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Rocketpot Technology©

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RocketPot Technology helps to grow and transplant advanced trees. The RocketPot Tree Growing System (RPTGS) helps manage roots — and roots "manage" trees. The RPTGS is a modular container system with a set of recommendations for use. Together, the containers and the set of recommendations make up a better practice for growing trees. It is a candidate for "best practice".

HARDWARE

The modular container system is a family of 3D air-root-pruning pots. They are "tools for growing trees" and remain in your nursery as far as possible. They are used and re-used year after year. RocketPot growing containers are usually replaced by vending bags at the point of sale.

The containers incorporate air root pruning to open ended cusps. Dr. Carl Whitcomb demonstrated this idea in Australia in March 1988. Modern models have a 25-mm air gap below the growing medium, making it a 3D-air root-pruning device. The containers have a life expectancy of at least 5 years.

At present, RPTGS is focussed on "advanced" trees, where an advanced tree is defined as a tree with calliper of 30 to 75 mm and a height of 2 to 4 m. The RPTGS principles probably have wider application.

Tree vending bags are part of RPTGS. They are: transparent, put your root quality on show, use only 5% to 8% of the weight of plastic used in typical solid-wall containers, and designed to last for a month, but are UV stable. They can work and last for over a year in extreme circumstances.

SOFTWARE

A set of 20 recommendations to achieve consistent success with advanced trees using the hardware has emerged. Recommendations 1 to 10 cover propagation and nursery production while recommendations 11 to 20 cover planting and after-care.

1) Use direct-sown seed without pricking out.
2) Use a lower porosity medium. Lower porosity media are now possible because the growing containers have 5% open area to the walls, 10% open area to the base, and a 25-mm gap between the grow medium and the nursery surface. Lower porosity media offer higher water-holding capacity and a better match with typical Australian planting soil horizons.
3) Minimise pot up steps when using these 3D air-root-pruning containers. Potting from tube to 20 cm or 30 cm then to 40 or 60 cm gives best results. Fast growing eucalypts are usually grown from tube to 30 cm to 60 cm over 2 years.
4) Use squat pots. The cohesive root balls generated by the system make squat pots possible.
5) Use cylindrical pots. They accommodate roots that want to grow out and down. Tapered pots have been found to cramp roots just where they want to grow. Cylindrical pots have a lower centre of gravity and resist wind throw.
6) Provide air under each pot. Vertical roots are now air root pruned because the humidity is low beneath the vented container. Containers on pallets are used to create a greater air gap. They are also "stepped down" steep nursery slopes. Vertical drainage tubes can be inserted through the base. These tubes are shipped with the tree.
7) Straighten the tree trunk. Trunks must be self supporting but also straight.
8) Grow the tree until roots "lock up". Root tips desiccate in dry air at the cusp tips in the walls and under the base. Each new root grows out and down; air root prunes and multiplies again until all the media's pore space is used. The roots and trunk reach a state of equilibrium.
9) Hold the tree in its RocketPot container to extend its shelf life. The trunk and roots remain in equilibrium. How long is an open question. Trials may throw some light on this.
10) Ship in tree vending bags. Trees can be held awaiting shipment in vending bags that cost about 10% of the cost of pots. Vending bags are quick to fit.
11) Drain each planting hole to another trench or drain.
12) Plant to a hole of the same depth as the root ball, and at least twice the diameter of the root ball.
13) Avoid teasing the root ball (normally).
14) Backfill with friable soil from the original hole.
15) Amend backfill in sandy soils — supply extra growing medium.
16) Flood in.
17) Mulch as wide as possible (but not the root ball itself).
18) Stake only when necessary, e.g., for tall trees with high sail area

and for vandalism resistance.

19) Water twice per week in the first spring.
20) Water at least twice per week in summer and once per week in autumn until self-sufficient.

