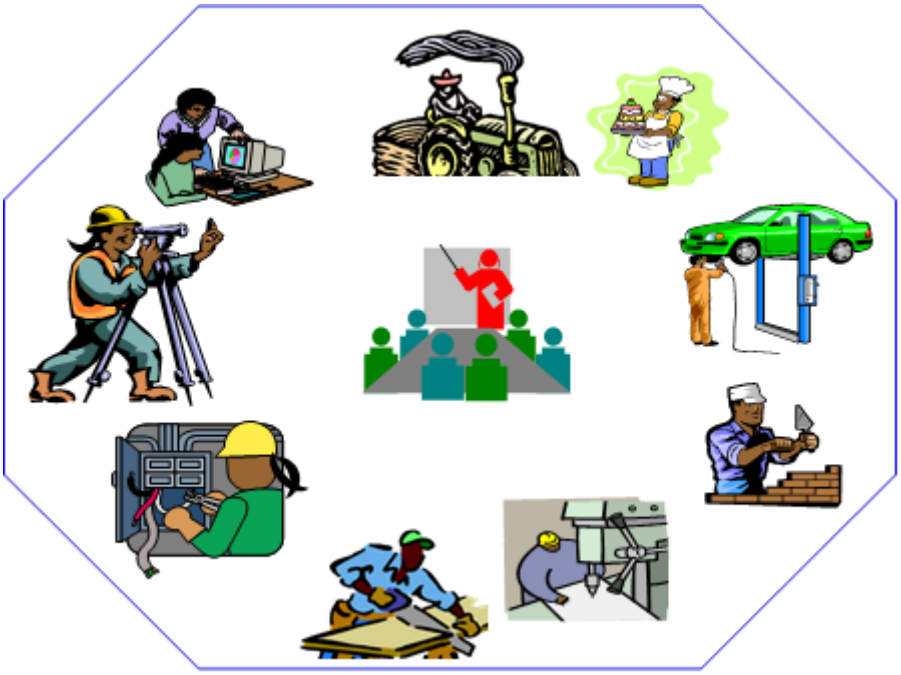
Horticultural Crops Production Level IV

Based on, march 2019, Version 2 Occupational standards



Module Title: Planning and Monitoring Compost Production

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GREEN FLOWER FOUNDATION

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LG #48	LO #1- Establish production requirements

Instruction sheet

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

- Reviewing raw material supply contracts and receivable data, sales and market trend information
- Identifying conditions that affect production
- Estimating production requirements
- Monitoring environmental and occupational health and safety (OHS) impacts
- Documenting production plan
- Confirming Facilities, personnel, machinery and equipment
- Developing and documenting contingency plan

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Review raw material supply contracts and receivable data, sales and market trend information,
- Identify conditions that affect production
- Estimate production requirements
- Monitor environmental and occupational health and safety (OHS) impacts
- Document production plan
- Confirm Facilities, personnel, machinery and equipment
- Develop and document contingency plan

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Reviewing raw material supply contracts and receivable data, sales and market trend information

1.1. Compost Preparation

Composting is the natural process of recycling organic matter, such as horticultural leaves residues and food scraps, into a valuable fertilizer that can enrich soil and plants. Anything that grows decomposes eventually, composting simply speeds up the process by providing an ideal environment for bacteria, fungi, and other decomposing organisms (such as worms, sow bugs, and nematodes) to do their work. Also composting is a biological process where micro-organisms decompose organic matter into fertile soil. The resulting decomposed matter, which often ends up looking like fertile garden soil, is called compost. Fondly referred to by farmers as “black gold,” compost is rich in nutrients and can be used for gardening, horticulture, and agriculture. it is the most fertile soil material you can use for planting, fertilizing, and amending soil. This is because it contains all the essential and necessary minerals and nutrients that plants need for flourishing growth and it also enhances the water-binding properties of the soil.

Factors determines compost preparation

- To be effective, the composting process needs**:**
- The right environmental conditions
- Enough oxygen
- Correct temperature level
- Enough moisture
- The right ratio of nitrogen to carbon
- Rich microbial population.
- Good quality of raw materials (which has easily decomposed and low toxicity to other plants)

Plenty air: Used to mix the composting material (human excreta, bio waste and/or garden waste) with bulking material such as sawdust, dry leaves, coconut coir and/or wood chips to create airiness to the compost.

Moisture: Should be moist, but not soaking wet, like a well squeezed out sponge.

Proper mix of carbon (C) to nitrogen (N) Ratio: Composting requires enough carbon, meaning bulking material, such as sawdust and dry leaves, and nitrogen which already exists in pee.

Generally, Composting is the aerobic decomposition of organic materials by microorganisms under controlled conditions into a soil-like substance called compost. During composting, microorganisms such as bacteria and fungi break down complex organic compounds into simpler substances and produce carbon dioxide, water, minerals, and stabilized organic matter (compost). The process produces heat, which can destroy pathogens (disease-causing microorganisms) and weed seeds. Raw materials are composted fastest when conditions that encourage the growth of the microorganisms are established and maintained. The most important conditions include the following:

- Organic materials blended to provide the nutrients that support microbial activity and growth, including a balanced supply of carbon and nitrogen (C:N ratio)
- Sufficient oxygen to support aerobic organisms
- Moisture levels that uphold biological activity without hindering aeration
- Temperatures needed by microorganisms that grow best in a warm environment

Table 1. Average carbon-to-nitrogen ratios of selected materials.

Material	**Ratio**
High Nitrogen Materials	
Alfalfa	13:1
Blood or bone meal	3:1 – 4:1
Coffee grounds	20:1
Cow manure	20:1

Food scraps	15:1 – 25:1
Grass clippings	15:1 – 25:1
Horse manure	30:1
Llama, donkey, alpaca manure	15:1 – 25:1
Pig manure	5:1 – 7:1
Poultry manure	5:1 – 7:1
High Carbon Materials	
Bark	100:1 – 130:1
Cardboard	200:1 – 500:1
Leaves	30:1 – 80:1
Mixed paper	150:1 – 200:1
Newsprint	560:1
Wheat straw	140:1 – 150:1
Wood chips	200:1 – 700:1

1.2. Source of Raw Material Availability

Human excreta can be composted just like any other organic matter. In fact, the composting process is even more rapid than when composting garden waste, because our digestive system has already done the majority of the breaking down for us. Most of the nutrients from human excreta are in urine but faeces are also an important source of potassium, phosphorus and organic matter.

Urine is a very good nitrogen fertilizer and can be separated from the solid faecal material on the source with urine diversion toilet seat or squatting pan. Urine can also be composted together with solid faecal material but some of the fertilizing value is lost in the process due to nutrient evaporation.

Most horticultural crop producers have waste organic materials derived from plants and/or animals waste that can be made into compost. This compost can then be used in crop production for higher yields and income. Compost has been found to be cheaper than inorganic fertilizers, improve soil productivity by readily providing nutrients, improving soil structure and Increase the water retention capacity. Compost is important because contains the main nutrients useful for the growth of plants – nitrogen (N), phosphorous (P) and potassium (K), improves the organic matter in the soil by providing humus, helps the soil hold both water and air for plants; and unlike chemical fertilizer, it also makes trace elements or micronutrients available to plants.

A wide variety of raw materials, or feedstocks, may be used for composting, including:

- yard waste,
- food scraps,
- agricultural materials,
- Horticultural leaves residues
- Industrial processing wastes,
- sludges, and
- municipal solid waste.

Most often there is a primary raw material to be composted and other materials are added. Rarely will an organic material have all of the characteristics needed for efficient composting, so other materials (amendments or bulking agents) must be blended to achieve the desired characteristics. Amendments can be added to adjust moisture content, C:N ratio, or texture. Bulking agents provide structure to hold up materials in a pile and maintain pore spaces for air movement.

1.3. Benefits of Compost

Some of the benefits of mature compost to soil and plants include its ability to:

- Improve soil structure
- Reduce inorganic fertilizer requirements
- Improve water infiltration and drought tolerance
- Reduce soil compaction and crusting
- Improve root growth and yields
- Increase microbial and earthworm populations in soil
- Protect plants from disease
- Slowly release nutrients to plants
- Improve nutrient-holding capacity
- Increase ease of cultivation
- Using compost as fertilizer saves money because the fertilizer is free and smaller amounts of chemical fertilizers are needed
- Using compost reduces the need to mine chemical fertilizers and people are not as dependent of the chemical fertilizer market prices
- It helps to return organic materials and nutrients to the soil instead of wasting them (e.g., to landfills and water bodies).
- Compost can be used on both ornamental/decorative plants and food plants.
- Reduces the Waste Stream
- Composting is a great way to recycle the organic waste we generate at home
- Cuts Methane Emissions from Landfills
- Because our solid waste infrastructure was designed around landfilling, only
- Improves Soil Health and Lessens Erosion
- Conserves Water
- Reduces Personal Food Waste

Anything that comes from the ground can be composted at home. While animal products can often be composted in municipal composting systems, at-home composting should avoid those items as they can attract animals and insects and leave pathogens in the final product.

Should identify compostable and un compostable materials

Do Compost

• Fallen leaves

• Finely chopped, woody pruning's

• Pine needles

- Untreated wood sawdust
- Lawn clippings
- Young weeds
- Vegetable & fruit peels and scraps
- Coffee grounds
- Tea bags
- Breads and grains
- Egg shells
- Manures from non-meat-eating animals

Don ‘t Compost

- Meat & bones
- Fish
- Dairy products
- Greasy foods
- Plywood sawdust
- Treated wood sawdust
- Diseased plants
- Dog, cat, or bird feces
- Poison oak
- Bermuda grass, ivy & rhizome grasses
- coal ash

1.4. Reviewing marketing plan and strategy

A key to the success of a composting operation is a marketing or distribution program for compost products. To develop long-term markets, the products must be of consistently high quality. Other essential marketing factors include planning, knowledge about end-users, following basic marketing principles, and overcoming possible regulatory barriers and product stigma.

