Horticultural crop production - Level-IV

Based on May 2011, Version 2 Occupational standards

Module Title: - Planning and implementing seed production crop establishment and maintenance

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LG #50	LO #1- Source information for input to planting plan

Instruction sheet

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

- Identifying and obtaining documents within the organization
- Gathering information regarding activities
- Identifying the specific target area, or paddock, for planting
- Assessing and accounting trash levels and seedbed conditions

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:

- Identify and obtaining documents within the organization
- Gather information regarding activities
- Identify the specific target area for planting
- Assessing and accounting trash levels and seedbed conditions

Learning Instructions:

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

Information Sheet 1- Identifying and obtaining documents within the organization

1.1 Introduction

Horticulture is the science and art of the development, sustainable production, marketing, and use of high-value, intensively cultivated food and ornamental plants. Horticultural crops are diverse; they include annual and perennial species, delicious fruits and vegetables, and decorative indoor and landscape plants. The horticulture industry can be divided into three areas: pomology, olericulture, and ornamental horticulture. Pomology is the planting, harvesting, storing, processing, and marketing of fruit and nut crops. Olericulture includes the planting, harvesting, storing, processing, and marketing of vegetable crops.

Production planning is one of a topic to which is of special attention for the producer and practitioners academic industry, because it is a problem that was important in the production process, with planning production of good then can increase the company profitability.

Several factors that need to be considered in planning the production of seed crop:

- Consumer demand,
- Advantage to be achieved,
- A charge required during the production process,
- The number of resources that there was either natural resources or human resources and rescheduled, it is rescheduled planting patterns that is the determination of the schedule cropping and harvest the schedule so that it can boost the profitability of agricultural products.

The documents that outline the organizations production planning for specified period the policies and procedures in relation to organic horticultural crop production ways and occupational health and safety , as well as the way in which potential environmental impacts should be approached.

The main elements of an organic system are:

- ✓ good soil management leading to good soil fertility, maintenance of high soil organic matter, high levels of microbial activity and good soil structure;
- ✓ well-designed crop rotations for balancing fertility, controlling weeds, and minimizing pest and disease problems;
- ✓ preventative and non-chemical approaches to weed, pest and disease problems;
- ✓ A profitable output of organic cash crops and/or livestock.

1.2. Organic horticulture

Horticulture is a complex and varied sector. The main types of production systems, and their key characteristics, are as follows:

Intensive systems:

- Fruit and vegetables only;
- High income - high cost systems;
- Typically small market garden type holdings selling directly through local outlets such as farmers' markets, local wholesalers and box schemes;
- Very labour intensive;
- Usually 3 years of crops with one or two years of fertility building;
- Fertility breaks are cut and mulched. Crops must be high value to compensate for the lack of income from the fertility breaks.

1.3. The principles of organic farming

Organic farming is underpinned by a set of guiding principles, drawn up by the International Federation of Organic Agricultural Movements (IFOAM).

These are:

The principle of health*:* Organic agriculture should sustain and enhance the health of soil, plant, animal and human as one and indivisible whole;

The principle of ecology: Organic agriculture should be based on living ecological systems and cycles, work with them and help sustain them. Food production is itself a component of the local ecology. The more in tune the production process is with that ecology, the smaller the chance of serious problems arising;

The principle of fairness*:* Organic agriculture should be built upon relationships that ensure fairness with regard to the common environment and life opportunities. This principle recognizes human and social issues as well as environmental concerns;

The principle of care*:* Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Generally, the information used for planning and implementing establishing of horticultural crop seed production will be obtained from different agricultural organization, horticulture crop production experts and related document…etc

Self-check 1	Written test

Name…… ID…… Date…

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

Test I: Give short answer (5point)

1. Define the following terms:
   A. Horticulture
   B. Horticultural crop production
   C. Production plan
   D. Organic farming
2. List and explain the common principles of organic farming?

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

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

Information Sheet 2- Gathering information regarding activities

2.1. Gathering information on similar time activities to planting

The activities and tasks undertaken by farmers for the cultivation of crops are commonly termed as agriculture, or agricultural practices. These include seven essential step wise processes: preparation of soil, sowing, adding manure ad fertilizers, irrigation, protecting from weeds, harvesting, and storage. Some activities may be occurring at the same time to planting/sowing. Therefore, it is important to gather information regarding the overlapping activities to adjust their sequence activities**.** This information may be gathered either through discussion with management or by reading the production plan and planting/sowing calendar of different agricultural crops.

For example, in areas of bimodal rainfall (Belg and Meher) production season in Ethiopia some activities like sowing/planting for meher season crops and harvesting that of the belg crops are overlap. In addition to this for some crop their planting /sowing calendar is occur at the same time. However, sowing time and agro ecology condition have great role in determining the horticultural crop production. In such condition, it is necessary to make discussion in order to adjust their sowing/planting calendar.

Critical factors to consider during this planning exercise are summarized as follows:

- ✓ Availability and quality of irrigation water;
- ✓ Field selection;
- ✓ Mechanical actions to be implemented;
- ✓ Chemical needs for pre-plant soil improvement;
- ✓ Tools and equipment needed for date cultivation;
- ✓ Labour needs;
- ✓ Irrigation design and installation;
- ✓ Leaching schedule;
- ✓ Hole preparation;
- ✓ Financial requirements and
- ✓ Time schedule.

Self-Check – 2	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions (5 pts)

1. Write down the use of gathering information on similar time activities to planting

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

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

Information Sheet 3- Identifying the specific target area

3.1. Identifying the specific target area, or paddock for planting

Different agricultural crops require varied optimal climatic conditions for better growth and development. It is important to select the crop according to the climatic suitability, so that the yields will be high. Hence , specific target area for planting is identified for planting different agricultural crops taking in to consideration of climatic suitability. The land selected for seed production must be fertile, preferably light textured, with adequate irrigation and proper drainage system. The field should be free from weeds and volunteer plants from the previous paddy crop. The field should not be infested with serious pests and diseases.

The land/field must meet seed production requirements. For certification purposes, field/land requirements of the enterprise must meet the selection requirements of the seed qualification control unit. The land must be ecologically suitable. The choice of the right nursery site is a prerequisite for proper seedling establishment, reduction in seedling damage and stuck during transplanting. The land selected for seed production must be:

- ✓ Fertile (organic fertilized),
- ✓ Preferably light textured,
- ✓ With adequate irrigation,
- ✓ Proper drainage system,
- ✓ Free from weeds and chemical residues
- ✓ Volunteer plants from the previous paddy crop and
- ✓ Free from the infestation of serious pests and diseases.

In general, land suitability study for agriculture is a very important technique in deciding future agricultural cropping pattern, planning and activities. Land suitability analysis is an assessment of an area to determine how proper or appropriate it is for a particular use of the land (such as growing a crop variety) in a particular location. Land suitability

tools have been extensively applied to identify better management practices in agricultural areas.

3.1.1. Identifying the environmental implications of the crop establishment

A. Climate factor

Climate largely determines the type of vegetation that grows naturally in any part of the world and the kinds of agriculture that are possible. The three most important factors in climate from the standpoint of plant response are:

- ✓ Temperature,
- ✓ Water supply/precipitation/ and
- ✓ Light.

There are also other factors like:

- ✓ Humidity,
- ✓ Solar radiation,
- ✓ Wind and
- ✓ Atmospheric gases

a. Temperature: - is often the factor limiting the growth and distribution of plants. It influences the rate of growth, development and number of flower that produce seeds. When temperature is below 15 ^{o}C frost or pale-yellow color of the plant parts occur. In any given locality, the length of growing season is known to vary as much as 30 days for different years. The ranges of maximum growth of the plant are 15-32 ^{o}C.

b. Water supply/irrigation availability:-water supply is the most important factor in determining the distribution of a crop plant. Although total annual precipitation is important, its distribution plays an essential role in crop production.

c. Light:-light affects the development of crop plants mainly through affecting their structural development, their food production and the time required species or varieties to produce seeds. Many plants are influenced by the length of day, especially in regard to flowering, fruiting, and the production of seed. This effect of light on plants is known as photoperiodism.

Some plants are known as long day plants and other as short day. The long day plants need a comparatively long day for flowering and their vegetative growth increases when the days are short. Wheat and oats are among the long day plants. The short day plants

such as maize, soybean and sorghum achieve their vegetative growth when the days are long and flower and produce seed when the days are short.

B. Soil factor

Soil factors are nutrients and water, soil moisture, soil temperature, soil air, soil reaction (acidity or alkalinity).

a. Soil moisture: - the amount of soil moisture has impact on performance of individual plants. If soil pores are completely filled with water, water logging condition is happen. Then water logging resulting in shortage of oxygen, leaching of plant nutrients, poor germination or nil, stunted growth, failure of seed formation, yellowing of leaves etc.
b. Soil temperature: - it is another soil factor that determining the growth of plants. It influences the rates of absorption of water and solutes, germination of seeds, growth of seeds, growth of roots, and decomposition of organic matter.
c. Soil reaction (soil acidity or soil alkalinity): - Some soils contain such as an excess of soluble salts that they interfere with crop growth. Plants are varying in their tolerance of alkaline soil or acidic soil. Among the tolerant crops are sugar cane, sugar beet, cotton, rye and many of the grasses. Grasses or cereals seem to be more tolerant than the legumes. Many crops are tolerant to acidic soil conditions and often make satisfactory growth.

C. Altitude/Elevation factor

The choice of a crop to be cultivated in a given locality is determined by its altitude. Based on altitude or elevation field crops are classified in to different groups. These are -

- Wurch: - greater than 3500m a.s.l.
- High land (Dega):- 2500-3500m a.s.l.
- Medium land (Woynadega):- 1500-2500m a.s.l.
- Lowland (kola):- 500-1500m a.s.l.
- Desert (harrur):- less than 500m a.s.l.

D. Pests: - the presence or absence of particular diseases or pests that attack the proposed crops should be checked.

E. Availability of inputs and other materials, tools and Equipments

Different inputs like land, planting materials, labor, etc and other materials like tools and equipment's should be available.

F. Accessibility: - The site should be accessible to all times and preferably be near the road, markets, processing facilities and ease for supervision.

Self-Check – 3	**Written test**

Name…… ID…… Date…

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

Test I: Short Answer Questions (10 pts)

1. List and explain the environmental implications of the crop establishment

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

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

ormation Sheet 4- Gathering information of trash levels and seed bed condition

4.1. Gather information of trash levels and seed bed condition

To some people, a fertile soil is simply one that supplies sufficient nutrients to the crop - but this is only a small part of the story. Organic producers work to a broader definition that encompasses all soil functions such as physical conditions and the level of aerobic biological activity as well as the ability to nourish plants. A healthy soil should **smell** like the broken down leaf litter of the forest floor – this wholesome earthy smell is typical of a healthy, well-aerated and biologically active soil. A rank marshy smell is a strong indicator of poor aeration, while little or no smell could indicate a low level of biological activity. The sense of **touch** will tell you much about the physical state of the soil. You should also be aware of how the soil feels beneath your feet as you walk across your land a springy softness is what you are hoping for.

Hardness can indicate surface compaction or dry conditions while stickiness is evidence of poor drainage. Tracking the changes to the surface across a field by just walking up and down can highlight problem areas. The most useful sense is **sight.** The appearance of the soil itself will, of course, provide you with important information, but the health and the type of the plants will tell you a great deal about the soil they are growing in. If weather and light conditions are favorable crops should be demonstrating good vigour if they are getting what they need from the soil. Colour is an important indicator – an even green colour from top to bottom of a crop plant and across the bed is a sign that all is reasonably well.

Any variation in colour on a single plant or across the bed should be investigated – this might be a variation in the ‘greenness’ or there might be stress colours such as yellow or red creeping in. Weeds can provide clues to fertility and condition of the underlying soil. If the weeds are struggling, you should be worried! Some weeds can provide

specific clues e.g. chickweed and fathen are indicators of good friability and nitrogen content, sorrel is an indicator of acidity and horsetail is linked with poor subsoil drainage.

One of the best methods for assessing soil structure is also the simplest, and will help you identify problems such as compaction, impeded drainage and restrictions to roots. You simply cut out a slice of topsoil and lift it out on a flat spade for a close examination of the layers, colours, the extent of root growth, earthworm activity, the structure and friability of the soil, and many more aspects.

Seedbed condition: - Horticultural crops are established by sowing seeds and planting their organic parts. Proper tilth is important for better germination and establishment of the seedlings. The field is ploughed repeatedly and brought to a fine tilth. Organic manures such as well decomposed FYM or compost are added and incorporated into the soil at the time of ploughing.

The methods of seedbed preparation and sowing differ with crops. Fine seedbed preparation is very much required for sowing of small seedbed crops. After ploughing, the field is converted into flat beds or ridges and furrows. The size of the beds is varies with the soil type and irrigation availability.

Self-Check – 4	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions (8 pts)

1. Explain the purpose of trash and good seed bed condition

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

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

LG #51	LO #2- Determine requirements of the seed crop establishment program
Instruction sheet	

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

- Considering plot history
- Identifying Species and cultivars
- Calculating and costing quantity of required
- Selecting Crop establishment procedures
- Planning Post-planting care
- Identifying and planning Plant germination and nutrient requirements
- Identifying Resources, tools, equipment and machinery
- Identifying Occupational Health and Safety (OHS) hazards
- Assessing risks and developing controls

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**:

- Consider plot history for suitability for a seed crop
- Identify Species and cultivars
- Calculate and costing quantity of required
- Select Crop establishment procedures
- Planning post-planting care
- Identify and plan plant germination and nutrient requirements
- Identify resources, tools, equipment and machinery
- Identify Occupational Health and Safety (OHS) hazards

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Information Sheet 1- Considering plot history

1.1. Consider plot history for suitability for a seed crop

Previous land use may influence its value as a potential nursery site. For example, past practices that have altered soil acidity or caused toxic chemicals to accumulate will be detrimental to growing seedlings.

- Has the site been altered?
- If so, when, and what was done?
- If the land has been leveled,
- Were any problems associated with the leveling?
- If so, has time ameliorated them?

The entomologist on the site-selection team should make a thorough evaluation. Ideally, the new site should be relatively free from annual and perennial weeds and weed seeds. Any previous crop species that is difficult to eradicate can become a weed problem. Costs of weed control can be very high; therefore, obtaining a weed-free site and managing to keep it weed free will be cost effective. Vegetation on the site should be identified by the selection team and control measures evaluated for all species.

Self-Check – 1	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions (5 pts)

1. Explain the use of plot history for seed crop?

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

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

Information Sheet 2- Identifying Species and cultivars

2.1. Introduction

Plant variety and cultivar identification is one of the most important aspects in agricultural systems. Organic conditions present a unique set of challenges for plants and breeders alike; the nutrients are in a less available form and the plant's root system has to work harder to meet the plants requirements; the restricted use of inputs means that organic growers are much more reliant on pest and disease resistance, early vigour to suppress weed growth and general good health of the plant to tolerate pest and disease problems. Good-quality seed has the following characteristics: it is generally true to species or cultivar;

- ✓ Capable of high germination;
- ✓ Free from diseases and insects; and
- ✓ Free from mixture with other crop seeds,
- ✓ Weed seeds, and
- ✓ Inert and extraneous materials.

2.2. Seeds, varieties and the organic standards

The organic standards require growers to use organic seed. However, this can be difficult for the horticultural sector because of the enormous diversity of crops and a lack of varieties available in organic seed to suit the range of growing conditions, seasons and markets. In practice, a derogation can be obtained from certification bodies to use non-organic but untreated seed where appropriate organic material is not available.

2.3. The development and availability of organic seed

We are beginning to see some varieties of major crops (e.g. potatoes) that have been developed specifically for organic systems. However, it takes at least 10 years and a lot of money to develop and commercialize a new variety. Therefore, the majority of varieties used by organic growers are developed for conventional systems but perform relatively well under organic conditions. The Centre for Organic Seed (COSI) is a web-based resource that carries the results of all these programmes and other seed and variety related issues plus up to date news, details of events and other information. The

site also provides direct access to the UK section of the Organic-x-seeds database, which records the availability of varieties in organic seed for most crops.

2.4. Choosing varieties

Choosing the right variety can be a complex process and you need to accept that it will probably take a few years, and lot of trial error, before you find the varieties that really suit you and your system. Vegetables, Citrus fruits, Herbs, spices, root crops, flowers, grape vines and other horticultural seed crops are the most common types of horticultural crop, whereas each of the have their own cultivar.

Some examples of vegetable and fruit cultivars:

- ✓ **Alliaceae (Onion Family). :**Onion, garlic, leek, shallot, chive
- ✓ Apiaceae (Carrot Family) :Carrot, parsnip, parsley, celery
- ✓ Asteraceae (Sunflower Family) :Lettuce, endive, salsify, Jerusalem artichoke
- ✓ Brassicaceae (Mustard Family) :Cabbage, broccoli, cauliflower, Brussels sprouts, kohlrabi, turnip, radish, Chinese cabbage, kale, collards, rutabaga
- ✓ Chenopodiaceae (Goosefoot Family) :Beet, Swiss chard, spinach
- ✓ Convolvulaceae (Bindweed Family) :Sweet potato
- ✓ Cucurbitaceae (Gourd Family) :Cucumber, muskmelon, watermelon, squash, pumpkin, gourd
- ✓ Fabaceae (Pea Family) :Garden pea, snap bean, lima bean, soybean
- ✓ Malvaceae (Mallow Family) :Okra
- ✓ Poaceae (Grass Family) :Sweet corn, popcorn, ornamental corn
- ✓ Solanaceae (Nightshade Family) :Tomato, pepper, eggplant, potato, husk tomato

There are many issues you need to take into account including:

- ✓ **The market.**

This is often the last thing that breeders look at, but it is right at the top of a grower's priority list. Multiple retailers often specify the varieties they want based on a range of factors they consider important. You will also be required to deliver large volumes of product over a very short period so F1 hybrids, that tend to develop more uniformly, are more suitable. Supplying a market stall, a box scheme or a restaurant is a different ball game altogether. The characteristics you are looking for are probably very different.

Typically, you will be supplying small amounts of produce over long periods, which means that uniformity of development is much less of an issue;

Yields.

While many conventional breeding programmes focus on maximizing yields, the organic grower often thinks more in terms of optimal yields. This takes account of the fact in organic systems nutrients are not very abundant and other characteristics, such as disease resistance are just as, if not more, important;

Vigour.

Good early vigour is very important in organic systems, particularly in relation to pest, disease and weed problems. In a situation where you cannot rely on chemical solutions, you need the crop to get away quickly to out-compete weeds and resist attack from pests and diseases;

Resistance to pests and diseases.

Certain varieties have high levels of resistance to specific pests and diseases. In Wales, the main challenge is from foliar diseases. Resistance to potato blight, for example, has been the focus of many breeding programmes. Other examples include resistance to downy mildew in lettuce and rust in leeks;

Seasonality.

If you are producing crops throughout the year, such as cauliflowers, cabbage or lettuces, you will need a suite of varieties that mature in the different seasons, in the same way, you can chose to cultivate winter or spring cereal varieties. In addition when choosing varieties, producers need to assess their strength and weaknesses and consider important factors such as:

- ✓ Target market or use
- ✓ Region where it's being grown i.e. climate
- ✓ Soil type
- ✓ Farming system
- ✓ Field history i.e. pest, disease and weed problems

Purchased seed are not expected to contain weed seeds, seeds of other varieties or crop specie or other materials such as stones and dirt, they should be stored in a dry damp free environment until use.

