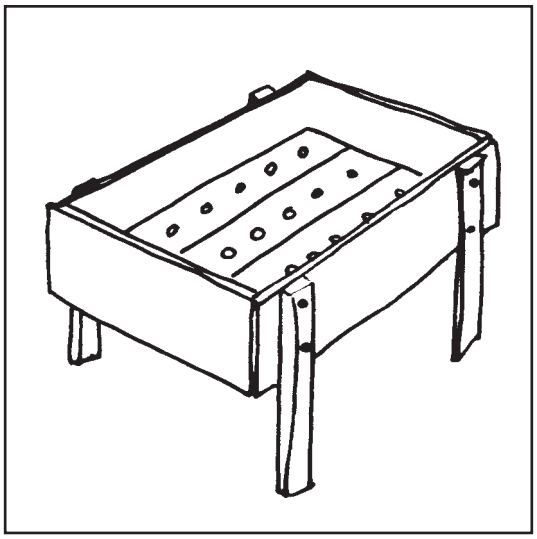
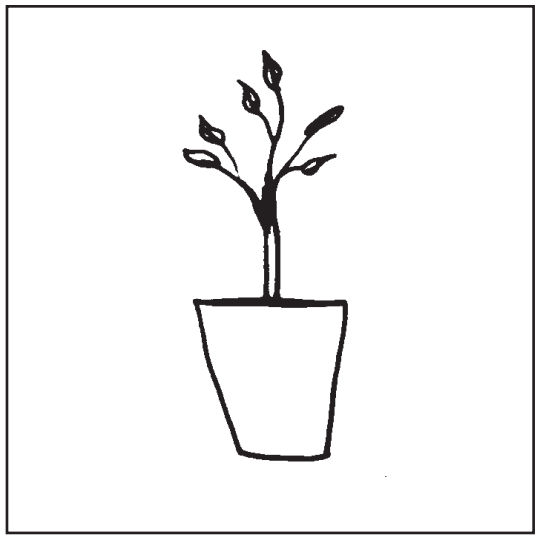
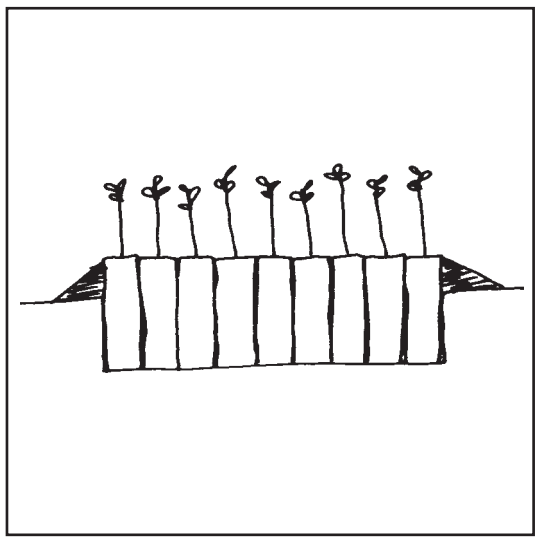
Raising Firewood and Fodder Trees in Nurseries







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What is a nursery?

A nursery is an area of land that is used for the purpose of growing plants from seeds or cuttings. A nursery may be in a garden or elsewhere, but wherever it is located, nurseries are planned as the temporary location where young plants are cared for, not their final growing site.

Why construct a nursery?

Raising trees in a nursery helps to give young trees a better start. Trees are planted for many reasons, for example:

- To make a hedge around a field
- As part of an intercropping system or to make an orchard
- To reforest an area or establish a plantation
- To prevent soil or water erosion

If tree seeds are directly sown out in the planting site, most young tree seedlings would be very susceptible to damage from animals, wind, heavy rainfall or drought. This means that a large proportion of seeds may not germinate and be wasted. Some seeds would not germinate at all because they are too fragile. The time and resources of the person who had bought and sown those seeds would also be wasted.

Nurseries help seedlings to grow into strong trees before they are planted out. Nurseries are useful because:

- Seedlings need daily care and watering, so can be cared for more easily.
- Pest and disease attack are more quickly identified.
- Fencing around nurseries protects seedlings from browsing animals.
- The most vigorous plants can be selected and the weakest can be discarded before planting the seedlings out.

Choosing a site for nursery establishment

Several factors should be considered before building a nursery:

- Seedlings need to be watered at least once a day so access to water is an important factor to consider. The availability of water may determine the maximum size of the nursery. A nursery should be located near a permanent well, a pond, a river or any kind of water source.
- The ground must be level or made level with terraces if the ground is sloping.
- A nursery needs to be in an area with well drained, preferably fertile soil which is protected from strong winds and flooding.
- The site must be protected from animals so fences must be built.

