic material in to simpler substance.
- These need certain conditions to live. These include moisture and air (Composting is an aerobic process, meaning that the microorganisms require oxygen to do their work).

- To make the best possible compost, the micro-organisms must be able to work optimally.
- This can be achieved if the following ***four*** factors are combined to the best advantage:

  (1) type of organic material
  (2) air
  (3) temperature
  (4) moisture

The composting process will be optimal when:

- Various materials of different decomposition rates are combined;
- the different materials are well mixed;
- The size of the heap varies from 1 x 1 meters to 3 x 3 meters. This makes it possible for the temperature to stay constant within the heap.

1.1. Stages of composting

A good composting process passes through 3 consecutive stages, these are as follows:

(1) Heating phase (fermentation)
(2) cooling down phase
(3) maturation phase.

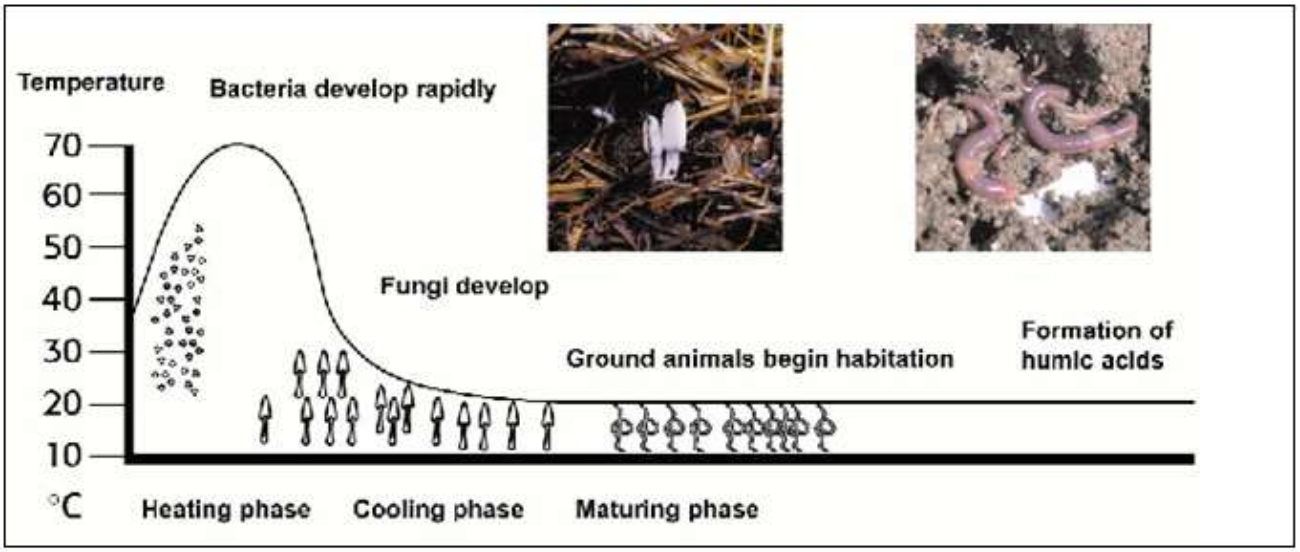

Figure 1.1 *Stages of composting*

Temperature taste

Figure 1.2 Temperature measurement is important to control the composting process

I. Heating Phase*:*

- During the first stage of composting, the compost heap starts to heat up considerably. This effect is known as ***fermentation*** and is the result of the breaking down of the complex and tough fibrous material of the organic matter.
- This fermentation process (decomposition) is strongest in the ***centre*** of the heap.

To get the fermentation going quickly and effectively, a number of factors are important.

- In the first place the compost heap should be made of all sorts of organic materials.
- Secondly, the right micro-organisms have to be present.
- Thirdly, it is very important that there is adequate oxygen and water.

- If these three conditions are met, heat is generated quickly. During fermentation the micro-organisms multiply and change at a rapid rate, which adds to the heating up process. In this way, a self-accelerated process is started.

- The fermentation stage usually begins after ***4-5 days*** and may take ***1-2 weeks***. Maximum fermentation takes place at a temperature of ***60-70 °C*** in the compost heap.
- If the temperature is too high, the necessary micro-organisms may die and decomposition comes to a halt. Due to its temperature, fermentation also has a **hygienic effect**.
- In the organic material, many pathogenic germs that are a threat to man, animal and plant, are destroyed. It is often suggested that fermentation kills weed seeds and roots too. However, in practice, this is quite disappointing. Many weed seeds are not destroyed in a normal compost heap, because the temperature is not sufficiently high. In some cases, the germinating power of weed seeds has even been known to increase.

A simple way to see if the fermentation process has started is as follows:

- Put a stick in the centre of the heap about 5 days after completing the compost heap or after the final turning over.
- Leave it there for about ***5 to 10 minutes***. After taking it out, feel it immediately. It should be considerably warmer ***(60 - 70 °C)*** than body temperature.
- If not, then this is an indication that something is wrong, perhaps the **material used** or **aeration is at fault.**

II. Cooling down phase; -

- The fermentation phase gradually changes into a cooling down phase. Decomposition occurs without much generation of heat and the temperature drops slowly.
- During this period ***new types of micro-organisms*** convert the organic components into humus. The heap remains clammy and hot inside and the temperature drops from ***50 °C to 30 °C***. By regulating the temperature, air and water supply, the process can be accelerated or slowed down.

How long this cooling down stage takes, it depends on

- the type of heap
- the material
- the attention given to it

- The climate etc. The cooling down period usually takes a few months, but in unfavorable conditions may require up to a year.

III. Maturation phase: -

- In this end phase of decomposition, the temperature drops to soil temperature, depending on the climate, ***15-25 °C***.
- Apart from the micro-organisms mentioned, the large soil fauna are active at this stage too.
- In temperate regions, earthworms in particular, feed on the strongly decomposed organic material, and in this way contribute to decomposition.
- In the tropical to semi arid regions, termites in particular play an important role, although these can also be very troublesome.
- This phase never really comes to an end; the decomposition process can go on infinitely at a slow rate.
- The compost is ready for use if it feels crumbly and looks like good brown/black organic soil.

Moisture content

Microorganisms are only active when sufficient moisture is available.

Excessive moisture, on the other hand, can lead to undesirable anaerobic processes which can even arrest the composting process. Water evaporation from the pile is important to prevent excessive temperatures as well as optimizing microbial activity. The quantity of water needed to maintain optimal moisture in the compost pile varies during the process. Water evaporation is important because of the high temperature of the pile. This evaporation is enhanced by intensive compost turning or active aeration of the pile. Maintaining optimal moisture content is therefore crucial during this period. Later, during the curing phase, much less water is lost, and water oversupply can quickly lead to excessive high moisture levels in the compost. To obtain a compost of homogenous quality, moisture distribution has to be homogenous in the pile. This is another reason for turning the compost pile periodically. The moisture content of the external layer of the compost pile (0-20 cm) is generally different from that of the rest of the pile. Therefore, moisture content should be determined using test

samples from inside the pile (typically 40-50 cm deep). Optimal moisture content for the composting process roughly corresponds to a dry matter content of about 50%.

