HORTICULTURAL CROPS PRODUCTION

Level II

Learning Guide#41

Unit of Competence: Undertaking propagation activities

Module Title: Undertaking propagation activities

LG Code: AGR HCP2 M11 LO1-LG-41

TTLM Code: AGR HCP2 TTLM 0120v1

LO 1: Prepare for plant propagation

Instruction Sheet	Learning Guide #41

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

- Interpreting range of propagation tasks
- Confirming propagation materials
- Identifying potential OHS hazards
- Selecting Suitable personal protective equipment (PPE)
- Selecting and **checking** appropriate tools and equipment
- Cleaning and sterilizing facilities
- Cleaning and storing equipment

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

- Interpret range of propagation tasks
- Confirm propagation materials
- Identify potential OHS hazards
- Select suitable personal protective equipment (PPE)
- Select appropriate tools and equipment
- Clean and sterilize facilities
- Clean and store equipment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-7.
3. Accomplish the “Self-check” in page 5, 8, 11,14, 18, 20 and 23
4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page 23. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
5. Do the “LAP test” in page 24 (if you are ready) and show your output to your teacher. Your teacher will evaluate your output either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide ----------.

Information Sheet-1	Interpreting range of propagation tasks

1.1 Definition

What is Plant Propagation?

Plant Propagation is defined as the multiplication of plants by both sexual and asexual means. Propagation is an art and science of multiplication of plants. The horticultural plants are propagated both by sexual and asexual methods. Most of the horticultural plants are now propagated through grafting and budding, few through cuttings, layering, seeds and micro-propagation. The propagation methods are broadly classified as sexual, asexual and micro-propagation.

Asexual propagation is the best way to maintain an individual plant that best represents a species. Clones are identical to their one parent and can be propagated only asexually.

The ***major methods of asexual propagation*** are as follows:

- **Cuttings** (rooting a severed piece of the parent plant)
- **Layering** (rooting a part of the parent and then severing it)
- **Offsets** (removing new shoots that form at a plant's base)
- **Separation** (dividing bulbs or corms)
- **Division** (dividing rooted crowns)
- **Grafting** (joining a piece of shoot and dormant buds from one plant to a different rootstock)
- **Budding** (joining a bud from one plant to a different rootstock)

Importance of Vegetative propagation

- ⌘ Maintenance of clones: **plants which are genetically identical.**
- ⌘ Avoidance of long juvenile period. E.g. production of avocado:
  - Started from seed: can take long time at least 7-8 years
  - Started from grafting: can take short time 3-4 years
- ⌘ Help to create combination of clones: To exploit good traits of combined plants as a single composite plant through techniques of grafting and budding
- ⌘ For propagation of seedless plants. eg. Banana, fig, pine apple, taro…
- ⌘ Control growth form of plants

Plants started from**:** seed: too big/tall in size -difficulty during management and harvesting operation from grafting/budding/cutting: small/medium

⌘ Maintain uniformity

Limitation

✪ Not easy and simple as compared to sexual propagation.
✪ High risk of disease transmission
✪ Need of trained man power
✪ Too expensive

Horticulture crops production: - is the practice/art/ of growing and harvesting of crops. Horticulture crop production is a complex operation. Because, it characteristic like perishable in nature, labor intensive, bulk, deteriorate easily and so on. Its success depends on management practice, market availability every post harvest operation of the crop and environmental factors, coupled with socioeconomic and political factors. It activities may consist:

- Site selection and clearing
- Seed bed preparation
- Sowing seeds or planting
- Management activities
- Controlling insect pest, diseases and weeds
- Harvesting, processing and storing.

Horticultural crops producers in primitive cultures selected specific crops, specific varieties, and prepare the land prior to planting. They plant in the right season, protected the crop from pests and adopted techniques to increase productivity in quality and quantity.

The importance of horticulture

- Improving the productivity of land,
- Generating employment,
- Improving economic conditions of the farmers and entrepreneurs,
- Enhancing exports and Diet
- Entertainment and Medicinal purposes
- Environment and Aesthetic value and, above all, providing nutritional security to the people, is now widely acknowledged.

Self-check -1	Written Test

Name: _____ Date: _____

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

1.Define propagation?(3pts)

2.What is the difference between sexual and asexual?(5pts)

3. List methods of asexual propagation(6pts)

Note: **Satisfactory rating - 14 points and above** **Unsatisfactory - below 14 points**

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

Answer sheet

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Information Sheet- 2	Confirming propagation materials

2.1 Confirming propagation materials

Sexual (seed): is involves floral parts of the plant that union of pollen and egg

Asexual (vegetative)

- Regenerate part of a parent plant into a new plant
- Genetically identical to its one parent involves stems, roots, or leaves

2.2 Purpose of seed selection and quality assurance of planting materials

The use of good quality seed has a great importance in crop production. Even though, all conditions require for growth is controlled, the yield will not be good if poor variety is used. Therefore seed selection and preparation have irreplaceable role in.

- ✪ Adaptability- they have the capacity to overcome environmental and natural hazards.
- ✪ Yielding ability- increased yield performance
- ✪ Improve quality of the produce or nutritional value
- ✪ Increase pest resistance trait (insect, disease, weed, etc.)
- ✪ To obtain a pure variety- no varietal mixture of the same crop

2.3 Characteristics of good quality seed

- ✪ They are pure variety (true to type)
- ✪ They are viable, and have germination capacity up to the standard
- ✪ They have uniform size, shape, color, texture, structure and appearance
- ✪ They are healthy free from inert matter
- ✪ They are whole (no break) and contain the desired moisture level.
- ✪ True-to-type planting materials in order to optimize production of quality fruits. For this reason vegetative propagation is essential to get true-to-type propagules. So the quality planting materials having uniform characters

2.4 Seed selection criteria

Good seeds must not only belong to a good variety, but they must also have the following characteristics:-

- ⇨ They should have strong germination ability
- ⇨ They should have uniform crop stand in the growing fields
- ⇨ They should have high and stable yielding ability
- ⇨ They should have resistance to pests

- Uniformity- uniform head or fruit producing ability
- They should have 1000 –grain weight

2.5 Seed/planting materials storage for high quality

- Keep in sealed container
- Refrigerate @ 40^0F
- Low humidity
- Viability can approach 5 years varies with species which viability will decline
- Check germination % of stored seeds prior to planting

2.6 Factors that affect Germination

- Water – Imbibition
- Oxygen – respiration takes place in all viable seeds
- Light requires
- Temperature
- some seeds have optimal temperatures for germination

2.7 Seedling Media Requirements

- Particle size should be fine and uniform
- Well drained
- Free of insects, disease, & weed seeds
- Low in total soluble salts
- Avoid soil from the garden which may heavy, not sterile

2.8 Transplanting Seedlings

- When young plants less susceptible to shock (transplant shock)
- Usually when 1st true leaves appear
- Can be left longer when grown in cell packs or individual containers
- After transplanting, wait 1-2 weeks before fertilizing at a low rate

Self-check -2	Written Test

Name: _____ Date: _____

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

1. Describe media requirements for seedling(5pts).
2. Mention the factors that affect Germination(5pts).
3.List characteristics of good quality seed/planting materials (5pts).

Note: **Satisfactory rating - 15 points and above** **Unsatisfactory - below 15 points**

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

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Information Sheet-3	Identifying potential OHS hazards

3.1 Identifying potential OHS hazards

Successful health and safety practice is based on collaboration and good will, as well as taking on board the opinions of the people concerned. It is hoped that this book will provide a basis for action to reduce the high numbers of deaths, accidents and diseases related to working life, and thereby contribute to safe and decent work for all.

3.1 Benefits of an OHS program for all workplaces

Even though an employer may not be required to initiate and maintain an OHS program, OHS programs can provide a number benefits. For example,

- OHS programs enable an employer to control its occupational health and safety risks,
- Improve health and safety performance,
- Provide a framework for attaining its health and safety goals and objectives. Further, OHS programs assist with implementation by delineating roles, responsibilities, and accountability for tasks, including checking and corrective action as the program evolves.
- A properly implemented OHS program can be expected to reduce injuries and the associated costs of disability and lost production hours

3.2 OHS policies and procedures

3.2.1. Government policy on occupational health and safety

Key features of a national policy on occupational health and safety

The formulation of the policy should reflect tripartite participation, i.e. there should be inputs from employers' and workers' organizations as well as from government.

- ❖ The policy should be consistent with national development objectives and policies as a whole.
- ❖ Ways of promoting adequate public awareness and eliciting political support should be envisaged in the policy
- ❖ The policy should include a plan for mobilizing the necessary institutional and financial resources
- ❖ Coordination among all concerned institutions should be fostered as an inherent element of the policy.

- All available means of action should be used consistently
- The policy should encourage voluntary compliance at enterprise level.
- The policy should be reviewed regularly.

3.3 Occupational health and safety policy within the enterprise

General framework

Since occupational accidents and work related injuries to health occur at the individual workplace, preventive and control measures within the enterprise should be planned and initiated jointly by the employer, managers and workers concerned.

Measures for the prevention and control of occupational hazards in the workplace should be based upon a clear, implementable and well-defined policy at the level of the enterprise. The occupational Health and safety policy represents the foundation from which occupational health and safety goals and objectives, performance measures, and other system components are developed. It should be concise, easily understood, approved by the highest level of management, and known by all employees in the organization.

The policy may be expressed in terms of organizational mission and vision statements, as a document that reflects the enterprise's occupational health and safety values. It should allocate the various responsibilities regarding occupational health and safety, including that of bringing policy information to the notice of every worker. The policy should also define the duties and responsibilities of the departmental head or the occupational safety and health team leader who will be the prime mover in the process of translating policy objectives into reality within the enterprise.

3.4 Employee responsibilities according to OHS legislation and national standards

Role of Employees

- Once you have been properly trained and instructed you must take care to look after your own health and safety and not put other workers at risk.
- Your responsibilities include:
- following health and safety instructions provided by the employer
- correctly using personal protective equipment and clothing
- taking care to use equipment safely and for its intended purpose
- reporting hazards and potential problems without delay
- reporting all work-related injuries and incidents that you think could result in harm to health and cooperating with the employer on health and safety matters.

Self-check -3	Written Test

Name: _____ Date: _____

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

1.Identify the role of employee and employers with regard to OHS policies and procedures?(7pts).

2.Write down the benefits of OHS with regard to agricultural work(6pts).

Note: **Satisfactory rating - 13 points and above** **Unsatisfactory - below 13points**

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

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Information Sheet-4	Selecting Suitable personal protective equipment (PPE)

4.1. Selecting suitable personal protective equipment (PPE)

PPE is defined in the regulations as 'all equipment (including clothing affording protection against the weather) which is intended to be work or held by a person at work and which protects him against one or more risks to his health or safety.

- Example:
  - Safety helmets,
  - gloves,
  - eye protection,
  - high visibility clothing,
  - Safety footwear and safety harnesses.
  - Hearing protection and respiratory protective equipment

Provided for most work situations are not covered by these regulations because other regulations apply to them. However, these items need to be compatible with any other PPE provided.

- **Protective equipment that must be available** These include:
  - Overalls.
  - Rubber gloves or leather gloves
  - Face shields.
  - Face mask and ear protectors
  - Steel capped boots/shoes
  - sunscreen lotion
  - Head protection
  - Hard hat

Safety Gear	Description	Function
Coverall 	This is a loose fitting garment worn over ordinary clothes. Coveralls can have long or short sleeves	Coveralls are worn over all of a person's clothing to ensure that they are not soiled and that the skin is covered for added protection against harmful substances such as pesticides When a coverall is not available a long sleeve shirt and long pants are worn.
Goggles 	This is a close fitting protective glasses with side shields. It has an elastic band to fit around the head to hold it in place.	It protects the eyes from dust particles, fumes and harmful chemicals. Safety glasses or goggles should be worn when spraying chemicals or carrying out any job where the eyes should be protected.
Respirator 	Dust mask /Respirator is an apparatus worn over the face to cover the nostrils. They also contain elastic bands to hold them in place.	The dust mask is used to prevent inhalation of dust or smoke. The respirator can also protect against dust or smoke but it is used primarily when spraying pesticides to prevent the inhalation of poisonous fumes from the chemicals. It has a filter so when worn on the face you are able to breathe clean air. The dust mask is disposable while the

- **Head protection**

- **Foot protection**

Wear leather boots with ankle protection. *For utility line clearance work*

- **Hand protection**

Wear gloves to protect against cuts, vibration, cold, harmful vegetation(thorn)

- **Clothing** As a general rule, wear

  Brightly colored,

  Fire resistant clothing.

When working near roadways or mobile equipment, wear high-visibility clothing

- **Leg protection**

Wear chainsaw pants that meet the current standard to prevent cuts when using a chainsaw.

- **Communications equipment**

Self-check- 4	Written Test

Name: _____ Date: _____

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

1. List personal protective equipment used during plant propagation activities (8pts)

2. Describe the purpose of each personal protective equipment (6pts)

3. Mention the sequence of wear and remove personal protective equipment (5pts)

Note: **Satisfactory rating - 19 points and above** **Unsatisfactory - below 19points**

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

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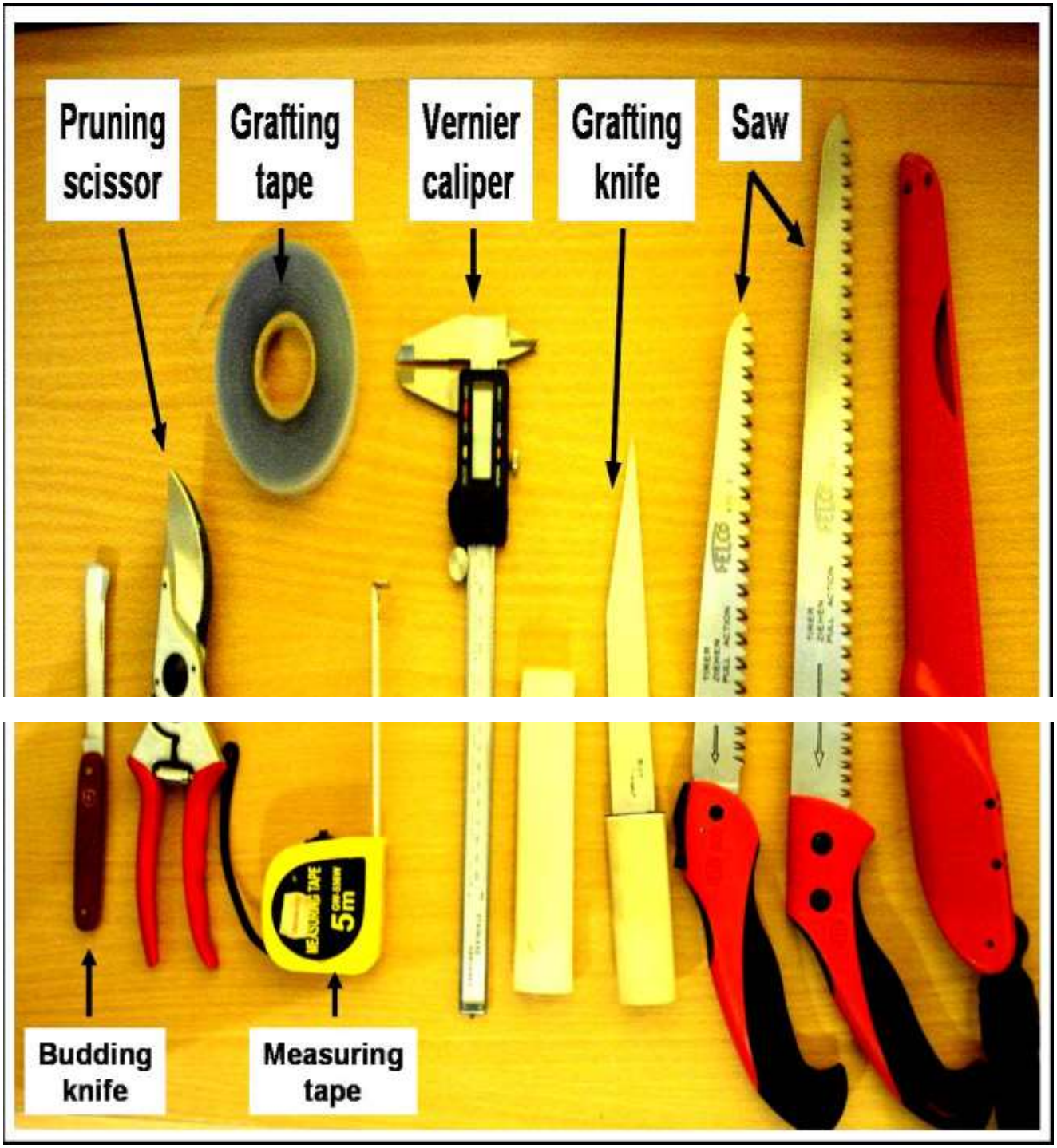
Information Sheet-5	Selecting and checking appropriate tools and equipment

