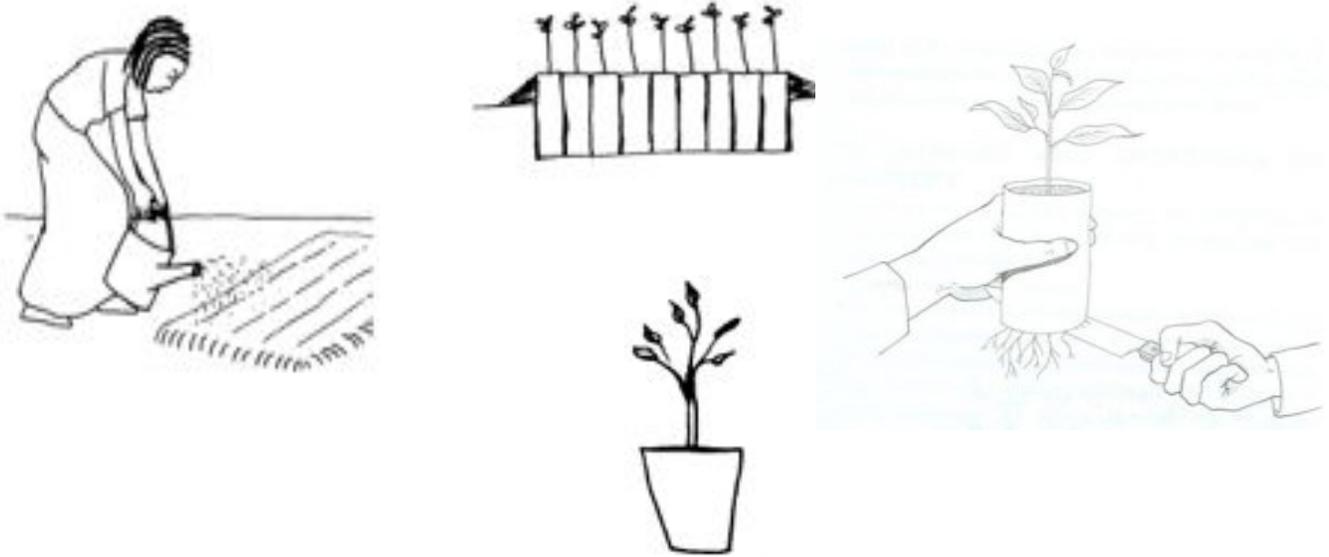


ELCT- NORTHERN DIOCESE

WOMEN-LED TREE NURSERY PROJECT



TRAINING ON TREE NURSERY ESTABLISHMENT

EVANGELICAL LUTHERAN CHURCH OF TANZANIA
– Northern Diocese

By
Godson Ulomi
gaulomi73@gmail.com
0784957530

1.1 WHAT ARE TREE NURSERIES?

A tree nursery is a managed site, designed to produce tree seedlings grown under favorable conditions until they are ready for planting. It can be an informal, small-scale arrangement or a large commercial enterprise. Nurseries vary in size, facilities (supplies, tools, equipment, etc), types of seedlings produced, and operations. They also differ significantly in quality and quantity of planting stocks produced. However, all nurseries primarily aim to produce sufficient quantities of high quality seedlings to satisfy the needs of seedling users. Users include the nursery operator themselves, individuals, community organizations, farmer groups, government agencies, non-government organizations,

Nurseries may often provide income generating opportunities for the operators and enhance the social capital, technical capacity and leadership skills of communities.

1.2 Important of tree nursery

Tree seeds germinate and trees grow readily under natural conditions. These delicate germinants (young seedlings) and young trees are exposed to adverse dry-season conditions and intense competition from other plants in natural forests or plantations. Tree nurseries can provide optimum care and attention to seedlings during their critical juvenile stage, resulting in the production of healthy, vigorous seedlings. In many cases successful reforestation requires nursery-grown seedlings, since degraded areas have unfavorable conditions making natural regeneration or direct seeding not feasible

1.3 Factors that influence nursery site selection

- Should be reliable supply of water, ideally being near a river or ponds or where a water tank is available.
- The site should be accessible all year round, so that customers are able to get seedlings easily, and so that nursery staff can manage plants and transport mature seedlings to planting sites and/or markets.
- Good soils and other planting materials such as sand should be available.
- The site should be protected from strong winds and from livestock,
- Should receive sun, and should be on a gentle slope to allow drainage.
- Avoid area with dangerous weeds and plants diseases.

