HORTICULTURAL CROPS PRODUCTION

Level III

Learning Guide#40

Unit of Competence: Implement a propagation plan

Module Title: Implementing a propagation plan

LG Code: AGR HCP3 M09 LO1-LG-40

TTLM Code: AGR HCP3 TTLM 0120v1

LO1: Prepare for propagation activities

Instruction Sheet	Learning Guide #40

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

- Interpreting and organizing Workplace information and tasks
- Selecting tools, equipment and machinery.
- Preparing growing environment
- Identifying propagation method.
- Implementing hygiene practices
- Identifying OHS hazards are identified,
- Assessing and reporting risks

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 and organize Workplace information and tasks
- Select tools, equipment and machinery.
- Prepare growing environment
- Identify propagation method.
- Implement hygiene practices
- Identify OHS hazards are identified,
- Assess and report risks

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, 11,24, 28, 30 and 33
4. If you earned a satisfactory evaluation precede to “LO2”.
5. If unsatisfactory, your teacher shall advice you on additional work. But if satisfactory you can proceed to Learning Guide ----------.

Information Sheet-1	Interpreting and organizing Workplace information and tasks

1.1 Definition

Plant propagation involves the formation and development of new individuals, which are used in establishment of new plantings. It is simply refers to the reproduction or multiplication of plant material of a specific cultivar, variety, breeding line or strain that possesses desirable characteristics, (such as fruit shape and internal quality) in such a way that more daughter plants are obtained from the mother plant. The production of true to type progeny from the mother plant is the prime objective of propagation. Plant propagation has been a useful tool since centuries, which has made possible the generations to pass through and sustain production especially for fruit plants since time immoral. Plant propagation depends on the plant species, variety, method of propagation, climatic and growth conditions. Man has propagated plant material almost as long as he has cultivated the land to produce food. For a long time, plant material was propagated mainly by using the seeds of existing plants. Better methods were discovered over time, methods that allowed the farmer to retain the desirable qualities of the plant material, while eliminating some of the less desirable qualities. Through these methods, the farmer was also able to eliminate the variations between plants of the same cultivar and produce more consistently. Today, farmers buy their plant material consisting of seed and seedlings from commercial seed companies or nurseries. The farmer is able to obtain plant material of a wide variety of cultivars, and that has qualities most suited to his specific environment.

Plant Propagation is important because:

- It multiplies the different species in large number.
- It protects the plant species which are endangered
- It improves the characteristics and quality of the plants.
- It produces quality and healthy plants on commercial base.

1.2. Organizing tasks and Interpreting work place information

Work procedure will be based on sound horticultural principles and practices and may includes supervisors, oral and written instructions, propagation program, enterprise standard operating procedures, specifications, production schedules, routine maintenance schedules, work notes, product labels, material safety data sheet, Integrated pest management (IPM) programs; manufacturers service specifications and operators manuals; waste disposal, recycling and re-use guidelines and OHS procedures must be interpreted and organized.

1.3 Principles of Workplace information

The trainees need to collect necessary information before preparing the plan. The information needed may include: agro-ecological data, socio-economic data, market information, propagation material availability, assessing services and site modifications required propagation techniques, sequence of operational activities in the propagation of horticultural crops and production guidelines for different horticultural crops (spacing, seeding rate, fertilizer requirement, types of chemicals used for control of insect pest and diseases of fruits, yield per hectare, etc.) and monitoring the activities. This can be done by visiting nearby metrological center, farmers' field, market, etc.

Work procedure will be based on sound horticultural principles and practices and may include supervisors oral and written instructions, propagation program, enterprise standard operating procedures(SOPs),specifications, production schedules, routine maintenance schedules, work notes, product labels, material safety data sheet(MSDSs);Integrated pest management(IPM) programs; manufacturers service specifications and operators manuals; waste disposal, recycling and re-use guidelines and OHS procedures must be interpreted and organized.

Self-check -1	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. What is the importance of Organizing tasks and Interpreting work place information?(10pts)

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

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

Answer sheet

Score = _____

Rating: _____

1.

Information Sheet-2	Selecting tools, equipment and machinery.

2.1 Selecting tools, equipment and machinery

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.

- Plastic containers and trays, scalpel,
- laminar flow cabinet,
- Autoclave, alcohol,
- Wheelbarrow,
- Trolley, mechanical trolley,
- Shovel, water spray container, dibblers and rubbish bins.

Materials used for propagation includes:

- Plant material
- Container (Tray, pots, sleeves, etc.)
- Rooting hormone
- Measuring tape
- Media
  - Sterile
  - Low fertility

- Well-drained
- Retains moisture
- Peat/perlite (1:1 mix)
- Vermiculite/perlite(1:1mix

Equipments and machinery for propagation

Different types of sprayers and dusters are available from manually to power operated such as knapsack sprayers, foot operated sprayers, power operated mist blowers and dusters for plant protection. Fogging machines and mist blowers are available which can be used in the green houses and for covered crop cultivation. Different types of pumps which includes centrifugal, turbine, submersible, axial flow, mixed flow pumps etc. are available for lifting of the water for irrigation. Including sprinkler and drip irrigation systems.

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 ber 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 -2	Written Test

Name: _____ Date: _____

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

1. List the Equipments and machinery used for propagation and discuss function each(10pts)

2. What is the use of sterilization Liquid?(3pts)

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: _____

1.

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2._____

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Information Sheet-3	Preparing growing environment

3.1. Preparing growing environment

In propagating and growing young nursery plants, facilities and procedures are designed to optimize the response of plants to environmental factors influencing their growth and development, such as light, water, temperature, gases, and mineral nutrition. In addition, young nursery plants require protection from pathogens and other pests, as well as control of salinity levels in the growing media. The propagation structures, equipment, and procedures maximize the plants' growth and development by controlling their environment.

Light

Light is important for photosynthesis as a source of radiant energy. Light also generates a heat load that needs to be controlled (i.e., too high a temperature can quickly desiccate and kill cuttings). The management of light can be critical for rooting cuttings, germinating seeds, growing seedlings, or shoot multiplication of explants during tissue culture propagation.

Water: Water management and humidity control are critical in propagation. Water management is one of the most effective tools for regulating plant growth. Evaporative cooling of an intermittent mist system can help control the propagation house microenvironment and reduce the heat load on cuttings, thereby permitting utilization of high light conditions to increase photosynthesis and encourage subsequent root development. Tissue culture explants are often grown in a liquid phase rather than on a solid agar media. While leaf water potential is an important parameter for measuring water status of seedlings and cuttings, and influences rooting of cuttings, turgor is physiologically more important for growth processes. The water status of seedlings and cuttings is a balance between transpiration losses and uptake of water.

Temperature: Temperature affects plant propagation in many ways. Seed dormancy is broken in some woody species by cool moist stratification conditions that allow the

germination process to proceed. Temperature of the propagation medium can be suboptimal for seed germination or rooting due to seasonally related ambient air temperature or the cooling effect of mist. In grafting, heating devices are sometimes placed in the graft union area to speed up graft union formation, while the rest of the rootstock is kept dormant under cooler conditions. It is often more satisfactory and cost-effective to manipulate temperature by bottom heating at the propagation bench level, rather than heating the entire propagation house .

Gases and Gas Exchange

High respiration rates occur with seed germination and plug development, and during adventitious root formation at the base of a cutting. During propagation in enclosed greenhouses, ambient CO_2 levels can drop to suboptimal levels, limiting photosynthesis and propagules development. The buildup of ethylene gas can be deleterious to propagules during storage, shipping, and propagation conditions. Ethylene also plays a role in plant respiration, rooting of cuttings, and seed propagation.

Mineral Nutrition: To avoid stress and poor development during propagation, it is important that the stock plants be maintained under optimal nutrition prior to harvesting propagules. During propagation, nutrients are generally applied to seedlings and plugs by fertigation (soluble fertilizers added to irrigation water) or with controlled-release fertilizers that are either.

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. Discuss the purpose of preparing growing environment ?(5pts)
2. List important factors that may considered during preparing growing environment (6pts)

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: _____

1.
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2._____
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Information Sheet-4	Identifying propagation method

4.1 Identifying propagation method

There are two methods of plant propagation: sexual and asexual

(A) Sexual Plant Propagation

Sexual plant propagation involves the union of the pollen (male organ) with the egg (female organ) in plants to produce a seed. The seed is made up of three parts: the outer seed coat, which protects the seed; the endosperm, which is a food reserve; and the embryo, which is the young plant itself. When a mature seed is exposed to favorable environment, it germinates and begins its active growth.

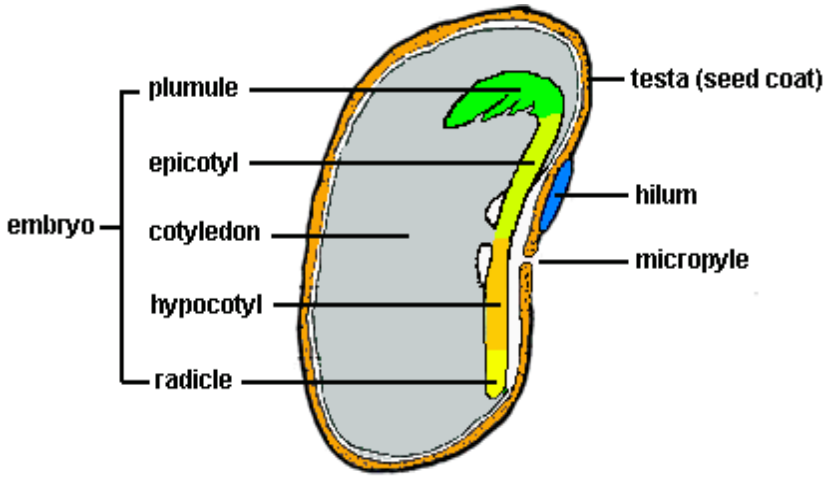

figure 4.1 Structure of a Seed

Advantages of Sexual Plant Propagation

- It is the easiest and least expensive method of plant propagation.
- Seedling trees are hardier and have longer life span.
- Plants which are difficult to propagate by vegetative method e.g. papaya, phalsa, coconut etc. can only be propagated by seed.
- The rootstocks on which the fruit varieties are budded or grafted are usually obtained by means of sexual propagation.
- Sexually propagated plants are more resistant to pests and disease.
- Large number of plants can be produced at a time by this method.

- Poly embryonic varieties (give rise to more than one seedling from one seed) can be propagated by seed eg. Nucellar Embryo in Nucellar Mosambi (Sweet Orange)

Disadvantages of Sexual Plant Propagation

- Seedlings take more time to bear fruits (late bearing).
- Quality of existing plants cannot be improved by sexual propagation.
- Plants propagated sexually are large in size, thus the cost of manuring, pruning and spraying increases.
- In case of sexually propagated plants, there is no assurance about genetic purity of the offspring or seedling.

(B) Asexual Plant Propagation

In this method the vegetative parts of plants such as leaves, stems, and roots are used for propagation. These plants may be taken from single mother plant or other plants. It is also called as vegetative method of plant propagation.

Advantages of Asexual Plant Propagation

- Plants propagated by this method are true to type and uniform in growth, yield and quality of fruits.
- Some fruits such as Banana, Pineapple, seedless Guava and seedless Grape varieties can only be propagated through vegetative means.
- Vegetatively propagated fruit tree comes into bearing earlier than seed propagated plants and have assured genetic configurations.
- Plants produced are of manageable size and have uniform fruits making harvesting easy.
- Some diseases can be avoided in susceptible varieties by grafting them on a resistant rootstock e.g. Use of Rangpur Lime" as rootstock for budding Mandarin Orange to avoid gummosis disease.
- Better rootstock can be conveniently combined with the method to suit the climatic requirement of the area.
- Repairing of damaged portion of plant is possible by asexual methods through bridge grafting or buttressing. These methods can be used for healing of the wounds caused by rodents.

- Inferior quality crown of the existing plants can be improved. For example, side grafting and crown grafting in mango.
- It is possible to grow multiple varieties on the same plant. One can grow numerous varieties of Roses and Mangoes on different branches of the same stock.
- Number of plant per hectare is more due to its small canopy and restricted growth.
- Vegetative propagation helps in rapid multiplication with modern techniques like tissue culture and other micro propagation techniques.

Disadvantages of Asexual Plant Propagation

- It is difficult and more expensive method of propagation in some plants like papaya, coconut, etc.
- Plants are generally not so vigorous and long lived as seedling plants and they require special skill for propagation.
- Hybridization in these plants is not possible because there is no variation in the progeny; these methods are not suitable for development of a new variety.
- Plants propagated by this method are not hardy and fall easy prey to adverse conditions of soil, climate, diseases, pests, etc.

1. Seed germination process: Germination in plants is the process by which a dormant seed begins to sprout and grow into a seedling under the right growing conditions. In bacteria or fungi, germination is the process in which a spore begins to grow vegetative cells, and sporeling hyphae .

Steps involved germination

- The seed absorbs water and seed coat bursts. It is the first sign of germination. There is an activation of enzymes, increase in respiration, and plant cells get duplicated. A chain of chemical changes starts which leads to the development of the plant embryo.
- Chemical energy stored in the form of starch is converted to sugar, which serves as food for the embryo during the germination process. Soon, the embryo gets nourished and enlarged, and the seed coat bursts open.
- The growing plant emerges out. Tip of the root first emerges, growing downwards, and helps to anchor the seed in place. It also allows the embryo to absorb minerals and water from soil.

- Some seeds require special treatment of temperature, light or moisture to start germination.

2. Stages involved in Germination process:

Seed germination means the growth of embryo into seedling and plant. The steps of germination of seeds are based on the time period and physiological changes.

1. Imbibition phase.
2. Latent phase.
3. Exponential growth phase.

Imbibition phase:

This is a phase where seeds imbibe water from surroundings. When a seed falls onto soil, it receives sufficient water and moisture. Then the actual process of germination starts. The water permeates through the seed coat and the seed material inside is drenched. The internal seed content imbibes (absorbs) water and the seed swells. This puts pressure on seed coat to provide eruption for germination. All the parts of a germinating seed become soft and smooth in this phase.

The food material inside the seed, now in presence of water provide sufficient energy. This helps the embryo to sprout out of the seed as a seedling. There is an internal active metabolism for the seed. This is a bit long time consuming process so it remain latent. The metabolic reaction is active and there is release of heat. This stage makes the seed ready to sprout out.

Exponential growth phase:

All the biochemical reaction get activated and plant growth hormones then guide the process of germination. By regulation of auxin a growth hormone, the root tends to grow into the soil while the stem forms and grows towards light. This process continues till the germination of seed into small plant is complete. Until the level of formation of leaves, the growth of plant is sustained by reserve food material, water and oxygen from air.

Once leaves form, food is synthesized from light using carbon-dioxide and water. Thus the seed germination process ends with formation of seedling which grows into big plant.