5.1 Choosing appropriate tools

Tools and equipments used for applying plant propagation are:-

- **Grafting knives-**This has to be a sharp knife, which should be sterilized before use
- **Grafting wax-**After the graft is made, some covering must be used to keep it drying out. Either hand wax or brush wax may be used.
- **Hand wax** is most commonly used for home grafting. It is softened by the heat of the hand and can be easily applied.
- **Grafting tape-**This is a special tape with a cloth backing that decomposes before girding can occur. Electrical and masking tapes are also used.
- **Budding strips-**Budding strips are elastic bands and look like a wide rubber band that has been cut open.
- **Nails-**Veneer and bridge grafts require long, thin nails. Half-inch nails are long enough for most grafts, except for bridge grafting, which may require ¾ inches nails. These help to hold the graft in place.
- **Chain saw-** The chain saw is used to do top working of big trees.
- **Temporary shade-**This is used to prevent newly grafted scions from rain water and wind. This could be shade nets, or rafters or loose thatch. This is also to protect the grafted seedlings from intensive sunshine.
- **Budding Knife** – A razor sharp knife used to make cuts on the seedlings and to cut off the bud-eye. The knife must always be sharp and in a good working condition to prevent tissue damage to the plant when cutting through it. If tissue damage occurs, the graft will most likely fail.
- **Budding Tape** – Clear polyethylene strips, used to maximize contact between the bud and the rootstock until the union and the healing is complete. It also prevents drying and excess water from getting in and rotting the bud.
- **Pruning Shears** – Bud-wood is cut using pruning shears. Pruning shears are also used where cuttings are used for propagation.
- **Sharpening Stone** – All blades become blunt with use and require periodic sharpening. A sharpening stone, or wet stone, and honing oil are required.

- **Sterilization Liquid** – Knives and shears must be periodically cleaned and sterilized properly with a solution of 10% bleach.



Figures 6.1 shows hand tools used for propagation

Self-check -5	Written Test

Name: _____ Date: _____

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

1. List and discuss function of tools and equipments used for plant propagation (10pts)
2. What is the function of budding knife during plant propagation? (6pts)

Note: **Satisfactory rating - 16 points and above** **Unsatisfactory - below 16 points**

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

Score = _____

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Information Sheet-6	Cleaning and sterilizing facilities

6.1 Cleaning and sterilizing facilities

Plant propagating tools and equipments should be free from of virus, insect, disease and other dangerous microorganisms. Infection grafting and budding union can cause difficulties with union.

For budding and cuttings, sterilization of pruning shears and budding knives ensures that the propagation material remains virus-free. Sterilization is accomplished by cleaning tools thoroughly with clean water and wiping the blades with a solution of 10% chlorine bleach

The solution should not be kept for more than five hours. A wetted cotton swab kept in a capsule is used to periodically treat propagation tools during nursery operations. Budding tools should be sterilized every time varieties are changed.

Because the bleach solution (Jik) is corrosive to most metals, sterilized tools must be rinsed in clean tap water, dried thoroughly and given a light coating of protective oil at the end of the day to prevent rust. A mixture consisting of 390ml clean tap water, 100ml clear vinegar**,** and 10ml oil provides long term protection from rust.

Self-check 6	Written Test

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

1. Discuss cleaning practices during plant propagation activities?(6pts)
2. List material used for sterilization activities(4pts).

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

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

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Rating: _____

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Information Sheet-7	Cleaning and storing equipment

7.1 Cleaning and storing equipment

After the end of each working day/season we have to disinfect and after disinfecting, since the disinfecting chemical has a corrosive nature should be rinsed every working tools and equipment with clean water, then drying with a cotton cloth, after this we should lubricate with oily lubricant (grease), wrapped with polythene sheet/bag (plastic sheet/bag) and keep appropriately in the right storage place.

Materials are returned to store or disposed of according to supervisor's instructions. Tools and equipment are cleaned, maintained and stored according to manufacturers' specifications and supervisor's instructions.

Storing cleaned and maintained tools and equipments according to manufacturers specification. An important aspect of any plant propagation activity is the maintenance and storage of tools and equipments. The cleaning in tool and equipment is a significant part of the overhead expenses in any operation. Proper selection and maintenance of equipment are important factors in managing any activities. Selecting the proper tool for the job and using the tool properly will increase efficiency and reduce maintenance problems. Purchase tools, which are well-made and suited to the intended use.

Self-check 7	Written Test

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

1. Discuss cleaning practices during plant propagation activities? (6 pts)
2. What is cleaning? (4pts).
3. List material used for cleaning activities(4pts).

Note: **Satisfactory rating - 14 points and above** **Unsatisfactory - below 14 points**

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

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Rating: _____

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Operation Sheet-1	Techniques of selecting tools and equipment's for plant propagation

Objectives:

- To select and check different types of tools and equipment used for propagation.
- To understand way of handle materials, tool and equipment used for horticulture crop propagation.
- To know how to use PPE properly and keep safety

Procedures:

Step 1. Wear personal protective equipment

Step 2. Go to store and open

Step 3. Select and check tools and equipment that are appropriate to tasks

Step 4. Then, separate functional and unfuctional tools and equipment that are appropriate to tasks

Step 5. Load to work site by arranging it according to their types

Step 6. Then, unload it when reach the site carefully

Step 7. Use it according to their functional or purpose of it designed

Step 8. After complete the tasks clean, maintain and repair it.

Step 9. Then, return to storage and store it properly. if any broken or problem report to supervisors.

LAP Test	**Demonstrate selection and check of plant propagation tools and equipment**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: You are required to perform any of the following task:

Task 1- Perform selection and check tool and equipments used for plant propagation.

List of Reference Materials

1. SAQA (South African qualifications Authority), 2006.Learner guide of agriculture. South Africa.

2. htt://www.garden.gear.co.uk/watering/mix.match-sprinkler system.

3. Glenn T. Sako Introduction to Plant Propagation pdf Assistant County Extension Agent

CTAHR, UHM

HORTICULTURAL CROPS PRODUCTION

Level II

Learning Guide#42

Unit of Competence: Undertake propagation activities

Module Title: Undertaking propagation activities

LG Code: AGR HCP2 M11 LO2-LG-42

TTLM Code: AGR HCP2 TTLM 0120v1

LO 2: Propagate nursery plants

Instruction Sheet	Learning Guide #42

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

- Understanding of handling seedlings and processing of cuttings and rooting
- Collecting propagation material
- Confirming cutting requirements
- Applying pre-treatment for the propagation method and species
- Carrying out Propagation techniques
- Proper handling of propagation materials
- Treating, grading and bundling of cuttings/rooting
- Labelling, packing and storing of bundles
- Applying water and nutrients
- Monitoring plant health and taking remedial action
- Carrying out Propagation activities
- Conducting Work with workplace environment
- Safe work practices
- collecting and disposing waste

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

- Understand of handle seedling and processing of cuttings and rooting
- Collect propagation material
- Confirm cutting requirements
- Apply pre-treatment for the propagation method and species
- Carry out Propagation techniques
- Proper handle of propagation materials
- Treat, grade and bundle of cuttings/rooting
- Label, pack and store of bundles
- Apply water and nutrients
- Monitor plant health and taking remedial action
- Carry out Propagation activities
- Conduct Work with workplace environment
- Safe work practices
- collect and dispose waste

Learning Instructions:

1. Read the specific objectives of this Learning Guide.

2. Read the information written in the “Information Sheets 1-14.

3. Accomplish the “Self-check” in page 33, 36, 40, 43, 50, 52, 54, 56, 59, 61, 64, 66 and 68.

4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page 69. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity ----------.

5. Read the “Operation Sheet” and try to understand the procedures discussed.

6. Do the “LAP test” in page 76 (if you are ready) and show your output to your teacher. Your teacher will evaluate your output either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide ----------.

Information Sheet-1	Understanding of handling seedlings and processing of cuttings and rooting

1.1 Maintaining planting materials under conditions that will ensure maximum viability

- keeping seeds and tubers dry and cool,
- keeping plants and plantlets cool and moist to prevent dehydration

⇨ Seed handling

It is the procedure of drying ,cleaning ,grading and packing seeds in seed handling is to maintain the temperature below 40^0C , not to dry seeds too fat, not to over dry, to operate carefully to avoid mechanical damage is necessary. Seeds for planting should be handled very carefully at harvest time (harvest only matured seeds), at threshing (prevent mechanical damage) and drying time (do not dry the seed too fast and over).

⇨ Storage condition

Even if the seeds are thoroughly dry before storage, they are subjected to the attacks of storage pests. Therefore, to prevent these we should have to use the right storage structure with optimum storage conditions. That is, temperature, relative humidity and moisture content of the seed should be kept to the recommended standard.

- **Low moisture content -12-14%**
- **Low temperature**
- **Low relative humidity-<70%**
- **Effective pest control**

1.2 Factor affecting planting material quality

a) **Method of production:-** which includes the activities from site and seed selection, cultivation time and method of planting to farm management practices.

b) **Method of handling:-** seeds for planting should be handled very carefully at harvest time (harvest only matured seeds), at threshing (prevent mechanical damage) and drying time (do not dry the seed too fast and over).

c) **Method of storage: -** even if the seeds are thoroughly dry before storage, they are subjected to the attacks of storage pests. Therefore, to prevent these we should have to use the right storage structure with optimum storage conditions. That is, temperature,

relative humidity and moisture content of the seed should be kept to the recommended standard.

Seedling handling: Handling involves seedling storage, transit and field handling.

A. Seedling Storage:

- Avoid damaging seedling bags or boxes to minimize damage to seedlings, tape up any hole to prevent moisture loss and drying of the seedlings.
- Keep seedlings and their containers out of direct sunlight.
- Allow space for air circulation between seedling boxes/bags.
- Don't allow seedlings to freeze. (Don't plant seedlings frozen for more than 2 days)
- Plant seedlings within two weeks of lifting if possible.
- Seedlings four weeks or older should be carefully checked for mildew, mold or decay.

B. Transit:

- Prevent injury when lifting seedling bags or boxes by keeping your back straight and lifting with your legs.
- Keep seedlings shaded and covered. A tarp will work if the vehicle is not covered (ie. van or truck with camper shell.
- Drive at speeds allowed by law and road conditions.
- Keep seedlings away from contamination commonly fuels or herbicides.
- Keep the area with seedlings free from sharp objects.
- Don't allow seedlings to freeze.
- Don't stack seedlings more than 2 boxes/bags deep without spacers to provide support.

C. Handling seedlings before and during planting:

- Keep seedlings moist – dry roots kill seedlings.
- Keep seedlings shaded and covered - high temperatures kill seedlings.
- Don't prune the roots unless the laterals are long (5 or longer) prune the laterals with a sharp machete to 3 to 4 inches in length. A good root system is essential to seedling growth and survival.
- Don't beat seedlings against objects to remove clay slurry
- Close boxes or bags and place out of direct sunlight
- Remove only minimum number or seedlings that can be planted quickly to avoid exposing roots to wind and sun very long.

- Discard cull seedlings – seedlings with a stem diameter smaller in diameter than a kitchen match, dry seedlings, or seedlings without a good root system.
- Don't dump out the whole box or bag of seedlings to sort them before planting.

Figure 1.1 show how seedling/planting materials preparation and their management

- **Care of seedlings at pruning**

Immediately before and after pruning, the seedlings should be watered thoroughly. It is best to do root pruning on cloudy or during the cool hours of days. Pruning is about 2 weeks. Putting pots on wire mesh above ground, so aerial root pruning can be done.

- Mechanical pruning: A sharp blade is pulled at a depth of 20cm through the transplanting bed. E.g. thin piano wire
  - Many seedlings can be pruned at the same time
  - For bare-rooted seedlings
- Shoot pruning (top-pruning)
  - cutting the seedlings shoot
  - For hardening certain species which planted in dry periods.
  - To control excessive shoot growth

The purpose of root pruning is:

- To strengthen the root development and lignifications (stimulation of growth).
- To control stem growth (so the final result will be a robust and vigorous seedlings)
- For competition of nutrients and soil moisture root systems (reduces transplanting shock)
- To encourage high recovery during transplanting

Self-check -1	Written Test

Name: _____ Date: _____

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

1. What is the importance of root pruning?(5pts).

2. Discuss the factor affecting planting material quality (10pts).

Note: **Satisfactory rating - 15 points and above** **Unsatisfactory - below 15 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Information Sheet-2	Collecting propagation material

2.1 Collect propagation material

Prior to seed/scion collection, you will need to select and mark good mother trees. These are the trees you will use as sources of high quality seed/fruit. Here are the major characteristics that determine a good mother tree:

- Healthy and free of diseases and insects
- Nearly mature
- Good producers of the desired product
- Growing in the midst of a healthy stand of the same species.

For good mother trees (mother trees for scion and root stocks)

- ✓ Collect seed from trees of local varieties producing good quantities of tasty, healthy fruit of marketable size.
- ✓ Low branching trees may be preferable as mother trees. It is easy to pick fruits from low branches.

For fruit trees, high quality varieties are usually grafted onto native or hardy rootstocks. To get a high quality fruit tree, these steps should be done:

- ❖ Grow seedlings of drought tolerant and disease resistant mother trees.
- ❖ Then graft a branch of a high quality variety onto the seedling when it is strong and well established.
- ❖ Keep your eyes open for trees of high quality varieties near your home. From these, you can obtain scions to use for grafting. Otherwise, obtain scions from commercial fruit nurseries.

2.1.1 Collecting scion wood

The success of any form of propagation depends on the quality of the scion wood to be grafted. Collect scion or bud wood early in the day while temperatures are cool and the plants are still fully turgid. The best vegetative buds usually come from the current season's growth or dormant wood that grew the previous year. Mature buds are most desirable; discard terminal and younger buds.

When collecting cuttings it is very important that the cuttings not be permitted to suffer any desiccation injury. This can happen quite rapidly, particularly during periods of warm weather. A good way to avoid desiccation is to wrap cuttings in moist paper towels. Cuttings can also be placed in plastic bags. However, care must be taken to avoid placing the bags in

a situation where heat can build up in the bags and injure the cuttings. When taking cuttings during periods of warm weather, collect cuttings early in the morning and immediately place them in coolers containing ice.

As a general rule cuttings should be stuck as soon as possible after they have been collected. If the cuttings are to be treated with a root-promoting compound, the sooner the cuttings are treated and stuck, the greater will be the rooting response. If a situation arises where cuttings cannot be stuck right away, they can be stored in a refrigerator until needed. When stored in the refrigerator, cuttings should be kept sealed in plastic bags. Generally, cuttings should not be stored for more than several days.

- **Time of taking cuttings**

Cuttings should preferably be taken from the shoots which have 6-7 leaves and the axillaries bud in the leaf remains dormant or in a slightly swollen stage after tipping the dormant apical bud. Cuttings are generally collected in the morning hours for keeping moisture and fresh.

- **Preparing single-leaf cuttings**

The cuttings are tested by flexing between the thumb and fingers-the soft portion at the top and the rigid portion at the bottom are not suitable. Good single-leaf cuttings come from the flexible middle portion. Single-leaf cuttings are made by a sloping cut above each lea**f**. Each cutting is 3-4 cm cong with a healthy mother leaf and an active auxiliary bud. Very long internodes can be shortened by another sloping cut. Finished cuttings must be placed in shade or water until planted in the nursery. The proportion of cuttings that survive falls if they are allowed to dry-out.

