Air Root Pruning to Accelerate the Growth of *Elaeagnus* ×*ebbingei* From Vegetative Cuttings©

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A study evaluated the effect of propagation in modules that allow air root pruning of lateral roots on subsequent growth of *Elaeagnus* ×*ebbingei* in 2-, 3-, 5- and 12-L pots, compared with standard plug/liner pot production systems. Air root pruning promoted earlier root growth than standard liner production, enabling earlier transplanting (by 3 months) and marketing. Height, branch number, shoot, and root dry weights of plants raised in modules that allow air root pruning were significantly greater than those raised in liner pots. Unlike those produced in the liner production system, air root-pruned plants increase in size as the pot sizes increase, providing a technique of accelerating the production of large specimens.

INTRODUCTION

Air root pruning is the control of root growth by the presence of air at the root tips. Once pruned, the root tip branches to produce many more secondary roots, which increases nutrient absorption and so enables the plant to grow more rapidly (Whitcomb, 2005).

Traditional module or liner propagation systems do not allow much air root-pruning of the lateral roots; hence these roots do not branch very much. This may result in roots coiling around the periphery of the pots, which may cause problems when they are planted out, especially if transplanting is delayed (Ewing, 2005).

The benefit of air root pruning to produce a dense, fibrous root system in large containers has been demonstrated for tree species using open-bottomed containers (Lovelace, 1998; Hoppé et al., 2005; Hoppé and Harun, 2005). Five-year-old root-pruned oak (*Quercus robur*) attained double the height, girth, and biomass (above and below ground) compared with bareroot transplants.

Air root pruning of high value, seed-raised *Cedrus, Fagus,* and *Ilex* using commercially available propagation modules has been demonstrated. Again, those plants raised in containers that provided air pruning demonstrated accelerated growth (Gamble and Harun, 2005).

The current project on cutting-raised *Elaeagnus* ×*ebbingei* aimed to investigate:

1) The effects of air root pruning at the propagation stage on subsequent plant growth compared with the traditional method of production, which uses plug trays followed by liner pots where air pruning of roots is minimal.
2) The effects of pot sizes on plants that have been propagated in a system that promotes air root pruning.

MATERIALS AND METHODS

In February 2006, *E.* ×*ebbingei* cuttings were taken following standard recommendations (Lamb et al., 1995). They were inserted into three alternative propagation modules: compressed Jiffy™ forestry pellets, which expand to 52 mm diameter × 95 mm

height after wetting; preformed Ellepots™ modules measuring 60 mm diameter × 60 mm height; and an 84-plug tray with 35-mm square cells.

The cell tray cuttings were later transplanted into 9-cm liner pots.

The Jiffy pellets and Ellepot modules allow air root-pruning of lateral roots because the growing medium is only held by a biodegradable membrane. The plug tray and liner pots have solid walls.

Rooting was carried out in a glasshouse using a mist chamber and bottom heat of 18 °C and a watering regime suited for each treatment as recommended by the module suppliers.

At root formation liquid feeding was carried out on all the treatments (18N-11P-18K with EC of 0.5–1.0 $ms \cdot cm^{-1}$).

Root development was assessed in June 2006; plants were then selected for potting on. Those in Ellepots and Jiffy pellets were already suitable for potting directly into 2-, 3-, 5- or 12-L pots, with a fibrous root system visible within the modules. Those in plug trays were transplanted into 9-cm liner pots containing standard nursery stock liner compost. The liners were ready for potting on in October 2006.

The final potting medium was nursery stock compost with 30% pine bark and controlled release fertiliser (Osmocote Exact™ standard 12–14 month) at 5.5 $kg \cdot m^{-3}$.

Following potting, the plants where placed in randomised blocks in a cold polythene tunnel. From potting all plants were liquid fed (18-11-18, EC of 1.2–2.5 $ms \cdot cm^{-1}$, increasing as the season progressed). In the first week of May 2007 all plants were moved to an outside standing-out bed with overhead irrigation. Average plant height, number of branches, total shoot, and root dry weights (drying at 85 °C for 24 h) were recorded at the end of June 2007 and statistically analysed.

RESULTS

Effects of Propagation Treatments. Plants propagated in Ellepots and Jiffy pellets were ready for transplanting into the final pot within 4 months from striking. Those propagated using plug trays and liner pots were not ready for transplanting until 7 months from striking.

