Air Pruning Techniques©

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INTRODUCTION

In May 1985 I was Program Chairman of the Australian Region Conference held in Rockhampton, Queensland. One of the papers presented at that conference was prepared by Dr. Greg Moore of the Victorian College of Agriculture and Horticulture, Burnley Campus (now the University of Melbourne, Burnley). This paper, "Getting to the Roots of the Problem," was one of the most thought-provoking I have ever listened to. Greg outlined root development problems in an experimental planting of *Eucalyptus regnans* seedlings established by the Victorian Forest Commission. The seedlings planted in this experimental plot were some of the first forestry seedlings grown in nursery tubes, rather than being produced in outdoor field beds. Eight years after planting, the trees were approaching 20 m tall with a breast-height diameter of up to 35 cm. At this time large numbers of the trees began to fall over, and root system inspections revealed serious root system deformities.

Greg Moore concluded that the root system deformities had occurred as a result of the small, round nursery tubes used in their production and the poor nursery technique involved in the transplanting of the seedlings into the tubes. Here we had, for the first time, a researcher telling the nursery industry that the reasons why root system distortions occur in nursery-produced plants is directly related to the containers used for production and the sloppy techniques used in propagation.

Moore identified two types of root system distortion:

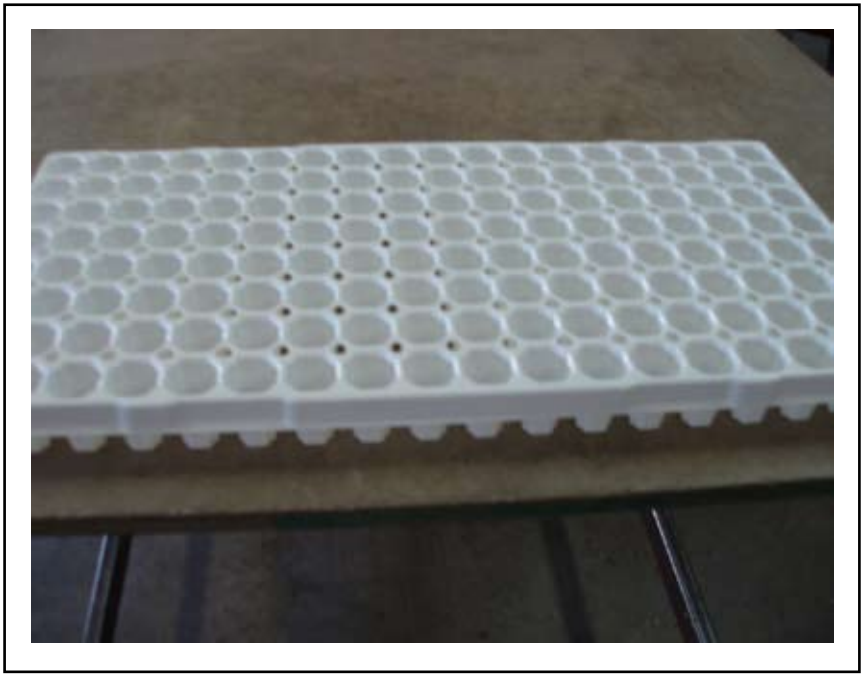
1) **Kinking.** This involves deflection caused to the developing tap root of a seedling due to the use of a very shallow tray for seedling germination. Many forestry organisations now shun pricking out of seedlings in favour of direct planting of seeds into deeper growing tubes to prevent kinking from happening.
2) **Circling.** Roots that come into contact with the side wall of a small, round tube will circle round the exterior of the root ball and eventually the root mass is spiralled inside the tube. Potting up of tubestock with circled roots into larger containers does not solve the problem. It merely hides the problem within a larger mass of potting mix. The 50-mm-round plastic tube that is still widely used in the production of tubestock in Australian nurseries is the greatest culprit of circling of the root system.