1.4 Factors that influence size of tree nursery

How big a nursery should be depends on many different factors, of which the following are most important.

- ❖ The space available for establishing the nursery. The land available on farms may only be small in area, but more space may be available in public land like school yards or church grounds.
- ❖ Whether you will grow the seedlings in pots or in beds, and whether they will be raised from seed or from grafts, or from bare rooted cuttings, etc... This will influence the amount of space each plant needs. Remember that in a nursery additional space is required for keeping collected soil, sand and manure, and for mixing these materials
- ❖ The numbers of seedlings to be raised for personal use and for sale. When considering the size of the market for seedlings, it is better to start by being conservative in estimating what your market will be.
- ❖ The amount of water that is available to maintain seedlings.

1.5. Facilities and resources in establishment of tree nursery

The basic tools needed for a nursery include jembes, pangas, shovels, watering can, and kitchen knives for root pruning, wheelbarrows; pruning knives, soil sieves, polythine tubes, rake, Top forest soil, manure, sand and tree seeds are all useful.

2.0 NURSERY SITE PREPARATION

2.1. When to start raising seedlings

The time to start work in the nursery depends on when field planting is planned. It is important to allow sufficient time for seedlings to grow to a size where they will survive well in the field (normally 30 to 45 cm, though this depends on the species, where seedlings will be planted in farms, and how they will be managed). The initial labour needed to establish a nursery, seed bed construction, soil collection, fencing, the procurement of tools, etc. This can be done some time in advance of raising seedlings. The sourcing of seeds or rootstocks that will be used to establish nursery plants will also often need to be done in advance.

2.2. Soil collection

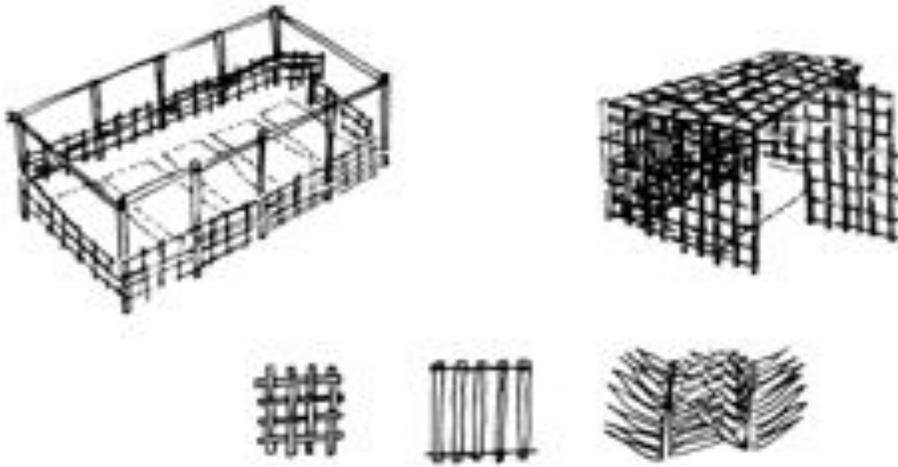
The soil used to raise seedlings should be fertile and should drain well; normally top forest soil is preferable. Once a suitable collection site has been identified, clear the surface of weeds, leaves and other litter, then dig out the topsoil to a depth of about 10 cm deep. Remove any stones and roots, ideally by sieving. Collect top forest soil 3 months before potting and raising seedlings.

2.3 Manure collection

The manure used to raise seedlings should be well decomposed and must be fine, composite manure or cow manure can be used, remove any debris and roots, ideally be sieving.

2.4 fencing

Fencing the area to offset livestock and wild animals. Local materials available at the site can be used for fencing the nursery site.