Sixteen months after the cuttings were struck, plants in all sizes of final pot that had been rooted in Ellepots or Jiffy pellets were significantly ($P < 0.01$) taller (at least 36% taller, see Fig. 1); with between three and five times as many branches (Fig. 3); two to five times greater shoot weight (Fig. 4), and 1.5 to 2.5 times greater root dry weight (Fig. 5) compared with those raised from cell trays and liners.

The differences were more pronounced as the final pot size was increased from 2 through to 12 L.

There were no significant differences between plants propagated in Ellepots and those propagated in Jiffy pellets (Fig. 2).

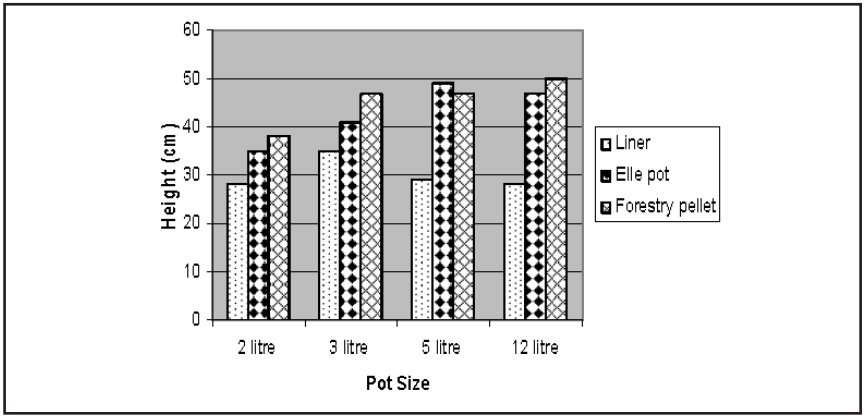

Figure 1. Height of *Elaeagnus* ×*ebbingei* in the three propagation treatments in relation to pot size.

Figure 2. *Elaeagnus* ×*ebbingei* in 2-L pots at 16 months from when cutting was taken. L = liner, E = Ellepot, F = Jiffy pellet

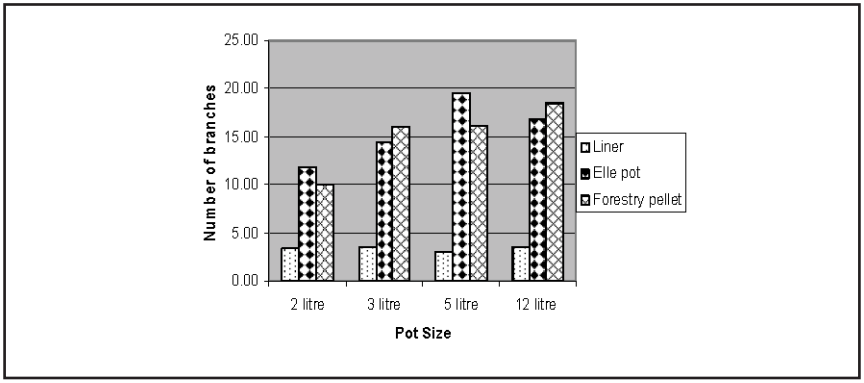

Figure 3. Number of branches of *Elaeagnus* ×*ebbingei* in the three propagation treatments in relation to pot size.

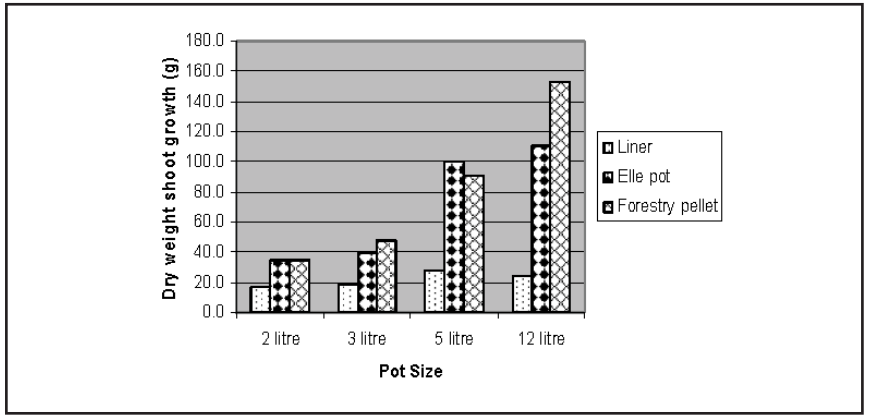

Figure 4. Dry weight of shoot of *Elaeagnus ×ebbingei* in three propagation treatments in relation to pot size.