Other considerations

- A germination bed should be made with loose fertile soil at least 10 to 15 centimetres deep. Remove any stones and break up large clumps of soil.
- Use clean soil which is free from weeds and disease.
- Add food for plants into the soil such as ashes or compost, which is well-rotted organic waste. (More information on compost can be obtained from HDRA).
- Protect the soil surface of seedbeds and seedboxes using mulches such as leaves, straw or grass clippings (or any other material which allows light in and air to circulate). This will protect the soil surface from running off or from forming a crust. *Note: Remove the mulch as soon as the seeds germinate.*

Types of nursery

A nursery can vary from a small area of land near the home to a large production unit. There are several ways to raise seeds on a small scale and choosing which method depends on many conditions such as the type of seed sown, weather conditions, soil type and availability of materials. Here are three possibilities:

1. Seeds can be sown in a seedbox or in a seedbed, then transplanted into a container when they are small and then planted out when the seedlings have established. This method is most commonly used as it involves less work although the containers can be heavy to transport. It is commonly used for small seeds or seeds which have a very poor germination rate.

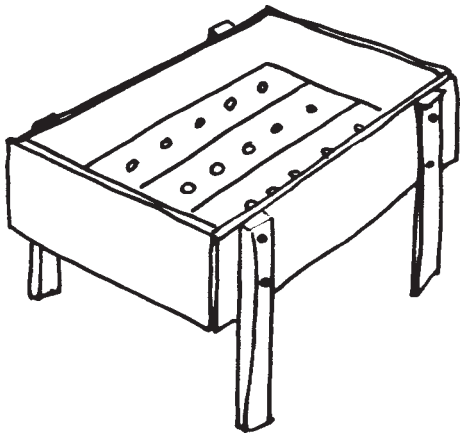
2. Seeds can be sown in a seedbed, then planted out to the permanent planting site as bareroot seedlings with a ball of soil around the roots. It is also useful if you have no containers. Bareroot transplanting can only be done in wet areas.

3. Seeds can be sown in containers (which can be of various sizes and different materials) and planted out. This method is most commonly used as it involves less work, although the containers can be heavy to transport.

Seedbox

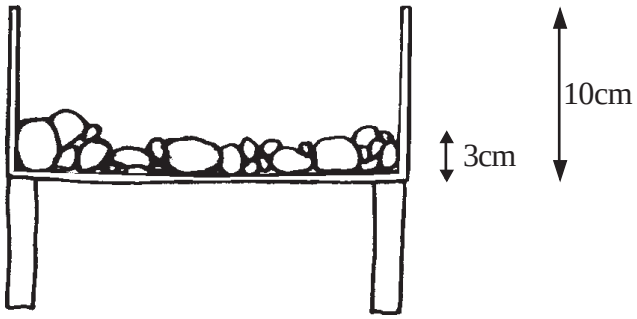
The seedbox is a movable small box. The box can be made of wood or a mixture of wood and metal sheets. It is useful to germinate seeds but not for growing them for any length of time. The box is made and used as follows:

1. Build a box with sides which are 10 centimetres deep. Make holes in the bottom of the box for drainage. Drainage can also be improved by putting legs on the box and raising the box off the ground. This also protects the seedlings from slugs, snails and other pests.



2. Prepare the soil, which is made of equal parts of soil, sand and compost. Break up any lumps and remove twigs. If possible sieve the soil through fine wire mesh.

3. Fill the bottom of the box with 3cm of gravel or small pebbles. Then add the soil.



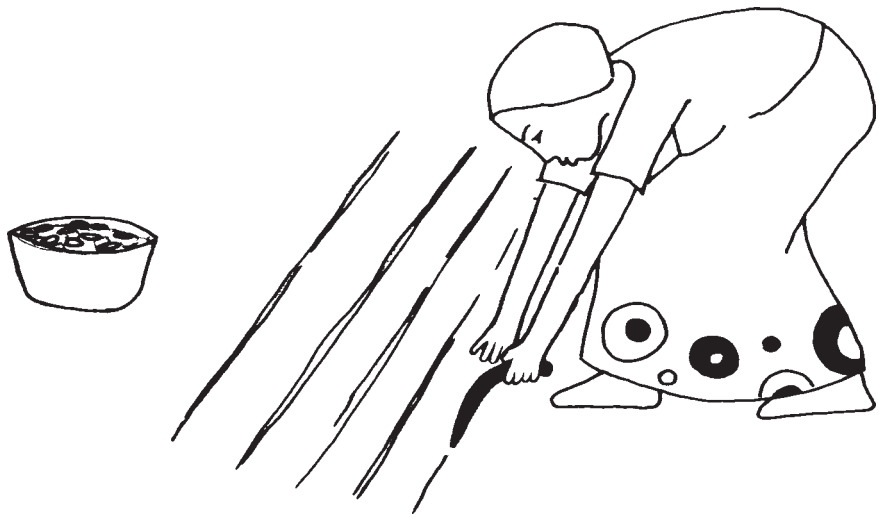
4. Then use a stick to make shallow furrows. Sow the seeds in the furrows. Sow thinly if the seeds are to stay in the bed for a long time and densely if they are to be transplanted. Alternatively, sprinkle the seeds over the surface of the soil. This is done for very small seeds.

5. Cover the seeds with a thin layer of soil or sand which should be no thicker than the seeds.

6. Water the seedbed thoroughly, but carefully, using a sprinkling system. If water is splashed on, the seeds may be uncovered or washed away.