An example of fencing using local materials

3.0 TREE NURSERY OPERATIONS

Tree nursery operations involves various activities such as, seed sourcing, Seed bed preparation, Sowing seeds, Potting, Pricking Out, Shading, Watering, Weeding, root pruning, application of additional fertilizers or manure

3.1. Sourcing seed and pre-treatments

3.1.1 Sourcing tree seed

It is important to use good quality seed in planting. Seed can be collected from trees locally, from farms, forest or public land as long as one collects from mature trees or can be bought from

suppliers. It is a good idea to collect seed with neighbours; then bulk this seed together and share it out. In this way, diversity is maintained in planted material, which is important in promoting good performance. When getting seed from a supplier, it is important to look at the seed and check that it appears to be of good quality, and hasn't been collected too early (is immature) or contains many empty seed. Before planting a lot of seed, it is a good idea to first check it's viability by seeing if it germinates well. Once you have an idea about viability, then it will be possible to estimate how many seed need to be planted to get a certain number of trees. Seeds can be bought from local seed dealers, from NGOs, and from institutions such as TTSA and the Forest Department

3.1.2 Pre-treating seeds

Sometimes it is important to treat seed before sowing in order to improve on the level, speed and uniformity of germination. These treatment methods can be used when seed does not otherwise germinate well.

The most common methods for pre-treatment are:

(a) Soaking seed in hot water until the seeds look swollen. This is used for seeds of trees such as *calliandra*, most *acacias*, *tamarind*, *leucaena* and *albizia*. Procedure: boil water and pour it over seeds in a container.

Allow to cool and leave the seed in the water until the seeds look swollen

(b) Soaking seed in cold/cool water. This method is recommended for seeds that have soft seed coats such as *sesban*, *dalbergia* species, *gmelina arborea* and *Gliricidia*, etc. The time for soaking varies between 12-48 hours, depending on the tree species.

Procedure: Soak the seeds in cold water which is 2 times its volume, remove all floating seeds

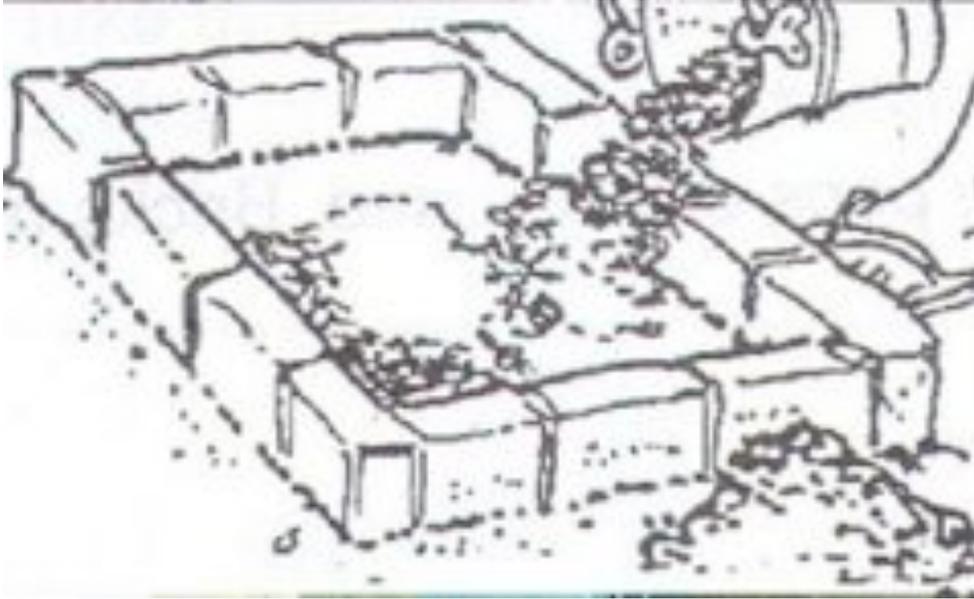
(c) Cracking the seed shell method. This method is used for tree species with a hard coat like *melia (mukau)*, *podo. Species*, *croton megalocarpus*, etc. The cracking is done to allow water penetration for easy germination, cracking is done using a sharp knife, a stone or a cracking machine

(d) Nicking-cut slightly the seed at one tip to allow water penetrate Seeds such as *Croton megalocarpus*, *Neem*, *Cassia spp.*

(e) Soaking seeds in running water. This method is used for tree treat *Tectona grands (teak)*. Procedure: put seeds into sack then soak into running water for 72 hrs.