Self-Check – 2	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. List the properties of good species/cultivar (5 pts)

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

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

Information Sheet 3- Calculating and costing quantity of required

3.1. Determine the recommended seeding rate of horticultural crop

Vegetables, **fruits**, flowers, ornamentals, and lawn grasses are examples of horticultural crops and are typically produced on a smaller scale with more intensive management than agronomic crops. Some horticultural crops are grown for aesthetic enjoyment and recreation within reason; most vegetable crops tend to use available resources. However, as a rule, higher plant populations need more water, nutrients and sunlight for optimum production of quality produce. Plant higher populations only if the crop is to be irrigated, fertilized and maintained to adequately provide for the increased number of plants. As the population is increased, fruit size tends to decrease.

Seed rate is the amount of seed required to cover a specific area. It can also be the number of plants per unit of land. Optimum number of plants per unit area or plant population per unit area required to utilize efficiently the available light, water, and carbon dioxide for better yield.

3.2. Factors that influence plant population or seed rate

- ✓ Size of cultivar.
- ✓ Size of seed.
- ✓ Amount of moisture available.
- ✓ Fertility status of the soil.
- ✓ When number of crops grown together.
- ✓ Sowing method
- ✓ Germination capacity of the seed.
- ✓ Sowing time.

3.2. Relationship between spacing, seed rate, and plant population

If the spacing between rows and plants is more, the seed rate required is and plant population is less. For example, if wheat is sown 30cm x 6cm, calculate the optimum plant population per hectare. Area occupied by single plant = (30/100) m x (6/100) m=0.018m^2

If plant population for 0.018m^2 = 1 plant

Plant population for 10,000m^2 =? Note: 1 ha = 10,000m^2

So that population for 1 ha = 10,000m^2/ 0.018m^2 =555555 plants

Calculation of seed rate

Seed rate (Kg/ha) =Area to be sown X test weight of seed X 100 x 100 / 1000 x 1000 X G% X P% X Spacing (m^2).

Example: Calculate the quantity of potato seed required for sowing 1 ha from the following given:

(a) 60cm X 25cm (c) P% =95%

(b) G% =90% (d) Test weight of seed =300g

Seed rate (Kg/ha) =1000 X test weight of seed X 100 X 100/1000 X 1000 X G% X P% X spacing (m2)

= 1000 X 300g X 100 X 100 /1000 X 1000 X90 X 95 X 0.15m2

= 300/128.25 =2.3 Kg/ha

Exercise 1. Calculate the seed rate/ ha for potatoes crop

G% =90% (c) Test weight of seed =50g

P% =90% (d) Plant spacing = 6cm

(f) Row spacing =30cm

Self-Check – 3	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. List explain the factors that influence plant population or seed rate (10 pts)

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

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

Information Sheet 4- Selecting Crop establishment procedures

4.1. Requirements of crop establishing procedures

When establishing a new date plantation, certain actions need to be implemented to ensure the long-term success of the plantation. One of these actions involve the initial land preparation, which should be done prior to transplanting of the plant material (offshoots or tissue culture-derived plants). The purpose of land preparation is to provide the necessary soil conditions, which will enhance the successful establishment of the young offshoots, or the tissue culture plants received from the nursery. Considering the nature of the date palm, one cannot "save" on this operation and hope for long-term sustainability of the plantation. The aim is to enable the date grower to plan and structure the implementation process in advance, ensuring the successful establishment of the date plantation. Planning forms part of the initial preparation and will help to limiting unnecessary stoppages during the implementation phase.

Successful crop establishment is crucial to achieve maximum potential yield. Timeliness of sowing is the most important factor followed by an evenly established and uniform plant stand. A uniformly established crop is the foundation for a potential high yield.

4.2. Common procedures of crop establishing

Field selection

The area selected for the establishment of the date plantation can influence the cost of land preparation to the extent that it may not be viable to proceed with the development at all. The authors' aim is to highlight the critical areas to be considered when selecting the land for the establishment of a new date plantation.

Physical land preparation

Once a suitable area for establishing the plantation is selected and the planning operation is fi nalised, the actual preparation can be activated. These activities are divided to structure and pace the implementation process in order to be ready for planting at the most suitable time, according to the specific regional climatic conditions.

Mechanical field preparation

The mechanical or initial soil preparation concerns mainly the preparation of a field for further detailed preparation such as irrigation system installation, whole preparation, etc. Actions, if applicable to the area, include:

- Debushing/bush clearing;
- Removal of stones and rocks;
- Ripping; and
- Levelling of the soil.

Irrigation system installation

The type of irrigation system to be used will be determined by the availability of water, topographical and soil conditions. When the initial soil preparation is completed, the installation of the required irrigation system will be implemented according to the prescribed design.

Soil improvement

The scheduling of the soil improvement programme will depend on the date grower, as certain applications could be combined with the initial actions of soil preparation. Due to the long waiting period, planting to first production, it is a trend to establish date plantations on new soils, with the exception of areas where date palm is used for intercropping.

If new soils are considered, the soil improvement programme will mostly deal with:

- The application of organic matter; and/or
- The elimination of soil salinity.

Organic material

In general, most soils are poor in organic matter content and the improvement of this situation plays an important role in soil fertility. Some of the advantages of a higher humus content in the soil are summarized as follows:

- Enhances crumb formation which improves the respiration of the roots;

- Increases the water infiltration rate;
- Increases the water holding capacity;
- Lowers soil compaction and crust formation; and
- Limits the harmful effects of alkalinity and improves the leaching of salts.

Salinity

In an attempt to reclaim salt affected soil, consideration should be given to:

- ✓ The type of salinity/alkalinity,
- ✓ The drainage possibilities of the soil profile,
- ✓ The origin or the source of salts,
- ✓ The quality of irrigation water and
- ✓ The leaching of salts from the soil.

If the source of salts is identified as drainage water from higher lying areas, a cut-off canal may be sufficient to eliminate this source of "salt" supply. Poor drainage normally goes hand in hand with soil salinity problems and therefore the improvement of the drainage potential should be addressed before any leaching programme is implemented. A soil cover (mulching) and the application of organic material will improve the water infiltration resulting in improved drainage (excluding soils with obstructive layers).

In saline soils (soluble salts present as chlorides, sulphates and/or carbonates of calcium, sodium or magnesium), only leaching will be necessary to drain the excess salts. In the case of alkaline and/or saline-alkaline soils, sodium can be replaced through the application of gypsum or acidifying agents like sulphur. Once the sodium has been replaced, a programme should be followed to leach it out. When the irrigation water is of poor quality, proper drainage and over irrigation, without the development of a water table, is very important.

Hole preparation/Seed bed preparation

The actual digging of the hole is one of the last actions before planting takes place, but it must be emphasised that this is not the final preparation for the planting operation itself. This is the point where the required inputs such as gypsum and organic materials

are worked into the soil and a start is made with the leaching programme. The reason why the leaching is only applied at this stage is because of the relatively small area that is occupied by the date palm. If the total area had to be leached, it would become very costly with little or no benefit in the long run.

Planting operation

This is probably the most critical phase in the establishment of a new date plantation. Mistakes at this point may lead to a poor survival rate of offshoots or tissue culture-derived plants, regardless of the efforts put in during the preparation phases. The aim is to assist the date grower to execute the planting operation in a way that will ensure a high transplanting survival rate in the newly established plantation. The planting operation is divided into different activities, which will be discussed separately. Sowing and transplanting.

Fig 4.1 different types of horticultural crop seed planting

Self-Check – 4	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Explain the procedures of seed crop establishments (10 pts)

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

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

Information Sheet 5- Planning Post-planting care

5.1. Post planting care or maintenance of established crops

Horticultural crop management practices is the group of agricultural practices used to improve the growth, development, and yield of agricultural crops. Other field practices include crop irrigation and mechanical, biological, and chemical methods of combating weeds, pests, and diseases. In crop production, the ultimate goal of any farmer is to get maximum yield per unit area. To obtain high yield, effective crop management practices, which are otherwise known as cultural practices, appeared to be of paramount value. Crop maintenance includes irrigation, pest and disease control, rouging, weed control, haulm destruction and harvest.

5.2. Post Planting Operations

These are operations carried out after planting which include the following: -

Weeding

This is the removal of unwanted plants found growing among the cultivated crops. Weeds compete with crops for limited environmental resources and harbor pests and diseases that are harmful to crops. Such competition usually becomes manifested in reduced crop growth and yield. Timely weeding is very necessary if crop yield is to be increased.

Thinning

This is the removal of weak or extra seedlings from a stand when the seeds per stand germinate more than required. Thinning is preferably done after rain when the soil is wet and care must be taken not to damage the roots of other plants.

Supplying

This is the practice of replanting the vacant positions created by poor seed germination. It is done when all the seeds have germinated.

Fertilizer Application

Cropping depletes plant nutrients from the soil and fertilizers are added to the soil to supplement or replenish the lost nutrients. By following fertilizer recommendations in terms of method, dosage, time and number of application, farmers may get back, more than double of their investment.

Mulching

This is the placement of materials such as dry grasses, sawdust, leaves, wood shavings etc over the soil surface. Mulching conserve soil moisture, regulates soil temperature, provides erosion control, suppresses weed growth, serves as vegetative cover, improves soil condition and increases soil fertility.

Control of Pests and Diseases

When pests and diseases attack crops, the result is low yield or sometimes-total crop failure. It is therefore necessary to control pests and diseases. This can be achieved using resistant varieties, good farm management practices, crop rotation, and use of natural enemies of the pests and spraying with insecticides.

Harvesting

When crops are fully matured, the useful parts are removed or detached from the parent plants for consumption or for sale. Timely harvesting is very important in crop production as delay in harvesting leads to reduction in crop yield and quality.

Processing

This is the process of transforming the farm produce into consumable form or into forms acceptable to the consumers.

Storage

Good storage fetches more money to the farmer as most of stored goods are sold during off-season when price is relatively high.

Marketing

This is the last stage of farm operations in which the farm produce to be sold are sent to the market. Marketing is very important in agriculture as it ensures the movement of goods and services from where they are produced to where they are not produced. Effective marketing strategy yields more profit to the farmer.

Self-Check – 5	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Write down the purpose of post planting practices of seed crop managements (10 pts)
2. List the common types of post planting practices (10 pts)

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

Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points

Information Sheet 6- Identifying and planning Plant germination and nutrient requirements

6.1. Plant germination and nutrient requirements

Germination is the growth of an embryonic plant contained within a seed; it results in the formation of the seedling. Whereas, germination refers to the process by which an organism grows from a seed or a spore. The most common forms of germination include a seed sprouting to form a seedling and the formation of a sporeling from a spore. Thus, germination occurs primarily in plant and fungal species. Seeds of many native species are challenging to germinate. One important thing a grower can do is to learn as much as possible about the life history, ecology, and habitat of the species he or she wishes to grow to understand the processes seeds from each target species go through in nature. Any observations will be valuable when trying to germinate and grow species that have little or no published information available. How seeds are handled, treated, and sown can affect the genetic diversity and the quality of the crop produced.

Germination is the sequence of events transforming a quiescent embryo into a metabolically active, synthesizing structure. Germination is controlled by dormancy and various environmental factors acting upon the seed. Seed quality is the composite term used to reflect germination, genetic purity, and freedom from foreign material, including inert matter, other crops, and weeds. The sequence of germination in its simplest form is: water imbibition, enzyme activation, hydrolysis and catabolism of storage material, initiation of embryo growth, anabolism and formation of new cell structures, rupture of seed coat, and emergence of the seedling.

Environmental factors such as temperature, light, pH, and soil moisture are known to affect seed germination. Burial depth of seed also affects seed germination and seedling emergence. Some seeds take two weeks or more to sprout. Poor germination can be caused by overly wet or cold soil, which causes seeds to rot. (The latter can be remedied with a Heat Mat.) If the soil was too dry, the seeds may not have been able to absorb enough moisture to sprout.

Most vegetables will germinate in 7-10 days but you can double that for carrots and treble it for celery. Here's a link to a handy germination table giving approximate times for most crops you are likely to grow. Seeds of many fruit crops remain ungerminated even under favorable conditions. Such kind of dormancy in seeds may be due to presence of hard and impermeable seed coat, germination inhibitors or due to improper development of embryo. Such seeds may re quire special treatments like scarification, soaking in water, growth regulators etc. for overcoming dormancy. This re view sum ma rises the latest developments in seed germination in different fruits cops. Most of fruit crops germinated from two weeks to six months.

The Seed Germination Process

- ✓ Imbibition: water fills the seed.
- ✓ The water activates enzymes that begin the plant's growth.
- ✓ The seed grows a root to access water underground.
- ✓ The seed grows shoots that grow towards the sun.
- ✓ The shoots grow leaves and begin photmorphogenesis.

Generally, Factor **Affecting** on **Germination** 1. Abiotic **Factors**: 1) Light 2) Temperature 3) Aeration (Oxygen) 4) Soil type and depth of sowing 2. Biotic **factors**: 1) Viability of **seed** 2) Dormancy period 3.

Factors influencing seedling establishment under field conditions include:

- ✓ The physical,
- ✓ Chemical,
- ✓ Biotic properties of the soil;
- ✓ Method,
- ✓ Date,
- ✓ Depth and rate of seeding; and
- ✓ Seed treatments.

The dominant environmental factors affecting establishment, **temperature** and **moisture**, are in a constant state of flux, which places substantial stress on the germinating and emerging seedling.

Ways of identifying crop nutrient need

Crop nutrients. Nitrogen (N), phosphorous (P), and potassium (K) are the three main nutrients that are conventionally supplied by inorganic fertilizers. Other products and processes such as organic manures, plants residues, and biological nitrogen fixation may also supply nutrients.

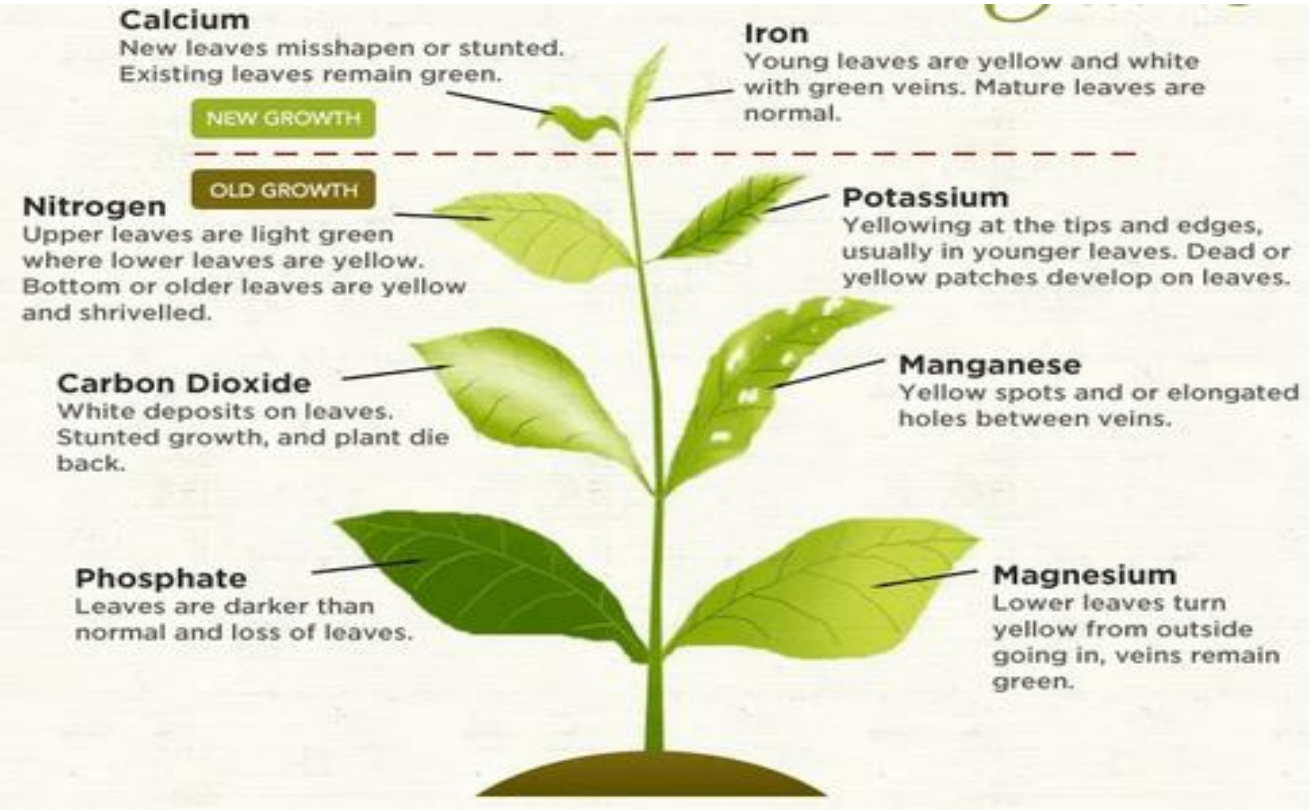


Fig 6.1 different nutrient deficiency symptoms

Plant Nutrient Deficiency Symptoms

Macronutrients

Calcium (Ca)

- ✓ **Symptoms:** New leaves are distorted or hook shaped. The growing tip may die. Contributes to blossom end rot in tomatoes, tip burn of cabbage and brown/black heart of escarole & celery.
- ✓ **Sources:** Any compound containing the word ‘calcium’. Also gypsum.
- ✓ **Notes:** Not often a deficiency problem and too much will inhibit other nutrients.

Nitrogen (N)

- ✓ **Symptoms:** Older leaves, generally at the bottom of the plant, will yellow. Remaining foliage is often light green. Stems may also yellow and may become spindly. Growth slows.
- ✓ **Sources:** Any compound containing the words: 'nitrate', 'ammonium' or 'urea'. Also, manure.
- ✓ **Notes:** Many forms of nitrogen are water-soluble and wash away.

Magnesium (Mg)

- ✓ **Symptoms:** Slow growth and leaves turn pale yellow, sometimes just on the outer edges. New growth may be yellow with dark spots.
- ✓ **Sources:** Compounds containing the word 'magnesium', such as Epson Salts.

Phosphorus (P)

- ✓ **Symptoms:** Small leaves that may take on a reddish-purple tint. Leaf tips can look burnt and older leaves become almost black. Reduced fruit or seed production.
- ✓ **Sources:** Compounds containing the words 'phosphate' or 'bone'. Also greensand.
- ✓ **Notes:** Very dependent on pH range.

Potassium (K)

- ✓ **Symptoms:** Older leaves may look scorched around the edges and/or wilted. Interveinal chlorosis (yellowing between the leaf veins) develops.
- ✓ **Sources:** Compounds containing the words 'potassium' or 'potash'.

Sulfur (S)

- ✓ **Symptoms:** New growth turns pale yellow, older growth stays green. Stunts growth.
- ✓ **Sources:** Compounds containing the word 'sulfate'.
- ✓ **Notes:** More prevalent in dry weather.

Micronutrients

Boron (B)

- ✓ **Symptoms:** Poor stem and root growth. Terminal (end) buds may die. Witches brooms sometimes form.

- ✓ **Sources:** Compounds containing the words ‘borax’ or ‘borate’.

Copper (Cu)

- ✓ **Symptoms:** Stunted growth. Leaves can become limp, curl, or drop. Seed stalks also become limp and bend over.
- ✓ **Sources:** Compounds containing the words ‘copper’, ‘cupric’ or ‘cuprous’.

Manganese (Mn)

1. **Symptoms:** Growth slows. Younger leaves turn pale yellow, often starting between veins. May develop dark or dead spots. Leaves, shoots and fruit diminished in size. Failure to bloom.
2. **Sources:** Compounds containing the words ‘manganese’ or ‘manganous’

Molybdenum (Mo)

- ✓ **Symptoms:** Older leaves yellow, remaining foliage turns light green. Leaves can become narrow and distorted.
- ✓ **Sources:** Compounds containing the words ‘molybdate’ or ‘molybdic’.
- ✓ **Notes:** Sometimes confused with nitrogen deficiency.