Figure 2.1 stem cuttings

Self-check- 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid

1. List the criteria for mother tree selection for propagation (5points)
2. Discuss factors that determine the success of any form of propagation (5points)

Note: **Satisfactory rating - 15 points and above** **Unsatisfactory - below 15 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Information Sheet-3	Confirming cutting requirements

3.1 Confirming cutting requirements

Prior to seed/scion collection, you will need to confirm and mark good mother trees. These are the trees you will use as sources of high quality seed/fruit. Here are the major characteristics that determine a good mother tree/plant for taking planting material:

- Healthy and free of diseases and insects
- Nearly mature
- Good producers of the desired product
- Growing in the midst of a healthy stand of the same species.
- High yield
- Have good nutritional value
- Vigorous and good tasty

For good mother trees (mother trees for scion and root stocks)

- ✓ Collect seed from trees of local varieties producing good quantities of tasty, healthy fruit of marketable size.
- ✓ Low branching trees may be preferable as mother trees. It is easy to pick fruits from low branches.

For fruit trees, high quality varieties are usually grafted onto native or hardy rootstocks. To get a high quality fruit tree, these steps should be done:

- ❖ Grow seedlings of drought tolerant and disease resistant mother trees.
- ❖ Then graft a branch of a high quality variety onto the seedling when it is strong and well-established.
- ❖ Keep your eyes open for trees of high quality varieties near your home. From these, you can obtain scions to use for grafting. Otherwise, obtain scions from commercial fruit nurseries.

3.2 Management of the stock plants to maximize cutting propagation

Selection and Maintenance of source plants that is easy-to-root (juvenile); rejuvenation of stock plant material. Manipulating the environmental condition of the stock plant in relation to:

(a) Water status,

(b) Temperature,

(c) Light (irradiance, Photoperiod, quality),

(d) Stock plant etiolation,

(e) Carbohydrates, managing carbohydrate/ nitrogen levels

(f) Type of wood selected, Seasonal timing

3.3. Treatment of cuttings

1. storage of cuttings
2. Auxins
3. Mineral nutrition of cuttings
4. Leaching of nutrients
5. Wounding

3.4 Treatment of cuttings

3.4.1. Storage of cuttings

Many propagators prefer to collect propagules from stock plants early in the day when cuttings are still turgid. If the cuttings cannot be stuck immediately, they are misted to reduce transpiration and held overnight in refrigeration facilities at 4 to 8^0c and generally stuck the next day. In general, successful storage of uprooted cuttings depends on storage conditions, state of the cuttings, and species. It is important that dry matter losses and pathogens be minimized. Within the storage unit, it is best to maintain nearly 100 percent humidity, and temperature should be as low as the hardiness of the given species can tolerate.

3.4.2. Treating cuttings with auxins and application methods

Naturally occurring and synthetic, auxins and non-auxins compounds have been reported to stimulate rooting in cuttings. IBA is the best auxins for general use because it is non-toxic to plants over a wide concentration range, and effective in promoting rooting of a large number of plant species. The main techniques for treating cuttings with root promoting compounds were developed:

1) Application of auxins-talcum powder mixtures;

2) dilute solution soaking; and

3) concentrated-solution dip

Treatment of cuttings with a fungicide, whether incorporated into the auxins-talcum powder mixtures or used in other ways, has been shown to protect newly formed from fungal attack, increase survival, and increase overall quality of the rooted cuttings.

The major **advantage** of using

1) Ready availability of commercial formulations, and

2) Simplicity and ease of application.

Self-check- 3	**Written Test**

Name: _____ Date: _____

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

1. List environmental manipulation of cuttings?(5pts).
2. What is the purpose of treat cutting?(5points)
3. Mention the natural hormone that used for promote root initiation of cutting (3points).

Note: **Satisfactory rating - 13 points and above** **Unsatisfactory - below 13 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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3._____

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Information Sheet-4	Applying pre-treatment for the propagation method and species

4.1 Treating planting materials

Treating planting material is vital when it comes to avoiding a diseased crop. It is very important to treat the plant material to make sure that you have a successful crop and to prevent illness in animals, insects and humans. There are a many ways to treat plant materials. Seed treatment is the process of applying physical, chemical or biological treatment to the seeds to keep it viable and healthy.

For the purposes of this manual, seed treatments are defined as chemical or biological substances that are applied to seeds or vegetative propagation materials to control disease organisms, insects, or other pests.

Seed treatment pesticides include:

- Bactericides
- Fungicides and
- Insecticides.

Most seed treatments are applied to true seeds, such as corn, wheat, or soybean, which have a seed coat surrounding an embryo. However, some seed treatments can be applied to vegetative propagation materials, such as bulbs, corms, or tubers (potato seed pieces). In horticulture, a seed treatment or seed dressing is a chemical, typically antimicrobial or fungicidal, with which seeds are treated (dressed) prior to planting. Before sowing, certain seeds first require a treatment prior to the sowing process. This treatment may be seed scarification, stratification, seed soaking or seed cleaning with cold (or medium hot) water.

Fungicidal seed treatments are used for three reasons:

(1) **To control soil-borne fungal disease organisms** (pathogens) that cause seed rots, damping-off, seedling blights and root rot;

(2) **To control fungal pathogens that are surface-borne on the seed**, such as those that cause covered smuts of barley and oats, bunt of wheat, black point of cereal grains, and seed-borne safflower rust; and

(3) **To control internally seed-borne fungal pathogens** such as the loose smut fungi of cereals

Objectives of planting materials treatment

- To prevent seeds from pests infestation.

- To break dormancy and induce higher germination percentage.
- To inoculate the seeds with Rhizobium (bio-fertilizer).
- To induce resistance to salinity, drought, frost, etc.

Types of seed treatment

- Physical seed treatment, soak in water.
- Biological seed treatments – Rhizobium.
- Chemical seed treatment – fungicides.

Types of chemicals used for seed treatment

- Insecticides, e.g. endosulfan
- Fungicide, eg. Thiram
- Fumigant

Seed disinfectant: - is treatment that eliminates pathogen from within the seed.

There are *three types* of disinfectant

- Fungicides, e.g. Bowistin, topsin, etc.
- Insecticides, eg. Endosulfan, Thiram
- Fumigant

Seed Treatment Application

- **Seed dressing;** –is mixing of the seed with powder or liquid chemical shaking with rotary seed dressing container.
- **Seed soaking;** –is immersing seeds in a chemical solution for certain period of time i.e., 10' to 48 hr.
- **Seed suffocating** (fumigation)

Effectiveness of pesticides depends on:-

- Toxic property of chemical
- Stage of application
- Ways of application
- Sequences of application

Self-check- 4	Written Test

Name: _____ Date: _____

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

1.List types of chemicals used for seed treatment (5pts)

2. What is importance of planting materials treatment?(7pts)

3. Describe three reasons of fungicidal seed treatments uses(5pts)

Note: Satisfactory rating -17 points and above Unsatisfactory – below 17 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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3._____

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Information Sheet-5	Carrying out propagation techniques

5.1 Propagation by Seed is primarily done to raise rootstocks required for producing grafted or budded plants. However, some fruit plants (papaya) are conventionally propagated by seeds.

5.2 Vegetative Propagation is referred as vegetative or asexual propagation.

Methods of vegetative propagation

There are different methods, which can be used for commercial multiplication of various horticulture plants. These include cutting, layering, budding and grafting.

5.2.1 Cuttings

It is the method of propagating in which the part of a plant having at least few buds, when detached from parent plant and placed under favorable conditions develop into a complete plant resembling in all characteristics to the parent from which it was taken. This method is commonly used in plants, which root easily and readily, thus, multiplication of plants is very quick and cheap.

5.2.2 Types of cuttings

Stem cuttings

A. Hardwood (matured, dormant hardwood after leaf fall and before new shoots emerge in spring.) eg grapes, fig, quince, olive, currants, kiwi, pomegranate, plum and apple rootstocks

B. Semi-hardwood- woody, broadleaved evergreen species but leafy summer cuttings taken from partially mature wood of deciduous plants can also be considered eg citrus and olive

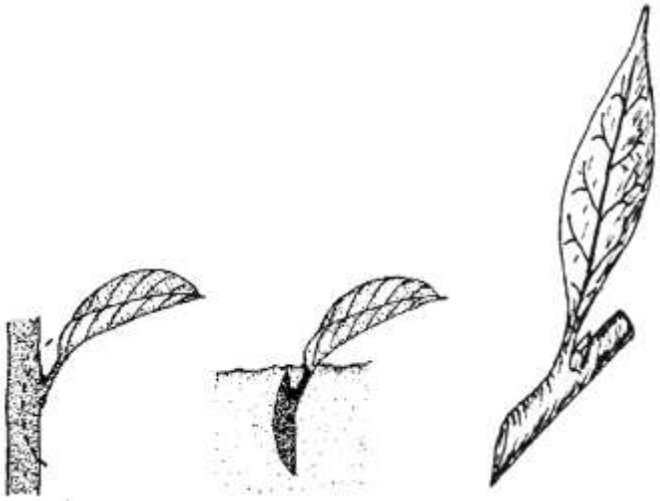
C. Softwood- Soft, succulent, new spring growth of deciduous or evergreen species eg. apple, peach, pear, plum, apricot and cherry under mist.

D. Herbaceous- succulent, herbaceous plants e.g. geranium, chrysanthemum, coleus or carnations

E. Leaf cuttings- leaf blade or leaf blade and petiole eg. Begonia rex (leaf pieces), Africon violet (leaf blade + petiole)

F. Leaf bud cuttings- Leaf blade, petiole and a short piece of stem with the attached axillary bud) e.g. Black raspberry, boysenberry, lemon, Tea and Rhododendron**.**

G. Root cuttings:- root pieces from young stock plants in winter or early spring) eg Pecan nut, blackberries

figures 5.1 shows type of cutting activities

5.3. Layering:- adventitious roots are caused to form on a stem while it is still attached to parent plant. The rooted or layered plant is detached to become a new plant growing on its own newly formed roots).

Uses of layering:

- ⇨ Natural reproduction (black raspberry).
- ⇨ Propagation of clones whose cuttings do not root easily (grapes, clonal rootstocks of apple & pear).
- ⇨ Producing large sized plants in short time.
- ⇨ Producing relatively small number of plants of good size with minimum facilities.

Most commonly used methods of layering are air, compound and simple layering.

Factors affecting regeneration of plants by layering

- ✪ Nutrition
- ✪ Stem treatment (shoot bent, shoot cut, girdling)
- ✪ Light exclusion
- ✪ Physiological conditioning
- ✪ Rejuvenation

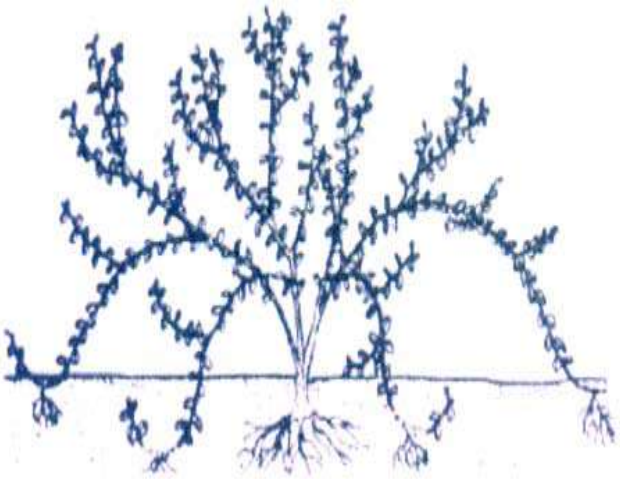
For root formation in layered plants factors like

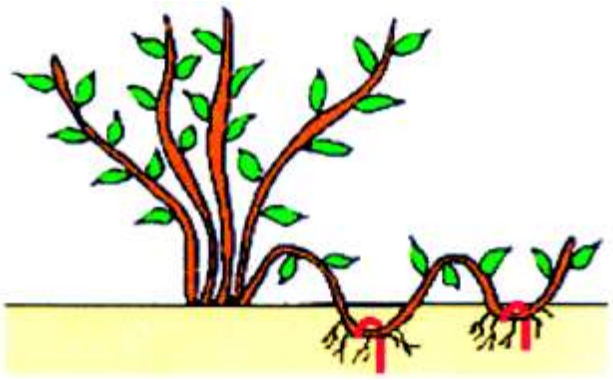
- ✪ Continuous Moisture
- ✪ Good aeration
- ✪ Moderate Temperature in the rooting zone

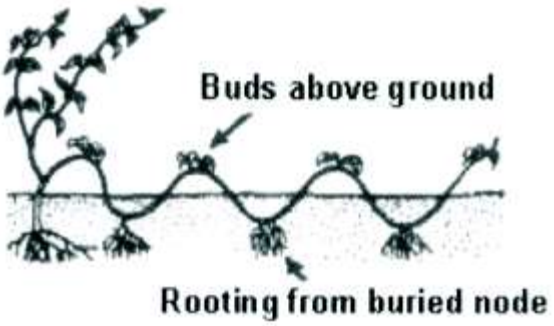
Types of layering

- ⌑ Tip layering (cover tips in late summer) eg Blackberries, trailing

- Simple layering (tip not covered/girdle) eg. Grapes
- Compound or Serpentine layering (same as simple but branch is alternately covered & exposed along its length) eg. Muscadine grapes
- Air layering (girdle and moist cover) eg Guava, Lemon, Fig
- Trench layering (branch or plant as a whole laid flat in trench) eg. Clonal rootstocks of Apple & pear ;quince etc.
- Mound layering or stooling eg Clonal rootstocks of Apple & pear