3. Factors affecting germination of seeds: Seed germination is affected by many factors like: Environmental and internal factors

Water: Seeds are most driest forms and they require water for germination. It helps seed in activation of enzymes to digest reserve food to rupture seed coat and to mediate all the physiological processes of seed.

Temperature: Soil temperature for seed germination is critical. Both low temperatures and high temperatures are not suitable for seed growth. Because enzymes are not active at low temperatures and physiology of growth is slow while at high temperatures they get denatured.

Oxygen: is vital to oxidize reserve food and provide energy for seed germination. Without oxygen seed do not germinate as seen in seeds sown very deep in the soil.

Sunlight: Seed germination varies in plants due to light. Some require light for germination while in other germination is inhibited by light. But light seems to guide direction of roots and stem from the seed.

Methods of Breaking Dormancy

One of the functions of dormancy is to prevent a seed from germinating before it is surrounded by a favorable environment. In some trees and shrubs, seed dormancy is difficult to break, even when the environment is ideal. Various treatments are performed on the seed to break dormancy and begin germination.

Scarification: Seed scarification involves breaking, scratching, or softening the seed coat so that water can enter and begin the germination process. There are several methods of scarifying seeds. In acid scarification, seeds are put in a glass container and covered with concentrated sulfuric acid. The seeds are gently stirred and allowed to soak from 10 minutes to several hours, depending on the hardness of the seed coat. When the seed coat has become thin, the seeds can be removed, washed, and planted. Another scarification method is mechanical. Seeds are filed with a metal file, rubbed with sandpaper, or cracked with a hammer to weaken the seed coat. Hot water

scarification involves putting the seed into hot water (170 to 212 degrees F). The seeds are allowed to soak in the water, as it cools, for 12 to 24 hours and then planted. A fourth method is one of warm, moist scarification. In this case, seeds are stored in non sterile, warm, damp containers where the seed coat will be broken down by decay over several months.

Stratification: Seeds of some fall-ripening trees and shrubs of the temperate zone will not germinate unless chilled underground as they over winter. This so called “after ripening” may be accomplished artificially by a practice called stratification. The following procedure is usually successful. Put sand or vermiculite in a clay pot to about 2.5cm from the top. Place the seeds on top of the medium and cover with 1.2cm of sand or vermiculite. Wet the medium thoroughly and allow excess water to drain through the hole in the pot. Place the pot containing the moist medium and seeds in a plastic bag and seal. Place the bag in a refrigerator. Periodically check to see that the medium is moist, but not wet. Additional water will probably not be necessary. After 10 to 12 weeks, remove the bag from the refrigerator. Take the pot out and set it in a warm place in the house. Water often enough to keep the medium moist. Soon the seedlings should emerge. When the young plants are about 7.5cm tall, transplant them into pots to grow until time for setting outside.

Another procedure that is usually successful uses sphagnum moss or peat moss. Wet the moss thoroughly, then squeeze out the excess water with your hands. Mix seed with the sphagnum or peat and place in a plastic bag. Seal the bag and put it in a refrigerator. Check periodically. If there is condensation on the inside of the bag, the process will probably be successful. After 10 to 12 weeks, remove the bag from the refrigerator. Plant the seeds in pots to germinate and grow. Handle seeds carefully. Often the small roots and shoots are emerging at the end of the stratification period. Care must be taken not to break these off. Temperatures in the range of 35 to 45 degrees F (2 to 7^0C) are effective. Most refrigerators operate in this range. Seeds of most fruit and nut trees can be successfully germinated by these procedures. Seeds of

peaches should be removed from the hard pit. Care must be taken when cracking the pits. Any injury to the seed itself can be an entry path for disease organisms.

Viability: Seeds ability to germinate varies on the method of storage, health of the parent, age of seed, maturity of seed, infections etc. So the seeds with good viability germinate faster.

Seed treatment

Objectives of seed treatment;-

- ✓ To prevent the seed against pest and diseases infestation.
- ✓ To break seed dormancy and to induce higher germination percentage.
- ✓ To inoculate the seed with Rhizobium bio fertilizer.
- ✓ To induce tolerance to salinity, drought frost etc..
- ✓ To promote nitrogen fixation by treating it with Rhizobium

Important of seed treatment: Seed treatment is the process of applying physical, chemical or biological treatment to the seed to keep it viable and health.

Types of seed treatment

1. Physical treatment
2. Biological treatment
3. Chemical treatment

1. Physical seed treatment

- It includes subjecting seeds to solar exposure, immersion in conditioned water etc.
- To induce higher germination, the seeds may be soaked in water before sowing or may be exposed to warm temperature. Early rooting may be induced by treating seeds with IBA or GA solutions.
- To induce or facilitates sowing and better germination in cotton seed treated with
- Sulphuric acid (H_2SO_4).

2. Biological Seed treatment

It includes the treatment of seeds with microbial cultivars such as that of Rhizobium to inoculate the seeds with microbial cultivars, to fix atmospheric nitrogen and release to the soil.

3. Chemical seed treatment

It includes treating seeds with fungicides, insecticides, nematocides etc.

Types of chemical used for seed treatment

1. Insecticides:- Parathion, phorate, chlorphriphos, furadan, dimethoateetc
2. Fungicides:- Thiram , thiophante(topsin), carbendazim, vitavax, dexonetc

Dressing seeds with chemicals

- **Insecticides for stored seeds**

Only use them with clean dry grain in good place. The seeds must be clean and dry in order to keep the high percentage of live seeds that will geminate.

Selection of insecticides: - The kinds of insecticides for fumigation may be used for stored seeds. Fumigants may kill many kinds of pests in store house by releasing toxic gas. Commonly used are:-

a. **Phostoxin** (AIP):- used for 1-4 pieces/m^3 in store, and 4-12 pieces /m^3 in open bam. Every pieces of space should be more than 2cm, avoid contact with water and keep the fire off.
b. **Methyl bromine** (CH_3Br):- suitable for condition of low temperature, spray for 0.5 Kg/37/m^3. The store house must be strictly sealed in.

- **Seed disinfectant**

- **Fungicides**: - for seed dressing, fungicides to seeds ratio is 0.3-1.0:100 for 10 to 48 hours.

  For seed soaking, fungicides to seeds ratio is 1:500-1000 for 10 to 48 hours.
- **Insecticides**: - quantity of usage is based on the insecticides but every seed should be coated with distributed insecticides used for seed coating. Insecticides, water and seed ratio is 1:50:50 suffocating for 4 to 6 hours
- **Fumigants: -** look at insecticides used for stored seeds. Ways of application

a. **Seed dressing**: - is mixing of seeds with the pesticides powder or liquid evenly, like high concentration of powder or WP, EC etc.

   Usage

   Powder: - dry dressing by man or in the mixer (Drum)

   Wettable powder or emulsion: - Prepare chemicals before seed dressing from 0.3% to 1.0% of the weight of the seeds.

b. **Seed soaking**

   It is soaking of the seeds into the solution for certain time. Prepare the solution usually 500- 1000 times solution. Soak the seeds into the solution for certain time, from 10 minutes to 48 hours. Spray out the seeds and dry the moisture of the surface of the seeds.

c. **Rinsing: -** is just like the soaking, only the time of seed in the solutions is much shorter than that of soaking, aims to kill the pest on the seeds.

d. **Seed suffocating: -** compounds the seeds with pesticides and suffocate for several hours.

   Usage:-

   - Chemical, water to seed ratio is 1:50:50
   - Mix the seed with the solution evenly
   - Pile with a cover of cloth, plastic film or sacks for several hours
   - Sow the seeds after drying the moisture on the surface of seeds

2. Asexual (Vegetative) Propagation

Budding is similar to grafting except that the scion is reduced to a single bud with a small portion of bark or wood attached.

- The single bud scion is joined with the rootstock to form a new plant.
- It is done in the spring or fall when the bark separates easily from the wood
- It is faster, easier and more economical than grafting
- No wax is needed & cambium does not need to be aligned; less scion is needed

  Examples: Roses, fruit trees

- Cutting: rooting a severed piece from a parent plant

- Layering
    - Rooting a stem while attached to the parent plant
- Division
    - Separation of multi-crown plants
- Grafting & Budding
    - Joining of 2 plant parts
- Tissue Culture
    - Aseptic culture of meristematic tissue

Micro propagation is *in vitro* propagation and many genetically identical plants are produced from **one plant**

- Rapid (compared to outdoors)
- Asexual
- *in vitro* propagation (in tubes/petri plates etc.)
- A single node will produce a shoot within 4-6 weeks that has 4-6 nodes.
- Each plantlet can be "sub cultured" to produce another 4-6 plants each.
- Hundreds of thousands of plants could be developed from one node. Since these are produced from auxiliary buds, the plantlets will be clones of the mother plant.

Advantages of micro propagation

- Economical in time and space
- Greater output -can produce millions of uniformly flowering and yielding plants
  - African biotechnologies - fruit crops banana and indoor pot flowers 6 million pieces per year
- Disease free
- Elite plants with exceptional characteristics
- facilitates safer movements of germplasm across nations. *In vitro* germplasm assures the exchange of pest and disease free material
- Great for vegetatively reproduced crops which produce few seeds or highly heterozygous seeds.

  Regeneration is possible because plant cells can be made *totipotent* using hormones.
  - differentiated tissue: stems, leaves, roots, etc.
  - undifferentiated (embryonic) cells are totipotent: can become a whole new plant by differentiating into a whole new plant.

  Plant Hormones are naturally occurring chemicals that influence plant growth.

  Growth Regulators are synthetic versions of hormones

  Cytokinins induce the production of shoots

  Auxins induce the production of roots

  The action of the different hormones / regulators is not consistent:
    - Different plants will respond to the same chemical differently.
    - Different plant parts from the same plant can respond differently
  - tissue must be sterile - completely free of any microorganisms; done using aseptic technique

    Starting tissue is called an *explants:* differentiated cells (these cells have developed to be part of specialized tissue (root, leaf, stem, ovary, cotyledon, etc.).

    Explants are plated on a sterile petri dish containing hormones and nutrients that promote the explants cells to develop into **Callus** - a mass of *undifferentiated* cells.

Callus cells are **totipotent**

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 micro 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

Score = _____

Rating: _____

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2._____
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3._____
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Information Sheet-5	Implementing hygiene practices

5.1. Implementing hygiene practice

One of the most rewarding processes in nursery production is plant propagation. However, the opportunity for pest and diseases to severely impact on propagation success should not be underestimated. Poor hygiene in plant propagation can lead to complete propagation failure or retardation in plant growth, both of which have significant cost implications. This highlights hygiene protocols that should be implemented during the four stages of propagation:

- ® Cutting material and seed collection
- ® Cutting preparation
- ® Propagating
- ® Hardening off.

Although seed treatment reduces the possibility of infections, infected fruits should be avoided when collecting seeds. Only healthy fruit still hanging on the tree are to be used, as rotten fruit and fruit lying on the ground might carry brown rot (Phytophtora) and contaminate the medium.

Sanitation treatment is extended to the media used, the containers, floors and benches. Propagation media, such as perlite and vermiculite, are sterile and classified as very low-risk by virtue of the temperatures they are subjected to during their processing. 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 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. Blunt knives and pruning shears must be sharpened using a sharpening stone. Go around in your community and identify the crops being produced in your area.

Enquire from the farmer(s) how he/she propagates the specific crop(s) and what tools and equipment are used for propagation of the crops. Also find out if they use any safety, sanitation and hygiene protocols when propagating their corps. Take pictures of the propagation material (if available), tools and equipment used in propagation and facilities where propagation is done.

The importance of sanitation during propagation and growing has become widely recognized as an essential part of nursery operations. During propagation, losses of young seedlings, rooted cuttings, tissue-cultured rooted plants, and grafted nursery plants to various pathogens and insect pests can sometimes be devastating, especially under the warm, humid conditions found in propagation houses. Ideally, sanitation strategies should be considered even in the construction phase of propagation structures. Harmful pathogens and other pests are best managed by dealing with the three situations where they can enter and become a problem during propagation procedures:

- The propagation facilities: propagating room, containers, pots, flats, knives, shears, working surfaces, hoses, greenhouse benches, and the like
- The propagation media: rooting and growing mixes for cuttings, seedlings, and tissue culture plantlets
- The stock plant material: seeds, cutting material, scion, stock material for grafting, and tissue culture. Sanitation practices in nursery include,

1. Prevention of insects, pests and diseases
2. Inspection for insect, pest and disease incidences
3. Environmental control leading to protection from harmful environment factors like hot sun, freezing temperatures, storms, etc.
4. Eradication of pests, diseases and weeds.

Sanitation Treatments

1. Sterilization of the propagation media, tools, and implements used is necessary in nursery plant production. Propagating media and tools can be easily sterilized by heat or by chemicals. A temperature of about 71 ^{0}C for 30 minutes is considered sufficient to kill almost all disease producing pathogens.

2. Chemicals used for sterilizations are Chloropicrin, Formaldehyde, Methyl Bromide.

3. Fumigation with chemicals is useful for destroying harmful bacteria, fungi and nematodes in a relatively small quantity of soil that is used for propagation of plants.

4. Drenching the medium with certain fungicides is also useful in eliminating pathogens from the soil, coco peat and other media.

5. General cleanliness of nursery area (inside and outside) and all the implements are necessary.

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 down hygiene protocols that should be implemented during the four stages of propagation (5pts).

2.What is the cause of poor hygiene in plant propagation?(5pts)

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-6	Identifying OHS hazards

6.1. Identifying OHS hazards

Workers have a duty to take reasonable care for their own health and safety and must not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to the use, handling and storage of hazardous chemicals at the workplace. Identifying hazards involves finding all of the foreseeable hazards in the workplace and understanding the possible harm that the hazards may cause. *OHS hazards* may include: disturbance or interruption of services, solar radiation, dust, noise, soil-, air- and water-borne micro-organisms, chemicals and hazardous substances, sharp hand tools and equipment, manual handling, moving vehicles, machinery and machinery parts, flying objects and uneven surfaces.

Self-check -6	Written Test

Name: _____ Date: _____

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

1. Discuss the importance of Identifying OHS hazards?(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: _____

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Information Sheet-7	Assessing and reporting risks

7.1. Assessing risk and reporting risks

Risk assessment is a process for developing knowledge and understanding about hazards and risks so that sound decisions can be taken about control. A risk assessment will provide knowledge to make informed decisions about controlling hazards and risks. The risk assessment needs to be tailored to the situation and to the organization in which it is conducted; it can be as simple as structured discussion during consultation or it can be more elaborate and formal.

Risk assessment assists in determining:

- What levels of harm can occur
- How harm can occur
- The likelihood that harm will occur.

