TREE NURSERY ESTABLISHMENT AND TREE MANAGEMENT

Training Manual for Community Tree Nursery Operators and Tree Farmers

By

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MODULE 1: TREE NURSERY ESTABLISHMENT AND MANAGEMENT PRACTICES

1. INTRODUCTION

1.1 What is a tree nursery?

A tree nursery is an area/ place where young trees (seedlings) are given special care.

1.2 Types of tree nurseries

(i) **Temporary or flying nursery:** can be used for a season or two, a year or two. **Permanent nursery:** Is meant to serve for a long period of time. In this case, seedlings are raised from year to year.

1.3 Factors to consider when deciding on the type of nursery

- The number of plants required
- The period the demand is likely to last
- Availability of transport/market

2.0 NURSERY ESTABLISHMENT

You need to consider; size, location, availability of water, skilled labour force and market for the seedlings.

2.1 Basic considerations for a nursery site

The ideal nursery site should have at least ¾ of the following requirements

- Easily accessible,
- Good permanent water supply e.g. spring, river, well, piped water system. The bore hole is preferable but usually not reliable at times,
- Gently slopping, well drained site,
- Good supply of suitable soil materials.

Avoid the following sites

- Heavy clay soils, Swampy valley bottoms and Exposed hilltops.

2.2 Materials needed for Nursery establishment

In all these, nursery operators are encouraged to use locally available material where feasible e.g. Jerry cans, hoes, basins, winnowers, pangas, tins and banana fibres, Poles, timber, grass, mats and nails.

2.3 Steps to be taken while preparing new nursery site

- Cut down all the trees/ shrubs on site
- Destroy any termite mound,
- Dig the area thoroughly,
- Allow some time for the grass to grow and stabilize;

- Protect the nursery site against animals and thieves

2.4 Procedure for nursery establishment

- Level the site of the beds and firm the soil,
- Mark out the shape and sizes of the beds,
- Erect the beds using durable poles,
- For the shade, one can use any local material available,
- Erect rivets (sawn timber or poles) around the beds,

2.5 Common mixtures for the nursery seed beds and transplant beds

i) Standard seed- bed soil mixture (SSM):
This is composed of 50% sieved black forest or top soil and 50% sieved sand. Therefore the ratio of soil to sand for SSM should be 1:1 but can keep varying depending on whether clay or sand component is higher in the soil build up.

Use of components
The forest soil give sufficient moisture holding capacity to promote good germination where as the sand is to produce a very porous, textured soil which allows good penetration of the roots of the germinating seeds and easy to lift when pricking out.

ii) Standard transplant bed mixture (STM)
This is the mixture of soil that can be used in the transplant bed or polythene tubings and gives the seedlings the most favourable growth conditions. It contains; 60% Un-sieved forest soil, 10% sand, 10% small stones (1cm diam), 10% clay and 10% composite manure.

Use of each component
Sand and small stones: Gives good root penetration and drainage characteristics,
Clay and top forest soil: Assists to bind near the roots to improve on the moisture intake and nutrient retaining qualities,
Composite manure: Supplies organic matter and nutrients to the soil.
The above mixtures can be left to mature for 2-4 weeks before use. Keep it moist.

2.6 Nursery Lay out

To obtain the maximum effect of the shade, beds should be orientated to run East- West to avoid direct sunshine. During March to September when the sun is in the northern hemisphere the shade should slope towards the north and the rest of the year when it is in the southern hemisphere, it should slope towards the south.

2.7 Methods of sowing seed

i) Broadcasting: This is the method of spreading seed on top of the SSM, either by hand or a mechanical broadcast. This mainly applies to small sized seeds.

ii) Drill -sowing: Is the method of making ruts or drills in the SSM into which seeds are linearly dropped in and lightly covered with SSM.