Zinc (Zn)

- ✓ **Symptoms:** Yellowing between veins of new growth. Terminal (end) leaves may form a rosette.
- ✓ **Sources:** Compounds containing the word ‘zinc’.
- ✓ **Notes:** Can become limited in higher pH.

Self-Check – 6	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. List and explain the types of essential plant nutrients (10 pts)

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

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

Information Sheet 7- Identifying Resources, tools, equipment and machinery

7.1. Selecting and confirming machinery and equipment

Before starting to establishment of horticulture crops, all necessary tools and Equipments should be gathered. Selecting proper tools and equipment are essential for the effective operation of establishment of horticultural crops. Equipping the agricultural site with the correct tools and equipment plays an essential role in achieving timely and good quality results. For every agricultural activity, there is an optimal combination of tools, equipment and labor. Depending on the nature and content of the works, the technical workers needs to know which tools to use and how to effectively combine them with manual labor. Site supervisors need to know how to use the tools and how to operate the equipment in order to secure good work progress and the expected high quality results

Faulty equipment is a common reason for delays on agricultural activities. A major responsibility of field supervisor is to ensure that tools and equipment are maintained in a good condition and are readily available when required for the various work activities.

In order to utilize the equipment and labor in the most effective way, the use of equipment needs to be carefully coordinated with the output of the work ranges. It is also important that workers know the full potential, as well as the limitation, of the use of manual and equipment-based works methods. Finally, equipment and machinery need regular maintenance, requiring good workshop facilities, a reliable supply of spare parts and qualified mechanical staff. Tools, Equipments and machinery used for horticultural crop establishment includes:

7.2. Simple Hand Tools

Spade: - used for digging the soil & making bunds & ridge

Axes and saws: - The shrubs and trees are cut down with axes & saws and removed from the field manually or by animal drawn carts.

Cutlass or machetes: - to lift root crops & to weed

Hand hoes: - used for weeding, available in different shapes of blades.

Sickle: - Most common hand tools used through Asian & African countries to cut the grasses & for harvesting the crops.

Shovel: - for working with loose soil modified animal drawn implements

Wooden float: - It is used for land smoothening with animal power before sowing.

Bund former: - Consists of 2 divergent gathering steel blades fixed to a frame work with a long wooden shaft pole. It is used for soil conservation practices also.

Wooden leveling board: - Used for leveling the paddy field after peddling.

Rake:- spring-toothed rakes are useful for removing stones, leaves& grass from lawns and paths

Broom used for cleaning

Auger

Water cane

Sprayers: used to apply pesticides, herbicides, etc. and for foliage application of fertilizers.

Figure7.1 Tools used to establish horticultural seed crops

7.2. Equipments and machines

Tractor is farm machinery which is a motor vehicle used to plough large farms. It usually has two large rear wheels with deeply treaded tyres.

Plow is farm implement (equipments) used for initial cultivation to loosen or turn the soil in preparation for sowing seed or planting.

The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to decay. As the plough is drawn through the soil, it creates long trenches of fertile soil called furrows. In modern use, a ploughed field is typically left to dry out, and is then harrowed before planting.

Field Cultivator is a two-wheeled cultivator used in seedbed preparation. They were an alternative to the harrow and were also used to remove any weeds that may have sprung up between the time a field was harrowed and crops such as wheat were to be drilled or sowed.

Drills an instrument with an edged or pointed end for making holes in hard substances by revolving or by a succession of blows

Planter is a farm implement, usually towed behind a tractor, which sows (plants) seeds in rows throughout a field. It is connected to the tractor with a drawbar or a three-point hitch. Planters lay the seeds down in precise manner along rows.

A sprayer is agricultural equipments used for spraying (applying) liquid substances to plants. These substances could be fertilizers, herbicides or pesticides. Based on the specification, size, and crop requirements sprayers are of different types.

Primary Tillage	**Secondary Tillage**
✓ Offset Disks	Disk Harrows
✓ Moldboard Plows	Seedbed Finishers
✓ Chisel Plows	
✓ Sub soilers	

Figure.7.2 tractor and disk harrow

Figure.7.3 Moldboard Plows

Types of PPE

Personal protective clothing and equipment may include:

- ✓ Boots
- ✓ Hat/hard hat Overalls
- ✓ Gloves
- ✓ Protective eyewear
- ✓ Hearing protection
- ✓ Respirator or face mask
- ✓ Sun protection, e.g., sun hat, sunscreen

Key Points about PPE

- Do before going to worksite
- Use carefully – don't spread contamination
- Remove and discard carefully, after finishing work
- Immediately perform hand hygiene

Self-Check -7	Written Test

Self-Check – 7	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page (4 pts):

1. What are tools used during establish horticultural crops for seed production?
2. List all equipments and machines used to establish horticultural crops for seed production.
3. Explain the functions of each equipments and machines.

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

Information Sheet 8- Identifying Occupational Health and Safety (OHS) hazards

8.1. Identifying, assessing and controlling existing and potential Occupational Health and Safety hazards

The term ‘’hazards’’ refers to anything which can affect an employee’s health. Occupational health and safety is concerned with health and safety in its relation to work the working environment. Laws, standards and programs related to occupational health and safety aim to make the workplace better for workers, co-workers, family members, customers and other stakeholders. Better occupational health and safety standards ensures good business, better brand image, high morale and employee peace of mind

Aims of occupational health

Occupational health should aim at:-

1. The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation
2. The prevention amongst workers of departures from health caused by their working conditions.

3. The protection of workers in their employment from risks resulting from factors adverse to health.

Hazards identification (assessing of hazards):

- ✓ Visual inspection of the area
- ✓ Understanding of site plans
- ✓ In addition, enterprise work procedures.

Types of hazards

Physical hazard like, noise, electricity, heat and cold

Chemical hazard like, toxic gasses, noxious fumes and corrosive liquids

Ergonomic hazard like, heat of workbench, the shape of a vehicle seat and the length of a control lever,

Radiation hazard like, radio actives materials

Psychological hazard like, stress from using equipment without proper training.

Biological hazard like, bacteria and viruses from air conditioning systems

8.2 Controlling of existing hazards

PPE, as defined by the Occupational Safety and Health Administration, or OSHA, is "specialized clothing or equipment**,** worn by an employee for protection against injury by blunt impacts, chemicals, infectious materials etc."

Purpose of PPE

The purpose of PPE is to reduce employee exposure to hazards when engineering controls and administrative controls are not feasible or effective to reduce these risks to acceptable levels.

Types of PPE

Personal protective clothing and equipment may include:

Foot protection: Workers must wear closed-toe shoes at all times to protect feet from chemical spills and sharp objects.

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

Hand protection: Hand protection is indicated for the possibility of severe cuts, lacerations, or abrasions, punctures, temperature extremes, and chemical hazards.

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

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

Hear Protectors: Hearing protectors come in two forms: plugs and muffs. Hearing protectors should always be considered "personal" equipment and should not be used by other individuals, except for muffs that are adequately cleaned and sanitized.

Key Points about PPE

- Do before going to worksite
- Use carefully – don't spread contamination
- Remove and discard carefully, after finishing work
- Immediately perform hand hygiene

Self-Check – 8	**Written test**

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. Define the hazards and explain its types (10 pts)

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

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

Information Sheet 9- Assessing risks and developing controls

9.1. Assess risks and develop controls

Hazard: Anything (e.g. condition, situation, practice, behaviour) that has the potential to cause harm, including injury, disease, death, environmental, property and equipment damage. A hazard can be a thing or a situation.

Hazard Identification: This is the process of examining each work area and work task for the purpose of identifying all the hazards which are “inherent in the job”. Work areas include but are not limited to machine workshops, laboratories, office areas, agricultural and horticultural environments, stores and transport, maintenance and grounds, reprographics, and lecture theatres and teaching spaces.

Tasks can include (but may not be limited to) using screen based equipment, audio and visual equipment, industrial equipment, hazardous substances and/or teaching/dealing with people, driving a vehicle, dealing with emergency situations, construction. This process is about finding what could cause harm in work task or area.

Risk

The likelihood, or possibility, that harm (injury, illness, death, damage etc) may occur from exposure to a hazard.

Risk Assessment

Is defined as the process of assessing the risks associated with each of the hazards identified so the nature of the risk can be understood. This includes the nature of the harm that may result from the hazard, the severity of that harm and the likelihood of this occurring.

Risk Control

Taking actions to eliminate health and safety risks so far as is reasonably practicable. Where risks cannot be eliminated, then implementation of control measures is required, to minimize risks so far as is reasonably practicable. A hierarchy of controls has been developed and is described below to assist in selection of the most appropriate risk control measure/s.

Monitoring and Review

This involves ongoing monitoring of the hazards identified, risks assessed and risk control processes and reviewing them to make sure, and they are working effectively.

The risk assessment procedure can best be illustrated in the following ways:

Step 1: Identify Hazards

WHS legislation in New South Wales requires that PCBUs, in consultation with workers identify all potentially hazardous things or situations that may cause harm. In general, hazards are likely to be found in the following;

- ✓ Physical work environment,
- ✓ Equipment,
- ✓ Materials or substances used,
- ✓ Work tasks and how they are performed,
- ✓ Work design and management.

In order to identify hazards the following are recommended:

- Past incidents/accidents are examined to see what happened and whether the incident/accident could occur again.
- Employees be consulted to find out what they consider are safety issues, I.e. ask workers about hazards near misses they have encountered as part of their work. Sometimes a survey or questionnaire can assist workers to provide information about workplace hazards.
- Work areas or work sites be inspected or examined to find out what is happening now. Identified hazards should be documented to allow further action. The work environment, tool and equipment as well as tasks and procedures should be examined for risks to WHS.
- Review information about equipment (e.g. plant, operating instructions) and Material Safety Data Sheets to determine relevant safety precautions.
- Welcome creative thinking about what could go wrong takes place, i.e. what hazardous event could take place here?

Step 2: Assess Risks

Risk assessment involves considering the possible results of someone being exposed to a hazard and the likelihood of this occurring.

A risk assessment assists in determining:

- How severe a risk is
- Whether existing control measures are effective
- What action should be taken to control a risk
- How urgently action needs to be taken.

A risk assessment should include:

- Identify factors that may be contributing to the risk,
- Review health and safety information that is reasonably available from an authoritative source and is relevant to the particular hazard,
- Evaluation of how severe the harm could be. This includes looking at the types of injuries/illnesses/harm/damage that can result from the hazard, the number of people exposed, possible chain effects from exposure to this hazard.
- Evaluation of how a hazard may cause harm. This includes examining how work is completed, whether existing control measures are in place and whether they control the harm, looking at infrequent/abnormal situations as well as standard operating situations. A chain of events related to a risk may need to be considered.

- Determining the likelihood of harm occurring. The level of risk will increase as the likelihood of harm and its severity increases. The likelihood of harm occurring may be affected by how often the task is completed, in what conditions, how many people are exposed to the hazard and for what duration.
- Identify the actions necessary to eliminate or control the risk; and
- Identify records that it is necessary to keep to ensure that the risks are eliminated or controlled. Other risk factors should also be identified as they may contribute to the risk: including
- The work premises and the working environment, including their layout and condition,
- The capability, skill, experience and age of people ordinarily undertaking work,
- The systems of work being used; and
- The range of reasonably foreseeable conditions.

Risk control methods includes:

- ✓ Avoidance,
- ✓ Loss prevention,
- ✓ Loss reduction,
- ✓ Separation,
- ✓ Duplication, and
- ✓ Diversification.

Self-Check – 9	**Written test**

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. Explain the assessing risks and developing controls (10 pts)

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

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

LG #52	LO #3- Prepare planting plan
Instruction sheet	

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

- Determining the seed crop and method of planting
- Preparing detailed plans
- Producing plan
- Assessing and calculating the resources
- Setting the target dates for planting
- Selecting and organizing The chemical applications
- Preparing plan environmental impacts
- Identifying and assessing Occupational Health and Safety (OHS) hazards
- Developing and communicating On-site procedures and schedules

- Identifying and obtaining approvals
- Planning contingencies

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**:

- Determine the seed crop and method of planting
- Prepare detailed plans
- Assess and calculate the resources
- Set the target dates for planting
- Select and organizing the chemical applications
- Prepare plan environmental impacts
- Identify and assess Occupational Health and Safety (OHS) hazards
- Develop and communicate On-site procedures and schedules
- Identify and obtain approvals
- Plan contingencies

Learning Instructions:

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

Information Sheet 1- Determining the seed crop and method of planting

1.1 Determine crop seed and method of planting introduction

In mature plants, photo taxis (growing towards the light source) overrides the gravitational impulse for the stalk and leaves, but the roots and the seed while it is underground rely on gravity for orientation In general agricultural crops in this are:

Horticultural crops:

- ✓ Tree, bush and perennial vine fruits;
- ✓ Perennial bush and tree nuts;
- ✓ Vegetables (roots, tubers, shoots, stems, leaves, fruits and flowers of edible and mainly annual plants);

Crop/variety selection range of vegetable and fruit crops/varieties suitable for home gardening are suggested based on:

- ✓ Nutritional value
- ✓ Yield and quality benefit to home gardeners
- ✓ Suitability to agro-ecology
- ✓ Low level of pests and diseases
- ✓ Ease of production
- ✓ Availability of seeds/planting material
- ✓ Ease of fitting (reduced complexity) into home garden production systems.

Based on the above-mentioned criteria lettuce, okra, Swiss chard, carrot, beetroot, cabbage, tomato, potato, sweet potato, faba bean and chickpea are selected

1.2. Methods of agricultural crop sowing / Planting

There are various methods used for sowing the seeds. Traditional Method. A funnel-shaped tool is used to sow the seeds traditionally.

Broadcasting.
Dibbling.
Drilling.
Seed Dropping behind the Plough.
Transplanting.
Hill Dropping.
Check Row Planting.

Broadcasting:

In broadcast method, the seeds are spread uniformly over well-prepared land. Broadcasting may be done by hand or mechanical spreader. Broadcasting is suitable for close-planted crops that do not require specific crop or plant geometry. It is used when the number of plants per unit area is more important than definite spacing from plant to plant. This is the usual method of sowing.

Fig 1.1. Broadcasting

Drilling

Drilling is the practice is of dropping seeds in rows or lines. Furrows at specified distance are made, and the seeds are dropped at definite depth and distance, covered with soil and are compacted Fairley. Seed can be drilled with help of seed drills (bullock or tractor drawn) and seeding funnels attached with country plough. Seeds and fertilizers can be drilled simultaneously. Mustard, carrot and sesame are sown by drilling.

Fig 1.2 seed drilling

Dibbling or planting

This method consists of putting or placing individual seed or seed material in a hole or pit, made at pre-determined depth and spacing by manual labor or with the use of

mechanical dibbler or planter. Generally, the crops with bigger size seeds and those needing wider spacing and specific crop geometry for their canopy development are sown by this method.

Fig 1.3 seed dibbling / planting

1.3. Planting machine /instrument

Wide ranges of crops are grown in the Ethiopia, all with various characteristics and requirements. There are a range of sowing and planting equipment available to satisfy the planting and sowing needs of all crops. These equipments can be categorized into three different types:

- ✓ Broadcasters
- ✓ Driller
- ✓ Planters

The equipment must have:

- ✓ Accurate metering to ensure the required plant population is achieved
- ✓ The ability to sow the seeds/plant into a range of soil conditions
- ✓ The ability to handle a range seed/plant sizes
- ✓ A range of easily adjustable sowing rates to suit a range of crops
- ✓ Uniform sowing/planting depth
- ✓ Sufficient hopper capacity to maintain output

Self-Check – 1	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. List and explain the selection criteria of seed crop and sowing methods (15 pts)

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

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

Information Sheet 2- Preparing detailed plans

1.1. Introduction

Farming and agriculture is a complicated business. To be successful, you need more than a green thumb and the willingness to get your hands dirty. You need to know how to operate your agricultural enterprise efficiently and not just forecast your crop rotations, but your cash position and revenue. To do that, you need a business plan. A good business plan will help your farm or food production business grow. It can improve your chances of receiving government grants or loans, help you manage your business through hard times, and identify additional forms of revenue like tourism or consulting. If you are not sure where to begin, check out our farms, food growers, food production facilities, and other agriculture-related sample business plans for inspiration, or to build a more modern plan that helps you easily manage your agricultural business we recommend you try live plan. It contains the same templates and information you see here, but with additional guidance to help you develop the perfect plan.

crop planning considers what, when, where and which plants to grow in relation to their requirements for space, sunshine, water, maturation, season of planting and tolerance for each other. Crop plans must include varieties of crops. Such “heirloom” varieties must be preserved for future generations. The contingency crop planning therefore is proposed to mitigate such situation through the choice of appropriate crop and varieties, cropping systems or other necessary relevant farm practices. To develop a contingency plan for an area, a detailed study of the rainfall data should be done first.

1.2. Crop production plan

Basic Concept of the Agricultural Production

Basic concept on the agricultural production is considered based on the existing situation of the priority irrigation schemes, farmers’ intention on farming and the agriculture and economic situation of the country.

- Paddy production is the first priority of farmers in the schemes
- Cropping pattern is to be arranged based on water potential
- Crops in the plan are to be selected based on adaptability,
- profitability and sustainability of farming

- Crop production is market oriented for increasing income.

In crop production systems, crop production (grain, fruit, forage, and biomass) is sustained through photosynthesis and uptake of water, nitrogen, and other essential plant nutrients. In livestock production systems, animals assimilate nitrogen through the consumption of amino acids in grains and forages. General principles of growth, development and yield (applied physiology) of field crops. IV. Influence of the climate (light, solar radiation, air temperature, rainfall and atmospheric humidity, wind, evapotranspiration, CO2-concentration) on crop growth and yield. Which includes the following class:

- ✓ Preparation of soil.
- ✓ Sowing.
- ✓ Adding manure and fertilizers.
- ✓ Irrigation.
- ✓ Protection from weeds.
- ✓ Harvesting.
- ✓ Storage.

Contents of proposal of crop cultivation:

Crops

Proposed crops are flexible to meet market demand, financial situation, available labour and other factors of farmers and market.

Cropping Pattern

Proposed cropping pattern is prepared by considering potential of water resource, agro-ecological zone of the DOA and strong farmers' intention to paddy cultivation. The priority irrigation schemes are classified in potential water resource and the Agro-ecological Zone as the Master Plan.

Crop Cultivation Area

Crop cultivation of the proposed crops determined on marketability, adaptability, profitability, labour use etc. as mentioned. The rates of cropping area on OFCs in the cropping patterns and seasons are as follows.

Anticipate Yield

The yield levels of proposed crops are determined based upon the DOA target yield.

Propose Crop Production

Based on the proposed cultivation area, the anticipated yields and the cropping rates, the production in the priority irrigation schemes should be estimated.

Propose Cultivation Practices

Crop management

Cropping calendar- Farmer in most of the place prefers and intended to cultivate paddy and they are waiting rainfall even after December and January.

Crop Budget-

Price of product, Seed rate, Fertilizer application, Agro-chemicals, Labour: Machinery and animal power and others.

Self-Check – 2	Written test

Name…… ID…… Date…

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

Test I: give short answer

1. Explain the contents of proposal of crop cultivation (10 pts)

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

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

Information Sheet 3- Producing plan

3.1. Requirements of producing production plan

A production plan is a detailed document that outlines the structure of the company's operations. In the plan, there is a structure, schedule, goal, activities, and the definition of resources in between.