A risk assessment should be done when:

- ➔ There is only limited knowledge about a hazard or risk, or about how the risk may result in injury or illness
- ➔ There is uncertainty about whether all of the things that can go wrong have been found
- ➔ The situation involves a number of different hazards that are part of the same work process or piece of plant and there is a lack of understanding about how the hazards may impact upon each other to produce new or greater risks.

7. 2. Controlling hazards and risks

Workplaces can be dangerous; there are many hazards that have the potential to kill, injure or cause ill health or disease. Protecting the health and safety of people in the workplace is a community expectation that makes good business sense. Workplace incidents can have a dramatic impact on people's lives (people in the workplace,

families and friends), and they can have significant financial impacts on organizations through loss of skilled staff and lost production of goods or services.

However, in many circumstances it will be the best way to determine the measures that should be implemented to control risks. It will help to:

- Identify which workers are at risk of exposure
- Determine what sources and processes are causing that risk
- Identify if and what kind of control measures should be implemented
- Check the effectiveness of existing control measures.

Self-check -7	Written Test

Name: _____ Date: _____

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

1.Define Risk assessment?(3pts)

2. How to control risks?(5pts)

3. Mention when risk assessment should be done (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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HORTICULTURAL CROPS PRODUCTION

Level III

Learning Guide#41

Unit of Competence: Implement a propagation plan

Module Title: Implementing a propagation plan

LG Code: AGR HCP3 M09 LO2-LG-41

TTLM Code: AGR HCP3 TTLM 0120v1

LO2: Select propagation material

Instruction Sheet	Learning Guide #41

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

- Identifying and selecting parent plant
- Selecting and collecting propagation material
- Selecting conditioning and storage requirements

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

- Identify and select parent plant
- Select and collect propagation material
- Select conditioning and storage requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-3
3. Accomplish the “Self-check” in page 39, 41 and 44
4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page 45. 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 46 (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	Identifying and selecting parent plant

1.1 Identifying and selecting parent plant

A. Identifying parent plant

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 criteria that determine a good mother tree/plant:

B. Criteria for Selection of mother Plants:.

- The mother plants of the variety should be genetically true to type and superior in quality.
- The mother plants should be healthy, vigorous, high yielding ability and free from any diseases, pest infestations and physiological disorder.
- The mother plants should have known pedigree records regarding bearing potential, fruit quality and problems, if any.
- The mother plants should be a productive and regular fruit bearer.
- Dwarfing and semi-dwarfing in nature
- Compatibility with the known commercial cultivars.
- Resistance/tolerance to biotic (diseases and pests) and abiotic stresses.
- Rootstock should have well developed and profuse root system.
- The rootstock should be easy to propagate vegetatively or from seeds.
- Early mature
- Good producers of the desired product
- Growing in the midst of a healthy stand of the same species.
- The purchase receipt of mother plant should be preserved to prove the origin and authenticity of the mother plants

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.

1.2 Mother plant selection and maintenance

Mother plant is the most important factor of plant nursery. 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. The success of any nursery depends greatly on the health and vigor of its mother plants. It is therefore necessary to obtain genetically sound mother plants to produce healthy and vigorous off springs. Not only selection of mother plants necessary but also proper care and maintenance of these plants is also essential to obtain vigorous and healthy growth. This can be achieved by taking appropriate care. Mother plants are irrigated regularly. Trees that are used for propagation material are called mother trees. Of course it is important to select outstanding mother trees. Mark the outstanding mother trees so that you can recognize them in years to come. Selection makes sense because the young trees will be expected to inherit the favorable characteristics from the mother tree, such as fast growth, upright or spreading shape of the tree crown, good flowering and fruiting and tolerance of diseases or pests.

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 criteria for selection of mother plants?(6pts)
2. Mention how to mother plant selection and maintenance?(6pts)
3. Why you identify parent plant? (6pts)

Note: **Satisfactory rating - 18 points and above Unsatisfactory - below 18 points**

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

Answer sheet

Score = _____

Rating: _____

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Information Sheet-2	Selecting and collecting propagation material

2.1 Selecting and collecting propagation material

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.

Separated living portion of a plant (such as a bud or shoot) joined to a stock in grafting and usually supplying solely aerial parts to a graft. Quality plants are produced only from quality seeds obtained from a reliable dealer. Select varieties to provide the size, color, and growth of plant. Many new vegetable and Flower varieties are hybrids, which cost a little more than open pollinated types. However, hybrid plants usually have more strength, more uniformity, and better production than non-hybrids and sometimes have specific disease resistance or other unique cultural Characteristics

Parameters of scion selection

- Behavior fruit
- One year old wood
- Pencil size
- At list it have 3 bud

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.

Self-check -2	Written Test

Name: _____ Date: _____

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

1. How to collect the stock ?(6pts)

2. How to collect the scion?(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

Score = _____

Rating: _____

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Information Sheet-3	Selecting conditioning and storage requirements

3.1 Selecting condition and storage requirements

Appropriate storage of planting materials. The viability of materials can be maintained by :

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

For best results, harvest only as much scion wood as can be used for grafting during the same day. Select only healthy scion wood that is free from insect, disease or physical damage. Be sure the stock plants are of good quality, healthy, and true to type. If large quantities of scion wood must be harvested at one time. If freezing temperatures are likely to damage plant tissues, collect scion wood for grafting in the fall after normal leaf drop but before severe winter temperatures. Otherwise, wait to collect until late winter. Store the wood in a plastic bag. Enclose a moist cloth, but leave no free water in the bag. Store the wood in a refrigerator between 35°F (1.7°C) and 40°F (4°C). Make sure that fruits or plant materials capable of generating ethylene gas (plant hormone that induces ripening/senescence) are stored in a different cooler than the scions or rootstocks. If refrigeration is unavailable, store the wood outdoors in moist sand in a well-drained, protected location where the soil will not freeze. Scions and stock plant are selected from the previous season's growth. Collect “bud sticks” of the cultivar to be propagated from vigorous current season growth. The middle buds generally are the best to use since the tip buds are too immature, and those near the base may be a cluster of buds or weak buds. The bud sticks are prepared by removing the leaves but leaving 0.25 to 0.5cm of leaf petiole on the stem. The scions should be tied securely, carefully labeled and placed in moist (not wet) sawdust or moss or wrapped in plastic material. They should be kept in a cool, moist place where they will remain fresh and

dormant until spring. The buds should be used as soon as practical but may be stored for three to four days. To store bud sticks:

- Wrap them in damp paper toweling,
- Attach a label for positive identification,
- Place in a polyethylene bag,
- Seal tightly, and
- Place in a refrigerator (32˚ to 45˚F).

Shortly after harvesting or receiving scion material, I recommend sealing the cut ends of the scion with water-based sealant such as liquid shade or tree seal. If you have a long bag leave the terminal bud on - then you have only one wound to seal. The sealed ends retard scion dehydration. Apply sealant to any area where the cambium has been broken, Pushing, packing and labelling, and controlling environmental parameters such as moisture, air, humidity and temperature Stick immediately or mist and hold overnight in a refrigerator

Fiure 3.1 collected scion

Stored graft wood is required for several grafting methods. Unless the wood is collected and stored properly, the grafting effort is designed for failure. A variety of problems may occur in the collection and storage process, including drying out or freezing the wood, immature buds, old shoots, and insect and/or disease damage.

Self-check -3	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 select condition for prepared planting materials ?(6pts)

2. Mention storage requirements for scion?(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

Score = _____

Rating: _____

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Operation sheet -1	**Techniques of collecting and storage propagation material**

Objective: To know how to select, collect and store propagation material

Material required: Budding knife, Grafting knife, A fine-tooth saw, Pruning shears, Dormant scion, Tying material such as grafting tape, adhesive tape and electrician's tape.

Procedures

1. Select suitable PPE and wear
2. Then, collect planting material from selected mother plant
3. Cut all scions to a uniform length, keep their basal ends together, and tie them in bundles of known quantity.
4. Label them, recording the cultivar, date of harvest, and location of the stock plant.
5. Wrap the base of the bundles in moistened burlap or sphagnum moss. Place them in polyethylene or waterproof paper bags, and seal the bags.
6. Store the bundles for short periods, if necessary, either iced down in insulated coolers or in a commercial storage unit at $^{0}0$ to 1.1^{o}C.
7. Never store scions in refrigerated units where fruits or vegetables are currently kept or have been stored recently.
8. Stored fruits and vegetables release ethylene gas, which can cause woody plant buds to abort, making the scions useless.
9. The scions should not be frozen during storage.

LAP Test	**Demonstrate how collect and storage propagation material**

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

starting time---------- Ending time----------

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

Task 1. perform how to collect and storage propagation material

List of Reference

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3. Kunte, Y.N., Kawthalkar, M.P.and Yawalkar, K.S. 2005. Principles of Horticulture and Fruit Growing. Agri-Horticultural Publishing House, Nagpur.
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HORTICULTURAL CROPS PRODUCTION

Level III

Learning Guide#42

Unit of Competence: Implement a propagation plan

Module Title: Implementing a propagation plan

LG Code: AGR HCP3 M09 LO3-LG-42

TTLM Code: AGR HCP3 TTLM 0120v1

LO3: Prepare propagating media

Instruction Sheet	Learning Guide #42

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

- Selecting media components
- Testing propagation media
    - Propagation techniques
    - Identifying media specification
- Handling media and components
- Selecting Storage requirements for the unused propagation media

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 media components
- Test propagation media
    - Propagation techniques
    - Identifying media specification
- Handle media and components
- Select Storage requirements for the unused propagation media

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 53, 58, 62, and 64.
4. If you earned a satisfactory evaluation precede to “LO4". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
5. Do 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 media components

1.1. Selecting media components

Propagation medium is a substance in which plant parts are placed for propagation. It provides initial support and favorable conditions for Plant Propagation. A good propagation medium is made up of components that provide optimum aeration, drainage and moisture holding characteristics. These are usually made up from combinations of peat moss, perlite, vermiculite, sand or similar materials. The primary role of a propagation medium is to provide support and moisture while the plant is developing. Maximum Yield explains Growing Media Growing media have three major functions:

- Physically support plant growth
- Allow for maximum root growth
- Supply roots with necessities such as water, air, and nutrients

Media for plant growth and seed germination has great significance in nursery business. The material for rooting and growing media may be used either alone or Incorporated with one or more products in combination. To prepare growing media use the following ratio

- For heavy (clayey) soils 1:2:2
- For medium (loamy) soils 1: 1:1
- For light (sandy) soils 1: 0:1

Most commonly this ratio is applicable 3(topsoil).1(sand), 2(compost).

For good results, the following characteristics of the medium are required :

- The medium must be sufficiently firm and dense to hold the cuttings or seeds in place during rooting or germination. Its volume must be fairly constant when either wet or dry; excessive shrinkage after drying is undesirable.
- It should be highly decomposed and stable (preferably with a 20C:1N ratio) to prevent N immobilization and excessive shrinkage during production.

- It must be easy to wet (not too hydrophobic) and retain enough moisture to reduce frequent watering.
- It must be sufficiently porous so that excess water drains away, permitting adequate penetration of oxygen to the roots all containers produce a perched water table that creates a zone of saturated growing medium at the bottom of the container.
- It must be free from pests: weed seeds, nematodes, and various pathogens.
- It must have a low salinity level.
- It should be capable of being steam-pasteurized or chemically treated without harmful effects.
- It should have a high cation exchange capacity (CEC) for retention of nutrients that may be applied pre incorporated and/or in a supplementary soluble and/or controlled-release fertilizer program.
- It should be of consistent quality from batch to batch, and reproducible.
- It should be readily available, and economical.

Examples of propagation media are

- Soil- sand, silt, and clay
- Sand – decomposed quartz particles 0.05 to 2.0 mm in diameter.
- Peat Moss – decomposed bog vegetation used to hold water in soil mixes
- Vermiculite – a hydrated magnesium-aluminum-iron silicate mica mineral that expands when heated
- Perlite - a gray-white volcanic silica material. Size range is from 1.6 to 3 mm in diameter
- Pumice – Volcanic rock used in mixes to increase aeration and drainage.
- Shredded Bark - wood products made from redwood, cedar, fir, pine, hemlock, or various hardwood bark species as a component in growing and propagating mixes
- Farm Yard Manure(FYM)

figure 1.1 Coco Peat: Soil-less medium used in Nursery

1.2 Preparing Soilless Growing Media

Although amendment combinations may vary, basic objectives in the preparation of a growing media are alike. An effective program should produce a growing media that is:

1. Porus and well drained, yet retentive of sufficient moisture to meet the water requirements of plants between irrigations;
2. Relatively low in soluble salts, but with an adequate exchange capacity to retain and supply the elements necessary for plant growth;
3. Standardized and uniform with each batch to permit the use of standardized fertilization and irrigation programs for each successive crop;
4. Free from harmful soil pests; pathogenic organisms, soil insects, nematodes and weed seeds
5. Biologically and chemically stable following pasteurization; primarily free from organic matter that releases ammonia when it is subjected to heat or chemical treatments.

Since innumerable amendment combinations can produce a growing medium with these characteristics, it is important to consider both the economic as well as cultural optimums. Factors that determine the cost of a growing medium include: transportation, labor, equipment, materials and handling. In many cases the cost of mixing a “custom”

growing medium exceeds that of the commercially prepared materials. These factors should be studied carefully before making a decision.

Figure 1.2 propagation of growing media component

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 characteristics of the medium that are required for plant propagation (8pts)

2. Describe the Examples of propagation media?(6pts)

Note: **Satisfactory rating - 14points 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-2	Testing propagation media

2.1. Testing propagating media

Pasteurization of Propagation Media: Propagation mixes such as bark, sand, and peat moss can contain pathogens and, ideally, should be pasteurized. The containers (bins, flats, pots) for such pasteurized mixes should, of course, have been treated to eliminate pathogens. Never put pasteurized mixes into dirty containers. New materials such as vermiculite, perlite, pumice, and rock wool, which have been heat-treated during their manufacture, need not be pasteurized unless they are reused.

Pasteurization of propagation media at lower temperatures with aerated steam is generally preferable to fumigation with chemicals. After treatment with steam, the medium can be used much sooner. Steam is nonselective for pests, whereas chemicals may be selective. In heating the soil, which should be moist but not wet, a temperature of 82°C for 30 minutes has been a standard recommendation because this procedure kills most harmful bacteria and fungi as well as nematodes, insects, and most weed seeds. However, a lower temperature, such as 60°C for 30 minutes, is more desirable since it kills pathogens but leaves many beneficial organisms that prevent explosive growth of harmful organisms if recontamination occurs.

2.2 Disinfection and Sanitation of Physical Propagation

Facilities-disinfection refers to the reduction of pathogens and algae, while sanitation refers to the level of cleanliness. The space where the actual propagation (making cuttings, planting seeds, grafting) takes place should be a light, very clean, cool room, completely separated from areas where the soil mixing, pot and flat storage, growing, and other operations take place.