When to use seedbeds

- When seed is old or when the germination is low or unknown, use a seedbed to test viability before filling too many containers and wasting resources,
- If seed does not store very well (that is if it is “recalcitrant”),
- If containers are not available, or not filled in time to use, seedbeds can be used until the containers are ready.

iii) Direct sowing: Is when sizeable (large sized seeds) are directly sown into containers or to the field.

Depending on the conditions in your nursery, including the tree species (size of the seed), number of plants to be produced and labour availability, a combination of direct sowing and use of seedbeds may be your best way of operating. Most nurseries use seedbeds to germinate seeds.

a) Direct sowing of seed into containers/pots

Direct sowing of seeds into containers saves time, labor and money, because the extra step of preparing a seedbed and transplanting is eliminated. Even if it takes a little longer to plant small seeds directly in the containers, it is easier and cheaper than pricking out. Direct sowing allows undisturbed seedling growth and thus reduces stress for the seedlings.

b) Direct sowing of seeds into the field

Some trees/shrubs can be established by sowing the seeds directly into an area or field where they are to grow until harvest time. This method is known as direct sowing. This method can be done in areas which receive reliable rainfall. Direct sowing can be a good method for species and technologies which require very many trees/shrubs, e.g. live fences, dense woodlots and improved fallows.

3.0 NURSERY MANAGEMENT

There are several recommended operations and activities while carrying out proper management of a tree nursery;

3.1 Watering

The regular supply of clean water is essential to plant growth. Plants are made out of more than 90% water. When grown in containers plants do not have the ability like mature trees to search for water from far below the soil surface.

The amount of water that seedlings require depends upon; Seedling age, amount of sunlight, soil type and turbulence (presence of wind).

Avoid; Dirty water as it contains many plant diseases. Salty water is also not good.

Some of the good nursery watering practices include;

- Regularly check the water status of the leaves to determine when to water,
- Water in the early morning and / or late in the evening,

Some of the poor nursery watering practices include;

- Watering according to a fixed schedule,
- Directing the water to the leaves and not the soil,
- Watering during mid-day,
- Watering quickly and only wetting the soil surface.

Remember;

- Over watering weakens plants and causes many diseases,
- If the soil is covered with green moss or algae that mean you are watering too often.

3.2 Pot filling

This is the filling of polythene tubes with soil. This should be done under a shade near the heap of the soil at the site of the transplant bed. The soil should be moist enough to run freely into the tube and easily firmed to form the bottom of the tube.

3.3 Pricking out

This is the act of lifting seedlings from the seedbed into the transplant bed or pots.

Poor pricking out practices include; Waiting until plants are large and have long roots, Pricking out plants into dry soil and then watering them, Constructing shade after pricking out is done, Carrying seedlings in your hand or on a plate without water and Preparing the holes with a finger – the hole might be too small or too big depending on the size of the finger used,

3.4 Shade and watering after pricking out

After pricking out, transplants require full shade for the first 2 – 3 weeks, then ½ shade for 1 week, after which no shade should be necessary. As the shade is decreased, the intensity of watering must be increased.

3.5 Weeding

This is the operation of removing weeds in order to reduce competition for water and nutrients.

3.6 Root pruning

Is the cutting back of the actively growing roots of the transplants. Root pruning is carried out so as: to avoid the roots of the seedlings inter – twining, to enable the transplants to develop a well established root system fit for easy establishment in the field and for the transplants not to penetrate into the soil and get established within the nursery site.

3.7 Hardening off

This is the process of creating hard conditions to the seedlings towards the planting season. Reduce the amount of water 4 weeks before seedlings are planted out.

3.8 Nursery hygiene practices

Good hygiene of the nursery site will lead to healthy and quality seedlings produced in the nursery.