7. Cover the seeds with a layer of dry grass. This protects the small seeds from the sun and conserves moisture. Remove the grass when the first seedlings appear.

8. Leave time for seeds to germinate. Some seeds, like mahogany take one month to germinate.



Using a stick to make furrows

<u>Advantages of using a seedbox:</u>

- It is useful for sowing small seeds like eucalyptus (*Eucalyptus* spp).
- It can be moved into shade, out of heavy rainfall or away from grazing animals.
- It is useful in wet areas because the box is off the ground, so waterlogging is prevented.

Seedbed

A seedbed is a piece of land that can be used for two things:

- To germinate seeds (just like the seedbox).
- To grow seedlings in until they are ready to be planted out to the permanent planting site. The plants grown in this system until they are ready to be planted out are called bare-rooted (or 'open-rooted') plants.

Seedbeds are prepared in the following manner:

1. Choose a suitable site using the advice on page 2.
2. Mark out where the seedbed is to be placed and how big it will be with a long piece of string. Seedbeds are usually long and thin strips with a walkway around the outside. This is to allow people to walk through the beds to weed them without walking on the seedlings. Seedbeds can be raised areas or plots of land surrounded with planks of wood, bamboo, stones or bricks. Seedbeds can also be sunken which means that they hold more water. Which type to chose depends on the soil and weather conditions. A sunken bed in a wet area may become waterlogged.
3. Add compost (it should be well-rotted), ashes and sand to the soil. Mix well. Sand loosens the soil and allows better drainage. It also makes it easier to uproot the seedlings when they are ready to be moved.
4. Loosen and break up the soil with a spade and smooth it out with a rake.
5. Use a stick to make shallow furrows.
6. Sow the seeds in the furrows. Sow thinly if the seeds are to stay in the bed for a long time and densely if they are to be transplanted.

7. Cover the seeds with a thin layer of soil or sand that should be no thicker than the seeds.

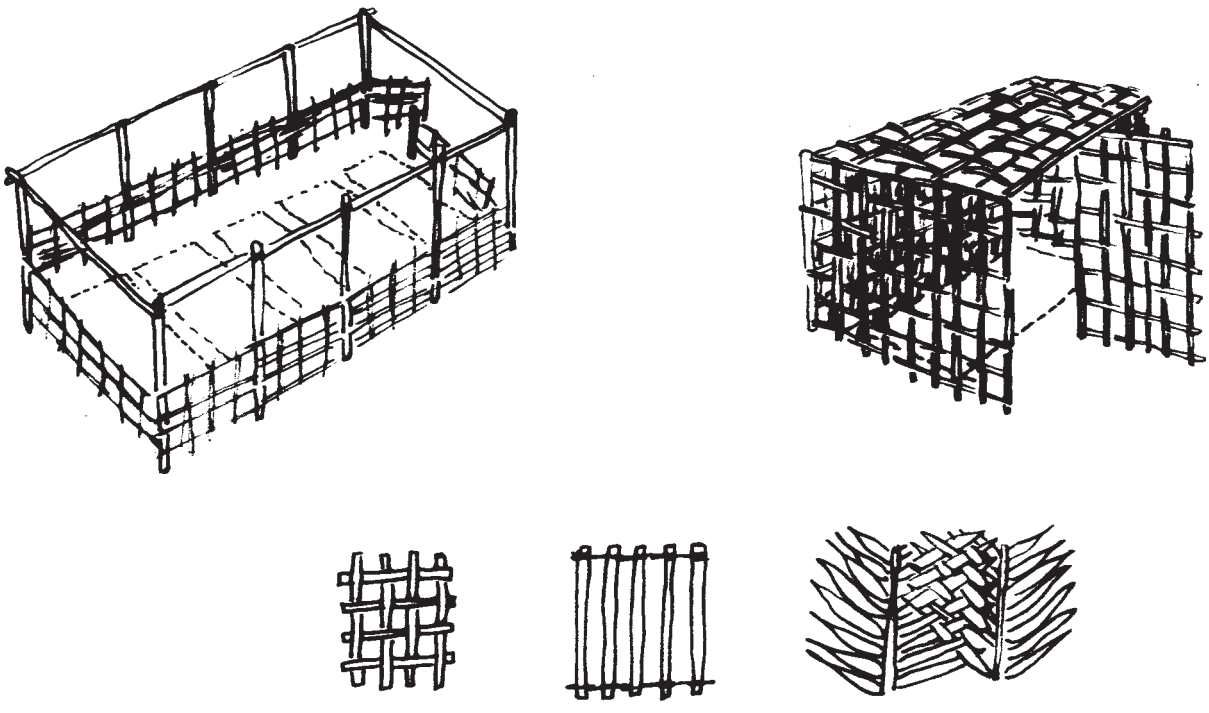
8. Water the seedbed thoroughly and carefully using a sprinkling system. If water is splashed on, the seeds may move or be washed away.

9. Leave time for seeds to germinate. Some seeds, like mahogany take one month to germinate.

10. When the seedlings have germinated and have 6 leaves, they are ready for transplanting into containers. If they are to be planted directly out to the planting site they should be no more than three months old.

