UNIVERSITY OF COPENHAGEN

Københavns Universitet

NUrsery planting soil - Suitable germination and plant growth media

Schmidt, Lars Holger

Published in:
Development Briefs. Technical

Publication date:
2021

Citation for published version (APA):
Schmidt, L. H. (2021). NUrsery planting soil - Suitable germination and plant growth media. *Development Briefs. Technical*, (17).

Download date: 17. Nov. 2026

DEVELOPMENT
BRIEFS
TECHNICAL
No. 17 - August 2021

Nursery planting soil - Suitable germination and plant growth media

Introduction

The major success or failure in raising healthy vigorous nursery plants is due to the root environment. Tiny, germinating plants are especially vulnerable to drought and waterlogging. Small seeds are often germinated in seed beds and later transplanted into planting pots. This involves mechanical stress during uprooting and physical stress from changing soil environment. Root distribution of potted plants is restricted to the volume of the nursery pot or poly-tube. Pots restrict root development and are more or less impermeable to water and air, except from drainage holes. While roots in natural plants would grow to find the most suitable environment, nursery plants rely fully on the pot conditions.

Controlling pot environment is generally difficult in tropical soil because of rapid decomposition of organic matter under warm and humid condition, this means the mineral soil in the pot will determine the pot environment.

A good pot environment makes plants grow quicker, and fast growing plants cope easier with possible stress.

Opposite, if the root environment is poor and plants do not thrive, the process can be self-deprecating.

Germination medium

Small seeds are often germinated in seed beds or trays because it is easier to control the environment than if they are sown directly in polypots.

If germination of the seeds is low, it is also preferred to sow in seed beds because several seeds should otherwise be sown in each pot. Germinating seeds rely on their own seed nutrients until they have established a root. Therefore they are less dependent on external nutrient supply. For seed germination medium is preferred a course grained medium with high sand content, as this reduces possible mechanical damage during transplanting because friable soil easily gives off from the roots when they are removed from the seed beds

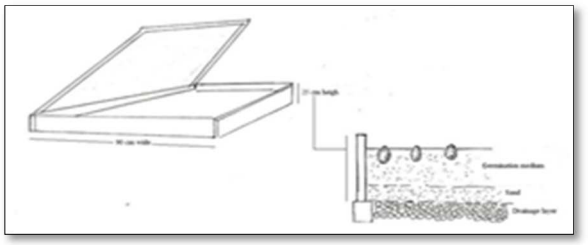


Figure 1. Seed bed with lid to protect new germinants from direct sun and heavy rain, which could wash way seedlings. The seedbed should be well-drained with a layer of sand. The germination medium is put on top of the drainage layer and seeds are sown on or slightly pushed into the soil surface.

Properties of good potting soil

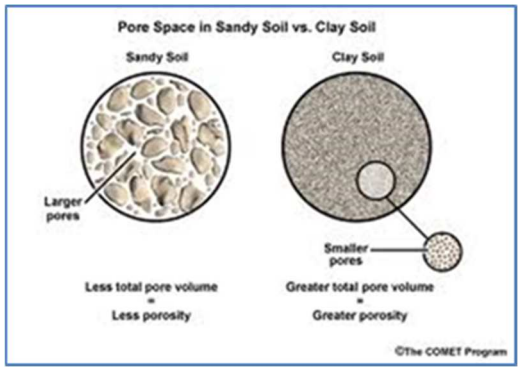


Figure 2. Balance between water and air in soil: Large pores hold less water, drain better and contain air space; small grain hold more water, drain poorly and leaves less pore space for air

The soil should have a good structure:

1. Friable, not too hard and not too soft, - both extremes restrict root development
2. Be able to hold water so seedlings do not dry out easily and yet allow sufficient drainage to allow air for respiration
3. The structure should be relatively stable so it doesn't change properties during the plants' stay in the nursery

UNIVERSITY OF COPENHAGEN

4. Preferably high organic matter

In addition, the soil must have sufficient nutrients to feed the seedling during growth.

An appropriate potting mix aims at balancing properties of different components into a suitable substrate with above overall properties. Individual components of potting soil depend on local availability, either collected from the field or purchased from markets. Potting mix may consist of topsoil, humus, sand and compost, mixed in different proportions:

Gravel or coarse grained sand: Soil that is very coarse grained (small stones, gravel and sand) has a good drainage, but it doesn't hold water well and contains no accessible nutrients. A potting mixture consisting entirely of such material is not good, because the soil will dry out easily and plants will suffer from lack of nutrients.

Silt or clay: Soil with very small grains (e.g. clay or silt) can be rich in nutrients and can hold a lot of water, but water replaces air space, and when clay dries out it gets very hard, so plant roots cannot grow. If soil tends to be very fine-grained it is suitable to mix it with some coarse grained or organic material.

Organic material (sawdust, rice husk, peat) can hold a lot of water. Drainage is usually not good but if the soil is allowed to dry out regularly, air will enter. It can be difficult, though, to regulate the water. Some organic matters like cow manure have high nutrient content; others like sawdust contain virtually none. Some organic matter may contain unwanted compounds, - sawdust contains for example tannin and lignin, which restricts root development. Manure can contain harmful organisms, and nutrient content is too high to be used directly as the only medium. Most deleterious compounds disappear though during decomposition. Rice or coconut husk are often used as component of potting soil. The decomposition of these compounds is slow, so they help keeping soil stable.