The moisture content can be estimated using the so-called fist test take a handful of compost and squeeze it as strongly as possible between the fingers. If water flows out, the compost is too wet. Open the fingers. If the compost ball disintegrates itself, the compost is too dry. If the compost ball stays compact, the compost moisture is optimal.

Figure 1.3 Fist test to control the humidity of compost during the composting process. From left to right: too wet, optimal, and too dry

Oxygen content

To have an optimal composting process, the oxygen content in the atmosphere of the compost pile has to be at least 3 to 5 %. It is also important to pay attention to the distribution of the oxygen in the pile, making sure that each piece of material is supplied with enough oxygen. Here, it is particularly important to avoid the formation of clods using efficient compost turning; otherwise, anaerobic conditions can be present in these chunks.To be sure that the aerobic conditions are present in the whole pile, we recommend a measurement of the methane (CH_4 content within the pile – this can be carried out using a portable gas analyzer). The absence of CH_4 is an indication of a homogenous distribution of oxygen in the pile. The oxygen demand is much more important during the thermophilic phase of the composting process. Later, when the microbiological activity decreases, the oxygen demand decreases strongly and continues at a low level. It is important to constantly maintain a minimal level of oxygen in the compost to ensure high biological quality, including during the storage of the mature products.

Available nitrogen

The nitrogen (N) in composts is mainly present as organic nitrogen, which is less available to plants. However, the greatest proportion of N taken up by plants is in the form of mineral-N. Three forms of mineral nitrogen are relevant in compost: ammonia (NH4-N), nitrite (NO2-N) and nitrate (NO3-N). The concentration of these three forms is evaluated during the composting process. NH4-N is the first form of mineralized nitrogen found in compost when the organic material is decomposed. NH4-N is soluble in water and when the moisture content becomes too low, the NH4-N is lost as it will be formed into gaseous NH3 (ammonia). NO3-N during the curing process, nitrification is ongoing and the NH4-N is transformed into NO3-N. If oxygen starvation happens during the curing phase or the storage, bacteria can use the oxygen of NO3 and transform it back to nitrite (NO2; toxic for the plants) or to nitrous oxide (N2O; strong greenhouse gas). NO2-N is an intermediate, phototoxic product arising during the nitrification. It can also be a result of the denitrification process by oxygen starvation at the end of the curing process or from compost storage.

1.2. Changes in physical characteristics

1.2.1. Appearance

Provided that the process is progressing satisfactorily, the composting mass gradually darkens and the finished product usually has a dark grey or brownish colour.

1.2.2. Odour

An assortment of odours replaces the original odour of the substrate within a few days after the start of the process. If the process is advancing satisfactorily, the succeeding odours probably could be collectively described as “faint cooking”. However, if conditions are unsatisfactory (e.g., an aerobiosis), the predominant odour would be that of putrefaction. If the C: N of the substrate is lower than about 20:1 and the pH is above 7.5, the odour of ammonia could become predominant. An earthy aroma is characteristic of the curing and maturing stages.

1.2.3. Particle size

Because of abrasion by the other particles and of maceration, the particle size of the substrate material becomes smaller. Additionally, decomposition renders fibers brittle and causes amorphous material to become somewhat granular.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List the *stages of composting*? (3 points)
2. List the equipment used for basic field tests of compost(3 points)

Note: Satisfactory rating – 6 points **Unsatisfactory – below 6 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	**Maintaining processing and operations records**

2.1. Identify and carry out site maintenance requirements.

Composting may be defined as a biochemical process by which diverse and mixed group of microorganisms breaks down organic materials to humus. Some favorable characteristics of site include:

- Located adjacent to Public Works Facility –
  - Facilitates site monitoring of pubic use and easy access by Public Works Staff as needed to complete tasks.
- Compost pad is fenced and site is generally buffered from residential receptors or
- impacting other sensitive areas –
  - Reduces negative residential impacted by sight, noise, odors and dust.
- Outgoing Material Demand –
  - Finished mulch and compost material moves offsite quickly because of the demand by residents and local landscapers.
  - This minimizes the need for large material storing areas.
  - Material is readily available for the rented gardens.
- Paved Compost Pad
  - The paved compost pad provides an efficient and solid working surface to manage compost piles, which minimizes impact

(E.g. pond) from rain events, reduces dust, improves vehicle mobility and eliminates soil and gravel being mixed into windrows.

2.2. Identifying Traffic access routes and site traffic/pedestrian safety rules.

Traffic Flow and Safety

- ✓ Residential and commercial vehicles that enter the drop off or
- ✓ Receiving area at the compost facility enter and park to unload or dump yard waste onto a centralized pile.
- ✓ In periods of low traffic volume, the current configuration appears to operate satisfactorily
- ✓ The configuration could be safer and more efficient.
- ✓ the finished compost and mulch is located inside the gate of the drop-off/receiving area,

2.3. Maintaining Vehicle access routes on site

- Vehicles, during the time of transportation of animal by-products other than manure or poultry litter must not enter any place where farm animals are kept.

- Vehicles and receptacles used for transporting compost products/material shall be maintained
- Containers, receptacles and vehicles used for transporting untreated material must be cleaned, washed and disinfected after each use, with the following exceptions:
- In the case of vehicles transporting only untreated catering waste, only the wheels of the vehicle need to be cleaned and disinfected
- Vehicles transporting external cleaning and disinfection procedures before leaving the Plant.
- This is particularly important in the case of vehicles transporting manure where the vehicle is returning to a place where farm animals are kept.
  - ✓ Wheel-wash facilities must be designed, operated and maintained in a manner which works properly.
  - ✓ In the case of manually operated cleaning and disinfection facilities for containers/receptacles /vehicles, the cleaning procedures must be recorded and signed off by the transporter.

Therefore, optimum conditions should be maintained to maximize the microbial activity in the compost production system. Influencing Factors

- ♠ C: N ratio in raw materials.
- ♠ Moisture content
- ♠ Aeration
- ♠ Reaction
- ♠ Shredding
- ♠ Turning
- ♠ Microbial activity
- ♠ Nutrient supply

❖ **C: N ratio in raw materials**:

- Low C: N ratio in raw materials is beneficial for decomposition.
- Low C: N ratio increases microbial activity.
- Green leaves are low in C:N ratio
- Do not use materials with high C:N ratio alone.
- Arrange high C: N ratio and low C: N ratio raw materials alternatively.