If many seedlings are to be raised for fuelwood or timber production it is easier and cheaper to raise the seeds in a seedbed and transplant them out to the planting site.

The seedbed may need protecting from animals, vandals or thieves. There are many designs of fences or enclosures which can be used.



Fence designs

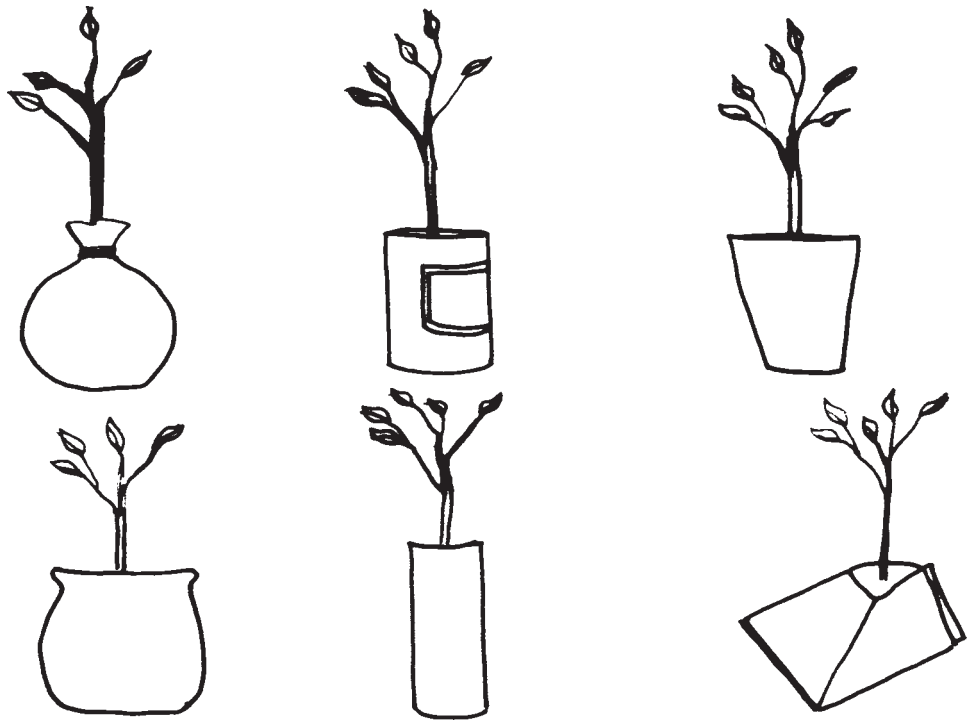
Advantages of using a seedbed: When transplanting from a seedbed, there is less weight to transport to the planting site.

Disadvantages: The disadvantages described are applicable to bare-rooted plants.

- Bare-rooted seedlings need more space in a seedbed because their roots grow more. This causes problems when digging the plant out because the roots will most certainly be cut and damaged. Some trees are difficult to remove from the seedbed because they have long taproots (carob trees and Leucaena). These trees may be killed because the taproot may be broken.
- Bare-rooted plants need more time in the nursery because they need to be stronger for the transplanting process, when their roots will be dug up and damaged.
- The nursery site must have good soil conditions.
- Planting bare-rooted seedlings is not suitable in dry or semi-arid areas because roots are exposed to air and heat. Unless watered every day seedlings will die.

Containers

Containers can be made of various materials. They can be earthenware pots, jars, milk cartons, cardboard or plastic bags. If you are using containers that you do not want to break, they should have an open neck which means that the rootball of the plant does not get damaged when finally planted into the ground.



Examples of containers

The size needed for containers depends on the type of trees grown. The distance which seedlings may need to be transported may also influence the type of container used.

All containers should have holes made in the bottom for drainage. If water cannot drain out then roots may rot and die, which may kill the seedling.

Transplanting into containers

Plants can be transplanted from a seedbed, or a seedbox, into containers when they are seedlings. Great care should be taken when handling seedlings. They are fragile and work has gone into getting them to the seedling stage so every effort should be made to keep them alive.

Transplant when the seedlings are small, with just a few leaves. Seedlings may be damaged if they are transplanting too early or too late. If they are transplanted early seedlings are too sensitive, too late and seedlings are easier to damage.

Transplanting should take place in the early morning, in the late evening or on a cool day. Then prepare for the transplanting as follows:

1. Water the seedlings in the seedbox or seedbed.

2. Prepare soil which is made of equal parts of sand and compost or rotted animal manure. If possible sieve the soil through fine wire mesh to break up any lumps. It may be useful to add clay to the soil if the soil does not have clay in it already, so that the rootball stays together when it is transplanted. Termite mounds are often a good source of clay.

3. Fill containers up to the top. Use a funnel or a similar device. Tap the container on the ground to compact the soil and add more to fill to the top. Watering will cause the soil to settle to about half a centimetre below the rim of the container. If the soil goes down to 1.5 cm below the rim then more soil or sand should be added.

