

Appendix 3: Nursery Operation*

1. Seed Treatment

In order to ensure good germination, seed pre-sowing treatment will often be needed. Methods differ ranging from soaking in cold water to scarification of the seed coat.

Detailed information for seed treatment and sowing is available in the "Farmer Tree Planting Manual" and, for some species, in the species leaflets produced by CTSP.

2. Seed Sowing

Seed can be sown directly into pots or seedbeds depending on species (see Species Fact Sheets, Module 9, of The Multi Purpose Tree Species Research Network). Seeds of species that germinate well, and more or less at the same time, can be sown directly. Direct sowing avoids damage and root distortion caused by transferring plants to larger containers. Seedbeds should be used when:

- Viability is expected to be low (less than 40%)
- Germination takes a long time
- Seeds are very small, or
- Seeds are very scarce or expensive.

For sowing in pots, two or more seeds (depending on germination rate) should be placed into each pot. For sowing in seedbeds seeds are put in rills running across the bed, making weeding easier. In both cases, the seeds should be placed at a depth equal to one or two times their diameter. The seedbeds or pots should be watered using cans with fine nozzles.

3. Pots

The most commonly used containers are plastic bags. These are available in various sizes with or without holes. If they do not have holes, eight holes extending to the base of the bag should be punched before filling with potting mixture. For Acacia and Eucalyptus which are normally kept in the nursery for three-four months, plastic bags of 9 x 14 cm (breadth x height, measure flat) are used. For seedlings with up to six months growing period, plastic bags of 10 x 17.5 cm are used, while 12.5 x 20 cm are used for seedlings up to one year old. If seedlings need to be in the nursery for longer period, then the bag has to be changed to a bigger size.

4. Potting Mixture

The potting mixture depends on the quality of the soil available. A mixture consisting of 50 % sandy loam, 40 % river sand, and 10 % organic material by volume is generally adequate. Examples of organic matter that can be used as good potting medium are peat, rice hulls, compost, one year-old manure, rotten sugarcane waste, rotten sawdust, and coconut husk.

Potting media are still being actively researched. For example Vuthy (2004) used a mixture of 40% river soil, 50% rice hulls, and 10% one year-old cowdung. Measurements

(): Some elements in this section was extracted and modified from Forestry / Fuelwood Research and Development Project.1994.*

taken at four months showed that *Acacia auriculiformis* seedlings grew significantly taller and bigger compared to other potting media.

5. Filling Pots

The pots can be filled by hand or with a funnel. When filling the pots, the lower third should be compacted firmly to prevent the mixture from falling out. The upper two-thirds of the mixture should be only compacted a little so that roots can develop easily.

6. Transplanting to Pots

When seedlings have developed a first pair of true leaves, they should be picked from seedbeds and planted in pots. Before picking, seedbeds and pots should be well watered. Seedlings should be lifted with a small trowel or a flat piece of wood. Only healthy, well-developed seedlings should be selected. If roots are too long they should be pruned.

To prevent seedlings from drying out, work should be done under shade in the late afternoon or on a cloudy day. Seedlings should be kept under a moist cover.

Dibble holes should be wide and deep enough so that roots will not bend. Holes can be closed by gently pressing the soil around the plant with the fingers. Plants should be watered and placed in a shaded area. Pots should be placed in the potbeds in an upright position.

7. Care and Tending

7.1 Shading

The seedlings of most species should be in about 50% shade. They should be gradually exposed to higher and finally full sunlight 2-3 weeks prior to planting. However, the seedlings of some species, e.g. *Acacia* and *Eucalyptus*, can be exposed to full sunlight.

7.2 Watering

- Watering should be done in the morning. A fine spray should always be used, particularly when the seedlings are small.
- To induce hardening off, watering should be gradually reduced one week or so before out-planting. Hardening off prepares the plants for the shock of transplanting and more difficult conditions in the field.

7.3 Weeding

- Weeds in the containers should be regularly removed to ensure that the seedling grows without competition for nutrients.
- To avoid damage to the roots of the seedlings in the bags, before weeding the seedlings need to be well watered.
- Careful manual weeding is recommended rather than the use of herbicides.

7.4 Grading Beds

- To prevent larger seedlings from shading smaller ones, the beds should be graded. Larger seedlings should be placed at one end, or in different beds, and the smaller

- seedlings at the other end.
- Depending on how long the seedlings remain in the nursery, grading might have to be repeated.

7.5 Pest and Fungi Control

- Damping off and root rot are common diseases caused by fungi. With damping off, seedlings often look pale and weak, finally collapsing at the root collar. This can be prevented by:
 - changing the soil in the seedbeds every 2-3 years
 - removing plants immediately if they are infected by fungi or attacked by pests
 - avoiding excessive watering
 - allowing for good drainage
 - ensuring good air circulation
 - weeding
 - thinning the seedlings in the beds
 - reducing nitrogen content (less manure and no chemical fertilizers)
 - using coconut husk as a potting medium.
- In case of fungal attacks, fungicides such as Blitox or Dithane can also be used. The solution can be prepared by dissolving 25 g of the fungicide in 5 litres of water. It is then applied to affected plants with a watering can or sprayer twice a week.
- Serious losses from insect damage are less common than losses from fungi; nonetheless, they can sometimes be severe, particularly in nurseries. Good cultural practices can prevent damage by insects. Many of these pests are soil-borne. They can be controlled using insecticides containing methyl parathion such as Methacid and Paramar. A 0.05% solution can be prepared by mixing one millilitre of the insecticide with two litres of water. It is then applied with a watering can equipped with a fine nozzle.

7.6 Root Pruning

If potted seedlings are placed on plastic sheets, root pruning should not be necessary. However, if seedlings stand on bare soil, it is necessary to prune the roots regularly by cutting those that come out of drainage holes. Root pruning can take place when seedlings are graded.

8. Preparation for Out-Planting

8.1 Hardening off

To help seedlings to survive after out-planting in harsher field conditions, they must be hardened in advance. The following techniques are useful:

- remove from shaded area 2-3 weeks prior to out-planting
- prune roots
- reduce the amount of watering one week before out-planting
- stop applying fertilizer toward the end of the stay in the nursery.

8.2 Culling

- Young seedlings of between 45-60 cm height are sufficiently large for planting in the field. When planting into existing vegetation larger planting stock should be used

whenever possible (around 100 cm), these larger plants being more easily seen and better able to withstand weed growth.

- Plants should be sorted according to their suitability for out-planting. Only good seedlings should be selected. Poor seedlings should be destroyed.

9. Packing and Transportation

- The seedlings should be well watered before transportation. They should be packed in wooden or plastic trays.
- The seedlings should never be handled by the stem or foliage; they should always be carried by the bags.
- To be sure that the seedlings are not damaged during transportation, they should not be packed loosely.
- Wind damage during transportation can be avoided by erecting appropriate screens on the truck. If possible plants should be transported in a covered vehicle. Travelling at high speed should also be avoided.
- Once at the planting site, seedlings should be placed in a protected, shaded area until planting. They should be watered thoroughly each day. The practice of immediate planting is better.