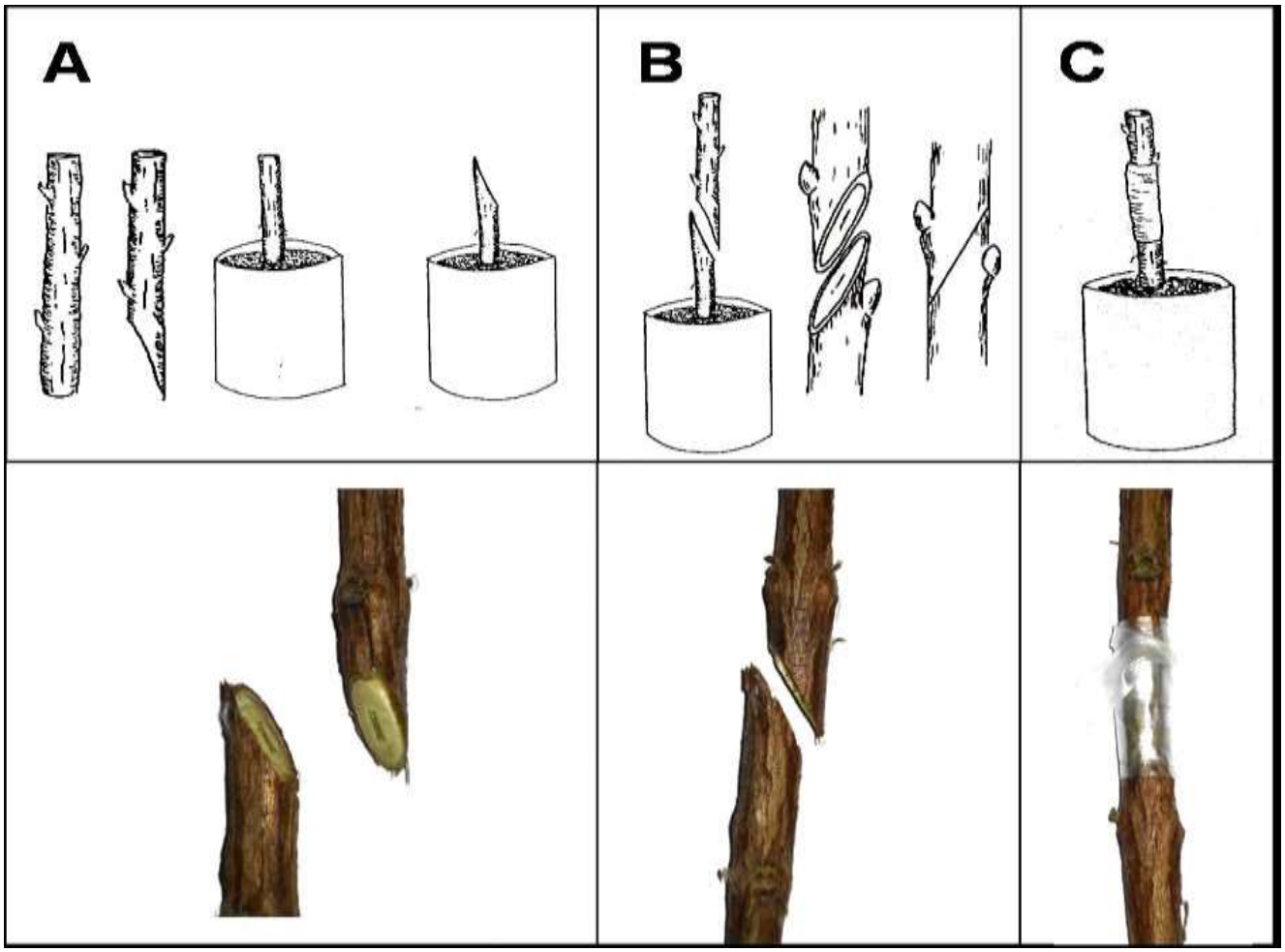






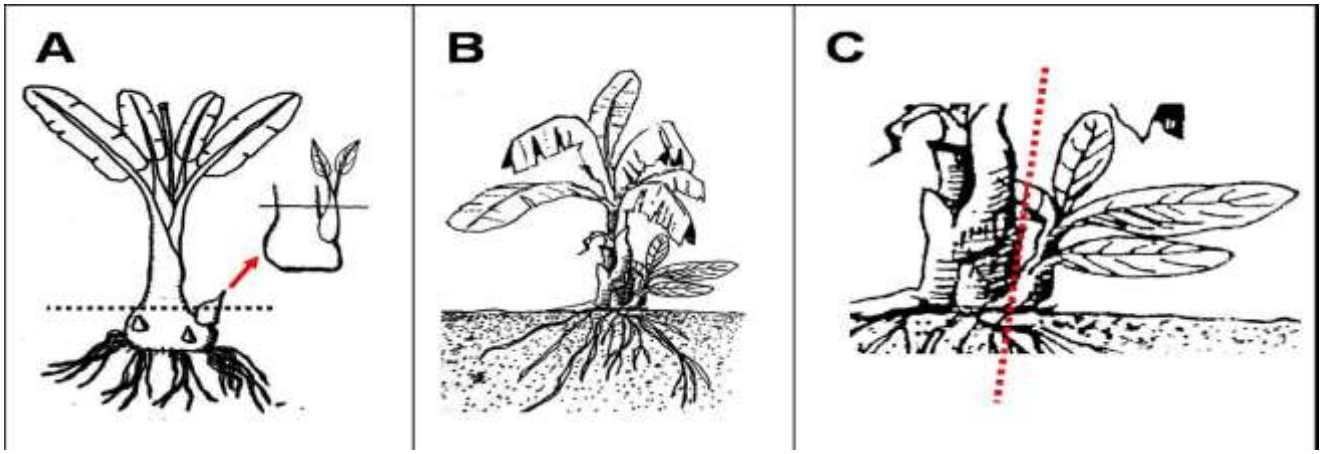
figures 5.2 shows types of layering

In case of grafting, a bud stick consisting of two or more buds is inserted into the stock whereas in budding only single bud with or without wood is inserted into the stock.


A
B
C

figures 5.3 shows types of grafting

Sucker propagation



figures 5.4 shows propagating by sucker

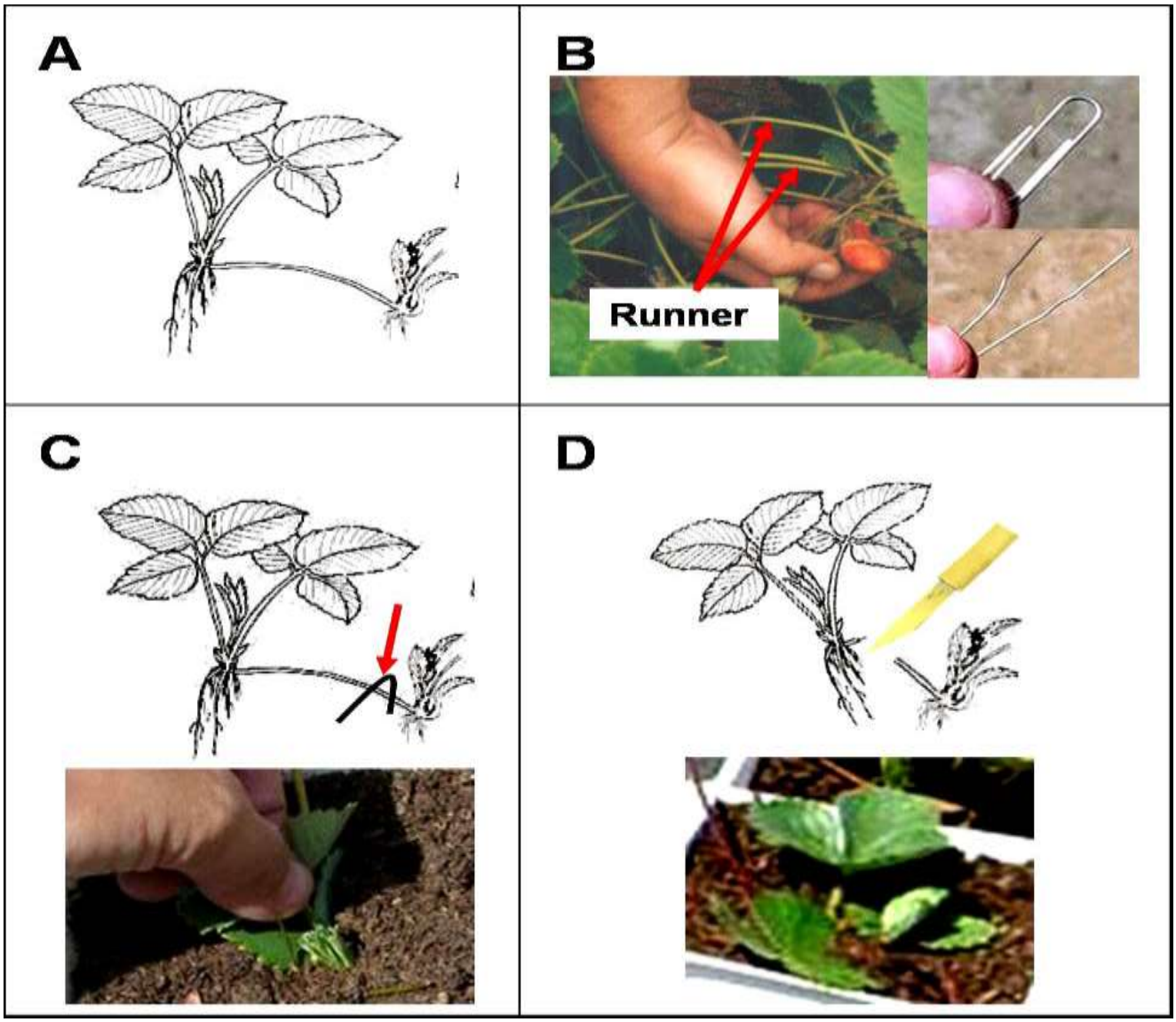


figure 5.5 show propagate by Runner

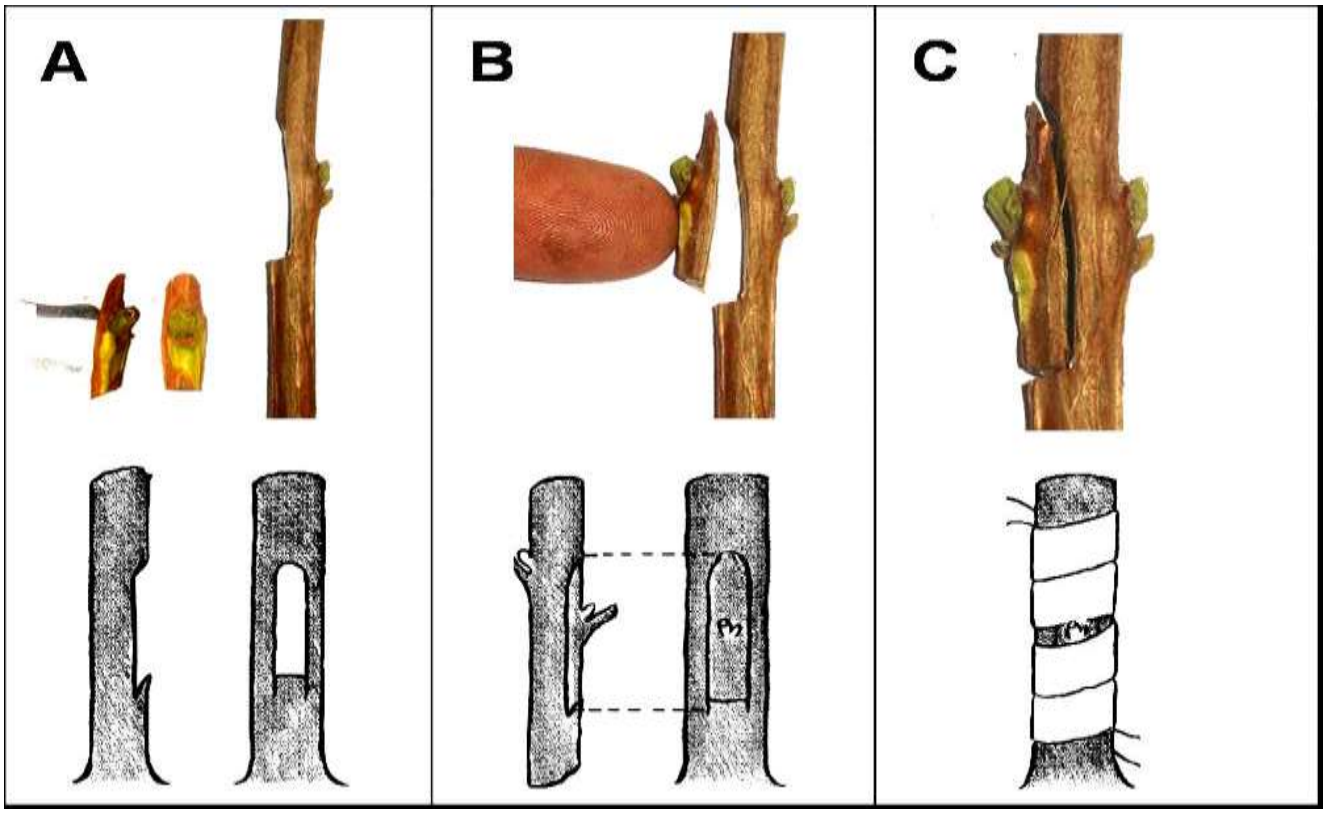


figure 5.6 show propagate by budding

Self-check- 5	Written Test

Name: _____ Date: _____

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

1. Define the following terms(10pts)
   a) Cutting
   b) Layering
   c) Budding
   d) Grafting
2. List and discuss types of cutting(6pts)

Satisfactory rating 16 points and above Unsatisfactory – below 16 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1. a._____
b._____
c._____
d._____
2. a._____
b._____
c._____
d._____

Information- 6	Proper handling of propagation materials

6.1 Proper handling/care of propagation materials of rootstock on nursery

Seeds should be harvested from selected tree (not picked from the ground) and after removal of the pulp, care should be taken, in planting them as soon as possible in the nursery in order to avoid drying out. It is common the infection of Phytophthora cinnamoni (root rot) and to eliminate this fungus seeds should be sunk in hot water at 50^0C for 30 minutes before planting.

Germination of the seed is hastened by removing the brown seed coats and cutting a thin slice from the apical and basal end of each seed before planting. The seed coat can be removed by wetting the seeds and allowing them to dry in the sun. The seed should be placed in the soil with the large basal end down, just deep enough to cover the tips. Seedling should be ready for grafting after 5 -6 months. The propagation by seed-for rootstocks production it is a necessary step before grafting with improved varieties (taken from well identified mother plants).

6.2 Shade

In the nursery the seedlings are kept under partial shade. They should have been hardened before delivery. Where hardening has been inadequate it is advisable to protect the seedlings with temporary shade. As mentioned before, the stems should be whitewashed. The leaves can also be protected by erecting a frame over the trees and covering this with grass or shade net. Once the leaves have penetrated with grass or shade net. Once the leaves have penetrated the grass they are hardened and need no further protection.

Self-Check- 6	Written Test

Name: _____ Date: _____

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

1. What is the importance of proper handling/care of propagation materials on nursery (10pts)
2. Discuss about requirement of shade (6pts)

Satisfactory rating 16 points and above Unsatisfactory – below 16 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Information- 7	Treating, grade and bundle of cuttings/rooting

7.1 Treating, grade and bundle of cuttings/rooting

Cuttings are only propagated in a controlled environment where humidity levels are between 80% and 95%, and not uncommonly at 100%. Required temperatures for successful propagation through this method are between 27°C and 32°C. A section of the plant is cut, treated in a fungicide mix (Captab and Benlate) and the end dipped in a growth hormone, for example Seradix B. The cutting is then planted in a growth-medium for rooting. Two weeks later rooting takes place and the rooted cutting can be transferred to a hardening-off area after six weeks. The disadvantage of this method is that it is management intensive and requires high technical equipment.

Feeding, watering, weeding, and getting rids of pests are basically common sense items. Do some research and take care of your grafted plant. Getting rid of suckers or growth from the root stock is not so obvious. Grafting is a forced adoption (union) to a mother plant (rootstock). If you do not get rid of the new growth (below the graft) from the rootstock, the mother plant will give her new growth 90% of her nutrients, and your graft will stagnate, and eventually wither and probably die.

Remove the grafting tape after the second flush to prevent girdling of the tree. Remove as much of the parafilm from the scion at the same time. How long does it take the scion to flush? From less than month to 3-4 months. As long as your scion is green, it is still alive.

Self-check- 7	Written Test

Name: _____ Date: _____

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

1. Describe how long planted plant need more treat?(6pts)

2. Discuss treatment required for plants (4pts)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Information- 8	Labeling, packing and storing of bundles

8.1 Labeling, pack and store of bundles

Labeling

It is important to label each piece since scion gets moved and identity lost. Label each piece of scion by wrapping with masking tape leaving a tag on which to print the variety name. Bundle like varieties together with a rubber band. Plants which are grafted and budded should be labeled and given with identification number to identify them from other plants which are not operated easily. This labeling and giving identification number helps to perform management activities.

Storage: The goal is to keep the scions in an atmosphere near 100% humidity, cool to maintain dormancy, preserve viability and, prevent microbial growth. Place a handful of slightly damp ground peat moss, to prevent microbial growth, in a gallon zip bag.

- Place scions in the bag, seal, and place in a refrigerator between 33 and 35 degrees F.
- Don’t store with ripening fruit. The ethylene gas encourages bud break and reduces chances of a successful graft.
- Check periodically to make sure scions stay moist. Add a few drops of water if needed.

Cautions

- Be sure of the variety.
- Don’t take scion wood from below the graft-union, from roots or from low vigor branches as this will be the rootstock variety, not the variety you are trying to propagate.
- Don’t take scion wood from currently patented varieties (unless you are only growing in your yard).

Self-Check- 8	Written Test

Name: _____ Date: _____

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

1. What is labeling?(3pts)
2. Discuss about requirement of label and storage (6pts)

Note: **Satisfactory rating - 9 points and above** **Unsatisfactory - below 9 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Information- 9	Applying water and nutrients

9.1 Applying water to plantings according to the irrigation schedule

Applying water to plants is an essential element of crop establishment activities. Water may be applied using irrigation systems, which may include drips; overheads, central pivot, micro irrigation, under tree, and flood.

⌘ **Water** is the essence of life, watering ensures better survival and growth of any seedlings

A good supply of water is very important for the growth of young seedlings in the nursery.

Water should be:- PH value less than 7 low salt content

The newly-sown container, seed trey (box) or nursery beds must never dry out, but keep moist continually (not soaking wet).