   Note: If using a polybag then, when squeezed, a slight imprint where the fingers were should be seen. However, the soil should not spill over the top. If it does then there is too much soil in the bag.

4. Keep containers in the shade to avoid evaporation.

5. Gently pull a seedling out of the seedbed or seedbox using a trowel or stick to lever it out. Try to keep some soil around the root of the seedling. Grasp the seedling by the leaves and not the stem as it is too fragile to be handled.

6. Using your fingers or a stick, make a hole the size and length of the rootball in the middle of the container.

7. Place the seedling in the hole to the same depth as it was in the seedbed or seedbox. Make sure that the roots are not turned upwards.

8. Fill the container with the soil mixture.

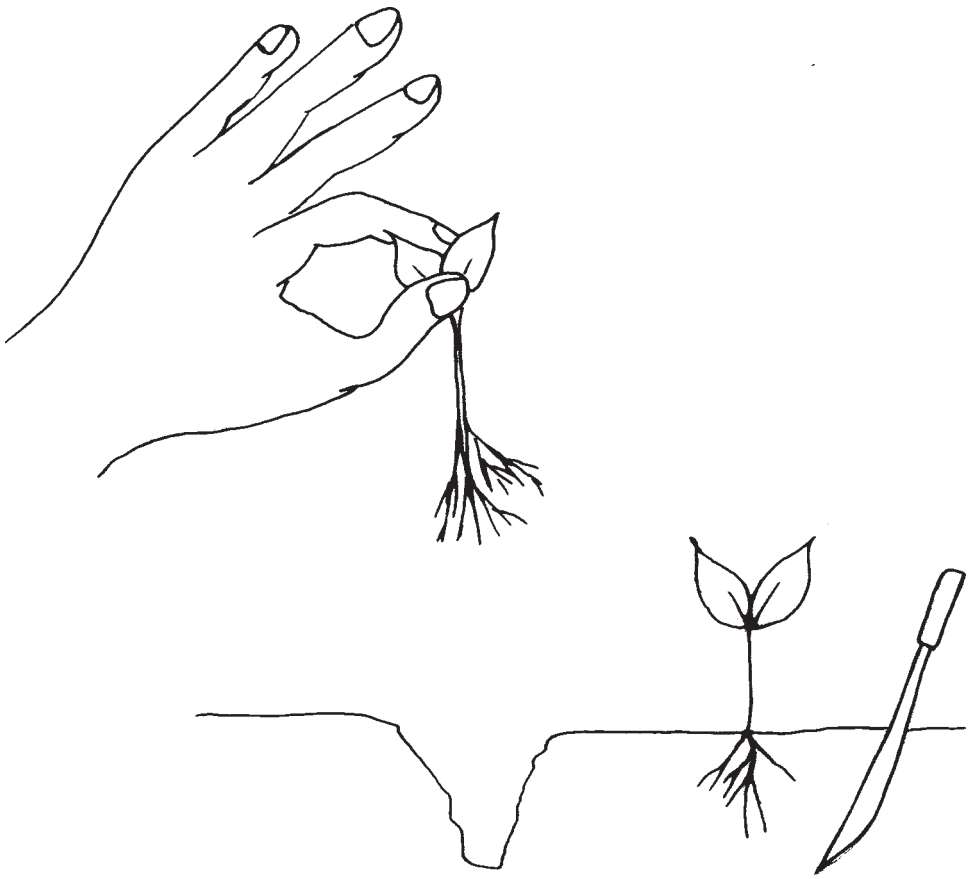
9. Compress the soil lightly around the base of the seedling and water well.

Note: Seedlings should not be left in containers for longer than three months or the roots will become distorted.

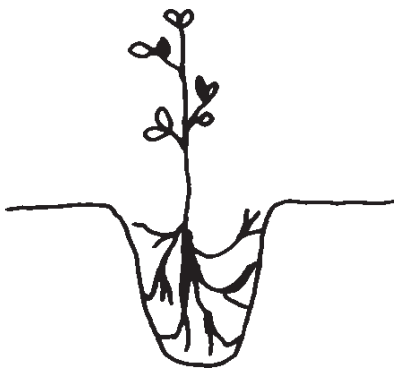
Direct sowing

It is possible to sow directly into containers. Seeds of high viability or large fruit seeds can be sown directly. In this case sow three seeds in every container.

If more than one seed germinates, remove the excess seedlings and discard or plant them in containers in which none of the seeds have germinated. Take great care when doing this and make sure the roots of the seedlings are not bent upwards (see the section on transplanting).



Pull the seedling out of the ground holding the leaves as the stem is too fragile



Make sure that the roots of the seedling are not turned upwards

Advantages of using containers:

- Root growth is contained within the container so seedlings are easy to transport (although they are heavy). When transplanted roots do not get exposed to air and heat as in the bare-rooted system.
- In arid conditions, potted plants have a better chance of survival because the earth and water around the roots gives them a good start. Also roots are not damaged as much.
- Good soil is preferred but is not essential at the nursery site.
- Seedlings can be placed closer to each other than in the open rooted method.
- The time in the nursery is shorter so it is less expensive in terms of labour and materials (water).
- Containers can be easily moved to the permanent site well before the planting out starts (as long as seedlings are still watered).