❖ **Moisture Content** :

- Moisture is necessary for microbes
- If moisture is low microbial activity is also low
- Too much of moisture is not suitable.
- Optimum moisture should be maintained throughout the process.
- A suitable cover should be used to maintain the optimum moisture content.

❖ **Aeration:**

- During the composting process O_2 should be well supplied and CO_2 should be easily released.
- If not anaerobic condition may take place.
- Under the anaerobic condition bad odor may appear.
- To obtain good aeration arrange different types of raw materials in layers
- Turning may increase the aeration.
- Keep the reasonable width in heap method (maximum 6-7 feet).

❖ **Reaction:**

- Reaction is important for microbial activity.
- In the alkaline condition activity of microorganisms may reduce.
- Therefore, liming materials such as ash, lime and dolomite are not recommended.
- In addition, under the alkaline condition N in raw materials may loss as NH_3.
- Ash could be added after completion of the composting process.

❖ **Shredding**:

- Shredding or chopping of raw materials in to small pieces will increase the microbial activity.
- Increase aeration
- Optimum size of pieces is almost 5 cm.
- Increase surface area for microbial activity.
- Shredding is laborious.
- Recommended raw materials such as banana trunk, hard raw materials etc..
- In general shredding is not recommended due to high cost.

❖ **Turning**:

- Increase aeration
- Increase decomposition
- Un-decomposed raw materials may mix properly.
- Facilitate to keep the optimum moisture by adding water or drying.
- It is laborious.

- Maximum 3 times turning is recommended

❖ **Microbial activity**:

- Add inoculants after every 2-3 layers of raw materials.
- Inoculants may increase the microbial activity and increase the decomposition.
- In addition to compost decomposed garbage or any other organic materials are suitable as inoculants.
- **Nutrient supply**:

- Addition of N fertilizers reduces the C: N ratio and increase the decomposition of raw materials.
- Increase the microbial activity.
- Increase decomposition.
- Rock phosphate is suitable to enrich compost with P

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the optimum conditions should be maintained to maximize the microbial activity in the compost production system. ? (5point)

2. Write the C: N ratio in raw materials? (5 point)

Note: Satisfactory rating – 10 points Unsatisfactory – below 10 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	**Reporting faults or variations observed at any stage of process**

The following table summarizes possible problems during composting and recommends solution

Table.1. problems during composting and recommends

Situation	Requirements / Possible solutions
1. Raw Material Composition	
Large amounts of sand Large amount of household hazardous waste d stones	Improve public awareness to reduce the proportion of inert materials in waste ✓ Adapt collection vehicle (e.g., by fitting mesh floor) to reduce sand content ✓ Remove organics from the mixed waste instead of removing the residues from the organic waste (inverse selection) ✓ Pre-screening of waste at the composting site with fine mesh size ✓ Improve public awareness to initiate source segregation ✓ Provide separate collection for hazardous materials
Composting parameters	
Nitrogen deficiency (high C/N value	✓ Add manure (cow, chicken, buffalo) or urea
Carbon deficiency (low C/N ratio)	✓ Add wood chips, dry leaves or saw dust
Too high temperature during thermophilic phase (> 70° C	✓ Turn pile ✓ Water pile if necessary
Too low temperature during thermophilic phase (< 30° C)	✓ Check moisture content, if necessary add water ✓ Check C:N ratio
High moisture content (> 70%)	✓ Turn pile, spread out pile before reforming and leave to dry ✓ Add sawdust or wood chips for absorbing moisture
Low moisture content (<	✓ Spread waste and sprinkle sufficient wate

40%)	
Odor development (anaerobic conditions)	✓ Insufficient oxygen!!! Turn the pile more often ✓ If waste is very sticky and compact, mix in coarse material like wood chips to increase aeration ✓ If heap is too wet, turn it and let dry before re-piling ✓ Avoid composting meat and fish leftovers
Climatic influences	
Hot and humid climate or high rainfall season	✓ Protect waste from getting soaked, use roofed area for composting and maturing ✓ Or, cover piles with tarpaulin or composting fleece
Hot and arid climate or extended dry season	✓ Use roof to protect compost from direct sunlight ✓ Or, cover with tarpaulin or composting fleece to avoid excess evaporation ✓ Water more frequently. Collect rainwater and store for dry season if possible
Frequent strong winds	✓ Check moisture more frequently as evaporation will increase
Vectors	
Excessive flies, insects	✓ Cover heap with 2 inch layer of coarse compost ✓ Make sure to receive fresh organic waste (not older than 2 days)

❖ **Reporting unsafe conditions**

Whenever a person observes what appears to be an unsafe or harmful condition or act the person must report it as soon as possible to a supervisor or to the employer, and the person

receiving the report must investigate the reported unsafe condition or act and must ensure that any necessary corrective action is taken without delay.

- **Emergency conditions**

If emergency action is required to correct a condition which constitutes an immediate threat to workers only those qualified and properly instructed workers necessary to correct the unsafe condition may be exposed to the hazard, and every possible effort must be made to control the hazard while this is being done.

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write at list 5 problems during composting and possible solutions?(12 points)

Note: Satisfactory rating – 12 points Unsatisfactory – below 12 points

You can ask your teacher for the copy of your answer

Score = _____
Rating= _____

Name: _____ Date: _____

Answer sheet

Horticulture Crops Production

Level III

Learning Guide-23

Unit of Competence: -Prepare Compost

Module Title: - Preparing Compost

LG Code: AGR HCP1 M L06 O6-LG -23

TTLM Code: AGR HCP1 TTLM 0120v1

LO6: Prepare value-added products

Instruction Sheet	Learning Guide #23

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- ✓ Identifying Compost and product additives
- ✓ Selecting, using, maintaining and storing Suitable personal protective equipment (PPE) and clothing
- ✓ Measuring and transporting compost and product additives
- ✓ Monitoring and checking value-added product
- ✓ Preparation method and machinery of value-added products
- ✓ operating plant and machinery in a *safe and controlled* manner
- ✓ Blending and processing compost materials and other product additives
- ✓ monitoring products and making adjustments to machinery operations
- ✓ combining or reassigning batch numbers of compost materials and other
- ✓ Clearing and cleaning blending, processing machinery and site.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- ✓ Identify compost and product additives
- ✓ Select, use, maintain and store suitable personal protective equipment (PPE) and clothing
- ✓ Measure and transport compost and product additives
- ✓ Monitor and check value-added product
- ✓ Preparation method and machinery of value-added products
- ✓ operated plant and machinery in a *safe and controlled* manner
- ✓ Blend and process compost materials and other product additives
- ✓ monitor products and make adjustments to machinery operations
- ✓ combine or reassign batch numbers of compost materials and other
- ✓ clear and clean blending, processing machinery and site

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1 to sheet 10”.
4. Accomplish the “Self-check1- Self-check10 in **page -140, 142, 144, 147, 150,152,154,156,158, and 160** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 in page 161.
6. Do the “LAP test” **in page – 162** (if you are ready).