At the end of each working day, all plant debris and soil should be cleaned out, the floors hosed down, and working surfaces washed with disinfectant solutions of sodium hypochlorite solution (Clorox), chlorine dioxide (Selectrocide), benzylkonium chloride, or pine disinfectant diluted according to directions. Benzylkonium chloride is long-lasting

and can be used for several days. Hydrogen dioxide (Zerotol, Oxidate) is a strong oxidizing agent used in sanitation of propagation facilities for the control of algae and pathogens.

2.3 Quality control tests

Quality control tests should be carried out by the end-user laboratory to ensure that the performance characteristics of the medium are within specification and that the methodology of medium preparation is satisfactory. Each lot/batch of prepared medium should be subjected to a minimal testing programme which will ensure that it is acceptable and will demonstrate a typical bacterial performance.

1. **PH value**: check that the pH of the prepared medium, when tested in final form at ambient temperature (25°C) lies within the range given on the product label. The medium should be discarded if the pH value lies outside the specified range.

2. **Sterility**: a representative sample of each lot/batch of medium should be incubated for 2-5 days at 35-30°C and 50-55°C. As a general rule, for a lot of 100 or less units a 3-5% sample should be tested. For a larger lot,10 random plates or tubes are taken. There should be no evidence of microbial growth after incubation. Discard all sterility samples when the tests have been completed.

3. **Growth performance**: test the growth support properties of the product by inoculating the medium with appropriate stock cultures and/or fresh isolates. Use a standard inoculation procedure and examine the quantitative and qualitative results obtained. If testing new lots/batches of media, inoculate old and new lots in one test and compare the performance of the two lots side by side.

4. **Stability**: periodically perform the above procedures on stored prepared media in order to determine whether the storage conditions will give optimal results.

2.4. Propagation techniques

In selecting propagating material, use only seed and those source plants that are disease and insect free. Some nurseries maintain stock plant blocks, which are kept carefully “clean. It is best to select cutting material from the upper portion of stock plants rather than from near the ground where the plant tissue could possibly be contaminated with soil pathogens. As cutting material is being collected, it should be placed in new plastic bags. After the cuttings have been made and before sticking them in flats, they can be dipped in a dilute bleach solution, or treated with various fungicides for broad-spectrum control of damping-off organisms before any Auxin treatment. However, once a cutting or seedling becomes infected with a bacterium, there is no effective control other than rouging-out and destroying the plant propagules.

2.5 Identifying media specification

An artificial, soilless mix also provides the desired qualities of a good germination substrate. The basic ingredients of such a mix are sphagnum peat moss and vermiculite, both of which are generally free of diseases, weed seeds, and insects. The ingredients are also readily available, easy to handle, lightweight, and produce uniform plant growth. “Peat-lite” mixes or similar products are commercially available or can be made at home using this recipe: 4 quarts of shredded sphagnum peat moss, 4 quarts of fine vermiculite, 1 tablespoon of superphosphate, and 2 tablespoons of ground limestone. Mix thoroughly. These mixes have little fertility, so seedlings must be watered with a diluted fertilizer solution soon after they emerge. Do not use garden soil by itself to start seedlings; it is not sterile, is too heavy, and will not drain well.

A. Media for Transplanting

Seedling growing mixes and containers can be purchased or prepared similar to those mentioned for germinating seed. The medium should contain more plant nutrients than a germination mix, however. Some commercial soilless mixes have fertilizer already added. When fertilizing, use a soluble house plant fertilizer, at the dilution recommended by the manufacturer, about every 2 weeks after the seedlings are

established. Remember that young seedlings are easily damaged by too much fertilizer, especially if they are under any moisture stress.

B. Containers for Transplanting

There is a wide variety of containers from which to choose for transplanting seedlings. These containers should be economical, durable, and make good use of space. The type selected will depend on the type of plant to be transplanted and individual growing conditions. Standard pots may be used, but they waste a great deal of space and may not dry out rapidly enough for the seedling to have sufficient oxygen for proper development.

figure 2.1 growing media for planting

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 the purpose of testing propagating media (8pts)
2. What is the relationship between media and Propagation techniques?(6pts)
3. What mean pasteurization of propagation media?(3pts)

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

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

Answer sheet

Score = _____

Rating: _____

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3.----------

Information Sheet-3	Handling media and components

3.1 Handling media and its components

The following media components can be used in propagation systems.

Soil

A mineral soil is composed of materials in the solid, liquid, and gaseous states. The solid portion of a soil is comprised of both inorganic and organic components. The inorganic part consists of the residue from parent rock after decomposition, resulting from the chemical and physical process of weathering. The organic portion of the soil consists of both living and dead organisms. Propagation in commercial horticulture is generally done with flats, containers, and/or pot systems using ***"soilless" media.*** Some exceptions to this are field budding and grafting systems, stooling and layering systems, field propagation of hardwood cuttings without intermittent mist, direct seeding of crops, and utilizing outdoor seedbeds.

Sand

Sand consists of small rock particles, 0.05 to 2.0 mm in diameter, formed as the result of the weathering of various rocks. Sand collected near the ocean (beach sand) may be too high in salts. Calcareous sand will raise media pH and should be tested prior to mixing with vinegar or a dilute acid.

Peat

Peat consists of the remains of aquatic, marsh, bog, or swamp vegetation that has been preserved under water in a partially decomposed state. Composition of different peat deposits varies widely, depending upon the vegetation from which it originated, state of decomposition, mineral content, and degree of acidity.

Sphagnum Moss Peat

Commercial sphagnum moss peat or sphagnum peat is the dehydrated young residue or living portions of acid-bog plants in the genus *Sphagnum,* such as *S. papillosum, S. capillaceum,* and *S. palustre.* It is the most desirable peat for horticultural purposes, but its high cost limits its commercial use. It is relatively pathogen-free, light in weight, and has a very high water-holding capacity, able to absorb 10 to 20 times its weight in water. Sphagnum moss has a pH of about 3.5 to 4.0.

Vermiculite

Vermiculite is a micaceous mineral that expands markedly when heated. When expanded, vermiculite is very light in weight 90 to 150 kg per cubic meter, neutral in reaction with good buffering properties, and insoluble in water. Vermiculite has a relatively high cation-exchange capacity and, thus, can hold nutrients in reserve for later release. It contains magnesium and potassium, but supplementary amounts are needed from other fertilizer sources.

Perlite

Perlite, a gray-white silicaceous material, is of volcanic origin, mined from lava flows. Usually, a particle size of 1.6 to 3.0 mm in diameter is used in horticultural applications. It is essentially neutral with a pH of 6.0 to 8.0 but with no buffering capacity. Unlike vermiculite, it has no cation exchange capacity and contains no mineral nutrients. It is most useful in increasing aeration in a mix. Perlite, in combination with peat moss, is a very popular rooting medium for cuttings.

Pumice Chemically, pumice is mostly silicon dioxide and aluminum oxide, with small amounts of iron, calcium, magnesium, and sodium in the oxide form. Pumice is screened to different size grades, but is not heat-treated. It increases aeration and drainage in a propagation mix and can be used alone or mixed with peat moss.

Rockwool (Mineral Wool) This material is prepared from various rock sources, such as basalt rock, melted at a temperature of about 1600°C. Horticultural rock wool is available in several forms shredded, prills (pellets), slabs, blocks, cubes, or combined

with peat moss as a mixture. Rockwool will hold a considerable amount of water, yet retains good oxygen levels.

Shredded Bark Shredded or pulverized softwood bark from redwood, cedar, fir, pine, hemlock, or various hardwood bark species, such as oaks and maples, can be used as an organic component in propagation and growing mixes and are frequently substituted for peat moss at a lower cost. Before it is used as a growing medium, pine bark is hammer-milled into smaller component pieces, stockpiled in the open, and often composted by turning the piles and watering as needed.

Coconut Fiber/Coir Coconut fiber (coir) is an economical peat substitute that can be mixed with a mineral component as propagation media. It is derived from coconut husks.

Compost: In some countries, compost is synonymous with container media for propagation and plant growth; however, we define *compost* (composting) as the product of biological decomposition of bulk organic wastes under controlled conditions, which takes place in piles or bins.

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 the media components that can be used in propagation systems (12pts)

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

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

Answer sheet

Score = _____

Rating: _____

1.

_____
_____
_____
_____
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Information Sheet-4	Selecting Storage requirements for the unused propagation media

4.1 Selecting Storage requirements for the unused propagation media

When potting in a greenhouse, the growing media used can have a major influence on crops. Growing media does not go bad, but changes do occur with aged product. Changes include draw-down of certain nutrients (if the blend has a starter nutrient charge), activation of limestone and decreased effectiveness of the wetting agent. For example, wetting agents can be consumed by native microorganisms found in the growing media components and can chemically degrade. Microbes in the growing media can potentially consume the fertilizer charge, especially nitrogen and iron. This may explain why crops planted in aged growing media get off to a slower start. These processes occur more rapidly with hot storage temperatures than with cold. The unused growing media was manufactured this way or it was caused by excessive fluffing with a bale breaker or soil mixer.

Self-check -4	Written Test

Name: _____ Date: _____

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

1. Describe use of selecting storage requirements for the unused propagation media (12pts)

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

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

Answer sheet

Score = _____

Rating: _____

1.

_____
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List of Reference

1. *http://dx.doi.org/10.29322/IJSRP.8.9.2018.p8115*
2.
3. FAO, 2010. Technical guidelines on tropical fruit tree management in Ethiopia
4. Stoltz L.P. and Strang J., 2004. Reproducing fruit trees by graftage: Budding and Grafting. University of Kentucky-College of Agriculture

HORTICULTURAL CROPS PRODUCTION

Level III

Learning Guide#43

Unit of Competence: Implement a propagation plan

Module Title: Implementing a propagation plan

LG Code: AGR HCP3 M09 LO4-LG-43

TTLM Code: AGR HCP3 TTLM 0120v1

LO4: Propagate plants

Instruction Sheet	Learning Guide #43

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

- Preparing propagation material
- Performing propagation techniques
- Handling plants
- Applying care
    - . identifying and employing propagation techniques

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 propagation material
- Perform propagation techniques
- Handle plants
- .Apply care
    - . identify and employ propagation techniques

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 72, 89, 91 and 94
4. If you earned a satisfactory evaluation precede to “Operation Sheet” in page 95-97. 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 98 (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	Preparing propagation material

1.1 Preparing propagation material

1.1.1 Preparing Root Stocks and scions/bud sticks

The budding operation begins when one year old whips of the appropriate rootstock are planted in early spring. Roots should be pruned to 15 to 20cm to facilitate planting. Any side shoots on the lower 10 to 12.5cm of the trunk should be cleanly pruned off. In mid-September, before starting the actual budding operation, check the bark on the stocks to see if it peels easily. (Irrigate if dry; bark will then slip in a few days.) If it does not slip and the cambium layer appears dry, the budding will not be successful. At budding time, remove all side shoots up to 10 to 15 cm above the ground to give a clear trunk area for inserting the bud. Place the bud about 5 to 7.5cm above the ground on the shade side of the stem. If a dwarfing rootstock is being budded, place the bud higher on the stem, usually 10 to 15cm above the ground.

Preparing the stock

- ✓ Seedling rootstocks should be healthy, vigorous, adaptive and resistant to any diseases and pests.
- ✓ Seedling rootstocks should be actively growing.
- ✓ Carefully clip off leaves (leave few at the top for photosynthesis), thorns and side twigs.
- ✓ Root stocks, about six inches above ground should be adequate

Bud stick preparation

- ➢ Bud sticks should be at dormant stage
- ➢ Bud sticks should be collected one/two days before start to budding
- ➢ Clip off /remove the leaves as soon as the bud sticks are cut.
- ➢ Discard the soft tips of the bud sticks

- Bud stick should be placed in closeable plastic bags and kept cool until use.

figures 2.1 show scion stick preparation

Select straight, smooth graft wood from 1-year-old wood 1/4- to 1/2-inch diameter. Cut shoots for grafts into 6-, 12-, or 18-inch lengths to give one, two, or three graft sticks. Each graft stick should contain at least three buds or nodes. Seal the end of the graft sticks with melted wax, grafting paint, or orange shellac. Only 1/4-inch of the end of each stick needs to be treated. When the seal is dry, tie the graft sticks in bundles no more than six each. Label each bundle with permanent ink on a wood or metal write-on label. The variety and year should be recorded on the label. Figure 2 is a graft wood bundle labeled and ready for packing material and storage.

figure 2.2 shows how to collect and prepare planting materials

figure 2.3 shows handling of scion sticks ready for Grafting

Prepare and establish propagation material

Propagation material:

- Seedlings
- Rooted cuttings
- Unrooted cuttings
- Divisions

Preparation methods:

- Trimming of cuttings
- Trimming of divisions
- Preparation of stocks
- Trimming of scions

Aftercare:

- Provision of water
- Provision of nutrients
- Temperature control
- Humidity control
- Removal of diseased material
- Training or trimming to promote appropriate growth formation
- Sub culturing

Self-check -1	Written Test

Name: _____ Date: _____

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

1. How to preparing the stock ?(6pts)

2. How to preparing the scion?(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

Score = _____

Rating: _____

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2._____

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Information Sheet-2	Performing propagation techniques

2.1 Performing propagation techniques/methods

Sexual propagation involves the union of the pollen (male) with the egg (female) to produce a seed.

Vegetative Propagation: The propagation of plants by the method other than sexual propagation is referred as vegetative or asexual propagation. It involves no change in genetic makeup of the new plant. All the characteristics of the parent plant are reproduced in the daughter plant due to exact duplication of chromosomes during cell division. Thus, the plants are true-to type in growth, ripening, yield and fruit quality. The major methods of asexual propagation are cuttings, layering, division, budding and grafting, sucker, bulb, runner. layering involves rooting a part of the parent and then severing it; and budding and grafting is joining two plant parts from different varieties.