3.2. Seed bed preparation

Nursery seed beds can be arranged in different ways. Raised beds are used for establishing bare-rooted seedlings; as the sides of the bed can be broken down to reveal the roots of plants, ready for transplanting. Staking slats of wood into the ground in a square or rectangle with sides of about 1 m and then filling this structure with soil (mixed with sand if possible) makes a raised bed. Alternatively, the sides can be made from bricks or the like. It is normal to germinate small seeds such as e.g. *Eucalyptus*, *sesbania* or *cypress* in such seedbeds, to allow them to germinate before transferring small seedlings to pots or planting them directly.



An example of a raised bed made from bricks with a mix of soil and manure

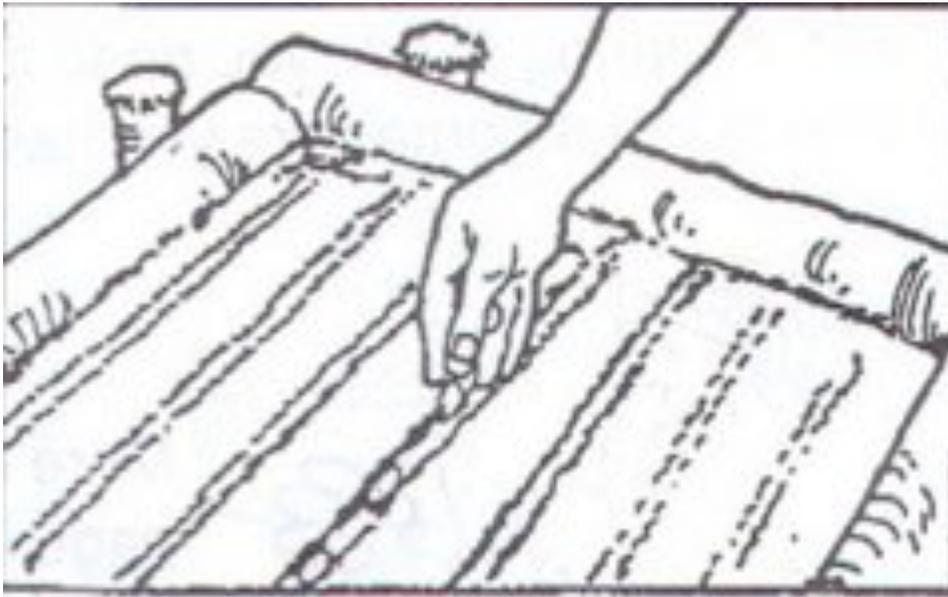


Leveling the soil of a raised bed, to a depth of about 2 cm from the top

3.4. Sowing seed

When raising seedlings in pots it is normal to use polythene tubes that are around 6 cm in diameter and 12.5 cm deep. Instead of using plastic tubes, other locally available materials that can be used include small tins, milk packets, cardboard boxes, banana fibre containers, calabashes and clay pots. It is better to use open-bottomed than closed containers, since this allows healthier root development and possible root pruning. If tins or other containers are being used, it is important that holes are made in the bottom to allow the movement of water. Seed sowing time depends on the species and the time it takes to attain size for planting out (30-45 cm). It is important the seeds are sown in time to enable the seedlings attain the recommended size (at least 30-45 cm in height). This should be attained before the onset of rains (April or November).

Fine and light seeds such as *Eucalyptus*, *Casuarina* are sown in transplant beds and later pricked out into containers. It is important that fine seed is mixed with sand and uniformly broadcast on the seedbed to avoid overcrowding that can lead to damping off.



Sowing seeds in a seedbed draw lines 10 cm. apart

Do not sow the seed too deep in the soil; the depth of holes should depend on the size of the seeds (usually 5 mm to 1 cm). Sowing too deep is likely to prolong seed germination period or seeds may rot. Put a seed in each hole; gently cover with soil equal to the size of the seed itself. Water the pots.

Make a light shade with grass (netting material) to cover the pots or the seed bed after sowing.



Cover the nursery with dry grass or maize stalk then water.

Water the sown seeds twice a day, early in the morning before 9.00 am and in the evening after 4.00 p.m. If this is not possible then water in the evening only since most of the water at this time is taken-up by the plant since there is very little evaporation.