Table 3.1. Format of seed crop production

R/No	Resource required	Units		Amounts	Unit cost	Total cost	remarks
1	Tools, materials and equipments						
	Seeds						
	Organic fertilizer						
	Human labour						
	Types of activities	Time	Human labour				
2	Site selection						
	Land preparation						
	sowing						
	Crop management						
3	Totally						

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1 define production plan (5 pts)

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

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

Information sheet 4– Assessing and calculating the resources

4.1. Assess and calculate the resources

The resources require will be stated in terms of personnel (these might be temporary, permanent, or contracted workers), machinery and equipment, consumables, and leasing arrangements that to be used for crop harvest. The resources required for the planting operations are assessed and calculated from;

The area to be sown,

The method of planting to be used, and

The available timelines.

It is important to assess and predict:

- ✓ Lab our required
- ✓ Equipment availability
- ✓ Input requirements (seed, fertilizer…etc)
- ✓ Cost requirements

Self-Check – 4	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. Explain the assess and calculate the resources (10 pts)

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

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

Information sheet 5– Setting the target dates for planting

5.1. Determining sowing or planting time

Sowing is a process of planting seeds into the soil. During this agricultural process, proper precautions should be taken, including the appropriate depth, proper distance maintained, and soil should be clean, healthy and free from disease and other pathogens including fungus. All these precautions are essential for seed germination the process of seeds developing into new plants. The sowing date affects the time to emergence and early seedling vigor. The sowing date affects the time to emergence and early seedling vigor. Different crops are sown in different season depending up on their climatic requirements.

Different crops are sown in different season depending up on their climatic requirements. Sowing crops at appropriate time increase crop growth ,development and yields due to suitable environmental available to crop at its stage. Some t times due to unfavorable weather and soil condition, un availability seeds ,fertilizers ,tillage and sowing implements ,the sowing is either done earlier or delayed beyond optimum time . In both cases germination, development, growth, and yields affected adversely therefore, agricultural crops should be planted as soon as the soil warms to minimum recommended temperature.

Self-Check – 5	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. List and explain the factors of time of sowing/planting crops (10 pts)

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

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

Information sheet 6 – Selecting and organizing the chemical applications

6.1. Requirements of pesticide application

Without crop protection, including pesticides, more than half of the world's crops would be lost to insects, diseases and weeds. Pesticides are important. They help farmers grow more food on less land by protecting crops from pests, diseases and weeds as well as raising productivity per hectare. Proper crop protection is important to produce higher quality crops with minimal wastage. This increase in productivity leads to less land, water and labour being required for food crops. With less land, being used biodiversity is preserved and less greenhouse gases are emitted.

Types of Pesticide Ingredients:

- ✓ Insecticides,
- ✓ Herbicides,
- ✓ Rodenticides, and.
- ✓ Fungicides

6.2. Common time of pesticide application

Seed treatment

Large number of disease, fungus, bacteria, viral and insect pests are carried or introduced through seed. Seed treat is process of application of chemicals or protestants to seeds, that prevent the carriage of insects and disease causing pathogens in or on seeds. Seed treatments also enable the seed to overcome seedling infection by soil borne fungi and bacteria.

Application of herbicides before planting

Normally the herbicides having greater toxicity on the emerging of seedlings are applied before sowing or planting. For example, glyphosphate or paraquat is applied to fallow fields. Some of the herbicides, which need proper incorporation in the soil, are applied before planting.

Use of herbicides in Zero tillage.

The concept has been developed with the availability of herbicides for weed control, which is one of objective of tillage operation. In this non-selective broad spectrum herbicides are used to kill a sod (grass, grass legume) or residues from previous crop.

Application of chemical post planting

Herbicide treatment enforced after planting and emergence of crops to control weeds is referred to as post emergence chemical application. E.g 2.4-D to control weeds.

Self-Check – 6	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Write down the importance of pesticides (10 pts)
2. Explain the time pesticide application (10 pts)

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

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

Information sheet 7 – Preparing plan environmental impacts

7.1. Prepare plan to minimize detrimental environmental Impacts

Pesticides can contaminate soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects, and non-target plants. Pesticides benefit the crops; however, they also impose a serious negative impact on the environment. Excessive use of pesticides may lead to the destruction of biodiversity. Many birds, aquatic organisms and animals are under the threat of harmful pesticides for their survival. While using chemicals for seed treatment and also application of chemicals post planting plan is prepared to minimize or eliminate including the proper disposal of the empty containers that any potential detrimental environmental impacts.

7.2. Application of organic input in Organic Farming

Chemical fertilizers, pesticides, and fungicides are widely used in agriculture to improve crop yields. Most of the compounds used are synthetic, and their overuse causes environmental pollution and human health problems. Currently, several countries are working to reduce the use of agrochemicals. Organic agriculture is now emerging as a sustainable alternative to traditional agriculture using environmentally friendly strategies such as the application of organic fertilizers from plant and animal waste and pesticides based on plant extracts and microbial.

However, the availability of commercial bio pesticides and organic fertilizers is very limited because there are certain barriers to the commercialization of biological products. These barriers include small available quantities of raw materials and strict registration laws requiring toxicological tests and other studies that are expensive and time consuming. Organic farming focuses details about the various organic fertilizers and pesticides that do not have the same disadvantages as synthetic compounds in terms of persistence and toxicity.

7.3. Control of detrimental environmental impacts

Detrimental environmental impacts such as wind erosion ,removal of top soil , the development of acid sulfate soils, and increased water run-off speeds would be avoided by suitable planning and appropriate decision. Pesticides can move off-site to

contaminate surface water and leach to groundwater. Damage to non-target organisms and pollution to the soil and air are well documented. The released pesticides into the environment and their impacts on many species have been known for a long time.

What can you do to minimize pesticide exposure?

- Buy organic and locally grown fruit and vegetables.
- Wash fruits and vegetables before eating.
- Know which fruits and vegetables have higher levels of pesticide residue.
- Grow your own produce.
- Use non-toxic methods for controlling insects in the home and garden.

Self-Check – 7	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. Explain the impacts of pesticides on Envaronment (10 pts)

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

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

8.1. Identify Occupational Health and Safety (OHS) hazards

People are always exposed to health risks and injuries because agricultural practices involve tools and equipments that may cut and create wounds and injure body and harmful chemicals such as pesticides. There are also harmful organisms in the field such as insects, snakes, weeds etc that may bite, sting causing physical trauma, pain, illness or even death. Intensive agriculture is critically dependent on pesticides for pest control, which may also pollute the environment. Therefore, applying health and safety systems in agriculture is essential to prevent or minimize injury, ill health, and death to those at work and those affected by work activities and furthermore, to reduce environmental pollution. It also helps to avoid the potential costs of interruptions to work-outputs from ill health or injury. People should work in safe and comfortable working environment.

Occupational health and safety is a discipline with a broad scope involving many specialized fields. In its broadest sense, it should aim at:

- The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations;
- The prevention among workers of adverse effects on health caused by their working conditions;
- The protection of workers in their employment from risks resulting from factors adverse to health;
- The placing and maintenance of workers in an occupational environment adapted to physical and mental needs;
- The adaptation of work to humans.

The hazard identification process requires that:

- past incidents/accidents be examined to see what happened and whether the incident/accident could happen again
- Employees be consulted to find out what they consider are safety issues, e.g. how could an employee be exposed to this hazard?
- work areas or work sites be examined to find out what is happening now

- Review information about equipment (e.g. plant, operating instructions) and Material Safety Data Sheets to see what is said about safety precautions.
- Some creative thinking about what could go wrong takes place, i.e. what hazardous event could take place here?

Self-Check – 8	Written test

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. Explain the hazard identification process requires (10 pts)

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

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

Information sheet 9- Developing and communicating On-site procedures and schedules

5.1. Carry out seed crop establishment operations

Schedule for planting has to be properly planned to suit seasonal influences ,weather and weather for casts ,as well as the local geography and the organizations resourcing situation. High quality seed is important for successful vegetable production. Seeds of the selected vegetable crops are imported. Currently, there are no breeding companies undertaking vegetable breeding and seed production in Ethiopia. Land preparation for planting involves plowing to "till" or dig-up, mix, and overturn the soil; harrowing to break the soil clods into smaller mass and incorporate plant residue, and leveling the field. Initial land preparation begins after your last harvest or during fallow period.

Points to be taken in to consideration during scheduling for planting are:

- ✓ Range of geographic
- ✓ Resourcing factors
- ✓ Operation that occur at the same time

Generally, the information required for the producers of seed crops includes:

Crop Selection

- Comparative pricing of different crops.
- For some crops, government releases prices of the crop at the time of seeding.
- Market demand and sale potential of the crop.
- Budget required for the cultivation of each crop.
- Feasibility of the crop considering climate and quality of land.
- Crop productivity compared with other alternatives.

Land Preparation

- Effects of any disease from the previous cultivation and steps needed to minimize this impact.
- Fertilizers needed to bring land to its normal fertility depending upon the previous crops and fertilizer used.
- Layout and design of the field with respect to crop for efficient irrigation.
- Latest techniques for leveling the fields and their cost.

Seed Selection

- Price and quantity needed per acre
- Average yield and sprout to sown ratio.
- Suitability to particular area and climate.
- Water requirement.
- Resistance to diseases.
- Location of distribution offices for the seed.

Seed Sowing

- Appropriate time to sow the seed.
- Optimal weather conditions at sowing time.
- Best method for the sowing of seeds.
- Seed sowing depth.

Irrigation

- Critical time for irrigation.
- Amount of water to be given to the plants.
- Frequency of irrigation.

Crop Growth

- Number of plants per unit of area. At times, more than optimum number of seeds sprouts are planted in a given area. Farmers must reduce density for healthy growth of plants.
- Average growth rate of the crop in normal conditions.
- Comparison of crop growth rate, leaf size, crop color etc. with expected growth for given conditions and input.
- Interventions needed to maintain expected growth.
- Frequency, quantity and method for fertilization.
- Proper time, frequency and method for plowing.
- Proper time, frequency and method for weeding.
- Expected pest and virus attacks, symptoms of such attacks, precautionary measure that can be taken in advance to avoid these attacks, immediate actions including pesticide to be used to kill pests and viruses, quantity of pesticide to be used per acre, most effective method for pesticide spray, avoid health issues related to pesticide spray.

Harvesting

- Proper time and method for harvesting.
- Comparative market rates.
- Proper crop storage.
- Cost of transportation.

Self-Check – 9	Written test

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. List and explain the information required for the producers of seed crops (10 pts)

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

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

Information sheet 10- Identifying and obtaining approvals

10.1. Assessing planting and management operation and taking action

The production is a set of procedures or activities conducted to create goods and services, in any production process required a planning process. In scheduling patterns of cropping farmers must respect all existing attributes, So as to maximize the profits of farmers, some attribute to note is, size of areas, production advantage, amount of seeds and age of the plant and production as well as the results of the life cycle of horticulture plant.

Production planning is planning about what products and how the company in question in a period to come will produce that. Production planning is part of operational planning within the company. The role of planning is merely intended to coordinate the activities of the sections that directly or indirectly in producing, planning, scheduling and controlling the production of the starting stages of raw materials, process, until the resulting output so that the company really can produce goods or services effectively and efficiently.

Factors of crop production

The four most important factors that influence crop yield are:

- ✓ Soil fertility,
- ✓ Availability of water,
- ✓ Climate,
- ✓ Diseases or pests,
- ✓ Availability of resource.

These factors can pose a significant risk to farms when they are not monitored and managed correctly. However, based on the factors of seed crop production, the production plan and its schedule will be reformed, after the communication of all experts.

Self-Check – 10	Written test

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. Explain the four most important factors that influence crop yield (10 pts)

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

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

Information sheet 11- Planning contingencies

11.1 Planning contingences requirements

A contingency plan is a plan devised for an outcome other than in the usual plan. It is often used for risk management for an exceptional risk that, though unlikely, would have catastrophic consequences. Contingency plans can also be referred to as 'Plan B' because it can work as an alternative action if things do not go as planned. The purpose of a contingency plan is to allow an organization to return to its daily operations as quickly as possible after an unforeseen event. The contingency plan protects resources, minimizes customer inconvenience and identifies key staff, assigning specific responsibilities in the context of the recovery.

How to prepare Contingency Plan

A contingency plan is a plan, and like any plan, it requires a great deal of research and brainstorming. In addition, like any good plan, there are steps to take to make sure you are doing it right.

1. **Identify and Prioritize Resources:** Research your company and list its crucial resources, such as teams, tools, facilities, etc., then prioritize that list from most important to least important.

2. **What Are the Key Risks?** Figure out where you are vulnerable by meeting with teams, executives and every other department in the organization to get a full picture of what events could compromise your resources; hire an outside consultant, if necessary.

3. **Draft a Contingency Plan:** If you can, write a contingency plan for each risk that you identified in the above steps, but start with what is most critical to the life of your organization. As time permits, you can create a plan for everything on your list. Whatever the plan, the thought behind each should be the steps necessary to resume normal operation of the company, thinking about communications, people's responsibilities, timelines, etc.

4. **Share the Plan:** When you have written the contingency plan and it has been approved, the next step is to make sure everyone in the organization has a copy. A

contingency plan, no matter how thorough, is not effective if it has not been properly communicated.

5. **Revisit the Plan:** A contingency plan is not chiseled in stone. It must be revisited, revised and maintained to reflect changes to the organization. As new employees, technologies and resources enter the picture, the contingency plan must be updated to handle them.

Project managers are adept at creating contingency plans, as the structure and actions are like many of the processes already familiar to their profession. For instance, a contingency plan breaks down tasks to get more detail and, in so doing, more control.

The following are the key steps in contingency planning:

- Note where there are resources that can be used in an emergency. Also, note where in your contingency plan these resources might be applied.
- Identify dates that if missed will negatively affect your plan, for example getting approval from a group or committee that only meets every now and then.
- Know your contingency plan. Check for any weak links and strengthen them. Identify any slack that you can find in it.
- See if you can find points in your plan where alternative routes can be taken, and think through each one's scenario to add flexibility to your plan.
- Use your experience to help you see patterns in your project's ebb and flow of activity to sharpen your plan.

Challenges of Contingency Planning

Like any plan, there are always challenges that managers need to think about before and during the process of creating their contingency plans.

Self-Check -11	Written Test

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

1. What is contingency plan? 7 points
2. How contingency plan is prepared? 8 points

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

You can ask your teacher for the copy of your answer

Information sheet 12- Determining Measurable indicators, specifications and targets

12.1. Determining measurable indicators and specifications of seed crop

The indicator has the capacity to be counted, observed, analyzed, tested, or challenged.

Self-Check – 12	Written test

Trueness to variety; the presence of inert matter, seed of other crops, or weed seed; germination percentage; vigor; appearance; and freedom from disease are important aspects of seed quality. High-quality seed lots should meet minimum standards for each of these characteristics If one cannot measure an indicator, then progress cannot be determined. Good-quality seed has the following characteristics: it is generally true to species or cultivar;

- ✓ Capable of high germination;
- ✓ Free from diseases and insects; and
- ✓ Free from mixture with other crop seeds,
- ✓ Weed seeds, and
- ✓ Inert and extraneous materials

Characteristics of good quality seed includes:

- ✓ Higher genetically purity:
- ✓ Higher physical purity for certification.
- ✓ Possession of good shape, size, colour, etc., according to specifications of variety.
- ✓ Higher physical soundness and weight.
- ✓ Higher germination (90 to 35 % depending on the crop)
- ✓ Higher physiological vigour and stamina

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 measurable indicators of seeds crops quality (10 pts)
2. Explain what they mean (10 pts)

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

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

Operation Sheet 1–Carrying out seed crop establishment

Objectives: To familiarize the trainees with the ways of operating the establishments of seeds crops**.**

Procedures to operations:

Step1. Select and use tools, materials and equipments use for field crop establishment

Step2. Identify and asses OHS hazards and risks of site preparation

Step3. Prepare planting materials based on characteristic of good planting materials

Step4. Determine optimum-sowing time based on types of crops and other factors

Step5. Decide recommended seeding rates based on types of crops and other factors

Step6. Select proper sowing/planting methods, which are suitable for crops

Step7. Sow/plant planting materials on prepared site based on the site of crops

Step8. Complete field crop establishment operations

LAP TEST	Performance Test

Name…… ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary information, work site, tools and materials you are required to perform the following tasks within 2: hour.

Task 1 perform the establishments of seed crops

Instruction sheet

Information sheet 1- Determining planting schedule

key responsibilities

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

- Determining planting schedule
- Key responsibilities before planting
- Implementing key responsibilities for planting
- Keeping record
- Documenting plan
- Reporting plan

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

- Determine planting schedule
- Key responsibilities before planting
- Implement key responsibilities for planting
- Keeping record
- Document plan
- Report plan

Learning Instructions:

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

1.1. Determining scheduling for planting

Identifying the possibilities and limits of the overall farm production plan and the rotation for each field is central to planning. At the farm scale, parameters such as market demand, available land, equipment, projected labor availability, and regulatory issues have to be reviewed annually. Farmers consider complying and keeping up with regulations to be among their most difficult tasks. This responsibility also includes numerous “communication” tasks, such as establishing market relationships, making labor arrangements, accessing information, and contacting suppliers.

Producing vegetables is a favorite pastime for many people. Homegrown vegetables have better flavor because they are harvested closer to their peak ripeness, which enables the production of more of their natural sugars. In addition, there is complete joy in watching a small seed develop into a delicious treat! Gardening provides a means of exercise, recreation and therapy, as well as opportunities for many to experience nature. Statements such as “Let me show you my garden” or “I grew that” give a sense of self-satisfaction worth way more than any monetary value. Home vegetable gardens range in size from a single potted tomato plant to large gardens. Make your garden the size that will meet your needs without becoming a burden.

Locate the garden in a sunny area. Six to eight hours of sunlight each day is preferred. The fruit bearing crops, such as tomatoes, peppers and squash, need full sunlight for best production. Otherwise, too much shade results in very little production for those crops. Schedule for planting and key responsibilities has to be properly planned to suit seasonal influences ,weather and weather for casts ,as well as the local geography and the organizations resourcing situation.

Points to be taken in to consideration during scheduling for planting are:

- ❖ Range of geographic
- ❖ Resourcing factors
- ❖ Operation that occur at the same time

Generally, critical factors to consider during this planning exercise are:

- ✓ Availability and quality of irrigation water;
- ✓ Field selection;
- ✓ Mechanical actions to be implemented;

- ✓ Chemical needs for pre-plant soil improvement;
- ✓ Tools and equipment needed for date cultivation;
- ✓ Labour needs;
- ✓ Irrigation design and installation;
- ✓ Leaching schedule;
- ✓ Hole preparation;
- ✓ Financial requirements and time schedule

Self-Check – 1	**Written test**

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Write down the generally, critical factors to consider during this planning exercise (10 pts)

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

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

Information sheet 2- Key responsibilities before planting

2.1. Key responsibilities before planting

When establishing a new date plantation, certain actions need to be implemented to ensure the long-term success of the plantation. Pre-planting operations in sequence are selection of the site, surveying of the soil and land measurement, clearing, stumping, field plotting or farm layout, tilling or ridging, ploughing, harrowing, nursery and nursery practices. A well-prepared field controls weeds, recycles plant nutrients, and provides a soft soil mass for transplanting and a suitable soil surface for direct seeding. ... This is important for effective weed control and for enriching the soil. Generally, it will take 3−4 weeks to prepare the field before planting.

Determining key responsibilities for specific preparatory process before Planting.

Planning

The area selected for the establishment of the date plantation can influence the cost of land preparation to the extent that it may not be viable to proceed with the development at all. The authors' aim is to highlight the critical areas to be considered when selecting the land for the establishment of a new date plantation. Before planting a crop the viability of the enterprise should be assessed as part of the overall business plan. It is important to assess and predict:

- Lab our
- Resource requirements
- Land

Soil improvement

The scheduling of the soil improvement programme will depend on the date grower, as certain applications could be combined with the initial actions of soil preparation. Due to the long waiting period, planting to first production, it is a trend to establish date plantations on new soils, with the exception of areas where date palm is used for intercropping.

