

Horticultural Crops Production

Level-IV

Based on March 2019, Version 2 Occupational standards



Module Title: Implementing and monitoring crop harvesting and post-harvest programs

LG Code: AGR HCP4 M16 LO (1-3) LG (46-48)

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LG #46	LO #1- Plan for harvesting.
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Instruction sheet :1
<p>This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:</p> <ul style="list-style-type: none"> • Assessing crop maturity and quality • Estimating optimum time to harvest crop • Determining and carrying out pre harvest treatments • Identifying enterprise's operations and licenses or permits requirements • Assessing resource requirements • Carrying out labor and equipment • Identifying and communicating enterprise requirements • Planning and implementing risk management strategies • Identifying and arranging fire prevention and control <p>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:</p> <ul style="list-style-type: none"> • Assess crop maturity and quality • Estimate optimum time to harvest crop • Determining and carrying out pre harvest treatments • Identify enterprise's operations and licenses or permits requirements • Assess resource requirements • Carry out labor and equipment • Identify and communicating enterprise requirements • Plan and implementing risk management strategies • Identify and arranging fire prevention and control
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- Assessing crop maturity and quality

1.1. Definition of harvesting

Harvesting- is the final agricultural operation but the first in the post-harvest system.

- It is the removal of entire plant or economic portion of plant after maturity
- It is defined as the removal of whole or part(s) of the plant at a time or at different interval depending on kind of crops to be harvested and consumers demand.
- It is also defined as the separation of fully or partially matured horticultural crop product from the mother plant.
- It may be also defined as the separation of the crop from the site of immediate growth.

It is considered as the last step in crop production, but the first step in the post production system. Therefore, it is important to perform the harvesting operation on time and with great care as it influence the subsequent processing and preservation of the crop.

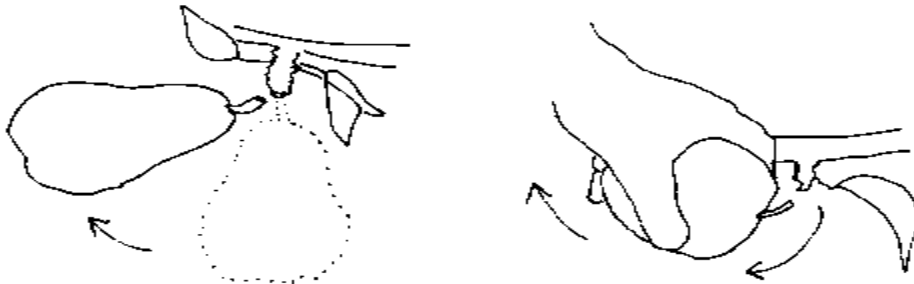


Figure: 1.1 hand harvesting practices



Figure: 1.2 Olive harvesting



Figure: 1.3 Harvested bananas



Figure: 1.4 Lettuce Harvesting



Figure: 1.5 Grape and mango harvesting

Identifying the correct stage of maturity and harvesting at proper time are important pre harvest factors. Maturity indices are important for deciding when a given commodity should



be harvested to provide some marketing flexibility and to ensure the attainment of acceptable eating quality to the consumer.

1.2. Assessing crop maturity and quality

Maturity is the stage of development leading to attainment of the consumer for a particular purpose.

Crop maturity- is defined as one of the stages of plant growth and development which indicates the time when a given crop has its own optimum flavor and texture for fresh eating or processing.

- It is also defined as an indication of the crop's development and its progress toward becoming a marketable product.

There are different definitions of crop maturity depending on type of crop and maturity. Some of these are:

- It is the time when a fruit or vegetable should be picked so that it will keep for the longest period in cool storage.
- It is also the stage at which the crop will develop optimum quality up on ripening (after harvest for banana, avocado, tomatoes...etc).
- The stage at which, when harvested, the fruit will develop optimum quality up on ripening (this apply to banana, avocado and other fruits that must be ripened after harvest before they can be consumed)

The proper stage of maturity in different horticultural crops is ascertained from size, color, tenderness, succulence, texture, sweetness and flavor. Choosing the correct time to harvest horticultural crops is more complicated than for most other crops because the product grows underground and others often matures unevenly. Correct harvest timing is essential to avoid yield and quality losses.

Optimum maturity at harvest is a very important determinant to the final quality of the product. For example: Fruits and vegetables picked too early or too late in season are more

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susceptible to physiological disorder and have a shorter storage life than those picked at the proper maturity. Fruits picked immature may not fully ripen.

The way of determining crop maturity depends on different morphological changes and crop maturity parameter that indicates proper maturity stage of a given crop to be marketed or stored. Some of these maturity parameters include size, weight, length, shape, color, ripeness, texture, skin condition, ease of removal and moisture content.

These characteristics may be measured by observation and maturity testing tools and equipment such as knives, sizing rings, color charts, refractometers, and penetrometers and produce firmness testers. The results are interpreted and analyzed by comparison with specification charts and enterprise and industry maturity standards.

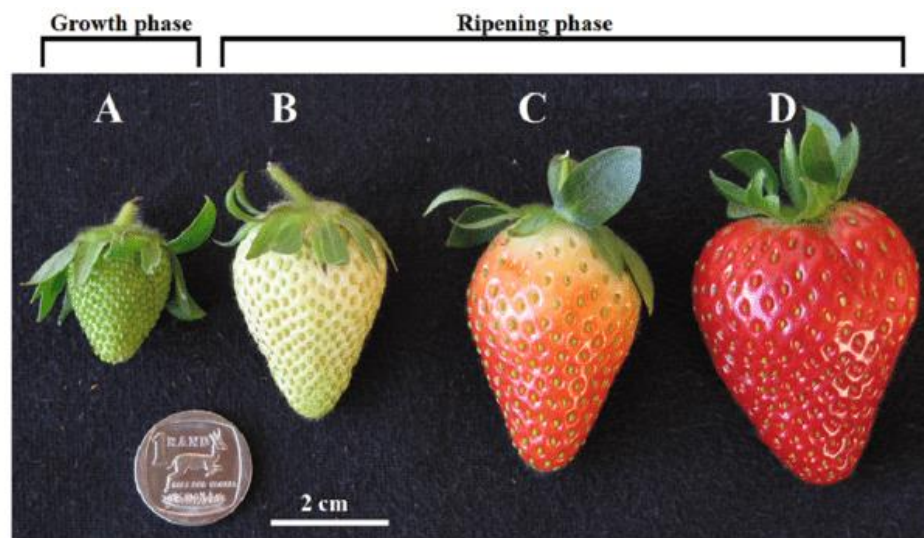


Figure: 1. 6 Strawberry growth and ripe stage.

1.3. Harvest maturity determination

- **Colour:** losses of green color, development of red, yellow or purple color. For most fruits and some vegetables.
- **Shape:** Ex. For banana, angularity. For mango, “full cheeks”.
- **Size:** Too many vegetables, ex. Zucchini.
- **Firmness:** Softening often occur by ripening, esp. For fruits. Exist specialized instruments for pressure testing.

- **Chemical measurements:** As fruits ripen the starch to sugar content decreases. Starch is converted into sugar and this alters the texture of the product and makes it softer. It also makes the product sweeter and of better taste. Starch content is tested using iodine. Sugar is tested as total soluble solids in the juice of the product.
- **Respiratory behavior:** In climacteric fruits
- **Calendar date:** For perennial fruits grown in climates which are uniform from year to year. Based on the producer’s experience.
- **Heat units:** A certain number of degree-days are necessary to mature a crop. If cool, longer. If hot, shorter time.

1.4. Practical uses of Maturity Indices

- **State and Federal regulations** often include a guide for minimum and maximum maturity that is acceptable for a given commodity
- **Marketing strategies** to obtain premium prices for commodities “Supply and demand” delaying or expediting harvesting and shipping of a particular crop at the beginning or end of the season requires a measure of maturity if quality is to be maintained
- **Efficient use of labor** – A measure of maturity is important for organizing start and end dates for harvesting to ensure labor and equipment availability and reduce harvesting costs

Physiological maturity versus horticultural maturity

Physiological maturity: When a plant or plant part will continue ontogeny even if detached.

Horticultural maturity: When a plant or plant part possesses the pre requisites for utilization.

In physiological sense, maturity refers to the attainment of final stage of biological function by a plant part or the plant as a whole.

The quality of vegetables can be preserved for a longer duration if it is harvested at an appropriate stage. For instance, in tomato, according to the use of fruits harvesting is done at various stages depending on the purpose. Generally, the tomatoes are harvest at mature green to turning stage for long distance marketing. For fresh local market, pink to light red tomatoes are harvested

Physiological maturity

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- Plant (part) has completed natural growth and development
- Certain stage of development so that upon harvesting from the plant commodity will continue to develop as if still on plant.
- Quality has reached minimum acceptable standards.

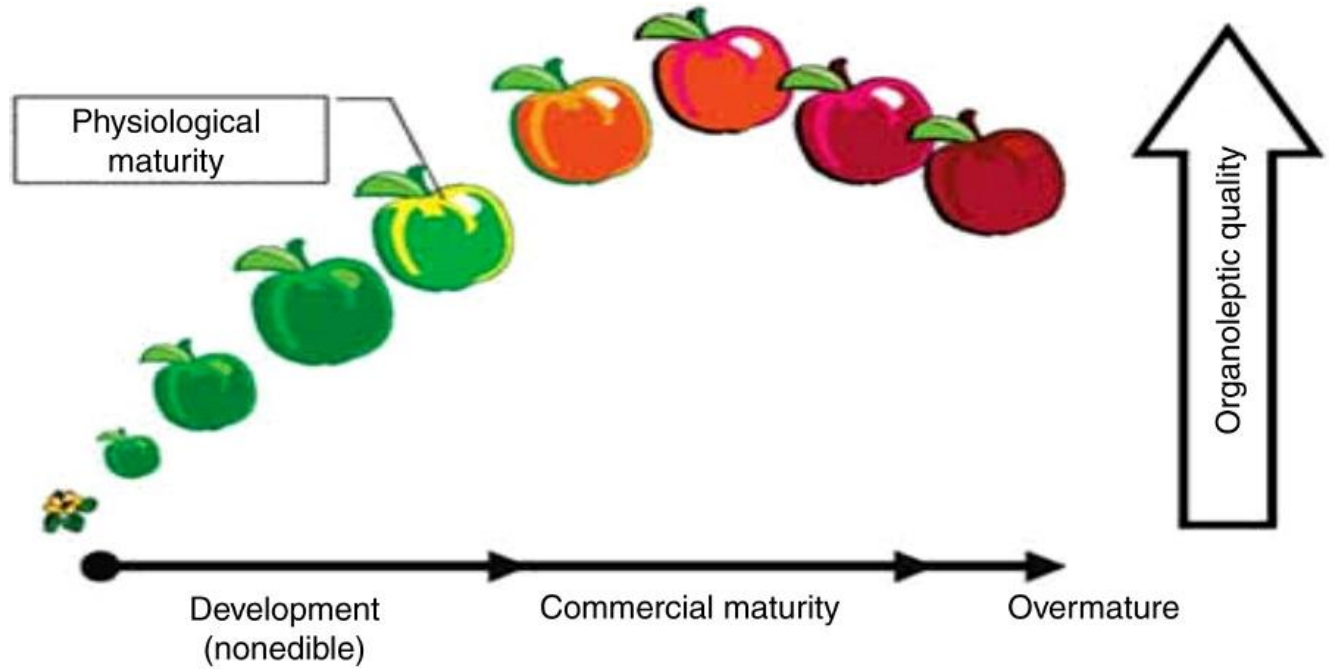


Figure: 1.7 apple maturity stage.

