

Propagation of the Unique and Diverse Western Australian Flora®

Amanda Shade

Assistant Curator, Nursery, Botanic Gardens and Parks Authority, Fraser Avenue
West Perth 6005, Western Australia, Australia
Email: amanda.shade@bgpa.wa.gov.au

INTRODUCTION

Western Australia has a world-renowned, highly diverse, and unique flora, with approximately 12,000 known taxa of vascular plants from over 220 families (Paczkowska and Chapman, 2000). Major families represented include Myrtaceae, Proteaceae, Mimosaceae, Epacridaceae, and Papilionaceae. This diverse flora has adapted to a wide range of habitats, soil types, and climatic conditions, from subtropical, deserts, and sand plains to eucalyptus forests, coastal heath, and mallee country. The southwest corner of the state in particular has extremely high diversity, with many endemic species. Unfortunately it also has many rare and threatened species, giving it the status of being Australia's only globally recognised biodiversity hotspot.

Kings Park is a 406-ha urban park that receives almost 5 million visitors a year. It includes a large area of remnant bushland (260 ha) with its own unique biodiversity and is also the home of Western Australia's 17-ha state botanic garden.

The botanic garden nursery is responsible for the propagation and production of Western Australian native species for the public displays in the botanic gardens. This botanic garden differs from most other botanic gardens, in that it mostly displays flora from Western Australia, with only a small percentage of allied flora from the eastern states of Australia, South Africa, and California. At present the Western Australian Botanic Garden showcases approximately 3,000 of the state's flora.

The nursery also propagates Western Australian native species for bushland revegetation projects within remnant bushland managed by the Botanic Gardens and Parks Authority; for conservation of rare and endangered species and affiliated research projects; for in situ and ex situ conservation generally; and for education projects.

PROPAGATION METHODS

Kings Park and Botanic Garden has access to the flora of the whole state, including rare and endangered species. Many of the species grown are not available commercially; have not previously been introduced into cultivation; or have very limited material available with which to work. New techniques and methods are continually being tried in order to gather information on the best possible way to propagate some of the more difficult species successfully. We propagate using seed, cuttings, or grafting.

Seed. Kings Park has a team of seed scientists dedicated to researching dormancy breaking and germination enhancement methods. Their findings enable the nursery to successfully germinate many different species from a range of different habitats.

Major pre-treatment methods employed include:

- Smoke treatment as a stimulant to germination. Seeds are soaked in a 10% smoke-water solution for 24 h before sowing. Examples of species this is used for include *Grevillea*, *Conospermum* (both Proteaceae), and *Conostylis* (Haemodoraceae). Butenolide has been found to be the compound in smoke that stimulates germination.
- Gibberellic acid (GA), also to enhance germination. Seeds are soaked in 1% GA solution for 24 h before sowing. Examples include *Santalum* (Santalaceae) and *Phyllanthus* (Euphorbiaceae). Gibberellins are plant growth regulators naturally involved in the germination process and by soaking seeds in a solution can overcome certain kinds of dormancy.
- Hot water treatment for seed coat scarification. Members of the Papilionaceae and Mimosaceae require their hard seed coats to be scarified prior to germination. Hot water is an effective method of doing this. Optimum soaking time for most species is 2 min.

Often germination can be further enhanced by combining seed pre-treatments. For example, seed of the red and green kangaroo paw, *Anigozanthos manglesii* (Haemodoraceae) achieves excellent germination if it is first subjected to heat of 100 °C for 3 h prior to smoke treatment. Other genera such as *Hibbertia* (Dilleniaceae) require exposure to both smoke and gibberellic acid for effective germination.

Manipulation of other variables includes experimenting with different media, fertilisers, germination environment, and the seed's physiological age. Many Western Australian natives have a very specific heat or cold germination pre-treatment requirement, and it is important to replicate this on the nursery to achieve successful germination. If growing out of season, northern species are germinated and grown on bottom heat at 30 °C while southern species are exposed to 15 °C to simulate winter.

Cuttings. As with seed, considerable success with difficult species has come from experimentation and manipulation of all the variables. Understanding the natural habitat of the species being propagated leads to a better understanding of what may or may not work.

Media, pre-treatments, hormone, environment, type of material, and time of year are all important factors considered when trying to strike species that have previously been largely unsuccessful.

The standard cutting medium is river sand, peat, and perlite, but other media are tried if this does not produce results. For example, composted jarrah-wood sawdust may be used to introduce more organic matter, together with a low-phosphorous controlled-release fertiliser and this often produces results where the standard medium does not.

Rockwool is another medium that has proven very successful for striking species from dry inland areas of the state, especially those with soft or furry foliage. Using our traditional medium in individual Fertil™ or peat pots has also greatly improved rooting in the Proteaceae especially *Grevillea*, *Hakea*, *Lambertia*, and *Conospermum* (Table 1).

Some Western Australian species produce widely varying results depending on the time of year they are prepared. Some perform well from semi-hardwood material, others, such as members of the Epacridaceae, will only root if very soft tip material is used in a high humidity environment.