3.5 Soil mixture ratio

Sieved Top forest Soil should be mixed with manure and sand in order to have a good ingredients for seedlings, the mixture should follow the ratio of 5: 2:1 then add 28gm of NPK, that is 5 parts of top forest soil, 2parts of manure, with 1 part of sand (if available).

3.6. Potting

The mixed ingredients (soil, sand and compost/manure) should be moistened and then pressed into containers to a depth of about three-quarters of the height of pots. Pots should then be

topped up more loosely with mixture and pressed down slightly to about 2 cm below the top. Heavy compaction should be avoided at the top of pots because it will inhibit root penetration. After pots filling, arrange them properly, the width should be 1m and the distance from one bed to another should be 1m so as to facilitate movement during weeding and watering.

Before planting seed, containers should be watered lightly. Sometimes, more than one seed can be planted in a pot and then, if more than one germinates, seedlings can be removed to leave a single individual



Pot filling



pots arrangement

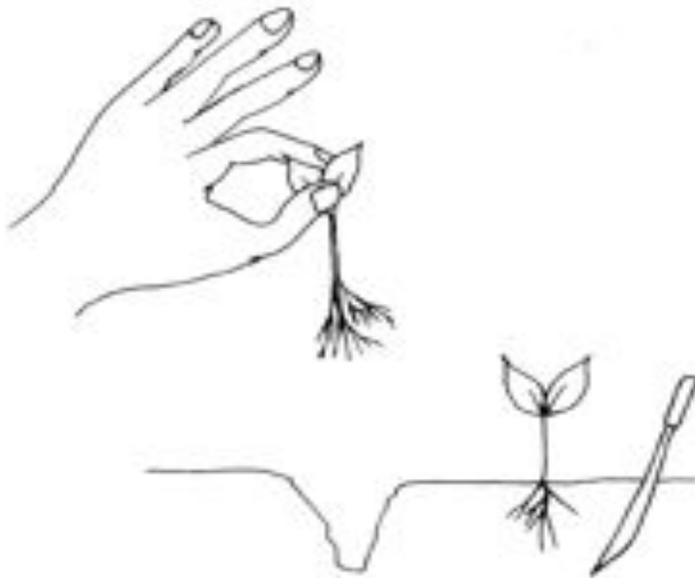
3.7. Pricking Out

This is the process of transferring young and tender seedlings from seedbeds into containers (pots). Pricking out should be carried out when the seedlings reach a height of 2 cm. This is usually about two weeks after sowing but depends on the species.

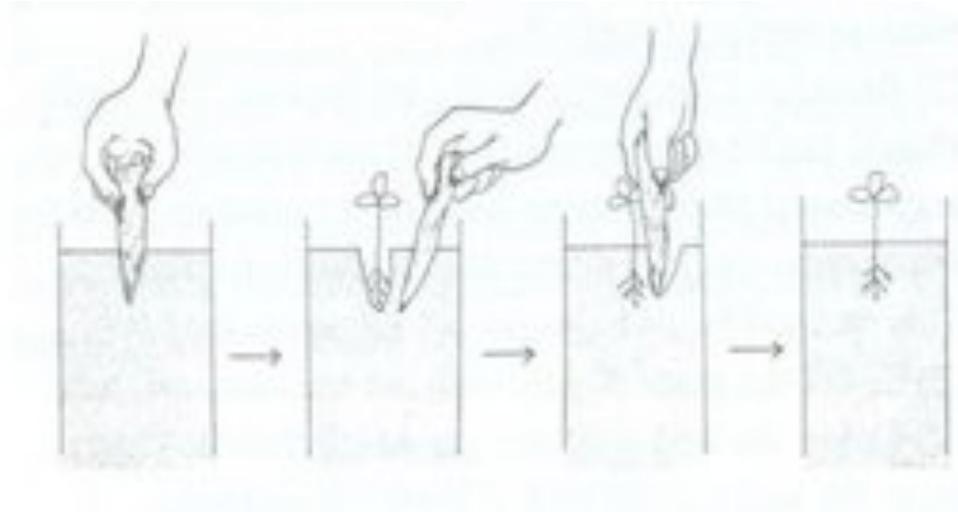
The pricking out process:

- ✚ Water the seedbed and containers properly before commencing the operation
- ✚ Ensure adequate shade is available
- ✚ Take an empty container and fill with water to $\frac{3}{4}$ levels.
- ✚ Hold the leaves of the seedlings and insert a pencil thick stick (dibble) underneath the root system to loosen the soil.