If new soils are considered, the soil improvement programme will mostly deal with:

- ✓ The application of organic matter; and/or
- ✓ The elimination of soil salinity.

Organic material

In general, most soils are poor in organic matter content and the improvement of this situation plays an important role in soil fertility. Some of the advantages of a higher humus content in the soil are summarized as follows:

- Enhances crumb formation which improves the respiration of the roots;
- Increases the water infiltration rate;
- Increases the water holding capacity;
- Lowers soil compaction and crust formation; and
- Limits the harmful effects of alkalinity and improves the leaching of salts.

Key activities under taken before planting may include:

- Equipment must be serviced to a reliable and operational standard
- Seed must be prepared and available
- Land of cultivation should be prepared properly and etc

Self-Check – 2	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Explain the Key responsibilities before planting (10 pts)

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

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

Information sheet 3- Implementing key responsibilities for planting

3.1. Determining key responsibilities for specific implementation

In agriculture, ploughing, levelling, and manuring are the three steps of soil preparation. Ploughing includes loosening and digging of soil. During ploughing, the soil becomes loose and the nutrients in deep soil come to the top. It is important to prepare the soil for sowing seeds because loosening of soil allows the roots to penetrate deep into the soil. In addition, loose soil has more air. Moreover, the loosened soil helps in the growth of microorganisms and earthworms, which add humus to the soil and increase its fertility.

All of the decisions and information generated through previous tasks and responsibilities are pulled together for analysis at this key phase of the planning process. The data on market options, equipment, labor and seed availability, and financial constraints, along with the overall farm and rotation goals are reviewed. Information is cross-referenced and, when necessary, weighted. Possible trade-offs are considered. For example, the field crew may be able to plant two fields to high-value crops but not also harvest an early crop the same week. Crop cultural needs are compared to each field's characteristics and conditions.

The following are key activities for specific implementation.

- Land selection under taken
- Land/seed bed must be prepared
- Seed bed must be leveled to a fine depending on seed sizes
- Organic matters or plant debris are properly in cooperated in to the soil

Land preparation

Preparing a site for sowing a crop depends on factors that include:

- Climate
- Weather
- Ground condition
- Previous treatment

Self-Check –3	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. List the factors preparing a site for sowing a crop (10 pts)

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

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

Information sheet 4- Keeping record

4.1. Requirements of keeping records

Farming is a business and good farm record keeping helps the farmer plan and do realistic forecasting. Record keeping provides valuable information on which methods work. The farmer can better predict price changes of inputs and produce from expenditures and sales records kept from previous years. Recordkeeping is the act of keeping track of the history of a person or organization's activities, generally by creating and storing consistent, formal records. Recordkeeping is typically used in the context of official accounting, especially for businesses or other organizations. A farm record is a document (in most cases a book) that is used to keep account of different activities, events, materials etc. regarding the farm operations.

Farm records are different from farm accounts in the sense that farm accounts deal only with the financial aspects of all farm operations. There are many benefits to keeping accurate, up to date records: Make essential business decisions to realize your goals. Make productivity projections and forward plan. Identify the strengths and weaknesses of your business.

What records should be taken?

Keeping full records just for the sake of keeping them is a waste of time and energy. It is sometimes useful to record what happens to each plot or crop each year, such as type of crop, fertiliser applications (time and amount), agronomy (seeding, weeding, sprays), visual impression of crop, harvest interval of forage crops and if known, crop yield. Unit costs s of all major farm inputs, such as fertilisers, fuel, irrigation water, concentrates and/or their ingredients, purchased forages, stock purchases. These are necessary for routine bookkeeping and to monitor seasonal changes and hence to plan future purchases.

Key financial records, s such as interest and principal repayment schedules, to plan repayments. Other key farm management records s such as rates and government charges, other administrative costs such as telephone and office upkeep, labourer's wages, capital investments, unusual weather events, dates of important meetings, credit repayments, changes in valuation of capital items such as land and livestock categories. Personal expenses, s to ensure the manager and farm family's imputed wages are realistic and that people are living within their means.

Types of farm records and their uses

- Daily farm records.
- Records of farm implements and equipment
- Record of agricultural inputs.
- Records of livestock and livestock products.
- Records of animal feeds.
- Production records.
- Records for farm use.
- Farm expenditure records.

Self-Check –4	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Explain the use of keeping records (10 pts)

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

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

Self-Chec-5	Written test

5 .1. Documenting the plan, scheduling, and key responsibilities

Process documentation is a method of collection, collation, analysis and communication of experiences in contextually-appropriate ways. Process documentation is a process, which helps project staff and stakeholders to track meaningful events in projects/ programmes. These insights are not only useful in themselves but they also allow for more effective innovation to take place, facilitate taking processes to scale allowing their adaptation to other locations and contexts, and contributes to paving the way for wider development goals to be achieved. In the agricultural crop production all activities involved during the process from starting up to, the end relevant data has to be documented.

The following activities may be documented in planting plan:

- Planting plan: it includes the objectives of the plan, specification and the targets
- Planting schedule: exact time of sowing different agricultural crops for each paddock
- Key responsibilities: all activities under taken for preparatory and implementation processes

There are two main types of product documentation:

Types of system documentation include a requirements document, source code document, quality assurance documentation, software architecture documentation, solution instructions and a help guide for advanced users.

- System documentation represents documents that describe the system itself and its parts.
- User documentation covers manuals that are mainly prepared for end-users of the product and system administrators.

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. Explain what the documenting plan (10 pts)

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

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

Information sheet 6- Reporting plan

6.1. Documenting plan type, formats and frequency of reporting required

Reporting is providing information about serious wrongdoing that you have become aware of at your workplace/ place of study. To ensure smooth workflow operations report must be submitted to both managers and operators or any concerned body. Therefore this is achieved by documenting production plan including the types of plan, format, frequency and detail of any reporting required concerned body are completed and clearly documented. Reports are well-researched, planned and organized documents that are written for a purpose. Types of reports include memos, meeting minutes, expense reports, audit reports, closure reports, progress reports, justification reports, compliance reports, annual reports, and feasibility reports.

Reports are divided into sections with headings and subheadings. Reports can be academic, technical, or business-oriented, and feature recommendations for specific actions. Reports are written to present facts about a situation, project, or process and will define and analyze the issue at hand.

Types of reports

- Long Report and Short Reports:
- Internal and External Reports:
- Vertical and Lateral Reports:
- Periodic Reports:
- Formal and Informal Reports:
- Informational and Analytical Reports:
- Proposal Reports:
- Functional Reports

Contents of formats

Here are the main sections of the standard report-writing format:

Title Section – This includes the name of the author(s) and the date of report preparation.

Summary – There needs to be a summary of the major points, conclusions, and recommendations.

Name…… ID…… Date…

Self-Check – 6	Written test

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 use of reporting (10 pts)

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

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

LG #54	LO #5- Monitor and adjust the planting plan

Instruction sheet

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

- Adhere monitoring point out line
- Observing and following check
- Communicating with operational staff
- Taking corrective action on planting plan

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

- Adhere monitoring
- Observe and following check
- Communicate with operational staff
- Take corrective action on planting plan

Learning Instructions:

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

1.1. Adhere monitoring point out line in the implementation of production plan

Project activities on agricultural production are to be operated within the agricultural support programmes. The types of programmes are field programme and farmer training programme in the extension programme, and seed production programme. Awareness programmes for understanding the Project concepts, the Project activities and the Project procedures initialize the Project activities. The concept of agricultural production and the procedure of activities are to be adopted to the beneficiaries. An initial stage of activity units at field levels as production groups. The subject of agricultural project on adaptive trials, demonstrations and training programmes for initial movement are also to be discussed in this period.

1.2. Technical Elements on Crop Production

Following individual element on crop production, possibly occur during the project implementation in the schemes. Paddy Production All the Project participants have been experienced paddy cultivation. The programme is aiming at strengthening producers' technical and management skills for profitable farming. Technical package of paddy cultivation according to agro-ecological zones and soil types prepared by DOA is available in extension service.

Planting time: Delay planting causes an insect attack and meet rain at harvest in maha season.

Land preparation: Deep ploughing is recommended, however short period of land preparation makes shallow ploughing.

Quality seed: Quality deterioration by repeatedly use of own seed is problem. Available sources for procurement and seed production in the scheme are needed.

Fertilizer application: Appropriate kinds, amount and timing are effecting directly for yield level. Excess dose of application is observed in some scheme. Yield response to application and economical effect have to check carefully. Use of organic matters as rice straw, cattle manure and green manure may need to consider for productivity improvement.

Weed control: Selection of weedicide according to existing weeds and appropriate amount are affecting yield and quality of products.

Insects and diseases control: Selection and application time of proper agro-chemical according to the degree of the outbreak.

Other pest control: Wild animals as elephant, rat and wild pig are serious problem in many schemes. Organization for protection is recommended.

Harvest and post-harvest: Timing of harvest is affecting for quality and yield loss. Effective use of labour may need to consider by the way of work and sources of labour. Effective use of machinery may need to consider for maintaining quality and economic efficiency.

Storage: Storage may need to consider for maintaining quality and protecting from pest attack.

Marketing: Major problem on marketing paddy is the price and the destination. Market information services and negotiable power by organization may need.

Monitoring the points out lined in the implementation plan are adhered to. The points that may out lined in the plan may include:

- Objective of the plan-the plan must have an objective
- Target of the plan
- Specification of the plan
- Methods to be used is also out lined
- Seed availabilities and etc

Self-Check – 1	**Written test**

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Explain what the outline point should be adhered in seed crop production plan (10 pts)

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

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

Information sheet 2- Observing and following OHS procedures

2.1. Requirements of OHS Procedures

A safety procedure is a systematic plan of how to perform a work procedure. This is used in cases where deviation from the procedure could lead to injury or accident. Occupational health and safety requirements are being followed by action that will reduce the occupational health and safety risk are the selection ,use and maintenance of personnel protective equipment ,the appropriate and responsible servicing of equipment and vehicles ,the use of safe manual handling systems ,and the protection from noise and dust. The purpose of the Health and Safety policies and procedures is to guide and direct all employees to work safely and prevent injury, to themselves and others. All employees are encouraged to participate in developing, implementing, and enforcing Health and Safety policies and procedures

3.2. Safe work procedures

Following the Risk Management process where identified hazards associated with various processes and plant, assessed risks, and identified and implemented control measures, it is useful and important in the management of safety and demonstration of due diligence, to write Safe work Procedures. The control measures identified can be written up as safe work procedures/or instructions that inform employees how to do the job safely.

Safe Work Procedures can also be used during OHS and induction training. While compliance with legislative requirements is a duty under the OHS law, the development and implementation of safe work procedures has many additional benefits.

These include:

- Allowing the business to structure an OHS training program based on the safe working procedures developed.
- Controlling procedures provides a basis for a safe place and system of work.

- Consistent task performance.
- Reduction of down time and lost time due to accidents.
- Improved productivity and profitability.
- Increased skill and understanding levels for employees.
- Assist in identifying suitable employment for injured workers.

Self-Check -2	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Write down the procedures of OHS (10 pts)

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

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

Information sheet 3- Communicating operational staff

3.1. Operational staff's communication

Operational staff and any contractors should be communicated with regularly to ensure smooth workflow operations and progress. Communication may also include personnel safety. Communication is simply the act of transferring information from one place, person or group to another.

Importance of communication

Effective Communication is significant for managers in the organizations to perform the basic functions of management, like:

- ✓ Planning,
- ✓ Organizing,
- ✓ Leading and
- ✓ Controlling seed crop production plan.

Communication helps managers to perform their jobs and responsibilities. Communication serves as a foundation for planning. All the essential information must be communicated to the managers who in-turn must communicate the plans to implement them. Organizing also requires effective communication with others about their job task. Similarly, leaders as managers must communicate effectively with their subordinates to achieve the team goals.

NB: Controlling is not possible without written and oral communication. Managers devote a great part of their time in communication.

Name…… ID…… Date…

Self-Check –3	Written test

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 use of communication in work place (10 pts)

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

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

Information sheet 4- Taking corrective action on planting plan

4.1. Taking corrective action on planting plan

The Corrective Action Plan is comprised of a set of initiatives evaluated by the working group and cross-Agency stakeholders to provide value for Agency acquisition management improvements. Corrective actions, on the other hand, eliminate the root cause of the problem, preventing future issues. The corresponding corrective actions, then, address the root cause of the fire, such as climatic condition, pest problems and resource scarcity.

Climate largely determines the type of vegetation that grows naturally in any part of the world and the kinds of agriculture that are possible. The three most important factors in climate from the standpoint of plant response are temperature, water supply/precipitation/ and light. There are also other factors like humidity, solar radiation, wind and atmospheric gases but generally they are of less influence than the three mentioned. Pests, plant diseases, and weeds can be serious threats to crops. Chemical companies say the only solution is to spray pesticides regularly. However, chemicals may cause more problems than they solve. Sustainable farming works with nature to keep crops, pests, diseases, weeds, and soil life in balance.

Key Steps to Plan and Implement an Effective Corrective Action System

- ✓ Understand System Requirements (Plan)
- ✓ Plan the Process (Plan)
- ✓ Develop and Document (Do)
- ✓ Conduct Training (Do)
- ✓ Implement (Do)
- ✓ Test the System (Check)
- ✓ Adjust and Improve (Act)

Self-Check –4	Written test

Name…… ID…… Date…

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

Test I: Short Answer Questions

1. Explain the requirements of taking correctives action (10 pts)

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

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

LG #55	LO #6- Determine requirements of seed crops

Instruction sheet

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

- Undertaking soil moisture measurement and assessment
- Calculating water requirements
- Assessing nutrient requirements and availability
- Assessing soil and plant inputs and treatments
- Monitoring cropping programs
- Documenting relevant data
- Identifying factors affecting crop capacity
- Implementing sustainable land management

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:

- Undertake soil moisture measurement and assessment
- Calculate water requirements
- Assess nutrient requirements and availability
- Assess soil and plant inputs and treatments
- Monitor cropping programs
- Document relevant data
- Identify factors affecting crop capacity
- Implement sustainable land management

Learning Instructions:

2. Read the specific objectives of this Learning Guide.
3. 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”.

1.1. Undertaking soil moisture measurement and assessment

Soil water

One of the most important functions as soil performs for growing horticultural crops is catching water during period of rain fall and storing it for the plant to use it at alter time. The process of soil water storage and movement can be very complex and highly mathematical. However, general understanding of process is essential in order to make decisions about what management and land nose problem. Hence, knowledge of the factors and processes controlling movement and storage of water in the soil is après request in agricultural crop production.

Soil water content

Soil water content refer to amount of water present in the soil. The soil water content expressed in two ways;

I. Based on its quantity

II. Based on its energy or potential

Quantitively soil water can be expressed on;

Mass basis-which refers the mass of water per unit mass of soil, is calculated as;

Om = mass of wet soil—mass of oven dry soil/ Mass of oven dried soil

Or

=mass of water/ Mass of oven dried soil

Where;

Om=mass wetness or gravimetric water content (g/g, kg/kg)

Mw=mass of water (g/g, kg/kg)

Ms =mass of oven dried soil (g/g, kg/kg)

Volume basis, which refers to the volume of water per unit volume of soil, can be calculated as;

$$O_V = \frac{\text{Volume of water}}{\text{Total soil volume}}$$

$$O_v = V_w / V_T$$

Where;

Ov = voltimetric water content (L3/L3)

Vw = volume of water (L3)

VT= total soil volume

Relationship between Qv and Qm;

$$Qv = Qm \times Pb / Pw$$

Where;

Pb and Pw are soil bulk density and water density respectively.

$$Pb = \frac{\text{mass of oven dry soil}}{\text{Total soil volume}}$$

Self-check 1	**Written test**

Name…… ID…… Date…….

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

Information Sheet 2- Calculating water requirements

Short Answer Questions

1. Assume the soil sample was collected from field for water content determination and the following data were recorded (6pts).

Mass of wet soil = 100g

mass after oven dry = 80g

Total soil volume = 70cm3

Calculate

1. Gravimetric water content
2. Bulk density of the soil
3. Volume wetness or volumetric water content`

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

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

2.1. Calculating water requirements

2.1.1. Water requirement of crops

There are important terminologies used to describe crop water requirements. They are; Evapotranspiration (ET); The combined process by which water is transferred from the earth's surface to the atmosphere. It is the combination of two processes;

Evaporation; from wet soil surfaces, lakes, rivers, oceans, etc.

Transpiration; from plant tissue through stomata to the atmosphere. When water supply is not limiting, the level of ET is largely related to the evaporative demand atmosphere imposed by the climate. For given crop it is also determined by; The crop itself and so its growth characteristics, Soil and soil water condition (such as water availability, hydronamic- properties, etc.).

Potential Evapotranspiration (PET); the maximum level of evapotranspiration induced by the climatic conditions. There is no limiting factor concerning the crop (effective full ground cover and optimal development), optimum availability of water, and optimum agronomic management. Reference crop Evapotranspiration, ET0; ET from an extended surface of 8 to 15cm tall green grass cover of uniform height, actively growing, completely shading the ground and not short of water. Maximum Evapotranspiration, ETm; represents the rate of maximum evapotranspiration of health crop grown in large field under optimum agronomic and irrigation management

Actual Evapotranspiration, ETa; the ET of given crop under the prevailing moisture conditions at that moment. This mean that the crop water requirements can full be met or not from the available water supply.

The water requirement of crop is calculated by the following formula

$$Pe = Pt-R-DP$$

Where

Pe =water requirement of crop or consumptive use (mm or cm)

Pt = total precipitation (mm or cm)

R = surface run off (mm or cm)

DP = deep percolation (mm or cm)

In agricultural crop production rain fall that considered of less value includes;

High intensity or large3 amount per unit time

Rain fall on already wet soil.

Irrigation water requirement (WR)-the depth of water needed to meet the water loss through ET of a disease-free crop growing in large fields under non-restricting soil conditions including soil water and fertility and achieving full production potential under the given growing environment. It is referring to the amount of water required to raise a successful crop in a given period.

Self-Check – 2	**Written test**

It can be formulated as;

WR = E+T+IP+Wm+Wu+Ws or

WR = ET+Wm+Wu+Ws or

WR = CU+Wu+Ws

Where;

WR -water requirement of crop cm

E = evaporation from field, cm

T = transpiration by crop plant, cm

IP = intercept precipitation by the crop that gets evaporated, cm

Wm =water metabolically used by crop to make their body weight, cm

Wu = un avoidable water loss during application, cm

Ws=water applied for special operation, cm

ET =evapotranspiration from field, cm

CU = consumptive use of water by the crop (ET+Wm), cm

Name…… ID…… Date…….

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

Short Answer Questions

1. Define the following terms? (5 pts.)
   A. Evapotranspiration
   B. Evaporation
   C. Transpiration;

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

Information Sheet 3- Assessing nutrient requirements and availability

3.1. Assessing nutrient requirements

When Horticultural crops are harvested, the nutrients that have been absorbed are removed; therefore, it is important that the nutrients are replaced and are available for

the next plants. This can be achieved by the application of chemical (inorganic) fertilizers, organic fertilizers or with organic manures (FYM and slurry).

Soil to produce enough yield, it must have adequate supply of all essential elements/nutrients. Out of 92 naturally occurring chemical elements16 are essential elements. All these elements are not required for all plants, but all can be essential for one plant or another.

Plant nutrients are classified in to two

1. Essential plant nutrients
2. Beneficial plant nutrients

1. Essential plant nutrients

Essential nutrients are required for plants to complete normal growth, development and reproduction.