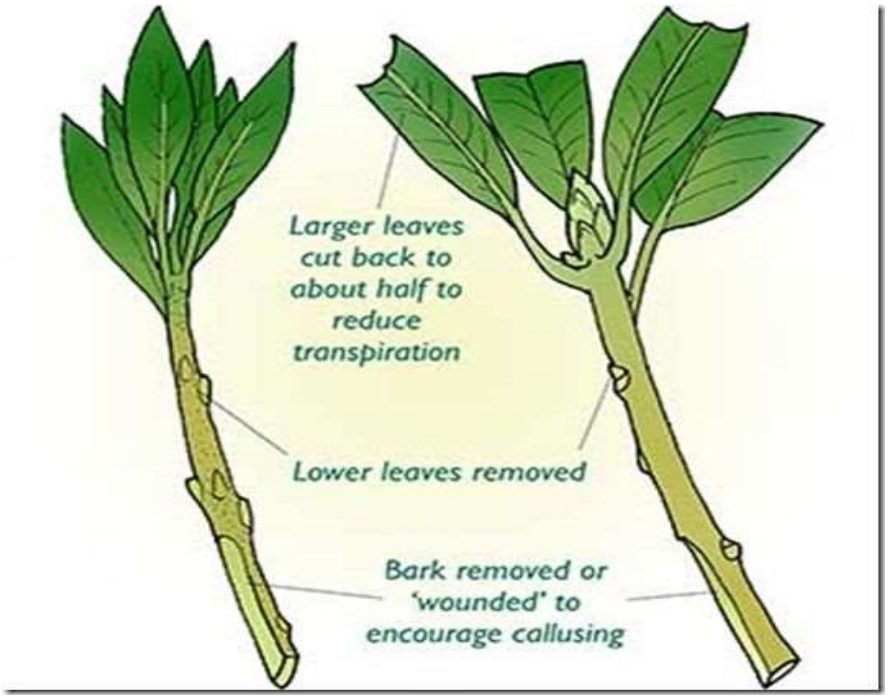
1. Cuttings : involve rooting a severed piece of the parent plant

- Many new plants from few stock plants and in a limited space
- Need structure and water
- can be simple
- some plant material are difficult to root wounding and rooting hormone

Types of Stem Cuttings

The four main types of stem cuttings are herbaceous, softwood, semi-hardwood, and hardwood. These terms reflect the growth stage of the stock plant, which is one of the most important factors influencing whether or not cuttings will root.

Figure 2.1 show cutting planting materials



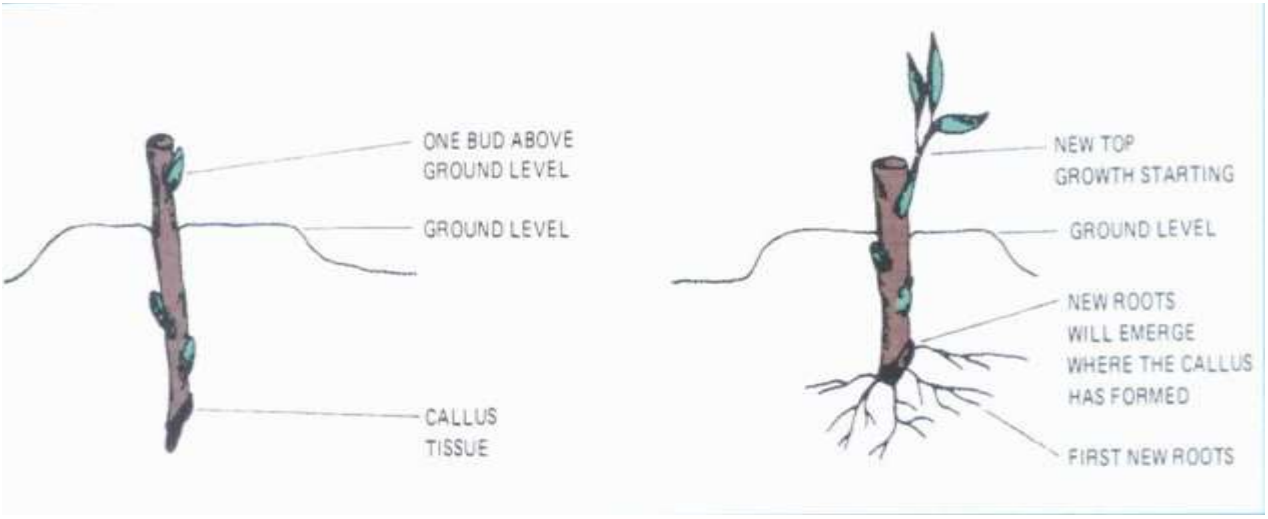


Figure 2.2 show cutting planting material

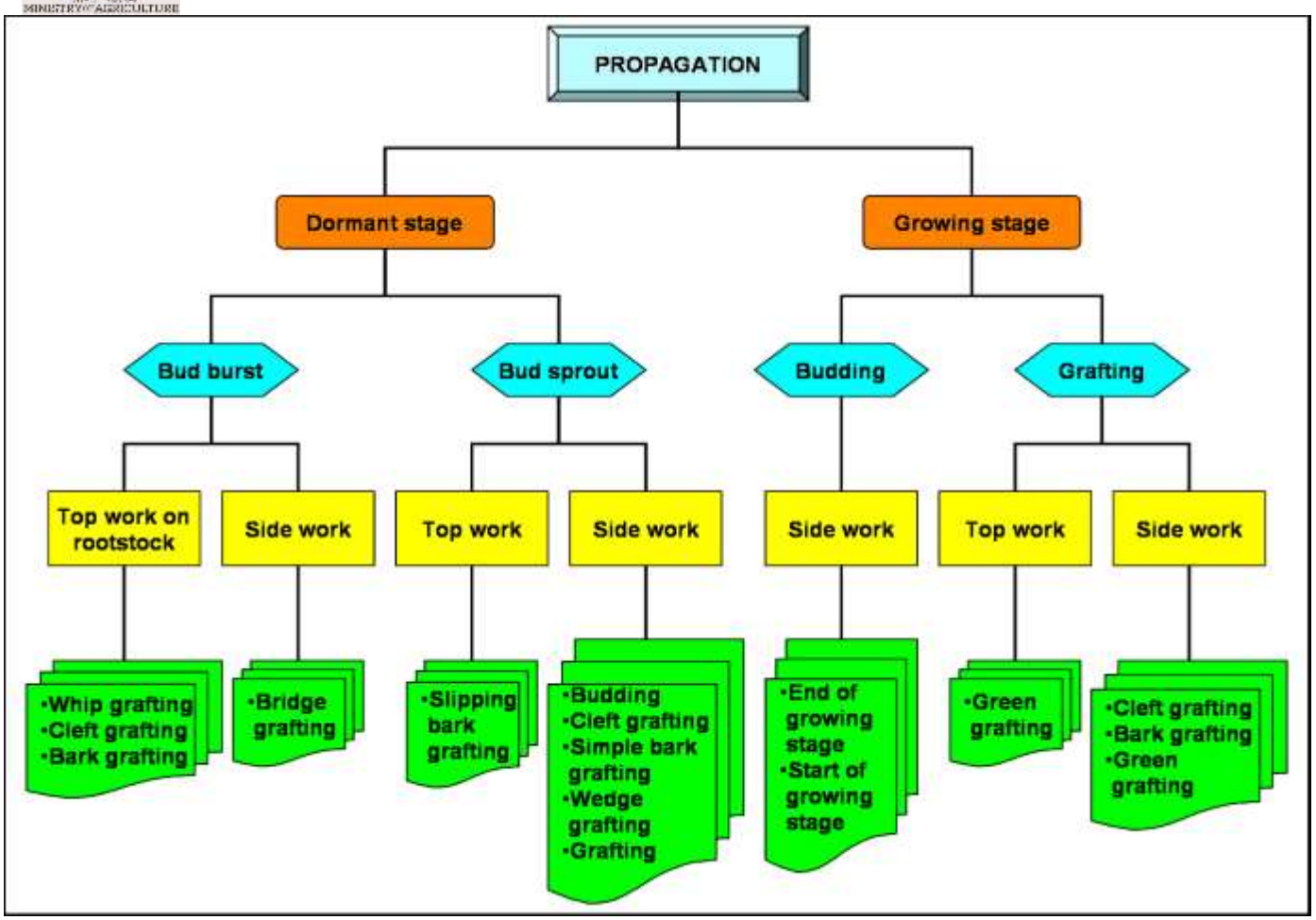


Diagram 2.1 show propagation by budding and grafting

2. Grafting: Grafting is another method of vegetative propagation, where two plant parts are joined together in such a manner that they unite and continue their growth as one plant. In this method, the scion twig has more than two buds on it. grafting is done when the plants are dormant while, in mango it is done when the trees are in active growth. The different methods of grafting are tongue grafting, cleft grafting, approach grafting, side grafting and veneer grafting.

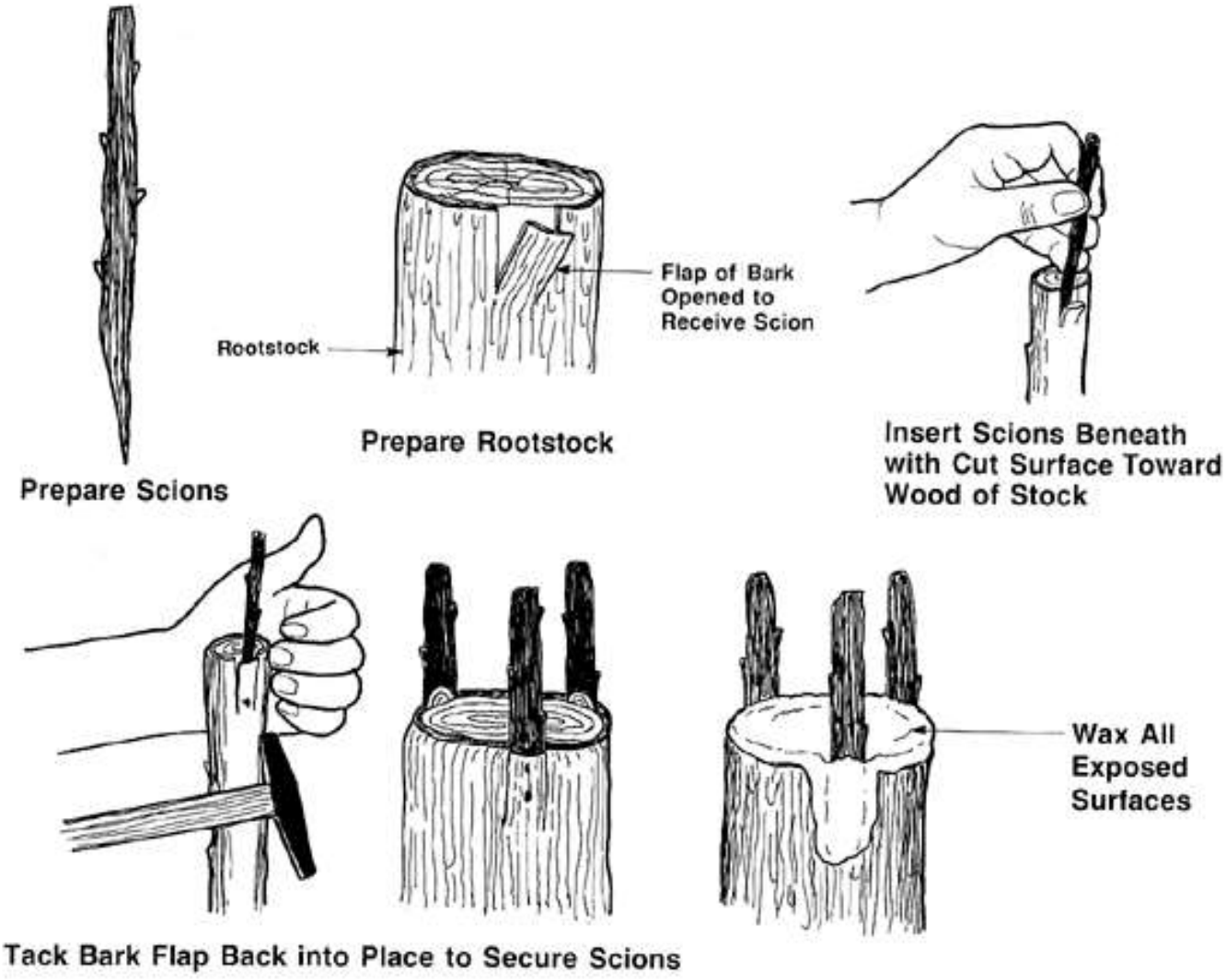


Figure 2.3. Bark graft.

