Ornamental *Eucalyptus* – Something for Everyone©

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INTRODUCTION

This research was conduct in conjunction with Dr Justin Rigden, Adelaide Research and Innovation, Adelaide, SA, and collaboration with Humphris Nursery (Victoria), Narromine Transplants (New South Wales), and Yuruga Nursery/Clonal Solutions Australia (Far North Queensland).

It is an example of a long term breeding program with lots of collaboration, funding, hard work and passion that is starting to bear fruit.

ORNAMENTAL EUCALYPT BREEDING

The *Eucalyptus* genus contains unique flora with over 700 species throughout Australia (and its closest northern neighbours) and represents one of Australia's greatest floral icons. *Eucalyptus* is the primary tree genus in Australia, and plays a vital role in all Australia's ecosystems providing habitat for native birds, insects and animals. There are a great number of species that are rarely seen in cultivation, with highly ornamental flowers, leaves, buds, and fruit. Harsh climatic extremes such as those experienced in many places in Australia and other parts of the world have prompted a renewed interest in Australian trees and plants, especially for street and urban landscape plantings, due to their resilient nature.

The majority of eucalypt species available in the Australian nursery sector are grown from seed, with a small number of grafted selections from the *Corymbia* subgenus. In order for ornamental eucalypts to become widely available to the Australian gardening public, they need to be improved through selection of superior forms. Clonal propagation can be highly genotype dependant and all selected forms must be clonally propagated to ensure genetic integrity. However, clonal propagation, such as cutting production, grafting and tissue culture, is difficult in most *Eucalyptus* species. As research to date has focused on a limited number of eucalypt species, there exists a large gap in knowledge as to how ornamental species will respond to clonal propagation. The development of a rapid, economic and reliable method of clonal propagation for ornamental eucalypts is essential for their ongoing development towards a viable commercial industry.

The University of Adelaide's Ornamental Eucalypt Development Programme (OEDP) commenced in 1996 with the PhD research by Kate Delaporte. Her thesis studies looked at aspects of development of eucalypts for ornamental horticulture and generated 100s of interspecific hybrids. These hybrids were planted in the Laidlaw Plantation, a 2-ha site at Urrbrae, South Australia, which now contains over 900 putative hybrid eucalypt genotypes, as well as around 350 individuals from 30 different species planted for breeding purposes, and is a significant germplasm resource for the OEDP pipeline of new introductions.

Research and development of ornamental eucalypts continued from 2000, with projects funded by RIRDC (Publication No 04/125, No 08/018 and No 04/120) the Playford Memorial Trust, with additional support from the Laidlaw Family, the Frank and Hilda Perry Trust and the SA State Government.

These RIRDC funded programmes sought to select superior forms for further development, including suitability for cut flower production (vase life assessments), propagation (trials including cutting propagation and grafting) and general production capabilities.

During that time, Humphris Nursery teamed up with the OEDP to undertake investigations into our top 10 selections for suitability for propagation by grafting. This required an examination of potential rootstock species and grafting methods, as the OEDP varieties at that time were from the Symphyomyrtus Bisectaria group of eucalypts, and far

different from the Corymbia types then available. The selection process was long, and difficult, but yielded results in 2012, with the first release of two OEDP selections, 'Nullarbor Lime' and "Nullarbor Rose'. These two cultivars are derived from crosses between dry land species from Western Australia, *E. macrocarpa*, *E. pyriformis*, and *E. youngiana*, and have retained the glaucous wax of the male parent *E. macrocarpa* and the more upright habits of the female parents. The cultivars are grafted onto selected seed grown rootstocks to make them more adaptable to a range of climates and soil types. It has been a slow and expensive process, with 5 years of research and development to find the best rootstock and grafting conditions. Production of plants for sale takes 12 months; plants are sold in a 20-cm pot and at a price comparable to other grafted ornamental eucalypts like the Summer series.

The OEDP received a much-needed boost to funding though the successful awarding of funding through Horticulture Australia Limited in 2010, in collaboration with the University of Adelaide and three Industry Collaborators.

HAL Project NY09023 investigated the reproductive biology of eucalypts and aimed to optimise propagation methods to enable a future eucalypt breeding programme. The partners in this project were Yuruga Nursery (Walkamin, FNQ) to investigate tissue culture, Narromine Transplants (Narromine, NSW) to investigate cutting production, and Humphris Nursery (Mooroolbark, VIC) to investigate grafting.