Compost characteristics desired by end-users vary with intended uses, but most compost users look for the following elements (in order of importance):

1. Quality (moisture; odor; feel; particle size; stability; nutrient concentration; product consistency; and a lack of weed seeds, phytotoxic compounds, and other contaminants)
2. Price (should be competitive with other composts, although high quality and performance can justify a higher price)
3. Appearance (uniform texture, relatively dry, earthy color)
4. Information (product’s benefits, nutrient and pH analysis, and application rates and procedures)
5. Reliable supply

After choosing suitable compost heap/pit/basket/barrel materials for compost making has to be identified. These materials include dry stalks (Stover) like maize, sorghum,

grasses with thicker stems, or thin branches from trees, which could not decompose easily. The other materials are a dry plant material which refers to all kinds of dry biomass such as straw of field crops, all kinds of weeds, grasses, etc.; Green plant materials - all kinds of green plant material; such as leaves and soft branches, weeds, grasses, etc.; qimemaqimem - Starter material = "spices"; testing stick. In addition to the composting materials tools and equipment like digging tools, measuring tape, water, bucket, etc. Generally, many people are not convinced about the availability of sufficient biomass but the farmers preferred time for making compost is immediately after the main rainy season before they start harvesting. It can be prepared the year round in irrigated areas, and particularly where vegetables are grown.

When selecting materials for composting, we have several primary goals:

- Provide the desired ratio of carbon (C) and nitrogen (N)
- Provide a balanced diet of all the other essential nutrients
- Provide the greatest possible biological diversity to inoculate the pile
- Provide a mix of particle sizes that favors aeration in the pile
- Provide materials that favor adequate but not excessive moisture retention
- Be careful not to use toxic materials.

Composting is the biological decomposition of biodegradable solid waste under controlled predominantly aerobic conditions to a state that is sufficiently stable for nuisance-free storage and handling and is satisfactorily matured for safe use in agriculture. It is as much an art as it is a science. One learns to compost much the way one learns to farm by doing. The fundamentals of composting are easy to grasp and implement, especially if a person discovers they have a true interest in the subject. Composting, as with farming, requires a spirit of trial and error to develop “know-how” and experience. While there are many wrong ways to compost, the “best way” to compost depends on many factors, including availability of land, equipment, and start-up capital.

Successful marketing of compost requires a foundation of knowledge about compost benefits to potential customers, uses for compost, the composting process, and compost characteristics. It helps to assure customers that your facility is legitimate and dependable. Compost facilities need to compete with other compost operations, as well as traditionally soil and planting media (such as peat). Compost operators need to

convince potential customers that compost is an effective alternative to these traditional products and that your compost product is the best.

Selling compost involves marketing, which means searching out potential buyers, advertising, packaging, managing inventory, matching the product to the customer desires, and maintaining consistent product quality.

Key factors in marketing a finished compost product include the following:

- **Color / texture / odor:** Users expect compost to be uniform in texture, relatively dry, dark brown or black in color, and to have an earthy (non-offensive) odor.
- **Reliable supply:** Customers, especially businesses and municipalities, expect a reliable supply, especially if they have been given a commitment.
- **Price:** The price must be generally competitive with other composts and compost substitutes and the price should not vary significantly over time. Discount incentives may be offered for large quantity orders; however, the discount should only become effective after purchase of an established minimum quantity within a defined period of time. Price quotes for contractors should be honored after bid award.

1.5. Compost marketing plan

Marketing is an essential component of a business and business plan. Financial lenders want accurate information about potential markets, sales potential, etc. A well- done marketing plan demonstrates a clear understanding of production, capital requirements, costs, market segments, alternative markets, customer needs and purchasing habits, and the competition. A marketing plan is only as good as the information it contains. Accuracy and thoroughness are vital to a marketing success.

A marketing plan should be a useful tool that is revisited on a yearly basis, and viewed and discussed by appropriate staff on a monthly basis. For established, successful businesses, the marketing plan will help to “tune up” and reaffirm the business’s ongoing activities. For a new business or one that is entering new markets, a marketing plan can be the key to business success. A marketing plan explains sales strategies, pricing, promotions, and benefits. It describes how you will get a customer to purchase your compost product. It is an essential part of any business plan and also functions as

a standalone document. Keep your marketing message short and your plan simple.

SWOT—Strengths, Weaknesses, Opportunities, and Threats—is a planning tool useful in business. Strengths and weaknesses are factors internal to the business. Opportunities and threats are external environment factors that may affect your business. A business plan and a marketing plan should include a list of the strengths, weaknesses, opportunities, and threats that affect or have the potential to affect your businesses. Your business and marketing plans should benefit your business by helping you to formulate ways to build on your strengths and take advantage of opportunities, while incorporating a strategy to overcome your weaknesses and threats to a business. A SWOT analysis should be included in a marketing plan. For instance: According to a U.S. Composting Council study conducted in 2000, the largest target market segments are landscapers, homeowners, and topsoil producers. The most popular applications of compost are for soil amendment, mulch, and growing media.

In any situation, the success of composting will be determined by the balance between production costs and the returns from the benefits provided. Costs include raw material assembly, processing, distribution and spreading. Returns need to reflect the benefits to the user together with recognition of the contribution that compost use makes to the environmental costs of managing organic wastes. Compost user benefits need to reflect all of the benefits associated with improvements to soil performance including soil fertility and health (savings in fertilizer and potentially pesticide use), irrigation and benefits from reduced erosion from both rain and wind. The wider environmental benefits to organic waste management need to include contributions to managing soil and water quality and to reducing carbon emissions.

Around the world, agricultural use of compost varies enormously and success usually reflects the market development approaches adopted. Invariably quality and applied cost relative to measurable returns are the main determinants of progress and overall, this market continues to be poorly developed. The reality is that the regular use of appropriate quality compost will increase returns. These improvements will increase over time. However, it will be essential for farmers to make adjustments to management that translate the benefits into better returns. Factors such as increasing landfill

reduction targets, increased landfill levies and restrictions on the use of raw manure are likely to increase compost use. Compost is used in a wide range of horticultural crops and some broad acre crops, as well as domestic and commercial landscape situations. Revegetation following mining and road construction, and remediation of contaminated sites are other markets with growth potential.

Horticulture, with its relatively intensive nature and potential for continued strong growth is a very important market. However, this growth is being constrained by concerns about compost quality, limited knowledge of both its benefits and how best to use it, and the cost that is typically incurred before crop establishment. Many horticultural industries, especially vegetable production, have the added advantage of being close to population centers that generate large volumes of feedstock for compost manufacture. Ultimately, compost use by horticulture and agriculture will be dependent on accessing adequate quality feedstocks from urban centers.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below

Test I: Short Answer Questions

1. What are the raw materials needed for making compost? (5 point)
2. Write at least three un compostable materials. (3 point)
3. What are the key factors determining product of compost? (3point)

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

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

Information Sheet 2 - Identifying conditions that affect production

2.1. Factors Affecting the Composting Process

1. Oxygen and Aeration

Aerobic composting consumes large amounts of oxygen, particularly during the initial stages. If the supply of oxygen is limited, the composting process may turn anaerobic, which is a much slower and odorous process. A minimum oxygen concentration of 5% within the pore spaces of the compost is necessary for aerobic composting. Oxygen levels within the windrows or piles may be replenished by turning the materials over with a front-end loader, or by means of mechanical agitation with a special compost turner.

2. C: N Ratio

Carbon (C), nitrogen (N), phosphorous (P), and potassium (K) are the primary nutrients required by the microorganisms involved in composting. Microorganisms use carbon for both energy and growth, while nitrogen is essential for protein production and reproduction. The ratio of carbon to nitrogen is referred to as the C:N ratio. An appropriate C:N ratio usually ensures that the other required nutrients are present in adequate amounts. Raw materials blended to provide a C:N ratio of 25:1 to 30:1 are ideal for active composting, although initial C:N ratios from 20:1 up to 40:1 consistently give good composting results. For C:N ratios below 20:1, the available carbon is fully utilized without stabilizing all of the nitrogen which can lead to the production of excess ammonia and unpleasant odors. For C:N ratios above 40:1, not enough N is available for the growth of microorganisms and the composting process slows dramatically.

3. Moisture

Moisture is necessary to support the metabolic processes of the microbes. Composting materials should be maintained within a range of 40% to 65% moisture. Experience has shown that the composting process becomes inhibited when the moisture content is below 40%. Water displaces much of the air in the pore spaces of the composting materials when the moisture content is above 65%. This limits air movement and leads to anaerobic conditions. Moisture content generally decreases as composting proceeds; therefore, you may need to add additional water to the compost. As a rule of thumb, the

materials are too wet if water can be squeezed out of a handful and too dry if the handful does not feel moist to the touch.

4. Particle Size

The rate of aerobic decomposition increases with smaller particle size. Smaller particles, however, may reduce the effectiveness of oxygen movement within the pile or windrow. Optimum composting conditions are usually obtained with particle sizes ranging from 1/8 to 2 inches average diameter.

5. Temperature

Composting will essentially take place within two temperature ranges known as mesophilic (50-105oF) and thermophilic (over 105oF). Although mesophilic temperatures allow effective composting, experts suggest maintaining temperatures between 110o and 150o. The thermophilic temperatures are desirable because they destroy more pathogens, weed seeds and fly larvae

in the composting materials. If the temperature of your compost pile is in the mesophilic range, try mixing the pile. If the temperature still does not reach the thermophilic range, review the factors described above to determine whether one or more of the factors is limiting the composting process. If you are still unable to increase the compost's temperature, the active stage of composting may be complete.

6. Time

The length of time required to transform raw materials into compost depends upon the factors listed above. In general, the entire decomposition and stabilization of materials may be accomplished within a few weeks under favorable conditions; but, research at Utah State University has shown that 10-14 weeks of active composting for dairy cattle waste is more common. Active composting will change depending upon the amount of natural moisture or water added to the compost, turning frequency, materials being composted, and temperatures reached.

- The recommendations are for rapid composting. Conditions outside of these ranges can also yield successful results.

- Depends on the specific materials, pile size, and/or weather conditions.