Table 1. Results using different rooting media on selected Western Australian species*

Species	Medium	Mean strike rate (%)	Highest strike rate (%)
<i>Dicrastylis fulva</i>	A	35	91
<i>Dicrastylis fulva</i>	B	58	100
<i>Lachnostachys verbascifolia</i>	A	15	36
<i>Lachnostachys verbascifolia</i>	B	41	88
<i>Grevillea flexuosa</i>	A	23	47
<i>Grevillea flexuosa</i>	C	61	94
<i>Hemigenia ramosissima</i>	A	0	0
<i>Hemigenia ramosissima</i>	D	80	100

*Results are based on medium only and do not take into account variations in other influencing factors. Number of replications per species is variable.

Abbreviations: A = Sand, perlite, and peat (2 : 1 : 1, by volume) in punnets; B = Rockwool cubes; C = Medium A in Fertal pots; D = sand, peat, and jarrah sawdust (1 : 1 : 1, by volume) plus fertiliser (see text).

Grafting. Two factors influence our decision to apply this technique with Western Australian species. The first is as a propagation method if no other technique has been successful, such as with many rare and endangered species or when there is very limited vegetative material available.

The second reason is for the purpose of display in the botanic garden. The soil in Perth is predominantly very sandy, and the climate is generally classified as Mediterranean. Consequently, species we attempt to display from different environments mentioned previously often struggle with these conditions. There are also other soil issues in the botanic garden such as nematodes and phytophthora dieback to consider. Some entire genera cannot be displayed on their own root systems. Different species are tested for their hardiness, tolerance to particular conditions, ease of propagation, and compatibility in determining their potential as a rootstock.

Major genera investigated over the past 20 years include *Eremophila* (Myoporaceae), *Verticordia*, *Darwinia* (both Myrtaceae), *Boronia* (Rutaceae), *Pimelea* (Thymelaeaceae), *Prostanthera*, *Hemiandra* (both Lamiaceae), and *Grevillea* (Proteaceae). There are currently many grafted specimens representing these genera on display in the botanic garden, having successfully determined suitable rootstocks for them.

All grafting is done by hand onto both established rootstocks and cuttings. Our preferred style of graft is a wedge graft — many of the species worked on have very small stem diameters, sometimes only a few millimetres thick, and other graft types have proven to be difficult to perform or do not provide the necessary stability.

Grafted plants are placed into a propagation tent within a glasshouse, with a single-gang fogging unit that maintains humidity at approximately 94%. Capillary matting over a heat mat is used within this tent to avoid the need for overhead watering while at the same time contributing to the humidity.

Rootstock selection is not limited to species within the same genera so as to provide a wide range of potential rootstocks for different situations (Table 2). Preliminary trials of the native species *Solanum orbiculatum* and *S. dioicum* onto

Lycianthes rantonnetii 'Royal Robe' have shown excellent compatibility, with encouraging signs regarding longevity of the plants.

Grafting of Australian natives is not yet a common practice in Western Australia, although we believe there is significant potential for a wider use of grafted plants, locally, nationally, and internationally. There is currently limited data available on suitable rootstocks, compatibilities of rootstock and scion, and longevity of grafts. At Kings Park and Botanic Garden we are attempting to not only improve our techniques and results but to also build up a body of supporting data on favourable combinations for others to access.

Table 2. Successful scion/rootstock combinations of selected Western Australia species.

Family	Scion species	Rootstock species	Rootstock qualities
Myoporaceae	<i>Eremophila nivea</i>	<i>Myoporum montanum</i>	Hardy, adaptable to range of conditions
Lamiaceae	<i>Prostranthera magnifica</i>	<i>Westringia dampieri</i>	Hardy, adaptable to range of conditions
Thymelaeaceae	<i>Pimelea physodes</i>	<i>Pimelea ferruginea</i>	Excellent for coastal conditions
Myrtaceae	<i>Darwinia meeboldii</i>	<i>Darwinia citriodora</i>	Hardy, good in heavy soils
Myrtaceae	<i>Verticordia</i> sp.	<i>Chamelaucium uncinatum</i>	Some forms show Phytophthora tolerance
Rutaceae	<i>Boronia megastigma</i>	<i>Boronia clavata</i>	Hardy, adaptable to range of conditions
Solanaceae	<i>Solanum dioicum</i>	<i>Solanum rantonnetii</i>	Exotic species
Rutaceae	<i>Diplolaena angustifolia</i>	<i>Correa pulchella</i>	Eastern Australian species

CONCLUSION

At the Kings Park nursery, a range of techniques are employed on Western Australian native plants, including growing from seed and cuttings and the use of grafted plants, to provide healthy material for display, research, and restoration. The focus is not on producing great numbers of any given species; it is more about repeatability and reliability and finding out what works and what doesn't.

Our aims are to grow endangered or difficult-to-cultivate species; to educate the public about their existence, their importance, and their beauty; to increase and develop new knowledge and skills in plant propagation techniques; and to share this information, so that this unique and special flora can be more widely grown and enjoyed.

LITERATURE CITED

Paczkowska, G., and A.R. Chapman. 2000. The Western Australian Flora, a descriptive catalogue. Wildflower Soc. Western Australia, Inc.