There is no fixed rule about the intervals between watering and quantity of water required, because this varies with:-

- species
- soil condition
- age of the seedlings
- Weather condition etc.

A very appropriate recommendation for total amount of watering per day is equivalent to 8mm rain fall. This means 8 liters of water/of seed bed.

⌘ **Frequency of watering**

Watering should be done frequency at least twice a day in small quantities. For instance, if watering is done twice a day, four liters/sq.m should be applied in each watering time.

⌘ **Time of watering**

The watering should be done early in the morning, before 10:00 and 4:00 after pm. This will enable the seedlings to utilize efficiently with the water sprayed onto them without being left.

Fine-host watering cans must be used in watering seed bed without grass mulch for buffer. If the cans are not available, try to use grass mulch.

Seedlings are watered immediately after transplanting. Therefore, light watering is carried out 2~4 times a day depending on the progress of the seedlings. Correct watering supplies the seedlings with just enough water for unrestricted growth. Well watered seedlings look healthy and vigorous. Excessive watering may results in tender, over grown, succulent plants, sometimes of yellowish in color.

Sufficient watering becomes obvious through wilting and stunned growth; however, the slight wilting young leaves during the middle of the day, when transpiration is highest. Some important facts. Bare roots require more water than container seedlings

Watering almost every day till hardening off for bare roots watering requirement depends on:

- Bed (soil texture)
- Solar radiation
- Species
- Wind, growth stage…etc.

Watering is done twice at the beginning preferable early in the morning and late in the afternoon, then lower watering gradually.

Care to be taken during watering.

- avoid damaging the seedlings (plants) & beds
- avoid over watering

Water: is one of the best criteria for choosing nursery site.

- The nursery site should be next to the area where water is available all the year.
- Near ponds; springs; rivers; lakes…
- On average 50 litters is required for 1000 seedlings per day.

Nutrients/Fertilizer: means a commercial fertilizer containing one or more of the recognized plant nutrients, which is used primarily for its plant nutrient content. Fertilizers are derived from a wide variety of natural and manufactured materials and are sold in solid, liquid and gaseous form (anhydrous ammonia). These materials are designed for use or claimed to have value in promoting plant growth or increasing plant-available nutrient levels in soils.

- Ensures that yields are higher than those obtained on the basis of inherent soil fertility by correcting either an overall deficiency or an imbalance of nutrients.
- Maintain and enhance the production potential of the soil.
- By increasing yields per unit area from suitable arable land, application of plant nutrients allows land of low quality,
- Balanced plant nutrition also results in an increased addition of organic matter through greater leaf residues, and root and stubble biomass.

Self-Check- 9	Written Test

Name: _____ Date: _____

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

1. What is the purpose of irrigation schedule?(10pts)
2. Discuss the importance of plant nutrition (6pts)

Note: **Satisfactory rating - 15 points and above** **Unsatisfactory - below 15 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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_____**-**

Information- 10	Monitoring plant health and taking remedial action

10.1 Monitoring plant health and taking remedial action

Care of appropriate environment for post-propagation aftercare; spacing and weaning young plants to a normal environment; growing media for plants; potting on; timing; provision of water and feed; training or trimming to promote appropriate growth formation.

Assuming suitable plant materials and proper technique, desiccation is the greatest hazard to the successful take. In cool climates or in the cool part of the year, new graft may need no special protection. Greater safety can be ensured by covering the bench of grafts with a polyethylene tent that hangs down far enough to maintain higher humidity but that permits some air circulation. The tent can be removed in 1 or 2 weeks, after the graft has healed. Under hotter conditions, the greenhouse will have to be made more opaque with whitewash. For only a few grafts, the tent and whitewash can be replaced with individual polyethylene sleeves, each covered by a light-colored paper sack. The larger tent is labor-saving and also permits easier monitoring of the grafts. Maintaining optimum soil moisture is of critical importance.

In about 5 weeks, most of the grafts will have pushed out 7.5 or 10cm. If they have started growing vigorously, as shown by size and a commonly reddish rather than grass-green stem color, they can be placed outside for further growth and initial hardening in 50 percent shade After at least 2 weeks here, harden them off in full sun for another 2 weeks or so, and they will be ready for potting up. You might plant the rootstock seeds around October; graft the stocks around December; place the young grafts in a protected area outdoors at about the end of January; in the open around the middle of February; and transplant them around the beginning of March. Different, staggered timetables may fit individual needs, and will provide more flexible workloads.

Self-check- 10	Written Test

Name: _____ Date: _____

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

1. What is the purpose of irrigation schedule?(10pts)
2. Discuss about time of watering (6pts)

Note: **Satisfactory rating - 15 points and above** **Unsatisfactory - below 15 points**
You can ask your teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Information- 11	Carrying out Propagation activities

11. Carrying out Propagation activities

All propagation activities carryout sexual by seed, relatively easy, but in many cases, you don't know exactly what you're going to get. Not all plants readily produce seeds (seedless various trees).

Vegetative:

- ⇨ by Grafting: Today's session is about the art of grafting.
- ⇨ by Cutting: relatively easy, but not all plants can be, or are easily propagated from cuttings.
- ⇨ by Layering: (air layer, mound, serpentine, trench, others)
- ⇨ by specialized stems and roots: (bulbs, corms, rhizomes, others)
- ⇨ by Micro-propagation: can generate many plants from a small stock, however requires special skills and facilities and longer growing process (similar to growing from seed)

Figure 1. Supplies needed for graft activities

Figure 2. This is an example of rootstock. A rootstock is typically grown from a seed.

Figure 3 Selecting scion and determine diameter with rootstock

Figures 4 above shows preparation of rootstock and scion.

figure 5 show inserting of scion in rootstock or grafting activities

figures shows Wrap the graft tightly with a cut rubber band

figure shows partial shade of after grafting activities

Information- 12	Conducting Work with workplace environment

12.1 Conduct Work with workplace environment

After all preparations made, and grafting area clean.

- Matching rootstock and scion available, remove all leaves and leaf petioles from the scion. Should have at least 2 buds on the scion.
- Grafting technique (whip, side, cleft, etc) determined
- Determine where on rootstock to graft, confirm match of scion, sterilize your tools.
- Make cut on your rootstock
- Make appropriate matching cut on your scion
- Attach your scion tightly to the rootstock with grafting tape.
- Wrap your scion with anti transpiration parafilm (you can do this before attaching the scion to the rootstock) (personal preference)
- Identify and date your graft (your name, scion and rootstock ID, date of graft)- use a soft lead pencil.
- Fertilize your plant, attach to drip line
- Clean your grafting tools, clean your grafting area.

Self-check- 12	Written Test

Name: _____ Date: _____

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

---

1. Discuss how you conduct work with workplace environment (10pts)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

_____

_____

_____

Information- 13	Safe work practices

13.1. Safe working practices

Tools used for budding should always be clean and sharp. Waxing of the union helps to prevent infection and should be done quickly after grafting and budding.

Tools and equipments should appropriate and sharp. Some of the equipments are

- Grafting wax
- Sharp knives
- Tying and wrapping materials
- Nails
- Chain saw

While working grafting/budding activity we have to handle the sharp tools as illustrated below in the picture to avoid any danger of cutting ourselves.

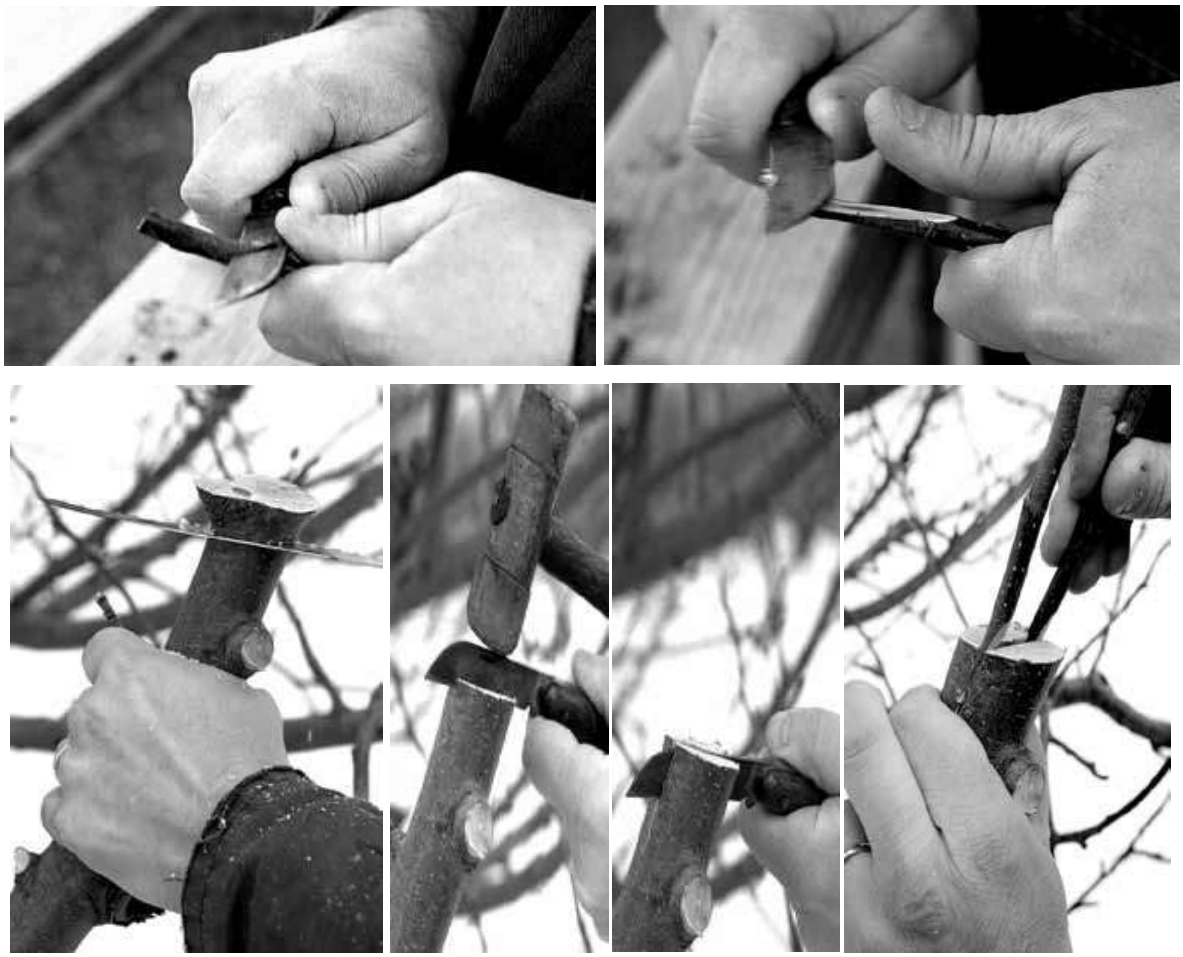

Figure: - 13.1. How to handle and use safely sharp tools

- NB: -Blunt knives and pruning shears must be sharpened using a sharpening stone.

Self-Check- 13	Written Test

Name: _____ Date: _____

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

1. What is the impact of contamination of budding and grafting materials with dangerous micro organisms? (6 pts).

Note: **Satisfactory rating - 6 points and above** **Unsatisfactory - below 6 points**
You can ask your teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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Information- 14	Collecting and disposing waste

14.1 Collect and dispose waste

After the end of each working day/season we have to disinfect and after disinfecting, since the disinfecting chemical has a corrosive nature should be rinsed every working tools and equipment with clean water, then drying with a cotton cloth, after this we should lubricate with oily lubricant (grease), wrapped with polytheen sheet/bag (plastic sheet/bag) and keep appropriately in the right storage place.

Disposing of old crops

Once the site for the farm has been selected and acquired, the farmer proceeds with clearing. This involves cutting down the vegetation that is growing on the land and then removing the dead plant material (old crops) from the cropping area. In traditional practice, the plant material is cut down with cutlasses, axes and saws.

Removing waste materials

The extent of soil disturbance is depends on the types of technology, knowledge of the producer, and the environment. Plowing is an age-old method of land preparation for seeding.

Materials to be removed from the field crop:-

- Unwanted vegetation (trees, bushes, weeds , etc)
- Tree roots, stones and stumps

- Avoiding cleared materials from the site:-
  - Burning waste, woods and diseased vegetation
  - Use the crop trash for making compost heaps
  - Construction materials

Advantages of removing waste materials

- It helps in loosening the compact layer of soil and pulverizing it, thereby improving aeration & the growth of plants.
- The harmful insects, pathogens and weeds harboring in the soil are exposed to the sun & killed.
- It helps in proper & uniform germination of seeds.
- It helps to bury surface vegetation and crop residues from the previous seasons crop ; so as to make it easy to plant & resulting in the addition of organic matter into the soil.

Self-check- 14	Written Test

Name: _____ Date: _____

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

1. What is the impact of contamination of budding and grafting materials with dangerous micro organisms?(6pts).

2. Discuss about importance of collecting and disposing materials(10pts)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Starting time:_____ Ending time:_____

Short Answer Questions

1._____

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2._____

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Operation Sheet-1	Techniques of carrying out Grafting activities

Objective: **To understand how to *graft fruit properly.***

Materials required for activities:

- Shovel
- Pickaxe
- Meter
- Fork
- Wheel barrow
- Watering can
- Pruning shears
- Grafting knife
- Para film
- Pruning shears
- Spoon
- Root pruner
- PPE

Procedure

Step 1: Select or grow your rootstock

Step 2: Select your scion

Step 3: Remove the top (apical growing point) of the rootstock with a sharp, clean pair of pruning shears

Step 4: Using a sharp, clean grafting knife, carefully make a cut across the center of the cut surface of the rootstock.

Step 5: Now, holding the scion vertically with the buds

Step 6: Next, pair the rootstock and scion together.

Step 7: Wrap the graft tightly with a cut rubber band or grafting tape to hold the graft in place.

Step 8: Using a piece of para film, begin wrapping the scion from below the graft.

Step 9: After grafting, it is important to keep the grafted plant well watered and in partial shade

LAP Test	**Demonstrate on Techniques of carryout grafting fruit activities**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: You are required to perform any of the following tasks

Task 1. Perform the Techniques of carry out grafting activities

List of Reference Materials

1. *http//www.fao.org*, 2002. Plant production and protection paper 156 rev.1.
2. *htt//www.manage.gov.in/publications farmers book.pdf.*
3. Jean Williams, 2014. Collection, Labeling and Preserving Fruit Tree Scions pdf, Peninsula Fruit Club.
4. Joel Buyinza and Vincent I Opolot, 2016. Tree nursery establishment and tree management training manual for community tree nursery operators and tree farmers, Kampala.
5. Loyd Collett, 2011. Grafting fruit trees, grafting pp-oregon-Ext.pdf.

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HORTICULTURAL CROPS PRODUCTION

Level II

Learning Guide#43

Unit of Competence: Undertaking propagation activities

Module Title: Undertaking propagation activities

LG Code: AGR HCP2 M11 LO3-LG-43

TTLM Code: AGR HCP2 TTLM 0120v1

LO3: Prepare parent Material for field budding and grafting

Instruction Sheet	Learning Guide #43

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

- Preparing parent material for budding and grafting
- Following hygiene practices
- Undertaking select and use appropriate tools and equipment
- Checking Performance parameters of the irrigation system

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

- Prepare parent material for budding and grafting
- Follow hygiene practices
- Undertake select and use appropriate tools and equipment
- Check performance parameters of the irrigation system

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-4.
3. Accomplish the “Self-check” in page 81, 83,86, and 90
4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.