4.0 COMMON PESTS AND DISEASES FOUND IN NURSERIES

a) Pests

- Gall flies are occasionally found in nurseries. The condition gets more serious when the seedlings are water stressed and the condition improves when the seedlings get enough water,

b) Diseases

- Damping off is a condition young seedlings rot at the root collar, die and fall over. This is a sign that the seedlings are getting a lot of water and this condition can be controlled by reducing or stopping watering until the improvement of the situation,

5.0 NURSERY RECORDS

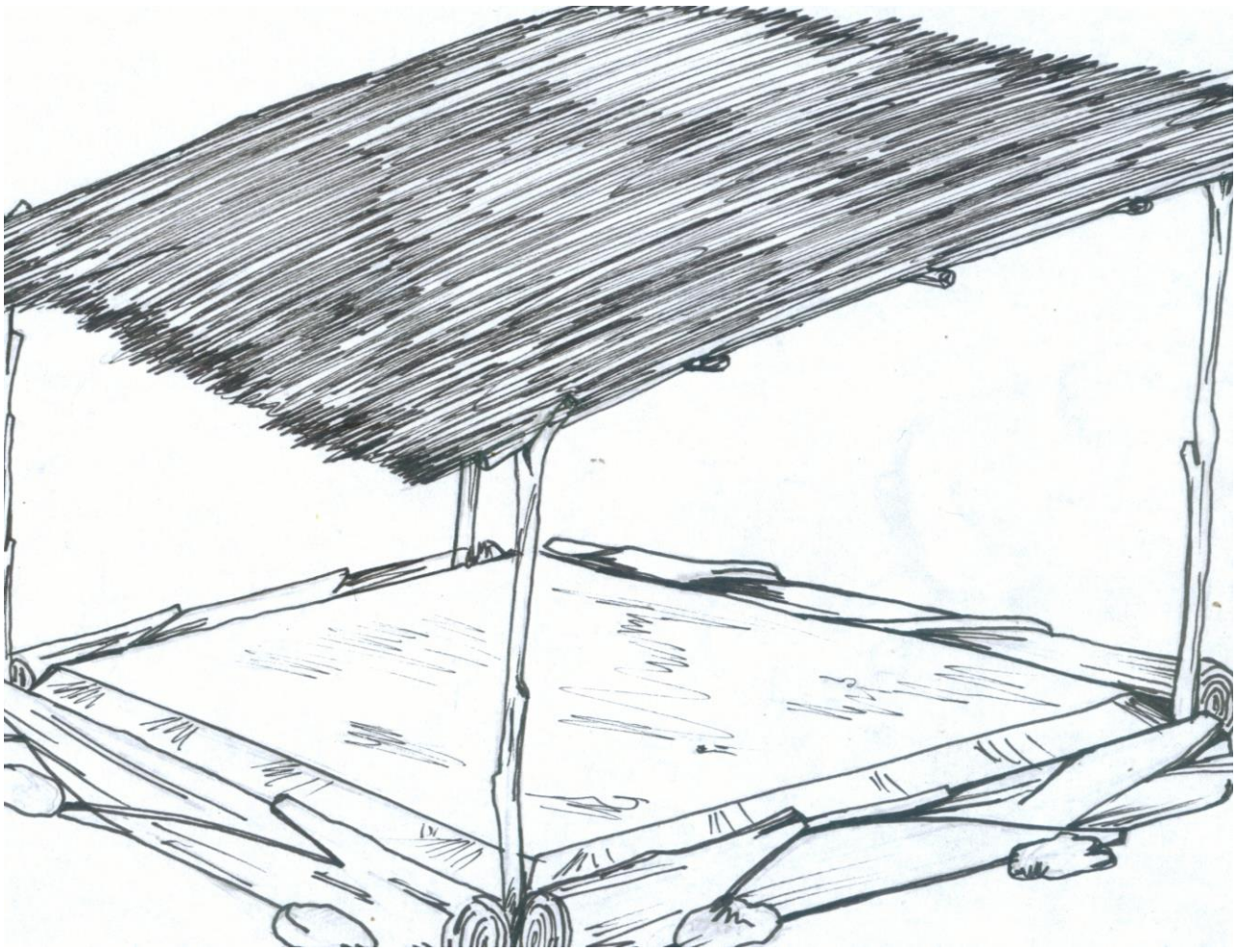
In order to have an effective nursery management you have to keep an up-to-date nursery records.