2.2 Compost Quality Determination

Compost quality is measured by several criteria, including the following:

a. Moisture Content

The moisture content of the compost product is controlled by storing the product so as to avoid significant moisture addition by rainfall. The product must be dry enough to allow hauling with conventional loading, hauling, and spreading equipment / methods. The 45 percent moisture content criterion for efficient screening also provides a dry enough product to meet these needs. Care must also be taken not to over-dry the product as well. When compost is too dry, it will generate dust when handled, and dry compost can be difficult to re-wet.

b. Nutrient Content

The nutrient content of compost is also a quality component. The major plant nutrients supplied by compost are nitrogen, phosphorus, and potassium. Most minor plant nutrients are also contained in compost and these also contribute to its quality. The level of nutrients in compost is controlled by the chemical composition of the material. While not a fertilizer, compost is often used as a fertilizer supplement.

c. Particle Size Distribution

This quality parameter is primarily a function of the screen size used. Different end-users of compost will have different requirements for particle size distribution of the compost. The most demanding user in this regard will be horticulturists that will use the material in potting mixtures. The specifications for particle size distribution requirements can be ascertained from users. Those who will use the compost to amend field soils (e.g., landscapers, orchardists, field crop growers) will have less stringent requirements, but still should be provided samples of the product to test prior to deciding on an appropriate particle size specification.

d. Stability

The term "stability" as used here means a product that will not undergo rapid decomposition or produce nuisance odors when applied by users. If the compost has undergone the adequate composting and curing procedures, there should be no problem in achieving a stable product. Assuring a minimum curing period of 30 days is important to producing a stable compost product.

e. Product Consistency over time

This quality parameter is one of the most important to users. In order to incorporate compost into their operating practices, users must be certain that each batch of materials has the same properties, within relatively narrow limits. Inconsistency in product quality will result in reduced consumer confidence and will jeopardize future marketing efforts.

f. Pathogen Reduction Criteria

Agricultural waste compost is not required by regulation to comply with the pathogen reduction criteria that are stipulated for municipal sludge (biosolids) compost. However it is good practice and may be required if a site permit is required for non-farm organic waste material. The compost product should fulfill the following criteria:

- The compost product should be brought to a minimum temperature of 131oF (55^{o}C) in order to fulfill the requirements of a biosolids stabilization process to further reduce pathogens
- In addition to stabilization, these elevated temperatures are effective at killing weed seeds, which is a very important product quality concern.
- The compost product should be exposed to a minimum composting period of 42 calendar days and a minimum curing period of 30 calendar days prior to distribution.

g. Storing compost

Matured compost should be stored either in its original compost pit or taken out and put under shade and covered until it is taken and used in a field. A sunny and windy place is not good for storing compost because many of the nutrients, particularly nitrogen, will be lost. Compost can be stored for 3-6 months.

h. Compost Application

There are different views about how and when to apply compost. It is true that the nutrients in compost are released to plants slowly. However, if compost is applied earlier than the crop is planted the nutrients will escape to the air. As soon as the compost is added to the soil, small amounts of nutrients are available to the germinating/growing plants. Therefore, compost application should be during planting time. This is because when applied at the same time the releasing process will be inside the soil.

If compost is applied before planting, it should not lie on the surface of the soil. It has to be ploughed or dug into the soil. If farmers use row planting, the compost should be put in the row with the seeds and then covered.

i. Rate of Compost Application

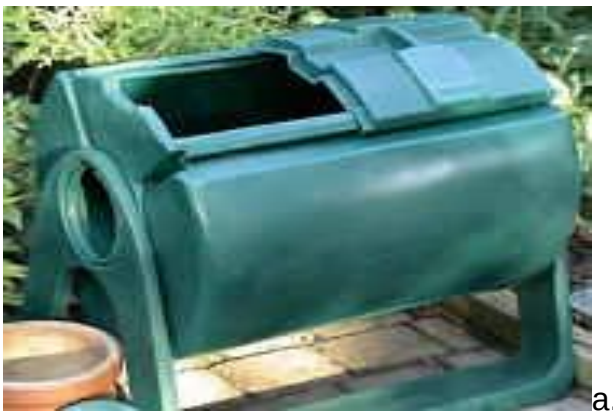
The rate of compost application depends on several factors such as soil factor, environmental factor, the cropping history of the land, etc. In general rate of compost application varies from 10-20 tons per hectare. Therefore, the farmer who planned to utilize the compost can determine and calculate the target area based on this rate

j. Compost Ingredients

Organisms that decompose organic waste need four key elements to thrive: nitrogen, carbon, air, and water. Since all compostable materials contain carbon, with varying amounts of nitrogen, composting successfully is just a matter of using the right combination of materials to achieve the best ratio of carbon to nitrogen and maintaining the right amounts of air and water to yield the best results. The ideal carbon-to-nitrogen ratio for a compost pile is 25 to 30 parts carbon for every 1-part nitrogen. If your pile has too much carbon-rich material, it will be drier and take longer to break down. Too much nitrogen-rich material can end up creating a slimy, wet, and smelly compost pile. Fortunately, these problems are easily remedied by adding carbon-rich or nitrogen-rich material as needed.

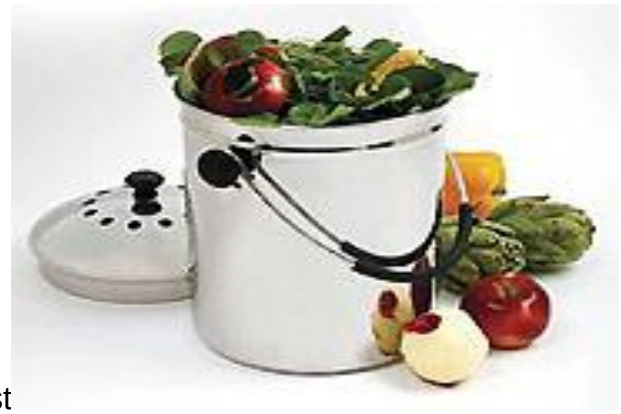
k. Compost Bin

Using a bin is the simplest and cheapest method for small-scale, at-home composting.



a. Design/ preparation of compost production container

b. Finished/ Matured compost



c. horticultural product by compost application

Figure 1.1 process of Enclosed Compost Bins

Self-check 2	Written test

Name…… ID…… Date…….

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

Test I: Say true for correct statements and say false for incorrect statements (2 point each)

1. The rate of compost application can depend on soil factor, environmental factor and the cropping history of the land.
2. A sunny and windy place is good for storing compost.
3. Too much nitrogen-rich material in the compost preparation can end up creating a slimy, wet, and smelly compost pile.

Test II: Short Answer Questions

1. Write the compost quality measurement criteria. (4 point)

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

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

Information Sheet 3- Estimating production requirements

3.1. Introduction

In any situation, the success of composting will be determined by the balance between production costs and the returns from the benefits provided. Costs include raw material assembly, processing, distribution and spreading. Returns need to reflect the benefits to the user together with recognition of the contribution that compost use makes to the environmental costs of managing organic wastes. Compost user benefits need to reflect all of the benefits associated with improvements to soil performance including soil fertility and health (savings in fertilizer and potentially pesticide use), irrigation and benefits from reduced erosion from both rain and wind. The wider environmental benefits to organic waste management need to include contributions to managing soil and water quality and to reducing carbon emissions.

At Industrial-scale, composting can be carried out in the form of in-vessel composting, aerated static pile composting, vermicomposting, or windrow composting.

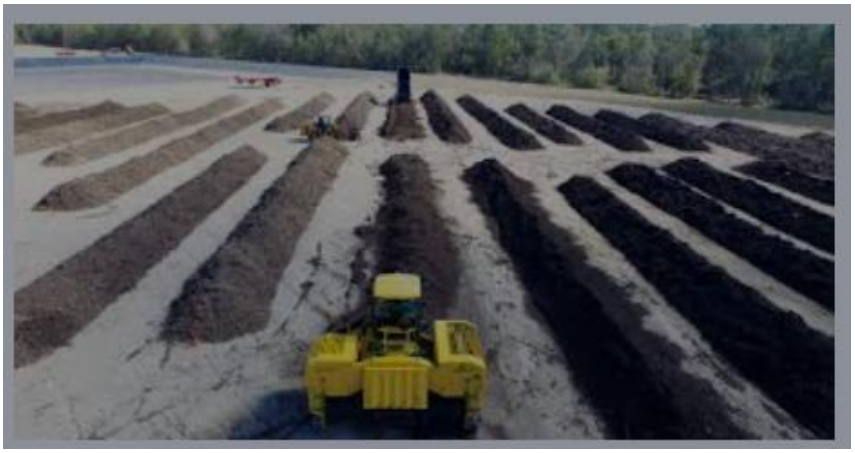


Figure 1.2 Windrow composting system

Vermicompost (vermi-compost): is the product of the decomposition process using various species of worms, usually red wigglers, white worms, and other earthworms, to create a mixture of decomposing vegetable or food waste, bedding materials, and vermicast. This process is called vermicomposting, while the rearing of worms for this purpose is called vermiculture. Verm cast (also called worm castings, worm humus,

worm manure, or worm faeces) is the end-product of the breakdown of organic matter by earthworms. These castings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than the organic materials before vermicomposting.

Vermicompost contains water-soluble nutrients and is an excellent, nutrient-rich organic fertilizer and soil conditioner. It is used in farming and small scale sustainable, organic farming. Vermicomposting can also be applied for treatment of sewage. A variation of the process is vermi filtration (or vermi digestion) which is used to remove organic matter, pathogens and oxygen demand from wastewater or directly from blackwater of flush toilets

Figure 1.3 Verm compost

3.2 Composting facilities and cost estimation

During compost production there are many cost considerations are under taken. In Compost production system the following things are the basic important to estimate production. For instance:

Design Basis

- Receiving waste

- Removal of non-compostable material by hand sorting
- Shredding by pulverizing classifier
- Fermentation with turning by wheel loader/other methods
- Maturing with turning by wheel loader/other methods
- Refining of coarse compost by screen
- Transporting matured product and etc.…

Estimation of time investment: Composting will require time and effort on your part. Your biggest time investment will be the initial set-up of the composting facility, which will vary from farm to farm, depending upon the size of the facility you plan, the method of composting you choose, the site preparation work required, and the equipment available to you. Set-up time can range anywhere from a few weeks to several months.

Once your composting operation is up and running, typical time investment for a routine operation can range from 4 to 16 man-hours per week. The time it takes from initial ingredient mixing through curing to the point of a stable product ranges from 60 to 120 days; 90 days is a good rule of thumb. But since composting is a continuous process, beyond that initial 90 days or so, you should always have some compost ready for use.

Total cost: The costs for setting up a composting operation will vary with your site, the size of your composting operation, the method of composting you choose, and the type of machinery you already have available.

Composting is as much an art as it is a science. One learns to compost much the way one learns to farm - by doing. The fundamentals of composting are easy to grasp and implement, especially if a person discovers they have a true interest in the subject. Composting, as with farming, requires a spirit of trial and error to develop “know-how” and experience. While there are many wrong ways to compost, the “best way” to compost depends on many factors, including availability of land, equipment, and start-up capital.

3.3 Major factors affecting compost demand and sales

- Compost quality.
- Product consistency.
- Product availability and producing enough compost product to meet demand.
- Economics of transportation and distance to markets.
- Economics and challenges associated with compost application.
- Progress toward developing industry standards and specifications.

