Mechanical Root Pruning in Container Nurseries
by Thomas D. Landis and Don Willis

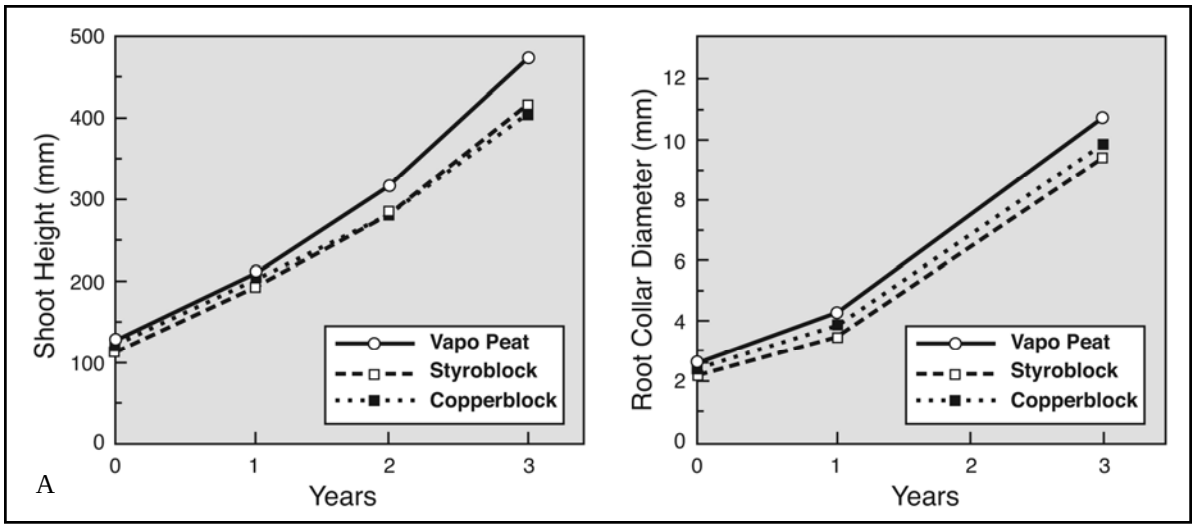
Trees and other native plants have aggressive root systems when can become physically distorted and physiologically impaired when grown in containers. These "root-bound" plants can fail to perform after outplanting and there have been instances of plantation failure from "toppling". Numerous articles have been written on the problem and at least 2 symposia have addressed root deformation in containers (Hulten 1982; Van Eerden and Kinghorn 1978).

Attempts to remedy the root deformation problem have taken 3 approaches, and we discussed the first two in past FNN issues:

1. Chemical pruning - This involves coating the interior walls of the container with a chemical that inhibits root growth. Cupric carbonate ($CuCO_3$) and copper oxychloride are commonly used. The chemical barrier causes roots to be chemically pruned at the container wall. These pruned roots become suberized but will begin to grow again after outplanting (Landis and others 1990).

2. Air pruning - Roots in all types of containers become air pruned when they reach the drainage holes along the bottom, and dry air causes roots to quit growing. Sideslit or airslit containers use this same concept on the sides as well as the bottom and field trials show that air pruned roots grow out rapidly after outplanting. A wide variety of these type of containers are commercially available (Stuewe 2008).

3. Mechanical pruning - This third option has been the least studied, primarily because the root pruning had to be done by hand which made it cost prohibitive. The classic research on mechanical pruning of bareroot seedling roots was done in New Zealand back in the



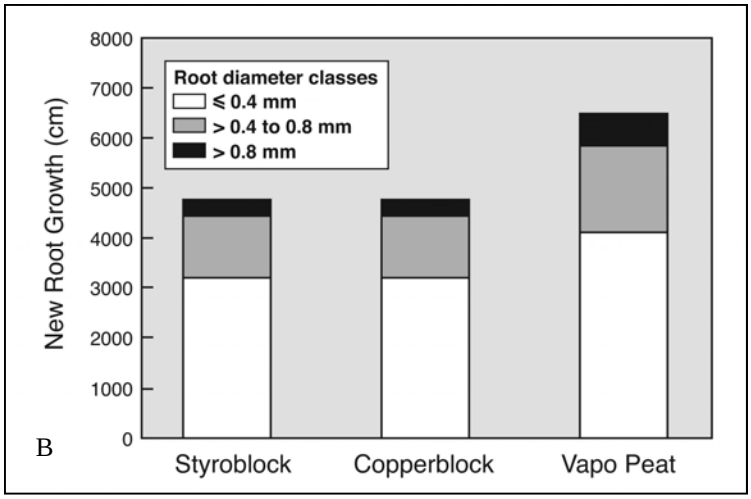


Figure 1 - Mechanically boxed pruned Vapo seedlings outperformed stock grown in Styroblock™ or Copperblock™ containers: shoot height (A) root collar diameter (B), and amount of new roots, (C). Modified from Krasowski and Owens (2000).