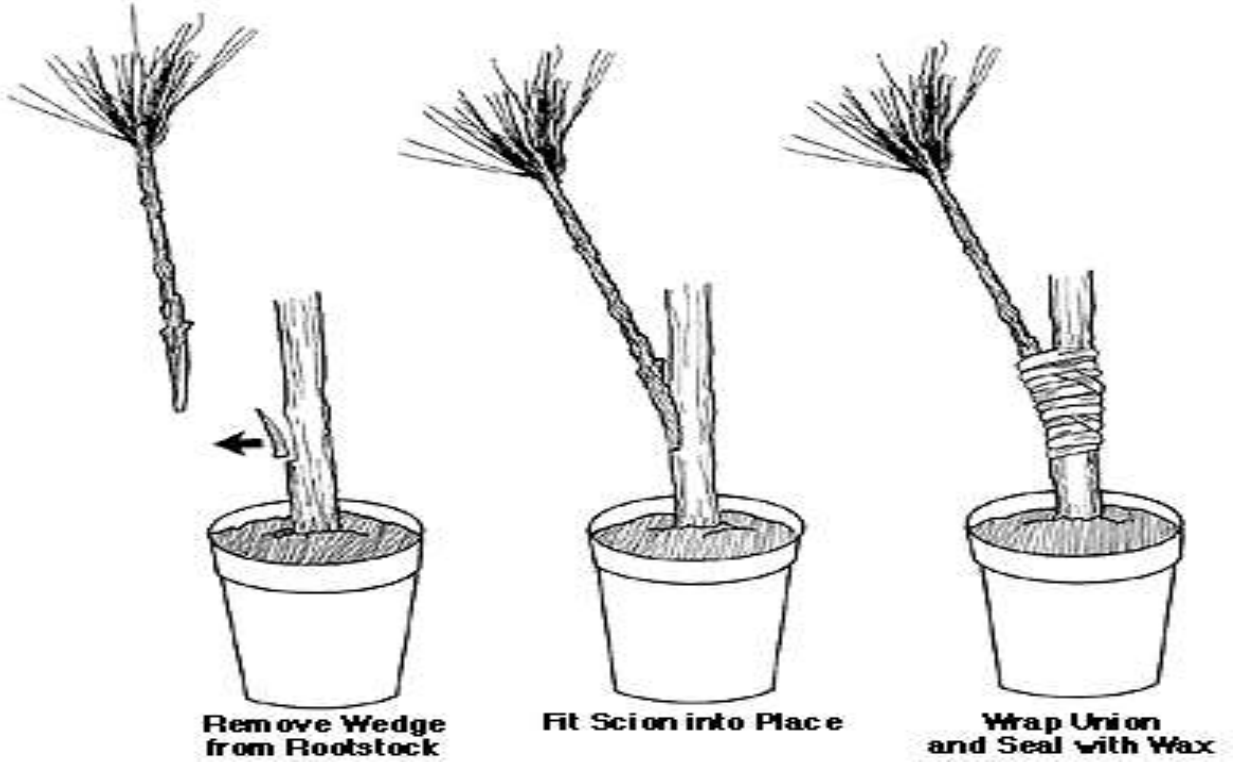


Figure 2.4. Side graft

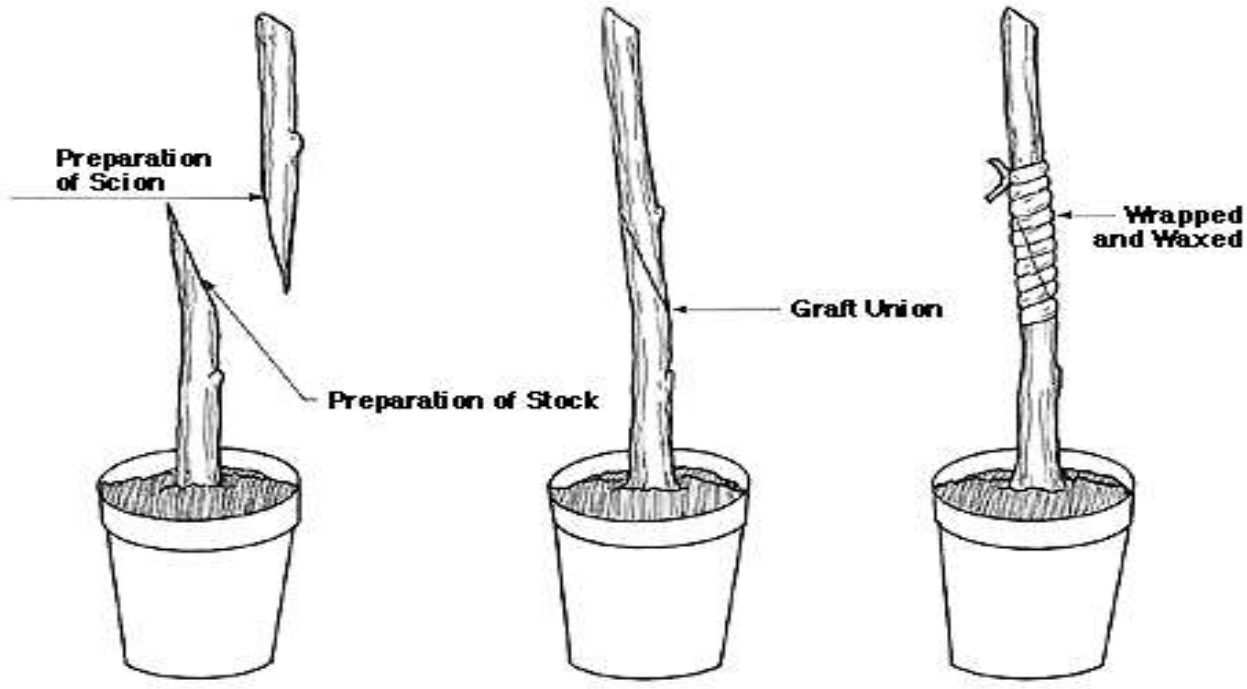


Figure 2.5. Splice graft

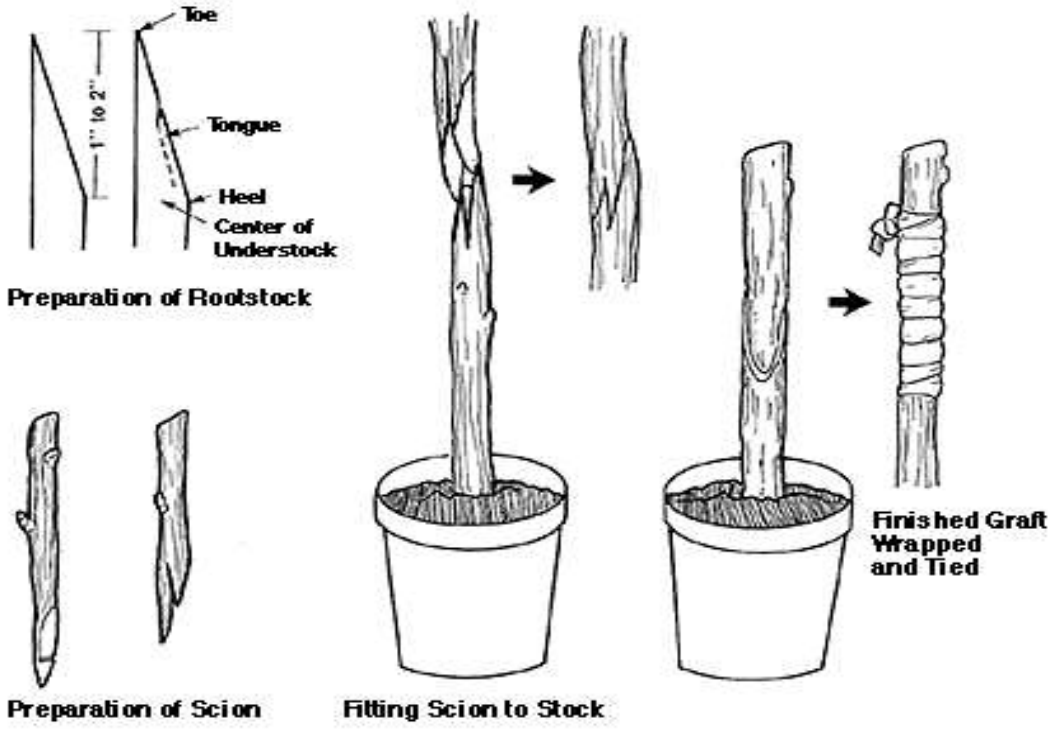


Figure 2.6. Whip and tongue graft

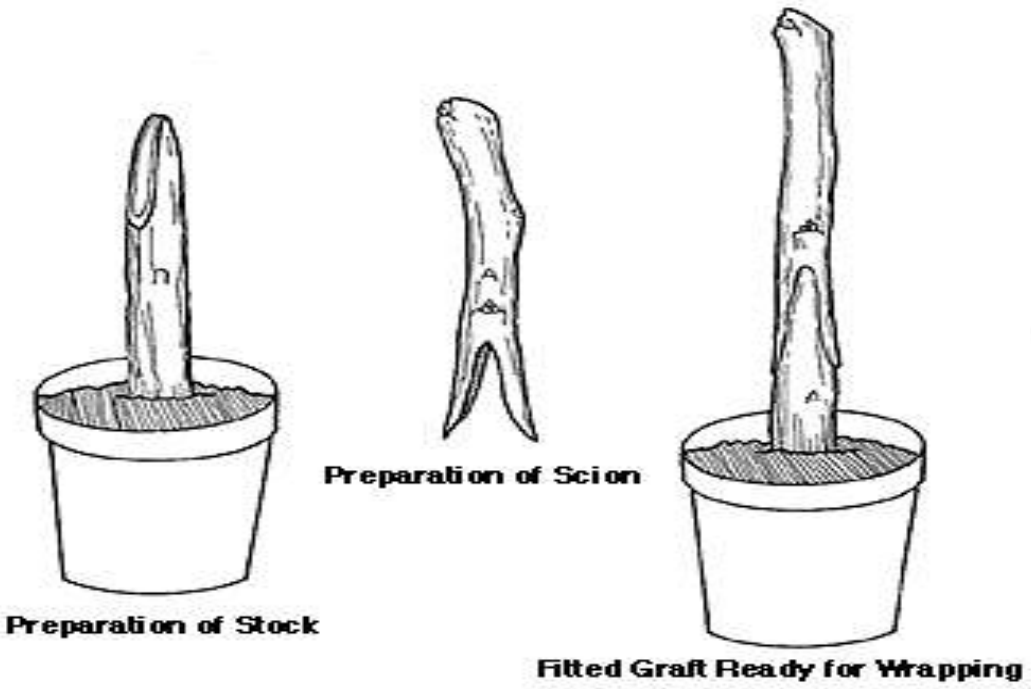


Figure 2.7 Saddle graft

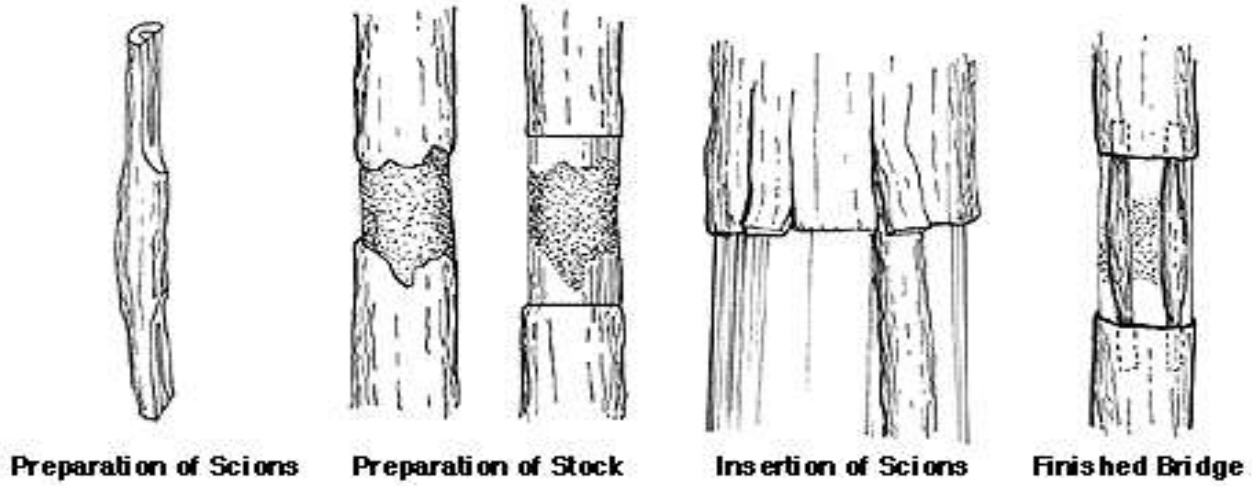


Figure 2.8. Bridge graft

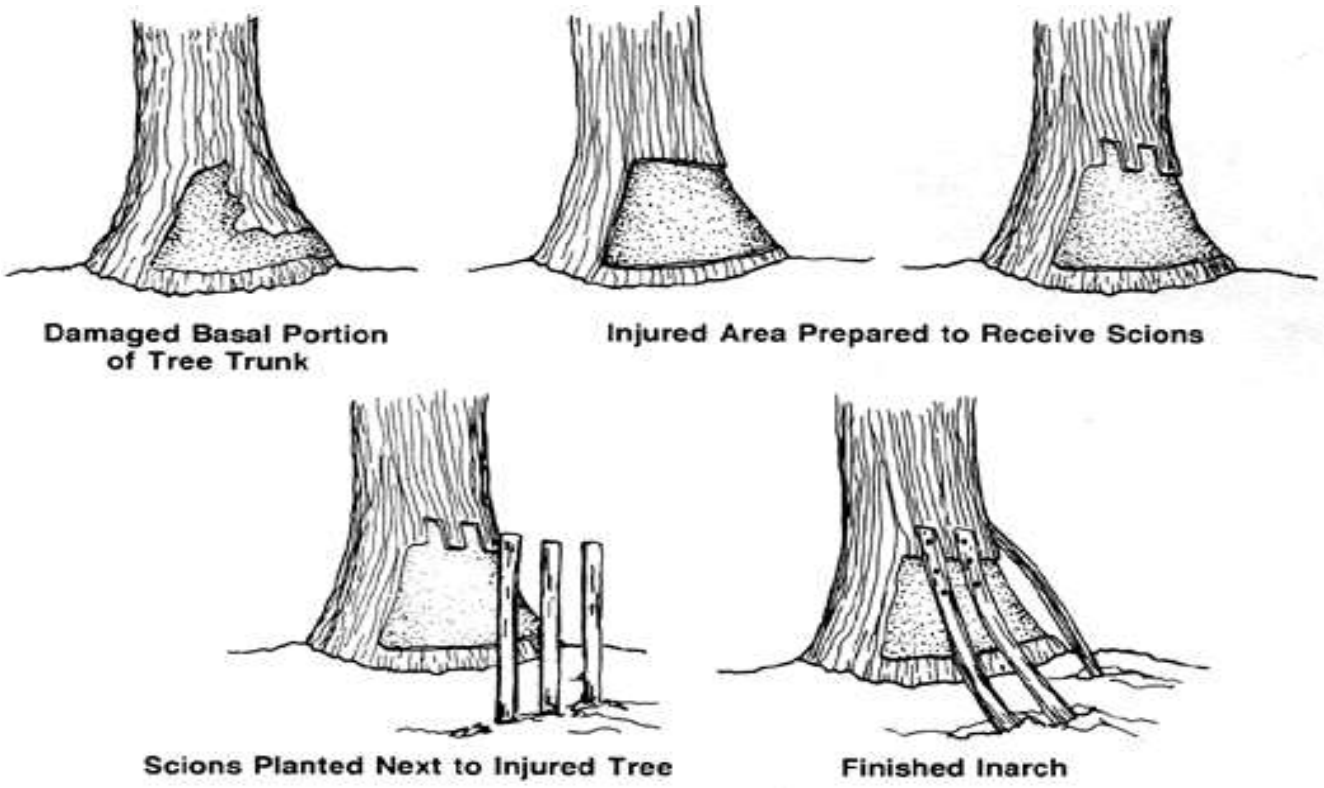


Figure 2.9. Inarch graft.