Self-check 3	Written test

Name…… ID…… Date…….

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

Test I: say true or false (2 point)

1. The success of composting will be determined by the balance between production costs and the returns from the benefits provided.
2. Vermicompost is the product of the decomposition process using various species of worms.

Test II. Write short answer/s

1. Major factors affecting compost demand and sales (4point)
2. Write the cost considerations under taken during compost preparation (4point)

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

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

Information Sheet 4- Monitoring environmental and occupational health and safety (OHS) impact.

4.1. Environmental Monitoring

Environmental monitoring is a tool to assess environmental conditions and trends, support policy development and its implementation, and develop information for reporting to national policymakers, international forums and the public.

There are a range of health and safety regulations relevant to the composting site. Composting is a natural biochemical process involving bacteria and fungi. Humans have been composting safely for thousands of years. however, we do suggest you always adhere to the following health and safety guidelines. Organic wastes can represent a large proportion of the solid waste stream in any rural community. Furthermore, farm households generate large amounts of manure that can pose a threat to the environment, especially watercourses, if not well managed because of nutrient overloading. Much concern about air, water and soil quality has been expressed in the past about the direct application of raw manure to agricultural land. Animal producers are being increasingly pressed upon to move towards environmental sustainability in managing the nutrients in the manure. Composting the organic portion of solid wastes has multiple benefits, such as a reduction in the quantity of wastes to be disposed, a reduction in environmental impacts resulting from manure storage and production of a material safe to use in agriculture. Advantages of composting also include killing of pathogens, fly larvae and weed seeds and improving the handling of manure and other residues by reducing their volume and weight. The need to increase soil organic matter in certain countries, such as those in the African continent, is an important reason for recycling organic waste in view of returning the nutrients to the soil.

Safety concerns with composting are more related to equipment operation. Especially with specialized compost pre-processing and turning equipment where blades, hammers, and flails rotate at high-speed resulting in material being thrown out, human contact should be minimized and operators appropriately shielded.

Health concerns related to the compost itself are minimal. While few pathogenic organisms are found in yard waste, normal sanitary measures, such as washing hands before handling food or toweling eyes, should be implemented.

In some cases, certain individuals may be sensitive to organisms in the compost itself, since many of the organisms are mod and fungi and tend to release spores. Once specific fungus has been documented as causing an allergic response in operators and that is the fungus Aspergillus fumigatus. This fungus in a naturally occurring organism in all decaying matter. The spores of this fungus are universal and can be found any place. Simple precautions such as OSHA approved dust masks and goggles can help limit exposure of individuals to dust and molds. Those individuals with conditions which may predispose them to an allergic response (conditions such as weakened immune systems, history of allergies or asthma, punctured eardrums, or medications such as antibiotics or cortical hormones) may not opt for working at a compost.

4.2 Environmental concerns

Composting is not free of environmental concerns. Both air and water resources can be unfavorably affected if composting isn't managed properly. Several gases are emitted during composting (ammonia, methane, nitrous oxide, hydrogen sulfide, volatile organic compounds, and carbon dioxide.) Ammonia and methane are two that can be addressed through management.

Ammonia –- Composting normally involves some loss of nitrogen. Ammonia forms as part of nitrogen transformations. Ammonia volatilization is associated with high temperature, low moisture content and alkaline ph. If the C:N ratio is too low (not enough carbon), the microbes don't have enough available energy to incorporate all the nitrogen into their cells. In that case, the microbes will "eat" all the carbon that's there, but the excess nitrogen will be eliminated as ammonia. Ammonia losses can be minimized by:

• Thoroughly mixing feedstock with proper proportions of carbon and nitrogen

• Meeting the need for oxygen, water, and other essentials

• Covering static piles with peat moss or finished compost, to absorb ammonia as it volatilizes

• Manures high in nitrogen (e.g. poultry litter) sometimes can't be economically amended with enough carbon to avoid ammonia losses. If this is a serious air pollution concern for an operation, the exhaust air from forced-air or in-vessel composting can be scrubbed or filtered to remove the ammonia.

Methane –Methane (CH) is produced under anaerobic conditions by methanogenic bacteria, and if any portion of a compost mass is allowed to "go anaerobic" because of too much water, too little porosity, or compaction, methane will be produced. As a greenhouse gas, methane is more than 20 times as effective (or detrimental) as carbon dioxide. Because the interior of large particles in even the best compost piles is essentially a low-oxygen environment, even good composting will yield some methane. Composting plays an important role in organic farming practices as well as in improving soil fertility. Among other benefits, the use of compost can improve access to food in rural communities with higher yields of vegetables and fruit obtained from a more fertile soil. Farm households have many reasons for joining a composting programme, as they possess almost all the basic requirements for composting. Feedstocks, air, water, land and labor are present already on the farm although the scale of composting would be an important determinant of the resources available. The resulting composting product is a resource for the farmer and can be an additional source of revenue.

The compost produced can be used on farm or sold to other farmers and community members. Like any product, compost must be marketed adequately and issues about producing a high-quality material need to be addressed if the farmer expects to get revenue from the composting operation.

4.3 Potential Hazards for compost Workers

- **Primary human pathogens**: including viruses, mycoplasmas, bacteria, fungi, and cysts or eggs of intestinal parasites, found primarily in disposable diapers and tissues and household medical waste s
- **Secondary pathogens and their toxins**: e.g., spores and endotoxins generated by bacterial and fungal growth within the composting process itself
- **Volatile and semi-volatile organic chemicals** of both synthetic and natural origin (including noxious odors)

- **Persistent, lipophilic organic chemicals**
- **Metals, other inorganic materials** (e.g., asbestos), **and organometallics**
- **Allergens** from household and yard wastes
- **Corrosive, caustic, explosive, and sharp materials**

4.4 Hazard Identification and Assessments

In composting primary hazards for workers include pathogens and their toxins, organic chemicals (many of them are in common household items such as solvents and cleaners), and heavy metals (from items such as batteries and consumer electronics), as well as mechanical and related hazards. In the compost products concerns Laboratory and ecological studies, as well as epidemiological studies of the distribution of disease and other adverse effects among people are needed to determine the potential outcomes of exposure to the hazards identified in composts and the composting process. The nature of effects on individuals, species, and living systems, as well as the time course over which these effects may take place, are needed to tie exposure to the outcome. Two points are particularly important in a risk assessment: the dose-response relationship (what exposure results in a given level of effect) and the character of the effect itself. Chronic effects of low-level exposure (e.g., problems in reproduction, neurology, immunology, cancer) are much more difficult to assess than immediate and apparent harm.

Depending on the operations, design and the quality control program, composting workers may be exposed to a number of pathogens, toxic substances, and other physical and chemical hazards. In addition, the composting own notable hazards. Note that a variety of safety practices process uses equipment and machinery that can have their and equipment have been introduced and adapted to the several parts of the MSW composting process, so that some or all of the risks may be appropriately managed.

Human and animal faecal materials are important sources of microbiological and chemical contamination for the production of compost. Micro-organisms linked to these sources include *Salmonella* and *Entero coccus,* and other intestinal bacteria. One of the most infectious organisms found in animal manure is *Escherichia coli*, which usually originates from ruminants, such as like cows, sheep and deer. Other significant microbiological hazards found in faecal material include *Salmonella* and

Cryptosporidium. Usually, vegetative bacterial pathogens and viruses decline in numbers within a few days of their introduction into the soil or onto the plant surfaces. However, they may survive (in low numbers) for several weeks or months. Survival in the soil is influenced by several factors, e.g. soil type, humidity, temperature and micro-flora. *E. coli* survived in bovine and ovine manure from several weeks to 12 months, depending on the environmental conditions. Therefore, animal manure and solid biological waste may provide safe, effective fertilizer only when it has been properly treated. If the treatment is inadequate (or there is no treatment), the risk of contaminating fruit and vegetables with pathogenic organisms is extremely high.

The risk of contamination from the manure and during its application to crops depends on various factors, including

- soil type,
- manure application rate,
- pH of the soil,
- composting method and
- time of application.

Continued application of untreated manure could lead to extended survival and build-up of pathogens which increases the risk of both contamination at that site and its spread to nearby sites.

In addition to microbial hazards, the use of solid biological waste on land can also introduce chemical hazards, such as heavy metals and toxic organic compounds. These materials may accumulate to levels that will be harmful to plants grown on the land. Another harmful effect from improperly treated manure is its impact on water quality due to the release of oxygen-demanding substances, suspended solids and nitrogen.

4.5 Treatments to reduce the risks

To convert organic waste into a safe fertilizer (compost), 'Good Manufacturing Practices' should be followed to reduce the presence of pathogenic bacteria. Composting is a natural, biological process by which organic material is decomposed. Bacteria and fungi that ferment the organic material and reduce it to stable humus carry out the composting process. Because the fermentation process generates much heat, it reduces or even eliminates biological hazards. If the heating process is managed

carefully it will kill those food borne pathogens that do not form spores. However, the adequacy of existing methods of composting and associated regulations needs to be reviewed.

Safety Precautions

Take standard safety precautions when handling the waste, e.g

- washing your hands afterward,
- avoiding touching your face.
- If you have a condition that predisposes you to an allergic reaction or infection, wear a dust mask while tending to your pile, especially in dry weather.
- Always wear gloves and cover cuts.
- Wash hands after handling waste/compost.
- If you suffer from asthma, related respiratory conditions or a compromised immune system, take specific precautions to avoid inhalation of dusts (e.g. wear a dust mask)

OHS hazards may be occurred during compost preparation

- biological hazards associated with raw materials or product
- ergonomic hazards associated with manual handling
- physical hazards such as: compressed air and hammer mills and grinders
- hot or cold weather conditions
- noise
- shredders
- underfoot conditions
- vehicles and mobile machinery
- sharps or other physical contaminants in materials
- emissions from vehicle and machinery operations

Personal protective equipment (PPE).

Personal protective equipment's

- Eye Protection
- Hand Protection
- Foot Protection
- Hearing Protection
- Protective Clothing

Self-check 4	Written test

Name…… ID…… Date…….

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

Test I: Write short answer/s

1. write at least four OHS hazards which may be occur during compost preparation. (4point)
2. Write the safety pre requisite needed during waste handling for compost preparation. (4point)

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

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

Information Sheet 5- Documenting production plan

5.1 Production planning

Production planning is the planning of production and manufacturing modules in a company or industry. It utilizes the resource allocation of activities of employees, materials and production capacity, in order to serve different customers. Different types of production methods, such as single item manufacturing, batch production, mass production, continuous production etc. have their own type of production planning. Production planning can be combined with production control into production planning and control, or it can be combined with enterprise. Production planning is the future of production. It can help in efficient manufacturing or setting up of a production site by facilitating required needs.