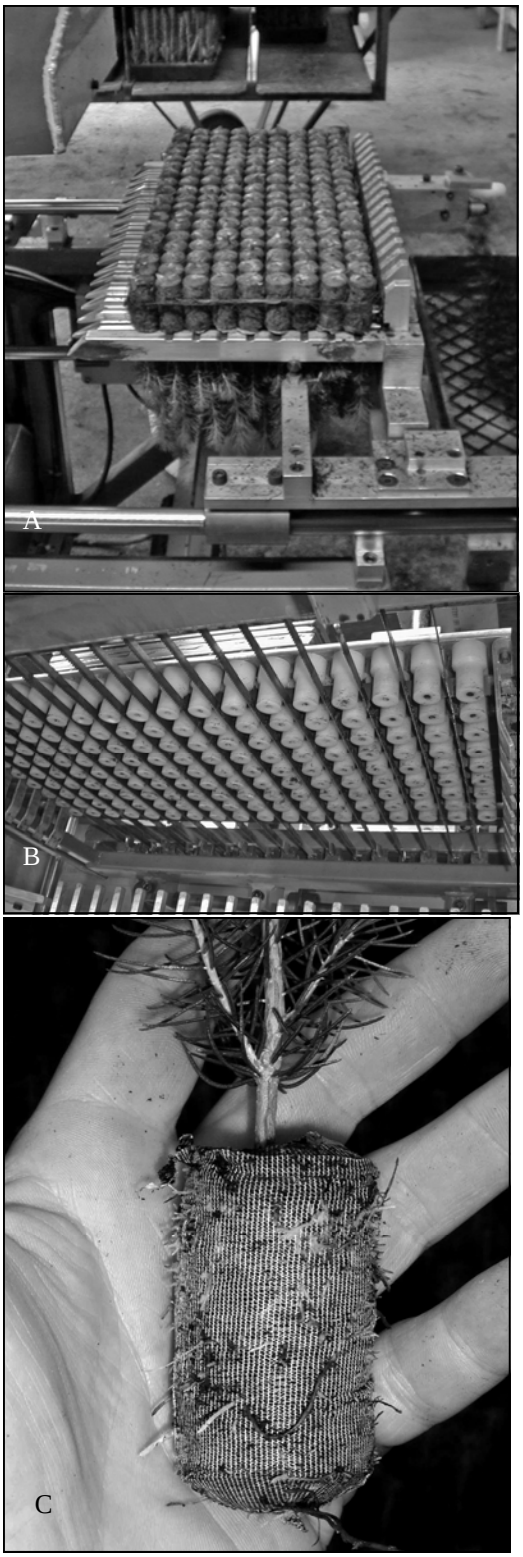


Figure 2 - The Jiffy® root pruning machine (A) has thin saw blades that cut root between Jiffy plugs in both directions (B), which produces a box-pruned seedling that is ready for outplanting (C). Photos by Don Willis.

1970s and early 1980s where they developed a new three-dimensional root culture called "box pruning". Box pruning consists of the vertically cutting lateral roots in all planes around the root system. Seedlings to be box-pruned must be precision sown, so that they are equally spaced within each row. A lateral root pruner is used to cut roots between the rows, and then the roots between seedlings in the are hand cut with a spade (Brunsden 1981). Outplanting trials of box-pruned nursery stock were very favorable, but the practice has not been widely adopted because of the hand labor involved.

Mechanical or box pruning of container stock has not been possible except for seedlings grown in blocks of peat-based growing media. For example, the Vapo system consists of a block of compressed peat moss with holes drilled in the top at regular spacing for seed placement. The peat block is placed in a plastic tray with slots on all sides to allow mechanical root pruning. The result is a box-pruned container seedling with roots cut on all sides. In a recent research trial with white spruce (*Picea glauca*) container stock (Krasowski and Owens 2000), box-pruned Vapo seedlings were compared to standard Styroblock™ stock and seedlings grown in Styroblock™ containers commercially treated with copper (Copperblock™). When measured 3 growing seasons after outplanting, the mechanically-pruned seedlings had significantly greater shoot height and stem diameter than the Styroblock™ and Copperblock™ seedlings (Figure 1A). The mechanically pruned Vapo seedlings also had better root egress in different 3 root size classes, compared to seedlings from Styroblock™ or Copperblock™ containers (Figure 1B).

One of the tree species that has shown the most problems with root deformation after outplanting has been lodgepole pine (*Pinus contorta*). In a comparison study, mechanically pruned container seedlings had less root deformation than conventionally produced stock in Copperblock™ conainers. (Krasowski1995).

Most nursery folks are familiar with Jiffy® pellets which consists of compressed peat moss surrounded by a thin plastic mesh. The pellets are arranged in a plastic tray, and one of the challenges of the Jiffy pellet system has been to prevent roots growing between the pellets. Recently, the Jiffy engineers developed an innovative mechanical root pruning machine (Figure 2A) that cuts roots between the cells in both directions (Figure 2B). The result is a mechanically box pruned seedling that should perform very well after outplanting (Figure 2C).

The Jiffy Mechanical Root Cutter has 2 loading stations and a variable speed motor which allows for different cutting cycle times depending on the amount of root pruning required between the pellets. An average cutting cycle time can range between 10 to 20 seconds. The equipment is designed to invert the tray, remove the carrying tray, and then the plastic insert before pushing the seedlings into the protected cutting area. This allows seedlings to be root pruned upside down (pellets exposed) without damaging the foliage (Figure 2A). The 2 sets of blades operate in 2 directions simultaneously, and this cross-cut action keeps pellets positioned properly during the full cycle. When finished cutting, the carrying tray is placed back over the pellets and inverted for carrying the seedlings to a holding area or to packing stations.

For more information on the Jiffy root pruning equipment, contact Don at:

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