- ✚ Pull out the seedlings gently and immediately put them in the container with water. Note that if the roots of the seedlings are kept under sunshine they lose water and may die.
- ✚ Make a hole at the center of the pot using a stick.
- ✚ If the roots are too long clip off the tip.
- ✚ Do not hold the stem of the seedling because they are tender and feeble –this may injure the seedlings.
- ✚ Hold the stick in the tilting position and insert it in the soil about one centimeter away from the seedling to the same depth as the hole.

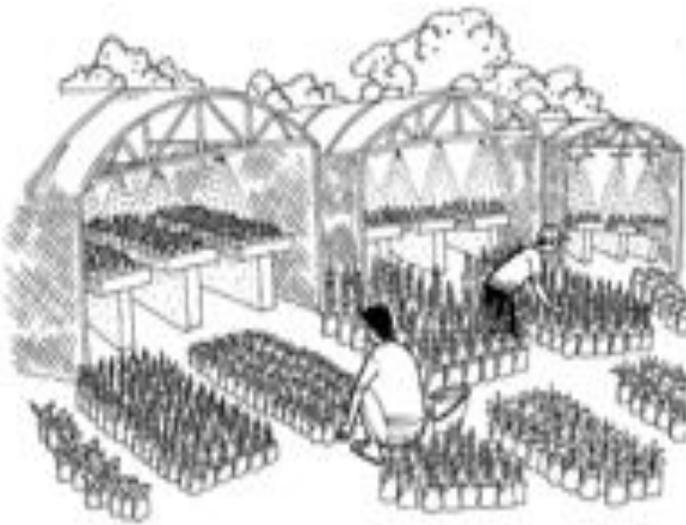


- ✚ Push the soil towards the seedling to hold it tightly. This ensures that all the air pockets around the roots are closed.
- ✚ Using your fingers cover the hole you made.
- ✚ Water the containers properly once more after planting. Seedlings pricked out from same batch of the seed bed should be arranged in the same place.



3.8. Shading

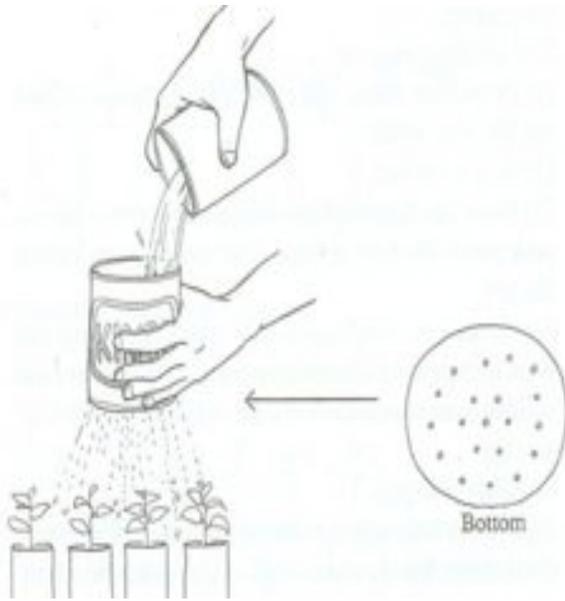
Construct a shade to protect the seedlings from direct sunlight for two to three weeks after pricking out. Use locally available materials such as grass, mats, or banana fibers for shade construction.