Information Sheet-1	Preparing parent material for budding and grafting

1.1 Preparing parent material for budding and grafting

To prepare parent material for budding and grafting. Proper selection is very necessary for mother plants. By considering its quantitative and qualitative characters, mother plants are selected, giving more maintenance and planted in nursery. They are planted according to the recommended planting distance. Care should be taken that the mother plants attain optimum vegetative growth. Mother plant plantation must be well classified according to the types and varieties. Seedling selected for mother plants are planted under poly house or shed nets. Locating your scion supply:

- Scions must have buds or nodes, preferably fat and ready to flush.
- Seasonal (buds are available limited time in a year)
- Select healthy scions and rootstock

plants:

- Grow the rootstock from seed or cutting.
- Prepare planting pots, media, fertilizer
- Transplant rootstock from seedling to larger pot(s)-sometimes a multi-transplant procedure with citrus .
- Care and fertilize (energize) rootstock and mother/scion plant (weeding, quick acting and time release fertilizer, and pest control). We need to have both root stock and scion healthy and energized

The Nursery:

- Misting system for seed germination & cutting propagation.
- Transplant area (tables, media, fertilizer, pots, etc.)
- Watering system and area for rootstock and grafted plants.
- Grafting tables (probably same as transplant area)

Self-check 1	Written Test

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

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

1. List the parameter to select mother plant for prepare budding and grafting materials (5pts)
2. where do the scion locate? (5 pts)

NOTE: Satisfactory rating – 8 points and above Unsatisfactory - below 10 points.

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

Score = _____

Rating: _____

Answer sheet

1. _____
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2._____
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Information Sheet-2	Following hygiene practices

2.1 Undertaking hygienic practices

Grafting and budding materials should be free from of virus, insect, disease and other dangerous microorganisms. Infection grafting and budding union can cause difficulties with union.

- ✓ Clean the grafting table and area.
- ✓ Set up material and sterilize your grafting tools
- ✓ Match your rootstock with your scion
- ✓ Start grafting!

Practical: sterilize grafting and budding materials and Keeping tools and equipments free from contamination. Tools used for budding should always be clean and sharp. Waxing of the union helps to prevent infection and should be done quickly after grafting and budding Plant propagating tools and equipments should be free from of virus, insect, disease and other dangerous microorganisms. Infection grafting and budding union can cause difficulties with union. For budding and cuttings, sterilization of pruning shears and budding knives ensures that the propagation material remains virus-free. Sterilization is accomplished by cleaning tools thoroughly with clean water and wiping the blades with a solution of 10% chlorine bleach

The solution should not be kept for more than five hours. A wetted cotton swab kept in a capsule is used to periodically treat propagation tools during nursery operations. Budding tools should be sterilized every time varieties are changed.

Because the bleach solution (Jik) is corrosive to most metals, sterilized tools must be rinsed in clean tap water, dried thoroughly and given a light coating of protective oil at the end of the day to prevent rust. A mixture consisting of 390ml clean tap water, 100ml clear vinegar**,** and 10ml oil provides long term protection from rust.

Self-check 2	Written Test

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

1. Discuss hygiene practices of tools and equipments during plant propagation work? (6 pts)

2. What is sterilization? (4pts)

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

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

Score = _____

Rating: _____

Answer sheet

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2._____
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Information Sheet-3	Undertaking select and use appropriate tools and equipment

3.1 Undertaking select and use appropriate tools and equipment

Tools used for budding should always be clean and sharp. Waxing of the union helps to prevent infection and should be done quickly after grafting and budding.

Tools and equipments should appropriate and sharp.

Some of the equipments are

- Grafting wax
- Sharp knives
- Tying and wrapping materials
- Nails
- Chain saw

The following tools are used in the propagation methods described above. For a full list of tools and equipment which can be used in propagation,

- **Budding Knife** – A razor sharp knife used to make cuts on the seedlings and to cut off the bud-eye. The knife must always be sharp and in a good working condition to prevent tissue damage to the plant when cutting through it. If tissue damage occurs, the graft will most likely fail.
- **Budding Tape** – Clear polyethylene strips, used to maximize contact between the bud and the rootstock until the union and the healing is complete. It also prevents drying and excess water from getting in and rotting the bud.
- **Pruning Shears** – Bud-wood is cut using pruning shears. Pruning shears are also used where cuttings are used for propagation.
- **Sharpening Stone** – All blades become blunt with use and require periodic sharpening. A sharpening stone, or wet stone, and honing oil are required.
- **Sterilization Liquid** – Knives and shears must be periodically cleaned and sterilized properly with a solution of 10% bleach (Jik).

figure 3.1 tools and equipment for propagation

Self-check 3	Written Test

Name---------- **Date----------**

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

1. List and discuss appropriate tools and equipment used plant material preparation (6 pts)

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

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

Score = _____

Rating: _____

Answer sheet

1._____
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Information Sheet-4	Checking performance parameters of the irrigation system

4.1 Checking performance parameters of the irrigation system

Required land with sufficient and assured supply of irrigation is the most important basic resource. Quality of irrigation water should be at prescribed level. Harmful factors can be tested by water testing in laboratory. The pH and electrical conductivity (EC) of irrigation water should be tested.

Before you begin operating your irrigation system (regardless of the type of system), you need to consider how much water to apply to the plants. Water is required to dissolve plant food materials in the soil and transport them in the plant. It is a major component of cell sap and plant tissues. It is also essential for photosynthesis. Transpiration is an important factor affecting the quantity of water used by plants, because it influences the amount of moisture absorbed by the plant roots from the soil, and governs the rate at which water moves through the plant.

Available moisture is lost from the plant root zone by transpiration and direct evaporation. As water is lost from soil, water moves from the lower soil levels, via capillary flow, to replace the moisture lost. However, this may not happen fast enough to meet the plants' requirements, or the soil reserves may be too low to supply replacement water until after the next rainfall. Without irrigation occurring at the right time, the growth of the crop may be retarded and not be productive. The worst result is that the crop dies.

Factors affecting plant water use

Apart from soil influences, there are other factors which affect the use of water by plants. These include:

- The plant species and the tolerance of the species to varying soil moisture conditions
- The rate of growth of the crop
- Weather conditions
- Depth of the root system.

Self-check 4	Written Test

Name---------- Date:----------

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

1.Discuss factors affecting plant water use ? (8pts)

2.List factors that influence the infiltration rate(6pts).

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

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

Score = _____

Rating: _____

Answer sheet

1._____
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2._____
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List of Reference

1. Chadha, K.L. 2001. Handbook of Horticulture. Indian Council of Agricultural Research. New Delhi.
2. Joel Buyinza and Vincent I Opolot, 2016. Tree nursery establishment and tree management training manual for community tree nursery operators and tree farmers, Kampala.
3. Loyd Collett, 2011. Grafting fruit trees, grafting pp-oregon-Ext.pdf
4. Richard Karamatsu and Steve Oshiro, 2014. Art of grafting pdf.
5. Sharma, R.R. 2002. Propagation of Horticultural Crops Principles and practices.

HORTICULTURAL CROPS PRODUCTION

Level II

Learning Guide#44

Unit of Competence: Undertake propagation activities

Module Title: Undertaking propagation activities

LG Code: AGR HCP2 M11 LO4-LG-44

TTLM Code: AGR HCP2 TTLM 0120v1

LO4: Prepare budding and grafting materials

Instruction Sheet	Learning Guide #44

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

- Selecting budding/grafting material
- Maintaining Viability of materials in storage
- Disposing discarded material
- Preparing stock
- Safe handling of budding/grafting materials and stock

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

- Select budding/grafting material
- Maintain Viability of materials in storage
- Dispose discarded material
- Prepare stock
- Safe handle of budding/grafting materials and stock

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-5.
3. Accomplish the “Self-check” in page 95, 97,99,102 and 104.
4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page 48. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity ----------.
5. Read the “Operation Sheet” and try to understand the procedures discussed.
6. Do the “LAP test” in page 49 (if you are ready) and show your output to your teacher. Your teacher will evaluate your output either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide ----------.

Information Sheet-1	Selecting budding/grafting material

4.1 Select budding/grafting materials take from

The propagation by seed for rootstocks production. It is a necessary step before grafting with improved varieties (taken from well identified mother plants). Planting materials take from:

- Actively growing portion at least one to two years of age
- Buds are collected from bud sticks which are small pieces of shoot of the same plant species, current season's shoot, and growing vigorously.
- Collect bud sticks that are in its vegetative stage not fruiting.
- The buds must be slender in shape and more pointed.
- Select the buds on the middle section of the bud stick because they are mature and ideal for budding.
- Grafting materials should be taken from middle part of branches
- Grafting and buds materials should be healthy

4.2 Selection and Storage of Scion Wood

Branches from last year's growth must be collected from disease free trees during the dormant season (preferably January). Grafting can only be successful with leaf bud not fruit buds. Apples have more fruit buds near the ends of new growth, some other fruits have more fruit buds at the beginning of new growth. So the mid-section is the best place to insure leaf buds. The scion wood is cut in 12 to 18 lengths, covered with damp (not wet) moss, sawdust, or paper-toweling and placed in a sealed plastic bag in the refrigerator. Storage temperature just above freezing is best. If buds start to grow the scion wood **cannot** be used for grafting.

Self-check 1	Written Test

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

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

3. List the criteria to select mother plant for budding and grafting plant propagation. (5 pts)
4. How do we collect the scion?(5pts)

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

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

Score = _____

Rating: _____

Answer sheet

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2._____
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Information Sheet-2	Maintaining Viability of materials in storage

2.1 Maintaining Viability of materials in storage

To keep buds from drying out, getting hot, or freezing (depending on the season), place the bud wood into plastic bags or wrap it in moist towels or burlap as you collect it. Place bud wood of only one variety in a labeled bag. Bud sticks that will not be used immediately should be bundled, labeled, and stored in moisture-retaining containers such as plastic bags or waxed cardboard boxes, which should be kept cool (32 to 45ºF). The longer bud wood is stored, the less likely it is to “take.”

Generally, bud wood stored for more than a few days should be discarded. In budding, the situation is somewhat different in that the “June bud” technique involves the use of previous season’s terminal growth, whereas the dormant budding is made from non growing buds on the current season’s growth.

The scions should be wrapped in non perforated plastic (a plastic bread wrapper is excellent) and placed in cold storage (30 to 40ºF) or buried in moist sand or sawdust until ready for use. When making the graft, remove an inch or two of the tip and basal portions of the scions to eliminate wood that may have dried out. Another reason for discarding the tip and basal portions is that the tip portion is too small and the base too large for proper handling. Furthermore, neither portion will have properly matured buds.

Bud stick should collect on the day where budding operation is to be done or collected bud stick or grafting materials must be wrapped properly with waterproof paper to prevent desiccation.

The viability of materials can be maintained by

- Appropriate storage
- Shade regulation
- Showering
- Wrapping
- Deeping in the solution

Self-check 2	Written Test

.

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

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

1. List maintenance of viability of propagating materials (8pts)
2. Describe the use of maintain viability planting materials(5pts)

Note: **Satisfactory rating - 13 points and above Unsatisfactory - below 13 points**

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

Score = _____

Rating: _____

Answer sheet

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2._____
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Information Sheet-3	Disposing discarded material

Disposing-off

- **Dropped leaves** that are collected when we are performing propagation activity.
- **Other vegetation** such as clippings, woody debris and dead plants and shrubs that are collected during grafting process.

Recycling

Currently there are several options for recycling some of the waste materials described above. Leaf and other vegetative debris can be made into compost for use at propagation nursery.

Self-check 3	Written Test

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

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

1. Discuss the waste materials management.(6 pts)
2. What is recycling of waste materials (4pts)

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

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

Score = _____

Rating: _____

Answer sheet

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Information Sheet- 4	Preparing stock

4.1 Preparing root stock

Young, vigorous fruit trees up to 5 years old are best for top working. Older apple and pear trees of almost any age can be top worked but the operation is more severe and those over 10 years old must be worked at a higher point. because of their 3 vigor and their strong, well-placed branches, are very good under stocks. Trees up to 5 years old can be grafted at one time. On older trees about half the upper and center part only should be worked at one time. The remainder should be worked a year later until spring.

4.2 Preparing the rootstock for budding

Rootstock can be grown in the field where it will be budded, or dormant liners can be transplanted into the field and then allowed to grow under moderate fertility until they reach the desired 7.5 to 17cm caliper. Since budding is generally done less than 10cm above the soil surface, leaves and side branches must be removed from this portion of the rootstock to create a clean, smooth working area. To avoid quickly dulling the knife, remove any soil from the rootstock where the cut will be made just before actual budding takes place. The stem can be cleaned by brushing or rubbing it gently by hand or with a piece of soft cloth.

4.3 Preparing the rootstock for budding

For bench grafting

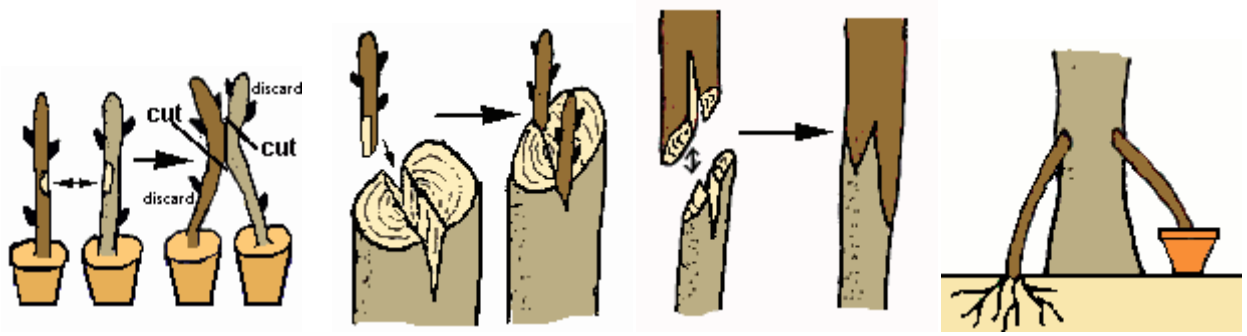
- The root stock is prepared by making a 2.5 to 5cm sloping cut at the top of the stock second downward cut is made into the stock, starting a third of the way down from the top end.
- The second cut is made about half as long as the first.
- The scion is prepared in the same manner.
- The two pieces are then fitted together with the tongues interlocking and the graft is wrapped and waxed immediately.

Cleft Graft

- The root stock is cut off squarely and
- Split vertically with a knife or cleft grafting tool to a depth of about 5 to 7.5cm
- Keep the knife in position or insert a chisel to keep the split open and insert the scions

Bridge and Inarch Grafts

- Trim the edges of the girdled section back to sound bark
- Place the scion along the trunk so that the beveled edges rest on sound bark
- Mark and remove the bark rectangles.
- The stem piece to be inserted should be slightly longer than needed to ensure a homely fit.
- Insert the scion and then secure with two number 16 or 18 wire nails at each end.



figures 4.1 shows, approach, cleft, tongue/whip and inarch grafts

Self-check 4	Written Test

Name---------- Date:----------

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

1. How to prepare rootstock for budding and grafting? (6pts)
2. Mention how to prepare rootstock for cleft grafting(6pts).

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

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

Score = _____

Rating: _____

Answer sheet

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Information Sheet-5	Safe handling of budding/grafting materials and stock

5.1 Safe handling of budding/grafting materials and stock

Rootstocks are usually grown from seeds. Good material should be used for root stock, i.e. plants with a well developed root system and resistance to soil-borne diseases. The seedlings are kept in the nursery longer and are grown to a bigger than normal planting size, since they have to fit with the scions. For most species the plants will be about 50–70 cm high when grafting takes place. Therefore seedlings should be grown in relatively big pots, i.e. at least 10–15 cm diameter, depending on species. The root stock is fit for grafting when the stem is about 0.6–1.2cm diameter at the upper third. The root stock should be tendered carefully before and after the grafting.

Before and after grafts should be covered with a protective coating immediately after completing the graft. Electrician's tape is an excellent material that will bind and protect graft unions. Choose a brand that is elastic and amply adhesive. A good tape for the purpose will stick well to itself. Do not stretch this tape too tightly or it may crack or weather. Better brands will last throughout the first summer, after which the tape is no longer needed. Asphalt water emulsion is now widely used as a protective coating on graft unions. It is of pasty consistency and can be applied with a brush. It is preferable, however, to smear it on thicker with a small paddle.