Information Sheet-1	Identifying Compost and product additives

1.1 ADDITIVES

When a mass of mixed organic waste from several sources, containing some fresh green material, and of suitable particle size range and moisture content, is composted in accordance with the optimum process parameters listed in Table 4, composting is usually rapid and a satisfactory product results. The further one strays from the ideal conditions of raw material and processing, the slower the composting process and the worse the product. In these cases the addition of other materials is often justified in order to improve chemical composition and physical structure of the heap, to supply desirable micro-organisms and to reduce nitrogen losses. Moreover, it is sometimes desirable to enrich the compost product with extra plant nutrients.

1.2.1 Activators

The optimum C/N ratio of a composting mass is 25-35/l at the start. It should contain a reasonable mixture of material which is rapidly broken down, some which is more slowly attacked in the heap and some which is woody, lignified and fairly resistant to attack in the heap but breaks down slowly in the soil afterwards.

If too much straw, stalk and woody material is present; the C/N ratio is likely to be much greater than the optimum value. The rate of reaction will then be slow, adequate temperatures for pathogen kill probably will not be reached and a lot of organic material will be oxidized by the micro-organisms in an attempt to reduce the C/N ratio towards 10/1. This will much reduce the amount of product produced; even then the product is likely to rob nitrogen from the soil when added. To prevent this occurrence, it is important to reduce the C/N ratio of the initial material by the addition of an activator containing extra nitrogen in a fairly reactive form. Materials with low C/N ratios at the top of Table 5 are needed such as urine, dried blood, night soil, sewage sludge, manures and young green plant growth. Although hoof and horn meal has high nitrogen content it is not suitable as an activator as the nitrogen is only released very slowly.

If organic materials are not available for use as activators nitrogenous mineral fertilizers can be used, such as urea, ammonium nitrate, and ammonium sulphate and calcium Cyanamid. Experience in the past appears to indicate that these are not so effective as organic sources of nitrogen; the latter apparently coat the surface of the organic waste with a

film of colloidal particles which help the retention of moisture on the surface, thereby aiding the micro-organisms in their attack. Even sawdust and wood shavings, which have little nitrogen present and contain mainly resistant cellulose and lignin, will break down in a few months if a source of nitrogen and of phosphate is added.Other materials which will activate or speed up the composting process, particularly during the initial few days when heat generation is important, are ones supplying sugars. These will cause a rapid increase in the population of the micro-organisms. Two products from the sugar processing industry have value in this respect. One is press mud cake obtained from molasses filtration; the other is vinasse, the effluent liquor from molasses conversion to industrial alcohol.

1.2.2 Inoculants

As composting results from the activities of micro-organisms, it might be expected that the process would be improved by the addition of inoculants of special bacterial cultures. At one time this idea was derided and some experimental proof obtained on a laboratory scale to show that no advantage was obtained. Micro-organisms develop extremely rapidly and within a few days their numbers can build up to the maximum allowed by the environmental conditions in the compost heap.

Recent work, however, indicates that the recycling of a small quantity, 1-2 percent by weight, of product compost from a previous heap will supply a population of acclimatized micro-organisms to the fresh wastes being assembled into a new heap. This beneficial effect with acclimatized micro-organisms has been demonstrated when composting municipal wastes and with plant materials such as evergreen leaves of holly, ivy and pine needles, which are normally difficult to degrade.

Work in India has also shown that inoculating a compost heap with a suitable strain of nitrogen-fixing bacteria Azotobacter in the presence of added rock phosphate will significantly increase the nitrogen content of the final compost. The inoculation is done once the heap has passed through the thermophilic stage of composting and is cooling down.

1.2.3 Other Materials

The addition of finely ground rock phosphate or calcium phosphate, up to 2 percent by weight, even without Azotobacter, has a beneficial effect both in speeding up the composting process and in nitrogen conservation. The first effect is believed to be due to stimulation of the micro-organisms which attack the cellulose. The second effect is due to stimulation of the

nitrogen-fixing bacteria Azotobacter which are present and a suppression of the denitrifying bacteria which break down the nitrate form of nitrogen.

The presence of 1-2 percent by weight of soil, particularly clay in a dry powdered form, is beneficial when sprinkled on the layers of wastes. It not only helps by introducing soil micro-organisms into the heap but also by holding on to ammonia cal nitrogen during the thermophilic stage until it can be used during cellulose decomposition later. The Chinese go much further and use larger quantities of river mud and silt, both within their heaps and plastered over the outside where it helps with heat insulation and odour control.

When the organic waste consists entirely of finely divided solids such as partially dewatered sewage sludge, it is virtually impossible for air to penetrate the mass. In such cases a bulking agent such as wood chips or fragments of rubber tyres is necessary to open out the heap structure. The bulking agent is sieved out of the compost product and recycled, though with some loss by degradation in the case of wood chips.

Many writers of books on composting have laid emphasis on the need to incorporate in a compost heap neutralizers or chemical bases such as calcium carbonate or lime. They postulate that because the initial products of composting are the simple organic acids and the mass goes slightly more acid to a pH of about 5.5, then chemical bases are needed to raise the pH to the level of 7.0 to 8.0 which favours the growth of bacteria and fungi. However, as shown in Figure 11 the mass normally starts to turn alkaline at the end of the mesophilic stage when ammonia is formed on the breakdown of protein material. The presence of chemical bases at this stage would help to liberate this ammonia from the heap. Hence the present authors can see no justification for adding chemical bases to normal compost heaps.

1.2.4 Compost Product Enrichment

Compost is essentially a soil conditioner containing a fairly low level of plant nutrients. Where food production needs to be increased and NPK mineral fertilizers can be afforded and transported to the locality, then there is some incentive for passing these through the compost heap. Care must obviously be taken with nitrogenous fertilizers to ensure that excess is not added, leading to nitrogen loss as ammonia. Nevertheless, the addition of nitrogen, particularly to mixtures with high C/N ratios, will reduce the amount of organic matter oxidized to reach the final C/N ratio, thereby increasing the amount of product

compost. As mentioned above, the addition of phosphate has a beneficial effect on a compost heap. The composting process makes the phosphate more water-soluble and hence more available to plants. Cheap rock phosphate can be used instead of the more expensive superphosphate which has been chemically treated to make it more water-soluble.

The addition of extra potassium fertilizer has no apparent beneficial effect within a compost heap. However, cheap forms of potassium rock can be added and will be made rather more water-soluble and more available to plants from the product compost.