Nutrients can be added via compost material, which consists of decomposed organic matters such as leaves, grass, ruminant manure and green manure. Good compost combines good properties of structure and nutrient.

Forest top soils sometimes have good properties of all the required factors: drainage, porosity, water holding capacity and nutrients. Further they may contain important soil microbes that will make the plants grow better. Unfortunately forest soil may also contain something that is not wanted in the nursery for example pathogens or allelopathic compounds.

Most nurseries use a mixture of different components

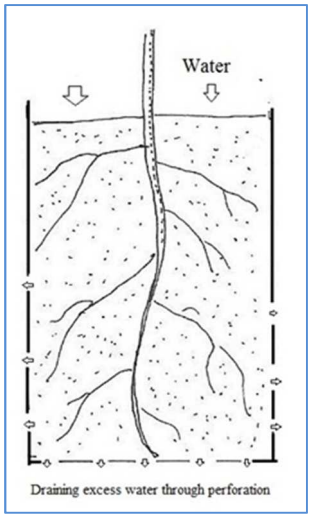


Figure 3. Water replaces air in pores causing anoxia in over-watered pots

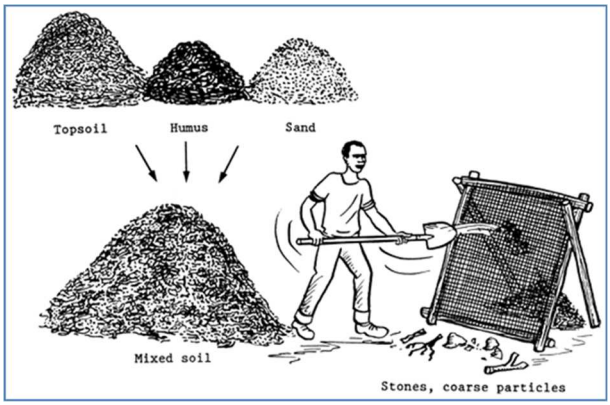


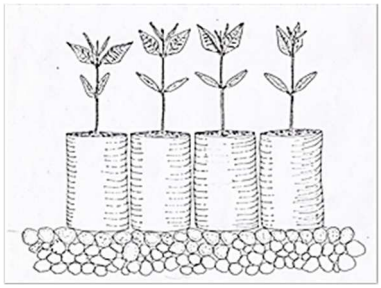
Figure 4. Mixture of different components of soil. The mixture is sieved to remove inconvenient large material such as branches, stones and leaves

Mixing potting soil

Different species have different requirements or tolerances to root environment. However, almost all species can grow in an 'average' substrate with above mentioned properties. A potting mix is created by mixing different fraction of components into a new uniform mixture, for example consisting of Topsoil:gravel:rice husk:compost in proportions 1:1:1:1. The mixture is usually sieved to remove possible large contaminating fragments. Once mixed, the mixture is ready for being filled into pots, - either prior to or in connection with planting or sowing.

Drainage

No matter how well drained is the potting soil, if seedlings are stocked on soil with impeded drainage, water can accumulate in the pots. Nursery seedling beds should always be well drained, either by establishing a drainage layer of gravel and sand, or by using seedling tables.



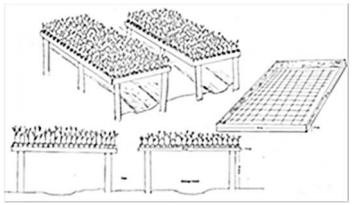


Figure 5. Drainage of seedlings. Upper: Seedlings placed on a layer of gravel. Lower: Seedlings placed on tables with drainage layer

Recommended readings

Forest Restoration Research Unit 2005. How to plant a forest: The principles and practice of restoring tropical forests. Biology Department, Science Faculty, Chiang Mai University, Thailand

Jaenicke, H. 1999. Good tree nursery practices. Practical guidelines for research nurseries. International Centre for Research in Agroforestry (ICRAF)

Miller, J.H. and Jones, N. 1995. Organic and compost-based growing media for tree seedling nurseries. World bank Technical Paper Number 264. Forestry Series

FAO (undated). Soil management: compost production and use in tropical and sub-tropical environments. FAO Soils Bulletin No 56. http://www.fao.org/docrep/018/s8930e/s8930e.pdf

Authors: Lars Schmidt, Luce Alvafritz

Note: This note was prepared as extension fact sheet for Harapan Rain Forest Project, Indonesia. Edited as DB for UoC by S. Moestrup and JPBL Lillesø

Material	Visual	Properties
Coarse grained material, e.g. river sand		Good water drainage, poor water holding capacity, low nutrients, good air space. Beach sand should be washed as it can contain high level of toxic salt
Fine grained material, e.g. forest top soil		Large water holding capacity, poor drainage, rich in nutrients, and microorganisms. Tends to get sticky when wet and hard when dry.
Compost, e.g. added cow manure		Poor drainage, large water holding capacity. High nutrient content (low C:N ratio) and gradual nutrient release.
Structured organic matters, e.g. bark, rice husk, sawdust, coconut husk, peat, leaf litter.		Combines good drainage with good water holding capacity, and keeps the soil mix stable. Some wood material may contain growth inhibitors (tannin); partial decomposition may reduce deleterious compounds