- Seventeen elements are considered to have met the criteria for designation as essential plant nutrients.
    - Macronutrients (>0.1%)
    - Micronutrients (<0.01%)
- Carbon, hydrogen, and oxygen are derived from **air** or **water.**
- The other 14 are obtained from **soil** or **nutrient solutions**

Commonly, for an element to be an essential nutrient, it must fit certain criteria.

1. The plant cannot complete its life cycle (seed to new seed) without it.
2. The element's function cannot be replaced by another element.
3. The element is directly involved in the plant's growth and reproduction.
4. Most plants need this element to survive.

Essential elements are divided in to two on the bases of their quantity required by plants but all are equally important. Essential elements used by plants in large amounts are called macronutrients and those, which are used in small amounts, are micronutrients.

It is possible to split the nutrients required by plants into major elements and trace elements

Major elements	Trace elements
• Nitrogen	Boron
• Phosphorus	Zinc
• Potassium	Copper
• Sulfur	Iron
• Magnesium	Chlorine
• Calcium	Manganese
	Molybdenum

We can classify Macronutrients in to Macronutrient and Micronutrient.

- Macro nutrients: - are required in large amount by the crop plants and they are also divided in to two Primary and Secondary Macro-Nutrients
    - Primary macro nutrient
      Nitrogen (N), Phosphorus (P_2O_5) and Potassium (K)
    - Secondary macro nutrient
      Calcium (Ca), Magnesium (Mg) and Sulfur(S)
- Micro nutrients
      Boron (Bo), Zinc (Zn), Copper (Co), Iron (Fe), Chlorine (Cl), Manganese (Mn) & Molybdenum (Mo).

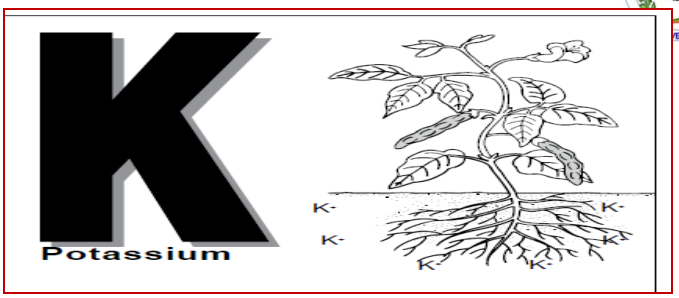
Major elements

Nitrogen:

Nitrogen this nutrient is supplied by fertilizers and organic manures. Farmers use legumes e.g. clovers, peas and beans for source of nitrogen because they have 'nodule rhizobium bacteria' which fix nitrogen in the air. Nitrogen is also produced naturally by bacteria, which decompose composts. Nitrogen is lost from soils through denitrification by different bacteria. Leaching also washes the element from soils.

One of the key soil nutrients is nitrogen (N). Plants can take up N in the ammonium (NH_4^+) or nitrate ($N0_3$-) form.

Potassium:



Fertilizers and manures supply potassium. Mineralization of rocks also releases potassium to soils. The potassium content of normal, health plant tissue can be in the range of 1 to 4%

- Potassium (K) is one of the 17 essential elements to all forms of life.
- Seventh most abundant element in the Earth's crust Yet only 1-2% is available
- Potassium: plays a major role in the metabolism of the plant, and is involved in photosynthesis, drought tolerance, improved winter hardiness and protein synthesis.
- Potassium is the third most commonly supplemented macronutrient.
- Plants that are deficient in potassium may exhibit reductions in yield before any visible symptoms are noticed.
- The potassium deficiency symptoms include yellowing of the margins and veins and crinkling or rolling of the leaves.
- An excess K, meanwhile, will result in reduced plant uptake of magnesium, due to chemical interactions
- changes.

Sulphur

Sulphur is supplied by fertilizers, manures and rain water.

Sulfur is essential nutrient, highly reactive, existing in six oxidation states and moving among the lithosphere, hydrosphere and atmosphere.

- Chemically, sulfur can react as either an oxidant or aNative sulfur crystal reducing agent.
- The sulfur in soils was derived from the weathering of plutonic rocks
- Sulphide in the primary minerals were released and oxidized to sulphate during the weathering process.

- Sulfur is a constituent of the amino acids methionine, cysteine, and cystine, its deficiencies results in serious human malnutrition
- Sulfur is a constituent of vitamins biotin, thiamine (vitamin B1)
- Many enzymes that regulate photosynthesis and nitrogen fixation contain sulfur

Calcium

- Calcium and magnesium are the two most abundant cat ions on the exchange complex in most soils
- These elements influence all ecosystems through their critical role in counteracting soil and water acidification
- These nonacid cations play three important roles:
  - ✓ Enhance pH buffering capacity
  - ✓ Lower the levels of acid cation saturation
  - ✓ Use as liming material to raise the pH of acid soils
- They are especially important in helping plants overcome a wide range of environmental stress.

Magnesium

- It is important component of chlorophyll and intimately involved in photosynthesis.
- Plays critical role in synthesis of oils and proteins.
- Activate enzymes that involve in energy metabolism
- The Mg^{+2} forms a bridge connecting ATP molecules
- Plants take up magnesium in its ionic form Mg^{+2}, which is the form of soluble Mg in the soil solution

Forms of micronutrients in the soil solution

Micronutrient	**Dominant soil solution forms**
Iron Manganese Zinc Copper	Fe^{2+}, $Fe(OH)_2^{+}$, $Fe(OH)^{2+}$, Fe^{3+} Mn^{2+} Zn^{2+}, $Zn(OH)^{+}$

Molybdenum Boron Nickel Chlorine Cobalt	Cu^{2+}, $Cu(OH)^{+}$ MoO_4^{2-}, $HMoO_4^{-}$ H_3BO_3 Ni^{2+}, Ni^{3+} Cl^{-} Co^{2+}

2. Beneficial nutrients

Beneficial nutrients are important for some plant growth, they are not absolutely essential for all plants, but may be beneficial for certain plants. Examples: Al, Co, Na, and Si

a. Why aluminum (Al), Cobalt (Co), Sodium (Na), and Silicon (Si) are beneficial to plant growth?
b. Aluminum stimulates the growth of tea (Camellia sinensis) but the reason is unclear
c. Cobalt is a micronutrient required indirectly by some plants. Example legumes (beans, peas, and related plants) live symbiotically with bacteria called Rhizobium. Rhizobia need cobalt for N_2 fixation.

Self-Check – 3	**Written test**

Name…… ID…… Date…….

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

Short Answer Questions

1. List primary macro nutrient? (3pts)

2. List secondary macro nutrient? (2pts)

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

Information Sheet 4- Assessing soil and plant inputs and treatments

4.1. Fertilizers and their efficient use

Fertilizers supply plant nutrients or amend soil fertility. Some fertilizers either mineral or organic can be used directly as plant nutrients, but most must be chemically processed in order to adapt them to plant needs. The amount of fertilizers to be applied should be based on diagnostic methods, e.g. graded according to the contain of available nutrients in the soil. Another approach is by plant analysis that can reveal hidden minimum factors.

4.2. Diagnosis of fertilizer requirement

Rate of fertilizer application sometimes based on local practical, but it is not very effective nor economic. Therefore, it remains necessary to ace nutrient status of soils and plants in order to provide guidelines for effective fertilizer use.

Method of diagnosis

Optical (plant observation)

-extent of deviation from full green color

-Identifiable deficiency symptoms

-Growth difference compared with plots without fertilizer

Chemical

-soil testing (contents of available nutrients)

-plant testing (leaf or plant extract)

4.3. Types of Fertilizers

Fertilizer refers to any compound that contains one or more chemical elements, organic or inorganic, natural or synthetic, that is placed on or incorporated into the soil or applied to directly onto plants to achieve normal growth. The main supply sources of plant nutrients include organic manures, plant residues, biological nitrogen fixation and commercial inorganic fertilizers. The type of fertilizers that are most commonly used for crop production in Alberta are chemical fertilizers.

Chemical fertilizers refer to commercially manufactured products containing a substantial amount of one or more plant nutrients. The chemical fertilizers can be broadly classified into: nitrogen, phosphorus, and potassium fertilizers. A straight fertilizer contains only one of the nutrients. A compound fertilizer contains two or more nutrients. A complex fertilizer that is formed by mixing ingredients that react chemically,

as opposed to a mechanical mixture of two or more fertilizers. Types of popular chemical fertilizer products used in Western Canada and, average nutrient contents are indicated in Table 2.

Table 4.1. Percentage of Nutrients in Selected Fertilizers

	Analysis	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Sulphur (S)
Nitrogen Fertilizers					
Urea	46-0-0	46	0	0	0
Ammonium Nitrate-(Granular)	34-0-0	34 0	0	0	
Ammonium Sulphate -Urea	34-0-0	34	0	0	11
Ammonium Sulphate	21-0-0	21	0	0	24
Anhydrous Ammonia (gas)	82-0-0	82	0	0	0
Urea-Ammonium Nitrate Solution	28-0-0	28	0	0	0
Phosphate Fertilizers					
Mono-Ammonium Phosphate	12-51-0	12	51	0	1.5
Mono-Ammonium Phosphate	11-55-0	11	55	0	0
Ammonium Polyphosphate Solution	10-34-0	10	34	0	0
Nitrogen Phosphates					
Ammonium Phosphate Sulphate	16-20-0	16	20	0	14
Ammonium Nitrate Phosphate	23-23-0	23	23	0	0
Ammonium Nitrate Phosphate	27-14-0	27	14	0	0
Urea Ammonium Phosphate	27-27-0	27	27	0	0
Urea Ammonium Phosphate	34-17-0	34	17	0	0

Potash Fertilizers					
Potash Chloride	0-0-60	0	0	60	0
Potassium sulphate	0-0-52-12	0	0	52	12
Sulphur Fertilizers					
Ammonium Sulphate	20-0-0-(24)	20	0	0	24
Gypsum (agricultural)	0-0-0	0	0	0	17
Elemental Sulphur*	0-0-0	0	0	0	90-99
Ammonium Thiosulphate Solution	12-0-0-(26)	12	0	0	26

All fertilizers must show the guaranteed nutrient analysis on the label. This states the content of three main nutrients: nitrogen, phosphate (P_2O_5) (a form of phosphorous) and potash (K_2O)(a form of potassium). It is shown by a series of three numbers. For example, if the numbers 10-10-10 appear on a 30 kg bag of fertilizer it means that the bag contains 10 per cent of each raw material (3 kg of nitrogen, 3 kg of phosphate and 3 kg of potash).

Self-Check – 4	Written test

Name…… ID…… Date…….

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

Short Answer Questions

1. List soil nutrient diagnosis methods? (2)

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Information Sheet 5- Monitoring cropping programs

5.1. Monitoring cropping programs

Cropping program include;

- Inter cropping
- Crop rotation
- Multiple cropping
- Mixed cropping

For evaluation of their effectiveness and future best practice, cropping program has to be monitored. From this one can easily understand that these cropping programs effective or not for future practice.

Self-Check – 5	**Written test**

Name…… ID…… Date…….

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

Write true if the statement is correct and false if its incorrect

1. If the data store fails, each farm server can run off the data in its Local Host Cache indefinitely (provided it can contact the license server).(2pts)

2. To restore a backup database or migrate to a new server, use the migrate command. (2pts)

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

Information Sheet 6- Documenting relevant data

6.1. Documenting relevant data

It is the result of the past record agriculture becomes a research today. Therefore, in horticultural crop production documenting relevant data used in future to evaluate effectiveness horticultural crop management and for continual analysis.

The documentation may include;

- Horticultural cropping type
- Climatic condition
- Input used
- Cropping management
- Yield per hectare

Self-Check – 6	**Written test**

Name…… ID…… Date…….

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

Short answer

1. List the important of documenting relevant data? (3)

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

Information Sheet 7- Identifying factors affecting crop capacity

7.1. Identifying factors affecting crop capacity

Factors that affect total horticultural crop capacity in an agricultural crop production are;

- Climatic

- Irrigation availability
- Soil types (sand soil, clay soil, loam soil, etc.)
- Pests (pathogen, insects, weeds, etc.)
- Topography (slop of land, i.e. steeply slop, medium, etc.)
- Soil and plant nutrient status (nutrient availability of soil)
- Paddock history
- Drainage (water holding capacity of soil)

Self-Check – 7	**Written test**

Name…… ID…… Date…….

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

Information Sheet 8- Implementing sustainable land management

Short answer

1. List factors affecting horticultural crop capacity? (10)

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

8.1. Implementing sustainable land management

For sustainable agricultural production, sustainable land manage has to be implemented in order to supply available nutrients. This is achieved through;

Soil amendment (manuring, applying fertilizer, composting, etc)

Reclaiming Soils: acidic, saline and alkaline soils must be improved for production of plants

Acidic soils can be improved by liming ($caco_3$) and organic fertilizer

Saline and alkaline soils can be reclaimed by drainage and using gypsum (CaSO4), sulfur, molasses and adopting sustainable soil practices by adding organic manures, mulching and suitable plant rotation.

Integrated nutrient management

Adequate plant nutrient supply improves food production and sustains livelihood. Nutrient management practices have been developed, but in most of the cases farmers are not applying recommended rates of fertilizers. They are not affordable by them. Therefore, integrated use of organic manures, crop residues, and bio fertilizers etc. with inorganic fertilizers fulfills plant nutrients required by various cropping systems.

The principle of integrated nutrient management is to maintain or adjust optimum plant nutrient supply from all possible sources of plant nutrients to achieve the required plant production. This is important in plant nutrient use efficiency and maintaining soil quality in terms of physical, chemical and biological properties.

Self-Check – 8	**Written test**

Name…… ID…… Date…….

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

Short answer

1. Define sustainable land manage has to be implemented?(3)

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

Operation Sheet 1– Undertaking soil moisture measurement

Objectives;

- To familiarize the learner with soil moisture measurement

- To prepare materials, tools and equipment for soil moisture measurement

Material required

- Oven dry
- Spade
- Bags
- Sensitive balance/analytical balance

Procedures

Step 1. Measure the small area

Step 2. Pour measured quantity of water in tank of sprayer (water)

Step 3. Spray the area uniformly with pump and nozzle tube used for spray.

Step 4. Measure the leftover water in tank (water.

Step 5. Calculate the amount of water actually used for spraying the plot+

LAP TEST	**Performance Test**

Name……. ID…… Date……

Time started: _____ Time finished: _____

Instructions: Given necessary information, work site, tools and materials you are required to perform the following tasks within 4: hour.

Task 1 perform soil moisture measurement.

LG #56	LO #7- Determine pest control

Instruction sheet

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

- Assessing evidence of pests and disease
- Determining integrated control measures
- Monitoring pest levels
- Modifying control program
- /dentifying areas of weed infestation

Learning Instructions:

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

Information Sheet 1- Assessing evidence of pests and disease

1.1 Assessing scope and size of the infestation

Required terminology

Scouting: - means observing orchard and plant conditions in order to gain information about the visible signs and symptoms of pests and diseases.

Symptoms: the external and internal reactions or alteration of plant because of attack of disease.

Sign: is the pathogen or its part or product seen on diseased plant.

Threshold: A boundary, where something starts or ends.

1.1.1. Identification Techniques for Insect Pests

Insect Sampling

Insect sampling is also sometimes referred to as scouting or monitoring. Why is sampling for pest and beneficial insects so important? Because it is of utmost importance for farmers and pest managers to understand insect activity in their crops and fields before they can make cost-effective and environmentally sound pest management decisions. Remember the underlying concept of Integrated Pest Management (IPM) is that no action is taken against a pest unless the pest is present and poses a threat to the crop. Thus, the main objectives of insect sampling (pest and beneficial) are to:

- Detect species that are present
- Determine their population density
- Determine how they are distributed in the field

Insect Identification

You most likely learned about the Linnean system of classifying organisms back in grade school. To review, insects are in the animal Kingdom and belong to the arthropod Phylum. Arthropods have external skeletons, jointed bodies and limbsand, in addition to insects, include crabs, lobsters, spiders, mites, centipedes and millipedes.

Insect arthropods are in a separate Class called Insecta distinguished from other arthropod classes by having three distinct sections: the head, thorax, and abdomen (Fig. 5). Insects can also be distinguished as having three pairs of legs attached to the thorax, and a pair of antennae on the head with some rare exceptions. Most insects have wings in the adult stage but again there are some exceptions.

At minimum insect pests must be identified to Order to select an appropriate, approved insecticide if needed. This is because approved biological insecticides like *Bacillus thuringiensis* have specific activity against certain insect orders, like Lepidoptera, Coleoptera and Diptera. But identification to species is required for other biological

insecticides like the insect granulosis and nuclear polyhedrosis virus products that are species specific.

But, whenever possible, key insect pests and beneficials should be identified down to the species level. Why? Because it is often the case that species within the same family and even genera will exhibit greatly different behaviors and may even have different host plants and natural enemy complexes. An identification to species will enable the gathering of all pertinent information about the species that can be used to formulate an effective management strategy.

Taxonomists to identify and classify insects including wing number, wing shape and venation, structure of antennae, legs or tarsi, mouthparts, and internal structures like genitalia, use many different insect characteristics. You are in luck that a course on insect taxonomy is well beyond the scope of this article. However, with some practice and knowledge of available resources you will soon become an “expert” at identifying insects in your field.

1.1.2. Identifying disease disorders.

When a pathogen is found on a diseased plant, the pathogen is identified by reference to special manuals; if the pathogen is known to cause such a disease, and the diagnostician is confident that no other causal agents are involved, and then the diagnosis of the disease may be considered completed. If, however, the pathogen found seems to be the cause of the disease but no previous reports exist to support this, then the following steps are taken to verify the hypothesis that the isolated pathogen is the cause of the disease:

1. The pathogen must be found associated with the disease in all the diseased plants examined.
2. The pathogen must be isolated and grown in pure culture on nutrient media, and its characteristics described (non-obligate parasites), or on a susceptible host plant (obligate parasites), and its appearance and effects recorded.

3. The pathogen from pure culture must be inoculated on healthy plants of the same species or variety on which the disease appears, and it must produce the same disease on the inoculated plants.

4. The pathogen must be isolated in pure culture again, and its characteristics must be exactly like those observe.

According to pests' damages to crops, pests can be divided into two types.

Economic pests mean pests cause a crop loss of about 5-10%, or even more in a definite field.

Non-economic pests mean pests cause a crop loss of less than 5% in a definite field.

Plant Pests: Plant pests are organisms that cause damage crops/plants by feeding and / or reproductive habits lead to a reduction in the quantity and quality of the crop produced. It includes insects, diseases, weeds, rodents, birds, and mammals.

Plant Disease: A plant disease can be described as an impairment of the plant's physiological functions through organisms such as fungi, bacteria or viruses. It is a harmful alteration of the normal physiological and biological development of a plant. Plant diseases are classified as biotic or abiotic.

Abiotic diseases: Abiotic diseases are caused by adverse environmental conditions, nutritional deficiencies or excesses, genetic defects and incorrect cultural practices. Abiotic diseases are best treated through prevention, which implies sound cultural and production management practices.

Beneficial organisms: In agriculture, beneficial organisms are organisms that contribute positively by their habits, for example by feeding on pest organisms or by pollinating flowers to enable fruit development. In other word, beneficial organisms are volunteer or cultivated plants, insects, spiders and microorganisms that out-compete and/or parasitize or predate on the pests and disease relevant to the IPM program.