Disadvantages:

- If left too long rootballing may occur. This is when plants grow too big and their root system gets bent and entangled. This can often lead to the death of the seedling when planted out. The roots of seedlings must be closely monitored and pruned.
- Containers are heavy to transport.
- Containers may need to be purchased which may be expensive. However preparing the seedbeds for bare-rooted planting may also be expensive.

Seedlings are usually smaller at the time of transplanting and may need extra support and protection from grazing animals.

Design of the container nursery

A container nursery size and layout needs to be designed and calculated beforehand. Planning should include bed size and location within the nursery site.

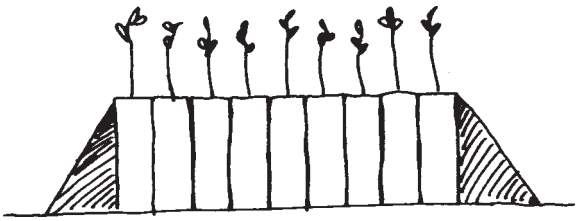
Beds should be roughly 1 meter wide so that weeding can be easily done. To give an idea of the size of a bed, for containers that are 6cm in diameter (5cm when squashed), you can fit 500 containers in a bed that is 1.3m wide and 3m long.

Plan the beds so that their longer dimension is placed in an east-west direction. Orienting the beds in this way means that trees on the inside of the beds have the same amount of sunlight as the ones on the outside.

What type of bed?

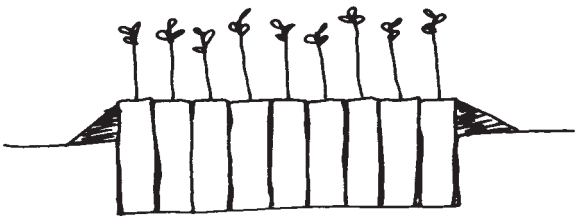
Beds can either be made on the surface of the ground or they can be sunk. Which type to choose depends on weather conditions. In a wet area plants may become waterlogged in a sunken bed.

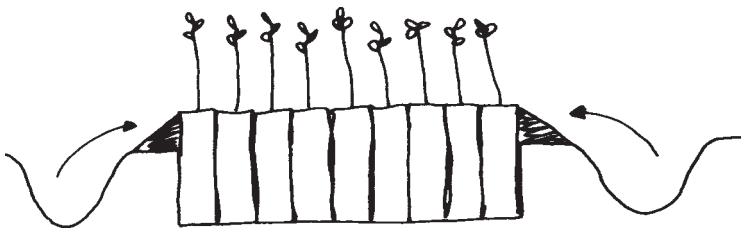
- Ground level beds: Earth should be piled around the outside to support the outer containers. This stops the outside containers from drying when the weather is hot and dry.



- Sunken beds: Sunken beds are made by digging trenches as beds. Containers are sunk into these trenches which are roughly three quarters of the depth of the containers. Earth is piled around the outside to prevent drying out when the weather is hot and dry.

  Where the earth is scooped up around the outside of the beds to protect the outer containers from drying out, drainage channels can be left. This means that excess rainwater can drain away more easily and not cause any damage.





Containers should be placed in neat rows within the beds to ensure that water and space are not wasted. For both ground level beds and sunken beds, the ground which the containers are to be placed on should be as flat as possible. Uneven ground will affect the growth of the trees due to uneven watering and sunlight.

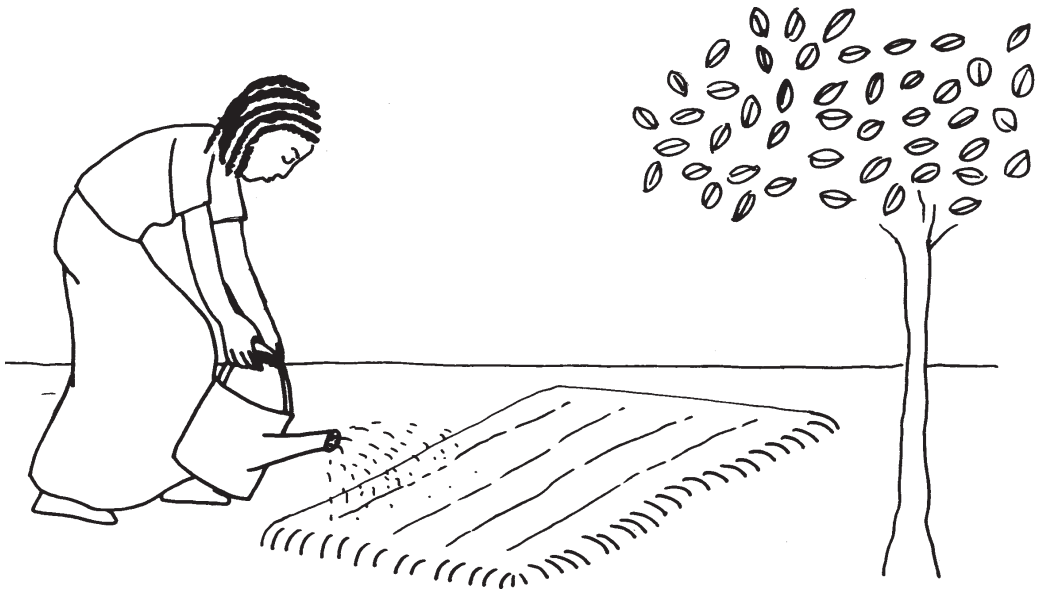
Nursery management

Watering

Watering is very important to give seedlings a good start. Watering should be done in sufficient quantity at regular intervals. It should be added gradually so that it does not form a puddle on the surface or run off and be wasted.