The compost heap can be used to rectify any major deficiencies in trace nutrients in local soils.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Briefly discus compost product additives?(8 point)
2. What is compost product enrichment?(4)

Note: Satisfactory rating – 12 points Unsatisfactory – below 12 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Selecting, using, maintaining and storing Suitable personal protective equipment (PPE) and clothing

Wear personal protective equipments during the work and properly maintain and store after finishing the work. PPE and clothing may include: apparel such as:

- Appropriate footwear
- Gloves
- hard hats
- high visibility clothing overalls emergency equipment and procedures such as:
- emergency procedure guides eye wash kit
- fire extinguisher
- first aid kit
- MSDS eye and hearing protection face shields and masks respirators.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List personal protective equipments?(6 points)
2. Write the function of personal protective equipments?(8 points)

Note: Satisfactory rating – 14 points Unsatisfactory – below 14 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Measuring and transporting compost and product additives

Preparation methods may include:

- Load-shifting
- measuring quantities
- mixing and blending materials
- particle size screening
- size reduction

3. Measuring and transporting required quantities of compost and product additives to product preparation areas.

You have to handle and transport materials, tools and equipments safely after work based on your supervisor instructions and the enterprise guidelines.

First

- Identify the functional materials, tools and equipments
- Clean the functional materials, tools and equipments
- Properly load and transport those materials, tools and equipments
- Then safely unload and place/store/ those materials, tools and equipments in a designated area**.**

All compost products are not created equal. Finished compost can vary significantly in chemical attributes like pH and soluble salt content, and in physical qualities like particle size, color and bulk density. These differences can result from variance in the initial recipe mix, feedstock characteristics, processing methods, refining steps, and additives.

Although native soils buffer crops to some extent from variations in pH and other parameters, container-grown plants aremore susceptible. Commercial growers raise high-value crops and can ill-afford even small failures due to poorly formulated growing media. Although its capacity for storing plant nutrients is enormous, compost is not a magical treatment for every plant. Understanding and effectively communicating the properties and capacity of your product(s) will ensure their proper application and overall success in the field

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. State hazards encountered in compost preparation?(3)
2. Discuss work place inspection?(3)
3. Discuss places in which regular inspection required?

Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-4	Monitoring and checking value-added product

4.1 Following up on conditions

When the compost pit has been filled or the piling of materials is complete, it should be checked regularly to make sure that there is enough but not too much moisture, and that it is getting hot, at least in the first two to three weeks. For compost made by piling materials on the ground: The stick can be inserted or pushed in horizontally between two layers about half way up the pit; or The stick can be pushed in vertically in the centre of the heap so it goes through all the layers. However, it is best if the stick or length of bamboo is placed in the centre after the foundation layer has been laid and then the layering process is completed with the stick remaining vertical. The stick must be longer than the height of the heap so that it can be pulled out and examined. For compost made in a pit: The stick or length of bamboo is pushed in vertically through the whole layer, or put in place while the compost pit is being filled. The stick must be longer than the depth of the pit.

How to make and use compost

Checking heat and moisture

One week after all the materials have been put in a heap or pit, and it has been covered, remove the inserted stick and immediately place it on the back of your hand.

1. If the stick feels warm or hot and the smell is good, the temperature is normal for the compost and good decomposition has started.

2. If the stick feels cool or cold and there is little smell, the temperature is too low for good composition. This usually means that the materials are too dry, and some water and/or urine should be added.

3. If the stick is warm and wet, and there is a bad smell like ammonia, this indicates that there is too little air and too much water in the compost. The materials will be rotting and not making good compost.

Correcting the problems If the materials are cool and dry

1. Lift up the top layers and put them to the side of the pit or heap.

2. Sprinkle water or cattle urine or cattle urine diluted with water on the material in the bottom.

3. Then put back the material in layers of about 25 cm each sprinkling water or a mixture of water and urine over each.

4. Replace the testing stick and cover the heap or top of the pit with soil, leaves, plastic etc., as described earlier.

If the materials are too wet

1. Collect some more dry plant materials and/or some old dry compost. Break up and mix the materials. If old dry compost is not available, use only the dry plant materials.
2. Lift off the top of the heap or take out the top half of the materials from the pit and put them to one side.
3. Mix the new dry materials with the wet compost materials in the bottom.
4. Put back the materials from the side of the heap or pit. If these materials are wet and decaying, put in alternate layers of new dry plant materials with the wet materials.
5. If the top materials are moist and brown showing compost making has started, put them back as they are.
6. Put back the vertical testing stick.
7. Do NOT seal the top but make a new test after a week. If the stick is warm or hot and the smell is good, good compost making has started and the heap or top of the pit can be sealed and covered. Testing for heat and moisture should be done every week to 10 days until mature compost is made.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. How to make and use compost? (8 points)
2. The stick must be shorter than the depth of the pit?(4point)

   a. True b. False

Note: Satisfactory rating – 12 points Unsatisfactory – below 12 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-5	Preparation method and machinery of value-added products

5.1 Using and performing preparation method and machinery for product and enterprise requirement

Methods to make compost

There are many ways of making compost. In this chapter different methods are given. We have gratefully made use of materials in order to be able to present many different methods of compost making in this Chapter.

Taking into account the factors mentioned before, such as availability of organic materials and weather conditions, a choice can be made from these methods.

In the long run everyone must work out a method to suit oneself. We advise you to experiment and find the method that suits best to your situation.

Indore method

The Indore Method is much used for composting in layers.

Building the heap

The basis of the heap should consist of twigs and cane shoots. The following successive layers are piled on top of this:

A layer of about 10 cm tough organic material which is difficult to decompose;

A layer of about 10 cm fresh organic material which decomposes easily;

A layer of 2 cm animal manure, compost or slurry from a biogas tank.

A thin layer of soil; the soil should be collected come from the top layer (top 10 cm) of clean (moist) soil (e.g. from under trees). This ensures that the right micro-organisms are brought into the heap. This sequence of layers is repeated until the heap has reached a final height of 1.5 to 2 meters. In this way the heap is composed of many layers. Building the heap should be done quickly, preferably within a week. See figure 5.

Figure 5: Example of an Indore compost heap

Turning over

During decomposition the heap has to be turned over regularly, in order that it remains well aerated and all the material is converted into compost.

The first turning over of the heap should be done after 2 to 3 weeks. The heap is broken down and built up again next to the old heap. The layers are mixed and the heap is, as it were, turned upside down and inside out. Again, a foundation of coarse plant material is

made first. Then the drier and outer, less decomposed part of the old heap is placed in the central part of the new heap. The drier material will have to be watered before the heap can be built up further. This core is covered with the rest of the material. The original layered structure is lost.

The second turning over takes place after 3 weeks and it may even be necessary to turn the heap over again for a third time. Repeat the moisture test and the temperature test a few days after each turning over operation.