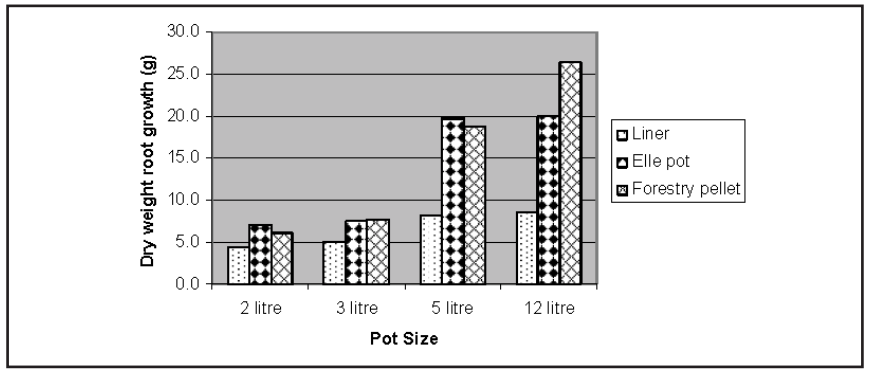

Figure 5. Dry weight of root of *Elaeagnus ×ebbingei* in three propagation treatments in relation to pot size.

Figure 6. *Elaeagnus ×ebbingei* raised in forestry pellets at the propagation stage and transplanted into (from left to right) 2-, 3-, 5-, and 12-L pots. Pictured at 16 months after cuttings were taken.

Figure 7. *Elaeagnus* ×*ebbingei* raised in liner pots, transplanted into (from left to right) 2-, 3-, 5-, and 12-L pots. Pictured at 16 months after cuttings were taken.

Effects of Final Pot Sizes. Sixteen months after the cuttings were taken, shoot and root dry weight increased with the increase in pot sizes from 2 to 12 L. However, the differences between pot sizes were greater in plants raised in Ellepots and Jiffy pellets compared with plants propagated in cell trays and liner pots (Figs. 6 and 7). This interaction was significant ($P < 0.001$).

Plants raised in Jiffy pellets continued to maintain rapid growth in the 5- and 12-L pots while those raised in Ellepots and those from plug trays/liner pots did not continue to maintain rapid growth in these pot sizes.

Final pot sizes significantly influenced plant height and branch numbers in the 2-, 3- and 5-L pots for plants raised in Ellepots and Jiffy pellets (Figs. 1 and 3). For plants raised in cell trays/liners, final pot size did not significantly affect plant height and branch number (Figs. 1 and 7).

DISCUSSION

Elaeagnus ×*ebbingei* cuttings successfully rooted in all three treatments but those in modules that allow air root pruning of laterals produced more fibrous roots than those propagated in the traditional cell tray and liner pot system. This has been confirmed with other species for example, *Pinus* and *Eucalyptus* (Jiffy, 2000).

As observed by Hoppé et al. (2005), Hoppé and Harun (2005), and Gamble and Harun (2005), air root pruning produces vigorous trees and young hardy ornamental nursery stock plants. Present investigation showed that air pruned, vegetatively raised species could be directly transplanted into the final pots producing a saleable 2- or 3-L pot plant 3 months earlier than the traditional cell tray/liner pot method of production. Omitting the liner stage would clearly result in saving labour and materials.

Plants produced in a system that allows air root pruning grow faster because final pot size is increased. It is likely that these plants, with their larger root systems, were able to exploit the larger amounts of nutrients available in the greater volumes of growing media in the larger sized pots. Air root pruning at the propagation stage therefore accelerates the production of *E.* ×*ebbingei* in larger pots within a shorter period of time than if plants were propagated in cell trays and then potted on through liners and then into increasingly larger pots as they grow.

Both the Ellepots and Jiffy pellets promoted air root pruning, which resulted in faster growth both before and after potting on than was observed in plants produced in the traditional cell tray/liner method. We are currently evaluating the use of Ellepots and Jiffy pellets for other seed and vegetatively raised species using a range of fertiliser treatments.

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