3.9. 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, nursery plants have only a limited volume of substrate and do not have the ability of mature trees to search for water from below the soil surface. The amount of water seedlings require depends on upon:-

- **Seedling age.** More water is required after germination when the seedling is young and at pricking out but this requirement reduces as the seedling grows in age. The amount of water should be reduced four weeks before the seedlings are planted out. At that stage, the soil can be left to dry out completely and the plants to wilt for a day. The process should be repeated several times.
- **Amount of sunlight.** If the area is sunny, more water is needed and vice versa. However, do not keep the area shady for too long to reduce water use.
- **Soil type.** A sandy soil loses water faster than a soil with high clay content hence need more frequent watering. However a clayish soil becomes hard and cracks if it dries out. The substrate should be watered thoroughly so the water should be directed to the soil and not the leaves except to dust the soil lightly. A watering can or a hosepipe with a nozzle should be used to ensure uniform distribution water and one should water the whole bed and not just the plants in the centre of the bed. Low water pressure is good but one should ensure that water gets to the bottom of the container to avoid a dry and hard bottom, which will affect the growth of the roots as they get to the bottom of the container. Water should be clean to ensure seedling health so water from such sources as kitchen waste should not be used. Too much water can damage the plants just as much as not enough water because of water logging which makes the roots not breathe. Avoid direct use of hosepipes while watering the seedlings as this may wash away the soil, Use a watering can or an empty tin with holes at the bottom.



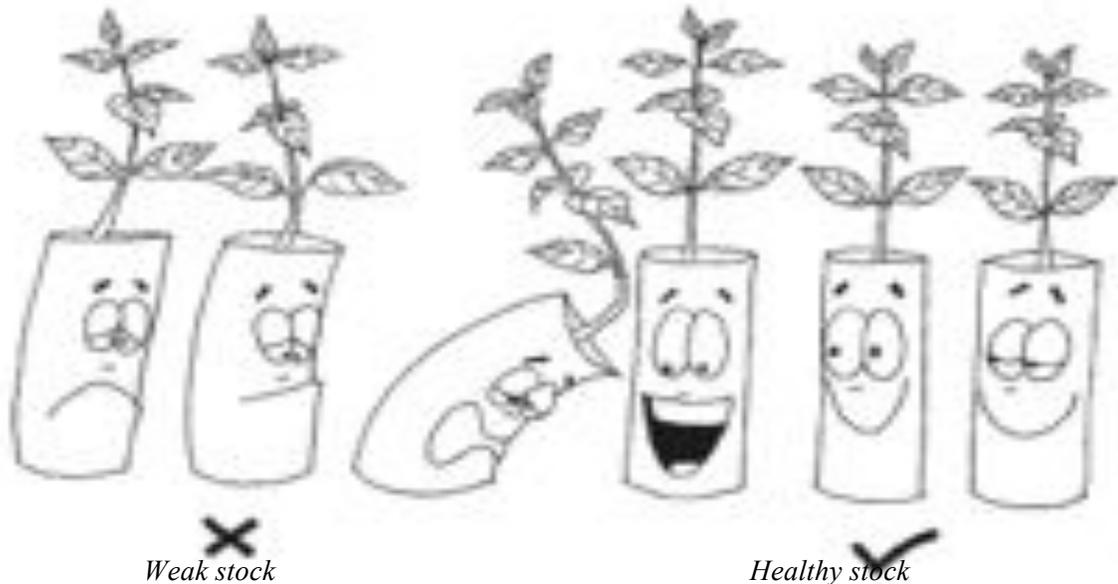
This is used to reduce the power of water drops which cause soil erosion. It helps distribute water evenly. As already mentioned, watering in principle should be done twice a day early in the morning and late in the afternoon after 4.00 pm. when the sun is not strong. If this is not possible, then water once a day in the evening. During rainy seasons, watering may be done once or not at all. Avoid under watering and over watering.

3.10. Weeding

Weeds are a threat to healthy seedlings development. They compete with seedlings for nutrients, water and light hence they must be controlled. With your hands or a dibble gently pull out unwanted growth, this should be done whenever weeds are observed. Remove all the weeds around the beds with a jembe and don't leave any rubbish around unless you are sure that this can be converted to compost.

3.11. Application of additional fertilizers (Nutrition)

Fertilizers or manure is applied when the seedlings show sign of weakness. The most common fertilizers are NPK and DAP. It's important to note that manure from livestock can also be used. However weakness of the seedlings can be caused not only by insufficiency of the nutrient but also by pests and disease.