Documentation Plan is a document written by technical writers (usually, team leads or project leaders) to shape up the details of the work to be done. It helps structure all the processes within the team, and grant everyone accesses to the essential information. A documentation plan can include varied elements. These are the things that get included to such plans by most companies:

- Project Name
- Scope and Objectives
- Detailed Content Plan
- Time Estimates
- Responsible Persons
- Workflow
- Resources
- Details (formats, ways of delivery to end users)

The organic waste to fertilizer production line make use of organic waste as raw materials including straw, livestock manure, cake feeds, organic waste produced by

processing of subsidiary agricultural products. Then these materials are made into organic fertilizer through microbial fermentation, deodorization and maturity.

During compost production process, make a necessary listing in the notebook of all the materials and ingredients used. It is important to note how much or how many. This is called recording or documentation.

Importance of documenting compost production plan

- Compute the costs of production
- Follow the standard procedures in computing for production costs
- It gives us a reference data on the materials used together with their correct magnitude.
- It determines the economic viability of the product.
- Documenting serve as a basis for planning.
- Documenting greatly help in making right decisions

During compost production (preparation) at industry level the following activities are recorded:

Production flow

1. Raw materials, area of production, (investment cost)
2. Composting and fermentation of the materials. Any qualified organic fertilizer must go through the process of composting and fermentation.
3. Mixing and crushing. The crushing machines include semi-wet material crusher, chain crusher, and hammer crusher. The mixing machines include double shafts horizontal mixer, single shaft continuous mixer, etc.
4. It is very important to choose what kind of granulating method in the production of organic fertilizer. Nowadays, there are disk granulation, rotary drum granulation, double roller extrusion granulation and other methods in the industry.
5. After granulating, most of the materials have formed particles, but the particle strength and water content doesn't conform to the standard. So, the drying process is essential.

6. After drying, the materials are transmitted to cooling machine through belt. When the temperature is cooled to be normal, this machine can further improve the particle strengths and reduce water content.
7. After cooling, there are powdery material. This machine can screen out the fine powders and large particles. Then the fine powdery are engaged in the granulation again.
8. The finished products go to the coating process, making the particles form a protective film and isolate from the outside air.
9. Packaging. The qualified products are packed by the automatic packing machine.

The compost production plan is one such important factor to consider during the planning and scheduling of working. Which intimates daily and weekly targets along with monthly and annual grand totals for the smooth supply chain management. Production scheduling templates are therefore an exclusive tool to induct a quick and precise schedule for any task. Usually, the production plan format varies according to the nature and type of project or product. Based on the stages and classes of product accomplishment, there are various planning trends, roles, and standards implemented and followed worldwide. The recent and most productive style of production is by devising the technical staff with reference to their expertise.

Self-check 5	**Written test**

Name…… ID…… Date…….

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

Test I: Say true or false (2 point each)

1. The compost production plan is one such important factor to consider during the planning and scheduling of working.

Test II: Write the short answer/s

1. Write the importance of documentation of compost production plan(4point)

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

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

Information Sheet 6- Confirming Facilities, personnel, machinery and equipment

6.1 Introduction

Composting facilities and equipment are equipment used in a process by which biological decomposition of organic solid waste is carried out under controlled aerobic conditions, and which stabilizes the organic fraction into a material which can easily and safely be stored, handled, and used in environmentally acceptable manner.

6.2 Composting Facility

a. Applicability

This section is applicable to all facilities or sites that treat solid waste by composting. Agricultural composting is managed according to a farm management plan written in conjunction with a conservation district, a qualified engineer, or other agricultural professional able to certify that the plan meets applicable conservation practice standard.

b. Location standards

There are no specific location standards for composting facilities, however, composting facilities must meet the requirements provided

c. Design standards

The owner or operator of a composting facility shall prepare engineering reports/plans and specifications, including a construction quality assurance plan, to address the design standards of this subsection. Scale drawings of the facility including the location and size of feedstock and finished product storage areas, compost processing areas, fixed equipment, buildings, leachate collection devices, access roads and other appurtenant facilities; and design specifications for compost pads, storm water run-on prevention system, and leachate collection and conveyance systems shall be provided. All composting facilities shall be designed and constructed to meet the following requirements:

When necessary to provide public access, all-weather roads shall be provided from the public highway or roads to and within the compost facility and shall be designed and maintained to prevent traffic congestion, traffic hazards, dust and noise pollution;

- Composting facilities shall separate storm water from leachate by designing storm water run-on prevention systems, which may include covered areas (roofs), diversion swales, ditches or other designs to divert storm water from areas of feedstock preparation, active composting and curing;
- Composting facilities shall collect any leachate generated from areas of feedstock preparation, active composting and curing. The leachate shall be conveyed to a leachate holding pond, tank or other containment structure. The leachate holding structure shall be of adequate capacity to collect the amount of leachate generated, and the volume calculations shall be based on the facility design, monthly water balance, and precipitation data. Leachate holding ponds and tanks shall be designed according to the following:

d. **Operating standards**.

Owner or operator of a composting facility shall:

a. Operate the facility to:

i. Control dust, nuisance odors, and other contaminants to prevent migration of air contaminants beyond property boundaries;

ii. Prevent the attraction of vectors;

iii. Ensure that only feedstocks identified in the approved plan of operation are accepted at the facility;

iv. Ensure the facility operates under the supervision and control of a properly trained individual during all hours of operation, and access to the facility is restricted when the facility is closed;

v. Ensure facility employees are trained in appropriate facility operations, maintenance procedures, and safety and emergency procedures according to individual job duties and according to an approved plan of operation;

vi. Implement and document pathogen reduction activities when Type 2, 3 or 4

feedstocks are composted. Documentation shall include compost pile temperature and notation of turning as appropriate, based on the composting method used. Pathogen reduction activities shall at a minimum include the following:

vii. Monitor the composting process according to the plan of operation submitted during the permitting process. Monitoring shall include inspection of incoming loads of feedstock's and pathogen reduction requirements of (a)(vi) of this subsection; and
viii. Analyze composted material for:

e - **Groundwater monitoring requirements**.

There are no specific groundwater monitoring requirements for composting facilities subject to this chapter; however, composting facilities must meet the requirements
f. Closure requirements. The owner or operator of a composting facility shall: Notify the jurisdictional health department sixty days in advance of closure. At closure, all solid waste, including but not limited to, raw or partially composted feedstock's, and leachate from the facility shall be removed to another facility that conforms with the applicable regulations for handling the waste.
Develop, keep and abide by a closure plan approved by the jurisdictional health department as part of the permitting process. At a minimum, the closure plan shall include methods of removing solid waste materials from the facility.
g - **Financial assurance requirements**.

There are no specific financial assurance requirements for composting facilities subject to this chapter; however, composting facilities must meet the requirements

Tools and Equipment's

- Moisture tester
- Cut lace/Machete
- Shovels/Spades
- Watering can
- Brush & grass cleaner
- Respirator
- Mattock
- Small carts,
- Wheel tractor
- Fork lift machine

- Sprayer

Self-check 6	Written test

Name…… ID…… Date…….

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

Test I: Write short answer/s (4 point)

1. Write at least four tools and equipment's needed during compost
2. Write at least four facility needed for undertaking composting process

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

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

Information Sheet 7- Developing and documenting contingency plan

7.1 Introduction

Contingency plan is a plan or procedure that will take effect if an emergency occurs. Emergencies often strike without warning and can cause major damage and financial loss. Any compost producers are strongly advised to develop emergency preparedness plans before an emergency occurs on the farm/ production area/site. First response to an emergency is the responsibility of an individual. Help should be sought once farm or ranch resources or ability has been overwhelmed. This contingency planning template will assist in formulating a preparedness plan which is specific to your farm operation.

The information in the plan will help to ensure the safety of family members, employees, and emergency responders, minimize financial loss, property damage, and protect the environment. the emergency response plan should include an overview of the property, identifying the location of storage areas, buildings, emergency equipment, utilities, wells and surface water. It should also include information on hazardous and flammable substances stored on the farm, manure handling information for livestock operations, and emergency contact telephone numbers.

Having a comprehensive contingency plan may be useful should the question of due diligence arise as a result of an emergency situation. It is also critical that insurance policies be obtained and kept up to date to ensure eligibility for relevant emergency financial assistance.

7.2 Contingency plan of compost

Contingency Plan for Permitted Landscape Waste Compost Facilities

a. A contingency plan must be established, addressing the contingencies and the following additional contingencies:

- Equipment breakdown;
- Odors;
- Unacceptable waste delivered to the facility;

- Groundwater contamination;
- Any accidental release of special waste; and
- Conditions such as fires, dust, noise, vectors, power outages and unusual traffic conditions.

b. The facility contingency plan must be available on-site and implemented as necessary.

Self-check 7	Written test

Name…… ID…… Date…….

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

Test I: Say true or false (2 point each)

1. Any compost producers are strongly advised to develop emergency preparedness plans before an emergency occurs on the farm/ production area/site
2. The facility contingency plan must be available on-site and implemented as necessary.

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

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

LG #49	LO #2- Schedule production to meet requirements.

Instruction sheet

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

- Calculating batch types and volumes of compost-based products
- Obtaining laboratory and field test data of compost materials during and post-production
- Monitoring and adjusting production schedule
- Making products

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Calculate batch types and volumes of compost-based products
- Obtain laboratory and field test data of compost materials during and post-production
- Monitor and adjust production schedule
- Make products

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following

“Operation sheets”

8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Calculating batch types and volumes of compost-based products

1.1 Introduction

Loss of mass and volume during composting of various feedstocks is an important consideration for compost operation management and facility design. Direct measurements of mass and volume in piles and windrows require specialized equipment and skills that render such measurements impractical for most commercial operations.

Batch Composting is the Continuous method of composting too slow. If there is enough to have access to a generous amount of waste material, and if well-organized and willing to expend the effort, it may prefer to stock-pile the ingredients and then to build a heap all in one hit. This is called Batch Composting. Because the initial mass of the pile is greater than in a 'continuous' pile which grows bit by bit, it can with a little extra attention, achieve higher temperatures, thus accelerating the speed of decomposition. When using the Batch system, you may find that a second or even a third pile becomes desirable, as once established and working well, disturbing the first one by adding more raw materials will tend to slow things down. Use a second batch of waste from the stock-pile to ensure a constant supply of the 'black gold'. Deodorization is easy. As for the exhaust, the batch processing can be done in the leak-proof structure. It is possible to set it up in little space. Huge area is not required for the set-up as the structure is up right. The operating time is significantly reduced. The automation is possible except at the time of ejection and insertion.