Physiological maturity versus horticultural maturity

Physiological maturity

Plant (part) has completed natural growth and development
 Certain stage of development so that upon harvesting from the plant commodity will continue to develop as if still on plant
 Quality has reached minimum acceptable standards



Figure: 1.9. banana maturity stage.

Horticultural maturity

- Stage of development when a plant possesses the quality prerequisites for use by consumers for a particular purpose
- All plant (parts) are harvested when horticultural mature but may be physiologically immature or mature
 - ✓ Examples of mature hort. / immature phys. crops: sweet corn, peas, snap beans, summer squash, cucumber and bean sprouts
 - ✓ Examples of mature hort. / mature phys. crops: winter squash, melons, tomato, pepper, eggplant, carnations, and rose

Horticultural maturity

Stage of development when a plant possess the quality prerequisites for use by consumers for a particular purpose.

Commodity can be horticulturally mature at any stage of development or physiological maturity



Figure:1.10 papaya maturity stage.

A. Age-related

- Number of days from planting to maturity
- Days from full bloom to harvest

Subject to environmental influences season to season variation

Can be modified by incorporating heat units with the chronological index to take account of the weather pattern during the growing season

B. Physical properties

- **External and internal color;**
 - ✓ Useful for many horticultural products
- **Size;**

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May not be a good indicator of maturity as can be influenced by many factors but useful for peas, beans, potatoes, celery Shape;

- **Shape**

For example banana (3/4 full, full ¾ and round full), cucumber

- **Solidity**- head lettuce and cabbage are harvested on the basis of the solidity of the head

- **Texture** -

- ✓ Firmness - (apples, pears, and peaches) used to determine harvest date and quality
- ✓ Tenderness - measured with tenderometer – peas

C. Morphological changes

- Development of an abscission layer – muskmelons Morphological changes
- Development of a waxy layer on the epidermis – plums, grapes, honey dew melons
- Development of netting on the surface – muskmelons
- Internal structure - formation of gel-like material surrounding the seeds of tomatoes
- Prior to tip opening – asparagus

D. Chemical composition

- Starch - apples, pears
- Soluble solids /Sugars - apples, pears, stone fruits, grapes
- Acids; sugar/acid ratio – citrus, pomegranates, kiwifruit
- Juice content - citrus fruits
- Per cent dry weight- avocado
- Astringency – persimmon, dates – low levels desirable
- Ethylene production – apples, pears (particularly those destined for long term storage)
Starch content in apples particularly useful for green apples eg. Granny Smith Stage depends upon the use



Non-destructive maturity analysis

Electronic Nose

- Used to detect aroma volatiles in a range of food types.
- Has been used for determining fruit maturity based on the production of aroma volatiles
- Statistical analysis must be performed to interpret data. Most research literature is based upon method verification and comparing data with more established methods of evaluating maturity.

Acoustic firmness sensor

Method taps the fruit and then “listens” for vibrations (resonance attenuated vibration). Fruit of different maturities produce different vibration profiles. Measures whole product not just a restricted area.

Spectroscopic analysis

Various different methods based upon the interaction of atoms or molecules with the electromagnetic spectrum.

- **Visible spectral imaging (380 – 770 nm):** Measuring surface color based on absorption of light energy by reactive groups in chlorophylls, carotenoids and anthocyanins. Used in packing lines to detect color of apples and peaches.
- **Fluorescence imaging:** Achieved by measuring electromagnetic radiation in the visible range following excitation with short wavelength radiation. Greatest use of application is in the measurement of chlorophyll fluorescence.

What is fruit ripening? A mature fruit undergoes physical and chemical changes before it becomes edible. During ripening it often loses its green color, there is decrease in acidity, softening of the tissues, increase in sugar content and the development of characteristic flavor.

Types of fruit ripening: There are two types of fruit ripening:

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- **Climacteric:** climacteric fruits are those in which ripening of fruits takes place after harvest, e.g. mango, banana,
- **Non-climacteric:** Non-climacteric fruits, on other hand, are those in which the ripening of fruit is only complete while on the plant and they fall to ripen if they are harvested from the plant, e.g. grapes.

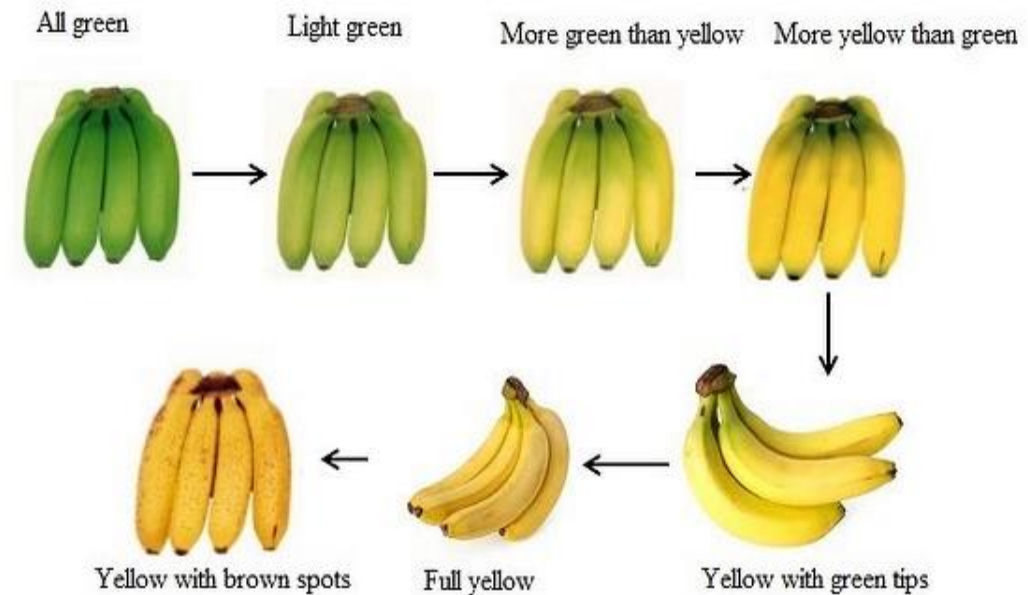
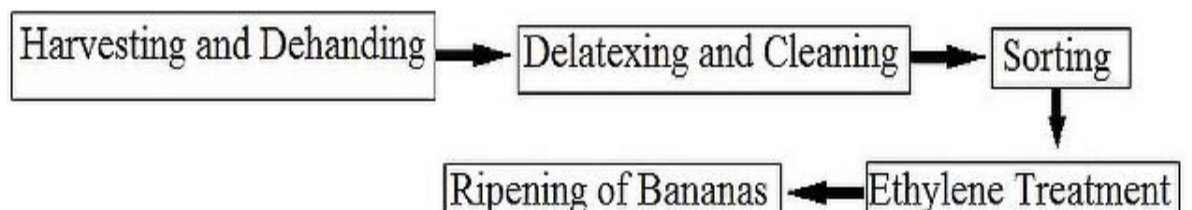


Fig. 1. Seven stages of ripening.



1.5. Maturity at harvest in relation to quality

- Maturity at harvest is the most important determinant of storage-life and final fruit quality.



- Immature fruit are highly susceptible to shriveling and mechanical damage, and are of inferior flavor quality when ripe.
- Overripe fruit are likely to become soft and mealy with insipid flavor soon after harvest.
- Fruit picked either prematurely or too late, are more susceptible to post-harvest physiological disorders than are fruit picked at the proper stage of maturity.
- With a few exceptions, all fruits attain optimal eating quality when allowed to ripen on the plant.
- Some fruits are, however, picked at a mature but unripe stage of development so as to allow them to withstand post-harvest handling conditions when shipped over long-distances.
- Maturity indices for such fruit are based on a compromise between those indices that would ensure the best eating quality to the consumer and those that provide flexibility in marketing.

1.6. Maturity indices for important some vegetables

1. Tomato:

a) Immature green: It is the stage of fruit, before the development of seeds fully and before surrounding the seeds by a jelly like substance. The fruits are harvested at this stage only for frying purpose.

b) Mature green: It is the stage of fruit when it is fully grown, and show brownish ring at the stem scar on removal of calyx and light green color at blossom end changes to yellowish green and seeds are surrounded by jelly substances filling seed cavity. The fruits at this stage are harvested for shipment to long distance and for long storage too.

c) Turning (breaker stage): It is the stage of fruit when one-fourth of the surface at blossom end shows pink colour. The fruits at this stage are harvested for local market.

d) Pink stage: It is the stage of fruit when three-fourth of the fruit surface shows the pink color. The fruit at this stage are also harvested for local markets.

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e) Hard ripe stage: It is the stage of fruit when nearly the whole fruit skin shows red or pink color but flesh is still firm. The fruits at this stage are harvested for table purpose, processing and for the extraction of seed too.

f) Over ripe stage: It is the stage of fruit when the fruit is fully red colored and soft. At this stage, the fruits can be used only for the extraction of seeds, not for table purpose and processing since the fruits onward start decaying (Rana, 2014).

2. Capsicum:

a) Green pepper varieties: Fully mature green fruits should be harvested before ripening.

b) Red and yellow varieties: Fully mature green fruits should be harvested at the onset of color change.

c) Pepper fruits at the time of harvest should be firm and crisp not tender and immature.