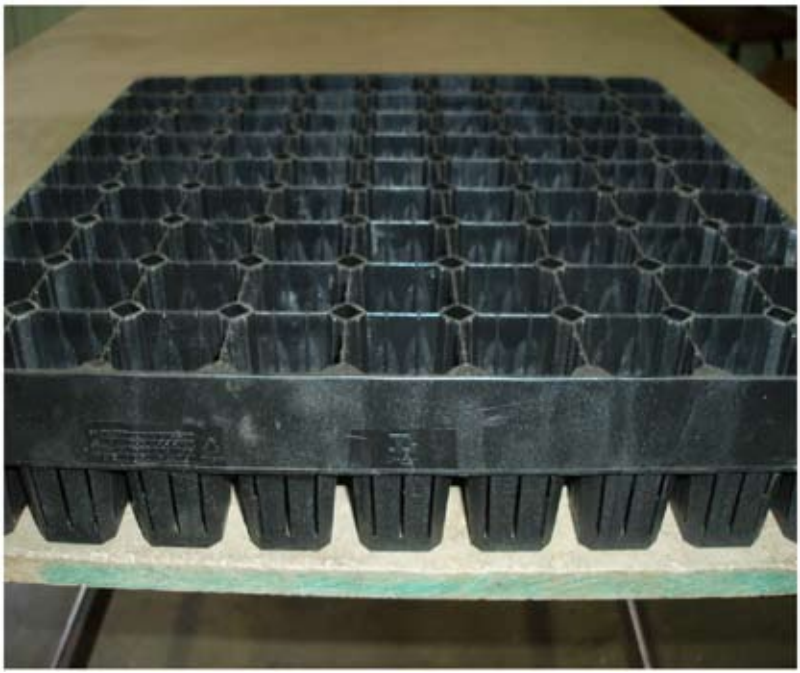
This paper outlines the concept of air pruning of the root system of seeds and cutting-propagated plants with the aim of preventing these types of distortions from developing.

A DEFINITION OF AIR PRUNING

Air pruning of tap or lateral roots involves the use of a zone of dry air positioned underneath the growing bench to cause a "shrivelling" or "burning off" of the root tips as they emerge through the base or the sides of the growing container. This pruning effect stimulates lateral root development from further back in the root system. An open-topped propagation bench encourages dry air around the base of the container.

Figure 1. Three examples of containers designed for air pruning.





This is especially the case where a bench heating system is incorporated into the bench. For effective air pruning to occur it is essential that the air underneath the bench is dry. Very moist air will prevent air pruning from occurring.

For successful air pruning of roots to occur we must have an appropriate size and shape of propagation cell and a style of growing bench that allows dry air to accumulate underneath the growing bench.

THE DESIGN OF THE PROPAGATION CONTAINER

Root system distortions that occur at the primary propagation stage will affect the plant for the rest of its life and must be prevented. There are many styles of propagation container that are very suitable for the prevention of root distortions. Some designs are based on an inverted pyramid cell shape, which deflects all roots downwards as they develop on the seedling or cutting and the roots grow out the base into dry air. Other styles of container have raised vertical ribs on the inside of the cell, which also act to deflect roots downwards. Some newer forestry seedling containers have vertical side slits in the walls of the cell, as well as an open base, so that air pruning occurs at the base and around the sides of the cell.

Where single tubes are used as the propagation container they must be unitised into a tray for ease of movement of the tubes. Plastic seed trays with a semi-solid plastic base are unsuitable as the base of the tray will be very moist and air pruning will not occur under these wet conditions.

The Design of the Propagation Bench. To enable air pruning to occur, the top of the bench must be open so that dry air accumulates under the propagation cells. Galvanised weldmesh bench tops are ideal for air pruning as the roots can grow through the base of the cell with no obstruction. Greenhouses with drop down side curtains below the bench tops will allow a good flow of dry air under the bench to assist air pruning.

At University of Queensland (UQ) Gatton Nursery Unit the propagation bench tops are open weldmesh design. At 100 mm below the bench top there is a warm water heating system comprising 12-mm black polyethylene pipes spaced 150 mm apart. The bench heating is designed to maintain 25 °C in the root zone. The warm air generated from the heating pipes optimises effective air pruning.

DEVELOPING A PRODUCTION SYSTEM FOR PROPAGATION OF A CROP

It is necessary for the propagator to develop a system of production that will effectively and efficiently produce a batch of high quality plants. For cutting propagation at UQ Gatton Nursery we propagate most of our cuttings in a 100-cell high-density plastic tray (see Fig. 1). The cell shape is based on an inverted pyramid shape with one single, large drainage hole in the base of the cell. The cell walls deflect emerging roots downwards and out through the drainage hole in the base. The dry air beneath the bench commences the air pruning process. By the time the rooted cuttings are moved up to the next stage of the production system, air pruning has already taken place.

The second stage in the production system is to tube the rooted cuttings into 50-mm square plastic tubes. These tubes have a large semi-open base and a series of internal vertical ribs that deflect roots downwards as they come into contact with the side walls of the tube. The square tubes are held in wire or plastic trays with an open base. They are grown on open weldmesh benches so that air pruning is an integral part of the growing on of the tubestock.