Conventional method of compost preparation

- Choose a spot that is at least partially protected from rain. Or Basket
- Depending on the Customers need (production area), raw material availability, tool and equipment availability, Estimate Volume/area of compost production site

(e.g., pit, heap, Barrel method). E.g., for rectangular, LXW, Square system, L^2 circle, etc.….

- Depending on the estimated compost production site, Gather and weighing the horticultural residues, animal manures and other wastes and bring them to the preparation site.
- Pile the plant residues (15 cm thick)
- For the next layer, spread the animal manure to a thickness of about 8 cm,
- followed by about 3 cm of good soil.
- Pile another layer of the materials in the same sequence and
- repeat until a height of about 1.5 meters of the compost pile is attained.
- Water the pile until it is sufficiently moist.
- Turn over or mix the pile with spading fork after 3 weeks, then again after five weeks.
- Harvest the compost in three to four months.

Figure 2.1 batch compost

the initial heap should be at least 1 cubic yard (meter) in volume. This allows heat to build and speeds up the process.

Make sure your stock-pile contains enough raw materials to complete each heap.

- Use twiggy, coarse material for the bottom layer.
- Add green, then brown materials about 7 cm (3 inches) deep, dampening each layer with the spray setting on your hose, as you go.
- You may care to use a small amount of activator (purists say this should not be necessary, but when just starting out…) or alternatively, a few handfuls of garden soil, to assist in stimulating decomposition.
- To help keep the ingredients warm and to protect them from rain, cover them with a tarpaulin or some sort of sheeting, anchored against the wind.
- For optimum results, turn the ingredients frequently, at least every 7-10 days. This oxygenates the mix, keeping temperatures high, so speeding up the process.
- Check weekly that your ingredients are not drying out and water sparingly, if necessary.
- Remember, because this is, once again, an “open” pile, you should not be trying to compost meat and dairy waste. The risk of animal visitors is just too high. Any kitchen waste you do add should be well buried in the center of the heap or at least covered with a layer of grass clippings, some soil or dry leaves. (A piece of old carpet does a good job, too.)

When you are undertaking Batch Composting, adding new materials after your compost has been established is not a good thing. Each addition interrupts the process and slows things up. Best to start to stock-pile a new lot of ingredients and then to start afresh in a second bin once you have collected enough materials to make up around 1 cubic meter.

With enough space in which to store your ingredients, with a generous supply of materials and room to house your bins, Batch Composting is perfect when done in a 3-bin set-up. Compost achieved – up to 3 months if you do it right

1.2

1.2 Compost calculation for specific area (plants)

The optimum compost application rate will vary depending on soil conditions, compost characteristics, and the type of landscape planting. When amending poor soils that are low in organic content, typical compost rates will be three to six cubic yards per 1,000 square feet. This corresponds to a 1-2inch layer which is then incorporated to an approximate depth of 4-6 inches. This results in an inclusion rate of 20-30% compost by volume. Factors which limit the rate of addition include salinity, ammonium, and heavy metals. Products that are typically high in salinity, like many manures, should be limited to approximately one cubic yard per 1,000 square feet. Products that are high in ammonium nitrogen (some biosolid composts) should be used with care since the ammonium can be injurious to young seedlings under certain conditions. If a compost high in ammonium is used, waiting several days after incorporation and prior to planting can reduce the potential for plant injury. When utilizing any organic amendment, it is important to thoroughly incorporate the amendment in order to avoid pockets or layers of organic material.

Application rates, timing in relation to crop establishment, and placement, are all factors that can influence results. Traditionally compost is broadcast and incorporated close to planting. however, when compost is immature and likely to create problems with establishment, such as with small-seeded crops such as carrots, then allowing 10 to 14 days delay will minimize potential problems.

1.3 Strategies for efficient use

Maximum benefits from compost require regular, repeated use. As soil organic matter levels and microbial populations develop, significant reductions in fertilizer, irrigation and pesticide applications will be possible. Soil organic carbon levels are influenced by:

- soil type - they are lower in light sandier than heavier soils
- management - cultivation in particular reduces levels
- climate - lower in dry arid and warm humid climates.

For vegetable production on light sandy soils, trials and commercial experience suggest that rates in the order of 20 to 25 m^3/ha are sufficient to achieve significant results. Reduced volumes by either banding or restricting placement to the planting beds are likely to maintain or even improve crop establishment but are unlikely to achieve the same increase in soil carbon.

In the longer term, it is feasible that lower rates of 10-15 m^3/ha/year will be sufficient. However, it must be stressed that rates will be determined by the adoption of management practices that promote soil organic carbon levels and the maintenance of effective soil organic cycles. These include reduced cultivation, greater use of cover or break crops, as well as minimizing the use of pesticides, fertilizers and other practices that disrupt beneficial microbial populations.

The addition of clay, either directly or as a component of compost, will also assist organic matter build-up. This is because of its positive influence in creating a wider range of pore sizes that in turn provide a more protective environment for the important microbial component of the soil biology, the ‘soil food web’.

Self-Check – 1	Written test

Name…… ID…… Date…….

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

Test I: Say true or false

1. The optimum compost application rate may vary depending on soil conditions and compost characteristics (2 point)
2. When you are undertaking Batch Composting, adding new materials after your compost has been established is not a good thing. (2point)

Test II: Write short answer/s

1. Write the procedures of conventional method of compost preparation (4point)

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

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

Information Sheet 2- Obtaining laboratory and field test data of compost materials during and post-production

2.1 Introduction

Compost testing is important for characterizing the beneficial physical and chemical properties of a compost, as well as, for identifying potential problems with compost use. Due to the diverse nature of feed stock and composting processes, the quality of available compost materials can vary widely. Successful use of compost relies on evaluating the soil to be amended followed by an evaluation of available compost materials, and then determining the best material and rate to meet the desired objectives. Soil testing is a first step in evaluating soils slated for landscape use.

A standard compost soil test will usually include determinations of soil pH, salinity, sodium hazard, boron hazard, lime content, organic matter and soil texture. Most laboratories will also determine available nutrient levels. A laboratory will usually suggest organic and/or chemical amendments. Non-routine testing may be required if there is a suspicion of soil sterilant (under asphalt or in rights-of-way) or contamination. Due to the diverse nature of feed stock and composting processes, the quality of available compost materials can vary widely. Successful use of compost relies on evaluating the soil to be amended followed by an evaluation of available compost materials, and then determining the best material and rate to meet the desired objectives. Soil testing is a first step in evaluating soils slated for landscape use. A standard horticultural soil test will usually include determinations of soil pH, salinity, sodium hazard, boron hazard, lime content, organic matter and soil texture. Most laboratories will also determine available nutrient levels. A laboratory will usually suggest organic and/or chemical amendments.

2.2 Compost quality parameters

A number of important compost parameters can also be determined by laboratory testing.

Particle size

particle size is determined by passing the compost through a set of sieves and then determining the weight fraction retained on each sieve size. For turf or landscape establishment all the particles should pass a one-inch screen with a minimum of 90% of the material by weight passing a ½ inch screen. Although a fine textured compost is generally preferred, excessive dust fraction (particles less than 500 micron) can cause difficulties in handling and can also be an indication of low organic content.

Organic content

Organic matter is the measure of carbon-based materials in the compost. High quality compost will usually have a minimum of 50% organic content based on dry weight. Another means of expressing organic content is to list the weight of organic matter per unit volume of compost. Most of organic material per cubic yard.

Carbon to nitrogen ratio

The carbon to nitrogen ratio is a parameter used to determine if a compost is nitrogen stable. Composts that are derived primarily from wood by-products have high carbon to nitrogen ratios unless additional nitrogen is added during the composting process. Biosolids and manures generally have low carbon to nitrogen ratios since these materials are nitrogen rich. In general, a carbon to nitrogen ratio of 35 or lower is preferred if the material is claimed to be nitrogen stabilized. At higher carbon to nitrogen ratios, nitrogen can be tied as the compost further decomposes. Nitrogen is then less available to plant material, and high levels of nitrogen fertilization are required to maintain optimum plant color and growth. Products with low carbon to nitrogen ratios (less than 20) can supply significant quantities of nitrogen as they decompose.

pH

pH is a numerical measure of the acidity or alkalinity of the soil. The pH scale ranges from 0 to 14 with a pH or 7 indicating neutrality. Most compost has a pH between 6 and 8. Products derived from wood residuals or peat moss can have pH values as low as 4.5, while manures are frequently alkaline (pH 8.0-8.5). Since specific plant species sometimes prefer a specific pH range, knowledge of both soil and compost pH can be important. pH can be further adjusted through the use of such materials as lime (to

increase pH) and sulfur or iron sulfate (to decrease pH). Composts with very low pH (<4.0) should be used with caution since the low pH can be an indication or poor 2 composting practices which result in the formation of potentially toxic organic acids. Soluble salts (salinity)Soluble salt concentration is the concentration of soluble ions in solution. It is usually expressed as electrical saturated extract of either soil or compost. Soluble salt levels in compost can vary considerably, depending of feed stock and processing. Compost may therefore contribute to or dilute the accumulative soluble salt content in the amended soil. Knowledge of soil salinity, compost salinity, and plant tolerance to salinity is necessary for the successful establishment of plant material. For most turf and landscape plantings the final salinity (EC) of the amended soil should be less than 4.0 dS/m. Higher soluble salt levels would likely require leaching irrigations. Soluble nutrients, particularly potassium, calcium and nitrogen typically account for most of the salinity in compost products. Sodium is an undesirable soluble salt. This element should ideally account for less than 25% of the total soluble salts in compost.

Moisture content

Moisture content based on as received weight should be between 35% and 60%. The moisture content of compost affects its bulk density and therefore may affect transportation cost. Moisture content can also affect product handling. Compost which is too dry can be dusty and irritating to work with while compost which is excessively wet can be heavy and difficult to uniformly apply.

Contaminants

Compost materials used for horticultural application should be as free as possible of inert contaminants such as glass, metal and plastic.