Time for decomposition

Decomposition is complete if the plant material has changed into an unrecognizable crumbly, dark mass. Twigs and thick stems do not decompose completely and can still be seen. Under favourable conditions, the decomposition process in the Indore Method takes 3 months, but under adverse conditions it may take longer than 6 months.

Some substances, such as human urine and wood ash promote the growth of the micro-organisms. A small amount of these in the heap is sufficient to accelerate their growth. If the process has to be speeded up spread some urine or wood ash over the thin layers of soil, but only in small quantities; too much ash kills the micro-organisms. Urine, diluted with water 1:4 is sprinkled over the heap, using a watering can. The Indore Method usually gives good results.

The advantages of this method are:

- The process can be kept under control and runs smoothly, because the heap is turned regularly;
- Compost is produced in a short time.

Disadvantages of this method are:

- it requires much water;
- It is very labor intensive.

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. State hazards encountered in compost preparation?(3)
2. Discuss work place inspection?(3)
3. Discuss places in which regular inspection required?

Note: Satisfactory rating – 15 points Unsatisfactory – below 15 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-6	**operating plant and machinery in a *safe and controlled* manner**

6.1 **Operating plant and machinery in a *safe and controlled* manner**

Safe and controlled operation of machinery and equipment may include:

- Appropriate selection and use of machinery and equipment
- Effective communication between work team
- Members maintaining working loads within specifications
- Using operational techniques for specific weather conditions.

6.2. Monitoring and controlling plant and machinery performance and efficiency in a safe manner

1. Throughout the production cycle, organic products must be kept completely separate from non-organic products.

2. All contact surfaces should be readily accessible for manual cleaning. If not readily disassembled for manual cleaning and cleaning in place (CIP) methods are used, it should be demonstrated that the results achieved are equivalent to those obtained by disassembly and manual cleaning.

3. Equipment in contact with food must be of such construction and materials that:

a) Contact surfaces are made from nonporous food grade materials.

b) They are smooth and free from cracks and crevices to prevent matter being absorbed by them, to enable them to be thoroughly cleaned and to avoid, as far as possible, food being contaminated.

Self-Check -6	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. How to Safe and controlled operation of machinery and equipment ?(6 point)
2. What is the function of tools and machinery smooth and free from cracks and crevices ?(8 point)

Note: Satisfactory rating – 14 points Unsatisfactory – below 14 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name---------- ---------- Date----------

Answer sheet

Information Sheet-7	Blending and processing compost materials and other product additives

. Blending and processing compost materials and other product additives

Product additives may include

- finished compost of varying maturity and characteristics
- Product additives such as: Biological inoculants
- bulking agents or other products that alter the visual, physical, chemical or biological characteristics of finished product
- Coloring agents
- Inorganic or organic fertilizer
- liming agents
- Wetting agents
- Raw materials (compostable organic materials)

Self-Check -7	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

3. How to blending and processing compost materials and other product additives (10)?

Note: Satisfactory rating –10 points **Unsatisfactory – below 10 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-8	monitoring products and making adjustments to machinery operations

. Monitoring and adjusting machinery operations to meet job sheet specification

Monitoring and adjustment of the working machine will begin from checking the area in which the work is found and which type of respective work will done by the machine

- Demonstrate correct manual handling
- Clarifying instructions and directions
- appropriate selection and use of machinery and
- effective communication between work team members
- maintaining working loads within specifications
- using operational techniques for specific weather conditions

Self-Check -8	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What are the functions of monitoring products and making adjustments to machinery operations (10)?

Note: Satisfactory rating –10 points **Unsatisfactory – below 10 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet 9	combining or reassigning batch numbers of compost materials and other

9.1. Combining batch numbers of compost materials and other additives

All composts will require the following information to appear on the label

Product name

Granted analysis

Name and address of the registrant or the responsible packager

Lot number

Directions for use

Net weight

Cautionary statements

Self-Check 9	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. Write the information that label on the compost during selling?(6 point)

Note: Satisfactory rating – 8b points Unsatisfactory – below 8 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

InformationSheet-10	**Clearing and cleaning blending, processing machinery and site.**

10. 1 Clearing and cleaning processing machinery and site to avoid contamination

Cleaning materials, tools and equipment's after work has so many advantages, such as:

- To prevent from rust
- To be durable and long life span to use
- To prevent our health and the environmental pollution etc.

Self-Check -10	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

3. Write the advantages of cleaning material, tools and equipments? (3 points)
4. Write the advantages of clearing and cleaning working site (5 points)

Note: Satisfactory rating – 8 points **Unsatisfactory – below 8 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Operation Sheet 1	**Selecting, using, maintaining and storing Suitable personal protective equipment (PPE) and clothing**

Procedure

Selecting, using, maintaining and storing Suitable personal protective equipment (PPE) and clothing

1. Select PPE
2. Wear PPE.
3. Maintain PPE after work
4. Store PPE

LAP Test	Practical Demonstration

Name: _____Date: _____

Time started: _____ Time finished: _____

Instruction: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hours.

Task 1. Selecting, using, maintaining and storing Suitable personal protective equipment (PPE) and clothing

Horticulture Crops Production

Level III

LearningGuid-24

Unit of Competence: -Prepare Compost

Module Title: - Preparing Compost

LG Code: AGR HCP1 M06 LO7-LG-24

TTLM Code: AGR HCP1 TTLM 0120v1

LO7: Conduct quality control inspection and readiness for sale

Instruction Sheet	Learning Guide #24

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- ✓ Inspecting and assessing finished / Value-added product
- ✓ Documenting Product details
- ✓ Processing non-compliant product
- ✓ Completing batch documentation
- ✓ Reporting work outcomes

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- ✓ Inspect and assess finished / Value-added product
- ✓ Document product details
- ✓ Process non-compliant product
- ✓ Complete batch documentation
- ✓ Report work outcomes

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 10.
3. Read the information written in the information “Sheet 1 to Sheet- 10”.
4. Accomplish the “Self-check1- Self check 10” **in page -168, 170, 173 and 177**respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet----
6. 6. Do the “LAP test” **in page – 42** (if you are ready).

Information Sheet-1	**Inspecting and assessing finished / Value-added product**

1.1. Inspecting and checking value added product for compliance with the job sheet

The identification and reviewing of job sheet processing requirements is important in order to know from what type of organization do have the best product by observing the following data.

• Batch number
• Compost (batch) recipe
• Job number
• Product batch order and packaging requirements
• Raw materials or product quantity and quality

Requirements

• Raw materials preparation (pre-processing) requirements

1.2 Compost sampling

A very important point is that compost assessment should be based on a representative sample. To do this, samples are taken 30-40 cm inside the compost pile at different places and mixed together. An initial evaluation of the homogeneity of the compost can be carried out during this process. Observation of important differences between the subsamples (in regard to moisture content, colour, structure) can indicate whether the management of the composting process and/or the storage of the product were not optimally performed. In this is not the case, caution with the product has to be taken. Observations and analyses have to be performed with fresh samples. If not possible, the samples can be stored for 2 to 3 days at 4°C.