Illustrations on Nursery Establishment

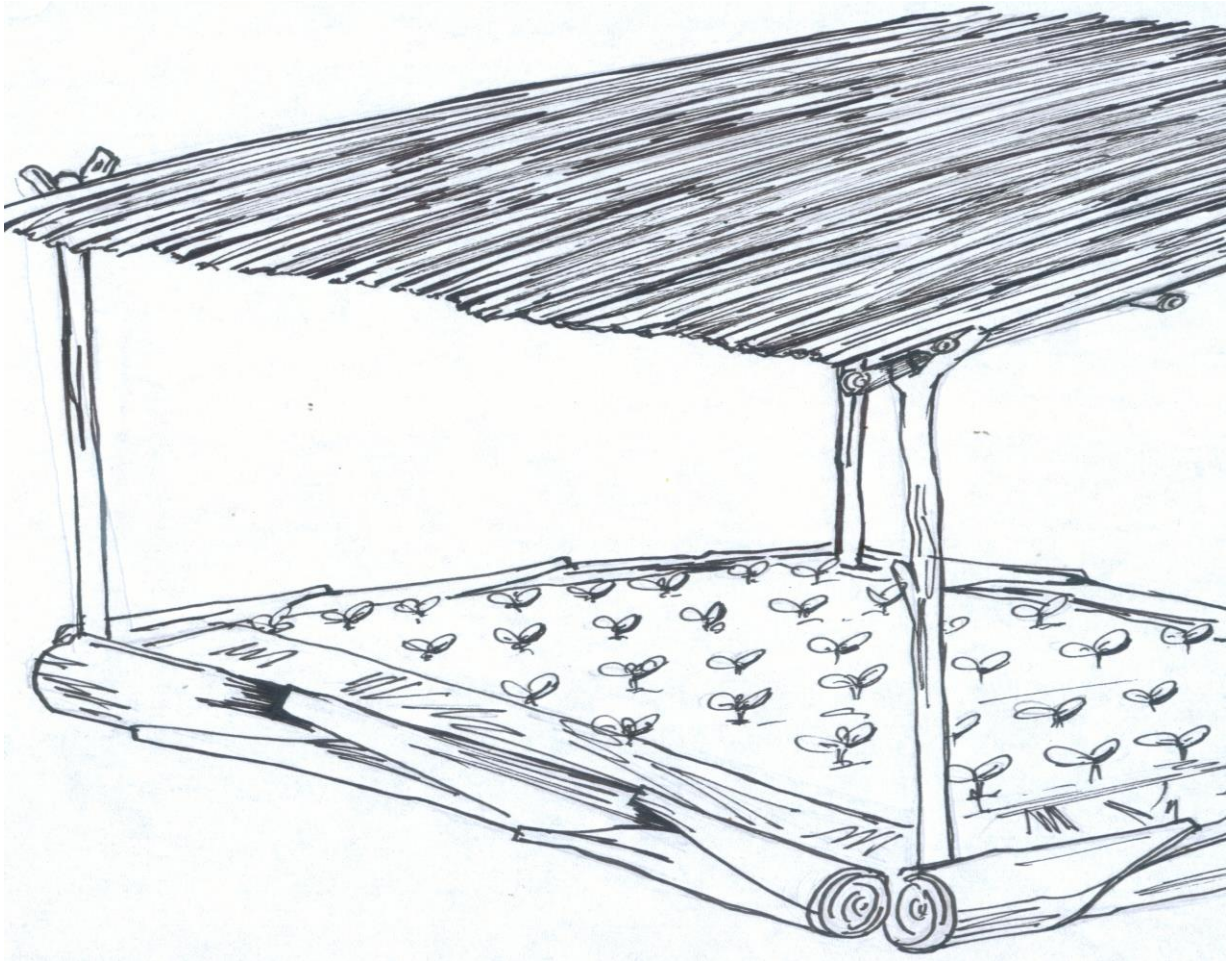
1. **Level the nursery bed and remove stones**