3. Onion:

Bulbs are considered mature when the neck tissues begin to soften and tops are about to abscise and decolorizes. Maturity can be judge by the neck of the plants drying up, tops falling over while the leaves are still green (Rana, 2008).

4. Sweet Potato:

When the leaves turn yellow and begin to shed, tubers can be harvested. Immature tuber, the cut surface shows dark greenish colour while the color will be milky white in fully mature tubers

5. Okra:

Immature green tender fruits should be picked 3rd to 5th day from the time of first pod formation or 3 to 7 day after flowering. Okra should be harvested when the fruits are bright green, the pods are fleshy and seeds are small.

6. Moringa: Fruits of sufficient length and girth are harvested before they develop fiber.

7. Cucumber: Fruits can be harvested from 45 days after sowing. The tender fruits (for salad) can be harvested on 8th to 10th day of flowering.

8. Bottle Gourd: Fruits should be light green, 30-35 cm long, tender with little pubescence persisting on the skin.

9. Muskmelon:

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a) Fruits are generally harvested 60-70 days after sowing, 30-40 days after anthesis and 25-30 days after setting, observing other changes of outer color of the skin.

b) Muskmelon is generally picked at 'half-slip' stages for commercial marketing (part of the pedicle remains attached to the fruit, i.e., abscission layer is not fully developed). Sugar and flavor are not found optimum, at this stage. Full slip is stage at which the pedicle separates easily from the fruit with little or no pulling. Fruits for distance market should be harvested when mature but before full ripeness to minimize to breakdown in texture and damage during transport. (Rana, 2008)

10. Watermelon:

a) The fruits are ready for consumption in about 30-40 days after anthesis (Nath *et al.*, 1987).

b) The portion of fruit resting on ground starts Turing color from creamy white to yellow.

c) On ripening, the rind become hard enough that resists penetration of thumbnail.

d) The sugar content of fruit measured as soluble solids using hand refractometre is reached 10 % or more in flesh near center of fruit.

e) On thumbing, the immature fruits give out metallic ringing sound and the ripened dull hollow sound (Chauhan, 1972).

11. Garden pea:

a) Early cultivars require as few as 1000 heat units to achieve maturity, whereas, late sowing cultivars may require more than 1600 heat units.

b) The pods are harvested when they are filled, tender, having high sugar content and changing color from dark green to light green. Any delay in harvesting turns the pods to poor quality due to conservation of sugar into starch, and this conversion takes place more rapid at high temperature.

12. Chilli: Chilli should be harvested at fully mature and before change from green to red whereas on approaching the ripe stage.

13. Potato: Yellowish and drying of haulms

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14. Cabbage: Solidity, firmness, squeaking of heads indicates maturity (Kalia, 2011).

15. Cauliflower: Curd size and colour are deciding factors. Snow white or creamy white, compact curds surrounded by turgid green leaves (Kalia, 2011).

16. Knol- khol: Harvest when the knobs are light green, tender and with delicate flavor having 5 – 8 cm dm.

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Self-check 1	Written test
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Name..... ID..... Date.....

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

Test I: Choose the best answer (4 point)

1. Unsafe work in terms of personal safety, work shop safety, and tools and equipment safety leads to
 - A. Accident
 - B. Damage
 - C. A & B
2. From the given choose which one is personal protective equipment.
 - A. Safety goggles
 - B. Safety shoes
 - C. Clothes
 - D. gloves
 - E. ear protection
 - F. all

Test II: Short Answer Questions

1. What is crop maturity? (3 pts)
2. How can we determine crop maturity? (3 pts)
3. Discuss the importance of determining crop maturity. (3 pts)
4. Discuss the importance of crop maturity parameters. (3 pts)
5. What is the major difference between horticultural maturity and physiological maturity? (3 pts)
6. What is harvesting? (3 pts)

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

Note: Satisfactory rating - 18 points

Unsatisfactory - below 18points

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 2- Estimating optimum time to harvest crop

2.1. Optimum time of harvesting

Harvesting at optimum time of maturity plays a key role in the shelf life and marketability of a given harvested products. Crops that are immature lose water rapidly and don't store well, in addition to not tasting their best. Crops that are over-matured can be tough and starchy, like beans and corn, or too soft and easily damaged, like plums.

Both immature and mature crops are subject to decay. Harvesting during the coolest part of the day is important because high temperatures lead to deterioration in highly perishable crops. The term "field heat" refers to the heat stored in crops from being out in the sun. In harvest and post-harvest handling you want to manage for reducing/taking out the field heat in your crops. Timely harvesting of the crop; reduce crop loss due to birds, insects, rodents and wild animals which implies better return to the farmer in terms of quality & quantity.

2.2. Time of harvesting

The proper time of harvesting is ascertained from the type of crop (i.e. maturity, size, texture, color, sweetness, flavor etc), the weather condition when harvesting and the purpose of production.

The optimum time for harvesting of succulent or fleshy vegetables;

- Early in the day
- During dark hours

The harvesting is usually carried out very early in the morning with following objectives;

- To maintain the full turgidity of leaves and other fleshy parts of the plant.
- Transpiration is minimum during dark hours and early in the day.

2.3. Factors affecting determination of time and methods of harvesting:-

- Species of crops:- Root and tuber vegetables can be harvested during any time of the day; whereas leafy should be harvested only early in the morning.
- Purpose of consumption: - Ripe fruits should be harvested for processing industries.



- Changing market demand: - Some crops such as carrots and beets may be harvested over a period of several weeks depending on market demand.

3.4. Cares (precautions) at harvesting

- Harvest only at the proper stage of maturity.
- Harvest as per the demand, purpose of consumption and distances of marketing.
- Do not harvest fruits or vegetables after spraying fungicides and insecticides for at least a week.
- Do not cause injury to the plants or produce while harvesting.
- Wash the harvested products after harvest and grade them before marketing.
- Harvest only in the morning when the produce is cool.
- Avoid harvesting during or immediately after rain as it creates favorable conditions for spread of pathogens
- Harvest at proper maturity stage
- Time of day to harvest. Most crops (with the exception of dry storage crops) are best harvested in the cool of the morning to avoid moisture stress at time of harvest and preserve marketability
- Crop turgor, soil moisture, and irrigation considerations prior to harvest.
- **Leafy crops** (e.g., lettuce, carrots, beets, spinach, greens, etc). Soil at 75% of field capacity to assure good turgor pressure and avoid soil compaction due to wet soil. Irrigating 24 hours prior to harvest is often ideal.
- **Storage crops** (e.g., onions, garlic, potatoes, winter squash, etc.). Soil and crops should be thoroughly dry prior to harvest and storage.

2.5. Keys for successful handling

Harvest at proper maturity stage

- Select, eliminate and separate products: with damage, for immediate sale, storage.
- Harvest during the coolest part of the day, keep products in shade after harvest. Protect from high temp. And sunlight throughout the post-harvest chain.



- Handle products with care to avoid mechanical injuries. Use correct packaging material and avoid overstocking. Avoid drops, impacts, and vibration and surface injuries.
- Keep good sanitation procedures. Clean harvest containers, display and storage facilities etc

Self-Check – 2	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write all the pre-conditions to implement horticultural crop harvesting? (3 pts)
2. How we establish suitable weather conditions for harvesting operation? (3 pts)
3. Write the proper time to harvest horticultural crops? (3 pts)
4. What is the major importance of determining the maturity level of a given horticultural crop? (3 pts)

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

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____



Information Sheet 3- Determining and carrying out pre-harvest treatment

3.1. Introduction

Pre-harvest treatments, either physical or chemical, may have a favorable or unfavorable impact upon postharvest quality.

Examples of treatments include such things as:

- The gathering of cauliflower leaves around the head prior to harvest to prevent yellowing.
- Twisting of cabbage (90 degrees) before harvest to break some roots and induce wilting - this causes the wrapper leaves to tighten, thereby helping to protect head during postharvest.
- Wrapping fruit while still on tree, e.g. apples, carambola (star fruit) and bananas may be wrapped with paper or plastic to prevent attack from birds, fruit flies and other pests or to enhance ripening or fruit color.
- Chemical treatments while in the field to extend postharvest storage life or enhance marketability, e.g., applying sprout inhibitors on potatoes or ethereal on apples to increase the red color.

In some cases chemical application can lead to postharvest residues which create marketing constraints. All physical and chemical pre-harvest treatments which affect the postharvest quality of the commodity under study should be identified.

3.2. Reasons for pre-harvest treatments:-

- To reduce weight of foliage.
- To facilitate mechanized harvesting.
- To facilitate bulk harvesting sorting, grading and packing by machines.
- To improve post-harvest life of produce.
- To delay harvest date.

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3.3. Chemicals used for pre-harvest treatment:-

- Cytokines - They are used for delaying harvesting dates.
- Growth regulators - Higher concentrations of many phenoxy compounds like 2,4-D; 2,4,5-T and 2,4,5-TP are used for reducing foliage.
- Diquat and paraquate - These are used in root and bulb crops for reduce foliage to facilitate harvesting.

3.4. Precautions in spraying of chemicals:-

- Avoiding toxic residual effect at harvesting.
- Reducing the cause of tainting, rendering them unpalatable.
- Restricting use of persistent organo chloride like DDT, BHC and aldrin.
- Determining the date of pesticide spray before harvest.

Self-check 3	Written test		
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Name..... ID..... Date.....

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

Test I: Choose the best answer (4 point)

1. Unsafe work in terms of personal safety, work shop safety, and tools and equipment safety leads to
 A. Accident B. Damage C. A & B D. None
2. From the given choose which one is personal protective equipment.
 B. Safety goggles B. Safety shoes C. Clothes D. gloves
 E. ear protection F. all

Test II: Short Answer Questions

1. How we establish suitable weather conditions for harvesting operation? (3 pts)
2. Write all the pre-conditions to implement horticultural crop harvesting? (3 pts)
3. What are pre- harvesting practices in horticultural crop harvesting? (3 pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 4- Identifying enterprise's operations and licenses or permits requirements



Introducing agrotourism, Direct Marketing, and On Farm Value Added Product Ventures.

1. Step 1: Evaluating Your Assets

2. Step 2: Components of a Business Plan

- Mission Statement
- Goals and Objectives
- Creating a Management Plan
- Creating a Marketing Strategy
- Forming a Financial Strategy
- Areas of Concern

3. Step 3: What is a Marketing Plan

- What is your Purpose?
- Advertising
- Investigating Competition
- Customer Service
- Working with your community (local and State

4. Step 4: Considering Local, State, and Federal Regulations

State of Delaware Codes and Ordinances a.