Self-check -5	Written Test

Name: _____ Date: _____

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

1.Define stock?(3pts)

2. Mention how budding/grafting materials safely handled?(5pts)

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

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

Answer sheet

Score = _____

Rating: _____

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List of Reference

1. Bose, T.K., Mitra, S.K., Sadhu, M.K. and Das, P. 2001. Propagation of Tropical and Subtropical Crops. Naya Prokash Publishers, Calcutta.
2. Chattopadhyay, T.K. 1999. A Text Book of Pomology. Vol. I-IV. Kalyani Publishers, Ludhiana.
3. Kunte, Y.N., Kawthalkar, M.P.and Yawalkar, K.S. 2005. Principles of Horticulture and Fruit Growing. Agri-Horticultural Publishing House, Nagpur.
4. Sharma, R.R. 2002. Propagation of Horticultural Crops (Principles and practices). Kalyani Publishers, Ludhiana.
5. *http://www.iihr.ernet.in*
6. *http://www.angrau.ac.in/*

HORTICULTURAL CROPS PRODUCTION

Level II

Learning Guide#45

Unit of Competence: Undertake propagation activities

Module Title: Undertaking propagation activities

LG Code: AGR HCP2 M11 LO5-LG-45

TTLM Code: AGR HCP2 TTLM 0120v1

LO5: Bud/graft scion

Instruction Sheet	Learning Guide #45

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

- Methods budding/grafting
- Sealing of bud/graft
- Applying labels and identification
- Recording accurately at the required time
- Identifying, rectifying and/or reporting process and equipment performance

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

- Methods budding/grafting
- seal of bud/graft
- Apply labels and identification
- Record accurately at the required time
- Identify, rectify and/or report process and equipment performance

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-5.
3. Accomplish the “Self-check” in page 112, 116, 118,120 and 122.
4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page 123. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity ----------.
5. Read the “Operation Sheet” and try to understand the procedures discussed.
6. Do the “LAP test” in page 125 (if you are ready) and show your output to your teacher. Your teacher will evaluate your output either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide ----------.

Information Sheet-1	Methods budding/grafting

1.1. Bud/graft scion

Grafting: is a process by which a piece of scion is attached to a root-stock in such a way that the combination of both scion and root- stock come in firm contact, so that the new secondary tissue resulting from cambial cell division in the scion and root stocks is closely knitted or it is a technique by which two plants are joined together and eventually grow together to become one.

1.2 The Purpose of Grafting and Budding

1. Perpetuating clones that are difficult to root from cutting.
2. Combining the benefit of stock and scion. some examples:
   - Disease resistance
   - Resistance to agro-climatic factor
   - Size and growth habits, e.g use of dwarf root stock(citrus on mandarins)
   - Fruiting characteristics-e.g sour orange rootstock causes of sweet orange to be smooth, thin-skinned and juicy, with excellent quality and storage characteristics.
3. Changing cultivars of established plants.
4. Repairing damaged tree
5. Changing of the tops of trees, usually from an undesirable variety to a desirable variety.
   - The growing of several kinds of flowers or fruit on one tree or plant.
   - The utilization of stocks which influence the growth of the scion.

❖ **Limitations of grafting:-**

- Grafting is limited to plants which develop the secondary plant body.
- Only structures which are closely related botanically will grow together.
- Disease /virus can transmit easily.

➢ **Root stock and scion relationships:**

Root stock is the lower part, but the scion is the upper part, root stock has a better adaptability, the scion can develop a desirable cultivar.

Cambium is a layer of cells located between a stem's xylem and phloem. New xylem and phloem cells. When the scion is grafted onto the rootstock, the cambium of the two must touch. originate from cambial tissue.

Graft union: The place where the scion and stock grow together.

Scion: The twig or bud that will become the top part of new plant. It is grafted onto the stock

Polarity: during grafting keep direction vertical the same direction

Sources of rootstock

(i) Seedling rootstocks - grown from seeds;

(ii) Clonal rootstocks- produced asexually (a rooted cutting, or a layered plant).

The success of grafting is governed by the following important requirements:

- The stock and scion must be compatible;
- The cambial region of the scion must be placed in intimate contact with that of the stock;
- The grafting operation must be done at a time when the stock and scion are in the proper physiological stage;
- Immediately after the grafting operation is completed, all cut surfaces must be protected from desiccation (i.e., all cut surfaces must be waxed); and
- Proper care must be given to the grafts for a period of time after grafting
- Grafting materials (knives) should be sharp and disinfected
- Scion must be in a correct polarity
- Rapid healing
- Scion be supported to prevent breakage due to wind or weight of fruit
- Avoid diseased or insect infested under stock or scion

Indicators of Successful Propagation

- **Trueness-to-Name:-** Different cultivars of citrus have different traits. These traits must be retained in the propagated plant material. The correct cultivar with few deviations from the original stock is expected at the end of the production chain.
- **Trueness-to-Type:-** The external traits of the plant, such as fruit-shape and size, must be identical to those of the mother-plant in a given environment.
- **Freedom from Pathogens:** Viruses and bacteria are a threat to the survival of the citrus industry and must not be present in propagated plant material.

Indicators of Unsuccessful Propagation

- Dead buds
- Diseased plants
- Mixed cultivars and

- ✪ Inferior plants are the main indicators of unsuccessful propagation.

Budding is a grafting technique in which a single bud from the desired scion is used rather than an entire scion containing many buds. Most budding is done just before or during the growing season.

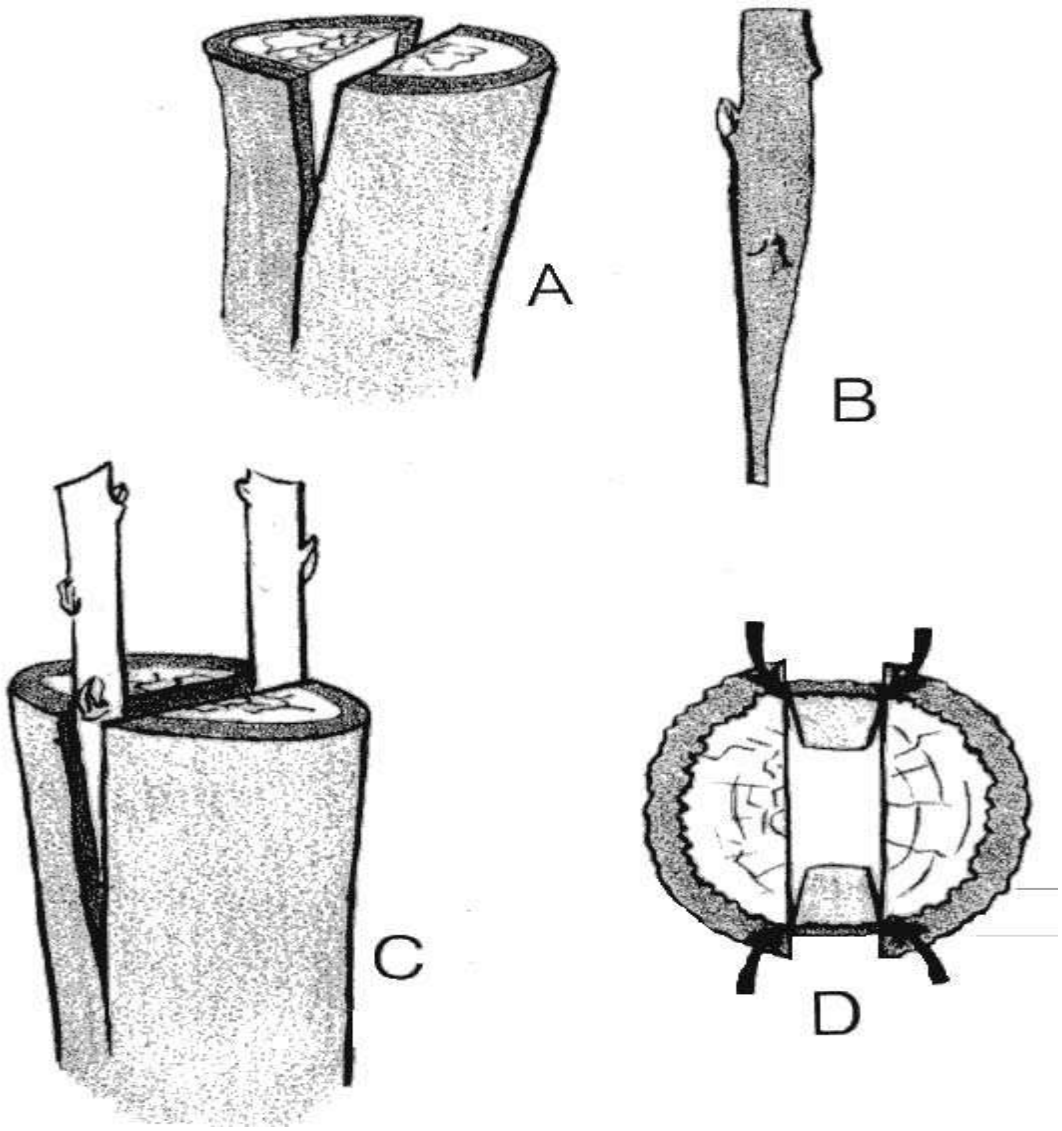
Budding is another form of grafting where only the bud is used rather than a piece of scion with several buds.

Advantages of budding

- Quick and efficient method of propagation.
- The best method of economical uses of planting material.
- Useful in plants in stronger union and protest and blowing out of scions.
- The operation is simple.

Disadvantages of budding

- ✪ Transmission of disease/virus.
- ✪ Budding method depends on the bark slipping.
- ✪ Budding is confined generally to young plants.



Figures 1.1 show rootstock, scion, grafted plant and grafting Union

Selecting suitable buds for grafting

As with bench grafting, you want to select your bud material from twigs grown in that year. Cut off a scion of this year's growth, and cut off the leaves (leaving the leaf stalks), this stops the scion drying out by losing water through leaf transpiration.

figure 1.2 show budding preparation

Self-check -1	Written Test

Name: _____ Date: _____

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

---

1. Define root stock and scion materials.(3pts)
2. What is the purpose of grafting and budding?(5pts)
3. What are the symptoms of grafting union incompatibility?(5pts)
4. Do you think that grafting is always successful? Explain.(4pts)

Note: **Satisfactory rating - 17 points and above** **Unsatisfactory - below 17points**

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

Answer sheet

Score = _____

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Information Sheet-2	Sealing of bud/graft

2.1 Sealing of bud/graft

Sealing bud/grafts accordingly Immediately after completion of the graft the scions should be protected from drying out by sealing and covered with wax. Use a grafting compound on the graft unions and other cut surfaces.

Bud and grafting need care after graft and bud. The bud and graft should heal in the following four weeks, but it is best to keep it wrapped up until the following spring. Before bud burst in spring, carefully remove the binding to see whether it has taken. If it hasn't, don't worry, you still have a viable rootstock that you can bench graft with and have another go. If it has taken, then cut the top off the rootstock down to just above the bud you have grafted, sloping your cut away from the bud to direct away rain water.

If both your grafts have taken, decide which one looks stronger and cut off the other. If you're keeping the top graft, flick the lower bud out to stop it growing. Remove any other buds that try to grow from the rootstock.

Seal the join with a wrap to hold the bud firmly in place on the rootstock until union and healing of wounds is complete, and to keep rain and irrigation water from running down the stem and from entering the join, which can prevent the bud from healing and which can cause diseases and infections. Fifteen days are generally long enough for the wounds to heal. Wrap the bud from below the incision, making several overlapping turns around the stem until the entire bud and incision are covered. Tuck the end of the tape beneath the last turn. Maintain firm pressure on the tape, but not so hard that it breaks. If the tape breaks it has to be removed and the wrapping started over again with a new strip.

After two weeks, when healing and union has occurred, remove the tape by making a vertical cut through it on the back of the rootstock. A live bud will still be as green as it was when inserted, while a dead bud will look brown or blackish, meaning that it did not take. If the bud did not take, another spot on the rootstock is selected for re budding.

The growth energy of the seedling must now be directed to the green bud, forcing it to grow. The rootstock seedling is subjected to practices, such as lopping or bending (gently bending

the top of the rootstock above the union to tie it to itself) and topping (cutting off the seedling 5cm above the union) to direct all its energy into the bud. These practices break bud dormancy and force the bud to grow within a week.

Figure 2.1: Wrapping the Budding Union

2.2 Factors affecting healing of grafting union

Often grafting operation is not successful. The ability of plant to be grafted succefully termed as grafting compatibility.

Symptoms of incompatibility include:

- Leaf yellowing and abscission
- Marked differences in the growth rate of stock and scion

The compatibility of graft/bud will affected by:

- The kind of plant :the scion and rootstock must be capable of uniting
- Growth activities of stock plant: some grafting and budding depends on bark slipping which means the bark should be easily peel-off
- Growth activity and quality of scion/bud wood materials: the scion materials or bud wood is normally one year old or less. always current season growth for bud wood
- Propagation method used: different method suited to different species. the best method should be selected
- cambial contact .the cambial regions of the scion must be placed intimate contact with that of rootstock
- virus contamination, insect and disease: infection of graft un ion can cause difficulties with union.
- equipment :proper tools and accessories should be used

Self-check -2	Written Test

Name: _____ Date: _____

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

---

1. Define seals?(3pts)

2. Mention the factors affecting healing of grafting union?(5pts)

3. Discuss different between Symptoms of compatibility and incompatibility(6pts**)**

Note: **Satisfactory rating - 14 points and above** **Unsatisfactory - below 14 points**

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

Answer sheet

Score = _____

Rating: _____

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Information Sheet-3	Applying labels and identification

3.1 Labeling and give Identification no.

Plants which are grafted and budded should be labeled and given with identification number to identify them from other plants which are not operated easily. This labeling and giving identification number helps to perform management activities.

3.2 Taking Care of Grafted and Budded Plants

Any shoots which grow below the graft on the rootstock should be removed, because they compete with the shoots of the scion. Recently grafted trees need a lot of water distributed on a regular basis. In the first year after grafting, avoid the application of any fertilizer, manure or compost, because the tree will begin to grow fast prematurely, which will not allow the graft to heal properly. Budded plants should be kept under cool conditions until the graft has joined in order to keep the bud from growing prematurely. As soon as the growing season starts, cut off the rootstock above the plant with a sloping cut. This will help the bud to begin growing.

Rub off the buds on the rootstock below the grafted bud as these other buds will only provide unnecessary competition with the grafted bud. This activity should be done on a regular basis until the rootstock buds stop appearing.

Self-check -3	Written Test

Name: _____ Date: _____

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

1.Define label?(3pts)

2.What is the use of label and give identification?(5pts)

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

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

Answer sheet

Score = _____

Rating: _____

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Information Sheet-4	Recording accurately at the required time

4.1 Propagation Records

Although propagation may begin with a particular plant using techniques from associates or references, eventually personal experience with specific material will enable the propagator to develop individual and unique techniques. These detailed modifications in procedures separate the average propagator from the really skilled propagator. Development of “individual tricks of the trade” depends on accurate records. Experience gained each season must be used for propagation decisions in subsequent years. A journal may be the easiest way to record procedures that work. Record all procedures as the actual work is being accomplished, rather than at the end of the day or week. Details are easily lost over even a short time. Information essential for a propagation procedural journal includes the following:-

1. Date propagation began.
2. Name of plant (common and scientific).
3. Source and type of propagating material.
4. Propagation medium used.
5. Hormones or growth regulators used including full chemical name and the rates of application
6. Environmental treatments applied.
7. Pesticide treatments applied.
8. Temperature and light conditions.
9. Misting settings in detail.
10. Date propagation completed.
11. Percent success or failure and reasons therefore.
12. Percent survival and vigor of plants after transplanting.

Self-check 4	Written Test

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

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

1. List the all essential information to be recorded at activity of plant propagation (15pts)

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

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

Answer sheet

Score = _____

Rating: _____

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Information Sheet-5	Identifying, rectifying and/or reporting process and equipment performance

5.1 Identifying of out of specification process and equipment performance

After complete records of the planted, number of plants with good stand, disease occurred at the farm, total financial capital exerted, total labor utilized, chemicals used, the rates, the dates of application, the approximate volumes (or weights) applied, the section of the area sprayed and/or the crops treated, and the name of the spray operator, must be maintained. Application equipment used, safety equipment worn and results of treatment, including damage, and amount of plant produced from the given site should also be reported and materials and equipments used for activities should perform their own function properly. The non-functional tools and equipments should identify and reported before.