2. **Nursery bed ready for sowing**

3. **Put rivets at nursery bed sides**



4. **Nursery bed sown with seed**



5. **Nursery bed with plant germinants/seedligs**

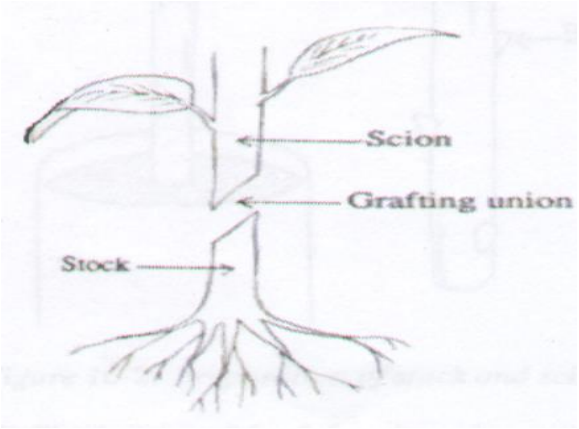
MODULE 2: TREE IMPROVEMENT PRACTICES (GRAFTING, BUDDING)

Learning objectives:

At the end of this module, trainees should be able to conduct a successful practical exercise in grafting and budding, with full knowledge of rootstock and scion preparation, and ably pass this knowledge to community members.

1.0 Introduction

Grafting is a form of vegetative propagation, which involves the union of two separate structures, usually woody parts of two plants. The common parts grafted are usually stems. The upper part is the scion and the lower part or root is called stock or rootstock.



The scion and the rootstock must belong to the same plant species or to the same family.

Grafting means that the qualities of the two parent plants are united in one plant. The scion has one or more buds from where all branches of the future fruiting grafted plant will grow from. All methods of joining plants are called grafting, but when the scion part has only a single bud, the operation is called budding. Fruit trees commonly grafted in Uganda include mangoes, avocadoes and citrus.

2.0 Reasons for grafting and budding

1. The fruit quality in the grafted tree will be exactly like that from which the scion was collected. If propagated by seed, there is no guarantee as to which characters will appear in the offspring.
2. Trees that produce seedless fruits can be propagated by this method
3. Grafted trees start producing fruits much earlier than those grown from seed.
4. A good quality fruit tree whose root system is usually damaged by soil pests and diseases or unsuitable to some soils can be grafted on a resistant rootstock
5. Make it possible to change tree product variety

Characteristics of the scion

- Quality of the fruits
- Productivity
- Early or late maturity
- Resistant to pests and diseases of the aerial parts
- Shape of the tree canopy

The stock plant determines

- The vigor of the plant
- The development of the root system
- Resistance to pests and diseases of the stem and roots

Stages in grafting

Grafting is carried out in three stages

1. First, the rootstock and then the scion are prepared
2. The rootstock and scion are bound together
3. Any leaves or suckers are cut off from the rootstock plant.

Some plant structures related to grafting

If you take a branch one or two centimeters in diameter and make a section, you will see:

- **Bark** – A layer of brown or green bark. The bark is tender and immature on young branches under the bark is the phloem which transports the food from the leaves.
- **Sapwood** – It is the moisture part of the wood lying between heartwood and the bark. It carries water and mineral salts from the roots.
- **Heartwood** – An area in the centre of the branch that is made of hard wood. It is used to support the tree

- **Cambium** – Is between the sap wood and the bark. It is not easy to detect because it forms a very thin layer of tissue. Its function is to produce wood on the inner side of phloem on the outer side. When the bark of the wood is lifted, the cambium is seen immediately below it.

It is important for the grafter to identify the cambium layer both in the rootstock and in the scion.