- Registering with the State
- Choose a Business Legal Structure
- Zoning and Building Code Regulations
- Signage in Delaware
- Public and Environmental Health
 - ✓ Food Safety
 - ✓ On Farm Accommodations
 - ✓ Public Safety
 - ✓ Water
 - ✓ Septic System
 - ✓ Road systems
- Parking on your Property
- Direct Marketing Concerns
- Labeling Goods
 - ✓ organic
 - ✓ general

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- Weights and Measures
- Obtaining Licenses
 - ✓ Business Licenses
 - ✓ Liquor Licenses
- Taxation
 - Lodging Tax
 - Labor taxes
 - Employer Identification Number
 - Employee State
 - Tax Registration

Human Resource Considerations

- Labor Training Information
- Contract Information

Checklists for Success

- Starting an Agritourism Operation (school tours, fall festivals, corn mazes)
- Starting an Animal Oriented Operation
- Starting a Bed & Breakfast
- Starting a Dairy Product Operation
- Starting a Direct Market Meat Operation
- Starting a Farmer’s Market
- Starting a Farm Market or Roadside Stand
- Starting a Greenhouse or Nursery Enterprise
- Starting a Meat Market on Your Farm
- Starting an On-Farm Dining Operation
- Starting a Portable Farm Related Food Business
- Starting an Small Scale Food Processing Operation
- Starting a Winery

Agriculture marketing is a cornerstone for Ethiopian population, which is located at the horn of Africa. Agriculture in Ethiopia records above 50 percent of the gross domestic product and engages 92 percent of the total population. Agricultural products comprise the predominant

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part of the country's total exports, with coffee accounting for more than 60 percent of the total export value and the remaining 40% are exports of hides and skins, oil seeds, and horticulture products such as fruits and vegetables.

Ministry of Agriculture reported that the country had obtained 7.1 million USD through export of over 21, 000 tons of horticultural products in the previous seven months since August 2006. Holland, Italy, Norway, Britain, Saudi Arabia and Djibouti were among the main export destinations, adding finger millet and strawberry were among the major export items. Mostly the products have been exported via the eastern border town Dire Dawa and the capital Addis Ababa

Ethiopia's appeal lie in its proximity to consuming markets, such as Europe and West Asia, its ideal climate conditions all year round, the improved investment code in the country, the accessibility to bank loans and the availability of land. Located in the equatorial belt, Ethiopia has an ideal climatic condition that helps in producing good horticultural products.

The Ethiopian government offers large tracts of land for horticultural companies on a perpetual long-lease at very attractive rentals. Horticulture products are perhaps mostly easily defined as what they are not. They are not cereals or the major industrial crops. Generally, but not exclusively, they are not staple crops.

Important characteristics of horticultural crops are that they

- Are mainly eaten for their contribution to the flavor and interest of food
- Are not basic food commodities
- Consumption level vary depending on the selling price
- Are not traded in large volumes and there is a limited market

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Self-Check – 4	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down all the safety requirements for horticultural harvesting.(2pts)

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2. Write three examples of Hazards parts during horticultural harvest? .(2pts)
4. What are the main purposes of Enterprise licenses? .(2pts)
5. Write down some important characteristics of horticultural crops.(2pts).
6. What are the Checklists for Success of enterprises? .(2pts)
7. What is a Marketing Plan? .(2pts)
8. Explain why CFG has become an important process.(2pts)
9. Creating a Risk Management Plan? .(2pts)

Note: Satisfactory rating - 18 points Unsatisfactory - below 18points

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 5- Assessing resource requirements

5.1. Introduction

All materials needed for harvesting horticultural crops will be selected and prepared before the commencement of the harvesting operation. The materials, tools and equipment's needed for harvesting vegetables may include:

- Containers: bags, sacks, cardboards, baskets, plastic sheets, trays, etc.

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- Cutting or clipping tools: shears, cutlass, knives, sickles, machetes, etc.
- Digging tools: spades, forks, towels, hoe, etc.
- Treatment chemicals

5.2. Harvesting containers- Picking baskets, bags and buckets come in many size and shapes. Several examples are illustrated below.

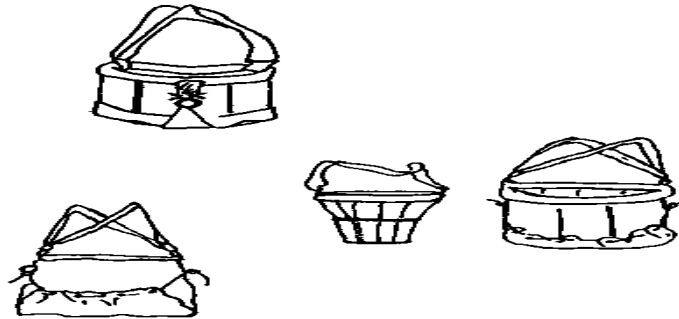


Figure: 1.11

Plastic crates are relatively expensive but are durable, reusable and easy to clean.

5.3. Harvesting tools- Some fruits need to be clipped or cut from the parent plant. Clippers or knives should be kept well sharpened. Pruning shears are often used for harvesting fruits, some vegetables, and cut flowers. A variety of styles is available as hand held or pole models, including shears that cut and hold onto the stem of the cut product. This feature allows the picker to harvest without a catching bag and without dropping fruits.

Straight bladed hand shears for fruits and flowers:



Figure:1.12 hand shear

Pole mounted cut and hold picking shears:

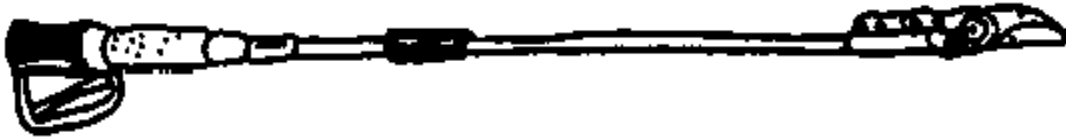


Figure: 1.13 Fruit picker

Using a cutting tool attached to a long pole can aid picking of crops such as mangoes and avocados when the fruit is difficult to reach. Cutting edges should be kept sharpened and the catching bag should be relatively small. The angle of the cutting edge and the shape of the catching bag can affect the quality of the fruit harvested, so it is important to check performance carefully before using any new tools.

Using a picking pole:



Figure: 1.14 picking pole

Picking poles and catching sacks can be made by hand or purchased. The collection bags illustrated below were woven from strong cord. The hoop used as the basket rim and cutting edges can be made from sheet metal or steel.

Hand woven collection bag

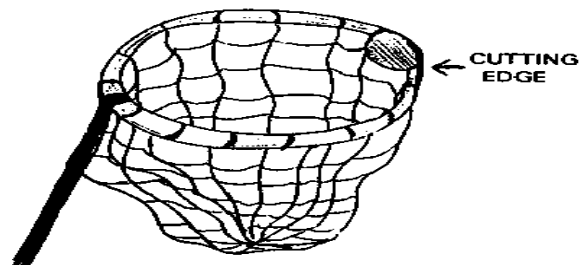


Figure:1.15 collection bag

Fruit trees are sometimes quite tall and letting fruit fall to the ground when it is cut from the tree will cause severe bruising. If two pickers work together, one can clip or cut the fruit from the tree, and the other can use a sack to break its fall. The catcher supports the bag with his



hands and one foot, catches the falling fruit, then lowers the far end of the bag to allow the fruit to roll safely to the ground as illustrated below.

Some nuts should not be knocked to the ground during harvest because of their open shells and relatively high moisture content. The harvesting practice illustrated below can be used with good results. Plastic sheeting or canvas is spread below the tree being harvested, and trees are mechanically shaken until the nuts drop. In the illustration below, two harvesters are gathering a sheet covered with produce.

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Figure: 1.16 harvesting tools

Self-Check – 5	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write all the materials, tools and equipment's that are used in implementing horticultural harvesting? (3 pts)
2. List of tools and equipment's for horticultural harvesting(3pts)
3. List of harvesting containers(4pts)

Note: Satisfactory rating - 10 points

Unsatisfactory - below 10 points

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 6- Carrying out labor and equipment

6.1. Introduction

Hand harvest is still the only practical method for many high value products that are either sensitive to bruising or that must be selectively picked. The mechanization of harvesting has proceeded in stages, thus, we may speak of completely mechanized, semi-mechanized, and non-mechanized harvest. In hand harvest, crops picking may use different ways, such as cutting, digging, clipping, pulling or shaking.

Those to be done are according the kinds of horticultural crop to be harvested. One advantage of hand harvesting is the ability to pick more small fruit which are often lost during mechanical harvest. The harvest labor requirement of fruit crops is quite high, frequently being more than 50% of the cost of production. The amount of labor required to hand harvest a given field will depend on yield, number of times harvested, and the amount of production.

Equipment required to carry out harvesting operations may include: contracted resources, field bins and boxes, grading gauge, knives, platforms, scales, trolleys, trucks, trailers and tractors, waste containers, picking tools, ladder, bags, etc. When hand harvest, the fruits should be careful picked and avoided any mechanical injuries from the hand harvesting process. If the product has wounds, it is easily attacked by microbe, and the respiration of fruits will be promoted, and the storage capacity and marketing value will be reduced.



Figure:1.17 Hand harvesting

cucumbers



Figure: 1.18: Hand harvesting Mango



© CanStockPhoto.com - csp61713368

Figure :1.19 Hand harvesting Lettuce



Figure:1.20 Hand tools harvesting grape fruit



Figure: 1.21 hand harvesting apple



Figure: 1.21 hand harvesting apple

Growers should secure picking labor well before harvest. Having sufficient labor is critical to the success of a farm operation.

Self-Check – 6	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down all the safety requirements for horticultural Harvesting.(3pts)
2. Write three examples of environmental Hazards?(3pts)
3. What are the main purpose of grinding machines?(3pts)



4. Write down some of Equipment required to carry out harvesting operations (3pts).

Note: Satisfactory rating - 10 points

Unsatisfactory - below 10 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet 7- Identifying and communicating enterprise requirements

7.1. Introduction

Before starting harvesting operation, communicating ideas and information to work team members, supervisors and other concerned bodies is the most important part of harvesting work.

Communicating and sharing of ideas and information to work team members and supervisors regarding the horticultural harvesting operation is important to:-

- Reduce work load among workers
- Reduce work place hazards and risks
- Successfully complete the harvesting operation
- Have quality and quantity harvested product

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- Reduce disagreement and biasness among workers
- Operate the harvesting activities based on crop type, part of the plant harvested, time of harvest, skill level and enterprise work procedures.
- Solve different problems that may occur during harvesting operation.