The OEDP identified a number of gaps in the knowledge base underpinning development of eucalypts for ornamental horticulture. Very little information exists on the relationship between climate and reproductive development, and also very little information on stigma receptivity and pollen viability for any species outside of the forestry industry. NY09023 sought to answer some questions about ornamental eucalypt species and hybrids:

1) How well does pollen of these species survive in storage, and what temperatures are optimum for germination?
2) How many days after anthesis (cap fall and pollen shed) do the stigmas become receptive? Previous research suggests anywhere from 0 to 10 days, but what is it for ornamental species? How does the phenology of a species/hybrid change and how do flower buds develop, and is there an effect of environmental conditions, such as temperature, day length or rainfall, on the timing of flowering?
3) What is the effect of flower size and genetic relatedness on "crossability"? If we cross *E. macrocarpa* with *C. ficifolia*, what are the chances that will produce viable seed? And what about the actual technique, can we use the methods developed by the forestry industry to make pollinations more efficient?
4) Propagation research: grafting, cuttings, and tissue culture all need investigating!

Humphris Nursery took on the propagation by grafting challenge, progressing their existing knowledge on methods to increase the efficiencies in production of rootstocks and grafted plants. Rootstock variability was identified as a problem area, and still remains one. Hopefully we can look at producing clonal rootstocks one day. Other problem areas identified are pre- and post- graft environmental conditions and scion size and maturity, and the time and expense of producing plants through grafting. An alternative propagation method would be desirable/more economic, but on-own-roots may be problematic?

Narromine Transplants, brave and generous souls, took on propagation by cuttings. Their approach investigated propagation by cuttings derived from mature trees (coppice) and from seedlings. One problem was the logistics of getting fresh cuttage material from Adelaide to Narromine in less than 3 days — the most efficient, although a trifle expensive, was to personally courier the fresh cut material to Narromine, a process which took 24 h, rather than express post or couriers which could take up to 3 days! The other problem, well, was simply eucalypts! They are extremely difficult to propagate by cuttings. The material has to be taken from coppice, and below a certain height on the tree, and at a specific maturity (firmness), number of nodes and intermodal length seems important too. Dan and his team produced some successes, but they were highly genotype

dependant, and not at all consistent or reproducible. Results are very dependant on maturity of tissue and the genotype. For example, one hybrid 22J, produced roots on cuttings taken in Oct. 2010, but failed to produce roots on material harvested in Dec. 2012. The difference was the maturity of the tissue — material harvested in December is just that little bit more mature and "harder" than material taken in October, even when coppicing occurred at the same time. Seed was sent to Narromine for germination and production of mother stock plants in situ, to eliminate the problem of transit time. Again, results were genotype specific, and also affected by season. So, back to the drawing board?

Yuruga Nursery and Clonal Solution investigated propagation via tissue culture, essentially micro cuttings. Using methods developed from the forestry industry, lines were established in culture from seed. This proved highly successful, with good initiation and multiplication from MOST seeds. Rooting and de-flasking proved much more difficult, and establishment even harder! Genotypic differences again reared their ugly heads, and created havoc, as every step is genotype dependant! One thing became clear early on; the *Corymbia* seed lines where much more suited to the standard tissue culture methods used by CSA than the *Symphyomyrtus*: *Bisectaria* lines parent at all stages of the process, including the media and conditions needed for multiplication and rooting, and for deflasking and establishment.

The other problem encountered with tissue culture is selection. If the plants are initiated into culture from seed, how do we select them for their ornamental characteristics? The first selection step is the actual initiation in culture — the line must multiply, root, and survive acclimatisation in sufficient numbers to be economically viable. Then, plants are set out to field trials to wait for flowering. This is most likely to take 5 years from seed, a long time in anyone's language, and for that whole time the lines must be maintained in tissue culture, with regular subculturing to maintain the health of the plantlets. If you are very lucky, you might get a line that flowers early, say, within 2 and a half years from seed. And it might have a flower colour that you are looking for. And it might have a habit that is desirable for home gardens and urban forestry. This is when you would need to start large scale field trials, in pots and in ground, to more thoroughly determine the characters of the new variety, and make sure it is stable.

The OEDP and collaborators are very happy to say that they were lucky that such a line was found, and we are progressing this little wonderplant through the field testing process as we speak.

SO, WHERE TO NOW?

The OEDP and collaborators are continuing to work with grafting and tissue culture propagation of ornamental eucalypt lines. While tissue culture is showing great promise for economical mass production of lines, it still has a long turn-around time until variety selection can take place. And there remains the question of the success of certain species/hybrid combinations on their own roots. Propagation by grafting remains an important tool in the OEDP kitbag, as some varieties may simply not grow on their own roots in all places in Australia. We are now ramping up to the next phase, with comprehensive trialling of a number of promising lines and looking to a bright and successful future. Myrtle rust is a current concern, and screening of taxa for tolerance will be part of our selection process.

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