Maturity and Stability

Maturity is the degree to which the compost is free of organic phytotoxic substances that can adversely affect seed germination on plant growth. Maturity and stability also relate to the level of biological activity in compost. Stable compost consumes almost no nitrogen or oxygen and generates little carbon dioxide or heat. Maturity and stability are difficult parameters to evaluate. Physical characteristics that are suggestive of a mature compost include a dark brown to black color and a soil-like or musty odor. There should be little or no recognizable grass or leaves. Compost that has a sour or putrid smell

should not be accepted. If the delivered compost is very hot (120F) or if the pile becomes very hot after rewetting, then the product is not stable.

Nutrient content

Although the nutrient content of compost is low compared to synthetic fertilizer products, compost is usually applied at greater rates and therefore nutrient contribution can be significant. The most commonly required nutrients are nitrogen, phosphorus and potassium. Composts are often analyzed for total and available nutrients. Wood residuals have relatively low nutrient content. Manure products are typically high in phosphorous and potassium. Yard waste products are often high in potassium. Materials derived from biosolids often have substantial nitrogen.

Heavy metal trace elements

Heavy metals are trace elements whose concentration are regulated by the EPA due to the potential for toxicity to humans, animals, and plants. Regulations governing the heavy metal derived from specific feed stocks have been promulgated on both the State and Federal levels. Trace elements referred to as heavy metals include arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Many of these elements are actually needed by plants for normal growth. Commercial compost producers are required to routinely test for heavy metals. This data is usually available from compost producers upon request.

Weed and disease

Commercial production of compost usually entails high temperature aerated composting which kills most weed seed along with diseases of animal and plant concern. Some yard waste compost can contain malva, burclover, and other weeds that are tolerant to heat. Compost producers and users need to be careful not to reintroduce processed, there has been very little evidence of plant disease carryover. In fact, there has been considerable interest in the ability of compost to suppress soil-borne plant diseases. Large compost producers are required to periodically check for diseases which are a concern from a human health standpoint. This data should be available from your compost supplier.

2.3 Compost analysis methods

Compost moisture, or water content, is expressed as a percentage of compost wet weight. Bulk density is expressed in pounds per cubic yard. Bulk density allows you to convert between weight units (tons) and volume units (cubic yards). Laboratories can perform a bulk density test, or you can perform one in the field. Field determination of bulk density often is more informative than laboratory measurement because it uses a larger volume of compost. Also, multiple samples can be evaluated to obtain an average bulk density.

Organic matter in many situations, organic matter is the most valuable component of compost for soil health improvement. Total organic carbon (TOC) is generally determined by combustion of compost in a specialized instrument equipped with a high temperature furnace and an infrared or other detector to determine the amount of C in the sample

Compost pH is a measure of acidity/alkalinity. Most plant-based composts are moderately acidic (pH 6) to moderately alkaline (pH 7.5). Manure-based composts usually have pH of 7 to 8. The high pH of most manure-based composts makes them unsuitable for acid-loving plants such as rhododendron and blueberry.

Electrical conductivity (EC) is an indicator of soluble salt content. Electrical conductivity is usually reported in units of mmhos/cm, mS/cm, or dS/m. These units are equivalent and have the same interpretation

Generally, the following parameters are some of the conventionally used for indicating compost quality:

- pH (5.5 – 7.5)
- soluble salts (<5 mmhos/cm)
- nutrient content
- water-holding capacity
- stability

- organic matter content
- moisture content (35% – 55%)
- particle size (3/8 inch – 1 inch)
- bulk density (<1,000 lbs/cu yd)

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: Say true or false

1. Compost testing is important for characterizing the beneficial physical and chemical properties of a compost (2 point)
2. Electrical conductivity (EC) is an indicator of soluble salt content of compost product. (2point)

Test II: Write short answers

1. Write the parameters which are determine compost product quality (5point)

Note: **Satisfactory rating -9 points** **Unsatisfactory - below 9 points**
You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Monitoring and adjusting production schedule

3.1 production planning and scheduling

Production planning is the function of establishing an overall level of output, called the production plan. The process also includes any other activities needed to satisfy current planned levels of sales, while meeting the firm's general objectives regarding profit, productivity, lead times, and customer satisfaction, as expressed in the overall business plan. The managerial objective of production planning is to develop an integrated game plan where the operations portion is the production plan. This production plan, then, should link the firm's strategic goals to operations (the production function) as well as coordinating operations with sales objectives, resource availability, and financial budgets.

The production-planning process requires the comparison of sales requirements and production capabilities and the inclusion of budgets, pro forma financial statements, and supporting plans for materials and workforce requirements, as well as the production plan itself. A primary purpose of the production plan is to establish production rates that will achieve management's objective of satisfying customer demand. Demand satisfaction could be accomplished through the maintaining, raising, or lowering of inventories or backlogs, while keeping the workforce relatively stable. If the firm has implemented a just-in-time philosophy, the firm would utilize a chase strategy, which would mean satisfying customer demand while keeping inventories at a minimum level.

The term *production planning* is really too limiting since the intent is not to purely produce a plan for the operations function. Because the plan affects many firm functions, it is normally prepared with information from marketing and coordinated with the functions of manufacturing, engineering, finance, materials, and so on. Another term, *sales and operations planning,* has recently come into use, more accurately representing the concern with coordinating several critical activities within the firm.

Production planning establishes the basic objectives for work in each of the major functions. It should be based on the best tradeoffs for the firm as a whole, weighing sales and marketing objectives, manufacturing's cost, scheduling and inventory objectives, and the firm's financial objectives. All these must be integrated with the strategic view of where the company wants to go.

The production-planning process typically begins with an updated sales forecast covering the next 6 to 18 months. Any desired increase or decrease in inventory or backlog levels can be added or subtracted, resulting in the production plan. However, the production plan is not a forecast of demand. It is planned production, stated on an aggregate basis. An effective production-planning process will typically utilize explicit time fences for when the aggregate plan can be changed (increased or decreased). Also, there may be constraints on the degree of change (amount of increase or decrease).

The production plan also provides direct communication and consistent dialogue between the operations function and upper management, as well as between operations and the firm's other functions. As such, the production plan must necessarily be stated in terms that are meaningful to all within the firm, not just the operations executive. Some firms state the production plan as the dollar value of total input (monthly, quarterly, etc.). Other firms may break the total output down by individual factories or major product lines. Still other firms state the plan in terms of total units for each product line. The key here is that the plan be stated in some homogeneous unit, commonly understood by all, that is also consistent with that used in other plans.

3.2 production scheduling

The production schedule is derived from the production plan; it is a plan that authorized the operations function to produce a certain quantity of an item within a specified time frame. In a large firm, the production schedule is drawn in the production planning department, whereas, within a small firm, a production schedule could originate with a lone production scheduler or even a line supervisor. Different format is used in compost

production schedule. For instance: compost preparation, format, compost utilization format……

Table 3. compost preparation format

S/No	Area to be fertilized	Rate (Qt/ha)	Total compost in Qt											
				December		January		February		March		April		
				No of pits	Qt of compost	No of pits	Qt of compost	No of pits	Qt of pits	No of compost	Qt of compost	No of pits	Qt of compost	
1														

Table 4. compost utilization plan Format

S/No	Compost preparation months	Compost utilization plan in (Qt)											
		December	January	February	March	April	May	June	July	August	September	October	November
1	December												
2	January												
3	Februar												
4	march												
5													
6													

Production scheduling has three primary goals or objectives.

The first involves due dates and avoiding late completion of jobs. The second goal involves throughput times; the firm wants to minimize the time a job spends in the system, from the opening of a shop order until it is closed or completed. The third goal concerns the utilization of work centers. Firms usually want to fully utilize costly equipment and personnel.

Often, there is conflict among the three objectives. Excess capacity makes for better due-date performance and reduces throughput time but wreaks havoc on utilization. Releasing extra jobs to the shop can increase the utilization rate and perhaps improve due-date performance but tends to increase throughput time.

3.3 The production planning and production scheduling interface

There are fundamental differences in production planning and production scheduling. Planning models often utilize aggregate data, cover multiple stages in a medium-range time frame, in an effort to minimize total costs. Scheduling models use detailed information, usually for a single stage or facility over a short-term horizon, in an effort to complete jobs in a timely manner. Despite these differences, planning and scheduling often have to be incorporated into a single framework, share information, and interact extensively with one another. They also may interact with other models such as forecasting models or facility location models.

It should be noted that a major shift in direction has occurred in recent research on scheduling methods. As a result of innovations such as computer-integrated manufacturing (CIM) and just-in-time (JIT), new processes being established in today's firms are designed to capture the benefits of repetitive manufacturing and continuous flow manufacturing. Therefore, much of the new scheduling research concerns new concepts and techniques for repetitive manufacturing-type operations. In addition, many of today's firms cannot plan and schedule only within the walls of their own factory as most are an entity with an overall supply chain. Supply chain management requires the

coordination and integration of operations in all stages of the chain. If successive stages in a supply belong to the same firm, then these successive stages can be incorporated into a single planning and scheduling model. If not, constant interaction and information sharing are required to optimize the overall supply chain.

3.4 Monitoring Compost production

Compost needs to entirely stabilize and mature before it can be used. Not only can immature compost damage your plants, but it can also attract rodents and other pests to your yard. You will need to stop adding material in order for your pile to mature (although in no-turn systems, the bottom of the pile may provide finished compost even if the top of the pile is still active). You can identify finished compost by looking for these characteristics:

- Texture: Crumbly and smooth, without recognizable scraps.
- Smell: Like a forest on a rainy day, or rich earth. Traces of ammonia or sour odors means the compost needs more time to mature.
- Color: Dark and rich
- Size: One-third the original size of your pile
- Temperature: Within 10 degrees Fahrenheit of the temperature outside (especially in the middle of the pile)

Once you have confirmed that your compost is mature, here are some ways you can put it to use:

- Use it as mulch
- Add it to potting soil
- Work it into crop beds
- Distribute it on lawns
- Mix it into garden beds
- Feed it to potted plants
- Add it to soil around fruit trees

Compost cannot go bad, but it can get too wet, too dry, or too old. You can still use compost that is old; it just might not have as many nutrients in it as fresh compost.

The basic process of composting includes the following five steps:

- Feedstock Preparation
- Composting
- Curing
- Screening
- Storage

In a nutshell, feedstock's and any required bulking agents are mixed together in suitable proportions and spread into rows or piles. Air and water are added to the piles in appropriate amounts while the microorganisms in the mixed materials begin to eat and process the nutrients in the feedstock. This phase of composting, which is the most active, lasts about a month and generates temperatures high enough to kill pathogens and weed seeds. When this stage is complete, the compost may be moved to a separate pile and allowed to cure for an additional two months.

