Propagating Tropical Trees With Suitable Root Systems for Display Greenhouses©

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INTRODUCTION

Historically, Eden Project has had a number of larger species, mainly trees that have either fallen or have been removed from our rain forest biome because they were unstable. There is a whole list of factors that have contributed to this instability but poor root systems rank high on this list. The growing container shape could still clearly be seen in the root systems of a number of the fallen or removed plants; often they had not put out good extension growth into the soil and tangled roots and poor root architecture were common.

Achieving good active root systems, particularly on our tree species, therefore became an important aim of the Eden Project nursery. Many of the rain forest trees for the biome are grown from seed at the nursery, so we decided to examine and compare propagation systems traditionally used at our nursery with some newer innovations.

Many of the tropical tree seeds propagated at the nursery have come from wild sources so often have poor viability and/or long germination periods. To make best use of nursery resources, this seed was usually sown in seed trays and pricked out when large enough to handle into 9-cm liners or deep (rose) pots (depending on seed/plant size). Air-Pots™ were occasionally used for potting on.

MATERIALS AND METHODS

Investigating the root systems on several *Artocarpus heterophyllus* (jackfruit) plants that were about to be planted in the biome uncovered some serious problems with badly kinked roots and roots far longer than the depth of the deep pots in which they had been grown. As a result of these findings, an initial trial was set up using *Carica papaya* (pawpaw) to compare the effect on the root system of pricking out seedlings into four different pot types: Proptek™ pots, RootMakers™, Rootrainers™, and 9-cm liners.

Both the Proptek pots and RootMakers are air-pruning pots, having holes in their side walls to air prune roots as they reach them. There is evidence that this helps both build a fibrous root system and prevent the root spiralling often seen at the base of container pots (Whitcombe, 2003) The Rootrainer pots (designed for use in tree propagation) have ridged inner walls to guide any root growth to the base of the pot, again to help prevent root spiralling. The root systems of plants grown in each of the pot types were washed and examined several weeks after pricking out.

To find out whether the architecture of these early-formed roots really matters, plants from each container type were grown on in 8-L Air Pots, to test the theory that any initial differences in root system at this stage would persist when grown on (Single and Single, 2010). After 5 weeks in the Air Pots, the root systems were again washed and examined.

A further trial was set up using *Ochroma pyrimidale* (balsa) seedlings to determine the effects of root architecture on performance after transplanting into

the biome soil. Seedlings were pricked out into either 9-cm liners or RootMakers, with all plants grown on further in 8-L Air Pots and finally planted into boxes (1 m^2 by 0.6 m deep) filled with a loose gritty compost similar to our biome soil. After 12 weeks growth, the compost was carefully removed by hand to expose the architecture and extent of the root systems that had developed.

RESULTS

Roots formed in the RootMaker pot were considered to have the best structure, being dense, compact, and well distributed. The Proptek pots were considered to have produced the next-best root systems. The roots from the Rootrainer pot had

Figure 1. Rootwashed *Carica papaya* seedlings from initial pricking out. Top left (pricked out into 9-cm liner), top right (pricked out into Root Trainer), bottom left (pricked out into Proptek™ pot), bottom right (pricked out into RootMaker™ pot).

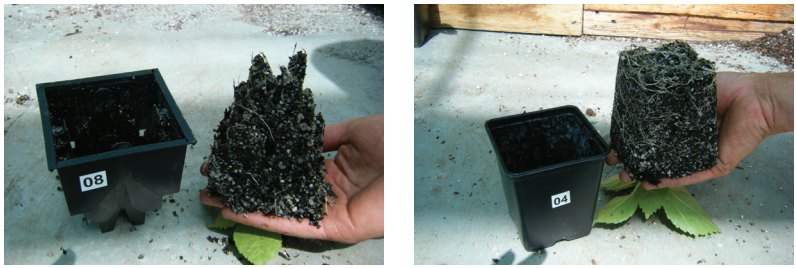

Figure 2. Root system of *Ochroma pyramidale* in 9-cm liner (right) and root system (left) from RootMaker™ pot.

maintained their "narrow shoulders" a shape that was thought unsuitable for our shallow soils and tropical tree species. Four out of six of the plants from the 9-cm liners had badly contorted roots (Figs. 1, 2, 3).

Effect of Root Architecture on *Ochroma pyrimidale* (balsa) Transplants. The RootMaker transplants were much smaller than the 9-cm transplants. They also had much less visible root on the outside of the root balls when compared with the 9-cm plants. This lack of visible root had also been noted in the *Carica papaya* trial. For the *O. pyrimidale* this top growth difference persisted until much later in the trial.

However, after final transplanting, the RootMaker plants grew away more quickly than those from the 9-cm liners and soon made up the initial difference in size.

Carefully removing the compost from the planting boxes revealed that two out of the three plants from the 9-cm liners had poor root architecture with much of the root system badly tangled and with evidence of root girdling. The plants quickly became unstable as the compost was removed. Two out of the three RootMaker plants had retained strong tap roots and had good root architecture. Roots extended to the sides and base of the planting boxes and ramified well through the compost. These root systems were extremely stable, even when completely undermined.

DISCUSSION

Producing plants with active root systems and good root architecture is critical to the stability and longevity of tropical tree species in display plantings such as those at the Eden Project. Our trials have confirmed that good root architecture must be "designed-in" from the moment seed is sown and that any root problems produced early on will persist.

Results from our trials using air pruning pots as pricking out pots for tropical tree species indicate that these are capable of producing very good root architecture, and that for such species 9-cm liners and deep (rose) pots should be avoided.

Owing to the holes in the side walls and shape of the pots, the Proptek and RootMaker pots do present a challenge as far as watering, handling, and potting is concerned but the superior root systems produced make any adaptation to nursery procedures worthwhile. The lack of visible root on the root balls of plants produced in these pots can be disconcerting and needs a leap of faith for those used to container pot root balls. The fact that the top growth and root ball appearance of tropi-

Figure 3. *Ochroma pyramidale* top growth and root system after 12 weeks from 9-cm liner (left top and left bottom) and from RootMaker™ pot (right top and right bottom).

cal plants such as those used in the Eden Project biome often gives no indication of any problems with root architecture means that finding a propagation system that almost guarantees good architecture every time is essential. In this case we have found that bigger is not better: before transplanting, plants grown in RootMakers are often smaller than those grown in conventional container pots but they will eventually make up the difference and, in the long term, the superior root systems are worth any initial lack of stature.

LITERATURE CITED

Single, J., and **S. Single.** 2010. Good roots matter from day one. Sibbaldia. 8:179–187.

Whitcombe, C.E. 2003. Plant production in containers II. Lacebark, Inc. Pub. and Research, Stillwater, Oklahoma, U.S.A.