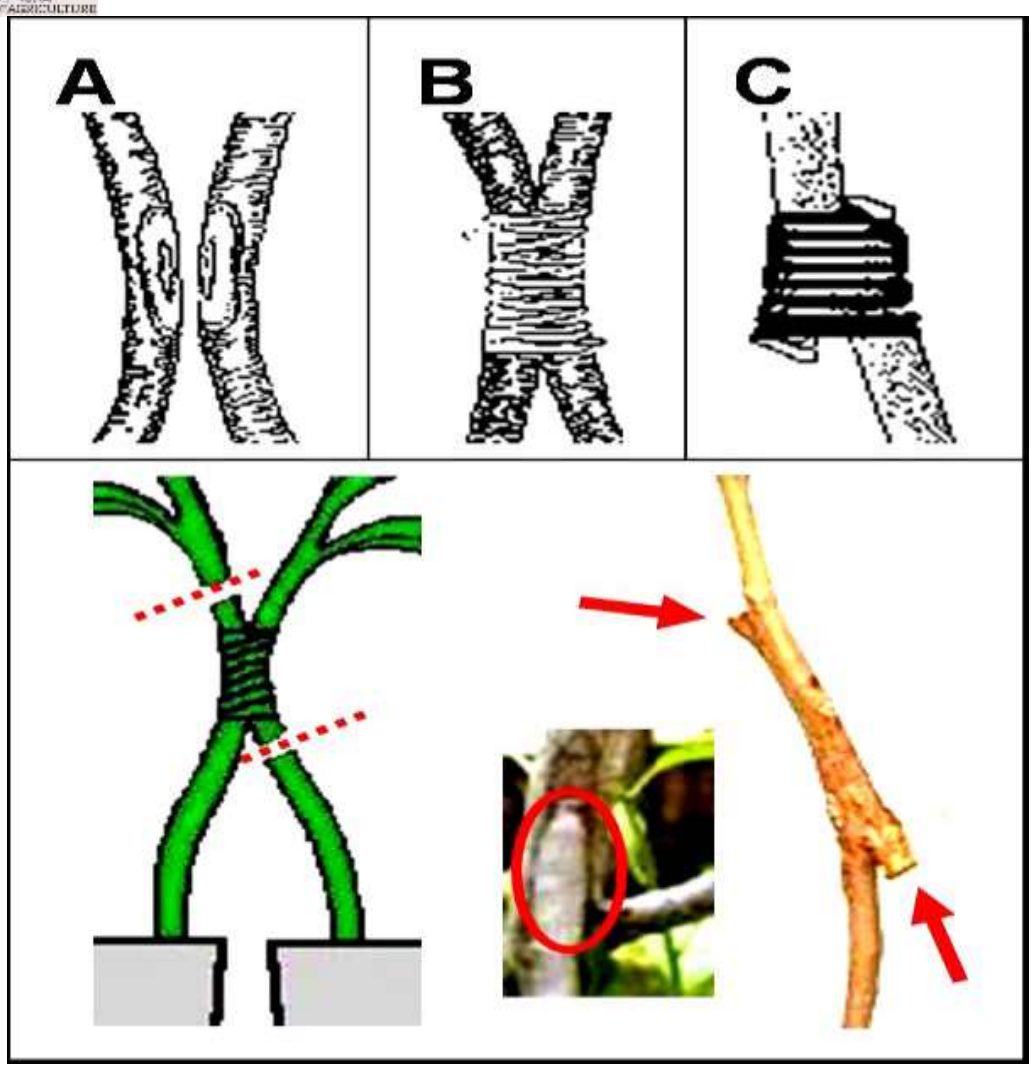


figure 2.10 show approach grafting

3. 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. However some species may be budded during the winter while they are dormant.

Types of budding

1. T-budding involves taking buds from one plant and inserting them under the bark of the rootstock

Preparing the stock

Figure 2.11 horizontal &middle cut RS . Completed inverted-T incision

Figure 2.12 bud preparation bud ready to insert

Figure 2.13 bud insertion Bud wrapped with polyethylene tape

2. Patch budding is used when the plant's bark is thick

- It done before growth starts in the spring
- The bud patch must be precisely matched with the patch opening in the bark on the rootstock

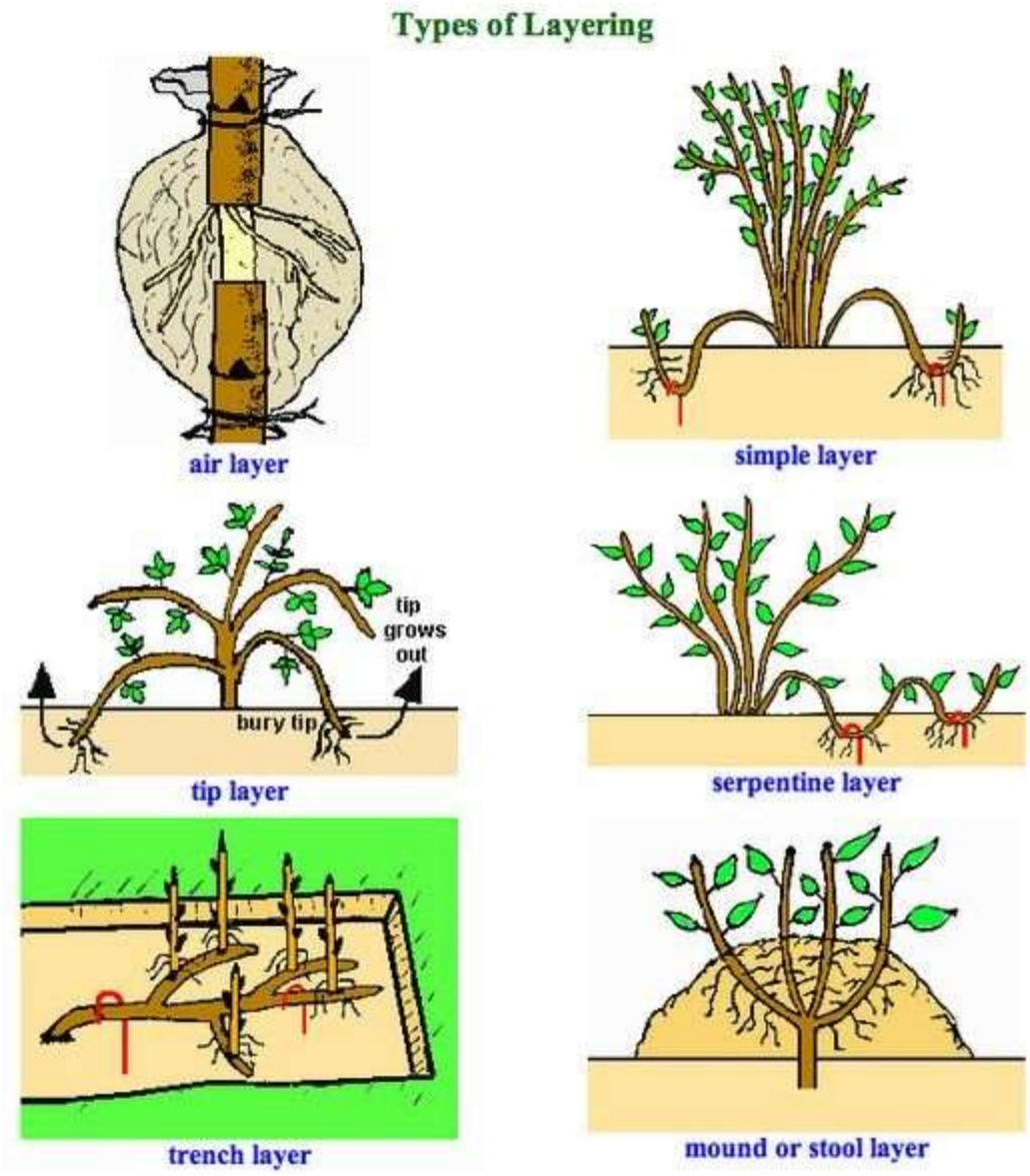
Figure 2.14 shows A healthy seedling ready for budding

Figure 2.15 Preparing rootstock removing bud patch

Figure 2.16 Bud patch removed from scion shoot

Figure 2.17 Tying budded portion after inserting the patch and Budding tape removed 21 days after budding

4. Layering: stems still attached to their parent plants may form roots where they touch a rooting medium. Severed from the parent plant, the rooted stem becomes a new plant. This method of vegetative propagation, called layering, promotes a high success rate because it prevents the water stress and carbohydrate shortage that plague cuttings. Some plants layer themselves naturally, but sometimes plant propagators assist the process. Layering may be enhanced by wounding one side of the stem or by bending it very sharply. The rooting medium should always provide aeration and a constant supply of moisture. There are six types of layering, Tip, compound, simple, air, mound and trench layering.



Figures 2.18 shows types of layering and how activities takes place

Other specialized organ vegetative propagation includes:

5. Runners are stems that grow horizontally above the ground. They have nodes where buds are formed. These buds grow into a new plant.

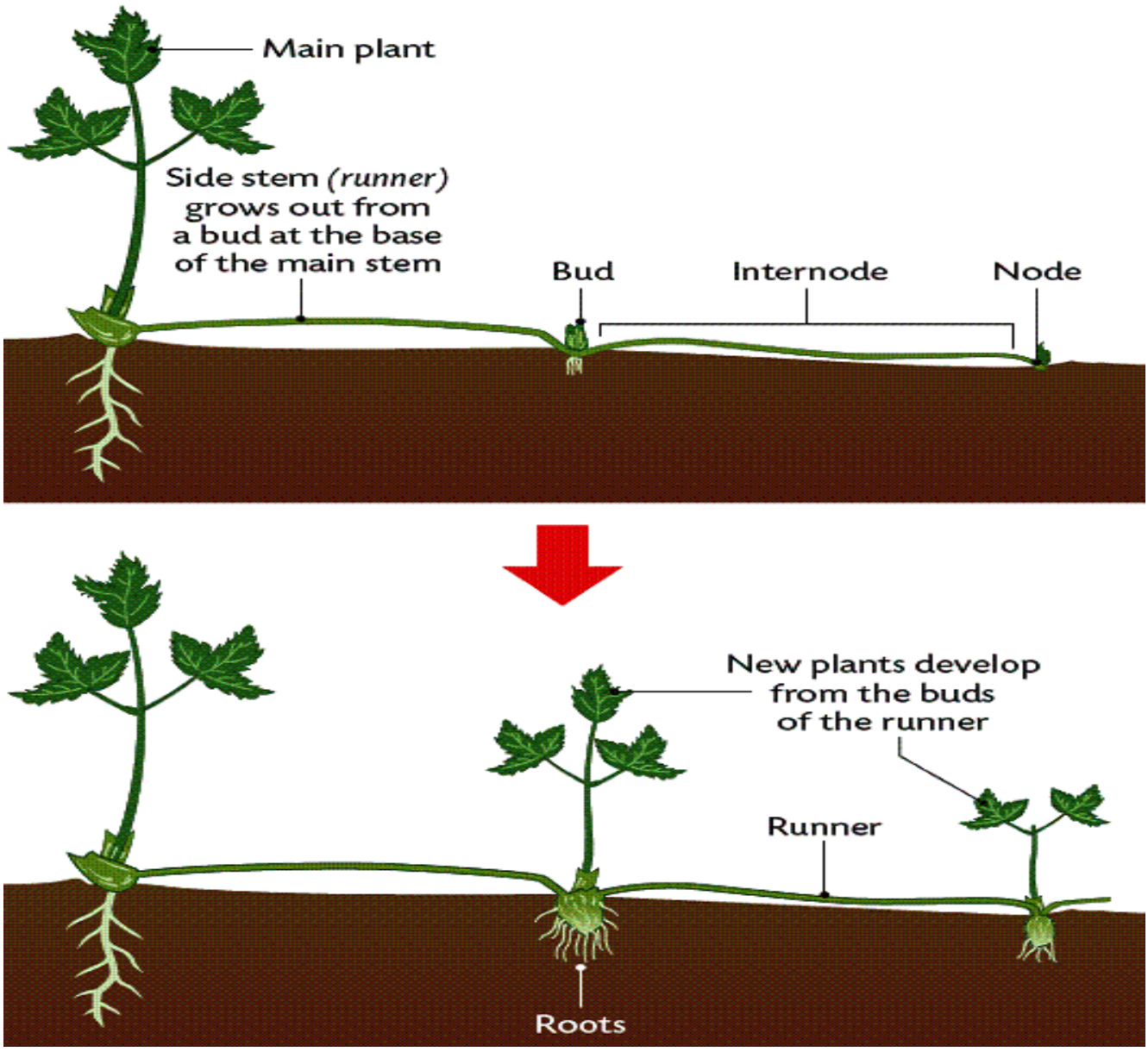
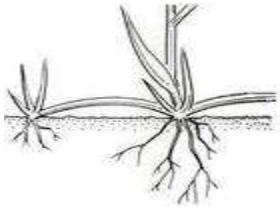
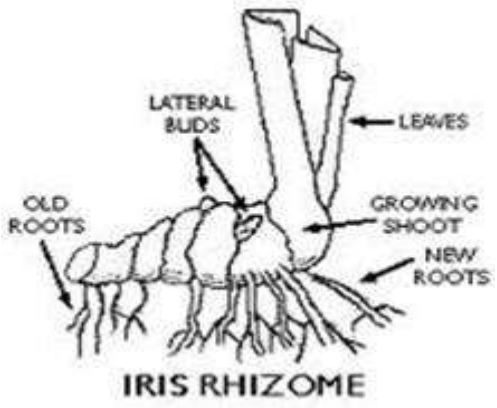


Figure 2.19 shows plant propagate by runners

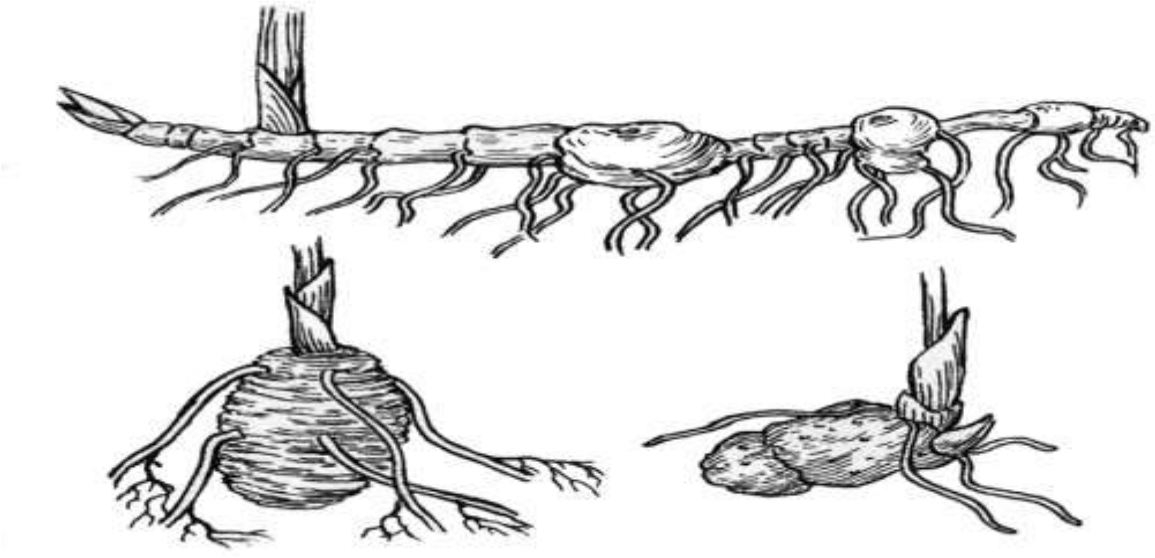
6. Runners/stolons: some plants produce long side shoots that develop roots, eventually forming a new plant. Example Strawberry, Spider plant.



7. Rhizomes: these are underground stems that can develop into new plants. They grow sideways in the soil and have a shoot with leaves. Example: Ginger.



A Rhizome is actually a stem of a plant, most commonly growing underground, that produces roots and stem shoots along its length from nodes. They are also known as rootstocks and creeping rootstalks. When cut into pieces, each piece of the Rhizome can potentially grow into a new plant through a process known as vegetative reproduction. Many plants are cloned in this manner, including asparagus, ginger, hops, Canna lilies, even the Venus Flytrap.