7.2. Enterprise requirements may include:

- enterprise policies and procedures, including waste disposal, recycling and re-use guidelines
- food safety and HACCP procedures and requirements
- harvesting methods or techniques to be used
- industry standards
- manager's oral or written instructions
- manufacturer specifications
- material safety data sheets (MSDS)
- operator manuals
- processes or actions undertaken to meet customer requirements
- product labels
- production schedules
- productivity rates
- quality standards to be achieved
- requirements for export markets such as:
- standard operating procedures
- Work notes and plans.

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Figure:1.22 communicate enterprises

Self-Check – 7	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions



1. Write down all the importance of communicating and sharing ideas of work team in harvesting (3pts)

2. Write three examples of Hazards parts?(3pts)

3. Write the main enterprise requirements?(3pts)

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet 8- Planning and implementing risk management strategies

8.1. Introduction

Before starting harvesting operation, it is important to assess insurance requirements and plan and implementing risk management strategies so as to have successful harvesting operation. Crop insurance is likely to cover: fire, hail, transport damage. People are key to the safe and efficient operation of any farm.



Farm staff and contractors as well as producers themselves stand for the quality of the produce and for environmental protection. Education and training will help progress towards sustainability and build on social capital. This section is intended to ensure safe practice in the work place and that all workers understand, and are competent to perform their duties; are provided with proper equipment to allow them to work safely; and that, in the event of accidents, proper and timely assistance can be obtained.

Permanent accident procedures must be clearly displayed in accessible, and visible location(s). These instructions are available in the predominant language(s) of the workforce and/or pictograms.

The procedures must identify, if appropriate the following; e.g.: farm's map reference or farm address- contact person(s)- location of the nearest means of communication (telephone, radio)- an up-to-date list of relevant phone numbers (police, ambulance, hospital, fire-brigade, access to emergency health care on site or by means of transport, electricity and water supplier); - how and where to contact the local medical services, Hospital and other emergency services. - Location of fire extinguisher;- emergency exits;- emergency cut-offs for electricity, gas and water supplies.- how to report accidents or dangerous incidents.

Are potential hazards clearly identified by warning signs and placed where appropriate?

Permanent and legible signs must indicate potential hazards, e.g. waste pits, fuel tanks, workshops, access doors of the plant protection product / fertilizer / any other chemical storage facilities as well as the treated crop etc. Warning signs must be present.

Is safety advice available/ accessible for substances hazardous to worker health, when required?

Information (e.g. website, telephone no, data sheets, etc.) is accessible, when required, to ensure appropriate action

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Figure:1.23 risk management process.

Self-Check – 8	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down the risk management requirements.(3pts)
2. Write three examples of Hazards parts?(3pts)
3. Write the ways of risk management?(3pts)



Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet 9- Identifying and arranging fire prevention and control

In conditions of very low relative humidity and high temperatures, the machinery used for harvesting and gathering crops can cause forest fires, which sometimes lead to serious harm to persons and their safety, to the loss of the crop and of the machinery, to a threat to farm buildings and it may ultimately also affect forest land.

The risk of fire caused by sparks when harvesting crops rises in conditions of low relative humidity (below 50 % there begin to be fires, while a peak in fires occurs with a humidity of below 30 %).

Statistically, the fire curve shifts in terms of time with regard to the relative humidity curve due to the effect of increased fire risk caused by radiation, with a fire peak between 1 pm and 2 pm, and ignitions concentrated between 1 pm and 5 pm; consequently, it is advisable to take the utmost precaution during the times of maximum sunlight.

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- Avoid the over-heating of machines or their bearings, as well as the build-up of static electricity with earth dischargers.
- Take extreme care in the maintenance of machines, i.e. clean the exhaust manifold and other points on the machine where the chaff and straw collect every day. Similarly, check the exhaust pipe gas outlet to ensure that the spark arresters are working properly. Provide extinguishers if speedy action for fire in the machinery is required, and water carriers for use on fire in cereal and straw.
- Whenever possible, ensure that there is an observer monitoring the whole of the harvested field in order to detect possible ignitions (the lorry driver or grain tractor driver or any other assistant).
- Ensure discontinuity between the areas already harvested, those not harvested and the forest land. For this reason it is very important that, whenever possible, you leave a strip of field around these areas with the disc ploughs after harvesting.
- On days in a heat wave with relative humidity of below 30%, it is advisable to reduce or, better still, stop activity between 1 pm and 5 pm.
- Schedule the harvest with the concerned body that is defense group (examole,ADF)so that the primary action material that the ADF may provide and its volunteers are coordinated and working together at times that the machines are working.
- When harvesting on uneven ground, it is advisable to raise the cutter a little, when turning the harvester between 1 pm and 5 pm (official time) to prevent friction against the ground and any stones. It is also advisable to cover the bottom of the skid with nylon or other non-metallic plates.
- Carry a mobile phone and alert immediately of any incident, and in the event of a fire.



Figure:1.24 Fire prevention materials

Self-Check – 9	Written test
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Name..... ID..... Date.....

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

Test I: Choose the best answer for the following question (2pts each)

1. Which one of the following is the requirement of relative humidity for harvesting cereals crops? (2pts)

- A. Below 40%
- B. Above 30%
- C. Above 60%
- D. Below 50 %

2. Which one of the following is time (time official) the best for ground harvest?(2pts)



A. 1am -----5am

C. 1pm-----5pm

B. 1pm-----5am

D. 1am-----5pm

3. Which one of the following is material using for fire preservation? (2pts)

A. Phone

C. Television

B. Combiner

D. all of the above

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Operation sheet 1: Identifying the maturity status of horticultural crops for harvesting

Objective: To know how to **Identifying the different maturity status of horticultural crops for harvesting**

Basically, identifying is the maturity status of a given crop is very crucial point to undertake crop harvesting. The way of identifying crop maturity depends on different morphological changes and crop maturity parameter that indicates proper maturity stage of a given crop to be marketed or stored. Therefore, to determine the maturity of a given horticultural crop, follow the following steps one by one.

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1. Select the type of horticultural crop to be identified (fruit, vegetables, flower, tubers...etc)
2. Prepare materials and tools (like knives, sizing rings, color charts, refractometers, pentameters...etc) available to test the maturity of a given crop depending on type of crop you have selected.
3. Carefully observe the maturity indices or parameters (like size, weight, length, shape, color, ripeness, texture, skin condition, ease of removal and moisture content, flavor...etc) and the type of maturity (physiological or harvest) depending on the type of crop you have selected.
4. Test the maturity of the crop by either using tools or equipments or through careful observation depending on the type of crop you have selected.
5. Interpret and analyze the results by comparison with specification charts and enterprise/industry maturity standards.
6. Finally, report to your supervisor or other concerned body what you have identified and faced when operating the tasks.

LAP Test: Practical Demonstration

Name_____

Date_____

Time started_____

Time finished_____

Instructions:

1. You are required to **perform** any of the following

- 1.1. Make sure you can identify crop maturity depending on crop type and maturity parameters

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- 1.2. Test the maturity status of a given horticultural crop.
- 1.3. Identify maturity indices for some horticultural crops.
- 1.4. The way of identification for each crop.
- 1.5. The type of maturity.
- 1.6. All the materials, tools and equipment's that you use in the task.

LG #47	LO #2. Coordinate the harvest programs
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Instruction sheet: 2



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

- Implementing effective communication strategies
- Implementing and adjusting harvesting operations
- Coordinating equipment operation
- Identifying and controlling existing and potential hazards

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:

- Implement effective communication strategies
- Implement and adjusting harvesting operations
- Coordinate equipment operation
- Identify and controlling existing and potential hazards

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- Implementing effective communication strategies

2.1. Introduction

Communication does not "just happen." Effective communication requires effective strategy - a coherent plan of action.

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To be effective, strategy must take three factors into account simultaneously:

- Your goals and objectives;
- Operational constraints and imperatives - things you must do and things you cannot do;
- Pertinent conditions in the environment.

Implementing effective communication strategies to ensure personnel safety and smooth flow of operations plays a great role in:-

- Solving different problems associated with harvesting operation
- Creating safe working environment
- Minimizing OHS hazards and using the corresponding care
- Facilitating the workers etc...

When your objectives involve communicating with others (when do they not?), the most pertinent environmental conditions consist of the **ideas** that your publics have about you and your objectives. It is sometimes said that "**perception is reality.**" More to the point: Your publics' perception is your reality.

Our communications approach to research is based on four premises:

- People respond not to the world as you see it, but to the world as they see it. They frame your issue in their mental pictures of the situation.
- Effective communication starts with hearing and understanding rather than talking and trying to convince. We know in our personal lives that the more we know about someone, the more effective we can be in communicating with him/her. This is no less true in a public setting, but it is more difficult.
- Communication is what the receiver does. Until and unless your "message" is heard and understood by the persons you are trying to reach, it is just noise.

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- There are no magic bullets. There is no single message that is going to connect with everyone.

The key to communicating effectively with people is to be flexible. According to the Office of Multicultural Affairs (1994), being flexible requires:

- keeping an open mind in unfamiliar situations
- being alert to the different ways people interact
- being aware that gender roles may differ and that there may be a call for organizing separate women-only groups
- ensuring that women are adequately represented
- seeking to understand the protocols of diverse ethnic community groups
- developing an empathy with, and understanding of, others who may have experienced great traumas during their lives
- being willing to provide information and to encourage and seek input from community groups and individuals
- being aware that some cultural groups and individuals may mistrust the motives of some organizations
- Being willing to learn and adapt demonstrating consistency and reliability.