3.12. Root pruning

Root pruning is the cutting of roots to control root system development beyond the container. Why root prune? When seedlings have reached to a certain size and their roots become longer than the depth of the pots. If the roots are left without pruning, they penetrate into the ground and develop the root systems there. Once the root system develops under the ground, it is hard to move the pots, and if the roots are cut when the seedling is old, the seedlings will be weakened; hence periodical root pruning is required before the root system reaches into the ground. The period and interval of pruning depends on different species and other conditions. Root pruning should be done regularly preferably every 2 –3 weeks. Prune when their roots have started to penetrate into the under surface.

Procedure;

- Water the seedlings properly before root pruning.

- Using a sharp knife or wire or scissors to cut the long roots underneath the container. You can also uplift the containers (wrenching) to cut overgrown roots.



The diagram above Illustrates root pruning using a knife; however when root pruning, the knife should face downwards while the plant being root pruned is place horizontally.

- Water the seedlings well after root pruning. This helps the plant withstand moisture stress.
- Note that to reduce root pruning, you can Place the seedlings on a bed of stones or on polythene sheet and this reduces root development.
- If the seedlings are in a raised bed, prune the roots by using a panga, knife or wire underneath the bed, soon after watering.

3.13. Hardening off

Hardening off is to expose the seedlings to harsh conditions to make them strong so that they will be able to survive under harsh climate in the field after planting out. It is also a gradual preparation of seedlings for field conditions.

Hardening off process;

- ✚ When the seedlings grow and reach the planting size, the shade should be removed to exposure to more sunshine
- ✚ Reduction in watering intensity (quantity) and frequency-water twice a week and later once a week

- ✚ Before planting out, root pruning should be carried out frequently or re-arrangement of pots to allow more adoption to stress.

4.0 SEEDLING PROTECTION

Seedlings are delicate and susceptible to attack by various pests and diseases as well as weather conditions. Such damages can seriously weaken or kill the seedlings. It is important that the damages be dealt with immediately. Damage and disasters in the nursery may be categorized as below.

4.1. Weather conditions

This is damage caused by the adverse weather conditions. We can either regulate watering or shading to comply with prevailing weather conditions.

4.2. Human

This is the stealing and/or intentional damaging of seedlings by human beings. Fencing and security are such options to overcome this.

4.3. Livestock and wild animals

Livestock and wild animals browse or graze on seedlings. Fencing can offset this. Rodents field mice/rates frequently cause serious damage to seedlings in the nursery as well as in the field by eating them. To control these, cleaning the nursery helps to reduce their population.

4.4. Insects

Termites are the most common recorded insects in the nursery. They eat the roots and stems of many tree species. Eucalyptus is particularly susceptible to termite attack.

Termite may be controlled by several methods;

- Putting a thin layer of ash (2-3 cm thickness) on the bed, where the pots or tubes of seedlings will be placed. However periodic application is required since ash cannot be effective for long
- Digging out the queen from nearby colonies (termite hills), use of plant extracts and chemicals in severe cases.
- Using chemicals such as Dieldrin and Aldrin

- If milk packs are used as pots wash the packs with soap water or solution of insecticide before use, otherwise termites may be attracted.

4.5. Fungal Disease

Although there are various diseases, which attack seedlings in the nursery, dumping off and wilt are described here since they are the most common fungal diseases in the country.

4.6. Damping Off

This is a fungal disease caused by *pythium spp.*, *Rhizoctonia salani* and other various fungus. The severity of the attack usually increases with increase in soil moisture.

Dumping off can occur before germination, after germination and at pricking out. The fungi attacks the seedlings at soil level and causes rotting of the part attacked consequently killing the seedling. Susceptible species include *Eucalyptus*, *Casuarina*, etc.

Conditions favorable to spreading of the disease are;

- High sowing intensity
- Over watering
- Using soil with under-composed material
- Damaging the bark of tender seedlings

Control measures: Use of optimum sowing density, Use of appropriate quantity of water or not damaging the bark of seedlings

4.7. Wilting

This is a dying bark of the main shoot of a seedling. It is mainly caused by overcrowding. Separating the seedlings or immediate planting out can help control it.

4.8 Powdery mildew

First small white powdery patches are formed on the leaf surface and later the whole surface of the leaf is covered with white powdery mycelial colonies. Damaged leaves gradually defoliate. This affects the growth of young seedlings. Control-fallen diseases leaves should be buried in soil or burned and the young seedlings sprayed with Benlate.