Above two figures 2.20 shows propagate by rhizome

7. Suckers: Banana is a good example of a plant that reproduces in this manner- a new stem grows from the base of an old one, forming a new plant.

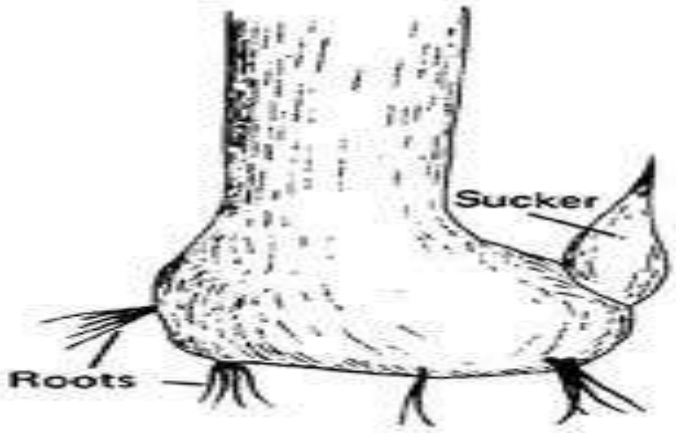
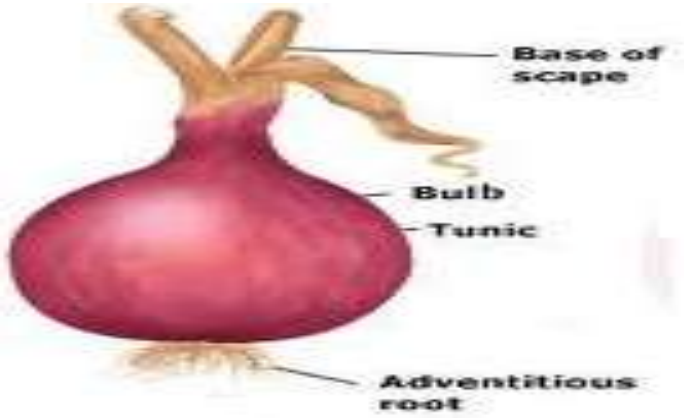
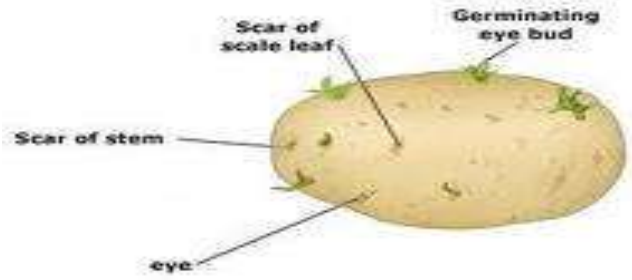


Figure 2.21 show propagate by sucker

9. Bulb: on plants such as the onion, there are lateral (side) buds which may grow to form new plants.



10. Tuber: swollen underground stems that can develop into new plants. Examples are Irish potato, carrots and turnips. Some tubers have swollen roots which are called **root tubers**. Examples of root tubers are sweet potato, cassava and yam.



11. Corm: this consists of one or more internodes with at least one growing point. Examples of plants with corms include banana, arrowhead and cocoyam.

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 asexual propagation techniques and discuss each?(8pts)

2. what is the difference between grafting and budding?(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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2._____
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3.----------

Information Sheet-3	Handling plants

3.1 Handling propagated plants

Collection and handling of scion material

If freezing temperatures are likely to damage plant tissues, collect scion wood for grafting in the fall after normal leaf drop but before severe winter temperatures. Otherwise, wait to collect until late winter. Store the wood in a plastic bag. Enclose a moist cloth, but leave no free water in the bag. Store the wood in a refrigerator between 1.7°C and 4°C. Make sure that fruits or plant materials capable of generating ethylene gas (plant hormone that induces ripening/senescence) are stored in a different cooler than the scions or rootstocks. If refrigeration is unavailable, store the wood outdoors in moist sand in a well-drained, protected location where the soil will not freeze growth with mature, plump buds. Remove the leaves by snipping through the petiole (the stalk of the leaf) and leaving a petiole stub of about 0.25 inch attached to the bud stick (the shoot with scion buds). You can store scion wood (bud sticks) in a refrigerator, but only for a few days. It is best to use the bud sticks immediately after collection. For either budding or grafting, select only plants of known quality or performance free of insects, disease, and winter damage. For fruit trees, collect wood only from those in production to ensure that the kind and quality of fruit will be what you expect

Self-check -3	Written Test

Name: _____ Date: _____

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

1. How to collect and handle the stock plant?(6pts)

2. How to collect the scion?(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

Score = _____

Rating: _____

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Information Sheet-4	Applying care

4.1. Applying care (post management)

After care may include application of preventative fungicides, fertilizers, water and nutrients

Hardening-Off

Hardening-off or acclimating rooted propagules, seedlings, and tissue culture plantlets is critical for plant survival and growth. In commercial production, it assures a smooth transition and efficient turnover of plant product from propagation to liner production to finished plants in protected culture (greenhouses, etc.) or containerization and field production. This smooth transition and turnover of plant production units is essential in the marketing, sales, and profitability of plant manufacturing companies. It is important to wean rooted cuttings from the mist system as quickly as possible . Reduction of irrigation and fertility in seedlings and plugs is done several weeks prior to shipping and/or transplanting to harden-off and ensure survival of the crop. Likewise, with acclimation of tissue culture-produced plantlets, light irradiance is increased and relative humidity is gradually reduced to stimulate the plantlet to increase photosynthetic rates and have better stomatal control. All of these ensure plant survival and a speedy transition when the acclimatized plant is shifted up and finished-off as a container or field crop.

Fertilizers

Fertilizers can be applied once the young plants begin to produce new growth. Fertilizer application is to be done very carefully. Vigorous growth of plant is always attractive to the buyer. Heavy manuring is not beneficial for storage of plants. Light manuring, watering is also important. Watering is done according to need of the plant. The nursery should have a water source of its own. Sprinkler system of irrigation is not advisable at the beginning. For sufficient vegetative and reproductive growth of plants, good

drainage system must be developed in between the beds and around the nursery. Adequately gentle slope in the pot bed surface is also desirable. It is extremely important to ensure that water logging does not occur in and around the pots and beds. Keen observation on attack of different pests and diseases is required. If the mother plants are infected, the propagated plants will also be infected therefore, necessary control measures in mother plants as well as in nursery plants should be taken immediately on observation.

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 applying care for propagated plant?(6pts)

2. Describe care required for post planted?(6pts)

3. What is the importance of hardening-off ?(3pts)

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

Objective: To know how to apply different techniques of propagation

Materials required:

- Plastic containers and trays, scalpel,
- Autoclave and alcohol,
- Wheelbarrow, Shovel, water spray container, dibblers and rubbish bins.
- Plant material
- Container (Tray, pots, sleeves)
- Rooting hormone
- Measuring tape
- Budding knife
- Grafting knife
- A fine-tooth saw for cleft grafting
- Pruning shears
- Dormant scions (cultivar labeled)
- Tying material such as grafting tape, adhesive tape, rubber strips
- Asphalt water emulsion compound for covering grafts
- A light hammer for bridge grafting

1.1. Procedure cutting

1. Select suitable PPE and wear
2. To take your cuttings, select healthy and vigours growth that's 7.5 to 15cm long
3. Then, cut off a section of stem
4. Remove the lower leaves
5. Clip off the leaves on the lower half of the shoot so you have a bare stem to insert into your potting mix.
6. Pot up your cutting

1.2. Procedure cleft Graft

1. Select suitable PPE and wear
2. Then, take scion from mother plant selected
3. Slice scion in both side by sharp knives
4. After that the root stock is cut off squarely and
5. Split vertically with a knife to a depth of about 5 to 7.5cm
6. Keep the knife in position or insert a chisel to keep the split open and insert the scions
7. Wax, Wrap and secure wound part or joining point

1.3. Procedure inarch Grafts

1. Select suitable PPE and wear
2. Then, take scion from mother plant selected
3. Slice scion in side by sharp knives
4. Prepare rootstock by trimming the edges of the girdled section back to sound bark
5. Place the scion along the trunk so that the beveled edges rest on sound bark
6. Mark and remove the bark rectangles.
7. The stem piece to be inserted should be slightly longer than needed to ensure a homely fit.
8. Insert the scion and then secure with two number 16 or 18 wire nails at each end

1.4. Procedure T-budding

1. Select suitable PPE and wear
2. Cut a T shape through the bark of the rootstock tree that selected
3. Open the flaps of the side of the T
4. Collect a bud from a bud wood stick by inserting the knife at the base of the bud & carefully cut out the bud including a sliver of wood
5. Make a horizontal cut just above the bud to sever it and the sliver of wood from the bud wood stick
6. Insert the bud, right side up, into the opening of the T cut
7. Slide it tightly into the cut and secure it with a rubber banding strip

8. Wrap the banding strip above and below the bud, stretching the banding strip to make a tight wrap that will prevent moisture loss

1.5. Procedure Tip layering

1. Select suitable PPE and wear
2. Dig a hole 7.5 to 10 cm deep
3. Insert the shoot tip and cover it with soil
4. Then, the tip grows downward first
5. Then bends sharply and grows upward
6. Roots form at the bend, and the recurved tip becomes a new plant.
7. Remove the tip layer and plant it in the early spring or late fall.

1.6. Procedure Air layering

1. Select suitable PPE and wear
2. Select stems of pencil size diameter or larger are best
3. Choose an area just below a node and remove leaves and twigs on the stem 7.5 to 10cm above and below this point. This is done on a stem about 30cm from the tip.
4. The cut is held open with a toothpick or wooden match stick.
5. Surround the wound with moist, unmilled sphagnum moss (about a handful) that has been soaked in water and squeezed to remove excess moisture.
6. Wrap and cover with plastic and hold in place with twist ties or electrician's tape.
7. Fasten each end of the plastic securely, to retain moisture and to prevent water from entering
8. After the rooting medium is filled with roots, sever the stem below the medium and pot the layer. The new plant will usually require some pampering until the root system becomes more developed. Provide shade and adequate moisture until the plant is well established.

LAP Test	Demonstration techniques of performing propagation

Name_____ Date_____

Starting time_____ Ending_____

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

Task1. Perform Cutting activities

Task2. Perform Cleft grafting activities

Task3. Perform Inarch grafting activities

Task4. Perform T-budding activities

Task5. Perform Tip layering activities

Task6. Perform Air layering activities

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HORTICULTURAL CROPS PRODUCTION

Level III

Learning Guide#44

Unit of Competence: Implement a propagation plan

Module Title: Implementing a propagation plan

LG Code: AGR HCP3 M09 LO5-LG-44

TTLM Code: AGR HCP3 TTLM 0120v1

LO5: Complete propagation operations

Instruction Sheet	Learning Guide #44

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

- Cleaning work site
- Collecting, recycling and dispose waste
- Completing records

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:

- Clean work site
- Collect, recycle and dispose waste
- Complete records

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the “Information Sheets 1-3.
3. Accomplish the “self-check” in page 103, 105 and 107.
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 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	Cleaning work site

1.1 Cleaning work site

Having accomplished your task or propagation operation, every material, tool, equipment and machinery as well as work site should be inspected. The inspection can show us the broken, harmed and the healthy tools, equipments and machineries. Over take cleaning and maintenance operation so that the equipments/machineries which can be maintained should be stored with the healthy ones; and those which cannot be maintained should be avoided.

All equipment, tools and plant shall be maintained in a safe and useable condition, in particular, but not exclusively, all grafting and budding knives, pruning shears/scissors, hammers, hand saws, secateurs etc be regularly checked, and the checks recorded, replaced as necessary to ensure constant safety and effectiveness. Proper storage is also essential. Refrigerate the bags of graft stick bundles at a temperature of 30 to 45 ^{o}F. Do not allow graft wood to dry out during storage. Take the desired wood out of refrigeration only as needed. Wood should not be heated and re cooled during the grafting season.

After completion crop propagation, tools, equipments and machinery have to be:-.

- Cleaned
- Maintained and
- Stored

N:B:-Disabling unused tools, equipment and machinery are stored neatly out of the way of crop propagation activities.

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 term cleaning (5pts)

2. Why you clean worksite after propagation activities complete?(5pts)

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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2._____
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Information Sheet-2	Collecting, recycling and dispose waste

2.1 Collecting, recycling and dispose waste

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 site.

Disposing of waste materials

Waste materials are of different unwanted materials as a result of the grafting operation. These can be discarded planting materials (scions sticks, bud sticks and root stocks), pruned plant branches (small or large), broken equipments and used plastic materials. These all needed to be managed and disposed in an appropriate site and method. Some of the methods of disposing wastes are composting, re-using, recycling and incineration the waste materials from the grafting operation.

- Waste material generated during crop propagation may include:- Small to medium branches, foliage, leaves, sticks, buds, flowers, fruit, bark, plant debris and chipped material
- Discard or compost pruned out shoots and branches.
- These plant parts will serve as dwelling sites for insects and diseases and should be removed from the area to reduce pest populations
- Unproductive, dead and broken branches, and those damaged by diseases and insects should be disposed. Otherwise, these might serve as source of pest and disease infection.
- Enhances a clean and safe work area

Self-check -2	Written Test

Name: _____ Date: _____

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

1.Mention Waste material generated during crop propagation (5pts)

2. How to recycle waste materials?(5pts)

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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2._____
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Information Sheet-3	Completing records

3.1 Completing records

3.1.1 Record Workplace Information

If you intend producing planting material in your nursery whether small or large for a number of years, you should consider keeping records. You may not like the idea. You may prefer handling the hoe to handling a pen, but as the years go by you will rely more and more on what you wrote down and wish you had recorded more rather than less.

Records are a powerful tool to make nursery work more rewarding. One forgets a lot within a year and as the years go by it becomes very difficult to remember what happened when and why. Even for a nursery of a single species. E.g. to raise planting material for improved fallows. Records do help. Moreover, for a single species you do not have to write down a lot. Other Information that should be recorded in the work place is like standard operating procedures (SOPs), specifications, production schedules /instructions, routine maintenance schedules, work notes, Material Safety Data Sheets (MSDS), manufacturer's instructions or verbal direction from the manager, supervisor or senior operator.

- Evaluating and reporting of evaluation results to concerned bodies is done at the work completion
- Report is an official document comprising of :-
  - Activities undertaken
  - Work progress/status and achievements of objectives and goals
  - Resource utilization
  - Risks and problems and corrective measures taken
  - Strengths and weakness
  - Summary and recommendations

Self-check -3	Written Test

Name: _____ Date: _____

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

1.Mention information that should be recorded in the work place (5pts)

2.What is the purpose of record workplace information?(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: _____

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2._____
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List of Reference

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