Air root pruning to accelerate the growth of *Elaeagnus x ebbingei* from vegetative cuttings

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ABSTRACT

The following study evaluated the subsequent growth of an ornamental nursery stock species *Elaeagnus x ebbingei* in 2, 3, 5 and 12 litre pots after being propagated in specialised modules which allow for air root pruning compared with plug/standard liner pot production system which does not.

Results show that air root pruning promoted early root growth compared with liner production enabling them to be transplanted 3 months earlier and hence marketable earlier. Height, branch number, shoot and root dry weights of plants raised in modules that allow for 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 technique whereby roots are pruned back by air movement at the root tips in a suitable container. Once pruned the root tip is stimulated to produce branches providing many more secondary roots. The development of many secondary roots increases nutrient absorption enabling the plant to grow more rapidly (Whitcomb, 2005). In the traditional system where air root pruning does not take place the roots do not branch as much. This may result in roots coiling around the periphery of the pots, which may cause problems when they are planted out especially when 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) using a similar technique of root pruning showed that five year old root pruned oak (*Quercus robur*) attained double the height, girth, and biomass (above and below ground) compared with bare root transplants.

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

The following investigation conducted at CAFRE, Greenmount Campus, on cutting raised *Elaeagnus x ebbingei* was set out to demonstrate:

1. The effects of air root pruning at the propagation stage on the subsequent plant growth compared with those propagated using the traditional method of production which uses plug trays followed by liner pots.
2. The effects of pot sizes on plants that have been propagated using the air root pruning technique and the current traditional method using plug trays and liner pots.

MATERIALS AND METHODS

In February 2006, cutting material of the species *Elaeagnus x ebbingei* were taken following standard nursery stock recommendations (Lamb et al., 1995). The cuttings were inserted into 3 propagation type modules i.e. compressed Jiffy forestry pellets which expand to 52 mm diameter x 95 mm height after wetting (Jiffy, 2001), ellepots supplied preformed modules measuring 60 mm diameter x 60 mm height (EllePot, 2006) and an 84-plug tray (the control treatment) 35 mm cell and later transplanted into 9 cm liner pots. The former two treatments allow for air root pruning as the growing medium is only held by a biodegradable membrane whereas the control treatment does not. Rooting was carried out in a glasshouse using a mist chamber and a bottom heat of 18^{o}C using 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 with a low concentration 18-11-18 of Electrical Conductivity (E.C.) 0.5 – 1.0 ms/cm.
In June 2006 after assessing root development, plants were selected for potting on. Those in ellepots and forestry pellets were potted directly into 2, 3, 5 and 12 litre pots, as they were considered 'ready' for potting. Plants were considered 'ready' when a fibrous root system was visible within the modules. Those in plug trays were planted into 9 cm liner pots containing standard nursery stock liner compost. The liners were only ready for potting on in October 2006.

The 2, 3, 5 and 12 litre pots contained nursery stock compost with a 30% pine bark and control release fertiliser of Osmocote Exact standard 12 –14 month at 5.5 kg/m3. Following potting the plants where placed in a cold nursery stock tunnel and laid out in a complete randomised block design with 3 blocks (replicates) x 3 propagation treatments x 4 pot sizes. From potting all plants were liquid fed with 18-11-18, E.C. of 1.2 – 2.5 ms/cm, 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^{o}C for 24 hours) for all the treatments were recorded at the end of June 2007 and statistically analysed.

RESULTS

a) The effects of propagation treatments

It was observed that the plants produced in ellepots and forestry pellets were ready for transplanting into 2, 3, 5 and 12 litre pots within 4 months after the cuttings were inserted. However, those produced in the traditional method of plug trays and liner

pots were not ready for transplanting until after 7 months, a delay of 3 months off production time.

Sixteen months after the cuttings were inserted, plants in the 2, 3, 5 and 12 litre pots produced in ellepots and forestry pellets at the propagation stage were found to be very significantly ($P<0.01$) larger (at least 36% taller) with regard to plant height (Fig. 1); with between 3 to 5 times as many branches (Fig. 3) and 2 to 5 times greater shoot weight (Fig. 4) and 1.5 to 2.5 times greater root dry weight (Fig. 5) compared with those raised in the traditional system. The differences were more pronounced as the pots increased in size from 2 through to 12 litres. There were however, no significant differences between those propagated in ellepots and forestry pellets (Fig. 2).

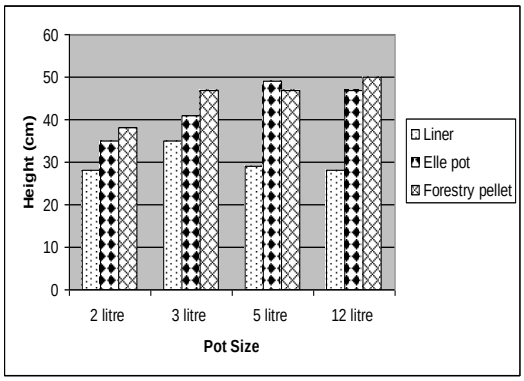

Figure 1. Height of *Elaeagnus x ebbingei* in the 3 propagation treatments in relation to pot size.