All grafting techniques depend for success in bringing together the cambium layers of both the rootstock and the scion. When they unite, they allow water and mineral salts to ascend from the rootstock to the leaves and manufactured food to pass down from the leaves.

The tissues, which form the union, are called **Callus**. Grafted trees can be identified by the presence of a thickened callus tissue at the point of union.

Selecting rootstocks and scions

Rootstock: Can be raised from seed and must be a variety well adopted to the soil and environment where the grafted trees will be planted e.g. must withstand drought in dry areas or tolerate waterlogged soils in valley bottoms.

Scion: Is obtained from the outermost branches of donor tree. The terminal parts should be well ripened. The branches selected should be vigorous with no pest infestation and there should be several well developed buds. The buds should be swelling slightly but not actually busting. The diameter of the scion should be about the same or slightly smaller than that of the rootstock.

Always graft in the rainy season when the trees are full of sap and the bark of the rootstock plants and the scions can be lifted easily. The rainy season is also the time when the cambium layer is most active.

Compatibility between rootstock and the scion

As a general rule, the rootstock and the scion come from two trees of the same species but of different varieties. Occasionally trees of different species but of the same family can be grafted successfully e.g. orange and lemon can be grafted on to sweet lime and grape fruit.

On the other hand, an avocado cannot be grafted to a mango nor a guava to a lemon because these fruits belong to different families.

Methods of grafting and budding

A Grafting

There are two common types of grafting; 1) splice grafting and 2) Top/wedge grafting

1. **Top/wedge grafting**

This method consists of slitting the rootstock lengthwise and inserting the tapered scion into the cleft.

Steps to be followed

1. Cut off the tip of the rootstock at the desired height. Leave one or more leaves to draw the sap.
2. Using a sharp blade split the rootstock down the centre, making a vertical cut about 3 cm long.
3. Taper the scion at the lower end on both sides. The length of the tail should be slightly shorter than the slit made in the stock.
4. Slip the tapered end of the scion into the cut made in the rootstock.
5. Bind the two parts tightly together using a transparent plastic tape.
6. The tape can be removed after the scion and the rootstock have been united.

2. **Splice grafting**

In this method side joining of the scion and rootstock is done**.**

Steps to be followed

1. Select a rootstock of about the same size as the scion. Cut the end of the rootstock in a slanting way as the lower end of the scion
2. Place the scion against the slanting cut of the rootstock and cover the union with a wrapping tape that holds the scion firmly and binds the two plant parts together .
3. Cover the scion with a transparent plastic bug up to a point below the joint of scion and stock
4. Put grafted plant under a shade (locally made)
5. Water regularly
6. Remove polythene bag when new leaves appear on scion

B. Budding

This is the technique of inserting a scion in the shape of a shield under the bark of the rootstock.

The shield is a small slice of the shoot with a bud in the centre. The shield is cut in such a way that it bears a bud, a piece of bark and cambium and a small tongue of sapwood.

Steps to be followed

1. Make a T shaped incision in the bark of the rootstock

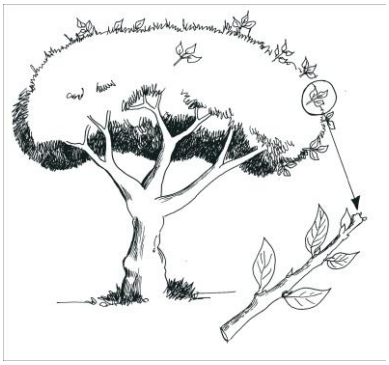
2. Cut the shield shaped portion of the shoot with a bud (i.e. cut from node). Cut off the leaf but leave a stub of stalk
3. Lift the edges of the incised bark of the rootstock
4. Insert the bud shield between sapwood and bark. Never touch the cut part of either the rootstock or the scion shield.
5. The bark of the rootstock is flattened back round the bud
6. Tie the grafted part with a transparent polythene tape but leave the bud uncovered
7. Put grafted plant under shed
8. Water regularly
9. When the bud starts to grow, cut off the upper part of the rootstock 1-2 cm above the point of union.