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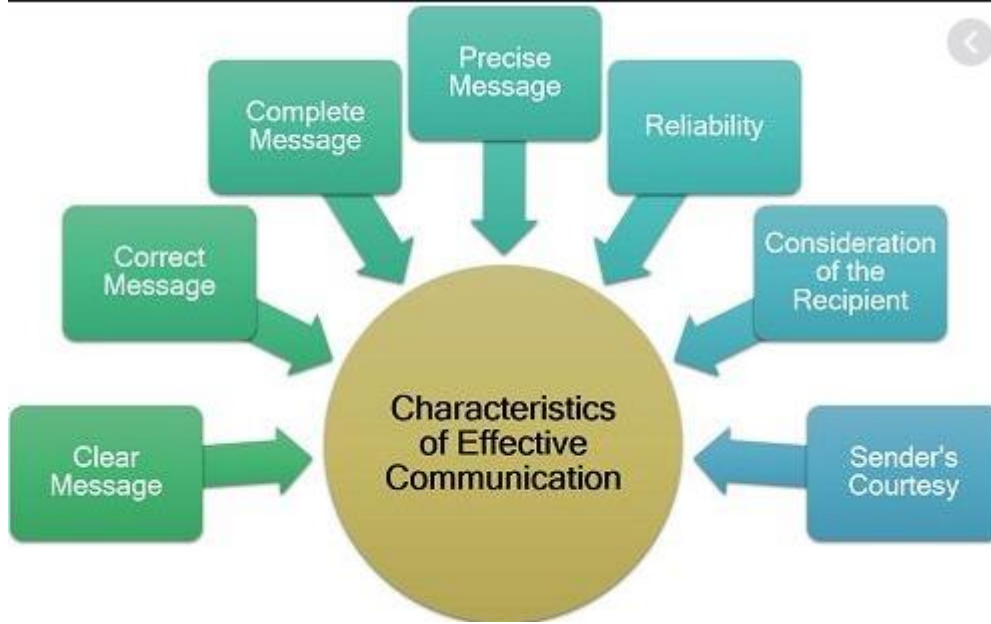


Figure: 2.1. Effective communication

Managing a Harvest Crew

What is the critical information that a manager must convey to the harvest crew?

- Accurately assessing maturity
- Harvesting tools and techniques
- Efficiency and safety
- Post-harvest handling strategy for each crop
- Packing

Self-Check – 1	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. What is the role of implementing effective communication strategies to undertake harvesting operation? (5 pts)
2. What are the major requirements to implement horticultural crops harvesting? (5 pts)
3. What will happen if do not harvest at proper time of maturity? (5 pts)
4. How can we identify potential risks and hazards? (5 pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 2- Implementing and adjusting harvesting operations



2.2. Introduction

Dear trainees! Now you are fully prepared and equipped with all necessary knowledge, skills and facilities to implement the harvesting operation. You know that, harvesting is considered as the removal of whole or part(s) of the plant at a time or at different interval depending on kind of crops to be harvested and consumers demand. Therefore it is important to perform the harvesting operation on time and with great care as it influences the subsequent processing and preservation of the crop.

To carefully implement horticultural crops harvesting, you will be expected to:-

- Strictly identify the type of horticultural crop to be harvested (fruit, vegetable, flower...) and the plant organ to be harvested (leaf, root, flower, fruit, bunch...)
- Identify and know the maturity status of the crop and maturity standards depending on the type of crop you are going to harvest
- Prepare all the necessary tools, materials and equipment's associated with the harvesting activities.
- Carefully identify all the OHS hazards and use the corresponding PPE to reduce the hazard
- Understand the nature of the crop to be harvested and prepare temporary storage facility depending on the type of crop to be harvested and parts of the plant to be harvested.
- Establish suitable weather conditions and carefully identify the major factors that affect the harvesting operation.
- Determine the method of harvesting and the time of the day suitable to harvest the particular crop.
- Communicate with the concerned bodies on the ways of risk management and mitigation.
- Now start the harvesting operation carefully by giving highest attention for the quality of products.
- Then start the **post-harvest activities** depending on the type of crop you have harvested

Self-Check – 2	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down all the safety requirements for Harvesting horticultural crop(3pts).
2. Write three examples of Hazards parts during harvesting?(3pts)
3. What are the carefully implement horticultural crops harvesting, you will be expected?(3pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 3- Coordinating equipment operation

2.3. Introduction



Preparing equipment prior to harvest ensures that it is in good shape for the heavy workload. It should be inspected for proper guarding and all worn parts should be repaired or replaced. Keeping extra parts on hand during harvest allows quick equipment repairs so employees are less likely to “make do” with broken machinery. Harvesting equipment should NOT be used unless it is in proper working order.

During harvesting operation, all the materials, tools and equipment’s must perform well so as to have successful harvesting and must be easy and familiar with the workers.

All the materials, tools and equipment’s should be:-

- Free from any contamination and diseases
- New or well maintained and enough in number
- Compatible with the harvesting produce and the harvester
- Suitable for the harvesting crop and for the worker etc...

Self-Check – 3	Written test
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Name..... ID..... Date.....

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



Test I: Short Answer Questions

1. Write down all the critical aspects before harvesting(5pts)
2. Write down the importance of cleaning materials before using(3pts)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet 4- Identifying and controlling existing and potential hazards

2.4. Introduction

One of the most important parts of your workplace safety and health system is an effective system to identify and control hazards. As an employer, it is your responsibility to know what

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hazards or potential hazards are present in your workplace that could cause harm to your employees.

You can help to prevent workplace injuries and illnesses by setting up a system to:

- Spot the hazard by identifying known and potential dangers to employees that could cause injury or health problems (e.g. chemicals, damaged or unguarded equipment, objects that could fall and strike someone, trip hazards, etc) To be effective, your system must enable and encourage employees to bring forward concerns about hazards.
- Assess the risk associated with each hazard. Determine whether workers are being exposed to the hazards you have identified and if the exposure is a risk to your worker’s safety or health, the hazard must be controlled.
- Find a safer way to carry out the task(s) at your workplace where hazards have been identified.

The best method is to eliminate the hazard, however if this is not possible or practical, you must control them.

Some methods of hazard elimination or control may include:

- Substitute a less toxic material in a work process
- Change the work design (e.g. maintain supplies at lower heights, eliminating the need for employees to climb ladders)
- Ensure all employees are properly trained before they begin any new task (e.g. working with new/different equipment)
- Change work procedures (e.g. have employees use lifting equipment rather than lifting items manually so they will be less likely to injure their backs)
- Ensure workers use/wear personal protective equipment(PPE) (e.g. safety eye wear, footwear and hearing protection)
- Every day, your employees are a valuable source of information about hazards and risks in the workplace. Take advantage of this by having your supervisors and experienced employees take the lead in identifying, assessing, and controlling hazards.



In determining potential hazards in a task or process the following factors could be considered:

- Is there exposure to noise, fumes or dust?
- How can the equipment fail in any way?
- Is the work physically demanding?
- Is the work made harder by the way it is organized (shift work, adequate rest breaks, etc.)?
- Is there enough space to move about?
- Can the person be struck by or contacted by anything while doing the steps of this job?
- Can the person be caught in, on, or between anything?
- Can the person slip, trip or fall?
- What level of supervision is required?
- Are there any exposures to psychological hazards (dealing with public complaints/abuse, shift work etc.)?

At the Worker:

Provide PPE (Personal Protective Equipment) and proper training for your staff. Have PPEs available and accessible to ensure they are used safely.

This control method should always be the last resort, and use in conjunction with other control measures.

- **Education and Training:** train employees on standardized safe work practice
- **Administrative Controls:** introduce policies, improve work procedures
- **Proper Housekeeping:** tools, equipment/machinery is less likely to cause injury if they are kept clean and well maintained

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- **Emergency Planning:** have written plans in place to handle fires, chemical spills, or other emergencies. Workers should be trained to follow procedures and use appropriate safety equipment
- **Hygiene Practice:** Reduce the risk of toxic materials being absorbed by workers or carried outside of work environment

Self-Check – 4	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

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1. Write down determining potential hazards factors could be considered(3pts)
2. Write down hazards control measures. (3pts)
3. How can You help to prevent workplace injuries(3pts)

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Operation sheet-2 Implementing and adjusting harvesting operation

To undertake harvesting activity of a given horticultural crop, it is important to practice some procedures regarding the task. Therefore, to undertake a proper crop harvesting practices, follow the following procedures carefully.

1. Strictly identify and select the type of horticultural crop to be harvested (fruit,



- vegetable, flower...) and the plant organ to be harvested (leaf, root, flower, fruit, bunch...)
2. Carefully identify the maturity status of the selected crop depending on the purpose of harvesting and maturity parameters.
 3. Prepare all the necessary tools, materials and equipments associated with the harvesting activities (like knives, machetes, rubber bunds, tractor, containers, buckets, baskets...etc) that aids in crop harvesting and reduces crop damages depending on the type of crop selected.
 4. Carefully identify all the OHS hazards and use the correct corresponding PPE to reduce the hazard
 5. Understand the nature of the crop to be harvested and prepare temporary storage facility depending on the type of crop to be harvested and parts of the plant to be harvested and adjust the time of harvesting depending on the nature of the crop.
 6. Establish suitable weather conditions and carefully identify the major factors that affect the harvesting operation.
 7. Determine the method of harvesting depending on the type of crop to be harvested and the availability of harvesting materials and the time of the day suitable to harvest the particular crop.
 8. Select suitable harvesting method depending on the type of crop to be harvested and the availability of harvesting materials.
 9. Communicate with the concerned bodies on the ways of risk management and mitigation.
 10. Now start the harvesting operation carefully by giving highest attention for the quality of products by reducing crop damage, wastage, and contamination.

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11. Then start the post-harvest activities (like Grading and sorting) depending on the type of crop you have harvested and carefully transport to the storage area.
12. Finally, complete your work by preparing work documents and reports including the risks and hazards that you have faced when performing the harvesting practices.

LAP Test 2: Practical Demonstration

Name _____

Date _____

Time started _____

Time finished _____

Instructions:

1. You are required to perform any of the following

1.1 Make sure you can identify crop maturity depending on crop type and maturity level.

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- 1.2. Identify all the OHS hazards and use the correct corresponding PPE.
- 1.3 Understand the nature of the crop to be harvested and adjust the time of harvesting depending on the nature of the crop
- 1.4. Identify the major factors that affect the harvesting operation.
- 1.5. Determine the method of harvesting depending on the type of crop to be harvested and the availability of harvesting materials

LG #48	LO # 3. Complete harvest operations.
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Instruction sheet: 3

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

- Locating Storage resources
- Identifying crop drying strategies
- Grading, packing and storing crop
- Monitoring work
- Harvesting operations and outcomes
- Providing feedback on performance
- Assessing own performance
- Documenting relevant information

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:

- Locate Storage resources
- Identify crop drying strategies
- Grade, pack and store crop
- Monitor work
- Harvest operations and outcomes
- Provide feedback on performance
- Assess own performance
- Document relevant information

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- Locating Storage resources

3.1. Definition of storage

Storage is very crucial post-harvest operation of agricultural products to extend the shelf life of the farm produce in good quality and safety till it arrives on the consumers hand to be consumed.