Figure 2. *Elaeagnus x ebbingei* in 2 litre pots at 16 months from cutting was taken. L = liner, E = ellepot, F = forestry pellet

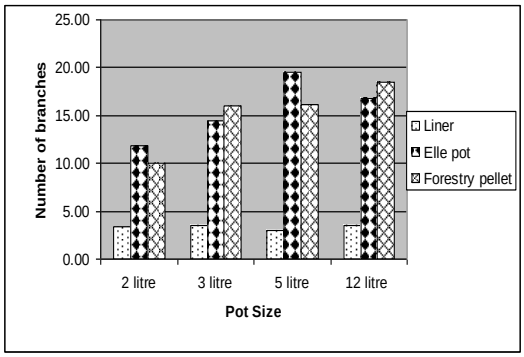

Figure 3. Number of branches of *Elaeagnus x ebbingei* in the 3 propagation treatments in relation to pot size

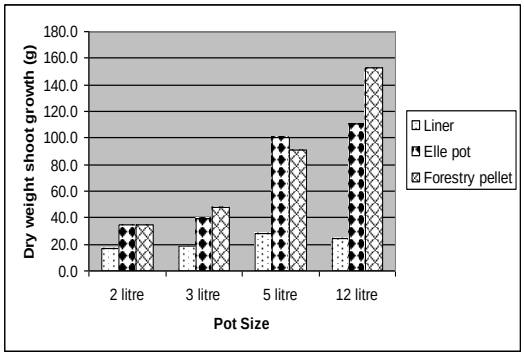

Figure 4. Dry weight of shoot of *Elaeagnus x ebbingei* in 3 propagation treatments in relation to pot size.

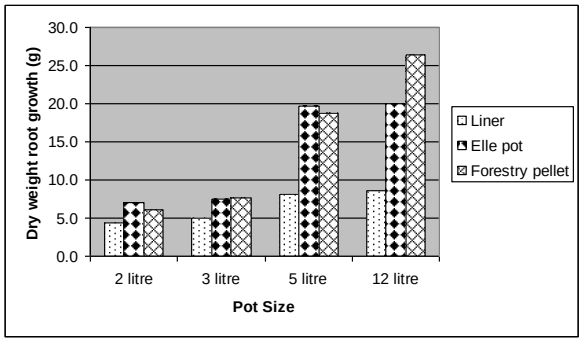

Figure 5. Dry weight of root of *Elaeagnus x ebbingei* in 3 propagation treatments in relation to pot size

b) The effects of pot sizes

Sixteen months after the cuttings were taken, shoot and root dry weight increased with the increase in pot sizes ranging from 2 to 12 litres. However, the rate of increase was

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

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

found to be greater in plants raised in ellepots and forestry pellets compared with plants propagated in the traditional system (Fig. 6 & 7). This interaction was very highly significant at ($P<0.001$). Also, those raised in the forestry pellets continue to maintain the rapid rate of growth in the 5 to 12 litre pots whereas those raised in ellepots and the traditional method of plug tray and liner pot did not continue to maintain this rate of growth for these pot sizes.

There were significant effects of pot sizes for plant height and branch numbers in the 2, 3 and 5 litre pots for ellepot and forestry pellets (Fig. 1 & 3). In the traditional system (liner raised) there was no significant increase in plant height and branch numbers between the 3 to 5 litre pots (Fig. 1 & 7).

DISCUSSION AND CONCLUSION

The investigation has shown that cuttings of *Elaeagnus x ebbingei* successfully rooted in all the three treatments but those in modules that allow air root pruning to occur produced more fibrous roots than those in the traditional 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 & 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 litre pot plant three months earlier compared with the traditional method of production. The liner stage of production is hence omitted saving labour and materials.

Plants produced using the air pruning technique increase in size as the pot sizes increased. It is likely that these plants, with their larger root system, were able to exploit the larger amount of nutrients (even though at the same concentration on a volume basis) in the larger sized pots. On the other hand, plants produced using the traditional liner method did not respond to increasing pot size which conforms with the traditional rule of thumb of potting on to larger pot sizes as the plants increases in size. Hence, air root pruning at the propagation stage accelerates the production *Elaeagnus x ebbingei* in larger pots within a shorter period of time.

Either of the root pruning modules promote root pruning and produce accelerated growth far superior to those plants produced in the traditional method. Investigations are still continuing to evaluate other seed and vegetative raised species under different levels of fertiliser.

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