How to look after grafted seedlings

1. Grafted plants must be shaded and watered until the scions have taken off completely
2. Systematically remove all the shoots growing below the grant union

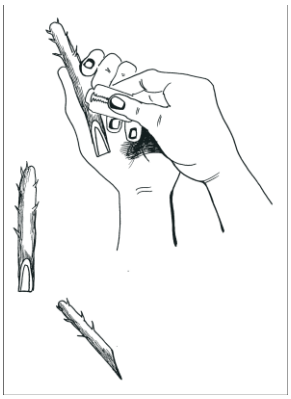
Selection of rootstock and scion
Rootstock should be upright with a well developed root system (contrast with one with twisted stem, bent root system).
The scion should be got from outermost branches of the donor tree (shown below)
Scion should have a slightly swollen bud but not actually busting. Diameter of scion should be about the same as that of the root stock (shown below)

Grafting illustrations

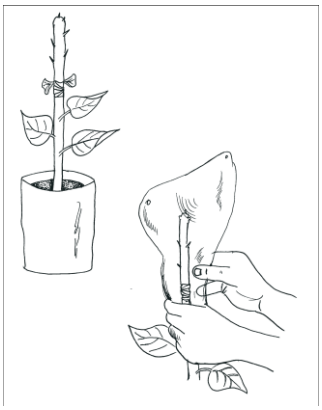


Collect scions from outermost parts of mature but not very old trees

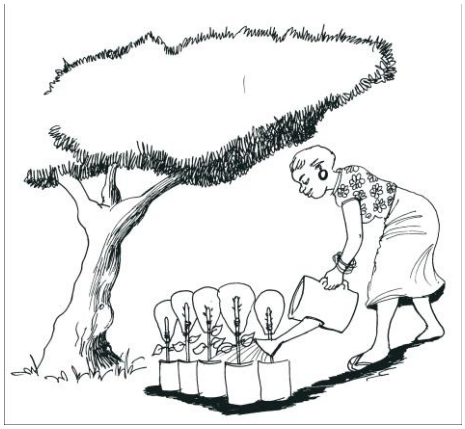
Cut off the top of seedling at about 0.5m high



Choose scions of the same diameter as rootstock. Use a slanting cut.

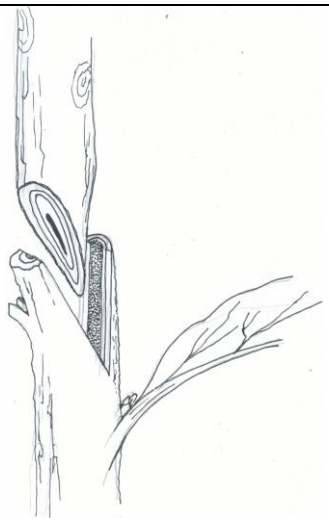
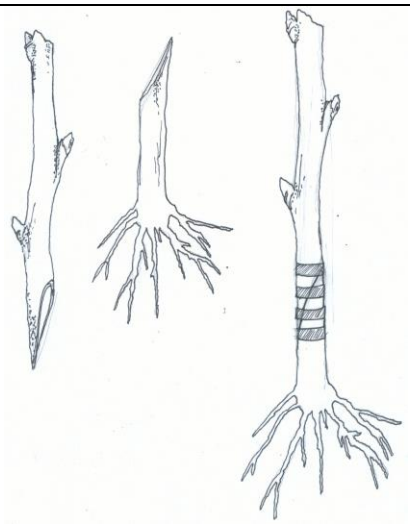