While curing, biological activity in the compost is still taking place, but at a much slower pace than in the active phase. After curing, the compost may be screened to create a more uniform size, remove rocks and un composted materials, and to recover some types of bulking agents for reuse. The compost should then be stable, that is, it should have a fairly consistent look and an earthy, inoffensive odor. It can then be stored for use on the farm or put up for sale in bulk or bag.

Figure 2.2 Screening process of matured compost

Compost is a living thing filled with organisms and micro biotic bacteria that require aeration, moisture and food. Learning how to store compost is easy to do and can increase in nutrients if stored on the ground. If you are making your own compost at such high levels that you cannot use it right away, you can also store it in a compost bin. You will need to control the moisture levels during compost storage, as it may become moldy when soggy, but it should not dry out completely either.

Any good gardener plans ahead. This may mean that your compost for the following year is finished before it is time to lay it. That means keeping compost in a condition where it is still moist and nutrient rich for the next season. One of the easiest methods of compost storage is on the ground covered with a tarp or plastic sheeting. This will prevent excess moisture from rain and snow runoff but allow a bit of humidity to seep in and keep the pile damp. An added benefit will be the worms that can get into the pile and leave their rich castings behind. One of the main considerations in how to store finished compost is space. Compost storage on the ground is an eyesore and requires garden space, which many home growers are short of. You can use your compost bin and keep the compost lightly moist and turned, but many of us have a constant batch of compost going and the bin is needed for the next generation of rich soil amendment.

Self-Check – 3	**Written test**

Name…… ID…… Date…….

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

Test I: Say true or false

1. Compost is a living thing filled with organisms and micro biotic bacteria that require aeration, moisture and food (2point)
2. Production planning is the function of establishing an overall level of output (2point)

Test II: Write short answer/s

1. What are the main characteristics used for identifying finished/matured product of compost (4point)?

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

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

Information Sheet 4- Making products

4.1 Making products

The organic fertilizer (compost) is produced from all the organic wastes. Anything that comes from the nature, like livestock excreta, garbage, discarded cooking oil is converted into the high-quality organic fertilizer. The valuable organic fertilizers are produced by processing the organic wastes having no utility value. This equipment is a structure with emphasis on durability and insulation. The 3-layered heat insulating material which is reliable and conformed to all the environments is used as wall material.

Compost Qualities of Interest to Consumers

Compost is made from a wide range of organic materials including all plant and animal products and crop, food, manure, timber and paper wastes. Inorganic materials such as clay, fly ash (from power generation) and potentially other by-products of the mining and mineral sands industries such as bauxite residue or 'Alka loam' can also be included. These non-organic materials can be used to modify compost quality and characteristics. Best quality compost is made from wastes that are separated at source or a known blend of materials such as green waste containing food. Source-separated feedstocks provide blending options that maximize composting process efficiency by allowing:

• adjustment of the carbon to nitrogen (C: N) ratio and rate of biological activity

• adjustment of porosity that assists with managing aeration

• reduced contaminant levels.

Composting equipment ranges from various physical turning and aeration devices to forced aeration static pile and in-vessel systems. Depending on the location and nature of the materials, composting may be carried out outdoors, indoors or within enclosed vessels. Enclosed systems are expensive to establish, but can provide maximum control over the composting process and odors. Regardless of method and equipment, composting is an aero. Regardless of method and equipment, composting is an aerobic process that requires good process management to ensure and maintain:

• C:N ratio in the range of 25 to 35:1

• adequate oxygen levels

• moisture levels between 40 and 60 per cent

• temperatures below 70°C and preferably between 55 and 65°C. The C:N ratio is adjusted by blending the different feedstocks

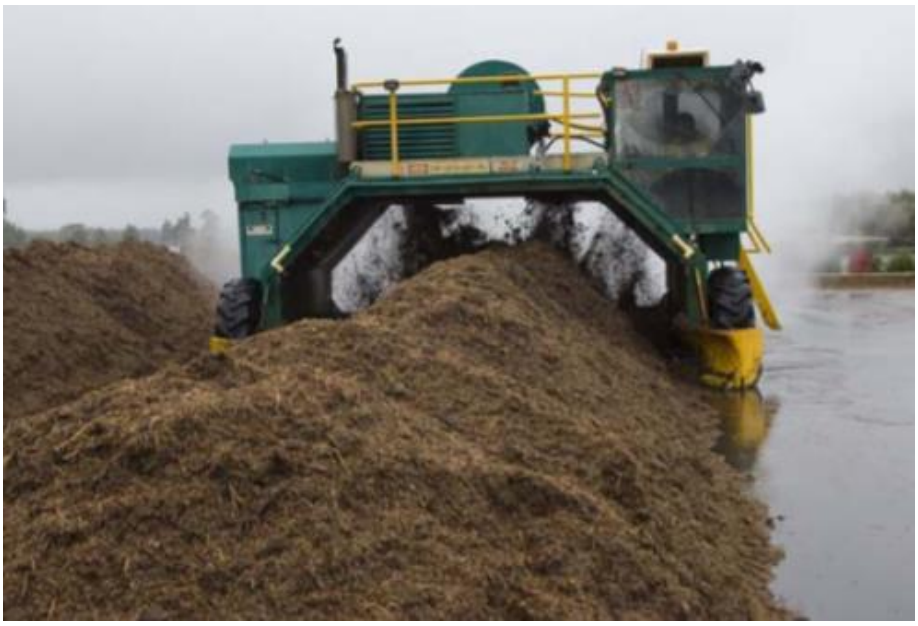


Figure 2.3 Large scale compost product

Weed Seeds

Consumers have shown a high level of concern regarding weed seed content in compost products according to surveys. Weed seeds are undesirable in gardening and potting soils, as well as other applications. Knowing viable weed seed content is valuable for both management and marketing purposes.

Soluble Salts and Maturity

Soluble salts and maturity can influence the health of plants. If soluble salts are too high, plant toxicity may occur depending on the tolerance of a particular species. Compost with low maturity may have a similar effect. Volatile substances may still be present in immature composts and may influence plant health.

Pathogens

Manure and other compost feedstocks may contain pathogens (disease-causing organisms). The heat generated in properly managed compost piles eliminates most pathogens. The finished compost would pose risks similar to potting mixes or garden soils. Consumers may want to know that pathogen risks have been minimized.

pH

Many plants grow optimally within a certain pH range. Knowing the pH of a compost will help consumers make decisions regarding how to use a product. Calculating the impact of compost additions on soil pH requires an understanding of the neutralizing value of the compost and is not simply based on compost pH.

Nutrient Value

Nutrients are almost always of value to consumers, since all plants have basic requirements to maintain health, and to grow.

Storage

Composting is a continuous process, therefore maintaining a given maturity or quality requires biological activity and storage time to be minimized. The biological activity depends on moisture levels, so allowing compost to dry out will permit storage with minimal change to the quality. When storage is required, continue turning the compost without any addition of water until moisture levels approach 30 per cent, then push it into large heaps and leave without further turning. Ideally it should be rewet prior to marketing in order to minimize dust during spreading.

Quality

Compost quality is complex and is related to the intended use of the final product. Aspects include its maturity, type, nutrient content and levels of contaminants. Useful measures include the C:N ratio, total nitrogen, available nitrogen including the nitrate to ammonium ratio, and Nitrogen Drawdown Index (NDI). Potential contaminants include disease, pests and weeds, inert materials such as plastics in all its forms, metal, glass and heavy metals.

Many heavy metals are important crop nutrients and compost often contains substantial levels of zinc and copper in particular.

Compost processes minimize these risks and quality assurance systems ensure that the risks are managed within acceptable limits. Most professional compost producers will have a quality assurance system and preference should be given to those that are independently audited.

Self-Check – 4	**Written test**

Name…… ID…… Date…….

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

Test I: say true or false

1. Compost is made from a wide range of organic materials including all plant and animal products. (2point)
2. Best quality compost is made from wastes that are separated at source or a known blend of materials such as green waste containing food. (2point)

.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**
You can ask you teacher for the copy of the correct answers.

Operation Sheet 1– monitoring compost production

PURPOSE: To get good quality of compost product
Materials required: weigher/ Balance, Bamboo stick/thermometer, oven dry, Note book, pH meter, EC meter,

Procedures:

- Wear personal protective equipment
- Asses quality of raw material (by physical observation)
- Weigh the raw materials
- Record and document the amount of raw material data
- document procedures in writing
- identify problems with production (factors affecting production)
- apply the solution one for emergency problems
- Assess the quality of production by laboratory and physical identification such as,
    - ✓ Moisture content
    - ✓ Bulk density
    - ✓ CEC
    - ✓ PH
    - ✓ EC
    - ✓ smell,
    - ✓ color,
    - ✓ temperature……)
- Record the production Data
- Report all activities to the concerned bodies

LAP TEST. 1	Performance Test

Name……. ID…….
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary tools and materials you are required to perform the following tasks within 2 hours. The project is expected from each student to do it.

Task-1: Perform monitoring compost production

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The trainers who developed the learning guide

No.	Full name	TVET	Level of education	A/ background	Email	Mobile
1.	Misgana Belay	Nedjo	MSc	Agronomy	Misbel2020@gmail.com	0911983854
2.	Leta Abebe	Waliso PC	BSc	Plant science	Letaabeba361@gmail.com	0922768274
3.	Deribew Gonfa	Fitche PTC	MSc	Plant Science	gonfad24@gmail.com	0912774688
4.	Chimdessa Wakuma	Bako	MSc	Horticulture	wakumachimdessa@gmail.com	0911359086
5.	Alemayehu Tesfaye	Nedjo	MSc	Plant science	alemayehutesfayem@gmail.com	0913214980
6.	Getenesh Belay	Holeta	MSc	Horticulture	Nebzek2@gmail.com	0911449053
7.	Tamirat Tirfesa	Bako	BSc	Plant science	tirfessatamiru@gmail.com	0926811647
8.	Tesfaye Tekola	Assosa	MSc	Agronomy	tttekola@gmail.com	0910550651
9.	Moti Taye	Bako ATVEVT	MSc	Plant science	Tayemoti12@gmail.com	0912801540
10.	Adisu Shamble	Bako ATVET	BSc	Plant science	Adisushambel2011@gmail.com	0920617572
11.	Hailu Dereje	Bishoftu PC	BSc	Plant scicne		
12.	Mamo Abdi	OTVETB	MSc	Environmental and sustainable development	Mamoab57@gmail.com	0917812505