**Caring for Seedlings in Nurseries**

“**Standing-down**” refers to the time that containerized trees are kept in the nursery – from potting until transportation to the planting site. After potting seedlings, place containers in a shaded area and water the seedlings. If using plastic bags, make sure that they remain upright and not squeezed together

The containers may be stood down on i) the ground, ii) on ground covered by various materials or iii) on raised wire grids.

If containers are stood down on bare earth, tree roots can grow through holes in the base of the containers into the underlying soil. When the trees are lifted for planting, the roots break. Supply of water from root to shoot is suddenly reduced and the plant goes into shock before it even reaches the planting site. Therefore, the containers must be lifted every few weeks, and **root pruning** performed.

The ultimate (and most expensive) solution is to stand down containers on raised wire grids. Roots growing out from containers are exposed to air and either stop growing or die. This is called **air pruning.** It encourages root branching within containers and the formation of a dense root ball, which increases the survival chances of trees after planting out.

**Water**

Each container holds a relatively small amount of water, so seedlings can dry out rapidly if watering is interrupted for more than a day, especially in a dry season. In contrast, over-watering can saturate the potting medium, which suffocates the roots. Water the trees early in the morning and/or late in the afternoon to avoid the heat of the day. Judge watering frequency according to the season and moistness of the medium.

Hand watering allows more control than automated sprinklers.

**Fertilizer**

Trees require large amounts of nitrogen (N), phosphorus (P) and potassium (K), moderate amounts of magnesium, calcium and sulphur and trace amounts of iron, copper and boron and others. The potting medium may supply adequate quantities of these nutrients, especially if rich forest soil is being used, but additional fertilizer application can accelerate growth. Plants with symptoms of nutrient deficiency, such as yellowing leaves, may be suffering from a nutrient shortage and should receive fertilizer. Fertilizer should also be applied when it is necessary to accelerate growth to produce plants large enough by planting time. Slow-release fertilizer granules are recommended. At FORRU-CMU, good results have been achieved adding about 10 granules of Osmocote NPK 14:14:14 (approx. 0.3 g) to the medium surface of each container every 3 months.

Do not apply fertilizer i) to rapidly growing species that reach a plantable size before the optimal planting time (since they will outgrow their containers) ii) to species in the Family Leguminosae and iii) immediately prior to hardening-off (as new shoot growth should not be encouraged at that time).

**Should the trees be inoculated with mycorrhizal fungi?**

FORRU found no significant advantage to applying mycorrhizal inoculae to containerized seedlings, since the fungi are already present in the forest soil component of the medium.

**Weeding**

Weeds, around the nursery, can harbour pests and their seeds may spread into containers. Grasses, herbs and vines should all be removed from the nursery grounds before they can flower. Weeds that colonize containers compete with tree seedlings for water, nutrients and light. Use a blunt spatula to remove them while they are still small.

**Disease**

Diseases can occur even in the best-maintained nurseries. There are three main causes:

* **Fungi:** although some species are beneficial, others cause damping-off, root-rots and leaf-spots (blights and rusts);
* **Bacteria**: most are harmless, but some cause damping-off, canker and wilts and
* **Viruses**: most do not cause problems, but some cause leaf-spots

Prevention is better than cure, so keep containers, tools and work surfaces clean using domestic bleach. Do not recycle plastic bags or medium. Make sure that the plants are not being over-watered, that there is adequate drainage within and beneath the containers and that the plants are well-spaced to allow air movement around them and to prevent direct transfer of pathogens from individual seedlings to their neighbours.

Remove infected leaves or dispose of diseased plants immediately. Routine spraying with chemicals should ***not*** be necessary. But sporadic use may be necessary to deal with a disease outbreak. **When using any pesticides, read the health warnings on the packet and follow all the protective precautions recommended.**

**How can pests be controlled?**

The most important pests include leaf-eaters such as caterpillars, weevils and crickets; shoot borers, particularly beetle and moth larvae; juice-suckers, such as aphids, mealy bugs and scale insects; root-eaters such as nematode worms; cutworms (larvae of certain moths) and termites (which also destroy nursery structures. Remove harmful animals or their eggs by hand, or spray the saplings with a mild disinfectant. If this fails to prevent infestation, then spray the saplings with an insecticide, observing all the health precautions on the packet.

**Grading for Quality Control**

**When handling plants, take care to avoid snakes or insects in the dense foliage of a batch of container-grown tree seedlings.**

Grading is an effective method of quality control. It involves arranging the growing trees in order of size, whilst at the same time removing stunted, diseased or weak ones. In this way, only the most vigorous and healthy trees are selected for hardening-off and planting-out. This maximizes post-planting survival. When the nursery is full, the smallest and weakest plants can be easily identified and removed to make room for new more vigourous plants. Perform grading at least once per month. Root pruning and disease inspection can be carried out at the same time. Wash hands, gloves and secateurs in disinfectant frequently to prevent spreading diseases from one block of plants to another. Dispose of poor-quality plants by burning them, well away from the nursery. Do not recycle the medium or plastic bags.

**Look out for problem plants**

* + - 1. Unbalanced - the shoot is too long and thin. It may break during handling. Prune back well before planting time.
      2. Malformed stem compromises future growth – dispose of it.
      3. Attacked by insects - burn it and spray surviving plants with insecticide
      4. Stunted growth – compared with other plants of same age – dispose of it.
      5. This plant is losing its leaves, possibly as a result of disease – burn it.
      6. This container was knocked over and spent some time lying on its side, resulting in a non-vertical stem – dispose of it.
      7. The perfect plant – well balanced, disease free and straight – with adequate care and rigorous grading, all plants in your nursery should look like this.

**1 2 3 4 5 6 7**

**How tall should the saplings be at planting time?**

Some fast-growing pioneer tree species can be planted out when only about 30 cm tall and for *Ficus* spp the recommended size is 20 cm tall, but for slower-growing climax forest tree species, it is better to plant trees around 40-60 cm tall. Small saplings have much higher post-planting mortality rates than larger ones do, because of competition with weeds, but very large saplings are much more susceptible to transplantation shock and more difficult to transport.

**Hardening off**

Weaning, or ‘hardening-off’, prepares saplings for the difficult transition from the ideal nursery environment to the harsh conditions of deforested sites. If they not hardened to the hot, dry, sunny conditions of planting sites, the planted trees suffer transplantation shock and mortality rates are high. About 2 months before planting, move all saplings to be planted to a separate area in the nursery and gradually reduce shade and the frequency of watering. Gradually reduce watering by approximately 50%, to slow shoot growth, and encourage smaller new leaves. Do not reduce watering to the point at which leaves wilt, as that stresses and weakens saplings. Regardless of the normal schedule, water the saplings as soon as any wilting is observed.

**The Ultimate Aims**

* >80% survival of saplings since pricking out.
* Mean sapling heights >30 cm for fast growing pioneer species (20 cm for *Ficus* spp) and >50 cm for slow-growing climax tree species at planting time.
* Sturdy stems, supporting mature, sun-adapted, leaves (not pale, expanding leaves) (“sturdiness quotient”, height (cm)/RCD (mm) <10).
* Root:shoot ratio of between 1:1 and 1:2; with actively growing, densely branching root system, not spiraling at the base of the container.
* No signs of pests, diseases or nutrient deficiency.

**Records**

Label seed trays and plants in the nursery with species names, batch numbers and dates of seed collection and pricking-out. Record when and where each batch of seeds was collected, seed treatments applied, germination rates, growth rates, diseases observed and so on. Finally, record when and to where saplings are dispatched for planting.

Steve Elliott

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