The rate at which changes occur in harvested products may be influenced by a range of environmental conditions, including temperature, humidity and atmospheric composition. All may be manipulated by careful management of the postharvest handling system to obtain the best possible results (quality some fruit) has the produce.

The demand of most harvested horticultural product is continuous. Their seasonal production and rapid deterioration after harvesting, makes storage and preservation essential in order to insure extended supply. Extending supply of fruits require retarding the physiological deterioration as well as preventing decay by microorganism.

The marketable life of most fresh products can be extended by prompt storage in an environment that maintains product quality. The desired environment can be obtained in facilities where temperature, air circulation, relative humidity, and sometimes atmosphere composition can be controlled.

Choosing of **different storage methods** depends on the type of the product, its use and the required storage time.

- **Common storage:** including caves, mounds, trenches etc. they are more common in areas where the temperature is low.
- **Cold storage:** involves use of refrigerator where the temperature and relative humidity are controlled.

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- **Controlled and modified atmospheric storage:** In these methods, the level of oxygen, carbon dioxide, temperature and relative humidity are controlled.

Storage resources may include:

- cool rooms and cold storage
- field bins
- other controlled atmosphere storage facilities
- pallets
- racks
- Temporary storage.
- Ware house diffused light storage etc.



Self-Check – 1	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

5. Discuss on the way of storing harvested horticultural products?
6. Discuss on the ways of extending the storage of life of a given harvested horticultural product? (3 pts)
7. What are the major factors affecting storage of harvested products? (3 pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 2- Identifying crop drying strategies

3.2. Introduction

Drying / Dehydration

The terms drying and dehydration means the removal of water.

Drying - is done by using non-conventional energy sources like sun and wind.

Dehydration – means the process of removal of moisture by application of artificial heat under controlled conditions of temperature humidity and air flow.

Various factors that affect the rate of drying of horticulture produce

- Composition of raw material
- Size, shape and arrangement of stacking of produce
- Temperature, humidity and velocity of air
- Pressure (barometric or under vacuum)
- Heat transfer to surface (conductive, convective / irradiative)

Several types of driers and drying methods, each method better suited for a particular situation, are commonly used to remove moisture from a wide variety of food products including fruit and vegetables. Sun drying is followed in certain crops such as prunes, figs, apricots, grapes and dates.

There are three basic types of drying process

- Sun drying / solar drying
- Atmospheric drying including batch (Kiln, tower and cabinet driers) and continuous (tunnel, belt, belt-through, fluidized bed, explosion puff, foam mat, spray, drum and microwave).
- Sub atmospheric dehydration (Vacuum shelf / belt and freeze driers) Common driers type.

Drying techniques / methods

A) Fruit and vegetable natural drying –

- **Sun or solar drying:** Surplus production and specially grown crops may be preserved by natural drying for use until the next crop can be grown and harvested. These can be cheaply distributed to areas where there are permanent shortages of fruit and vegetables.
- **Shade drying:** It is done for products which can lose their color and or turn brown if put in direct sunlight. E.g.: Herbs, Green and red sweet peppers, chillies, green beans and okra.
- **Osmotic dehydration:** Here the prepared fresh material is soaked in a heavy or thick liquid sugar solution or strong salt solution and then the material is solar dried.

B) Common driers used for drying / dehydration

- **Air convection driers:** All air convection driers have some sort of insulated enclosure, a means of circulating air through the enclosure and a means of heating this air –
- **Kiln drier:** It is the simplest kind of air convection drier. These are generally used to dry large pieces of material. E.g.: apple and Potatoes.
- **Cabinet, tray and Pan driers:** Advanced method, the food is loaded on trays or pans in a thin layer. Hot air is blown across the food trays. It is used for small scale operations.
- **Tunnel and continuous belt driers:** These driers are most commonly used for dehydrating fruit and vegetable. Here also hot air is blown across the trays.
- **Belt through driers:** the belt is usually of metal mesh and heated air is blown up through the mesh. The belt moves continuously keeping the food pieces in through. All products cannot be dried by this method.
- **Air lift driers:** These are generally used to finish dry materials that have been partially dried by other methods.



- Fluidized bed drier: In fluidized bed drying, heated air is blown up through the food particles with just enough force to suspend the particles in a gentle boiling motion. E.g.: grains and peas.
- **Spray driers:** Are used for liquids and low viscosity pastes and purees.

Flow sheet for drying / dehydration of fruits and vegetables

Fruit and vegetable → (Mature and free from insects and disease) → Washing → Peeling → Preparation → Blanching → Spreading on flat-wooden trays → Sulphuring (usually @ 1.8-3.6 kg/ton of fruits) → Drying/ Dehydration (with occasional stirring) → Sweating → Packing (air tight container or polythene bags) → Storage (at ambient temperature in dry place)

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Self-Check – 2	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down three types of drying methods(3pts)
2. Write down steps of fruits and vegetable drying process(3pts)
3. What are the Common driers used for drying / dehydration(3pts)
4. What are the techniques/methods of natural drying of vegetables and fruits(3pts)
5. What are the factors that affect the rate of drying of horticulture produce (3pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____



Information Sheet 3- Grading, packing and storing crop

3.3. Introduction

After harvesting, harvested products are subjected to some essential operations which prepare these products for markets as well as storage, Pre-Storage treatments, Grading/Selection, sorting, Storage, Packaging, Transport, Processing and Marketing are the major ones.

Grading is the grouping or sorting of the harvested crops based on some standards to eliminate all unsatisfactory products. The separation of harvested products from the bulk into different categories, on the basis of size, color, shape, etc, is called grading. Grading is done based on some specified standards, such as size, color, shape, texture, varieties, maturity, blemishes and etc. It can be done visually or mechanically

Factors to be considered in grading: - harvested products are graded into different categories on the basis of following quality parameters:-

- Uniformity in size, shape, color and ripeness.
- Uniformity in appearance.
- Variety.
- Seed content.
- Moisture content.
- Good visual appearance (absence of visual defects).

The importance of grading is:

- To eliminate all unsatisfactory items (defects)
- To increase the quality and storage life of the harvested products
- To attract markets and obtain high sell price
- To minimize contamination of the product from pests and disease.

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Dumping: Produce must somehow be removed from the field bin or harvesting container and moved through the packinghouse. This first step is known as "dumping". Dumping must be done gently, whether using water assisted methods or dry dumping. Wet dumping can decrease bruising and abrasions by using moving, chlorinated (100-150 ppm) water to carry delicate produce. When using dry dumping, padded, sloped ramps or moving conveyor belts can decrease injuries to produce.

Pre-sorting: Pre-sorting produce is usually done to eliminate injured, decayed, or otherwise defective produce (culls) before cooling or additional handling. Pre-sorting will save energy in that culls will not be handled. Removing decaying produce items will limit the spread of infection to other units, especially if postharvest pesticides are not being used.

Sorting: Under this operation, injured, bruised, cut, over-sized, under-sized, decayed, shriveled vegetable & fruits are sorted. After sorting, healthy lot is left free from any unwanted subject. Vegetable & fruits are subjected for sorting manually or mechanically placing them on running belt.

Cleaning: Before fresh harvested horticultural products are marketed, various amount of cleaning are necessary. Cleaning typically involve the removal of soil, dust, adhering debris, insects and spray residue. These normally require both spray of water and wet bruising. Chloride is often added to the wash water as a disinfectant. For some commodities, such as kiwifruits and avocados, dry brushing may be sufficient to clean the produce. Other commodities, however, such as bananas and carrots, require washing.

The choice of brushing and/or washing will depend upon both the type of commodity and the type of contamination.

- Wash before cooling and packing: tomatoes, cucumbers, leafy greens
- Wash to remove latex, reduce staining: mangoes, bananas
- Wash after storage: sweet potatoes, potatoes, carrots
- Dry brush after curing or storage: onions, garlic, kiwifruit
- Do Not Wash: green beans, melons, cabbage, okra, peas, peppers, summer squash

Sanitation is essential, both to control the spread of disease from one item to another, and to limit spore buildup in wash water or in the packinghouse air.

Storage: The marketable life of most fresh products can be extended by prompt storage in an environment that maintains product quality. The desired environment can be obtained in facilities where temperature, air circulation, relative humidity, and sometimes atmosphere composition can be controlled.



Figure:3.2. Organic horticulture storage system

Self-Check – 3	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down the major importance of grading? (3 pts)
2. Write At least three factors affecting seed grading?(3pts)
3. Discus on some the post-harvest activities like drying, cleaning, grading, sorting and packing operations? (4 pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 4- Monitoring work

3.4. Definitions of terms

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Workplace: - is a location where someone works for his or her employer, a place of **employment**. It can be range from a back yard to a commercial poultry farm in terms poultry farm.

Operation: - is the work of managing the inner workings of your business

Organization: - place where groups of people work together to achieve a common goal, or goals.

Manager: - is the person who deals with unexpected problems or issues and decides the most appropriate course of action to take.

Efficient – work done on time and within the given resource constraints

Effective– the service or product meets quality standards and the job is done

3.4.1. Monitoring work operation

Monitoring is a process of determining how well our plans are being implemented. You cannot monitor something if you do not have a plan or basic structure of how something should be done, or a defined goal or target.

Work operations refer to the work itself and includes systems and procedures, staff performance, and levels of service in the workplace.

These operations can include:

- Service delivery – ensuring staff provide the level of service established/determined as appropriate for the establishment or department
- Customer satisfaction – generating feedback from customers about how they perceive the service being provided
- Products supplied and the nature of them – this can be the physical aspects and facilities of the rooms, drinks, food and entertainment we supply
- Dealing with paperwork – some staff may have as their main role the generation and administration of documentation: this has immediate impact on customers and internal calculation of statistics.



3.4.2. Overview of management responsibilities

It is common that a worker has both management and operational responsibilities and to be part of a work team.

Managers are often responsible for staff who have multiple tasks and who move between jobs and tasks. Content-free managers are common. That is, they have not necessarily been trained in, or worked directly in, the department or area they are managing.

Most staffs are directly or indirectly involved in setting goals for the organisation and working out ways to best achieve them.

A manager is responsible for coordinating the work people do to achieve specific goals. Because most organizations aim to make profits and meet customer expectations, managers are also required to make sure the work is done efficiently and effectively

A manager is also the person who deals with unexpected problems or issues and decides the most appropriate course of action to take.