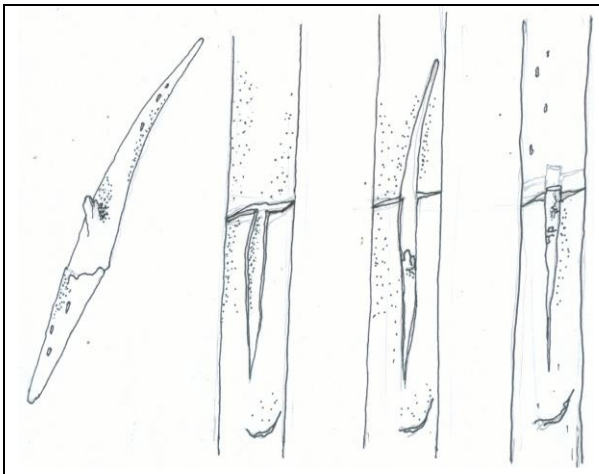
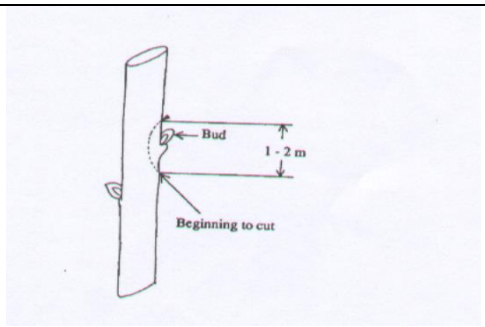
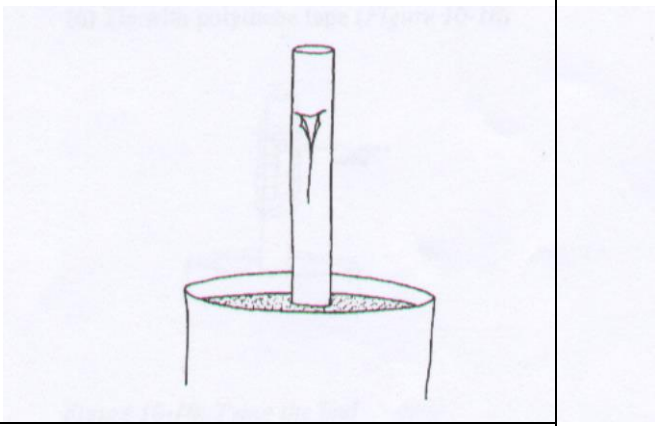
Ensure proper placement of scion & rootstock & tie the joint firmly, cover with clear & clean polythene bag over the graft below the graft point.

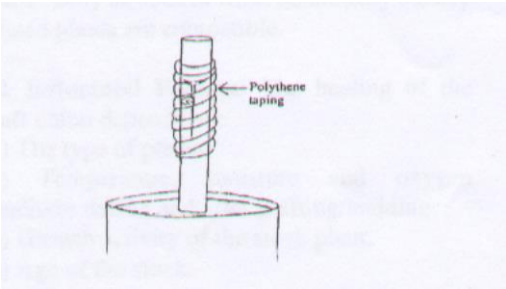
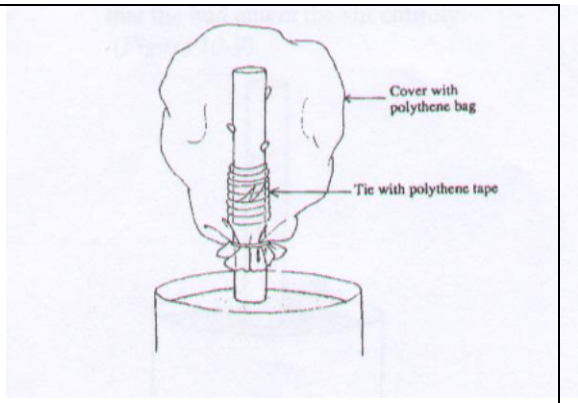


Water grafted plants regularly under shade

Remove polythene bag when the scion sprouts & continue watering

	
Top or wedge grafting	Splice grafting

	 Bud stick 
T-budding	T-cut for inserting bud

	
Tying the bud	Tying and wrapping the union