OBJECTIVES OF THE ROCKETPOT TREE GROWING SYSTEM (RPTGS)

1) Reduce obvious failure modes to nil. Plant rejections by advanced tree growers continue. Street tree deaths occur by self-strangulation. Would direct sowing or striking cuttings to 3D-air-pruning containers help to prevent such problems?
2) To increase the shelf life of nursery tree stock. Low shelf life is the primary cause of many problems. Tube shelf life is particularly important. How much does RPTGS increase shelf life? Research is so badly needed. My suggestion is at least fivefold. Good nursery management remains essential — RPTGS can help.
   In an article in Australian Horticulture Feb 2002 edition, Derek Moore said "…there is little basic scientific data available on the effect of various container-production systems on the root growth and subsequent landscape establishment of a wide range of different tree species."
   Many advanced tree growers are moving to side slit tube systems. There may be other systems?
3) To cut nursery costs. Less pot-up steps are being used to get to the end product, a case study is in progress; *Eucalyptus viminalis* potted from Lannen side slit trays to 30-cm RocketPot in March 2001 and transplanted to 60-cm pots in January 2002. At mid March 2002 calliper was 30 mm and height 2.0 m, i.e., a taper of 1.5%. Improve growth rates. Use light-weight vending bags weighing 5% to 8% of hard-wall containers.
4) To reduce re-establishment time for trees planted out. My figures suggest a reduction of 1 year in 1, precise and independent data are badly needed. Table 1 summarises observations of growth following planting of three *Angophora costata* in Osburn Street, Wodonga, in September 1999. One tree was grown in a 3D-air-root-pruning container (AP), and two in hard-wall containers (HW). In summary, I expect that the AP tree will be twice the height and calliper of the HW trees by March 2003.
5) To cut nursery plastic waste by 50% to 95%, using light-weight vending bags.
6) Professional pride and profit. Differentiate your product and service in a competitive market — and prosper.

Table 1. Comparison of growth for *Angophora costata* planted in Osburn Street, Wodonga, September 1999.

Date	Pot type	Height (m)	Calliper (mm)	Stability
Sept. 99	HW	1.6	na	Staked
	AP	1.8	na	Unstaked
Mar. 01	HW	3.7	65	Unstable
	AP	5.2	90	Stable
Mar. 02	HW	4.0	90	Unstable
	AP	7.0	150	Stable

Acknowledgments. The RocketPot Tree Growing System has been created with help from many dedicated growers, horticultural professionals, landscape professionals, and their clients. Thank you all.

The Role of Micronutrients and How They Affect Plant Growth©

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THE MICRONUTRIENTS

It is generally recognised that there are 16 nutrients that are essential to plant growth. Three of them carbon, hydrogen, and oxygen are obtained from water and the atmosphere and comprise most of the dry matter of the plant. The remaining nutrients are classed as fertiliser nutrients, which are chiefly obtained from the growing medium but can be supplied by foliage application. Six of these are categorised as major or macro-nutrients and the remaining seven as minor, micro- or trace nutrients. The essentiality of micronutrients was established in hydroponic studies over a period of 94 years beginning with iron in 1860 to chlorine in 1954. The remainder were proven to be essential in a period from 1922 to 1939.

Other nutrients that may have benefits for some plants but are not, at this stage, regarded as essential, are silicon, cobalt for soil-grown legumes, nickel, sodium, and vanadium.

The term "micro" refers to the fact that they are needed by plants in much lower concentrations than the major nutrients. The least needed of the major nutrients, magnesium and phosphorus, appear in the dry matter of plants at approximately 20 times the levels of the most needed micronutrient, iron.

Even amongst the micronutrients there are differences in regard to the amount required. In Nutritional Disorders of Plants (1992), adequate ranges in the dry matter of nursery plants show molybdenum to appear in the least amount 0.15 to 1 ppm, followed by copper 4 to 15 ppm, zinc and boron 15 to 80 ppm, and manganese 25 to 120 ppm. The adequacy range for iron is not clearly established.