Typically, a manager has four functions:

- **Planning** – setting goals and targets, overseeing the development of plans, systems and processes for achieving goals, working out how best to get there within a budget
- **Organizing** – coordinating the resources, staff, plant and facilities to achieve goals
- **Leading** – providing the direction, support, encouragement, feedback and training staff need to do their job well
- **Monitoring** – supervising staff, and monitoring and adjusting systems and procedures to make sure goals are achieved as planned.

Managers will work differently depending on a number of factors. Depending on management tasks and level of responsibility in the organisation, managers are categorized into

- Chief executive officers

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- Middle level
- direct supervisor

1. Chief executive officer

They are more reliant on conceptual skills.

For example, a chief executive officer (CEO) is likely to be more involved in:

- Dealing with the board of management
- Broad organisational planning
- Positioning the enterprise in the marketplace
- Securing large contracts for the business
- Balancing the finances of the organisation
- Leading the enterprise as a whole.

2. Middle level manager

They are likely to need strong planning and interpersonal skills

The middle level manager is more concerned with:

- Operational planning
- Establishing staffing levels within given budgets
- Dealing with unresolved problems
- Setting up systems and procedures
- Supervising sales and contracts
- Encouraging staff and setting up systems to support them.

3. Supervisor

They are required to understand the technical details of how the operation is working, and they also need to have strong interpersonal skills.

The supervisor or line manager – is more likely to:

- Work directly with staff on a day-to-day basis



- Monitor their workload and workflow
- Handle queries and issues as they arise
- Verify systems are implemented and suggest changes if they are not working.

Their role and responsibilities depend on the size and type of the organisation they work in

- In large organisations,
 - ✓ Roles and responsibilities are more likely to be defined and separated,
 - ✓ Managers will work in specific teams or units.
- In a smaller enterprise,
- Managers required to work across a number of areas (for example, in sales and marketing and distribution).

The culture of the enterprise

All organizations have a culture or a mind-set or a particular way of operating. The culture of a business is often described as “the way we do things around here”.

The culture could be:

- Supportive of staff
- Customer-oriented
- Friendly
- Comfortable
- Casual
- Total quality management in focus/nature
- Blaming
- Negative
- Stressful
- Or any combination of the above.

Preferred style of operation

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Managers are people with different personalities. They feel comfortable working in a way that reflects their personal style. This is not to say that managers cannot and should not learn, but it is an acknowledgment that management should know their strengths and build on these. They should also know their shortfalls and work towards improving these.

Self-Check – 4	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

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1. What is monitoring? (2pts)
2. What is manager's function? (4pts)
3. Discuss the difference between efficiency and effective (4pts)

Note: Satisfactory rating - 5 points

Unsatisfactory - below 5 points

Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet 5- Harvesting operations and outcomes

3.5. Introduction

Equipment is cleaned in accordance with manufacturers' specifications, organizational procedures and regulations.

- Attachments and other ancillary equipment are cleaned and stored to minimize damage and to maximize hygiene according to manufacturers' specifications, organizational procedures and regulations.
- Insecticides are applied as required by the organization and the harvest strategy.

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- All containers, leftover fluids, waste and debris from the maintenance and servicing work are disposed of safely and appropriately.
- All required records and documentation are completed accurately and promptly in accordance with organizational requirements. Harvesting machinery and vehicles are cleaned according to enterprise procedures and the manufacturer's specifications.
- All containers, leftover fluids, waste and harvest debris is disposed of safely and appropriately.
- All required workplace records are completed accurately and promptly in accordance with enterprise requirements.

Harvesting operation evaluation

- Formal evaluation of operations will be done by staff of the crops Authority
- Self-regulation by logging companies to ensure compliance with the Code of Practice for horticultural crops Harvesting and monitoring of performance is recommended.

Timing of evaluations

- Crops authority officers will evaluate operations at each inspection.
- Maximum time between evaluations should be 3 months. Inspection at 1-month intervals is preferable.
- If the evaluation results in a suspension of operations, a further field evaluation should be carried out to verify that all the work is completed to the required standards, before the suspension is lifted.

Evaluation procedures

- All evaluations require ground inspection.
- The crop authority officer should be accompanied by a representative of the company and other authorities as appropriate.

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- Preliminary evaluations may be undertaken from small format photography/satellite images of logging areas which have been flown since the last inspection. Assessments of operations from photography need to be checked in the field.
- Areas inspected and evaluated should include a representative sample of:
 - Current harvesting operations;
 - Areas completed since the last inspection;
 - Areas where the company was directed, at the previous inspection, to do further work.
 - During the inspection, all areas of non-compliance with the Code or the harvesting contract are to be explained to the company representative.
 - The company representative is requested to sign the evaluation form as a true record of the inspection.

Self-Check – 5	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down Evaluation procedure(3pts)
2. What are the Time of evaluation(3pts)
3. What are the Harvesting operation evaluation(3pts)

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



Answer Sheet

Score = _____

Rating: _____

Name: _____

Date: _____

Information Sheet 6- Providing feedback on performance

All the situations faced during the harvesting operation should be provided as a feedback to personnel under supervision.

The feedback may include:

- Problems associated with:-
 - ✓ Resource deficiency
 - ✓ Health problems
 - ✓ Environmental conditions
 - ✓ Work load
 - ✓ Infrastructures etc...
- Any advantage and disadvantage you have got from the work



- Technical problems
- Hazards etc...

Self-Check – 6	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Write down Importance of feedback(3pts)

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Answer Sheet

Score = _____
Rating: _____



Name: _____

Date: _____

Information Sheet 7- Assessing own performance

3.7. Introduction

Being a leader means that people are willing to follow you. They choose to follow; they don't have to be made to head in the direction you want them to go. This can only happen if you have the knowledge and skills you need to perform in your role, and that you are able to behave in the right way. This knowledge and these skills combine to-gather to shape your behavior—what you actually do and how you do it.

The knowledge you need includes knowledge about the people you lead and the tasks you have to perform. You also need to know about the organization's goals, policies and procedures (how tasks should be performed). The skills you need include the skills needed to per-form the different tasks you have to perform, and skills in communicating with people, motivating them and recognizing what makes them tick.

You also need skills in recognizing your own strengths and weaknesses. Assessing your own performance is all about being able to recognize what you need to be able to do and knowing how well you actually do it.

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What makes a good team leader?

Team leaders usually have to do the same sort of work as the people they lead—they are members of their teams as well as being the leader of the other team members. This is probably the hardest kind of leadership role. It makes it really important that you understand what the role is all about and what knowledge and skills you need. A study done into management and leadership a few years ago identified 12 of the most important features of effective leadership. These are described below.

What makes someone a good leader?

1. Communication and social skills Being able to explain things clearly, ask questions, listen well, and be aware of what people really feel (as opposed to what they may say).
2. Personal drive, sense of purpose and motivation Knowing where you are going, and why, and not needing to be supervised and controlled to make sure you do what is needed.
3. Dependability, conscientiousness and persistence being trusted to do things, and not giving up at the first hurdle.
4. Ability to motivate others Getting other people to do what is needed because they want to, not because they are told to.
5. Innovation and vision Not being stuck in the past, but welcoming new tasks and new ways of working.
6. Honesty and integrity Doing what you say you will do, and not doing what you believe is wrong.
7. Self-confidence, willingness to accept challenges and take risks, emotional maturity Someone people respect and trust, who knows their own capabilities and who is willing to try out new things.
8. Ability to inspire trust By not letting people down, they learn to believe in what you say.
9. Intelligence You don't have to be academic to be interested in what is happening and why, and to be willing to learn and solve problems.

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- 10. Knowledge about the organization you work for what its goals are, how it is structured and what is happening across the organization.
- 11. Genuine interest in others and valuing them you care what people think and feel about a situation, and show them the respect and trust you want them to show you.
- 12. A team orientation you like working with a team of people.

Self-Check – 7	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

- 1. What makes a good team leader(3pts).
- 2. what makes someone a good leader?(3pts)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____

Information Sheet 8- Documenting relevant information

3.8. Introduction

As harvesting is completed all data has been under taken during the process has to be documented for future analysis.

The following data has to be documented after completing harvesting operation.

Your document may include:-

- harvest workers tallies or working hours,
- written harvest instructions,
- dates of harvest,
- withholding periods (time since last chemical spray),
- crop yield from each section,
- weather conditions during harvest,
- percentage crop deterioration,
- maturity measurements taken,
- storage conditions,
- machinery settings or adjustments,
- machinery repairs and maintenance,
- dispatch details and delivery dockets
- total labor required to perform the harvesting operation
- Total cost consumed thought the harvesting operation etc...

- Methods of harvesting
- Resource. Equipment, tools and machinery used



- Man power per hectare
- Any treatment used before harvesting
- Problem encountered during harvesting
- Control measure taken
- Estimation of post-harvest yield
- Was the harvest good or fair or poor

Self-Check – 8	Written test
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Name..... ID..... Date.....

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

Test I: Short Answer Questions

1. Why important to documentation(3pts)

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

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

Answer Sheet

Score = _____
Rating: _____

Name: _____

Date: _____



References

1. Dhatt, A.S., Mahajan, B.V.C., Sandhu, K.S., Garg, A and Sharma, S.R. (2007) Handbook on Post-harvest Handling of Fruits and Vegetables. 3rd edition, PHPTC, PAU, Ludhiana
2. Friend Manufacturing Corporation, Prospect Street, P.O. Box 385, Gasport, New York 14067, USA.
3. Kader Adel A (2002). Post-harvest Technology of Horticultural Crops. 3rd Edition, University of California, Agricultural and Natural Resources.
4. Kader Adel A and Merita Cantwell (2006). Produce Quality Rating Scales and Color Charts. Postharvest Horticulture Series No 23. Post-harvest Technology Research & Information Center University of California, Davis
5. Kitinoja, L and Gorny, J. (1998) Post-harvest technology for fruits and vegetables Produce marketers: Economic opportunities. Quality and Food Safety by, Department of Pomology, University of California, Davis. A joint publication of UC Post harvest Outreach Program and Punjab Horticultural Post harvest technology Centre, USAID/ACE
6. Thompson A.K. (1996) Post harvest Technology of Fruits and Vegetables. 1st Edition, Blackwell Science, Inc. USA.
7. Wardlaw, C.W. and Leonard, E.R. (1936). The storage of West Indian Mangoes, Low Temperature Research Station Memoir 3, 47 pp.
8. Wills, R; McGlasson, B; Graham, D and Joyce, D (1998) Post harvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals. 4th Edition, CAB International, UK.
9. Von Loesecke, H.W. (1949). Bananas. Wiley Inter-sciences, London.



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