Seeds should be watered as soon as they have been sown. For at least the first month, seedlings should be watered twice a day. The exact amounts of water needed will depend on the type of soil and location. Watering should be done in the early morning and late afternoon or evening to avoid evaporation due to heat. Avoid strong jets that damage the seedlings.

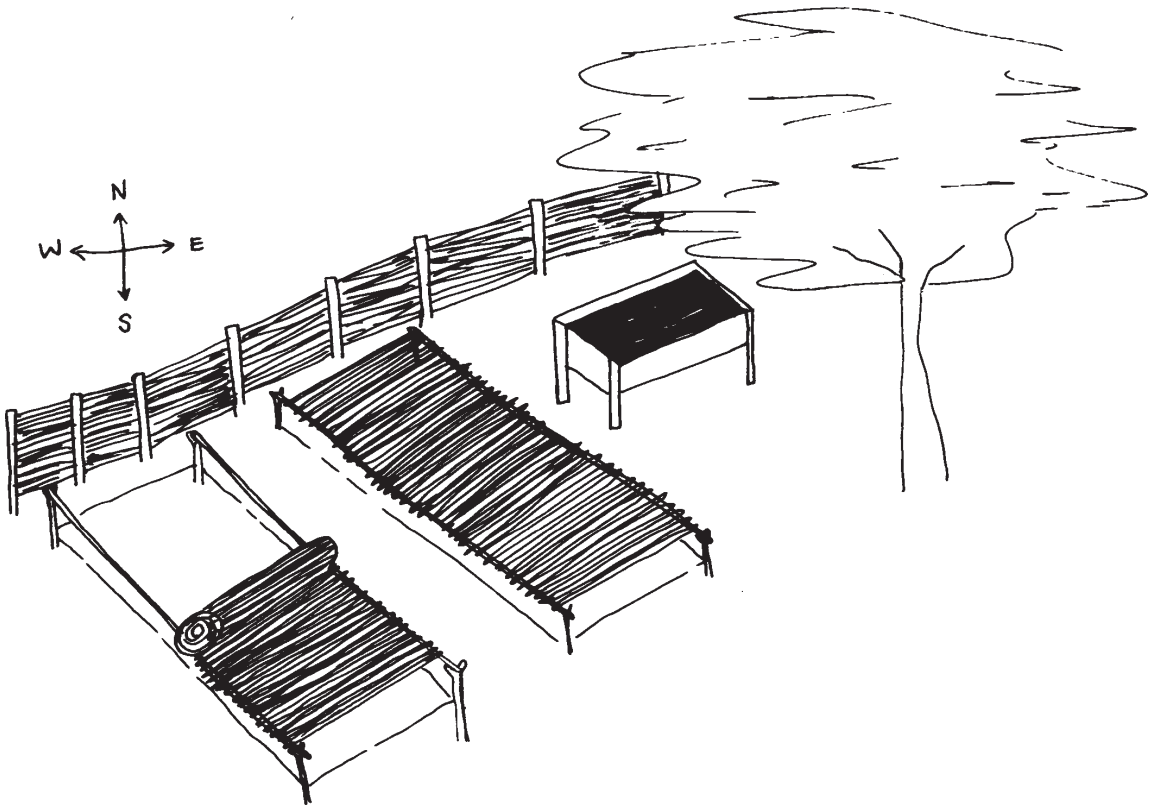
The plants should receive approximately 5 millimetres of water each time. The top 20cm of the soil should be kept moist. Knowing exactly how much to water comes with experience. Too little causes the seedlings to wilt and too much may cause disease and kill them.



Water as soon as seeds are sown

Shading

Protect seedlings from the sun, especially when they are young. This can be done by situating the nursery in the shade of trees or constructing a shade roof.



Seedlings must be protected from the sun

Weeding

Weeding should be carried out every week to avoid competition between seedlings. This can be done by hand weeding in containers or carefully hoeing in seedbeds. Seedlings that are not weeded grow weakly.

Pests and diseases

In general, tree seedlings are not prone to attack. Although there are a few pests and diseases worth mentioning.

- Termites: Termites can attack wooden boxes and milk cartons. Some termites can do extensive damage to seedlings but it is important to remember that not all termites are pests.

  There are several ways to discourage or reduce termite populations. Methods of control include applying solutions made from the neem tree (*Azadirachta indica*) or marigolds (*Tagetes minuta*). More information on termite control can be obtained from HDRA.