1.2. Insects

Insects are a small animal which belongs to Anthropoid phylum; their body part is divided into three sections, head, thorax and abdomen. Their small size, remarkable

range of adaptation, rapid rate of reproduction, great mobility and efficient water conservation enable them to colonize nearly every habitat, including all the types in which crop production takes place. These features of insects contribute towards making their control of paramount importance to the farmer. Some insects are beneficial as pollinators of flowers and as predators which feed on destructive insects. Other types of insects are directly harmful as pest of crops, as carriers of diseases and as destroyers of stored food. Insect damages on crops can be direct or indirect damages. The direct damages of insects are leaf defoliation, distraction growing points, boring tunneling of the stem of the plants, suck for the phloem sap. Indirect damages of insects may be transmitting diseases from crops to crops.

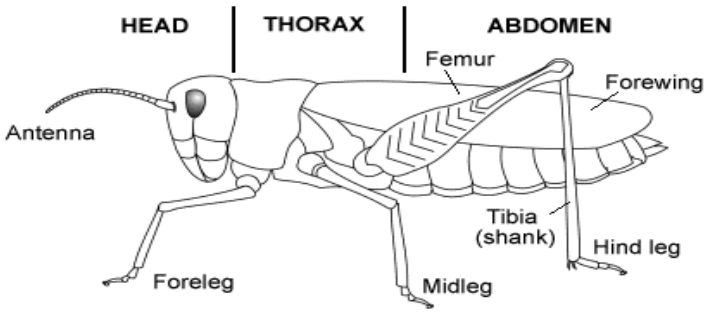
1.2.1 External structure of insect

Common features

All adult insects have two physical characteristics in common. They have three pairs of jointed legs, and they have three body regions -- the head, thorax, and abdomen.

Head

The head has antennae, eyes, and mouthparts. Antennae vary in size and shape and can be a help in identifying some pest insects. Insects have compound eyes made up of many individual eyes. These compound eyes enable insects to detect motion, but they probably cannot see clear images.



Anatomy of Grass hopper

The four general types of mouthparts are: Chewing-biting, piercing-sucking, sponging, siphoning.

Chewing mouthparts contain toothed jaws that bite and tear. Cockroaches, ants, beetles, caterpillars, and grasshoppers are in this group.

Piercing-sucking mouthparts consist of a long slender tube that is forced into plant or animal tissue to suck out fluids or blood. Insects with these mouthparts include stable flies, sucking lice, bed bugs, mosquitoes, true bugs, and aphids.

Sponging mouthparts are tubular tongue-like structures with a spongy tip to suck up liquids or soluble food. This type of mouthpart is found in flesh flies, blow flies, and house flies.

Siphoning mouthparts are formed into a long tube for sucking nectar. Butterflies and moths have

1.2. 2. Life Cycles of Insects

Most insect reproduction results from the males fertilizing the females. The females of some aphids and parasitic wasps produce eggs without mating. In some of these insect species, males are unknown. A few insects give birth to living young; however, life for most insects begins as an egg. The series of changes through which an insect passes in its growth from egg to adult is called **metamorphosis**. There are two types of metamorphosis: incomplete and complete.

Incomplete metamorphosis: Insects in this group pass through three different stages of development before reaching maturity: egg, nymph, and adult. The nymphs resemble the adult in form, eat the same food, and live in the same environment. The wings become fully developed only in the adult stage. E.g. locust, aphid, etc

Complete metamorphosis: The insects with complete metamorphosis pass through four stages of development: egg, larva, pupa, and adult. The young, which may be called larvae, caterpillars, maggots, or grubs, are entirely different from the adults. They usually live in different situations and in many cases feed on different foods than adults. Examples are the beetles, butterflies, flies, mosquitoes, fleas, bees, and ants.

Insect's classification categories

Insect's classification categories are: kingdom, phylum, order, family, genus, and species. An example of the classification of an insect:

Musca domestica (housefly)

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Diptera
Family	Muscidae
Genus	Musca
Specific	Domestica

1. 3. Plant diseases

The concept of plant diseases

In plants, then, a pathogenic agent or environmental factor and leads to the development of symptoms can define disease as the malfunctioning of host cells and tissues that results from their continuous irritation. For a disease to occur three conditions have to be fulfilled at the same time. This is commonly known as disease triangle.

- A virulent pathogen should be present
- A plant should be susceptible
- The environment should be suitable

If one of the three appears late, or early or missing, the disease will not occur. Therefore, any practice, which disturbs any of the three conditions or break the triangle, will be considered as a disease management method.

Significance of plant diseases

Plant diseases are significant of humans because they cause damage to plants & products. The major effects of plant disease include:

- May limit crop choice
- Reduce the quantity & quality of products in the field & during storage.
- Increase the cost of production

- Cause economic loss to growth
- Increase prices of crop for consumers
- Destroy the beauty of nature
-

Plant disease can be classified in different ways:

- On the basis of their occurrence on the plant (Localized /systemic)
- On the basis of their mode of perpetuation (seed, soil or airborne)
- Based on the symptoms they caused (rust, blight, wilt...)
- Type of plants affected (cereal, coffee , forest diseases etc)
- Plant organs they affected (Root, stem, fruit or foliage diseases)
- Occurrence & spread (Endemic, Epidemic, sporadic, pandemic diseases)
- On the basis of major causal agent

- Infections - Biotic (fungi, bacteria, virus, Nematode..)
- Non- infectious - Abiotic (climatic factors, mineral toxicity air pollination, cultural practices...)

1.3.1. Causes of plant diseases

A. Infectious/biotic plant disease

Infectious diseases are plant diseases those caused by biotic organisms. They grow and multiply in host, and transmit from one plant to other plant. These include:

- Diseases caused by fungi
- Diseases caused by prokaryotes(bacteria and mycoplasmas)
- Diseases caused by parasitic higher plants
- Diseases caused by viruses and viroids
- Diseases caused by nematodes

B. Non-infectious/abiotic diseases

Noninfectious diseases are diseases those are caused by non living, environmental factor. Non-infectious disease is sometimes termed as **disorders**. They are characterized by:

- Occurred in the absence of the pathogen (no sign of disease);

- Can't transmit from diseased plant to the healthy plant;
- Infect the plant in all stage (seed, seedling, and mature plant);
- Distribute evenly in the field (no diseases center, no disease developing factors.)

The following factors will cause noninfectious diseases:

- Too low or too high a temperature, e.g. scorching, freezing;
- Injury by air physical phenomena , e.g. wind, rain, thunder;
- Lack or excess of water or moisture in soil or air e.g. drought, water logging.
- Diseases caused by chemical factors:
- Lack or excess of nutrient element;
- Air pollution;
- Misuse of pesticides or chemical products;
- Improper cultural practices.

1.3.2. General characteristics of plant disease pathogens

I. Bacteria

Definition: Any of the unicellular, prokaryotic microorganisms of the class Schizomycetes, which are unable to make their own food, reproducing by fission. The majority of bacteria are strict saprophytic.

Shapes: Most plant pathogenic bacteria equipped with thread-like flagella

1. Rod-shaped
2. Spherical
3. Spiral § § §
4. Comma ,,,

Reproduction: by fission, every 20 minutes once, multiply very quickly and migrate throughout the plants very quickly.

Dissemination:

- By transporting diseased plant materials.
- By animals such as insects, birds.
- By splashing rains or wind-blown dust.

Penetration: entering crops though wounds and small natural openings (such as stomata and hydathodes)

Damage: secreting toxins, which kill host cells, causing cells grow abnormally or break down crop tissues.

Table 1.1. Some of pathogenic genera of bacteria

	Shapes	Signs	Symptoms
Pseudomonas	Rod-shaped, one or more polar flagella	White or yellow colonies	Wilt, leaf spot
Xanthomonas	Rod-shaped, polar flagella	Yellow colonies	Wilt, rot, leaf, leaf spot
Agrobacteria	Rod-shaped, peritrichous flagella	White, rarely yellow colonies	Gall
Erwinia	Rod-shaped, petitrichous flagella	White/cream or yellow colonies	Soft rot, die-back, leaf spot

Identification of bacteria

- ✓ Cell shape.
- ✓ The number and arrangement of flagella.

II. Fungi

Any of numerous eukaryotic organisms of the kingdom Fungi, which lack chlorophyll and vascular tissue and range in form from a single cell to a body mass of branched filamentous hyphae that often produce specialized fruiting bodies. Most of the species are strictly saprophytic, only a few species attack living plant when temperature and moisture conditions are favorable.

Penetration:

- ✓Through wounds and natural openings.
- ✓By forcing their way directly though the plant's protective epidermis.

Dissemination:

- ✓By air currents, splashing rains to transport spores.
- ✓By animals such as birds, insects or mites.
- ✓By diseased plant materials.

✓By farmer's hands, clothing and equipments.

Identification of fungi:

- ✓ Spores: shape, size ,manner and arrangement of spore on the sporophore.
- ✓ Fruitification or spore-bearing structure.

Common diseases caused by fungi: Leaf rust, wilt, galls, stem blight, scabs and others.

III. Viruses

Any of various simple submicroscopic parasites of plants, animals, and bacteria that often cause disease and that consist essentially of a core of RNA or DNA surrounded by a protein coat. Unable to replicate without a host cell, viruses are typically not considered living organisms.

Basic structures: viruses consist of nucleic acid (5-40%) and protein coat (capsid, 60-95%)

- Nucleic acid consists of RNA or DNA, but not both.
  1. Most plant pathogen viruses consist nucleic acid with RNA.
  2. Nucleic acids are the main element for infection.
  - Coat protein are proteins surrounded the nucleic acid, protecting the nucleic acid from external damage.

Reproduction: Viruses can't reproduce by their own, but reproduce by incorporating their nucleic acid into the nucleic acid of a plant cell---interfering with normal cell division and growth of the host plants.

Symptoms:

- ✓ Yellow to light-or dark-green mottling.
- ✓ Stunting or excessive growth.
- ✓ Early leaf-fall or loss of vigor.

Penetration: Plant viruses enter cells only though

- ✓ Wound made mechanically.
- ✓ By vectors especially aphids and leafhoppers.

Dissemination: Viruses are transmitted from plant to plant by:

- Vegetative propagation, e.g. by budding, grafting.
- Mechanically though sap.

- Seeds, pollens, insects, nematodes and other animals.

As for insect vectors, there are two kinds of transmission.

1. **Non-persistent transmission** (e.g. pepper mottling virus)
   - ✓ The acquisition period is short.
   - ✓ The inoculation period also short.
   - ✓ No incubation period in the insect.
2. **Persistent transmission** (e.g. potato leaf rot virus)
   - ✓ Acquisition period is long.
   - ✓ Inoculation period is long.
   - ✓ There is an incubation period.

IV. Nematodes

It is any of several worms of the phylum Nematoda, having elongated, cylindrical, non-segmented bodies, commonly microscopic, often narrowing at each end.

Reproduction: Nematodes reproduce through laying eggs.

Sexual

- ✓ Sex separate nematodes.
- ✓ Hermaphroditic (both sexes in one nematode)

Asexual: parthenogenetic (eggs produced without fertilization)

Harmful and beneficial roles of nematodes

Harmful roles

- ✓ Feeding on root or underground stems of plants.
- ✓ High population affect the water and nutrients absorption by infecting the roots.
- ✓ The wounds caused by nematodes often act as ‘open doors’ to root-rotting and wilt-inducing fungi and bacteria and some viruses.

Beneficial role: feeding on parasitic fungi, bacteria, and other organisms.

Penetration:

- ✓ Through wounds;
- ✓ Directly penetration by their stylets, by repeated back and forth movement of their stylets creating a small opening in the cell wall.

Dissemination:

- ✓ Spreading by themselves in the soil.
- ✓ Spreading by anything that carry soil particles.
  1. Farm equipments.
  2. Irrigation
  3. Animal feet and others.

Symptoms:

Plant with large population of parasitic nematodes is often express symptoms of drought, nutrient deficiencies such as yellowing of the foliage.

3.5. Diagnosis of plant Disease

A cause is associated to disuse. In strict sense, cause (in pathogen that incites infectious disease and any agent that injures plant) means anything inflict the plant to suffer. Therefore, causal agents are not only those animate in nature but also are inanimate. The animate causes are fungi, viruses, bacteria, nematodes, parasitic higher plants, mycoplasmas and protozoa. The inanimate causes are genetic or physiologic disturbance, soil factors, nutrition deficiencies, climatic condition, chemical factors, etc.

For a person who is to diagnose plant disease, it is prudent to first determine whether the disease is incited by a pathogen or an environmental factor. When typical symptoms of a disease are present for some cases, it is fairly easy for a somewhat experienced person to determine whether the disease is caused by a pathogen or an environmental factor. In most cases, however, a detailed examination of the symptoms and an inquiry into characteristics beyond the previous symptoms is necessary for a correct diagnosis.

General Symptoms and signs of plant Diseases

Disease symptoms are divided in to three general categories:

1. **Necrotic symptoms –** these are those symptoms that result from cessation of function of living tissues, leading to death. Necrotic tissue is dead tissue.
2. **Atrophic or hypoplastic symptoms:-** are those symptoms result from underdevelopment or retardation of function.

3. **Hypertrophic or hyperplastic symptoms:** - these are symptoms result from over development or acceleration of function.

Self-check 1	Written test

Name…… ID…… Date…….

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

Test I: Choose the best answer (10 point)

1. What are the common ways used for assessing pest?

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

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

Information Sheet 2- Determining integrated control measures

2.1. Selecting control measures suitable for the infestation from IPM strategy

2.1.1. Insect pest Control

The control of the various insect pests affecting crop plants is a major problem for crop production. Insect pests may be controlled by means of various cultural practices, the use of chemicals known as insecticide and, biological methods of insect control.

Cultural Methods of Insect Control

Hand picking: for example, fully grown adult grasshoppers and caterpillars of some insects may be partially controlled by hand picking.

Crop rotation: since insects are generally selective in the choice of crops they attack, a rotation of crops can result in a reduction of insect numbers when new crops are planted.

Tillage practices: ploughing harrowing normally reduce the population of soil pest by exposing them to sunlight and desiccation, and to predators and parasites.

Weed control: some weeds act as host to insect pest, timely control of weeds would deprive them of their host.

Adjusting time of planting: it is used to avoid period when insect's population is at its peak. For example sorghum midges can be effectively controlled by planting early so that flowering is complete before the adult midge population reaches damaging levels.

Resistant varieties: pest may also be controlled by planting pests resistant varieties. New varieties, resistant to an increasing number of insect pests have been produced in recent years by the research institute.

Timely harvesting: prompt harvesting is known to help protect maize and beans from damage by maize weevil and bean bruchid.

Observance of a closed season: some pest cannot survive in the absence of a specific host plant. Observing a closed season for the cultivation of this plant provide effective control. A good example is the pink bollworm (*pectinophora gossypiella*) provided no cotton is grown during the closed season, this pest is deprived of a carry-

over site for the next season, with the result that its population is kept below the level at which it causes serious economic loss.

Trap cropping: A trap crop is used to divert the pest from the main crop. The pest usually prefers it to the main crop for feeding or egg laying. The trap crops are grown in strips at appropriate intervals within the field. The pest population concentrates on the trap crop, while the main crop suffers little damage.

Optimum plant density: the biology of both pest and their natural enemies can be affected by plant density. For example, bean fly infestation in kidney bean is less severe in densely planted crops than in thinly planted ones (Abate, 1990) Similarly, populations of aphid *Aphid craccivora* are lower and the spread of rosette virus, of which this insect is a vector, is less rapid on more densely sown fields of groundnut (Farrell, 1976a).

Crop sanitation: cleaning crop fields after harvest and burning crop residues to destroy over wintering pest populations are important cultural practices.

Cropping patterns:

For example intercropping check the spread of pest and is less frequent than in monoculture. Host plant resistance

Host plant resistance works in three major ways:

- Antixenosis
- Antibiosis
- Tolerant plants

- **Antixenosis:** Or non-preference refers to the innate qualities of the plant that render it unsuitable to the insect for ovipositional, feeding and shelter. Examples of antixenonsis are resistance of pubescent varieties to the potato aphid (*Aulacorthum solani*) and to leafhoppers and of nectar less cotton to plant bugs.
- **Antibiosis**: Plants possessing antibiosis have deleterious effects on the pest feeding on them. Seeds of some pulses contain substances that inhibit the growth or reproduction of storage pest.
- **Tolerant plants:** Are those plants that suffer little damage in spite of supporting a pest population capable of inflicting heavy yield losses. Example is the introduction of resistant variety of cotton to cotton leafhopper (*Empoasca lybica*) in some parts of Africa, which relegated it to minor pest status.

Biological Method of Pest Control

Biological control refers to the use of living organisms for the control of pests. It is the use of predators, which feed on harmful insects and reduce their numbers to a minimum. Broadly speaking, biological control also includes the use of pathogens (bacteria, fungi, viruses, protozoan, and nematodes). Biological control using parasites and predators has been effectively utilized in the control of Kenya mealbug (*Planococus kenyae*) by *Anagyrus spp.* Releasing of lady beetle, parasitic insects, frogs, birds, some kinds of bug can control African bollworms.

Wasp

Regulatory method of pest control

Regulatory methods depend on legislation to enforce the quarantine of plant material. The legislation requires that propagating material (seeds, cuttings, whole plant) imported from abroad be accompanied by a phytosanitary certificate stating that they are free from pests and diseases. Materials are inspected by a trained quarantine officer at the port of entry and if dangerous organisms are found the whole consignment may be destroyed.

Insect growth regulators (IGR)

IGR are substances that interfere with the growth and development of insects. These compounds do not kill the insects immediately and thus do not prevent pest damage on a current crop.

Sterile insect technique (SIT)

In SIT, insects (male or female) are mass reared in the laboratory, sterilized (by radiation or chemosterillants) and released in the field. They mate with the wild population and produce sterile progeny. Because of its technicality and high cost, this method has no application in sub-Saharan Africa.

Chemical Method of Insect Pest Control

The most effective method of controlling insect pest is by spraying or dusting crops with insecticides.

2.1.2. Disease control

General approaches to disease control

Disease control refers to disuse or reduction in the incidence or severity of disease and usually concerned with plant populations. Control aspect is desirable only when the cost, in terms of money and effort, is materially less than the loss cause by the disease.

Main control measures are avoidance and exclusion, protection and resistance.

- **Avoidance and Exclusion:** refers to the practice of avoiding disease by planting at times when, or in areas where inocula of the pathogen is ineffective, rare or absent. The main objective in this case is to prevent entry of a disease into an area of field or plant population.
- **Eradication:** reducing, inactivating, eliminating or destroying inocula at the source. Either from a region or from an individual plant in which it is already established. Crop rotation, sanitation, biological control, removal and destruction of susceptible hosts, elimination of alternate and weed host are major control measures in eradication. Good example is the control strategy developed for foot rot disease of faba bean.
- **Protection:** preventing infection by interposing a toxicant or other effective barrier between the susceptible host and the pathogen. Spraying or dusting and modification of the environment are the major protection measure against diseases of legumes is a major method of protection. Chocolate spot of faba bean and *Ascochyta blight* of field pea are controlled by foliar spraying of *chlorothalonil* at the rate of 2.5kg/ha active ingredient at weekly interval.
- **Resistance*:*** altering the effectiveness of the inocula by employing resistant hosts including all techniques that contribute to altering the physiological process, structural nature of habits of individual plant or plant population in order to make them tolerate or resist the infection. This control measure is applicable to almost all plant disease found in most crops although there was no resistant variety of faba beans or field against disease were released up to now.

2.1.4. Integrated Pest Management:

Each control measure is not always effective when used alone. Therefore, there is a general agreement among scientists of any two or more control measures that are compatible to the farming system and each other are advisable. The idea is to live with disease by keeping it below economic threshold level. The mechanism is to methods which reduce (i) the rate disease development=r, (ii) initial inoculum=X_0, and (iii) favorable time=ti for disease development. Because of epidemic is a function of X_0, r and ti.