1.3 Assessments with own senses

Observations of compost with own senses (eyes, nose, touch) can provide information about the compost quality. These observations cannot replace chemical analyses or plant tests, but they can complement them

1.3.1 Color of the compost

At the beginning of the composting process, the material presents a mosaic of colour deriving from the input materials. During the process, a homogenization of the colour takes place, and, with the evolution of the humification, the compost becomes brown or blackish. If the compost is too dry during the process, grey moulds can be observed.

Figure 1.1 View of organic material at the beginning of the composting process (left) and mature compost (right).

1.3.2 Odours

Compost always smells but the odours can be more or less intensive and more or less agreeable depending on the management process. The odour of compost depends on its maturity and on the process management. Young composts containing nitrogen-rich materials smell of ammonia, and will be transformed during the maturation processes into a product with the smell of forest soil. Disagreeable odours such as that of “rotten eggs” or butyric acid are typical for poorly controlled anaerobic processes in the compost pile. Organic acids are formed as a result of oxygen starvation, and they cannot be transformed forward, which causes the emission of intense and disagreeable odours.

1.3.3 Structure of the compost

Mature compost produced by an optimal process has a crumbly structure and no recognizable starting material except for some wooden pieces. The presence of much fibrous material is a sign that the compost is not sufficiently mature. This can happen if the humidity content of the compost pile was too low especially in the hot phase. The ammonium present in the pile would therefore be lost as ammonia, leading to a shortage of N for the microorganisms and insufficient decomposition, even when water is available. When such fibrous compost is applied, there is risk of nitrogen immobilization in the soil

Figure 1.2 Fibrous compost (left) and crumbly compost (right)

1.3.4 Wood breaking test

The wood breaking test also allows the characterization of the degree of maturity of the compost and the risk of nitrogen immobilization in the field after its use.

Degradation of wood starts after the high temperature phase. Hence, we observe only minor degradation of wood in young compost, and clearly attacked wood in mature compost. If relatively raw wood is applied to a field soil, the microorganisms responsible for its degradation will immobilize the available nitrogen in the soil in order to perform the degradation. This nitrogen is therefore temporarily unavailable to the plants which inhibits their growth

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

4. Write the physical characteristics of compost (5points)
5. What is structure of the well decomposed compost (5points)

What are the conditions that affect the production of organic fertilizers? (5points**Note:**

Satisfactory rating – 10 points **Unsatisfactory – below 10 points**

Score = _____

Rating= _____

You can ask your teacher for the copy of your answer

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Documenting Product details

2.1. Documenting product accurately and promptly according to enterprise procedures

Keeping complete records of organic fertilizer preparation and use is part of a GAP program. This includes information about:

♠The preparation of the fertilizer

♠The source of the starting material

♠ details of composting procedures

♠ The results of microbiological tests on the composted material.

Records should also be kept on:

♠ The dates, amounts and methods of applying the fertilizer

♠ The person responsible for the application etc.

These records will help to verify that appropriate steps were taken to ensure the safety of the produce and to trace both the origins of the used materials used and other products from the growing area, when required.

Suggestions for information to be recorded:

- Origin of the organic materials used
- Date composting process started
- Treatment applied
- Turning of windrows (minimum five times)

Temperatures during composting (daily temperature readings of 55°C (131°F) or higher should be attained). Period at 55°C (131°F) or higher for windrow composting.

Documenting during compost preparation

- Source and physical make-up of composted material
- Amount used
- Place of application
- Date of application
- Method of application
- Person responsible for application

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

3. Write the document during compost preparation (5 points)
4. Write the information to be recorded: during compost preparation(4 points)

Note: Satisfactory rating – 9 points **Unsatisfactory – below 9 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Processing non-compliant product

3.1 Negative indicators

Composts may also decrease the performance of soil or potting soil mixes. Therefore a set of negative function indicators is mentioned. Many of these indicators only need to stay clear of critical values used in the market. Those that are less clear are discussed:

1. Nutrient content.

At the moment most potting soil producers do not correct the nutrient spectrum of the base dressing in potting soils to complement the nutrients present in the added compost.

The reason is that the fertilizers used by the potting soil producers have fixed NPK ratios and many adjustments for compost require single element additions. The use of single elements requires more expertise than some producers feel they can deliver, although it seems worthwhile to further this issue by supplying information. The reverse situation occurs where some elements in the compost are high enough to negatively affect plant growth or plant quality. The most common elements in excess are potassium and sodium. Often the amount of compost that can be mixed in soil or potting soil is limited by one or other of these elements.

2. Stability.

Over time, the organic material may be broken down by microbial action. As a consequence the mix loses the positive influences of lower bulk density, higher air content, higher water storage, and higher infiltration rate. In potting soils the loss of volume and the increase in the downward movement of finer more mobile particles may result in worse properties than without compost. Therefore a certain basic stability of the compost is required.

3. Nitrogen immobilization.

The breakdown of organic matter by microbial action results in a massive uptake of nitrogen by microorganisms. As microorganisms compete for nitrogen more efficiently than plant roots, the nitrogen uptake by the plants can be severely restricted even when the total analysis shows ample nitrogen (immobilized in the microbial mass). An element analysis of the

nutrient solution will demonstrate depletion though. Extra nitrogen may need to be added to maintain proper plant growth. To know the proper dose, the Nitrogen Fixation Index (NFI) is measured. More stable compost show less nitrogen immobilization.

4. Hydrophobicity / rewetting rate.

Some compost becomes increasingly hydrophobic upon drying. Especially in potting soils this is a negative property which can cause costly hand worked corrections of water content of plants in the borders of batches or fields i.e. those plants which evaporate slightly more.

5. Mineral matter content.

A minimum may be required by certification bodies, usually >20%-w/w.

