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## 3 Producing quality nursery seedlings

**Nurseries are structures where seedlings are grown from seeds before being planted out in the field for site restoration. The production of seedlings is more costly and labor-intensive than seeds that are sown directly. However, planted at the right period, the chances of survival are greater only in the first years because they have been monitored in a nursery where they have been given the appropriate amount of water, shade, and protection from browsing. In the AAD project, results show that for most of the species after three rainy seasons, there is hardly any growth difference in the field between a direct sown seedling and a nursery planted seedling.**

### Establishing and managing a nursery

If a nursery needs to be established, it is important to define its exact role and production capacity, as well as the dimensions and location respectively for the restoration site. The nursery should be kept as close to the plantation site as possible to reduce the need for transportation, as it can be very costly to transport thousands of seedlings across long distances (1 potted seedling weighs about 1 kg!) The establishment of a temporary nursery on the restoration site or in a nearby vicinity, to be removed once the seedlings have been planted, is also a feasible option.

Firstly, the establishment of a village nursery near the settlements would allow easier access to both water and for the working force. A local nursery could prove to be more effective as it would reduce the need to transport seeds being collected in stands close to the restoration site.

Secondly, nursery management would focus on the organization of the nursery's main areas and equipment. Specific areas are required for: seedling beds and propagators (seed-trays), substrate preparation and composting, storage of equipment (including picks, shovels, mattocks, shovels, wheel barrows ...).

Finally, sound management serves to keep detailed records of the production, deliveries, accounts, and nursery reports. Production reports record inputs (and dates) such as: seeds, compost, treatment products and outputs such as seedlings produced and their quantities, qualities, germination responses, age and information for monitoring seedlings growth. Keeping track of their performance is important to improve the quality of the seedlings produced and increase cost-effectiveness. In addition, accounting documents are needed to record the sales and/or outflows of seedlings, expenditures and revenues, as well as lists of clients and their contact details. Substrate quality is a key element that directly affects the growth of seedlings and generally consists of a mixture in variable proportions of:

- soil;
- a nutrient-rich material such as compost;
- an inert material such as sand.

Different proportions of these components will result in different soil textures, hence a different capacity for retaining water and nutrients. The ideal nursery substrate must have good cohesion and be able to retain sufficient water and nutrients without producing heaviness (should not stick to the hands), in addition, soil organic matter and fertility should be high. It is strongly advised not to re-use soil from old bags while preparing for new seedlings, so as to prevent contamination.

In order to facilitate the nursery management, the seedlings should be organized in rows, taking into account the following:

- The space between rows should allow easy access for maintenance;
- The number of seedlings per row should be constant, to facilitate counting, transport, etc.

### Pre-treating seeds for germination

Each seed has a specific type of dormancy (exogenous, endogenous, both) and in order to lift dormancy it is important to follow a specific protocol, which may include: mechanical/scarification, boiling and acidification treatments.

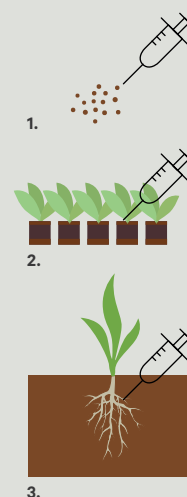
Throughout the AAD project, innovative techniques have been tested on the use of inoculation with micro-organisms to improve the establishment and performance of seedlings in the field (box 3). Such treatments can be applied at different stages for example, the coating of seeds, nursery seedling inoculation, or soil inoculation in the field. The results are very promising and these techniques are being further developed for their mainstreaming and widespread adoption.

### BOX 3. Inoculation with micro-organisms applied to restoration planting (seeds and seedlings)

Some natural symbiotic associations provide mutual benefits between soil micro-organisms (bacteria and fungi) and the plants through their roots. These associations include:

- **Rhizobium** (bacteria) which facilitate nitrogen fixation through root nodules (mostly in legumes – e.g. Acacias - and pulses);
- **Mycorrhiza** (fungi) living on the plant roots and providing mutual benefits, and present in 95% of tropical plants.

Inoculation consists of integrating inoculum (i.e. living micro-organisms) into the plants by using different techniques. Experiments have shown that the inoculation of propagules in the nursery with appropriate mycorrhizal fungi or rhizobia and other seed treatments facilitates and accelerates the establishment of seedlings by increasing water and nutrient uptake, and improves the vitality of plants subject to various stressful situations. Different inoculation techniques that can be applied to restoration planting include: **1.** Coating of seeds for direct sowing. **2.** Nursery seedling inoculation. **3.** Soil inoculation in the field.



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## Nursery seedlings management and preparation for the field

Watering is best carried out by hand (with a hose or a watering can). Frequent watering is needed until the seeds germinate, since germination is always triggered by water. During hot conditions watering should be carried out in the evenings to minimise evaporation. Mulching and protection from strong sunlight are also effective to reduce rapid water evaporation. Weeds compete with the seedlings for water and nutrients and should therefore be removed, furthermore, they also can impede air circulation and be potential sources of pathogens.

After 3 to 6 months, seedlings of the faster growing species such as *Acacias* usually reach a height of 40 to 80 cm in height. Generally, at this stage of development their chances for survival should be good, once in the field. Slower growing species such as *Balanites aegyptiaca*, *Faidherbia albida*, and *Tamarindus indica* may need a total of 14-18 months in nursery before plantation. For this reason, it is important to plan restoration projects carefully with a timeframe that is long enough for the production of species that grow more slowly.

Two weeks before planting the water quantity can be divided into two parts, in order to facilitate adaptation to dryer conditions and the seedlings must be watered abundantly the day before planting. If using bare-root seedlings they should be extracted from the soil carefully, using a sharp knife or pruning shears to prune the roots. Some seedlings will require pruning their aerial part as well. The roots need to be protected with humid soil and placed into propylene bags for transportation to the planting site.

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## KEY RECOMMENDATIONS

### CHAPTER 3

**Prior to the establishment of a nursery, it is essential to define its precise role and include where and how many seedlings will be used. The nursery location and production capacity and size will be defined accordingly.**

**Maximize nursery efficiency by carefully choosing the substrate, following the germination treatment, and care for seedlings (water, shade).**

**Continuously monitor seedlings growth for adaptive management.**



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