IPM can be defined as the judicious selection and use of compatible control options to keep pest population below damaging levels. IPM is based on knowledge of the ecology and population dynamics of the pest and its natural enemies. The emphasis here is on controlling pests rather than attempting to eradicate them altogether.

Control measures employed as part of an IPM program may include cultural control, physical control, mechanical control, legislative control, botanical control, biological control, resistance varieties and chemical control. The chemical control measure will be used as the last option where the other control measures will be ineffective in controlling the pests in question.

Physical control:

Physical control measures include barriers, traps, trap crops, tillage, fire, grazing, mowing and adjusting planting location or timing to destroy or evade pests.

Cultural control:

Cultural control measures include farming practices used to reduce persistent pest problems. These activities include using crop rotations, fertilizer practices, cultivation, sanitation and seeding practices (e.g. seed quality, rate, timing. and depth) to decrease the vulnerability of the crop to persistent pest problems.

Biological control:

Biological control measures refer to the use of beneficial living organisms (predators, parasites, insects and diseases) to regulate or suppress pest organisms. Biological control can be achieved either by encouraging natural pest enemies, or by introducing and releasing natural enemies. Currently, very few of these measures are available for western Canadian field crop production.

Chemical control:

Chemical control measures involve the use of conventional pesticides and other chemicals for pest control.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. Explain determining integrated pest control measures (10 pts)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Monitoring pest levels

3.1. Monitoring insect pest and diseases control methods/IPM plan

Insect pests can be monitored in several ways. The most common methods are actually counting the number of insects present or estimating the amount of insect damage. Insect counts usually are expressed as the number of insects per plant or plant part (e.g., number of insects per leaf). Insect crop damage is often expressed as percentage of the plant damaged (e.g., percent leaf defoliation).

Other insect monitoring methods include collecting insects with a sweep net, shaking crop foliage and counting dislodged insects, and trapping insects. Disease monitoring can be accomplished through scouting fields weekly and examining foliage for early disease symptoms. Also, monitoring the weather can indicate when conditions are favorable for disease development. Pest alerts and newsletters provided by MSUE county agents and other MSU personnel indicate pest pressure and outbreaks in the region and state

Once control measures have been applied, it is essential that the efficacy of the application is monitored, both in terms of its impact on targeted pests and diseases and on non-target plants/animals and beneficial insects or external environment. Scouting must continue as per usual after treatments have been made. Monitoring of the controlling methods involves; monitoring the effects of the control methods applied on pests. Monitoring is important to investigate whether there is an environmental problem created due to the application of chemicals during the implementation process.

Sustainable agriculture requires that soil and water quality be maintained. Some farm practices have the potential to cause environmental harm, which may affect rural and urban areas alike. Many of the potential negative impacts of farming can be greatly reduced by the use of Best Management Practices. These are agricultural practices that reflect current knowledge about conserving natural resources and environment without sacrificing productivity.

Monitoring results will help to take action on or adjust the control methods. Depending on the data gathered from the assessment made on the effectiveness and side effect of the implemented control measures, the remedies should be given to make correction in the IPM methods to meet the enterprise specifications. So it proves that the pests and diseases will be controlled effectively, and the damage to non-target organisms will be minimized in the next control.

3.2. Assessing effectiveness of control methods

The effectiveness of a control measure, as distinct from its efficiency, is reflected by the number of pest surviving after treatment, or from a practical point of view amount of damage occurring after treatment. Consequently, any actions, which reduce a pest population, will automatically improve the effectiveness of a control treatment, even the efficiency of that treatment remain unchanged. The kind of action which encourage a pest population build up are destruction of predator & parasites, insufficient, crop rotation, presence of weeds & alternative host in vicinity of the crop, a low standard of hygiene etc.

Monitoring is used to see whether the applied method is effective or not. From the recorded data, it is possible to determine whether there has been a decline in pest level and if this level is now below the action threshold. The recorded and plotted monitoring data would speak for itself. Where it is found that treatments did not have the desired effect, alternative treatments may be considered. It is advisable to consult an expert in this regard, as this may be an indication that the specific pest is resistant to the prescribed treatment. The presence of pest, pest numbers and disease symptoms should be looked at strategic positions in crop field and recorded.

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. Explain monitoring pest levels (10 pts)

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

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

4.1. Selecting treatments for the infestation

Regular field and crop inspection is necessary to detect and monitor the development of infection or infestation of crops in the field. Accurate information about what pests is present, how fast the infections or infestations are spreading and how serious / how much crop damage is being caused is essential if control measures are to be taken as necessary and on time.

The process of crop inspection is called scouting and is carried out by crop scouts**.**

Crop scouts are personnel trained to:

- Examine crops
- Identify pests, diseases and disorders
- Estimate the severity of infection/infestation and or amount of crop damage caused
- Record and report findings

So, you will be expected to be able to carry out crop scouting and contribute to the planning of a control programme as necessary or to train and supervise the work of crop scouts.

4.2. Selecting treatments for the infestation

Control measures or methods may include:

- ✓ Cultural methods
- ✓ Physical methods
- ✓ Biological methods
- ✓ Chemical methods
- ✓ Integrated pest management

Cultural method

Cultural control: is the reduction of pest population by using agricultural practice or it is the practice of modifying the growing environment to reduce the prevalence of unwanted pests and optimal crop growing conditions and unfavorable conditions for pests such as:

- ✓ Fertilization
- ✓ plant density
- ✓ crop rotation
- ✓ time of planting
- ✓ pruning; thinning
- ✓ Trap crops
- ✓ Pruning
- ✓ Thinning
- ✓ Inter-cropping
- ✓ Resistant crop varieties

Biological methods

It is the control of a pest by the introduction of a natural enemy or predator, parasites on an unwanted host or prey population. Natural enemies can be very common in unsprayed fields. When certain pesticides are applied, natural enemies may be killed, removing their control effect on the pest.

Greatest controlling effect natural enemies

- ✓ **Predators**: other organisms that eat the pest such as ladybirds, spiders, lacewings
- ✓ **Parasites:** organisms that must live in or on another organism to complete their life cycle such as parasitic wasps and flies

How natural enemies encouraged

- ✓ Using pesticides only when necessary, particularly early in the season.
- ✓ Using a seed dressing rather than a foliar spray if an early season pesticide is regularly needed
- ✓ Intercropping, border planting, and relay cropping of suitable plants.
- ✓ Leaving refuge habitats in and around the field where natural enemies can shelter and find food.
- ✓ Introducing and releasing natural enemies.

Chemical methods

Chemical control: is the use of chemicals to control, suppress or minimize pests such as

- ✓ Synthetic pesticides

- ✓ Natural pesticides
- ✓ Pheromones
- ✓ Insect growth regulators sometimes included under biological control

Negative or effect of pesticide:

- ✓ Pest may develop resistance to the pesticide.
- ✓ Injury to applicator and others.
- ✓ Impacts on non-target organisms, including natural enemies of pests, pollinators, wildlife, and plants.
- ✓ Environmental contamination, such as residues in food and water.
- ✓ Safety hazards in production, transportation, and storage

Integrated pest management (**IPM**) is a strategy that focuses on long-term prevention of pests or their damage through a combination of all available techniques such as

- ✓ Mechanical
- ✓ Cultural
- ✓ Biological
- ✓ Sanitation or prevention
- ✓ Chemical
- ✓ Application
- ✓ External factors
- ✓ Economic and Decision making

Self-Check –4	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. List the methods of integrated pest managements (10 pts)
2. Explain the impacts of using pesticide (10 pts)

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

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

Information Sheet 5– Identifying areas of weed infestation

5.1. Introduction

Weed: weeds are often called as plants and refer to a plant growing where it is not wanted.

Beneficial organisms: beneficial organisms are volunteer or cultivated plants that out-compete the weed, insects and other non-vertebrates, and microorganisms that attack the weed.

Weed interference with production

- Competing for water, nutrients, light, and space,
- Contaminating the product at harvest,
- Harboring pest insects, mites, vertebrates, or plant disease agents,
- Releasing toxins into the soil that inhibit growth of desirable plants.

5.3. Characteristics of weeds:

The major characteristics of an ideal weed are:

- Germination requirements fulfilled in many environments
- Discontinuous germination is common
- Continuous seed production, and very high seed out put
- Tolerant and plastic
- Dispersal adaptations, and regeneration
- Inter-specifically competition ability
- Morphological similarities with crop plants and seeds
- Deep rooted

5.3. Economic importance of weed

About 300 weed species in agriculture cause serious economic losses in crop production. Losses caused by weeds occur in the field as well as in the storage i.e. from the time of sowing

until consumption. The loss caused by weeds is greater than those losses caused by other pests. The losses caused by weeds may be classified as direct, indirect, and non-agricultural losses. Some of the direct losses are:

- Weeds reduce the quality and quantity of agricultural produce
- Weeds may affect the healthy of animals
- Weeds obstruct water flow in irrigation as well as in drainage canals
- The cost of weed control is high comparing to the cost of other pest control
- Weeds interfere with different agricultural operations (activities)
- Weeds increase loss of water by transpiration

Indirect costs of weeds are:

- Serve as alternative hosts for other pests
- Reduce the economic value of lakes or other water resources, and cause undesirable odors and flavours in the water
- Cause land abandonment, and constitute a fire hazard
- Reduce yield and quality of livestock products, and the value of real estates

The nonagricultural losses are:

- Affect the health of humans
- Impair visibility along roads and railway lines
- Reduce the quality of education

It is not fair to conclude that weeds are always the enemy of any society because various people have used weeds differently.

Some of the positive role of weeds is:

- Erosion protection, and nutrient recycling
- Increase organic matter of the soil, and serve as hosts for useful insects
- Source of food for humans and animals
- Source of drugs, pesticides, fuel, and raw materials for industries
- Provide employment opportunity for transit labour

Self-Check – 5	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. Explain the weed and its infestation (10 pts)

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

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

Information Sheet 6- Selecting integrated control methods

6.1. Methods of weed control in horticultural farm

Methods of weed control in coffee farms are ploughing, hoeing, slashing, mulching, chemical control, and biological control

Ploughing

This practice is undertaken in field where crop is to be planted to eliminate grass weeds. The land (field) is first ploughed at the end of the rainy season and ploughed again during the dry season. So that the roots of grasses and shrubs are brought to the surface and desiccated. Then these roots are collected and burnt.

Hoeing

Hoeing is one of the best methods of controlling weeds in crop farms, hoeing must be done before and after the rainy season; however, care must be taken during hoeing not to damage the feeder roots, which are found 5-25cm below the soil surface. Furthermore hoeing facilitates water infiltration by decreasing runoff and incorporates organic matter into the soil.

Ashing

This is simple method of weed control in crop farm, where weeds are cut back to about 1-2cm from the ground by using a bush-knife (Gegera) before the weed plants set seeds. Depending on existing weed type and its growth intensity, more slashings could be required in a year. However, care must be taken not to damage the stem of the coffee plant during slashing.

Mulching

Mulching is one of the easiest and cheapest methods of weed control in crop farms. Here cut vegetative materials are laid 5cm thick not touching the stem of the crop, around the plant. Mulching helps in preserving soil moisture, controls soil erosion and increases soil fertility.

Shading

Shade suppresses weed growth by blocking sunlight reaching the weed plant. Shading occurs through permanent shade trees or mutual shading from close spaced.

Chemical control

Before planting effective control of grass weeds like Digitaria sclarum (couch grass) and the sedge (Cyprus spp.) could be achieved by the use of herbicides. But if herbicides are to be sprayed after planting care must be taken that not to damage young coffee plants with spray drift.

Integrated pest management (IPM)

Pest management involves reduction, eradication and prevention of pest population.

Management of host involves improving plant vigor, including resistance through nutrition and genetic manipulation and protection by chemical means.

Management of environment involves water, soil and crop management.

The principles of IPM are based on **avoidance, exclusion, eradication, protection** and **host resistance**.

They are stated as follows:-

Avoidance: - is a methods used to avoid pests from establishing themselves in a particular area.

- Planting time adjustment
- Selection of geographic area
- Selection of field
- Using pest escaping varieties
- Selection of pest free seeds for planting

- Modification of cultural practices.

Approaches of integrated pest management

- Use of resistant or tolerant varieties
- Cultural practices
- Soil solariztion
- Biological control
- Botanical agents:- using natural pest control agents that are derived from plants
- Inter cropping
- Trap crop and Judicious selection of chemicals

Self-Check – 6	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

2. List and explain integrated control methods (10 pts).

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

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

Information Sheet – 7 selecting and scheduling activities to comply pest management strategy

7.1. Integrated pest management (IPM) requirements

IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. However, in generally pest problems management's strategies includes:

1) Monitoring activities for the presence and abundance of pests within the grove;

2) Determining whether pest population densities are high enough to cause economic loss;

3) Selection of a profitable, worker safe and environmentally compatible management option. Pesticide application should only be considered after the results of monitoring activities have been completed, and other potential causes of tree or grove decline are evaluated and corrected. In addition, a truly integrated strategy requires consideration of pesticide selection, when the choice exists, prior to application.

Pesticide selection should not be based only on cost effectiveness, but also on toxicity to non-target species, product solubility, persistence, leaching potential, irrigation schedule, soil type, and other site characteristics. Various sources of information are available for characterizing specific soil types and irrigation schedules for predicting and minimizing movement and leaching potential of most citrus agrochemicals.

Once a need for pest control has been established and a chemical has been selected, the grower must decide on rate and timing of application. Agricultural chemicals should be applied only at the labeled or recommended rates. Lower rates applied more frequently combined with sound irrigation management practices can significantly reduce chemical movement. Split applications of pesticides or fertilizers will reduce the amount applied at any one time, thereby

reducing the amount that might be leached at a given time. Controlled release (encapsulated) formulations, when available, also provide the advantage of reduced leach ability.

The timing for application of most pest management/crop production chemicals should be entirely dependent upon pest population biology, abundance, and tree growth periods, and not on the calendar. Applications during the summer rainy season should be avoided whenever possible. In some instances, pests may require treatment during times when rainfall can be expected, but application should be delayed if heavy rainfall is imminent, and subsequent irrigations adjusted to account for rainfall amounts.

Most soil-borne pests are associated with citrus roots. For pesticide applications targeting soil-borne pests and diseases, pesticide efficacy occurs primarily within the zone of application, and to a much lesser degree, due to the systemic activity of these pesticides, within and around roots outside of the zone of application. Since a large majority of fibrous roots grows within the top 24-30 inches of soil and decrease in abundance from the tree trunk to the row middle, pesticide placement to maximize under-canopy coverage is of critical importance. Pesticide placement under the tree canopy can significantly improve overall pest control and minimize leaching by targeting applications to areas of highest fibrous root and pest density. Tree skirts may need to be raised by pruning to improve application equipment access under the tree canopy.

The five elements of integrated pest management include:

- Preventing pest problems;
- Monitoring for presence of a pest problem;
- Establishing tolerable levels based on plant/human health, economic and aesthetic thresholds;
- Treating pest problems to reduce populations below established tolerable thresholds;
- Evaluating the effects and efficacy of pest treatments.

Self-Check – 7	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. Explain the pest management strategy (15 pts)?

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

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

Information Sheet 8- Maintaining severity of infestations and records of treatments

8.1. Assess of the infestation or infection

A successful and sustainable pest management depends on the knowledge of the strategy, pest biology and pest ecology in agroecosystem. Commercial growers prevent and control pests and diseases for optimum plant growth. They choose the most cost-effective management practice to match the type of crop they are growing and market they are supplying. Integrated pest management or IPM is where a grower uses a combination of cultural, biological and chemical methods to prevent or control pests and diseases. This approach came about because pests and diseases have developed resistance to chemicals, and consumers have become concerned about chemical use and residues on fruit and vegetables.

The development of an effective pest control strategy is reliant and contingent on ten pillars including:

- Correct identification of the pest and its pest-status;
- Determination of pest etl;
- Knowledge of the available control tactics;
- Selection of control tactic(s);
- Decision of appropriate timing (when?), conducive technique (how?) And targeting site (where?);
- Determination and choice of the pest control goals;
- Selection of effective pest monitoring tool/techniques;
- Identification of factors causing failure of pest control tactics;
- Public awareness and long-term commitment;
- Planning for and improvement in in pest management strategies.

A comprehensive knowledge of various pest and ecosystem associated aspects like pest population ecology and dynamics, pest population structure and interactions and structure, function and regulators of ecosystem is compulsory for determining an appropriate pest management strategy.

8.2. Undertaking control operations

Many methods can be used to help manage pests. Most often, they can be categorized as either chemical or non-chemical methods. Many non-chemical approaches are used either to prevent infestations from initially occurring, or to minimize the severity of infestations. When non-chemical approaches, such as the use of pest resistant varieties, cultural, physical, mechanical, and biological controls are inadequate, chemical control may be justified.

Self-Check – 8	Written test

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

1. Explain the maintaining severity of infestations of pest and their treatments (10 pts)

Note: **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Operation Sheet-1	Perform pest control plan

Materials needed: Rope, small pieces of cloth (that can be wrapped around a plant or branch when scouting), insect net, paper and pen to take note, pocket knife, old newspaper or paper towel and hand lens

Procedures

1. Identify pests
2. Determine pest,
3. Plan preventative strategies
4. Monitor pests
5. Decide on need to Control measure
6. Select optimal pest control tactics
7. Implement control
8. Evaluate activity

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: You are required to perform the following as directed

Task 1 Perform of pest control plan

Operation Sheet-2	Assessing of the infestation or infection

Materials needed Rope, small pieces of cloth (that can be wrapped around a plant or branch when scouting), insect net, paper and pen to take note, pocket knife, old newspaper or paper towel and hand lens

Procedures

1) Prepare the necessary equipment necessary equipment.
2) Gather background information for the field including previous season crop, adjacent crops and non-crop areas and chemicals applied on the crop or on neighboring crops
3) Apply basic scouting procedures. Look at the problem at field level. Search for a pattern
4) Scattered problem randomly through the field or occurring in a pattern
5) Look problem visibility along the edge, entrance of a field or following a waterway
6) Observe problem in the affected area more severe in low areas or exposed slopes
7) Observe pattern matches with a certain filed activity like tillage, spraying or harvesting
8) Recording each activity

LAP Test 2	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: You are required to perform the following as directed

Task 1. Perform assessing of the infestation or infection

Reference Materials

Ag rios,G.N. (1988)Plant pathology.3rd.Acadamic press, New york

Philley, G. L., and H. W. Kaufman. 1997. Non-Chemical Control of Plant Diseases in the Home Garden. L.

Texas AgriLife Extension. Texas Plant Disease Handbook, Texas AgriLife Extension. http://plantpathology.tamu.edu/texlabn/notice.html

Plant Nursery Management: Principles and Practices. Central Arid Zone Research Institute, Jodhpur

Principles and Practices for Sustainable Fruit Production (version 2009) .Ratha Krishnan, P., Rajwant K. Kalia, Tewari, J.C.

Principles and Practices for Sustainable Fruit Production (version 2009) .Ratha Krishnan, P., Rajwant K. Kalia, Tewari, J.C. and Roy

Plant Nursery Management: Principles and Practices. Central Arid Zone Research Institute, Jodhpur, 40

Principles and Practices for Sustainable Fruit Production (version 2009) .Ratha Krishnan, P., Rajwant K. Kalia, Tewari, J.C.

Tony Little, David Frost, 2008 Organic fruit and vegetable production

http://farmindustrynews.com/mag/farming_bulking_2/

http://farmindustrynews.com/planters/john-deere-launches-high-speed-planter
https://www.projectmanager.com/blog/contingency-plan

https://encyclopedia2.thefreedictionary.com/Planting+Material

https://encyclopedia2.thefreedictionary.com/Planting+Material

https://www.ufseeds.com/learning/common-vegetable-problems/M.M. 2014.

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