6. Heavy metal, PCA's, plant diseases, human diseases are all bound by legal upper limits.

7. Plant growth inhibitors and seeds.

These obviously

- ✓ Informing Sales and operational staff members for sale and/or preparation of value-added products.
- ✓ Reporting work outcomes

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. In what condition landscape expert do interact with other staff and customers? 4 points
2. Where does landscape architects work belong? 5 points
3. Discuss employer duties in landscape work? 7 points

Note: Satisfactory rating – 16 points **Unsatisfactory – below 16 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheets

Information Sheet-4	Confirm Compliance of compost / Value-added product batch

Measuring quality

To assess the quality of compost, basic properties must be measured to allow buyers and producers to effectively negotiate a price. Insufficient measurements will result unfounded decisions, consequent poor results and a slow down in the development of compost as a product. Composters sometimes report properties and methods used for the internal process control of a composting plant1. This can result in readings that have little or no value for the end users. Examples are composting time and temperatures reached. Composters also report end user relevant properties of importance using unfamiliar methods. This can results in the failure of end users to understand reported values. Examples are EC, pH and nutrient content. The results are very different and virtually impossible to read if one is not familiar with the exaction method. Some of the common sources of confusion are: available versus total nutrients; choice of extraction method; reporting units in mg or mmol; Using %-v/v or %-w/w. These will be discussed below.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

4. Write the important of site security for stockpiling?(2 points)
5. Define raw materials storing area?(2 points)
6. Define Residuals storage areas?(2 points)

Note: Satisfactory rating – 10 points Unsatisfactory – below 10 points

You can ask your teacher for the copy of your answer

Answer sheet

Score = _____

Rating= _____

Name: _____ Date: _____

Short answer questions

Information Sheet-5	Reporting work outcomes

10.1 Reporting working out comes

Reporting means informing related information to a person who concerns.

On completion of your work, you should have to record and report what you have got from your work so far. Your record should include strong side of your work, weak side of your work, problems that you have faced during the work, possible solutions that is taken and the overall conditions of the work.

Now, depending on your objectives of the work, you should have to report the workout comes to your supervisor. A recording and reporting work outcome is important to:-

- ❖ Get the feedback of the work
- ❖ Improve the weakness and encourage your strength
- ❖ Get full information about the work
- ❖ Know the total cost wasted during the work(cost of production)
- ❖ Know the total yield (profit) obtained from the work and etc.

For example if we want to report the problems we can use the following table format

Table.1 Example of problems reporting format

No	Activities	Type of problem	Possible solution
1			
2			
3			

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the importance of recording and reporting work outcome (3point)
2. What is reporting? (3pts)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answers

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

REFERENSE

1. April 2013, National Organic Waste Composting Strategy
2. Aendekerk, T. G. L. 2002. Use-related quality classification of compost. In *International Symposium: Composting and Compost Utilization 56*, Columbus, Ohio
3. Marinari, S., G. Masciandaro, B. Ceccanti, and S. Grego. 2000. Influence of organic and mineral fertilisers on soil biological and physical properties. *Bioresource Technology* 72:9–17.

Horticultural Crops Production

Level III

Learning Guide-25

Unit of Competence: -Prepare compost

Module Title: - Preparing compost

LG Code: AGR HCP1 M06 LO8-LG-25

TTLM Code: AGR HCP1 TTLM 0120v1

LO8. Clean up area

Instruction Sheet	Learning Guide#25

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- ✓ Clearing and cleaning loading-shifting machinery and other processing equipment
- ✓ Clearing raw materials and finished compost products
- ✓ Cleaning Processing site

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- ✓ Clear and clean loading-shifting machinery and other processing equipment
- ✓ Clear raw materials and finished compost products
- ✓ Clean Processing site

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 4.
3. Read the information written in the information “Sheet 1, Sheet 2, and Sheet 3.
4. Accomplish the “Self-check 1, Self-check 2 and Self-check 3” **in page -48, 51 and 54** respectively.

Information Sheet-1	Clearing and cleaning loading-shifting machinery and other processing equipment

1.1. **Clearing and cleaning Loading-shifting machinery and equipment to avoid contamination**

An effective cleaning programmed must be established and maintained. Product and other debris must not be allowed to accumulate in production areas or on the site as a whole.

1. Frequent and regular cleaning by scraping, brushing, aspirating and washing should be employed in storage areas, cleaning and drying equipment, conveyors and other accessible equipment, to avoid the buildup of problem areas and residues. Where a problem does arise steam cleaning is recommended.

2. All product contact surfaces must be clean before work begins and cleaned as frequently as necessary throughout work periods to prevent the buildup of undesirable microorganisms which could contaminate the product.

3. Wet cleaning routines and the use of disinfectants and sanitizers must be followed by a thorough rinsing with potable water to prevent residues remaining on surfaces where they might contaminate the food products.

4. Detergents, disinfectants and sanitizers must be properly labeled and stored safely when not in use to avoid the risk of contaminating the products.

5. The following materials may be used for cleaning purposes provided they are approved for use in food processing establishments and effective steps are taken to ensure that residues do not remain on contact surfaces:

• Detergents, disinfectants and sanitizing agents approved for use in food processing establishments

• Terminal sanitizers

• Washing in or with a controlled hypochlorite solution

(Note: All the above requires a rinse with potable water after use

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

4. Write the advantages of cleaning and disposing of materials, tools and equipment after work (6points)

Note: Satisfactory rating – 6 points **Unsatisfactory – below 6 points**

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Clearing raw materials and finished compost products

2.1 Clearing and cleaning raw materials and finished compost products to designated areas, and processing site

Organic Products Management

PURPOSE: To ensure all precautions are taken to prevent contamination products that are determined as organics.

RESPONSIBILITY:

It is the responsibility of the management to ensure that the following procedures are adhered to and understood by all relevant personnel and the personnel follow State or local health department requirements. The Commercial Manager is responsible for ensuring the procurement procedure with regard to organic products is adhered to. The Technical Manager is responsible for ensuring any necessary risk assessments etc. are carried out.

2.2. Maintaining of tools, materials and equipment

- M maintenance and storage of materials, tools and equipment is very important for their reuse, minimizing cost to buy other new materials, tools and equipment.
- As we have seen in the above proper storing based on their category is very important.

2.3. Cleaning materials, tools and equipment after work

- -Cleaning materials, tools and equipment after work has so many advantages, such as:
- To prevent from rust
- To be durable and long life span to use
- To prevent our health and the environmental pollution etc.

2. 4. Reporting and following the direction of super visor

-Dear trainees you have to respect your super visor's instructions during and after your organic production work activities.

2.5. Benefits of cleaning working materials

- Dear trainees we have already seen the advantage cleaning materials, tools and equipment after work, so you can read the above.

2.6. Disposing unwanted materials, tools and equipment base on super visor direction

-Disposing means removing the materials, tools and equipment which are not functional during our work. So you have to properly dispose in the designated area.

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List down the benefits of cleaning working materials(5)

Note: Satisfactory rating – 5 points Unsatisfactory – 5 below points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

REFERENSE

1. April 2013, National Organic Waste Composting Strategy
2. Aendekerk, T. G. L. 2002. Use-related quality classification of compost. In *International Symposium: Composting and Compost Utilization 56*, Columbus, Ohio
3. Marinari, S., G. Masciandaro, B. Ceccanti, and S. Grego. 2000. Influence of organic and mineral fertilisers on soil biological and physical properties. *Bioresource Technology* 72:9–17.

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Profile of trainers participate on special Horticultural Crop Production TTLM development for Level III at Adama 2020