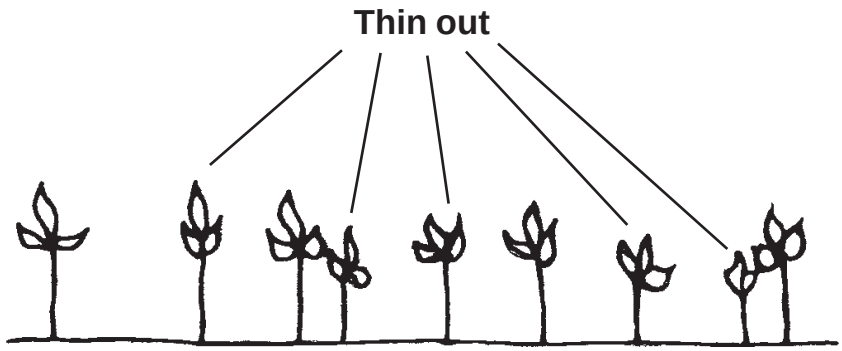
- Fungi: A common disease in nurseries is caused by fungi. ‘Damping-off’, as it is known, is caused by overwatering and stagnation of water in the nursery. Symptoms are the discoloration and wilting of the stem which begins at the base of the stem and moves upwards. The leaves may also become affected.

Damping off can be prevented by providing good drainage and allowing water to evaporate in the sun. Little can be done to stop the fungi once it has settled in. Early detection, and weeding out infected plants are vital. More information on specific pests can be obtained from HDRA.

Thinning seedlings in bare-rooted seedbeds

Young seedlings in a bare-rooted bed often need thinning out. This means that when there are too many seedlings growing in a small area, seedlings need to be pulled out and either planted or potted somewhere else. When there are too many young plants in crowded conditions, the resulting trees are of different sizes, and have poor root systems. This is due to competition for space. Seedlings may die if thinning is not done at the proper time.

Seedlings should be thinned when the plants are approximately 10 to 15cm tall. Thinning should be done by leaving approximately 5cm between each stem. The seedlings that are chosen to remain should be the most healthy and vigorous ones.



Thinning seedlings to 5cm apart

Root pruning

The roots of seedlings raised in containers often grow out of the holes which have been made at the bottom for drainage. This usually starts to happen a month after sowing. These roots need to be broken by simply moving the containers or, trimming them off with scissors or a sharp knife, or else the containers will be very difficult to move. The trees will also be very difficult to plant because the root system will be so long. It may seem dangerous to trim seedling roots off but it is not at all. In fact, trimming the bottom roots encourages the growth of smaller roots in the soil. Containers should be moved and roots should be trimmed preferably every month.

Note: Seedlings should not be left in containers for longer than three months as the roots will become distorted.

Preparing for transplanting to the planting site

Size

A general rule to determine whether a seedling is the right size for planting out is that it should be more than 15cm high but less than 100cm. Different trees grow to different sizes so it can be difficult to tell if a plant is ready for planting out. In general the root system should be no longer than 20cm. Any longer and severe root damage can occur and the plant may die. To find out if a tree is ready for transplanting take a seedling out of it's container or bed and measure the roots.

Hardening off

Hardening off is the gradual reduction of water and shade during the last few weeks in the nursery. This prepares the seedlings for the conditions they will live in when they are planted out to their permanent site.

4 to 6 weeks before planting out, reduce the watering to once per day. After about a week at that rate, water every other day. If the trees do not begin to wilt the amount of water can be reduced even further. If the trees do wilt, water the plants immediately to stop more damage.

Also, 4 to 6 weeks before planting out, start removing the shade for a few hours every day. Little by little remove the shade so that the plants are in the sun all day.

Selection

Two weeks before planting out, move the seedlings about within the nursery. Move the containers to break any roots that have rooted into the ground. Some seedlings suffer due to this move and may die. This kind of selection means that you will not plant a weak seedling which will die soon after planting.

Before planting out, look at the nursery and take out any trees that are diseased, very small, very large or discoloured.

Very large trees have outgrown their containers and their root systems are deformed. These trees have a higher chance of dying. It is therefore better to choose average sized plants.

Reference list

‘**Reforestation in Arid Lands**’ (1986) F R Weber and C Stoney. Volunteers in Technical Assistance, 1815 North Lynn Street, Suite 200, Arlington, Virginia 22209, USA.

‘**If a Tree Falls**’, A Voluntary Services Overseas guide to raising and planting trees in Kenya.

‘**Food from Dryland Gardens’** (1991) David A. Cleveland and Daniela Soleri. Centre for People, Food and Environment, 344 South Third Avenue, Tuscon, Arizona 85701, USA.

‘**Agroforestry Technology Information Kit**’ (1990) International Institute of Rural Reconstruction, Room 1270, Riverside Drive, New York 10115, USA.

Notes

Further information on nurseries can be obtained from HDRA. Other publications include booklets covering composting and the neem tree as well as single information sheets about crop pests and diseases and their control, natural pesticides and green manures. Please write to:

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