Some of grafting and budding materials are:

1.Budding knife
2.Grafting knife
3. A fine tooth saw for cleft grafting
4. Pruning shears
5. Dormant scions (cultivar labeled)
6. Tying material such as grafting tape, adhesive tape, electrician's tape or rubber strips
7. Asphalt water emulsion compound for covering grafts
8. A light hammer for bridge grafting
9. A cleft-grafting chisel and mallet, or a heavy knife or hatchet can be used for a small job

Self-check -5	Written Test

Name: _____ Date: _____

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

---

1. How identification of out of specification process and equipment performance evaluated? (8pts).

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

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

Answer sheet

Score = _____

Rating: _____

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Operation sheet -1	Techniques of undertake bud and grafting activities

Objective: To know how to bud and graft scion with rootstock

Material required: Budding knife, Grafting knife, A fine tooth saw, Pruning shears Dormant scions and Tying material such as grafting tape

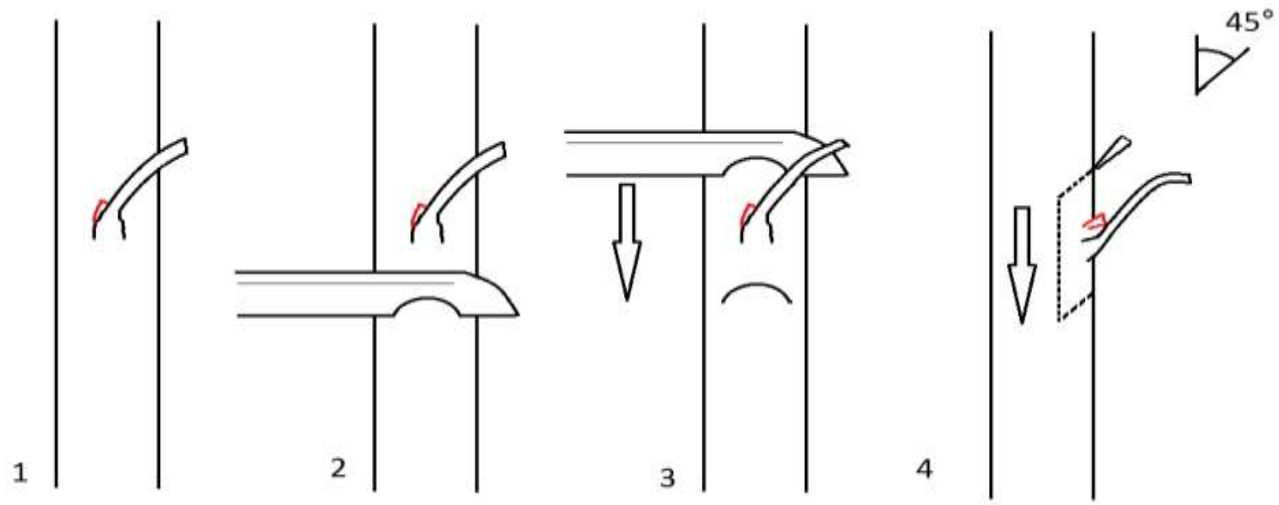
Procedures

Step 1. Adjust materials required for activities

Step 2. Wear suitable PPE

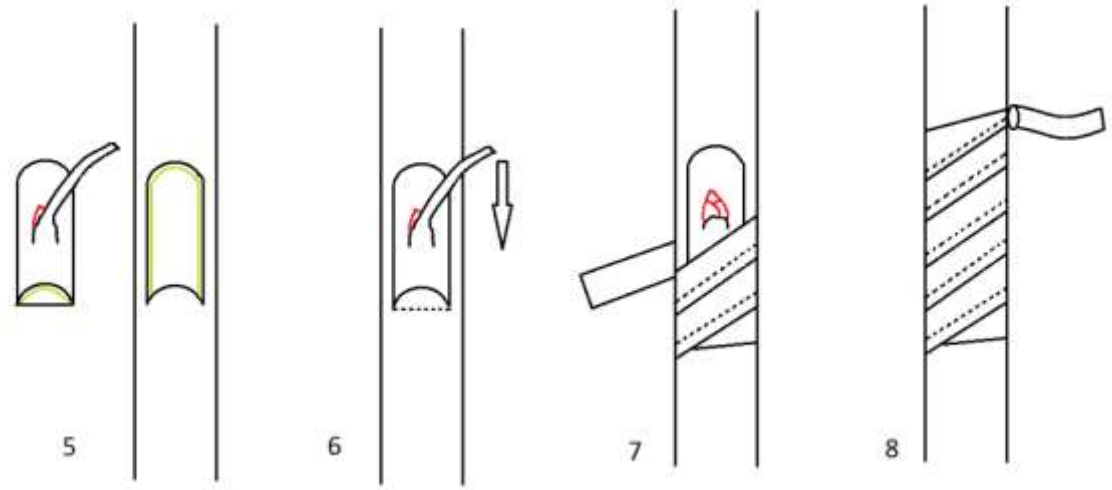
Step 3.Select and prepare buds that you are going to graft to your rootstock between the leaf stalk and the stem.

Step 4. Make a cut at about 45° down into the scion wood, about an 2.54cm below the bud. The cut should be deep enough to go through the rind and slightly into the wood, but not deeper. see figures below 1-4.



Removing the chip for bud grafting

step 5. Remove the knife and do exactly the same about one 2.54cm above the same bud.
step 6. From here, carefully draw the knife down behind the bud in a slicing motion making use of the whole length of the knife, until you reach the first cut. see the following figure 5-8.



Inserting the bud graft

step 7. Using the leaf stalk as a handle, remove the bud. Be careful not to touch the cut surface as the natural oils and dirt from your skin can interfere with the grafting process of 'healing'.

Step 8. Insert the bud slice into the rind gap you have just created in the rootstock. Take care to ensure that the cambium layers of the bud and rootstock sections meet, press down on the leaf stalk until it breaks off. Its job as a handle is over.

Step 9. Starting from the bottom, firmly wrap the bud in place with grafting tape. Make sure you overlap the tape as you wrap it up, over the bud itself, and right up over the top cut.

Step 10. Unless you have self-adhesive grafting tape, tie it off with one or two back hitches. The purpose of binding the graft is twofold; firstly it holds tightly the cambium layers together to ensure good enough contact for healing, and secondly it stops the graft from drying out.

Step 11. Label your tree with the variety name, rootstock type, date grafted and how many grafts

LAP Test	**Demonstrate techniques of undertake bud and grafting activities**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: You are required to perform any of the following tasks

Task1. Perform techniques of undertake bud and grafting activities

List of Reference

1. FAO, 2010. Technical guidelines on tropical fruit tree management in Ethiopia

2. L.P. Stoltz and J. Strang, 2004. Reproducing fruit trees by graftage: Budding and Grafting. University of Kentucky-College of Agriculture

3. Sharma, R.R. 2002. Propagation of Horticultural Crops (Principles and practices).

4. Propagating Avocados, Principles and Techniques of Nursery and Field Grafting pdf, University of California, Division of Agriculture and Natural Resources.

HORTICULTURAL CROPS PRODUCTION

Level II

Learning Guide#46

Unit of Competence: Undertake propagation activities

Module Title: Undertaking propagation activities

LG Code: AGR HCP2 M11 LO6-LG-46

TTLM Code: AGR HCP2 TTLM 0120v1

LO6: Complete propagation activities

Instruction Sheet	Learning Guide #46

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

- Disposing of/storing Unused grafting material
- Cleaning and storing tools and equipment
- Following hygiene practices and Waste removal
- Waste management
- Recording workplace information

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

- Dispose /store Unused grafting material
- Clean and store tools and equipment
- Follow hygiene practices and Waste removal
- Waste management
- Record workplace information

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-5.
3. Accomplish the “Self-check” in page 130, 132,134,137 and 139.
4. If you earned a satisfactory evaluation precede to “Operation Sheet--------. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity ----------.
5. Read the “Operation Sheet” and try to understand the procedures discussed.
6. Do the “LAP test” in page 49 (if you are ready) and show your output to your teacher. Your teacher will evaluate your output either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide ----------.

Information Sheet-1	Disposing of/storing Unused grafting material

1.1. Disposing-off/storing unused grafting materials

Disposing-off

- ✓ Dropped leaves.
- ✓ Clippings,
- ✓ Woody debris and dead plants and
- ✓ Shrubs that are collected during grafting process.

Recycling

Currently there are several options for recycling some of the waste materials described above. Leaf and other vegetative debris can be made into compost for use at propagation nursery.

Storing

We have to store all grafting materials after disinfecting with chemicals and rinsing with clean water, dried and lubricated with lubricant oil (grease) to avoid corrosive. .

When working in plant propagation there is range of un wanted waste materials left over that needs to be dealt with things such as old or broken pots/tubs un used root bound plants, un wanted cutting materials , surplus potting media, soil, fertilizer, ,bags, tags ,packing materials ,mulches, plant debris and faulty irrigation parts. It is best practice when finished to leave completely clean working areas free of rubbish all materials should be disposed of according to local council guidelines and the waste management and pollution control act.

Methods of waste disposal could include:

- ➢ Organic waste; mulch and composting is suitable for plant debris, recycle card board and paper.
- ➢ Inorganic waste; plastic// metals /paper based materials may be recycled, reused or returned to manufacturer for inorganic materials that cannot be recycled it is best to take them to an authorized land fill (don't burn old containers as given off are toxic).
- ➢ Always clean up and dispose or recycle your old pots.

Self-check -1	Written Test

Name: _____ Date: _____

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

---

1. Define disposing?(3pts)

2. What is recycle?(5pts)

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

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

Answer sheet

Score = _____

Rating: _____

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Information Sheet-2	Cleaning and storing tools and equipment

2.1 Cleaning equipment

After the end of each working day/season we have to disinfect and after disinfecting, since the disinfecting chemical has a corrosive nature should be rinsed every working tools and equipment with clean water, then drying with a cotton cloth, after this we should lubricate with oily lubricant (grease), wrapped with polythene sheet/bag (plastic sheet/bag) and keep appropriately in the right storage place. Materials are returned to store or disposed of according to supervisor's instructions. Tools and equipment are cleaned, maintained and stored according to manufacturers' specifications and supervisor's instructions.

Selecting the proper tool for the job and using the tool properly will increase efficiency and reduce maintenance problems. Purchase tools, which are well-made and suited to the intended use. Commercial usage may entail more heavy duty demands on equipment.

1. Clean dirt and debris from tools after each use.
2. Oil metal parts to prevent rust.
3. Lightly sand rough wooden handles and apply linseed oil.
4. Repair loose handles.
5. Sharpen blades of cutting tools.
6. Store tools in a clean dry storage area.
7. Protect surfaces of cutting tools in storage.

Self-check -2	Written Test

Name: _____ Date: _____

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

1.Discuss about cleaning equipment after activities (6pts)

2.How proper using the tool will increase efficiency and reduce maintenance problems?(6pts).

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

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

Answer sheet

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Rating: _____

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Information Sheet-3	Following hygiene practices and Waste removal

3.1 Following hygiene practices and Waste removal

Hygienic practices should reduce the likelihood of introducing hazards that may be difficult or impossible to control at later stages of the propagation Examples: pesticides, antibiotics, mycotoxins, microorganisms in foods eaten raw or fresh Premises, equipment, surfaces and facilities should be located, designed and constructed to ensure: minimum contamination proper maintenance, cleaning, disinfection, protection against pests. Hygiene control: Time and temperature, Humidity, contamination Microbiological specifications Incoming materials (incl. packaging materials) Water, air, steam Management, documentation, recall procedures

Keep potentially contaminated materials separated from uncontaminated ones

- Assure effectiveness of treatments
- Assure effectiveness of cleaning
- Assure reliability of measurements, tests and
- Recording
- Perform hazard analysis when changes occur

Establishments and equipment should be kept in condition to: facilitate sanitation procedures function as intended, particularly at critical control points prevent contamination of food e.g.debris,chemicals,pests, dust etc. Cleaning procedures involve: removing gross debris from surfaces, applying a detergent solution rinsing with water, disinfection where necessary and dry cleaning.

Self-check -3	Written Test

Name: _____ Date: _____

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

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1. How to keep potentially contaminated materials separated from uncontaminated ones?(6pts)

2.What is the importance hygiene practices?(5pts)

Note: **Satisfactory rating - 11 points and above** **Unsatisfactory - below 11 points**

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

Answer sheet

Score = _____

Rating: _____

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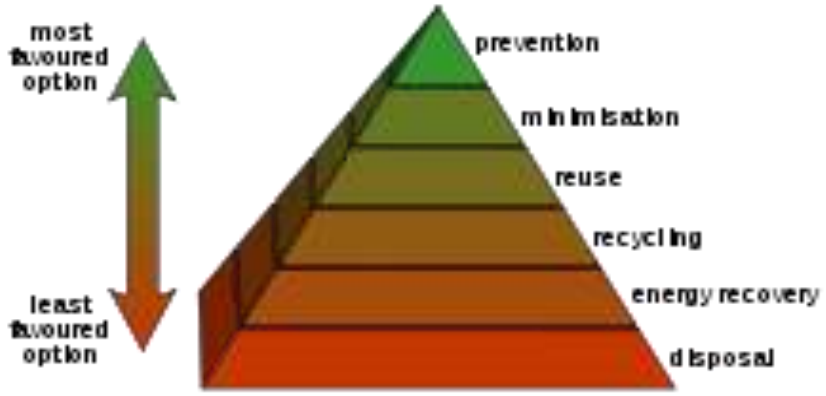
Information Sheet-4	Waste management

4.1 Waste management

Waste Management is devoted to the presentation and discussion of information on solid waste generation, characterization, minimization, collection, separation, treatment and disposal. There are two types of agricultural crop residues. Field residues are materials left in an agricultural field or orchard after the crop has been harvested. These residues include stalks and stubble (stems), leaves, and seed pods. The residue can be ploughed directly into the ground, or burned first. In contrast, no-till, strip-till or reduced till agriculture practices are carried out to maximize crop residue cover. Good management of field residues can increase efficiency of irrigation and control of erosion. Simple line transect measurements can be used to estimate residue coverage.

Waste management is the collection, transport, processing, recycling or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous substances, with different methods and fields of expertise for each. Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator.

Waste management concepts: There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely used concepts include:



The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.

Self-check -4	Written Test

Name: _____ Date: _____

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

1.Define waste?(3pts)

2.What is the importance of waste management?(5pts)

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

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

Answer sheet

Score = _____

Rating: _____

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2._____
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Information Sheet-5	Recording workplace information

5.1. Keeping Farm Records

Records are important to the financial health of your farm. Good records do not ensure your farm will be successful; however, success is unlikely without them. Farm records are like report cards students receive in school. With a farm report card, you can tell how well you are managing your operation compared with other producers in your "classes. You also can see the strengths and weaknesses of your farm operation.

Besides use as a management tool, farm records are essential for preparing income tax reports. Also, most banks require extensive records from farmers to formulate credit ratings. Finally, records are important in establishing eligibility for participation in government programs, determining the proper level of insurance coverage, and negotiating lease arrangements.

5.2 Improving Farm Records

Accurate records are essential for evaluating your farm's performance: accurate analysis requires accurate data. Too often farmers rely on publications which describe an "average" farm instead of personal records that describe their farm. To make the best financial decisions concerning your farm, use data collected from your farm. You can make your recordkeeping job easier. Consider using forms and accounting systems designed especially for the farm. A good source for recordkeeping books is your local Extension agent or agricultural lender. Also, software packages for farm recordkeeping can be purchased for your personal computer.

Self-check -5	Written Test

Name: _____ Date: _____

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

1. Define accurate records(3pts)

2.What is the purpose of improving farm records?(5pts)

3. How to keep farm records (2pts)

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

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

Answer sheet

Score = _____

Rating: _____

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3._____
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List of Reference

1. Metric OPSS (Ontario provincial standard specification), 2005. General specification for the management of excess materials.
2. Ronald H. Schmidt and Daniel J. Erickson, 2017. Sanitary Design and Construction of Food Processing and Handling Facilities, Florida.
3. Richard Karamatsu and Steve Oshiro, 2014 .Art of grafting pdf.

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